ALBANY IRON ORE PROJECT
PUBLIC ENVIRONMENTAL REVIEW

Southdown Magnetite Proposal

EPA Assessment No. 1596

Grange Resources Ltd

Southdown Magnetite Proposal

EPA Assessment No. 1596

GRANGE RESOURCES LIMITED
ABN 80 009 132 405

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Albany Iron Ore Project
Grange Resources Ltd Southdown Magnetite Proposal
Invitation to Make a Submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

The Albany Iron Ore Project comprises the Grange Resources Ltd 'Southdown Magnetite Proposal' and Albany Port Authority 'Albany Port Expansion Proposal'. The Southdown Magnetite Proposal involves open pit mining of the Southdown Magnetite Deposit near Wellstead, with the magnetite concentrate pumped as slurry through a buried pipeline to the Albany Port. The slurry will be dewatered, stockpiled and loaded onto Cape size vessels for export. The Albany Port Expansion Proposal involves dredging within Princess Royal Harbour and King George Sound to facilitate access of Cape size vessels. Dredged material will be used to reclaim land to construct an additional berth adjacent to the Port, with excess dredge material placed in deep water within King George Sound. APA will lease the reclaimed land and the new berth to Grange to accommodate their port infrastructure.

This document covers the assessment of the Southdown Magnetite Proposal. In accordance with the *Environmental Protection Act 1986*, a Public Environmental Review (PER) has been prepared which describes the proposals and their likely effects on the environment. The PER is available for a public review period of 8 weeks from 19/02/07, closing on 16/04/07.

Comments from government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to the government. If you are able to, the EPA would welcome electronic submissions in particular, emailed to the project assessment officer or via the EPA's Website (see address below).

Where to Get Copies of this Document

Printed copies of this document may be obtained, at a cost of $10, from:

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Copies may also be obtained from www.grangeresources.com.au

Why Write a Submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Electronic submissions will be acknowledged electronically. The proponent will be required to provide adequate responses to points raised in submissions. In preparing its assessment report for the Minister for the Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information. All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in each report.

Why not Join a Group?

If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to ten people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a Submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposal. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable. When making comments on specific proposals in the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

Points to Keep in Mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether and the reason why you want your submission to be confidential.

The closing date for submissions is: 16/04/07

The EPA prefers submissions to be sent in electronically. You can either e-mail the submission to the following address:

eia@dec.wa.gov.au

OR

use the submission form on the EPA's website:

www.epa.wa.gov.au/submissions.asp and click on the EIA Assessment Submission option

OR

You can post your submission to:

The Chairman
Environmental Protection Authority
PO Box K822
PERTH WA 6842

Attention: John Guld

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The Project

The Albany Iron Ore Project comprises two related proposals; the Southdown Magnetite Proposal by Grange Resources Limited (Grange) and the Port Expansion Proposal by Albany Port Authority (APA). Although the proponents have distinct roles and responsibilities, both proposals are interconnected such that neither proposal could be undertaken on its own. The Project in its entirety, referred to as the Albany Iron Ore Project, will be treated as a single project for the purposes of Environmental Impact Assessment (EIA).

Grange proposes to construct and operate an open pit magnetite mine at the Southdown Magnetite deposit approximately 90 km east, north-east of Albany in the south-west of Western Australia (WA). The magnetite will be magnetically separated, concentrated and pumped as slurry via a buried pipeline 104 km to newly installed berth facilities at the Albany Port. The magnetite slurry will be dewatered at the port facility, and stored for export to south-east Asia on Cape size vessels. The recovered water will be transported back to the mine for re-use. Approximately 0.425 ha of land will be reclaimed along the northern shore of Princess Royal Harbour to accommodate the pipelines. The pipeline reclamation is comprised of two sections adjacent to the foreshore of Princess Royal Harbour (Figure 2.1, Figure 2.2 and Figure 2.3). One section extends 80 m west of Point Melville, and the other eastwards 1,100 m from Point Melville adjacent to existing reclaimed land to a point close to the location of the new City of Albany's planned ANZAC Peace Park.

The port facilities will be constructed and operated by Grange and will include a concentrate thickener tank, filter plant, storage shed and ship loader. The Southdown Magnetite Proposal includes the shipping of magnetite concentrate on Cape size vessels.

The APA proposes to expand the Albany Port to facilitate the access of Cape size vessels and by increasing available industrial land for port operations. The expansions will involve dredging parts of Princess Royal Harbour and King George Sound, disposal of excess dredge material in deep water within King George Sound, land reclamation of up to 9.0 ha of Princess Royal Harbour to provide industrial land and the construction of a new berth. APA will lease the reclaimed land and the new berth to Grange to accommodate their port infrastructure.

This Public Environmental Review (PER) document examines the environmental implications associated with the Albany Iron Ore Project as part of the State Government environmental impact assessment under the *Environmental Protection Act 1986.*

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Existing Environment

Existing Environment - Southdown Magnetite Proposal

The Project area occurs in the south-west Botanical Province and is situated within two biogeographic regions. The mine site will be located within the Western Esperance Plains (ESP-1) Fitzgerald IBRA (Interim Biogeographic Regionalisation for Australia) sub region, and the pipeline infrastructure traverses both this sub region and the Southern Jarrah Forest sub region.

Physical Environment

The Stirling Ranges dominate the topography of Albany-Mt. Barker District, with the rest of the area consisting essentially of a sand plain overlying a shallow basin of sedimentary strata that descends gradually from about 200 m AHD in the north-west to 50 m AHD in the south-east along the coast. Wetlands lie between the sand plain and the coastal fringe where hills of sand, limestone, and bedrock reach from sea level up to elevations of 100 m.

Acid sulphate soils sites have been identified where the pipeline enters Albany townsite from the west along Lower Denmark Road or the Public Transport Authority's Rail Corridor, and along the northern shore of Princess Royal Harbour. Drainage lines into the King and Kalgan Rivers have also been identified as moderate to low risk of potential and actual acid sulphate soils.

Rivers in the region generally flow in a southerly or south-westerly direction and discharge into estuaries, most of which are permanently or intermittently closed to the ocean. The Southdown Magnetite Proposal footprint passes through two water catchments, the Albany Eastern Hinterland Catchment and the Albany Harbours Catchment. Within the Albany Harbours Catchment there are two major rivers which the proposed pipeline will cross. These are the King and Kalgan Rivers.

In the basement granites of the south coast, groundwater occurs in fractures in the upper parts of these rocks and also in weathered layers near the surface. In the vicinity of the Southdown Magnetite Proposal, two sub-basins of the Bremer Basin contain sedimentary strata including some spongolite and sand/ sandstone aquifers to depths of 140 m. The aquifers are part of the Werillup Formation and Pallinup Siltstone of the Plantagenet Group. The groundwater in the area flows in a south, south-easterly direction and the water level at the Project site varies from about 9 m to 24 m below ground surface.

Vegetation and Flora

The mine is located within the Cape Riche vegetation system and the pipeline traverses the Cape Riche, East Kalgan, Narrikup and Albany vegetation systems. Much of this area has been cleared since the 1960s for farming purposes. Vegetation along the proposed pipeline route occurs as scattered native remnants of variable size, surrounded by cleared farmland utilised for mixed cropping and grazing. At the mine site, 14.8% of the proposed footprint is remnant native vegetation in 20 separate blocks. Approximately 5 ha of the anticipated vegetation that will be disturbed along the pipeline is remnant vegetation. The flora and vegetation surveys conducted for the Project were undertaken on the remnant blocks of native vegetation only.

The total of unreserved vegetation (of any type and in any condition) remaining in the three sub-catchments (Sandplain West, Mountains to Coast and East Sandplain) either traversed by the pipeline or in the proposed mine site on the Pallinup Sandplain is approximately 20.6%. This falls below the threshold level of 30% below which species loss is considered to accelerate exponentially at the ecosystem level (EPA, 2000). The reservation status of much of the vegetation remaining in the sub-catchments is even lower, with the total area of original vegetation reserved in the three sub-catchments (in any class of reserve) totalling 4.6%.

EXECUTIVE SUMMARY

There are no Threatened Ecological Communities within the Project footprint. Additionally, there is no evidence from literature or ground surveys to suggest that any vegetation units at the mine site are groundwater dependent.

No Declared Rare Flora (DRF) were recorded from the Project footprint in the current survey. A total of seven taxa of conservation significance were recorded within the mine site and pipeline footprints in the surveys of spring and summer 2005/2006, mostly in previously undocumented locations. Six species were recorded within the proposed mine site only (*Commersonia* sp. Mt Groper (RG Cranfield & D. Kabay 9157), *Chordifex leucoblepharus*, *Microcorys lenticularis*, *Monotoca aristata*, *Dryandra calophylla*, *Goodenia filiformis*) and one species was recorded within both the proposed mine site and the pipeline footprint (*Calectasia obtusa*).

Fauna

Three major fauna habitats occur within the mine site; (1) Mallee–Heath, (2) Seasonally inundated wetlands and (3) Low sand dunes. The proposed pipeline corridor crosses six major fauna habitats; (1) Jarrah woodland, (2) Jarrah/ Marri/ Sheoak woodland, (3) Peppermint woodland, (4) Mallee-Heath, (5) Estuarine, and (6) Rivers, creeks and other wetlands.

Seven fauna species of conservation significance were recorded during a fauna survey of the pipeline corridor. These species were the; Western Ringtail Possum (*Pseudecheirus occidentalis*), Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*), Western False Pipestrelle (*Falsistrellus mackenzei*), Australian Bustard (*Ardeotis australis*), Peregrine Falcon (*Falco peregrinus*) and the Southern Brown Bandicoot (*Isoodon obesulus fusciventer*).

Specimens from the Short Range Endemic (SRE) survey represented seven potential SRE fauna groups. These included Mygalomorph spiders, Pseudoscorpions, Scorpions, Isopods, Millipdes (Diplopoda), Centipedes (Chilopoda) and Bothriembyron land snails. Only two Mygalomorph spiders and one Bothriembyron land snail SRE species were recorded at the proposed mine site and within the proposed pipeline corridor.

The Southdown Magnetite stygofauna survey has confirmed that there are no stygofauna of conservation significance in the vicinity of the planned mine pit. The most significant taxa recorded by the survey are understood to be the syncarids and a candonid ostracod that are known to be obligate groundwater taxa (stygobites). They have been recorded from at least four sites (WST2, RED22, and DB13 - Syncarida, and RED2 - Candonidae) of which three sites are outside of the modelled drawdown footprint (Figure 6.19, Figure 6.20).

Heritage

A desktop survey revealed that the Southdown Magnetite Proposal will potentially impact an ethnographic Aboriginal heritage site (Site ID 21837, Creek 3) listed on the Department of Indigenous Affairs - Aboriginal Site Register. Disturbance to these sites will require clearance under Section 18 of the *Aboriginal Heritage Act 1972* prior to commencement of works. The pipeline will also intersect a site called Kinjarling, currently not registered on the Department of Indigenous Affairs - Aboriginal Site Register. Archaeological and ethnographic surveys of the mine site and pipeline located and recorded seven archaeological sites at the Southdown mine site and one new ethnographic site was recorded. This site was a historical campsite and water source located within urban Albany at Point Melville.

Table S1 Key Characteristics of the Southdown Magnetite Proposal (EPA Assessment No. 1596).

Key Aspect	Description
Mining Operations	
Proposed operation commencement	Construction: 2007; and Production: 2009.
Project life span	Minimum 22 years.
Anticipated year of decommissioning	Not before 2030.
Proposed mine location	90 km east, north-east of Albany, 10 km south west of Wellstead.
Deposit	Southdown Magnetite Deposit.
Size of ore body	Mineral Resource: 479 Mt Mining Schedule: Approximately 411.5 Mt
Ore type	Magnetite.
Ore mining rate	18 - 20 Mt pa (6.6 – 7.0 Mt pa Concentrate).
Waste rock mining rate	40 - 55 Mt pa.
Total estimated production	Approximately 145 Mt Concentrate
Stripping ratio (waste rock: ore)	2.6:1 t/t
Estimated area of mine pit	400 ha
Depth of mine pit	Up to 300 m below ground surface.
Depth of water table	9-24 m below ground surface.
Topsoil Stockpiles	70 – 100 ha
Total vegetation at mine site	Remnant vegetation : 282.6 ha Plantation: 155.6 ha Total: 438.2 ha
Total estimated area of clearing at the mine site	Grange intends to retain a minimum of 30 ha of remnant native vegetation on the mine site. Vegetation to be cleared will be a maximum of 408.2 ha of which: Remnant vegetation: 252.6 ha Pine Plantation: 155.6 ha
Processing Requirements	
Primary crushing	Jaw and cone crushers.
Secondary crushing/ grinding	High Pressure Grinding Rollers and Ball Mills.
Separation	Wet magnetic separation and concentration.
Product characteristics	80% less than 42 micron.
Tailings characteristics	• Approximately 268.5 Mt of tailings material total; • One tailings stream (well graded, ranging form clay/silt to sand/gravel sized particles) 13% moisture content; and • Tailings are considered Potentially Acid Forming.

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Key Aspect	Description
Tailings Storage Facility	• External TSF facility area: 250 ha footprint; • Elevation between RL 152 and 166 (max. height 40 m); and • Approximately 73% backfilled into pit from Year 7.
Flotation	• Reverse flotation to reduce sulphur content in magnetite concentrate.
Waste rock characteristics	Total waste rock: 385 Mbcm of which: • 93% Non Acid Forming; • 4% Acid Forming; and • 3% Potentially Acid Forming.
Waste rock stockpiles	• External dump area: 620 ha (maximum); • Elevation RL 180 m AHD, 45 m height; and • Up to 50 % backfilled into pit from Year 5.
Mine Site Infrastructure	
Power source	Supplied via Western Power SWIS. Third Party supplier to be decided via competitive tender process.
Maximum annual power requirement for mine site	550-600 GWh pa
Water source	Water to be harvested from the mine site. Surface water storage facilities will have an approximate capacity of 1.1 Mm^3 and take up an approximate area of 0.33 Mm^2.
Maximum annual water requirement	2.7 GL pa (60GL over 22 year mine life)
Mine plant and administration area	100 ha
Ancillary infrastructure	• Administration building; • Ablutions block; • Package sewage plant; • Crib room; • Car parking and access roads; • Security gates; • Workshop, stores and spare parts storage facility; • Ammonium Nitrate storage; • Explosives magazines; • Fuel storage and re-fuelling facility; • Water storage; • Electrical substation; • Laboratory; and • Emergency power generators.
Total estimated footprint of mining	1590 ha

Key Aspect	**Description**
operations	
Pipeline	
Pipeline route and length	104 km. Proposed route illustrated in Figure 2.3.
Pipeline land tenure	Registered easements over: • Freehold land; and • Crown Land. License over Rail Corridor land.
Total area of pipeline footprint	220 ha of which: • approximately 5 ha is remnant vegetation; and • 0.425 ha is for foreshore reclamation (adjacent to the existing reclaimed foreshore of Princess Royal Harbour, for a length of 1,180m).
Soil profile of route	Generally soils, clays, laterite and some peat.
Slurry and return water pipeline • Length • Pumping Stations • Minimum depth	 • Approximately 104 km. • Two, one at Southdown mine site and one at Albany Port. • Buried minimum of 750 mm below surface or at a depth appropriate to land use.
Contaminated sites	A small section of the pipeline intersects a historic contaminated site within the Albany township.
Port Infrastructure	
Area required	Up to 9 ha on reclaimed land made available by APA.
Infrastructure required for processing	• A concentrate thickener tank, two agitated storage tanks, one emergency storage tank, a return water storage tank, a filter plant and a return water pumping station; and • A minimum of 350,000 tonne capacity concentrate storage shed with reclaim facilities.
Infrastructure required for ship loading	• A wharf and ship loader capable of loading concentrate into Cape size vessels; and • Related conveyors and other material handling equipment.
Ancillary Equipment	Air compressors, an emergency generator, fire water booster, electrical substation, offices and a control room.
Approximate annual power requirement for port infrastructure	85 GWh pa
Site layout	Concentrate stockpile will be fully enclosed in a storage shed.
Vessel frequency	Approximately one vessel per week.
Gaseous Emissions during Operation	
Greenhouse Gas	750,000 (t/pa)
NOx	166,000 (t/pa)
SO_2	551,000 (t/pa)

EXECUTIVE SUMMARY

Key Aspect	Description
CO	18,000 (t/pa)
PM_{10}	3,000 (t/pa)
VOCs	3,000 (t/pa)
Waste	Approximately 4000 t/yr general solid waste (inert and putresible) and 200 kL/yr liquid waste (waste hydrocarbons) will be produced. These figures are subject to change with more detailed project scoping. General waste will be disposed of in an approved landfill. Hazardous liquid waste (waste hydrocarbons) will be removed from site and disposed in an approved facility.
Disturbance Footprint Summary	
Southdown Magnetite Proposal	1810 ha (not including land reclamation area)

Table S2 Total Albany Iron Ore Project Disturbance Footprint.

Total Albany Iron Ore Project Disturbance Footprint	
Southdown Magnetite Proposal	1810 ha (not including land reclamation area)
Albany Port Expansion Proposal	473 ha
Total Albany Iron Ore Project disturbance footprint	2283 ha

Project Characteristics Table Key:

AHD – Australian Height Datum	Mbcm - Million bank cubic metres
GL - Gigalitre	Mt – Million tonnes
GWh –Giga Watt hour	pa – per annum
ha – hectares	RL – Relative level
km - kilometre	t– tonne
m – metre	TSF – Tailings Storage Facility
mm - millimetre	

Potential Impacts and Proposed Management Strategies

Table S3 Key Environmental Factors, Potential Impacts and Proposed Management for the Southdown Magnetite Proposal: Project Overview.

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
Ecosystem Integrity and Ecological Sustainability	• Maintain the integrity, ecological function and environmental factors associated with the Wellstead - Albany area and the land and waters of King George Sound and Princess Royal Harbour. • Ensure, as far as practicable, that the Project meets or is consistent with the sustainability principles in the National Strategy for Ecologically Sustainable Development (Commonwealth 1993).	• Vegetation clearing for mine site and pipeline footprint.	• Changes to wider ecosystem function. • Habitat fragmentation. • Loss of habitat. • Inadequate design and management of the Project could result in unacceptable environmental, economic and social impacts. Conversely, economic constraints need to be taken into account in the protection of the environment and social values.	• Project design and management will be developed along the sustainability principles outlined in the National Strategy for Ecologically Sustainable Development (Commonwealth 1993). • Rehabilitation of disturbed areas to best suit future land use. • Stakeholders will be consulted and engaged in identifying and managing issues of significance.	• National Strategy for Ecologically Sustainable Development (Commonwealth 1993). • Position Statement No. 6 Towards Sustainability (EPA, 2004). • Guidance Statement No. 55 Implementing Best Practice in proposals submitted to the EIA process (EPA. 2003).	• An ecologically sustainable operation.
Biodiversity	• Avoid adverse impacts on biological diversity, comprising flora and fauna and the ecosystems they form, at the levels of genetic, species, and ecosystem diversity.	• The Project is within the Western Esperance Plains Fitzgerald IBRA sub region, and the Southern Jarrah forest region. • The Project impacts the land and waters of King George Sound and Princess Royal Harbour.	• Significant species, communities or habitats could occur within the Project footprint and be impacted by land clearing, construction, or operational activities.	• Significant habitats and flora and fauna of conservation significance will be avoided where possible, and / or management strategies implemented to ensure that the conservation status of the communities and species is not affected. • Rehabilitation of disturbed areas to best suit future land use.	• Position Statement No 3: Terrestrial Biological Surveys as an element of Biodiversity Protection (EPA, 2002).	• No significant loss of biodiversity.

Table S4 Key Environmental Factors, Potential Impacts and Proposed Management for the Southdown Magnetite Proposal

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
Geology and Landform	• Maintain the integrity, ecological functions and environmental values of geology and landform. • Minimise permanent landform alterations and establish stable, sustainable landforms that will not compromise post-disturbance land uses. • Ensure that rehabilitation achieves an acceptable standard compatible with the intended post – disturbance land use, and is consistent with appropriate completion criteria.	• Excavation of mine pit. • Construction of tailings storage facility, waste dumps and mine infrastructure. • Pipeline construction.	• Temporary and permanent changes to landforms from mining operations. • Temporary changes to landforms from pipeline construction. • Increased ponding through alterations in topography that enhance retention of rainwater and runoff.	• Minimise the Project footprint and progressively back fill the mine void. • Tailings will be managed to prevent groundwater contamination, and TSF's constructed for long term stability. • Waste dumps will be constructed in compliance and consultation with relevant guidelines and authorities to reduce potential erosion and provide progressive rehabilitation of the landform. • Maintain a conceptual closure plan throughout the life of the operation. • Progressively rehabilitate disturbed areas including the pipeline trench as soon as practicable.	• Guidelines on the Safe Design and Operating Standards for Tailings Storage (DME, 1999). • The Strategic Framework for Tailings Management (DoIR, 2003). • Environmental Notes on Mining Waste Rock Dumps (DME, 2001). • Mine Void Water Issues in WA (WRC, 2003). • Landform Design for Rehabilitation (Environment Australia, 1998). • Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2005).	• The mine site will modify existing landforms and result in permanent new landforms. These will be rehabilitated to establish stable, sustainable landforms that will not compromise post-disturbance land uses. • There will be an incremental widening of the existing road due to reclamation along the northern shore of Princess Royal Harbour.
Soils	• Maintain the integrity, ecological functions and environmental values of soils. • Maximise the retention and viability of topsoil resources for future	• Mine site construction and operation. • Pipeline construction.	• Increased soil erosion by both wind and water due to clearing of vegetation. • Alteration to soil structure, changes in soil chemistry, and changes to the natural soil	• Prior to clearing, a Threatened Flora and conservation Management Plan will be developed to salvage seed and genetic resources. It will be developed and implemented in parallel with the Rehabilitation Management Plan to avoid	• Identification and Investigation of Acid Sulphate Soils (DoE, 2004). • General Guidance on Managing Acid Sulphate Soils (DoE,	• Topsoil, vegetation debris and seed will be stripped, appropriately stored and utilized in rehabilitation and original land uses restored where

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
	rehabilitation. • Ensure that rehabilitation achieves an acceptable standard compatible with the intended post-disturbance land use, and is consistent with appropriate completion criteria. • Identify potentially acid generating material; selectively handle this material, and store the material so that leachate is not generated.		forming processes caused by activities such as stripping, stockpiling, compacting for infrastructure, trenching for pipeline and spillage of hydrocarbons. • Reduced viability of seeds, nutrients, organic matter and micro-organisms due to inappropriate stockpiling of topsoil. • Spread of existing acidic material and creation of new acid sulphate soils from exposure of sulphidic material. • Contamination of groundwater, surface water and surrounding ecosystems from inappropriate management of dewatering during pipeline construction. • Lowering of the water table may expose acidic material due to dewatering at the mine site. • It is not anticipated that there will be any dewatering associated with the pipeline	impact where possible and appropriately minimize and remediate impacted areas to the pre-disturbance state where possible. • Acid Sulphate Soils management includes identification and mapping of potential and existing acid sulphate soils. • Acid Sulphate Soils Management Plan includes the avoidance of potential sites based on a risk assessment and prescriptive management, where required, including targeted surveys along the pipeline route, mitigation and rehabilitation contingencies.	2003). • Acid Sulphate Soils Planning Bulletin No. 64 (WAPC, 2004).	practicable. • Stockpiling will be avoided where possible. • Sensitive sites such as waterways and conservation areas will be protected from potential acid sulphate soil impacts through implementation of the Acid Sulphate Soils Management Plan. • Existing acid sulphate soils will be contained, and creation of acid sulphate soils minimized through the implementation of site specific Acid Sulphate Soil Management Plans.

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
			construction. This will be clarified after a geotechnical assessment of the pipeline has been conducted.			
Dewatering, Waste Rock and Tailings	• Clearly identify potentially acid generating material, selectively handle this material and store the material so that leachate is not generated. • Ensure that waste is contained and isolated from ground and surface water surrounds and treatment or collection does not result in long-term impacts on the surrounding environment.	• Excavation of mine pit. • Construction and operation of tailings storage facility (TSF), waste dumps and mine infrastructure.	• Production of Acid Rock Drainage (ARD) from oxidation of sulphidic material. • Contamination of soil, groundwater and surface water from ARD. • If acid generating material is included in ore processing, contamination arising from sulphidic material transport and handling, processing plant spills, tailings storage, pipeline breach and dewatering activities and dust generated from TSF. • Dewatering at the mine site could result in lowering of the watertable, allowing oxidation of acid generating materials.	• An ARD Management Plan will be developed in consultation with regulators. • Waste rock stockpiles will be planned and constructed in compliance with relevant guidelines. • Mine site landforms and infrastructure will be located a minimum of 100 m back from adjacent properties and roads such as the South Coast Highway. • Drains, sediment traps and settling ponds will be constructed around the perimeter of waste dumps and TSF's to control runoff and ensure no sediment loss impacts to adjacent land. • ARD from waste dumps will be managed primarily through reducing the ingress of oxygen or infiltrating waters. • The TSF will be designed in compliance with the relevant guidelines to achieve efficient, cost effective and safe long term storage of tailings with	• Guidelines on the Safe Design and Operating Standards for Tailings Storage (DME, 1999). • Strategic Framework for Tailings Management (MCMPR, Minerals Council, 2003). • Mine Void Water Issues in WA (WRC, 2003). • Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2005).	• ARD will be managed through prevention of oxidation of potentially acid forming material, and through treatment of ARD where necessary. • The groundwater in the vicinity of the mine site will be monitored through a series of monitoring bores.

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
				minimal environmental impact. • The external TSF will have a perimeter embankment constructed with inert waste rock. Cells constructed within the TSF will be surrounded by a shell of engineered fill (inert mine waste). • The in-pit TSF will contain cells, similar to the external TSF, to manage the tailings in discrete areas to reduce the ARD potential. The cells will be sequentially filled then capped with inert mine waste rock, or covered with a store and release cover system which will effectively encapsulate the tailings within the cell.		
Contaminated Sites	• Prevent any extension of, or increase in severity of existing contaminated sites. • Reduce the risk of impact on the health and safety of personnel from existing contaminated sites. • Prevent the development of new contaminated sites.	• Pipeline construction and land reclamation.	• Spread of existing contaminated sites along Albany foreshore. • Creation of new contaminated sites through inappropriate storage or handling potentially contaminating material.	• Areas of potential concern have been identified in surveys. • Known contaminated sites have been taken into account during the planning of the pipeline route and avoided where possible. • A Phase 2A Intrusive Investigation of the Railway Depot (Location 9) will be conducted prior to EPA assessment of the PER. • A Phase 2B Intrusive Investigation for other contaminated site locations	• Draft Contaminated Sites Regulation 2004. • Guidance No. 33 Environmental Guidance for Planning and Development. • Contaminated Sites Management Series (DoE): including • Reporting of Site Assessments (DoE); and • Development of a Sampling and	• Disturbance of existing contaminated sites will be localised, with no spread of identified sites. Contaminated sites formed as a result of the Project (TSF and waste dumps) will be encapsulated and managed to prevent further contamination.

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
				potentially impacted by the pipeline route will be conducted prior to pipeline construction. • Where unavoidable specific targeted surveys and management plans will be developed for areas along the pipeline in conjunction with the overall Contaminated Sites Management Plan. • The creation of new contaminated sites will be avoided by implementing procedures described in the Contaminated Site Management Plan and the Construction and Operational Management Plans. These include methods for chemical and hydrocarbon storage and handling. • Spill management procedures require spills to be cleaned up on occurrence and contaminated soil removed to an appropriate disposal or bioremediation site.	Analysis Programme (DoE).	
Hydrogeology	• Maintain the quality and quantity of groundwater so that the existing and potential uses, including ecosystem maintenance are protected. • Maintain the integrity, ecological functions and environmental values of wetlands.	• Excavation of mine pit. • Pipeline construction and operation. • Mine site operation and dewatering.	• Disturbance to natural underground drainage patterns from the mine pit. • Ecological impacts on vegetation and stygofauna from water table drawdown. • Degradation and	• A groundwater model for the Southdown Magnetite mine site was developed and used in planning to predict groundwater inflows, levels and drawdown. • The mine will be designed to ensure the safe storage and handling of hazardous materials.	• Australian New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ ARMCANZ, 2000). • Environmental Water Provisions for Western Australia; Statewide Policy No. 5 (WRC,	• Mine site dewatering is predicted to result in a drawdown cone area of 12.2 km² over the life of mine. Groundwater potentially impacted by the oxidation of fresh bedrock will flow into the mine pit

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
	• Minimise impacts to groundwater resources during mining.	• Construction and operation of port infrastructure.	contamination of groundwater sources from inappropriately constructed TSF, waste dumps and hydrocarbon or chemical spills. • The unlikely event of a pipeline breach will have minimal transient impacts to surface and groundwater resources. • Impacts to groundwater from potential spills during construction and operation of the port infrastructure.	• Groundwater will be monitored and compared with the groundwater modeling predictions. • An Operating Strategy will be developed in consultation with the DoW. • Environmental Management Plans for construction and operation works have been developed. • On-site landfill facilities (if required) and waste rock dumps will be constructed with vertical separation from the groundwater table, sufficient to minimise the potential for groundwater contamination. • Engineering controls for the pipeline are designed to minimise the risk of pipeline damage or breach. • An Emergency Response Plan has been developed for the pipeline in the unlikely event of a breach. • Potential groundwater impacts in the vicinity of the Port will be managed as part of the Project Construction Environmental Management Plan.	2000). • Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2005).	and be managed in the site water management system. • The drawdown cone will develop slower than the rate of mining, resulting in a limited impact on the pre-mining groundwater conditions in the eastern end of the proposed pit. • Groundwater monitoring bores will assist with monitoring the expansion of the drawdown cone as mining progresses and potential impacts on the surrounding groundwater regimes. • The pipelines have a very low risk of failure, however, a breach will be detected and managed in accordance with the Pipeline Construction and Operation Management Plan to minimise environmental impacts.

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
						• Groundwater will not be contaminated as a result of Project activities as operational controls will minimise the risk of spills and engineering controls such as bunding and sumps will prevent any spills causing adverse environmental impacts.
Surface Hydrology and Water Harvesting	• Maintain the quality and quantity of surface water so that existing and potential environmental values, including ecosystem maintenance, are protected. • Maintain the integrity of ecological functions and environmental values of wetlands and drainage systems. • Minimise adverse impacts to surface water quality and natural drainage pattern during pipeline construction. • Control and contain contaminated water on site to prevent entry into the natural drainage	• Mine site and port operation. • Pipeline construction.	• Overflow of water storage facilities into the surrounding environment during flood events. • Un-intentional discharge of impacted water. • Mosquitoes breed in fresh, brackish, salt and polluted water in natural and artificial situations. Large exposed water retention / storage areas have the potential to become mosquito breeding grounds. • Temporary river and stream diversion and drainage patterns during pipeline construction. • Stormwater runoff from	• Surface runoff and groundwater flowing into the mine will be harvested and utilised as process water. Mine site infrastructure will be designed to collect and store surface runoff and stormwater with minimum erosion of the landscape. • Water harvested from the mine site will be managed as two separate systems non-impacted and impacted. • Excess non-impacted (clean) water may be discharged subsequent to treatment in sedimentation ponds, where necessary. Excess impacted water, if any, will be directed into the mine pit and contained on-site.	• Australian New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ ARMCANZ, 2000). • Position Statement No. 4. Environmental Protection of Wetlands (EPA, 2004). • Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2005). • Erosion and Sediment Control Guidelines (IEAust (Qld), 1996). • NSW Department of Conservation and Land	• No permanent impacts to surface water surrounding the mine site are anticipated as all water run off within the site will be harvested as process water. When excess water is collected from the mine site, the water will be contained and treated and/ or flowed through settling ponds to ensure water is of acceptable quality prior to discharge to the environment. • Pipeline construction through creeks and

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
	system and surrounding vegetation.		port infrastructure may enter the marine environment if not suitably contained.	• Mosquito management strategies will be developed and implemented in consultation with the DoH and the City of Albany. • Stormwater at the Port will be managed as two separate systems; 'contained' and 'general' through bunding, sumps, gross pollutant traps or silt traps and storage tanks. • Water from the contained system will be collected in a sump and pumped to the thickener for re-use in the mining process. • Water from the general system will be collected in sumps, then directed through a central gross pollutant trap to a storage tank before exiting a marine outfall.	Management Urban Erosion and Sediment Control (NSW Department of Land and Water Conservation, 1992). • AS 3500: 1 2003 Plumbing and Drainage. • Australian Drinking Water Guidelines (2004). • Guidance No. 40 Management of Mosquitoes by Land Developers (EPA, 2000).	rivers will result in short term increased turbidity in these waters. No long term impacts to wetlands or waterways are anticipated from the pipeline. • No impacts to surface water in the vicinity of the Port are anticipated as water from the contained system will be collected in a sump and pumped to the thickener for re-use in the mining process. Water from the general system will be collected in sumps, then directed through a central gross pollutant trap to a storage tank before exiting a marine outfall.
Vegetation and Flora	• Maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in	• Clearing for mine site, port and pipeline infrastructure.	• Clearing of native vegetation. • Fragmentation and degradation of vegetation communities. • Spread of dieback through movement of soils and vehicles.	• To decrease the footprint of the Project and minimise environmental impacts, Grange has proposed backfilling of approximately 70% of the tailings and 50% of waste rock into the pit. • Progressive rehabilitation will be conducted throughout the	• Position Statement No. 2 Environmental Protection of Native Vegetation in WA (EPA, 2000). • Position Statement No. 3. Terrestrial Biological Surveys as an Element of	• No DRF species will be impacted by the Project. • The following populations of Priority flora will be cleared: Mine:

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
	knowledge. • Minimise the loss and adverse impacts to native vegetation and plant habitats. • Protect Rare and Priority Flora species that occur within the proposal area.		• Weed infestations in newly cleared bush land. • Increased dust deposition on vegetation from mining activities and increased exposed ground. • Disturbance to threatened flora populations. • Disturbance of one of three known *Commersonia sp*. Mt Groper population areas. A population of this species has been located in a wetland outside of the Project footprint.	Project life with revegetation continued after mine closure. • Potential spread of dieback and weeds will be managed through hygiene measures developed in compliance with DEC. • Dust management strategies have been prepared in the Project Construction Environmental Management Plan. • Rare Flora baseline surveys have been conducted for all disturbance areas. • Limit the extent of vegetation clearing, e.g. marking clearing limits. • Grange will prepare and implement a Threatened Flora Management and Conservation Plan for the Project to address management of Threatened Flora impacted by the proposed development. • The Threatened Flora and Conservation Management Plan will outline specific, comprehensive propagation and management strategies for *Commersonia sp*. Mt Groper.	Biodiversity Protection (EPA, 2002). • Position Statement No. 9 Environmental Offsets (EPA, 2006). • Guidance Statement No. 3. Separation Distances between Industrial and Sensitive Land Uses (EPA, 2005). • Guidance Statement No. 51. Terrestrial Flora and Vegetation Surveys Environmental Impact Assessment in WA (EPA, 2004); and • Policy Statement No 9, Conserving Threatened Species and Ecological Communities (CALM, 2003).	• The population area of Priority 1 *Commersonia sp.* Mt Groper (RG Cranfield & D. Kabay 9157). • Two populations of Priority 2 *Chordifex leucoblepharus*. • One population of Priority 2 *Microcorys lenticularis*. • Two populations of Priority 2 *Monotoca aristata*. • Two populations of Priority 3 *Calectasia obtusa*. • Two populations of Priority 3 *Dryandra calophylla*. • Three populations of Priority 3 *Goodenia filiformis*. Pipeline: • One population of Priority 3 *Calectasia obtusa*.

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
Terrestrial Weeds and Dieback	• Avoid introduction of terrestrial weeds and disease. • Reduce the spread of existing weeds and disease within the Project area. • Implement control measures to prevent the spread of dieback associated with Project works.	• Construction of the mine site and the pipeline.	• Transport and spread of weeds and dieback from vegetation clearing, earthmoving activities, disturbance to native vegetation and increased vehicle traffic. • Competition of weeds with native species for space, nutrients and water. • The movement of soil through earthmoving activities and vehicles associated with the Project can potentially spread dieback into sensitive areas.	• Compliance with applicable weed management strategies and implementation of hygiene procedures included in the Project Construction Environmental Management Plan and Pipeline Construction and Operation Environmental Management Plan. • Quarantine and hygiene management strategies are compliant with DEC and EPA requirements. • Strategies include the provision and use of clean-down facilities and ensuring that earth moving equipment is free of dirt and plant materials prior to entry and exit of sensitive and/or dieback quarantine areas.	• ARMCANZ, ANZECC - The National Weeds Strategy. • CALM - Environmental Weed Strategy for Western Australia. • City of Albany - Environmental Weeds Strategy. • State Weed Plan Steering Group - A Weed Plan for Western Australia. • EPA - The national 'Threat Abatement Plan for Dieback Caused by the Root-rot Fungus *Phytophthora cinnamomi*)'(2001). • Policy Statement No.3, Management of Phytophthora and Disease Caused by it (CALM, 1998).	• No weeds will be introduced to the mine site by Project activities. Existing weed infestations within the pipeline corridor footprint will be managed where required. • Implementation of the Dieback Disease Management Plan will ensure no introduction of dieback into the remnant vegetation and conservation areas adjacent to the Project footprint.
Terrestrial Fauna	• Maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or	• Vegetation clearing for the mine site, processing plant and associated infrastructure.	• Loss and degradation of fauna habitat and disturbance to fauna activity patterns through the removal of native vegetation.	• Disturbed areas will be rehabilitated as soon as possible, with ongoing rehabilitation throughout the mine life to facilitate habitat restoration.	• Guidance Statement No. 56. Terrestrial Fauna Surveys for Environmental Impact Assessment in WA (EPA, 2004).	• Fauna loss is not anticipated to have regional significance as the fauna present within the proposed mine site are mostly wide-ranging and are

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
	management of adverse impacts and improvement in knowledge. • Minimise Project impacts to fauna.	• Trenching for pipeline construction. • Mine site operation and closure.	• Alteration of habitat from introduced flora and fauna. • Impact on native fauna from noise and vibrations, contamination of habitat, increased road traffic and mine voids. • Animal deaths associated with water storage ponds at the mine site. • The exposed trench during pipeline construction has the potential to trap animals.	• Site personnel will be familiarised with potential species of conservation significance and report all sightings to environmental personnel. • The use of barbed wire on site will be prohibited. • Southern Brown Bandicoots (*Isoodon obesulus fuscIventer*) may be trapped and relocated outside of the mine footprint in consultation with DEC. • Remnant vegetation will be retained as much as possible within the mine site. • Rehabilitation will comprise the distribution of mulched vegetation across rehabilitation areas, the planting of native vegetation used by local fauna, and the placement of hollow logs on the ground as refuge for fauna. • Creation of fauna egress points in steep sided dams in the corners and at strategically placed points. • For areas of free standing water where water quality may pose a risk to fauna, gas cannons, or bird balls may be used as deterrents.	• Position Statement No. 3. Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002). • CALM Draft Policy Statement Number 9. Conserving Threatened Species and Ecological Communities.	likely to be present within the surrounding national parks and conservation estate. • It is anticipated that there will be no impacts to fauna associated with the pipeline construction.

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Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
				• Putrescible waste hygiene measures will be implemented to reduce the likelihood of foxes being attracted to the area. • A detailed management strategy is included in the Pipeline Construction and Operation Management Plan and includes using fauna refuge points, restricting the time the trench is left open and employing a fauna expert to remove trapped fauna.		
Fauna of Conservation Significance	• Maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. • Avoid Project impacts to threatened species.	• Vegetation clearing for the mine site, processing plant and associated infrastructure. • Pipeline construction activities. • Mine site operation and closure.	• Fauna of conservation significance may be directly impacted upon by the proposal through individual animal deaths, or indirectly impacted upon through habitat loss, degradation and fragmentation of ecosystems and isolation of populations, noise pollution and increased predation pressure. • Seven species of conservation significance have been recorded (Western Ring-tailed Possum, Carnaby's Black Cockatoo, Forest Red-tailed Black Cockatoo, Western False Pipestrelle, Australian	• Rare fauna baseline surveys have been conducted for all disturbance areas and locations of any fauna of conservation significance. Survey information has been plotted onto maps. • Information from fauna surveys conducted in the area will be used to avoid impact to species and habitats of fauna of conservation significance. • Implement operational control procedures and employee training programmes to protect native fauna from intentional harm, and to appropriately manage injured fauna if found. • Death of fauna of conservation significance will be reported to DEC, if required.	• Guidance Statement No. 56. Terrestrial Fauna Surveys for Environmental Impact Assessment in WA (EPA, 2004). • CALM Draft Policy Statement Number 9. Conserving Threatened Species and Ecological Communities.	• There will not be significant impacts to fauna of conservation significance as the remnant vegetation to be cleared at the mine site and in places along the pipeline represents a marginal part of the species habitat. • Pipeline construction in the vicinity of the Cuming Road reserve may temporarily disturb Western Ringtail Possums foraging in the vegetation; however, there will be no clearing of vegetation or possum habitat, and therefore no

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
			Bustard, Peregrine Falcon and Southern Brown Bandicoot). • Pipeline construction may potentially interface with two listed threatened fauna species, the Short-billed (Carnaby's) Black Cockatoo (*Calyptorhynchus latirostris*) listed as Endangered under the EPBC Act 1999, and the Western Ringtail Possum (*Pseudocheirus occidentalis*) listed as Vulnerable under the EPBC Act 1999.	• Bandicoot translocation may be undertaken prior to commencement of clearing. • Carnaby's Black Cockatoo strategies will focus on habitat management of non-breeding areas and include; promoting the retention of existing feeding habitat through conservation offsets and re-establishment of feeding habitat for the Cockatoo in the long term through mine site rehabilitation with appropriate vegetation species. This will be outlined in the mine closure plan.		significant impact to this species. • There will be no significant impacts to breeding habitat for Carnaby's Black Cockatoo from the construction of the mine site or pipeline. As foraging habitat is well represented in the vicinity of the proposed mine site, it is anticipated that offset measures, such as land acquisition and protection, will reduce the impact of clearing at the mine site to the species.
Short Range Endemic Invertebrate Fauna	• Maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. • Minimise Project impacts to fauna.	• Vegetation clearing for the mine site, processing plant and associated infrastructure. • Pipeline construction activities. • Mine site operation and closure.	• Habitat loss and further fragmentation through clearing of native vegetation. • Increased risk of wildfire associated with movement of employees and machinery. • Degradation of fauna habitat due to invasion of weeds and spread of dieback. • Disruption to resident fauna due to increased noise and dust pollution.	• As the clearing footprint within the mine site will remove most of the remnant vegetation, limited clearing controls are available. • Additional surveys will be conducted prior to ground disturbance to ascertain the distribution and fully determine the conservation status of the spiders *Yilgarnia currycomboides* and *Chenistonia "paludigena" ms.*, and the mollusc *Bothriembryon sp. "Wellstead"* will be conducted prior to ground	• Guidance Statement No. 56. Terrestrial Fauna Surveys for Environmental Impact Assessment in WA (EPA, 2004). • Position Statement No. 3. Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002).	• Populations of SRE invertebrate fauna within the clearing footprint and the majority of invertebrate fauna that do not have aerial dispersal abilities will be lost due to clearing of up to 252.6 ha of native vegetation for construction of Project infrastructure.

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Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
				disturbance activities. • The Mygalomorphae trap-door spider species *Chenistonia paludigena ms.nom. BYM*, was recorded in the Fuller Rd reserve. Where possible, pipeline construction across the Fuller Rd reserve will be within or adjacent to one of the two cleared areas present at the reserve and immediately rehabilitated.		
Stygofauna	• Maintain the abundance, diversity, geographic distribution and productivity of subterranean fauna at the species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. • Minimise Project impacts to stygofauna and stygofauna habitat. • Maintain the quantity of groundwater so that the existing and potential uses, including ecosystem maintenance, are protected.	• Mine excavation and dewatering. • Use of hydrocarbons and chemicals during Project construction and operation.	• Direct removal of subterranean habitat from excavation of habitat strata. • Modifications and removal of stygofana habitats through alterations to groundwater levels from dewatering and groundwater extraction. • Contamination of groundwater from mining and associated activities.	• Pre-clearance surveys for stygofauna within and outside the Project foot print have been conducted. • Site infrastructure and operational controls will be implemented to prevent contamination of ground water. These include appropriate management of tailings, hydrocarbons and chemicals, and waste water and emergency response in the event of a pipeline failure. • Regular testing of regional groundwater levels and water quality will be maintained throughout the Project. • Stygofauna sampling will be conducted as part of the groundwater monitoring programme. Parameters measured will be sufficiently	• Guidance Statement No. 54. Consideration of Subterranean Fauna in Groundwater and Caves during EIA in WA (EPA, 2003). • Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006).	• No direct impacts to stygofauna populations in the Southdown area are anticipated as initial sampling indicates that there are no stygal species within the modelled groundwater drawdown footprint. • Potential sources of contamination at the mine site will be managed to prevent contamination of the surrounding groundwater.

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Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
				sensitive to give adequate warning of a decline in species numbers.		
Air Quality-Dust	• Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards. • Minimise dust associated with the construction and operation of the mine, pipeline and port facilities. • Minimise exposed surfaces through clearing minimisation, staged clearing and progressive rehabilitation.	• General construction activities e.g. blasting and earthworks. • Mining operations such as pit excavation, and overburden and waste handling. • Vehicle traffic on access roads and haul roads. • Mineralised material handling, crushing and processing.	• Dust generated from general construction activities may affect vegetation and fauna habitats through accumulation on leaf surfaces inhibiting respiration and limiting plant growth. • Dust levels may impact on safe operations by reducing visibility on site and may results in health issues. • High dust emissions are expected to be restricted to short-term events such as blasting, and on high wind days in summer. • Initial modelling suggests that peak impacts during summer months will be directed away from the nearest receptors in the Hassell National Park, and the closest residences immediately to the east of the mining leases. • Seasonal rainfall and wind variations may occur during the	• Conventional dust management practices common to the mining industry in WA will be implemented, particularly in areas with high dust generating potential. A Dust Management Plan will be incorporated into the Project Construction Environmental Management Plan • Dust control measures will be incorporated into Project design such as enclosed processing areas and stockpile sheds at the Port where the impact of dust emissions are significant. • Minimisation of vegetation clearing. • Staged clearing and progressive rehabilitation to minimise exposed areas. • Regular inspections to visually assess dust generation. • Ambient dust monitoring where appropriate.	• Guidance Statement No. 18 Prevention of Air Quality Impacts from Land Development Sites (EPA, 2000). • Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006). • National Environmental Protection Measure for Ambient Air Quality.	• Environmental guidelines for dust relevant to human amenity are unlikely to be approached at the nearby nature reserve areas. These guideline levels are considered to be conservative with respect to vegetation. • Although predicted PM_{10} concentrations exceed NEPM standards in preliminary modelling at the three residences closest to the mining operation, the implementation of dust management measures and monitoring will ensure that the Southdown Magnetite Proposal will not adversely affect environmental values or human health. • The Stirling Range National Park is located at approximately 13 km,

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Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
			estimated 22 year mine life. During drier and/ or windier periods the potential for additional dust to be generated at the mine site may arise.			north-west of the Project site. Air quality impacts at sensitive sites within the National Park, including the Eastern Stirling Range Montane Heath and Thicket Threatened Ecological Community will be less than those at all other receptors.
Noise and Vibration	• Minimise the noise associated with the construction and operation of the mine, pipeline construction, land reclamation and port construction activities. • Protect the amenity of nearby residents by ensuring that noise levels meet the statutory requirements and acceptable standards.	• Construction of the mine, pipeline and port infrastructure. • Mine site and port operation. • Blasting at the mine site will be required.	• The construction and operation of the mine will increase the ambient noise levels in areas adjacent to the operations. • Combined noise from fixed plant and mobile plant at the Southdown Magnetite mine site is likely to exceed the night-time assigned levels at the three residences within approximately 4.5 km of mining operation's mobile plant. • As mining operations approach the eastern end, residents nearby (Beulan, Nymann and Grasfeld) will be affected.	• Once requirements for mobile plant and fixed plant have been established, the noise model for mine site operation will be refined and control measures implemented to ensure operation noise emissions are acceptable. • Noise and vibrations exposure levels will be monitored against the compliance requirements of the *Mines Safety and Inspection Act 1994*. • The operational mine camp will be located off-site. • Barriers up to 20 m in height will be built between the mine, road areas and local houses if required. • For occupied residences within 4.5 km of the mine site, Grange will double glaze the windows	• Environmental Protection (Noise) Regulations 1997. • Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006). • AS2670:2001 Evaluation for human exposure to whole body vibration. • AS2436-1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites. • Proposed Town Planning Scheme Policy – Albany Port Noise Buffer Area Policy (Adopted 2003).	• Management strategies will be implemented through a Noise Management Plan to ensure that noise associated with the mine and port operations comply with AS 2436-1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites and *Environmental Protection (Noise) Regulations 1997.* Mine site: • Implementation of operational controls will ensure that interior noise amenity at residences surrounding the mine

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
			• Existing port operations generate noise levels that exceed assigned levels at the nearest neighbours. This is likely to continue. • Temporary inconvenience to landholders and the general public during port and pipeline construction.	and install air conditioning units or implement other appropriate strategies to ensure interior noise amenity meets the relevant Australian Standard after treatment. • Noise generated by mining operations will be minimised at night by scheduling trucks to work below the top of the dump, ensuring a physical barrier between the trucks and the nearest sensitive premises. • Backfilling of the mine void further reduces noise as equipment is operating below surface level. • Blasting at the mine site will only occur in daylight hours (and modification of blasting practices to reduce noise emissions). • Equipment selection and designs will be engineered for minimum noise. • Temporary pipeline construction noise will be managed through the Noise Management Plan and communication with owners of the freehold properties traversed by the pipeline. • Construction at the Port will be conducted in compliance with		site meets the relevant Australian Standard after any treatment. Pipeline construction and reclamation: • Construction works will be scheduled to occur during day-light hours where possible. Construction noise is anticipated to exceed day time limits by between 7 and 9 dB (A) unless a dozer or similar vehicle with noise emissions less than the 118 dB (A) is used.

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Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
				the noise practices set out in Section 6 of Australian Standard 2436-1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites'. • Port facilities will be enclosed and well sealed from openings to the west-north-west to prevent breakout in the direction of the nearest neighbour.		
Odour Emissions	• Ensure that emissions do not adversely affect environmental values or the health, welfare or amenity of people and land uses by meeting statutory requirements and acceptable standards.		• No part of the Southdown Magnetite Proposal is anticipated to generate odour.	• None required.	• Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006). • EPA Guidance Statement No. 3. Separation Distances between Industrial and Sensitive Land Uses (EPA, 2005).	• No part of the Southdown Magnetite Proposal is anticipated to generate odour.
Gaseous Emissions	• Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards. • Minimise emissions to levels as low as practicable on an on-	• Use of fuel and energy for plant and equipment operation. • Detonation of explosives used in blasting.	• Emissions of greenhouse gas through fuel combustion and energy use will result in a contribution to the State's greenhouse gas emissions. • The majority of these gaseous emissions are associated with the production of electricity for the Project. As the	• Greenhouse gas emission minimisation will be incorporated into mine planning in accordance with EPA Guidance Statement for Minimising Greenhouse Gas Emissions • Land clearing will be minimised where possible. • Vehicle movements will be minimised and fuel	• Guidance Statement No. 12. Guidance Statement for Minimising Greenhouse Gas Emissions (EPA, 2002) • EPA Guidance Statement No. 18 Prevention of Air Quality Impacts from Land Development Sites (EPA, 2000).	• Once operational, the Southdown Magnetite Proposal will generate greenhouse gases, mainly from the consumption of electricity and diesel fuel. Emissions of greenhouse gas and other gaseous emissions from construction and

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Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
	going basis and consider offsets to further reduce cumulative emissions.		proposal does not involve refining of the magnetite, gaseous emissions are anticipated to result through activities such as fuel combustion and use of paints and solvents.	consumption used as a requirement in selecting vehicles. • Grange will comply with National Environment Protection Measures and relevant state legislation through reporting all emissions that trigger reporting thresholds to the National Pollution Inventory.	• EPA Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006). • Australian methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2002 Series. • National Environmental Protection Measure for Ambient Air Quality (NEPM, 1998).	operations will be kept as low as practicable.
Waste (General and Hazardous Waste)	• Reduce the volume of waste through product selection, reuse and recycling. • Ensure that waste is contained and isolated from groundwater and surface water, and that storage, treatment or collection does not result in long term impacts on the surrounding environment. • Minimise the environmental impacts of hydrocarbons/chemicals (fuels, solvents, cleaning	• Construction and operation of mine site, pipeline and port facilities will generate a variety of solid waste materials including tailings, solid waste, hydrocarbons and chemicals, sewage and grey water. • Tailings will be generated in the form of 'wet' slurry during the	• Inappropriate management of tailings, solid waste, hydrocarbons and chemicals, sewage and grey water, could result in contamination of soils, ground or surface water bodies.	• General waste will be disposed in an approved landfill. • On-site landfill areas (if required) will be constructed with sufficient vertical separation from the groundwater table to minimise the potential for groundwater contamination. • Sewage and grey water will be treated on-site using package sewage plants. • Liquid effluent generated at the site includes laboratory waste, oils and water from the workshop will be managed in accordance with relevant	• Water Quality Protection Guidelines No. 10 Mining and Mineral Processing Above-ground fuel and chemical storage (2000). • Australian Standard 1940-2004: The storage and handling of flammable and combustible liquids. • Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006).	• The management of general and hazardous waste is expected to result in negligible environmental impacts.

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Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
	fluids etc.) through appropriate storage, handling and disposal.	life of the Project.		legislation. • Storage of bulk fuel will be in above ground tanks within bunded, impermeable enclosures, or in double skinned tanks. • Spill response equipment will be located in the vicinity of work areas, with site personnel trained in spill response management. • Storage of explosives will be in a remote magazine in accordance with the Explosives and Dangerous Goods Act 1961. • Hazardous waste will be removed from site by a licensed contractor for disposal in an approved facility in accordance with the requirements of the controlled waste regulations.	• Guidance Note S301, Storage of Dangerous Goods Licensing and Exemptions (DoCEP, 2006). • Guidance Note MH401, Dangerous Goods in Ports-Guidelines for the Development of a safety management system (DoIR, 2003). • Australian Code for the Transport of Dangerous Goods by Road and Rail (National Road Transport Commission, 2005). • Water Quality Protection Note; Irrigation with nutrient rich wastewater (DoE, 2004).	
Electromagnetic Radiation	• Ensure that radiological impacts to the public and environment are kept as low as reasonably achievable and comply with acceptable standards.	• Ore concentration process. • Mine site laboratory facilities may have potential radiation.	• Electromagnetic radiation may result in long term health issues for employees as well as residents in the vicinity of the operations. • Accumulation of electromagnetically radioactive material may also result in the	• If sources of significant electromagnetic radiation are identified, management strategies for point sources will be developed and implemented.	• Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006).	• Electromagnetic radiation will be managed so as to have negligible environmental impacts.

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
			formation of new contaminated sites, the inability to meet closure criteria and impacts to health and well being of flora and fauna in the area.			
Visual Amenity, Landscape and Geo-heritage	• Minimise Project impacts to community use and access of significant environmental features. • Ensure that aesthetic values and public experience of the landscape are considered and measures are adopted to reduce the visual impacts on the landscape. • Maintain and protect any significant landscape and geo-heritage values and maintain the integrity, ecological functions and environmental values of the soil and landform.	• Mine and port infrastructure and site selection. • Pipeline construction.	• The mine is not compatible with existing land uses and will result in highly visible, medium to permanent changes to the landscape. • Permanent impacts of port infrastructure visible from residential properties, recreation areas and historical and memorial sites. • Impacts to visual amenity at tourist, historical, memorial, recreational, residential and scenic sites. • The slurry pipeline will be buried and, following rehabilitation will be un-noticeable.	• Undertake public communication and consultation during planning phase. • Rehabilitation structures will be stable, re-contoured, progressively rehabilitated and shaped to mimic local landforms where possible. • Tree screening will block the view of the mine site from surrounding travel routes. • The majority of the port side infrastructure will be contained within a shed. • Port side infrastructure, including the storage shed will be constructed with neutrally coloured, non-reflective material.	• Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006). • State Planning Strategy and associated policies (WAPC, 1997); • Town of Albany Town Planning Schemes No. 1A and No 3 (Shire) District Schemes, (City of Albany, 2004).	• The Southdown Magnetite Proposal will have limited visual impact at both the mine site and the Albany Port. • Visual impacts from the mine site during construction and operation will be screened from view with vegetation. Long term, the landforms will be rehabilitated with native vegetation.
Social and Cultural Environment	• Avoid disturbance to maritime, cultural and heritage sites. • Ensure compliance with relevant legislation	• Mine site construction. • Pipeline construction.	• No sites of cultural, social or environmental listed on the register of National Estate Database will be impacted by Project works.	• Ethnographic and Archeological heritage surveys have been conducted at the mine site and along the proposed pipeline corridor to identify indigenous heritage	• Guidance Statement No. 41. Assessment of Aboriginal Heritage (EPA, 2004). • DoIR - Guidelines for	• Significant European Heritage will not be removed, damaged or altered. • Significant sites

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
	including the Heritage of Western Australia Act 1990 and the Aboriginal Heritage Act 1972. • Respect the rights of all land owners.		• The proposed pipeline route potentially impacts two sites of indigenous significance: a registered site Creek 3 (Site ID 21837), and Kinjarling. • Excavation and construction works for the mine site and pipeline could potentially uncover and damage currently unidentified aboriginal sites. • Initial investigations, construction activities and events of pipeline failure may impinge on the privacy and convenience of land owners.	sites. • Any part of the proposal occurring adjacent, behind or across the road from a registered site will be referred to the Heritage Council as a development application under the Heritage of Western Australia Act 1990. • The locations of existing registered sites will be taken into account during mine planning. • Registered sites will not be removed, damaged or altered without Section 18 approval from the Minister of Indigenous Affairs, under the Aboriginal Heritage Act 1972. • Traditional custodians will be consulted and a representative present during pipeline construction. • Training will be provided to all personnel detailing the importance of avoiding heritage sites and reporting of any suspected heritage sites and exclusion zones. • Concerns raised by land owners will be addressed and resolved as part of securing tenure for the pipeline.	Consultation with Indigenous People by Mineral Explorers. • Pipeline Easement Guidelines (APIA / VFF, 2004).	identified from the Aboriginal Sites register and during ethnographic and archaeological surveys and construction will not be removed, damaged or altered without approval under Section 18 of the Aboriginal Heritage Act 1972.

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
Decommissioning and Rehabilitation	• Ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values. • Fulfill commitments made to stakeholders and regulators regarding closure outcomes.	• Decommissioning of the mine site, pipeline and port infrastructure.	• Environmental values of the area will be impacted as a result of the proposed development due to the construction of mine pits, waste dumps, TSF, pipeline and land reclamation. Most of the impacts will be localised at the mine site and the existing Port, with minimal disturbance anticipated from the pipeline.	• A conceptual closure plan has been developed to comply with AMEC Mine Closure Guidelines (2000) and ANZMECC Strategic Framework for Mine Closure (2000). • Decommissioning will comprise the safe dismantling and removal of infrastructure, the appropriate disposal of waste materials and the impacted areas returned to an array of vegetation types and fauna habitats that reflect the pre-disturbance state as closely as possible. • Rehabilitation will occur progressively where possible as disturbed areas are no longer utilised. • The rehabilitation programme will be described in the Threatened Flora and Conservation Management Plan and will include development of completion criteria to determine when rehabilitation can be considered self sustaining. • Following rehabilitation, areas will be monitored and treated for weed invasion	• AMEC - AMEC Mine closure Guidelines (2000). • ANZMECC - Strategic Framework for Mine Closure (2000). • DoIR - Mine Closure Guideline for Minerals Operations in WA. (2000). • WRC Mine Void Water Issues in WA (2003).	• Rehabilitation of portions of the TSF, waste dumps and other impacted areas will commence as early as possible in the mining phase. • Mine site infrastructure will be removed at the end of mining and waste dumps and TSF rehabilitation completed to support self-sustaining ecosystems. A portion of the mine pit will be left open at the end of mining operations.

EXECUTIVE SUMMARY: Potential Impacts and Proposed Management Strategies

Environmental Factor	Environmental Management Objectives	Relevant Project Component	Potential Impacts	Environmental Management	Applicable Standards	Predicted Outcome
Ship loading	• Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards; • Maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	• Port operations.	• Increased loading of vessels in Princess Royal Harbour may increase the potential for water and sediment contamination through potential spills of magnetite during ship loading.	• Potential contamination associated with operational spillages during ship loading in the Port will be managed as part of current Port management procedures.	• Australian New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC / ARMCANZ, 2000). • National Ocean Disposal Guidelines (Commonwealth of Australia, 2002).	• Shipping operations will be conducted with no adverse environmental impacts.

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Environmental Management Commitments

Table S5 Southdown Magnetite Proposal Environmental Management Commitments.

Commitment Number	Topic	Actions	Objectives	Timing	Seek advice from
1	Project Construction	Prepare a Project Construction Environmental Management Plan that: 1. identifies activities that may result in environmental impacts; 2. identifies controls to reduce the risk of impacts; 3. documents procedures for risk control; 4. describes communication of procedures; and 5. describes monitoring procedures to assess the effectiveness of controls.	Provide a framework for continual improvement and minimise risk of impacts from construction.	Prior to construction.	DEC, DoW, DIA, DoIR
2	Project Construction	Implement the approved Project Construction Environmental Management Plan referred to in Commitment 1.	Ensure continual improvement and minimise risk of impacts from construction.	Commencement of construction.	
3	Project Operation	Prepare an Operation Environmental Management Plan that: 1. identifies activities that may result in environmental impacts; 2. identifies controls to reduce the risk of impacts; 3. documents procedures for risk control; 4. documents communication of procedures; and 5. describes monitoring procedures to assess the effectiveness of controls.	Provide a framework for continual improvement and minimise risk of impacts from operations.	Planning. Prior to commencement of operations.	DEC, DoW, DIA, DoIR

Commitment Number	Topic	Actions	Objectives	Timing	Seek advice from
4	Project Operation	Implement the approved Operation Environmental Management Plan referred to in Commitment 3.	Ensure continual improvement and minimise risk of impacts from operations.	Throughout operations.	
5	Project Construction and Operation	Prepare a Project Environmental Management System that is consistent with the principles of ISO 14001:2004.	Provide a framework for continual improvement and minimise risk of impacts.	Planning. Prior to construction.	DEC
6	Project Construction and Operation	Implement the approved Environmental Management System referred to in Commitment 5.	Ensure continual improvement and minimise risk of impacts.	Life of Mine	
7	Acid Sulphate Soils	Conduct a targeted acid sulphate soil survey along the route of the pipeline that: 1. identifies survey methods and design; 2. will comply with relevant guidelines; and 3. will be developed in consultation with DEC.	Identify areas of Acid Sulphate Soils along the pipeline route that may require specific management strategies.	Planning. Prior to pipeline construction.	DEC
8	Acid Sulphate Soils	Prepare Acid Sulphate Soil Management Plan/s for the pipeline (as required) that: 1. set out procedures to minimise the creation and spread of acid sulphate soils; 2. monitors the effectiveness of control measures; and 3. ensures that effective rehabilitation can be achieved.	Identify and document specific management procedures to minimise short and long term impacts of pipeline construction	Planning. Prior to pipeline construction.	DEC
9	Acid Sulphate Soils	Implement the approved Acid Sulphate Soil Management Plan/s referred to in Commitment 8	Conduct pipeline construction activity in a manner that: 1. minimises creation and spread of acid sulphate soils; 2. monitors effectiveness of construction methods; and 3. allows for effective	Throughout pipeline construction activities.	

EXECUTIVE SUMMARY: Environmental Management Commitments

Commitment Number	Topic	Actions	Objectives	Timing	Seek advice from
			rehabilitation where possible.		
10	Acid Rock Drainage	Prepare an Acid Rock Drainage Management (ARD) Plan that sets out procedures to: 1. investigate and identify potentially acid forming materials; 2. minimise the generation of ARD; 3. control and contain ARD; 4. monitor the effectiveness of control measures; and 5. ensure effective rehabilitation can be achieved on closure.	Ensure potentially acid forming waste rock and tailings are adequately managed.	Prior to commencement of mining.	DoIR
11	Acid Rock Drainage	Implement the approved Acid Rock Drainage Management Plan referred to in Commitment 10.	Manage acid forming waste rock and tailings adequately.	Commencement of operation and through to closure.	DoIR
12	Contaminated sites	Conduct a Phase 2A Intrusive Investigation for the contaminated site (former and current railway depot: Location 9) intersected by the proposed pipeline.	Determine the nature and extent of contamination at Location 9 (former and current railway depot).	Prior to the completion of the EPA's assessment of this proposal.	DEC
13	Contaminated sites	Conduct a Phase 2B Intrusive Investigation for other contaminated site locations potentially impacted by the pipeline route.	Determine the nature and extent of contamination of site locations potentially impacted by the pipeline route.	Prior to pipeline construction.	DEC
14	Contaminated sites	Prepare Contamination Site Management Plan/s that set out procedures to manage construction activities.	Ensure construction activities are managed so as to prevent impacts to human health and the environment.	Prior to pipeline construction.	DEC
15	Contaminated sites	Implement the approved Contamination Site Management Plan/s referred to in Commitment 14.	Manage construction activities to prevent impacts to human health and the environment.	Commencement of pipeline construction.	DEC

EXECUTIVE SUMMARY: Environmental Management Commitments

Commitment Number	Topic	Actions	Objectives	Timing	Seek advice from
16	Groundwater	Prepare a Groundwater Management Plan that will: 1. set out procedures to model the short and long term hydrogeological impacts of dewatering and surface water harvesting; 2. develop a Groundwater Operating Strategy and a monitoring programme; and 3. identify procedures to minimise impacts to groundwater aquifers.	Ensure short and long term hydrogeological impacts of dewatering and surface water harvesting are adequately managed.	Prior to dewatering activities.	DEC, DoW
17	Groundwater	Implement the approved Groundwater Management Plan referred to in Commitment 16.	Adequately manage the short and long term hydrogeological impacts of dewatering and surface water harvesting.	Commencement of dewatering and throughout life of mine.	DEC, DoW.
18	Pipeline Construction and Operation	Prepare a Pipeline Construction and Operation Management Plan that will: 1. identify environmental and social impacts of construction and operation of the pipeline; 2. outline control procedures for these impacts; and 3. describe monitoring measures to assess effectiveness of controls.	Ensure pipeline construction activities are managed to minimise environmental and social impacts of construction and operation of the pipeline.	Prior to pipeline construction.	DEC, DIA, DoIR.
19	Pipeline Construction and Operation	Implement the approved Pipeline Construction and Operation Management Plan referred to in Commitment 18.	Manage pipeline construction activities to minimise environmental and social impacts of construction and operation of the pipeline.	Commencement of pipeline construction and throughout operation.	
20	Surface Hydrology and Water Harvesting	Prepare a Surface Water Management Plan that will set out procedures to: 1. minimise the human health and environmental impacts of surface water harvesting; 2. minimise the impacts of mining and	Ensure surface water harvesting and water quality are adequately managed.	Prior to construction and mining.	DEC, DoIR.

Commitment Number	Topic	Actions	Objectives	Timing	Seek advice from
		processing to surface water quality; and 3. monitor the effectiveness of management procedures.			
21	Surface Hydrology and Water Harvesting	Implement the approved Surface Water Management Plan referred to in Commitment 20.	Adequately manage surface water harvesting to protect water quality.	Commencement of surface water harvesting.	DEC.
22	Vegetation and Flora	Prepare a Threatened Flora and Conservation Management Plan that will set out procedures to maintain the abundance, diversity, distribution and conservation status of threatened flora species.	Ensure Threatened flora species are adequately managed.	Prior to mine and pipeline construction works.	DEC
23	Vegetation and Flora	Implement the approved Threatened Flora and Conservation Management Plan referred to in Commitment 22.	Adequately manage threatened flora species.	Life of mine.	DEC
24	Vegetation and Flora	Conduct appropriate investigation and surveys to determine the distribution and abundance of Commersonia sp. Mt Groper (RG Cranfield & D. Kabay 9157).	Minimise impacts to distribution and abundance of Commersonia sp. Mt Groper (RG Cranfield & D. Kabay 9157).	Prior to impacts to the potential seed reserve at the mine site.	DEC
25	Vegetation and Flora	A minimum of 30 ha of Albany Blackbutt (*Eucalyptus Staeri)* mallee heath and chittick scrub-heath vegetation at the mine site will be fenced off and retained.	Preservation of mine site vegetation for conservation purposes.	Prior to construction and throughout life of mine.	DEC
26	Vegetation and Flora	As a Primary offset, Grange will rehabilitate using provenant species impacted by Project clearing. The Secondary offset will be to purchase and protect, or otherwise contribute towards the protection of, remnant bush areas of similar conservation value to that being impacted by the Project. Where possible, Grange will achieve a net environmental benefit in this regard. On closure, these areas will be divested to the state government or other appropriate conservation body, or otherwise covenanted to protect remnant bush areas.	Implement appropriate Environmental offsets.	Overall.	DEC

EXECUTIVE SUMMARY: Environmental Management Commitments

Commitment Number	Topic	Actions	Objectives	Timing	Seek advice from
27	Terrestrial Weeds and Dieback	Prepare a Dieback Disease Management Plan that will set out procedures to: 1. identify the dieback status of Project areas; 2. demarcate hygiene boundaries within the Project footprint; 3. prevent the spread of dieback through appropriate hygiene practices; and 4. monitor the effectiveness of dieback control measures.	Ensure current status of dieback/disease is not extended beyond the hygiene boundaries.	Prior to construction.	DEC
28	Terrestrial Weeds and Dieback	Implement the approved Dieback Disease Management Plan referred to in Commitment 25.	Manage Project works to ensure dieback/disease is not extended beyond the hygiene boundaries.	Commencement of construction and throughout life of mine.	DEC
29	Terrestrial Fauna	Rehabilitate cleared and offset areas with appropriate vegetation species to establish feeding habitat for Carnaby's Black Cockatoo.	Compensate for the loss of feeding habitat for Carnaby's Black Cockatoo due to Project clearing.	Throughout life of mine.	DEC, DoIR
30	Air Quality - Dust	Prepare Dust Management Plans that will: 1. identify dust emissions and sensitive receptors; 2. outline procedures for dust monitoring at sensitive receptors; and 3. describe control procedures to minimise dust emissions. 4.	Minimise dust emissions, their impacts and provide a framework for continual improvement to minimise risk of impacts from operations. Monitor dust emissions.	Prior to construction.	DEC
31	Air Quality - Dust	Implement the approved Dust Management Plans referred to in Commitment 29 as part of the plans described in Commitment 2 and Commitment 4.	Adequately manage Project related dust emissions.	Commencement of construction and throughout life of mine.	DEC

EXECUTIVE SUMMARY: Environmental Management Commitments

Commitment Number	Topic	Actions	Objectives	Timing	Seek advice from
32	Noise	Prepare a Noise Management Plan for the Southdown Magnetite mine site and port facilities. The management plan will set out procedures to: 1. reduce noise emissions through design; 2. minimise noise emissions from construction and operation through operational procedures; and 3. monitor the effectiveness of these controls.	Ensure that noise emissions are controlled and comply with the *Environmental Protection (Noise) Regulations 1997.*	Prior to construction.	DEC
33	Noise	Implement the approved Noise Management Plan referred to in Commitment 30.	Manage Project related noise emissions to comply with the *Environmental Protection (Noise) Regulations 1997.*	Commencement of construction and through life of mine.	DEC
34	Gaseous Emissions	Grange will apply to participate in the Greenhouse Challenge Plus programme and WA Strategy.	Contribute to the Greenhouse Challenge Plus programme and WA Strategy as required.	As required.	Common-wealth Government
35	Gaseous Emissions	Grange will comply with National Pollution Inventory reporting requirements for emissions that trigger reporting thresholds.	Conform to National Pollution Inventory reporting requirements.	As required.	DEC
36	Waste (general and hazardous)	Grange will ensure that spill response equipment will be readily accessible in each work area, and that spills will be controlled at the source, contained and cleaned up as soon as they occur. Contaminated material will be removed and bio-remediated (if biodegradable) or disposed at a licensed facility.	Prevent and contain spills.	Throughout life of mine.	DEC
37	Visual Amenity and Geo-Heritage	Prepare a Visual Impact Management Plan for the mine and port facility to: 1. identify potential visual impacts of the Project; 2. describe control options; and 3. monitor effectiveness of these controls.	Design mine and port facilities that achieve visual quality objectives.	Prior to construction.	DPI, DEC, DoIR City of Albany

EXECUTIVE SUMMARY: Environmental Management Commitments

Commitment Number	Topic	Actions	Objectives	Timing	Seek advice from
38	Visual Amenity and Geo-Heritage	Implement the Visual Impact Management Plan for the mine and port facility.	Construct mine and port facilities that achieve visual quality objectives.	Commencement of construction.	DPI, DEC, DoIR City of Albany
39	Social and cultural environment	Grange will: 1. Engage a Community Liaison Officer for the construction phase of the Project. 2. Nominate an appropriately competent person who, irrespective of other duties, will be responsible for liaising with the community during the operational phase of the Project.	Maintain communication of Project activities with stakeholders by providing a point of contact.	Construction and operation.	DIA, City of Albany
40	Social and cultural environment	Obtain approvals relevant to the *Heritage of Western Australia Act 1990* and the *Aboriginal Heritage Act 1972* for disturbance to heritage sites.	Ensure that no heritage sites are disturbed without a permit.	Prior to disturbance of sites of significance.	DIA, CoA
41	Social and cultural environment	Prepare a Heritage Site Management Plan that will: 1. address indigenous and non-indigenous heritage sites; 2. set out procedures to protect sites from unapproved disturbance; and 3. manage disturbance to sites in a manner that is aligned with traditional values.	Ensure indigenous and non-indigenous heritage values are maintained or protected.	Prior to disturbance of sites of heritage significance.	Appropriate custodians, DIA
42	Decommissioning and Rehabilitation	Prepare a Conceptual Mine Closure Plan: 1. that is aligned with AMEC Mine Closure Guidelines (2000) and ANZMECC Strategic Framework for Mine Closure (2000); and 2. review and update the Conceptual Mine Closure Plan as required.	Maintain a conceptual Mine Closure Plan.	12 months after Project approval.	DEC and DoIR

EXECUTIVE SUMMARY: Environmental Management Commitments

Commitment Number	Topic	Actions	Objectives	Timing	Seek advice from
43	Decommissioning and Rehabilitation	Prepare a finalised Mine Closure Plan that will: 1. define appropriate closure criteria necessary for the establishment of safe landforms and self sustaining ecosystems; and 2. set out procedures for monitoring in order to meet compliance with the closure criteria.	Establish safe landforms and self sustaining ecosystems post closure.	Twenty-four months prior to mine closure.	DEC and DoIR
44	Ship Loading	Shipping operations and ship loading will comply with APA requirements to minimise the risk of material spillage.	Manage shipping operations to minimise impacts of spillage and comply with APA requirements.	Throughout shipping.	APA

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Section 1 Introduction

Section 1.1 Albany Iron Ore Project

The Albany Iron Ore Project comprises two related proposals; the Southdown Magnetite Proposal by Grange Resources Limited (Grange) and the Albany Port Expansion Proposal by Albany Port Authority (APA). Although the proponents have distinct roles and responsibilities, for the purposes of environmental impact assessment the two proposals will be treated as one project.

Section 1.2 Southdown Magnetite Proposal Overview

The Southdown Magnetite Deposit is located approximately 10 km south-west of the town of Wellstead and 90 km east, north-east of the City of Albany in Western Australia (WA) (Figure 2.1). Re-evaluation by Grange of drilling completed in 1986/1987 reported a resource of 76 Mt of magnetite grading 37.4% magnetite at a cut-off grade of 15% in the western 2 km of the Southdown Magnetite Deposit. A drilling programme undertaken in 2004/2006 by Grange identified a significant resource of high grade magnetite mineralisation within a quartz magnetite gneiss. On 26th September 2006 Grange announced a revised indicated and inferred resource of 479.1 Mt grading 37.3% magnetite at a cut off grade of 10% magnetite. The deposit is 50-100 m thick and metallurgical evaluation has shown that a magnetite concentrate grading approximately 69% Fe could be achieved by grinding the mineralised material and concentrate using magnetic separation.

The proposed mine site is bounded on the south-eastern side by the South Coast Highway and on the north-eastern side by Gnowellen Rd (Figure 2.2). The proposed Project consists of open pit mining of the Southdown Magnetite Deposit. Waste rock will be stockpiled, with the mineralised material crushed, ground, screened and then magnetically separated to produce a magnetite concentrate. The tailings stream, ranging from clay/silt to sand/gravel will be well graded (13% moisture content) and conveyed to the tailings storage facilities (TSF). The magnetite concentrate will be pumped as slurry, approximately 104 km to a concentrate storage facility located at the Albany Port. The slurry will be dewatered and then stored in a storage facility before being loaded onto Cape size vessels and shipped to Malaysia. Water recovered from the filtered slurry will be pumped back to the mine site for re-use in the concentrator via a return water pipeline buried along side the slurry pipeline (Figure 2.3). In Malaysia the magnetite concentrate will be used to make Direct Reduction and Blast Furnace pellets (in a pellet plant to be built by Grange) for sale to regional steel producers.

Components of the proposed Project are described in detail in the following sections, with a summary of estimated land use requirements for the Southdown Magnetite Proposal outlined in Table 1.1.

Table 1.1 Land Use Requirements..

Activity	Area (ha)
Mine Administration Area and Plant	100
Mine Pit	400
Waste rock Stockpile	620
Mine Tailings Storage Facility	370
Mine Topsoil Storage	70-100
Mine Site sub-total:	***1590***
Pipeline (during Construction Phase)	220
Port (leased from reclamation)	Up to 9.0 ha
Total	***1819***

Section 1.3 The Proponents

The Albany Iron Ore Project is two related proposals consisting of the Southdown Magnetite Proposal by Grange Resources Limited and the Albany Port Expansion Proposal by Albany Port Authority. The proponents' contact details, roles and responsibilities are as follows:

Grange Resources Limited

Address	Contact	Responsibilities
Grange Resources Limited ACN:009 132 405 Level 11, 200 St Georges Terrace Perth, Western Australia 6000 Telephone: + 61 8 9321 1118 Fax: + 61 8 9321 1523 www.grangeresources.com.au	Managing Director: Geoff Wedlock Email: gwedlock@grangeresources.com.au	• Construction and operation of Southdown Mine. • Construction and operation of the pipeline, including foreshore reclamation for pipeline. • Construction of new port terminal facilities. • Ship loading. • Operation of port facilities in accordance with lease agreement with APA.

Albany Port Authority

Address	Contact	Responsibilities
Albany Port Authority 85 Brunswick Road Albany Western Australia 6330 Telephone: +61 8 9892 9000 Fax: +61 8 9841 7566 www.albanyport.com.au	Chief Executive Officer: Brad Williamson Email: brad@albanyport.com.au	• Dredging of Port basin and access channel through King George Sound. • Disposal of excess dredge material. • Land reclamation adjacent to existing port facilities in Princess Royal Harbour. • Provision of navigational aids. • Construction of new berth. • Management of shipping.

ecologia has been engaged by Grange and APA to facilitate the environmental approval process. *ecologia*'s role is to:

- Represent the proponents when liaising with government and public stakeholders.
- Provide advice to Grange on the environmental requirements for the Project approvals process.
- Undertake selected environmental impact assessment studies.
- Provide specialist technical advice on selected environmental matters.
- Prepare and facilitate documentation required for the environmental approvals process.

The environmental manager and key contact for this proposal is:

Environmental Manager: Garry Connell
ecologia Environment
1025 Wellington Street
WEST PERTH WA 6005
Telephone: +61 8 9322 1944
Fax: +61 8 9322 1599
Email: garry.connell@ecologia.com.au

1. INTRODUCTION

Grange has engaged a range of specialists as part of the Project's feasibility study team, outlined in Table 1.2.

Table 1.2 Composition of Project Team.

Project Aspect	Technical Advisors
Resource Modelling	**Golder Associates Pty Ltd** 1 Havelock Street WEST PERTH WA 6005 Telephone: +61 8 9213 7600
Metallurgical and Process Engineering	**ProMet Engineers** 267 St Georges Terrace PERTH WA 6000 Telephone: +61 8 9476 5700
Contaminated Sites	**URS Australia Pty Ltd** Level 3, The Hyatt Centre, 20 Terrace Road EAST PERTH WA 6004 Telephone: +61 8 9221 1630
Hydrogeology – Mine Site	**Golder Associates Pty Ltd** As Above
Bore field Investigations	**Rockwater Pty Ltd; Consultant Hydrogeologists** 76 Jersey Street JOLIMONT WA 6014 Telephone: +61 8 9284 0222
Terrestrial Vegetation and Flora	***ecologia* Environment** 1025 Wellington Street WEST PERTH WA 6005 Telephone: +61 8 9322 1944
Terrestrial Fauna	***ecologia* Environment** As Above
Stygofauna	**Rockwater Pty Ltd; Consultant Hydrogeologists** As Above
Dust	**Sinclair Knight Merz Pty Ltd** 7th Floor Durack Centre, 263 Adelaide Terrace, PERTH WA 6001 Telephone: +61 8 9268 4400
Noise	**VIPAC Engineers and Scientists Ltd** 5/324 Great Eastern Highway, ASCOT, WA 6104

	Telephone: +61 8 9277 3335
Gaseous Emissions	**Kewan Bond Pty Ltd** Suite 7, 4-6 Adelaide Street Fremantle, Western Australia 6010 Telephone +61 8 9335 8860
Visual Impact Assessment	***ecologia* Environment** As Above
Heritage	**Brad Goode Consulting Anthropologist** 79 Naturaliste Terrace Dunsborough WA 6281

Section 1.4 Project Scope and Timing

The Grange Southdown Magnetite Proposal consists of an open pit mine at the Southdown Magnetite Deposit, located approximately 10 km south-west of the town of Wellstead and approximately 90 km east, north-east of the City of Albany in Western Australia (WA). The ore will be crushed, ground, magnetically separated, screened, and mixed with water to form a concentrate slurry. The slurry will be pumped via a buried pipeline 104 km to a newly constructed slurry terminal located at the Albany Port. Reclamation of 0.425 ha of foreshore intertidal zone is required to accommodate the pipelines where the pipeline route traverses the northern shore of Princess Royal Harbour for approximately 80 m west of Point Melville and 1, 100 m east of Point Melville. The slurry will be dewatered and loaded onto Cape size vessels for transport to south-east Asia. The water extracted from the slurry will be recycled for use at the mine.

It is anticipated that the mine pit will have a production rate of 18 to 20 Mt pa ore feed producing approximately 6.6 to 7.0 Mt pa of saleable concentrate product. The mine is expected to have a minimum life time of 22 years, resulting in substantial regional and state benefits.

The mine site, pipeline, ship loading, construction and operation of port infrastructure and ship loading will be undertaken as part of the Southdown Magnetite Proposal. Grange will lease industrial land from the APA for its port facilities.

The Albany Iron Ore Project timeframe is outlined in Table 1.3.

Table 1.3 Project Timeframe.

Activity	Timeframe	Proponent
PROJECT APPROVALS		
Referral of Project to ODAC / EPA	September 2005	Grange/APA
Submission of Project Scoping Document	April 2006	Grange/APA
Submission of draft PER Document	July 2006	Grange/APA
Submission of final PER Document	February 2007	Grange/APA
Public comment period ends	April 2007	Grange/APA
Response to public comments	May 2007	Grange/APA
Release of EPA Bulletin	July 2007	Grange/APA
Ministerial Approval	October 2007	Grange/APA
PROJECT IMPLEMENTATION		
Mine construction	January 2008 –December 2009	Grange
Pipeline construction	January 2008 – June 2009	Grange
Port infrastructure construction	June 2008 –November 2009	APA/Grange
Mine production	August 2009 onwards	Grange
First shipment	February 2010	Grange

Section 1.5 Document Structure and Purpose

This document is submitted to the EPA as a Public Environmental Review (PER) for assessment of the environmental impacts of the Project, and to propose management measures under the *Environmental Protection Act 1986*. Preparation of this document has been undertaken in accordance with the scope outlined in the Environmental Scoping Document for the Project as agreed with the EPA, and according to the 'Guidelines for Preparing a Public Environmental Review/ Environmental Review and Management Programme (EPA, 2004). This PER has been structured to clearly delineate the environmental characteristics, impacts and proponent's responsibilities of the proposals.

Section 2 Environmental Impact Assessment

Section 2.1 Environmental Approvals Process

Section 2.1.1 Legislative Framework

The Project is subject to compliance with both Federal and State legislation during construction and operation phases. Legislation applicable to the Southdown Magnetite Proposal includes, though is not necessarily limited to those in Table 2.1.

Table 2.1 Legislation Applicable to the Project and Responsible Government Agencies.

Legislation	Responsible Government Agency
Commonwealth Legislation	
Environment Protection and Biodiversity Conservation Act 1999	Department of Environment and Heritage
Native Title Act 1993	National Native Title Tribunal
State Government Legislation	
Aboriginal Heritage Act 1972	Department of Indigenous Affairs
Agricultural and Related Resources Protection Act 1976	Department of Agriculture, Western Australia
Bush Fires Act 1954	Bush Fires Board
Conservation and Land Management Act 1984	Department of Environment and Conservation
Contaminated Sites Act 2003	Department of Environment and Conservation
Country Areas Water Supply Act 1947	Department of Environment and Conservation
Dangerous Goods Safety Act 2004	Department of Consumer and Employment Protection
Environmental Protection Act 1986	Department of Environment and Conservation
Explosives and Dangerous Goods Act 1961	Department of Consumer and Employment Protection
Health Act 1911	Department of Health
Heritage of Western Australia Act 1990	Heritage Council of Western Australia
Local Government Act 1995	City of Albany
Local Government (Miscellaneous Provisions) Act 1960	City of Albany
Metropolitan Water Supply, Sewerage and Drainage Act 1909	Department of Health
Mining Act 1978	Department of Industry and Resources
Mines Safety and Inspection Act 1994	Department of Consumer and Employment Protection
Soil and Land Conservation Act 1945	Department of Agriculture, Western Australia
Water and Rivers Commission Act 1985	Department of Environment and Conservation

2. ENVIRONMENTAL IMPACT ASSESSMENT

Legislation	Responsible Government Agency
Waterways Conservation Act 1976	Department of Environment and Conservation
Wildlife Conservation Act 1950	Department of Environment and Conservation

Section 2.1.2 State Assessment Process

The Western Australian *Environmental Protection Act 1986* requires proposals that are likely to have a significant impact on the environment, to be referred to and assessed by the Environmental Protection Authority (EPA).

EPA Referral and Level of Assessment

Due to the complexity of the Albany Iron Ore Project, the proponents (Grange and APA) opted to partake in the Integrated Project Approvals System facilitated by the Office of Development Approvals Co-ordination (ODAC) of the Department of Premier and Cabinet. As part of this process, the proponents prepared and submitted a Project Definition Document for review through the ODAC. The Project Definition Document was lodged with ODAC and distributed to regulators on the 16th August 2005. An ODAC facilitated Screening Meeting held on the 31st August determined that the Project could proceed to agency scoping, with comments from agencies forwarded to the proponents. An Agency Scoping Meeting was held on the 20th September 2005 with comments forwarded to the proponents. Agency comments were taken into account in the preparation of the Environmental Scoping Document.

To maintain clear distinction between the two proposals, the Albany Iron Ore Project was referred to the EPA as two separate referrals under the Integrated Project Approvals System. One referral relates to the Southdown Magnetite Proposal by Grange to construct and operate a mine, associated pipelines and Project related port facilities (EPA Assessment No, 1596, Section 5). The other referral relates to the Albany Port Expansion Proposal by the APA to undertake dredging within Princess Royal Harbour and King George Sound, land reclamation and the construction of a new berth (this is dealt with in the Albany Port Expansion Proposal PER, EPA Assessment No, 1594).

Based on the information in the referrals the EPA determined that the likely environmental impacts are sufficient to warrant formal assessment of the proposals under the *Environmental Protection Act 1986*. The level of assessment for the Project was set at Public Environmental Review (PER) with an eight week public review period as advertised in the West Australian newspaper on the 26th September 2005. No appeals were lodged against the EPA's decision on the level of assessment.

Project Scoping

An Environmental Scoping Document was prepared consistent with the requirements of Section 6.1 of the *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002* to provide a framework for the formal environmental assessment of the Project. This document distinguished the scopes of the two proposals within the Project and provided a summary of the existing Project environment, potential environmental impacts, proposed management responses, proposed scope of works for environmental investigations, stakeholder consultation programme, Project timeline and peer review mechanisms. The Environmental Scoping Document was submitted to the EPA on the 8th of November 2005. Grange and the APA met with the EPA Board on the 19th January 2006 to review the Project scope. Comments from this meeting were incorporated into the final Scoping Document, which was accepted on the 1st May 2006.

Public Environmental Review

On approval from the EPA this PER document will be advertised and released for public comment. The EPA will consider all comments received during the public review period, and provide copies of submissions to the proponents for their response. On completion of the public review period, the proponents will prepare a document containing their response to the submissions. The EPA will then complete its assessment of the Project and submit its recommendations on the two proposals to the Minister for the Environment.

The EPA's recommendations will be advertised as two distinct bulletins. The public and the proponents have the opportunity to appeal against these recommendations. Appeals will be assessed by the Minister for the Environment. If the Minister determines that the Project can proceed, legally binding conditions will be imposed on the Project pursuant to Section 45 of the *Environmental Protection Act 1986*. These conditions will be released as two distinct Ministerial Statements.

Approval

Once State Ministerial and Federal approvals have been granted, the proponents of the Albany Iron Ore Project will obtain State approvals to construct and operate key infrastructure under various State legislation. Required approvals for the Southdown Magnetite Proposal include but are not limited to:

- Mining proposal to be submitted to the DoIR for activities subject to compliance with the *Mining Act 1978.*
- Works approval from the Department of Environment and Conservation (DEC) for activities subject to compliance with the *Environmental Protection Act 1986* and related regulations.
- Approval to disturb Aboriginal sites to be applied for under Section 18 of the *Aboriginal Heritage Act 1972.*
- Permits under the *Rights in Water and Irrigation Act 1914.*
- A Regulation 17 Application for a License to Take (ie capture, collect, disturb, study) Fauna for scientific purposes under the *Wildlife Conservation Act 1950*.
- The proposed Grange magnetite export facility will require its own DEC licence to be held by Grange.

Section 2.1.3 Commonwealth Assessment Process

The Southdown Magnetite Proposal will be subject to environmental approvals from the Federal Department of Environment and Heritage (in conjunction with State Government approvals). The Project will result in impact to flora and fauna that are rare and / or protected under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999*) for the Commonwealth of Australia and the *Environmental Protection Act 1986* for the Western Australian Government.

The Southdown Magnetite Proposal interfaces with the Short-billed (Carnaby's) Black-Cockatoo (*Calyptorhynchus latirostris*) listed as Endangered, and the Western Ringtail Possum (*Pseudocheirus occidentalis*) listed as Vulnerable under the *EPBC Act 1999*. The proposal was referred to the DEH and was deemed to be a controlled action, requiring approval from the Federal Minister for the Environment and Heritage.

The State *Environmental Protection Act 1986* PER process has been accredited by the DEH for assessment of matters requiring Federal approval under the *EPBC Act 1999* for the Albany Iron Ore Project. The PER process will be used to assess the potential impacts to the Short-billed (Carnaby's) Black-Cockatoo (*Calyptorhynchus latirostris*) through clearing of vegetation associated with the Southdown Magnetite Proposal.

Section 2.2 Principles of Environmental Protection

The EPA takes into account the following principles in the assessment of development proposals:

(1) The Precautionary Principle

Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by –

(a) Careful evaluation to avoid, where practicable, serious or irreversible damages to the environment; and

(b) An assessment of the risk-weighted consequences to various options.

(2) The Principles of Intergenerational Equity

The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

(3) The Principle of the Conservation of Biological Diversity and Ecological Integrity

Conservation of biological diversity and ecological integrity should be a fundamental consideration.

(4) Principles in relation to Improved Valuation, Pricing and Incentive Mechanisms

(a) Environmental factors should be included in the valuation of assets and services.

(b) The polluter pay principle – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.

(c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes.

(d) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those responses to environmental problems.

(5) The Principle of Waste Minimisation

All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.

Grange and the APA have embraced the EPA's principles of environmental protection as part of Project engineering and design. The environmental objective of the Project's design, in order of priority, is to:

- Completely avoid the impact if possible.
- Substitute with a lesser impact.
- Include engineering solutions to reduce the degree and risk of impact.
- Design operational controls and emergency response around reduction of impact consequences.
- Provide environmental offsets for the impact.

2. ENVIRONMENTAL IMPACT ASSESSMENT

The Southdown Magnetite Proposal has applied these principles of environmental protection through consideration of alternative designs for the Project, comprehensive environmental investigations, stakeholder and community engagement and the commitment to local employment for construction and operation phases of the Project. Table 2.2 below, outlines how the principles of environmental protection have been considered within the proposal.

Alternative Project design concepts were evaluated, with the final design based on environmental, financial and engineering considerations and constraints. Alternative Project designs are outlined in Section 4.4.

The DEC has and will continue to be consulted on advice for preservation and/ or conservation Projects to which the proposals can contribute as primary and secondary offsets. Specific offsets are discussed in Section 7.

In addition, Grange will implement an Environmental Management System (EMS) consistent with the principles and with guidance from the international standard ISO 14001:2004 for environmental management systems. This will facilitate a systematic process for ensuring compliance with legal requirements, minimisation of environmental impacts to as low as reasonably practicable, and continual improvement in environmental performance.

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Table 2.2 Principles of Environmental Protection for the Southdown Magnetite Proposal.

Principle	Relevant Yes/No	Consideration of Principle	Addressed Yes / No	Section(s) In PER
1) **The Precautionary Principle** Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by – a) careful evaluation to avoid, where practicable, serious or irreversible damages to the environment; and b) an assessment of the risk-weighted consequences to various options.	Yes	Careful evaluation of the Southdown Magnetite Proposal has been undertaken to avoid, where practicable, serious or irreversible damage to the environment. Specialist surveys and modelling have been undertaken to assess the existing Project environment and determine potential impacts. These investigations include: • Bi-season flora and fauna surveys of the Project footprint. • Short-range endemic survey of the Project footprint. • Groundwater modelling at the mine site. • Stygofauna sampling at groundwater drawdown areas and control sites. • Dieback assessment to be conducted prior to ground disturbance. • Acid rock drainage assessment for potential acid generating material at the mine site. • Phase 1 contaminated sites assessment along pipeline route with commitments for Phase 2 investigations at key locations. • Visual impact assessment. • Archaeological and ethnographic survey. • Dust modelling. • Noise modelling.	Yes	Section 6.6, Section 6.7 Section 6.7.4 Section 6.5 Section 6.7.5 Section 8.8 Section 8.3 Section 8.4 Section 8.19 Section 6.8 Section 8.13 Section 8.14

2. ENVIRONMENTAL IMPACT ASSESSMENT

Principle	Relevant Yes/No	Consideration of Principle	Addressed Yes / No	Section(s) In PER
		• Preliminary greenhouse gas and polluting emissions evaluations.		Section 8.16
		Additional investigations will be conducted where required to provide sufficient information to address actual and potential environmental impacts.		
		The pipeline route has been selected to avoid remnant native vegetation wherever practicable.		
		Specific management plans will be developed and implemented as part of risk based impact avoidance and management. These include:		Technical Appendices:
		• Project Construction Environmental Management Plan (EMP).		Section 13.17
		• Operation EMP.		Commitment 3
		• Environmental Management System consistent with ISO 14001.		Section 13.20
		• Site specific Acid Sulphate Soil Management Plans.		Commitment 8
		• Acid Rock Drainage EMP.		Commitment 10
		• Contaminated Sites EMP.		Commitment 14
		• Groundwater EMP.		Commitment 16
		• Pipeline Construction and Operation EMP.		Section 13.18
		• Surface Water EMP.		Commitment 20
		• Threatened Flora and Conservation EMP.		Commitment 22
		• Dieback Disease EMP.		Commitment 27

Principle	Relevant Yes/No	Consideration of Principle	Addressed Yes / No	Section(s) In PER
		• Dust EMP. • Noise EMP. • Visual Impact EMP. • Heritage Sites EMP. • Conceptual Mine Closure Plan. • Mine Closure Plan		Commitment 30 Commitment 32 Commitment 37 Commitment 41 Section 13.20 Commitment 43
(2) **The Principles of Intergenerational Equity** The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Yes	Grange will be mining a finite resource which will require the disturbance of approximately 1590 ha of rural land which includes 252.6 ha of remnant native vegetation. Agricultural activities have resulted in significant impacts to native vegetation throughout the region and over most of the proposed mining area. Several Aboriginal Heritage sites and artefact scatters will be disturbed during pipeline construction and mining operations. Grange has prepared a Conceptual Closure Plan to prevent or minimise long-term environmental impacts and address long term post mining land use considerations. Potential Offsets include: • Purchase, protect and rehabilitate existing degraded land. • Survey blocks for conservation and preservation potential. • Financial contributions to regional conservation initiatives.	Yes	Section 5.1 Section 6.8 Technical Appendix: Section 13.19 Section 7 Section 7 Section 7

2. ENVIRONMENTAL IMPACT ASSESSMENT

Principle	Relevant Yes/No	Consideration of Principle	Addressed Yes / No	Section(s) In PER
		• Financial contributions towards recovery and curation of aboriginal artefacts.		
(3) **The Principle of the Conservation of Biological Diversity and Ecological Integrity** Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Yes	Baseline studies have been undertaken to assess the environmental values of areas that could be impacted by the proposal. The Project has been designed to minimise clearing of native vegetation where practicable. Environmental impacts have been minimised through mine planning and plant design. Management plans will be implemented as required. Construction of a buried pipeline was deemed the most appropriate option for ore transportation. This option involves a one-off construction period with immediate rehabilitation, minimal maintenance and flexibility for the route to avoid sensitive areas and clearing of remnant vegetation where possible.	Yes	Section 6.6 Section 6.7 Section 5.1 Section 5.2
(4) **Principles in relation to Improved Valuation, Pricing and Incentive Mechanisms** a) Environmental factors should be included in the valuation of assets and services. b) The polluter pay principle – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and	Yes	Environmental management costs associated with the Proposal (including pollution control, waste minimisation and management, rehabilitation and revegetation) during construction and operation are part of the planning and financing of the Project.	Yes	

2. ENVIRONMENTAL IMPACT ASSESSMENT

Principle	Relevant Yes/No	Consideration of Principle	Addressed Yes / No	Section(s) In PER
assets and the ultimate disposal of any wastes. d) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those responses to environmental problems.				
(5) **The Principle of Waste Minimisation** All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Yes	All reasonable and practicable measures will be taken to minimise the generation of waste and its discharge into the environment. The preferred management options in order of priority will be to avoid, reduce, reuse, recycle and recover waste.	Yes	Section 8.17 Section 8.6

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2. ENVIRONMENTAL IMPACT ASSESSMENT

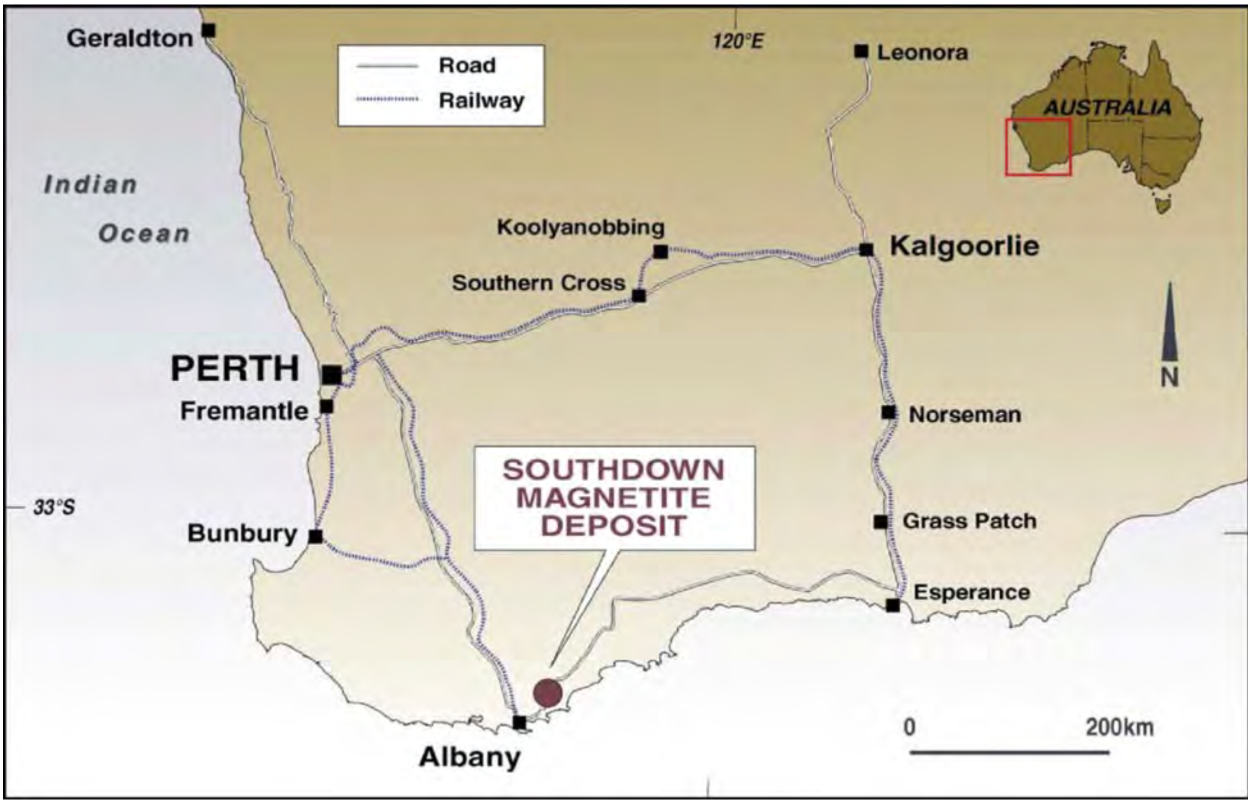

Figure 2.1 Location Plan of the Southdown Magnetite Proposal

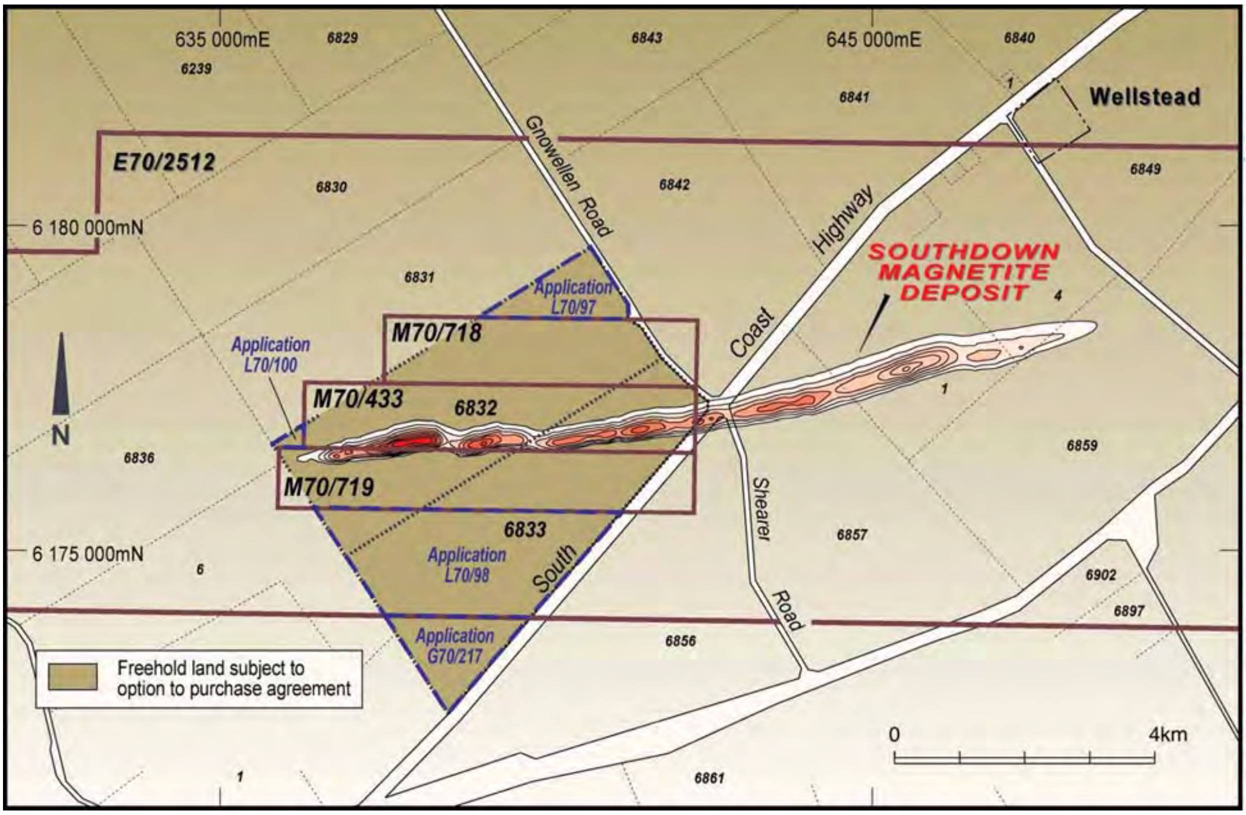

Figure 2.2 Location of Southdown Magnetite Proposal Mining Leases

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LEGEND
PIPELINE ROUTE
MINING LEASES

rev	details	date
B	Pipe route update	08-02-07
A	Original drawing	08-01-07

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Harley Survey Group Pty Ltd
116 Serpentine Road. ALBANY WA 6330
T: 08 9841 7333 F: 08 9841 3643
E: hsgalb@harleygroup.com.au

survey: COMPILED	cad file: 12937-124B.dgn
drawn: JBdS 08-01-07	checked:
horiz datum: MGA 94	level datum: NA

scale at A4: 1 : 380000
all distances are in kilometres
0 5 10 15

client: GRANGE RESOURCES LIMITED

description: SOUTHDOWN MAGNETITE PROJECT GENERAL LOCATION PLAN

drawing no: Figure 2.3

PYRMONT HOUSE
ALBANY

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Version	Details	Date
A	ORIGINAL DRAWING	13-08-05
B	Pipe Route Edit and Mining Lease Numbers	01-11-05

LEGEND

- PIPELINE ROUTE
- MINING LEASES
- REMNANT VEGETATION
- PLANTATION - PINE
- HOUSE

CAD File Name
12937-021B.dgn

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ORIGINAL DRAWING SIZE IS A3

SOUTHDOWN PROJECT

GRANGE RESOURCES LIMITED
A.C.N. 009 132 405

Scale	1 : 4000
APPLICABLE TO ORIG. A3 DRAWING	
Survey	COMPILED
Drawn	JBdS 13-08-05
Checked	
Level Datum	A.H.D.
Horiz Datum	M.G.A.94

MINE SITE - EXISTING ENVIRONMENT PLAN

HARLEY SURVEY GROUP PTY LTD
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A.C.N. 009 101 786

Figure 2.4

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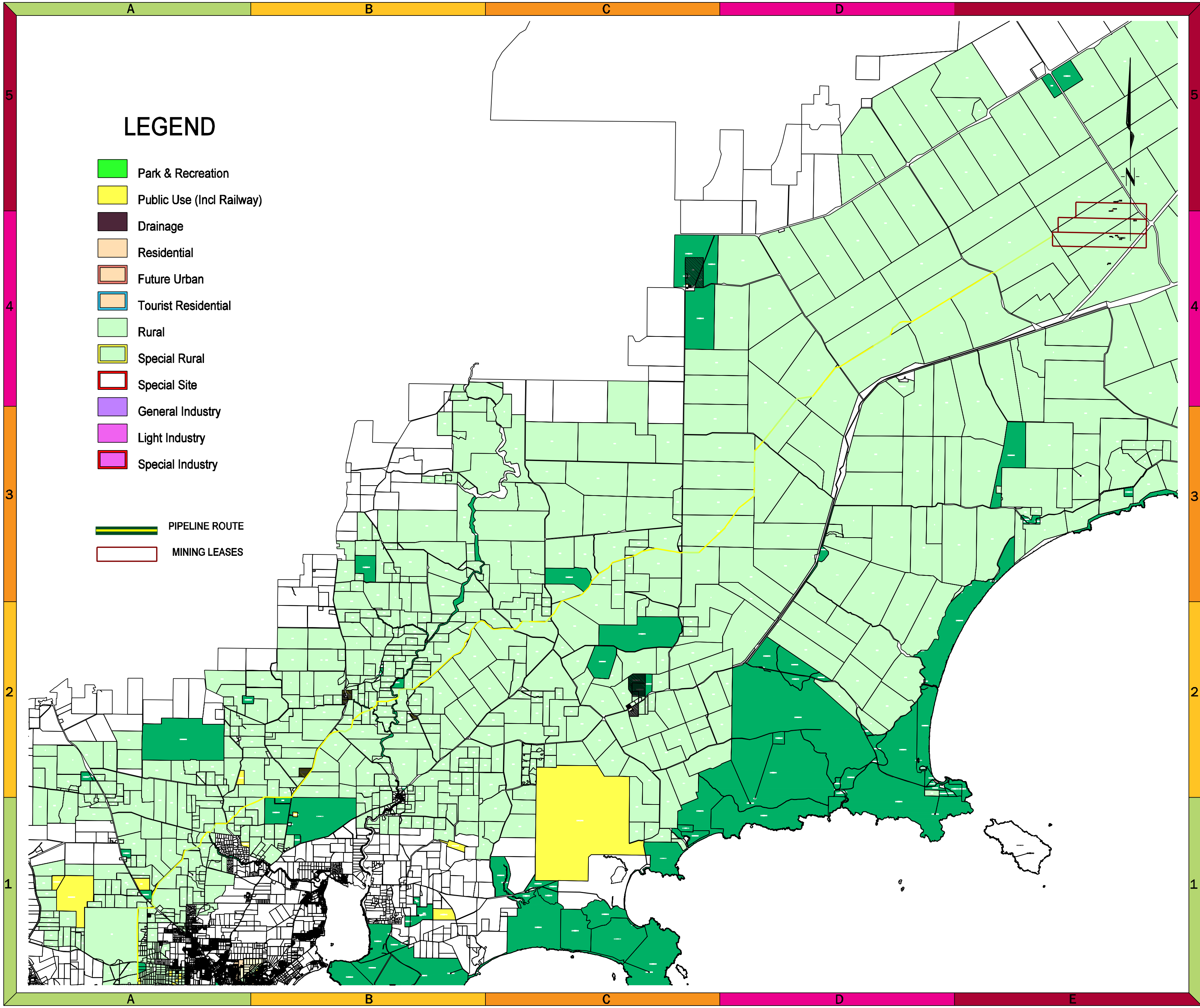

rev	details	date
C	Pipe Route Current 19-10-06	19-10-06
B	Pipe Route and Mining Leases	02-11-05
A	Original drawing	29-08-05

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survey: COMPILED
cad file: 12937-023C.dgn
drawn: JBdS 09-11-05
checked:
horiz datum: MGA 94
level datum: NA
scale at A3: 1 : 250000
all distances are in kilometres
0 5 10 15

client: GRANGE RESOURCES LIMITED A.C.N. 009 132 405

description: SOUTHDOWN MAGNETITE PROJECT ZONING PLAN

drawing no: Figure 2.5

PYRMONT HOUSE
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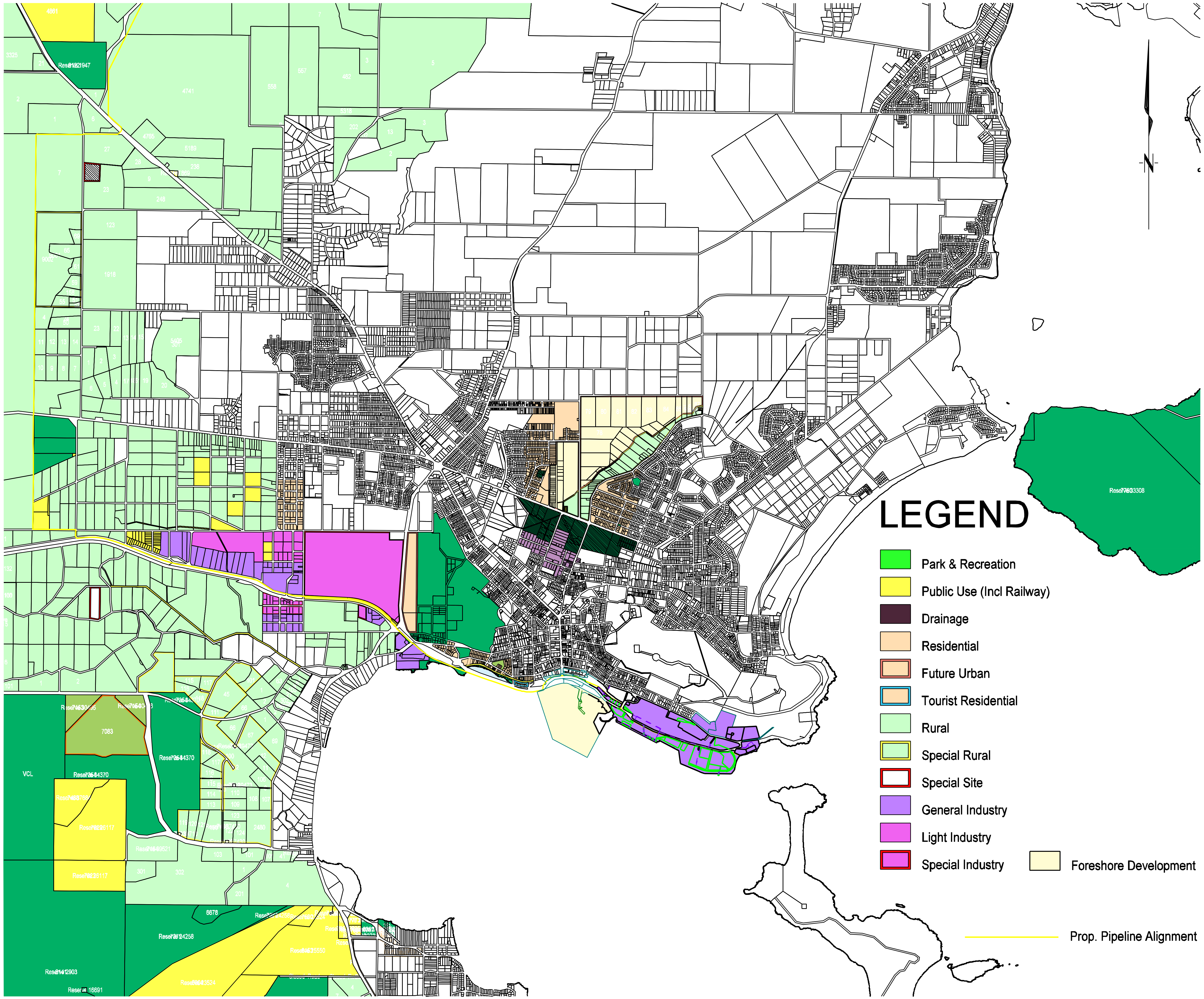

rev	details	date
C	Pipe Route Current to 19-10-06	19-10-06
B	Pipe Route and Additional Zoning Areas	02-11-05
A	Original drawing	29-08-05

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survey: COMPILED
cad file: 12937-024C.dgn
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checked: XXXX XX-XX-XX
horiz datum: MGA 94
level datum: NA
scale at A3: 1 : 50000
all distances are in kilometres
0 1 2

client: GRANGE RESOURCES LIMITED A.C.N. 009 132 405

description: SOUTHDOWN MAGNETITE PROJECT ZONING PLAN

drawing no: Figure 2.6

PYRMONT HOUSE
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2. ENVIRONMENTAL IMPACT ASSESSMENT

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Section 3 Stakeholder Engagement

Section 3.1 Stakeholder Consultation Programme

Grange and APA have been in consultation with key regulatory groups, non-government agencies as well as the Albany and Wellstead communities since the commencement of the feasibility studies. Concerns raised during consultation have been taken into consideration in this document.

Section 3.1.1 Public and Non-Government Organisation Consultation

A number of methods have been used to engage the public on the proposed Project, depending on the issue or information required. The following community and environmental groups have been invited to public meetings or consulted directly on relevant aspects of the Southdown Magnetite Proposal:

- Albany Indigenous Heritage Reference Group;
- Albany Probus Club;
- Albany Rotary Club;
- Conservation Council of WA (Perth);
- Greens WA;
- Marine Conservation Community Network (Perth);
- Albany Chamber of Commerce and Industry Inc.;
- Wellstead Progress Association (Wellstead); and
- Wildflower Society of WA.

Public meetings were held in Wellstead in February 2005 and February 2006, with Project information presented to the Wellstead Progress Association. The community was also given an opportunity to raise queries or concerns. Approximately 60 people attended these meetings. Presentations were also made to the Albany Probus Club and the Albany Rotary Clubs.

A public meeting was held in Albany on the 21st March 2005 to present Project information to the community and to give the public an opportunity to raise queries or concerns. Details of the Albany meeting were advertised twice in the local papers (Albany Weekend Extra and The Weekender) which were distributed to the Albany and Wellstead areas. In addition, a Project brochure with a reply paid comment sheet was mailed dropped to 10,000 residences in the Albany town area prior to the public meeting. Approximately 75 people were present at the public meeting where a video and power point presentation of the Project scope was given by Grange and the APA. Concerns raised by the community were mainly centred on the reclamation and dredging works, the impacts on recreational activities, and the visual impacts of port infrastructure on the reclaimed site. There was also positive support from members of the community who encouraged the economic and employment growth that would be associated with the Project.

A briefing session similar to the public meeting in Albany was held in Perth on the 28th June 2005. Invitees to this meeting included representatives from government agencies as well as the Wildflower Society of WA, Conservation Council of WA, Aquaculture Council of WA, the Marine Conservation Community Network and the Greens. Discussions revolved around the scope of Project works and the types of investigation that will be conducted.

A marine stakeholder group has been formed consisting of groups and individuals with commercial and non-commercial interest in the scope of the marine works as part of the Albany Port Expansion Proposal.

Public meetings and consultation with this stakeholder group are outlined in the Albany Port Expansion PER (EPA Assessment No. 1594).

To date 32 written submissions have been received for the Albany Iron Ore Project. The submissions were a mixture of positive comments about the Project and concerns regarding the need for land reclamation and its impacts to the marine environment and its current use. There were also questions raised about rehabilitation of pipeline footprint post construction, plans for local training and employment and potential for impacts to maritime sites of value. These concerns and specific comments raised by regulators have been addressed in this document.

Section 3.1.2 Landowner Consultation

There is extensive and on-going consultation with landowners and lessees (including the Albany Port Authority, City of Albany, Water Corporation, Main Roads Department, timber plantation companies, and Public Transport Authority) that could be affected by the pipelines route. Processes are underway to resolve issues of access for investigations, construction and operation. Feedback from landowners to date has been positive with on-site meetings allowing them to have input into the proposed alignment. Offers to acquire an easement for the pipelines over the land have been submitted to each landowner for consideration. Negotiations to finalise these agreements are progressing.

Section 3.1.3 Regulator Consultation

Briefings, meetings and discussions have been held with a range of federal, state and regional agencies and advisory bodies. They include the:

- City of Albany;
- Department of Agriculture (Perth);
- Department of Environment and Conservation (DEC, Perth and Albany);
- Department of Environment and Heritage (DEH, Canberra);
- Department of Health (DoH, Perth);
- Department of Indigenous Affairs (DIA, Perth and Albany);
- Department of Industry and Resources (DoIR, Perth);
- Department of Planning and Infrastructure (DPI, Perth and Albany);
- Department of Premier and Cabinet (DPC, Perth);
- Environmental Protection Authority (EPA, Perth);
- Environmental Protection Authority Services Unit (EPASU, Perth);
- Great Southern Development Commission (GSDC, Albany);
- Main Roads Department (Perth and Albany);
- Public Transport Authority (Perth); and
- Water Corporation (Perth and Albany)
- Western Power (Perth and Albany).

These agencies have been involved in Project discussions and invited to comment on relevant aspects of the scope and adequacy of investigation methodologies. Accordingly, Grange and Albany Port Authority has refined and expanded the scope of environmental investigations.

The Great Southern Development Commission (GSDC) facilitates a monthly Project working group meeting. Members of the group include Albany representatives of DEC, Western Power, Main Roads, Water Corporation, DPI, DoIR, City of Albany, Albany Port Authority and Grange Resources. The meeting is used as a forum to discuss Project requirements, progress against Project phases, and to help resolve local issues that may arise.

Grange will continue consultation with regulators throughout the Project planning, construction and operation to ensure that issues regarding the Project are managed appropriately.

Section 3.2 Peer Review Process

Key environmental investigations for the Southdown Magnetite Proposal will be reviewed by an independent reviewer (Table 3.1) selected by the proponent. Technical reports associated with the Project will be sent to reviewers and their comments sought on the adequacy of the investigations, accuracy of findings and soundness of data interpretation. These Peer Review reports will be submitted to the EPA prior to the completion of their assessment of the Project.

Table 3.1 Peer Review for Project Investigations.

Investigation	Reviewer
Terrestrial Mine Site and Pipeline Fauna Surveys	Edith Cowan University - Dr Graham Thompson
Mine Site and Pipeline Flora Surveys	
Short Range Endemics Survey	WA Museum - Mark Harvey
Visual Impact Assessment	John Cleary Planning - John Cleary

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Section 4 Project Justification

Section 4.1 Project Background

Australia is the world's largest exporter and the world's third largest producer of iron ore (with 17%) after China (21%) and Brazil (20%). Although iron ore resources occur in all the Australian States and Territories, almost 90% of identified resources occur in WA. Iron ore, the raw material used to produce iron and steel provides the foundation for one of Australia's major export industries. In 2005 Australian companies exported 239.4 million tonnes (Mt) of iron ore, an increase of 14% on 2004 exports. Of this, almost all iron ore was exported as Lump or Fines product with only 1.1 Mt exported as added value product, namely pellets. Due to the proximity of WA to the high-growth Asian economies, sea borne trade in iron ore is established and is forecast to show continued growth.

Investigations of the Southdown Magnetite Deposit by Grange have revealed a resource of 479 Mt grading 37.3% magnetite at a magnetite cut-off grade of 10% (Grange, 2006). Mine planning work has indicated that over 411.5 Mt of magnetite ore could be economically mined at a strip ratio of approximately 2.6:1 [waste (t): ore (t)], giving the mine a minimum lifetime of over 22 years. Metallurgical evaluation has also shown that a concentrate grade of approximately 69.0% Fe can be achieved by grinding the mineralised material and using magnetic separation.

Based on current mine planning and plant design the Project will produce approximately 6.6 Mt pa of magnetite concentrate, totalling approximately 145 Mt over 22 years. Grange intends to ship the magnetite concentrate from Albany to a new pellet plant to be constructed in South-East Asia, where it will be made into Direct Reduction (DR) and Blast Furnace (BF) pellets. Pellets are sintered, centimetre-sized spheres of mineralised material with a high iron content and uniform quality. The BF pellets will be sold to steel producers in China, Japan, Korea and Taiwan; whereas DR pellets are used in direct reduction processes based on natural gas and will be sold to producers in Malaysia, Indonesia and the Middle East.

Section 4.2 State and National Benefits

WA's economy is heavily dependent on mineral resource projects, and its future growth and development rely on the continued viability of resource development projects. This is the first mining project of this size for the Albany region and will provide financial and social benefits for the area through employment, infrastructure and flow-on effect to the non-mining sector.

The mining of the Southdown Magnetite Deposit will result in substantial regional and state benefits, including:

- Investment of capital into the WA economy.
- Major infrastructure construction associated with the proposed mine, pipeline and port, to be undertaken over two years.
- Power upgrades to the Albany Region.
- Construction of a port facility that can berth Cape size vessels.
- Direct local employment in the south-west, peaking at around 1000 people during construction and an operational workforce of around 200.
- Increasing demands for goods and services creating business and employment opportunities.
- Additional Commonwealth and State Government revenues through collection of additional royalties, taxation and other charges.

- Increased export value of WA iron ore to international customers.

From an economic standpoint the Project will provide both direct and indirect employment opportunities in the south-west region, as well as substantial investment in infrastructure.

Section 4.3 No Development Option

The consequences of not proceeding with the proposed Southdown Magnetite Proposal are that the economic and employment benefits of the proposal as outlined in Section 4.2 will not be achieved.

Section 4.4 Evaluation of Alternatives

Grange has embraced the concept of sustainable development as part of the Project engineering and design phases of this proposal. As such, Grange is evaluating the key social, environmental and economic impacts of the proposal. The proposal endeavours to provide positive impacts and social benefits wherever feasible, and strives to reduce its negative impacts to as low as reasonably practicable.

Impact avoidance and reduction opportunities that are being implemented include:

- Engineering and design of infrastructure to reduce dust, noise and visual impacts.
- Recycling of process water to reduce water requirement from external sources.
- Backfilling of mine void to decrease the size of external storage facilities and minimise long term impact to the groundwater table.
- Progressive rehabilitation at the mine site with provenance native vegetation used by local fauna, and the placement of hollow logs on the ground as refuge for fauna.
- Reduced long term impacts to the City of Albany socially and financially through use of a pipeline to transport ore rather than by road or rail.
- Pipeline route designed to minimise clearing of native and remnant vegetation and avoid environmentally sensitive areas.

Where impacts are unavoidable, Grange seeks to:

- Prevent impacts of conservation significance.
- Prevent development of new contamination.
- Reduce waste and emissions to as low as practicable.
- Provide environmental offsets for its impacts.

Consideration of alternative designs aligned with this approach of sustainable development is discussed in the following sections.

Section 4.4.1 Alternatives: Mine Site

Mine Plan and Design

Issues factored into the design alignment of the mine pit and placement of infrastructure including waste rock stockpiles, processing plant and tailings storage facility include:

- Topography of the land and suitability for supporting infrastructure.
- Early access of high grade mineralised material.
- Progressive backfilling of pit void from year 5 of mine life.

- Management of sulphidic material to remove, reduce or control its presence in tailings and waste.
- Engineering and operational controls for noise and dust reduction.
- Location of plant and infrastructure to maximise efficiency of operations.

The extent of impact reduction will be based on the characteristics of the ore body and the necessary economics of the mine plan.

Tailings Storage Facility (TSF)

Tailings management methods will seek to maximise stability of the TSF, improve water recovery and minimise soil and water contamination by sulphidic materials. Options available for tailings storage are dependent on the chemical and physical properties of the tailings. Several tailings storage options were considered. These included:

- in pit storage;
- co-disposal with the mine waste;
- tailings thickening;
- implementation of paste technology;
- splitting of the tailings into coarse and fine streams with dry stacking of the coarse;
- dry cake tailings; and
- conventional paddock type TSF.

The option for tailings storage external from the pit (ie no backfill) has included consideration of a conventional paddock style TSF, as well as a facility that will commence as a side-hill style TSF, before being raised sufficiently to develop into a fully enclosed paddock style TSF. Assuming storage of gravel tailings with the sands and slimes, the TSF would store a total of 206 Mm^3 (representing the total tailings output for 25 years of 348 Mt). The TSF dam footprint would be 405 ha, reach a maximum height in excess of 70 m (to RL 205 m) and be formed with 14º outer slopes to facilitate rehabilitation.

The associated process water storage facility would have the capacity to store the following volumes of water:

- decanted supernatant water;
- incident rainfall from the TSF;
- rainfall runoff resulting from the operational areas of the sand/gravel storage area (surrounding the slimes impoundment);
- recycled water that is pumped back from slurry concentrate dewatering at Albany Port facilities; and
- pit dewatering water.

However, utilising a combination of backfilling of the mine void with tailings and construction of a much smaller surface TSF would result in a final TSF landform with an outer crest elevation of between RL 152 m to 166 m, 40 m above the existing natural ground level, and a footprint of approximately 250 ha. This preferred option is outlined in greater detail in Section 5.2.5.

Management of Acid Mine Drainage

The tailings material has been classified as potentially acid forming, due to the presence of trace sulphides (pyrite and pyrrhotite) and low carbonate content of waste materials. Management options considered are, to use flotation to remove trace sulphides from the tailings prior to storage, or to manage the tailings as potentially acid forming.

Methods of acid mine drainage management considered include:

- Encapsulate potentially acid forming material within non-acid forming waste.
- Sub-aqueous deposition of the slimes.
- Maintenance of a saturated slimes beach by appropriate cycling deposition around the TSF.
- Co-disposal of the sand and gravel sized tailings and their subsequent compaction in thin layers, to reduce pore spaces within the material.
- Mix tailings streams at the plant to form a paste, then pump to the TSF, as paste material is considered more resistant to erosion and acid mine drainage potential.

Waste Rock Management

The direct waste material produced by the mining operation is anticipated to be 385 Mbcm. Assuming a swell of 30% this material would require 500 Mlcm of dump space. Two options for storage of this material have been considered, the first being all external storage and the second being mixed external and backfill storage.

External placement of waste material within the mining lease would necessitate a single dump with a footprint of 950 ha, a height of 75 m (210 mRL) and an overall slope of 11º on the outside face. This dump would have the capacity to contain all the mined waste plus the coarse rejects from the processing plant if required.

A combination of external placement and progressive backfilling into the mine void would significantly decrease the footprint of the external dump to an area 620 ha and a height of 45 m (180 mRL). This preferred option is outlined further in Section 5.1.4.

Water Source

Several potential water sources were investigated to meet the process water requirement (approximately 2.7 GLpa, 60 GL total) for construction activities, dust suppression, mineralised material processing and slurry production. Potential sources assessed were:

- Utilisation of treated water from the Water Corporation’s Albany wastewater treatment plant.
- Groundwater from the Werillup Formation in the King River area.
- Water harvesting from the Southdown Magnetite mine site, utilising surface runoff and groundwater flowing into the mine.

Utilisation of up to 1.4 GLpa of wastewater from Albany’s wastewater treatment plant was considered as the Water Corporation currently feeds approximately 1.8 GLpa of treated waste water onto a Blue Gum Tree Farm surrounding the treatment plant. This quantity of waste water is growing at a rate of 3-4% pa and the tree farm is close to full capacity. Grange began negotiations with the Water Corporation to utilise this water source, with the intention to treat the wastewater before delivery to the mine site via pipeline. Strict Department of Health regulations applying to the use of waste water in industrial systems however, have made this option impractical from an occupational health and safety and engineering perspective.

Establishment of a borefield in the King River/ Millbrook area was considered to supply the water requirement of the Project, as investigations have revealed moderately-large supplies of fresh to brackish groundwater in the Werillup Formation (Rockwater, 2005b). The conceptual borefield would comprise eight to 16 production bores, with water pumped to the mine site via the return water pipeline. The potential environmental impacts associated with the modelled drawdown footprint from taking up to 2.7 Glpa of water resulted in further investigations into other potential water sources for the Project.

Hydrogeological studies of water inflows into the open pit and rainfall runoff from impacted mining areas indicate that significant amounts of water are available for use in the process.

The proposal to harvest water at the mine site to meet water requirements for the proposal is outlined in Section 5.4.2 and Section 8.6.

Workforce

Fly-in/fly-out type operations offer city domiciled employees the opportunity to work remotely whilst enjoying all the benefits of city living during leave breaks. This form of employment has become widely adopted across WA despite the adverse impact that such employment has on employees' families. The Great Southern region is an attractive area to live in and has a population base that will, in the company's opinion, be able to provide sufficient personnel with relevant skills to fill most operational positions. The company is aware that there are presently many people who live in the region working on fly-in/fly-out mines elsewhere within the state. The company intends to implement a local employment policy targeting employees from Albany and other towns and communities within the region. Professional positions will be filled with these employees being required to reside in the Great Southern region. A camp will be established near the site to allow employees the option of on site accommodation rather than commuting on a daily basis.

Section 4.4.2 Alternatives: Magnetite Concentrate Transport

The mine site is located 90 km east, north-east of the Albany Port. The main alternatives assessed with regard to mode of magnetite concentrate transport were road, rail and pipeline. The potential positive and negative environmental and health aspects of each option are outlined in the following tables.

Road Haulage

The Southdown Magnetite Deposit is located approximately 90 km from the Albany Port. Haulage would be from the mine site into the City of Albany via South Coast Highway and into the Port of Albany via Princess Royal Drive. Princess Royal Drive is the main access road to the Port of Albany and runs adjacent to the railway line in to the port. Haulage of the magnetite concentrate by road has a range of potential environmental and health aspects that are outlined in Table 4.1.

Table 4.1 Evaluation of Alternatives: Road Haulage.

Factor	Pros	Cons
Road trains	• Increased job opportunities.	• High one-off capital outlay to purchase vehicles. • Costly, ongoing vehicle maintenance. • Ongoing variable fuel costs. • Ongoing greenhouse gas emissions. • On-going waste emissions from vehicle maintenance. • Increased traffic on roadways with associated impacts of heavy vehicles.
Magnetite	• Easy magnetite recovery in case of spillage.	• Small scale spills probable. • Potential for road verge / vegetation staining along the route.
Increased Highway usage by large vehicles.	• Road infrastructure is pre-existing. • No licenses required to use existing infrastructure. • Roads will need to be upgraded which will benefit other users.	• Cost of road upgrades and maintenance. • Increased potential for vehicle accidents. • Increased native fauna road kill.
Frequent large vehicles traversing City of Albany	• Roads will need to be upgraded which will benefit other users.	• Cost of road upgrades and maintenance. • Potential traffic congestion. • Increased risk to pedestrian safety. • Increased vehicle noise in residential areas.

4. PROJECT JUSTIFICATION

Rail Haulage

Railway transport is frequently used for overland transport of bulk products. Transport of magnetite concentrate from the mine site to the Albany Port would require the construction of a rail spur up to 90 km long, traversing rural farmland to link up with the existing railway line. Construction of a rail link would have significant environmental impacts during construction, operation and maintenance in respect to long term removal of vegetation, noise and greenhouse gas emissions. Factors considered during assessment of this option are listed in Table 4.2.

Table 4.2 Evaluation of Alternatives: Rail Haulage.

Factor	Pros	Cons
Rail Way Construction	• Employment for construction workforce.	• No existing loading point in close proximity to the mine. • High one-off capital outlay for infrastructure purchase rolling stock and construction. • Wide construction corridor is required, with a need for permanent access road for maintenance. • Potential impacts on surface drainage.
Operation	• Increased employment opportunities.	• Current rail loop in the Port does not facilitate efficient rate of transport. • Increased disruption to traffic flow at rail crossings. • Significant noise emissions from train movements especially at the Port end at night.
Magnetite	Ideally suited to bulk loading onto trains.	• Damp concentrate does not easily drop out of rail cars when dumping at Port end.
Ongoing Impacts	• Existing infrastructure will be available for increased haulage if magnetite production expands.	• Permanent, above ground infrastructure. • Ongoing maintenance costs. • Ongoing variable fuel costs. • Ongoing greenhouse gas emissions. • No opportunity for rehabilitation of cleared areas until rail line is decommissioned. • On-going visual impact.

Pipeline

Transportation of magnetite from the mine site to the Albany Port would require the construction of a buried pipeline approximately 104 km long. The magnetite will be transported as slurry. Factors considered during assessment of this option are listed in Table 4.3.

Table 4.3 Evaluation of Alternatives: Pipeline.

Factor	Pros	Cons
Pipeline Construction	• Employment for construction workforce. • Narrow construction corridor required (25 m). • 100% rehabilitation of cleared areas which can be progressed alongside construction.	• High one-off capital outlay for infrastructure purchase and construction. • Less than 4 ha green field clearing. • Reclamation of 0.425 ha of intertidal zone adjacent to existing land reclamation along the northern shore of Princess Royal Harbour.
Operation	• Pipeline is buried and thus not noticeable. • No noise or dust emissions. • Cost of pumping is low. • Pipeline integrity can be remotely monitored by pressure control and detectors. • Risk of pipeline failure has been proven to be very low.	• Short term impact in the event of pipeline failure as magnetite will be recovered and the site rehabilitated.
Magnetite	• Slurry water can be recycled. • No increase in water consumption. • Return water pipeline will be within the same easement as slurry pipeline. • Return water line used for make-up water.	• Return water pipeline required for recycling.
Ongoing Impacts	• Pipeline footprint can be rehabilitated immediately post construction. • Very low maintenance costs. • Unobtrusive maintenance using internal pipe cleaning equipment. • No visual impacts due to burial of pipe.	• Land reclamation adjacent to existing land on the northern shore of Princess Royal Harbour.

The pipeline will have minimum long term environmental impacts. Once constructed, the pipeline will provide an unobtrusive, low maintenance, low risk, low cost method for transporting the concentrated magnetite slurry approximately 104 km from the mine site to the Port facility.

Section 4.4.3 Alternatives: Pipeline Route

Pipeline route selection has taken the following factors into consideration:

- land holder access agreements;
- most direct route;
- avoidance of remnant native vegetation;
- avoidance of environmentally sensitive sites;
- avoidance of acidic or water logged soils;
- available underground space for pipeline infrastructure;
- ease of river crossings.

The pipeline route selected is the option that best fits the above constraints, as outlined in Section 5.2.5 and Figure 2.5.

Section 4.4.4 Alternatives: Magnetite Export

Cape size vessels are required for the economically viable export of magnetite. Smaller vessels can be berthed at the Albany Port, however, have a lower carrying capacity requiring more frequent trips. The cost of smaller ships includes increased fuel usage, greenhouse gas emissions and increased vessel passage in Harbour.

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Section 5 Project Description

Section 5.1 Mining Operations

Section 5.1.1 Location

The proposed mine is located on farm land, approximately 10 km south-west of the town of Wellstead, and 90 km north-east of the City of Albany. Within a 20 km radius there are several homesteads including; Buelah, Nymann, Grasfeld, Yorklands, Marshall Plains, Warrigal, Severn Hills, Wilangi, North and Black Gin. The proposed mine site is located 5 km north-east of the Hassell National Park and approximately 15 to 20 km to the south-east of the southern boundary of Stirling Range National Park.

The proposed mine site is bounded on the south-eastern side by the South Coast Highway and on the north-eastern side by Gnowellen Rd (Figure 2.4) with the site boundary defined with latitudes and longitudes outlined in Table 5.1.

Table 5.1 Mine Site Boundary.

Latitude	Longitude
34º 34’ 48.65”S	118º 30’35.50”E
34º 32’ 15.02”S	118º 33’07.86”E
34º 32’ 10.18”S	118º 33’07.58”E
34º 31’ 48.43”S	118º 32’39.37”E
34º 31’ 31.66”S	118º 32’25.96”E
34º 31’ 28.56”S	118º 32’19.19”E
34º 31’ 21.95”S	118º 32’18.17”E
34º 30’ 54.06”S	118º 31’55.85”E
34º 32’ 35.12”S	118º 28’48.03”E

Section 5.1.2 Tenure and Zoning

The Southdown magnetite deposit is located on three granted mining leases (M70/718, M70/719 and M70/433) held by Grange covering an area of 1,712.025 ha (Figure 2.2). The tenements are located on private freehold land and following negotiations with the land owners on access and compensation, an agreement over Lots 6832 and 6833 was signed on the 18th October 2004. The agreement includes an option to purchase the land. Surface rights to the land within the mining leases were granted by the Department of Industry and Resources (DoIR) on the 19th October 2004.

Grange has also applied for one general purpose lease (G70/719) and three miscellaneous licences (L70/97, L70/98 and L70/100) over those portions of Lots 6832 and 6833 not covered by the mining leases. Infrastructure will be contained within the three mining leases where possible, with any additional requirements to be placed on the general purpose lease and three miscellaneous licences (when granted). An exploration licence E70/2512 held by Rio Tinto Exploration Pty Ltd surrounds the three mining leases and grant of the three miscellaneous licences is subject to the consent of Rio Tinto Exploration Pty Ltd.

No amendment to a regional planning scheme or town planning scheme is required for this site. The freehold Lots 6832 and 6833 are zoned as rural land under the City of Albany Town Planning Scheme No 3 and illustrated on Figure 2.5.

No subdivision or development approval is required from the City of Albany or Western Australian Planning Commission for the proposed development at the mine.

Along the pipeline corridor, Grange will register an easement on freehold and leasehold properties under the *Land Administration Act 1997*.

Approval for an offsite accommodation camp will be obtained from the City of Albany and will be included in the Project Management Plan in line with the *Mining Act 1978* and the *Mines Safety and Inspection Act 1994*.

Section 5.1.3 Proposed Mining Method

Open cut mining is proposed for the mining of the Southdown Magnetite Deposit. The proposed mine pit will have a footprint of approximately 400 ha, a strike length of 6 km and a depth of 300 m. The mine pit will have an anticipated production rate of 18 - 20 Mt pa of magnetite ore producing approximately 6.6 Mt pa of magnetite concentrate product. Waste rock will be mined at an annual rate between 40 - 55 Mtpa.

The mine is expected to have a minimum life of 22 years.

Based on pit optimisation work, a preliminary life of mine schedule has been developed for Southdown. The mine schedule involves mining the long, narrow deposit in a series of 350 m wide cuts with the first stage starting at the western end and progressing to the east throughout the mine life (Figure 5.1).

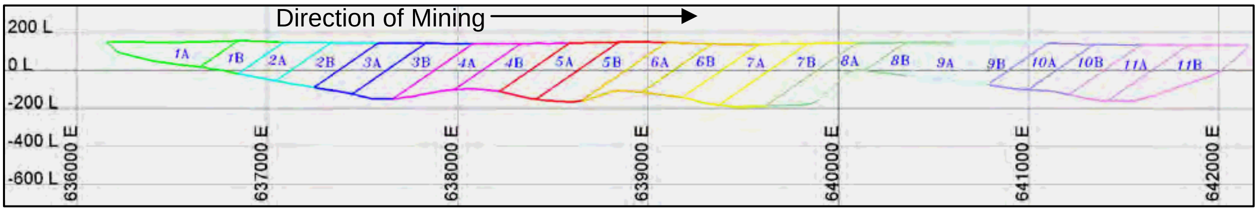


Figure 5.1 Long Section Showing Stages of Mining.

Section 5.1.4 Waste Rock Management

Characterisation of the geochemistry of the Southdown Magnetite Deposit (Golder, 2006) indicated that although a sulphidic shear has been identified dipping parallel with the ore bodies (Section 6.3.1), the proportions of waste will be:

- 93% Non Acid Forming;
- 4% Acid Forming; and
- 3% Potentially Acid Forming.

Preliminary estimates indicate that approximately 54% of the waste rock can be backfilled into the mine void from Year 5 onwards (Golder, 2005a). Waste rock will be used to create basins approximately 1000 m long by 75 m deep within the pit, for filling with plant tailings (Golder, 2005a). Not all the material is able to be placed into backfill for geometric, scheduling and economic reasons and will be placed in an external dump. The total volume of waste rock is estimated to be 1050 Mt (Golder, 2006).

The external dump will cover an area of approximately 620 ha to a height of 45 m (RL 180 m AHD (Australian Height Datum)), and overall slopes of 11° (Golder, 2005a). The stockpile will be designed to minimise erosion, mimic local landforms where practicable and ensure that no single part of the stockpile has to discharge excess amounts of storm water. The dump will be developed from the west to the east. The dump face will be rehabilitated immediately at the completion of dumping, with dust suppression measures implemented until vegetation has been established.

Where available, topsoil will be taken to a depth of 0.3 m from the pit, waste rock stockpile, tailings storage facility, ROM (run of mine) pad and crushed mineralised material stockpile areas. The topsoil will be stockpiled separately in various parts of the leases as mining progresses and spread during rehabilitation.

Section 5.1.5 Dewatering

Hydrogeological modelling for dewatering at the mine pit has been conducted (Golder, 2005c). The water from pit dewatering will be used for processing plant make-up water. Water pumped from the in-pit sumps will be managed as impacted water which may contain elevated metals and/or low pH and which might not be suitable for off-site discharge (Golder, 2005c). Water pumped from dewatering wells (if not required for mineral processing) may be suitable for discharge, depending on water quality. Excess impacted water, if any, will be contained on-site. This is outlined further in Section 5.4.2.

Section 5.1.6 Mineralised Material Processing and Concentration

Mined ore will be crushed to minus 32 mm using primary and secondary crushers. A portion of the minus 32 mm material will be pre-concentrated using dry magnetic separation. The magnetic portion is transported with the rest of the crushed material to a plant feed stockpile. Non-magnetic material will join with mine tailings for mine waste disposal. Crushed material will be stockpiled on a crushed ore stockpile. Reclaimed material from the stockpile will then be reduced to below 0.7 mm using the latest High Pressure Grinding Roll (HPGR) technology. The HPGR product will be wet screened at 3 mm with the oversize material recycled and the undersize material magnetically concentrated.

Concentrate that is less than 3 mm will be ground in a closed circuit ball mill to an approximate size of 80% passing 90 micron followed by intermediate magnetic separation to remove liberated waste material. The magnetic concentrate will then be ground in another closed circuit ball mill to a size of 80% passing 38 micron. Once the concentrate is at this size, it will pass through triple stage magnetic separation to remove slimes and liberated waste material. The concentrate reports to a flotation plant for the removal of sulphide containing materials. The final concentrate is then thickened and stored ready for pumping to Albany. Areas where slurry is handled and processed will be contained within a bund wall. The process layout is illustrated in Figure 5.2, Figure 5.3, Figure 5.4 and Figure 5.6, with the elevations presented in Figure 5.4 and Figure 5.5.

The plant will be modular in design to achieve maximum operational utilisation when conducting maintenance on HPGRs, ball mills, screens and magnetic separators.

As sulphidic material will be processed in the concentrator, it will be necessary to treat the concentrate to produce a low and consistent sulphur content in the product. This will be achieved through reverse flotation which removes a substantial proportion of the sulphur bearing material from the concentrate. Test work completed to date shows that by using reverse flotation, the sulphur content in the concentrate will be reduced from approximately 0.7% to 0.2% and produce a tailings product containing approximately 12% sulphur. The reverse flotation will produce approximately 250,000 tonnes per annum of high sulphur floats containing 12% sulphur made up of 20% pyrrhotite and 80% magnetite. The proponent will be investigating ways to recover the valuable magnetite by passing this material over a magnetic separator to recover the magnetite for returning to the slurry circuit and ways to rapidly oxidise the pyrrhotite in a controlled environment. Oxidation of pyrrhotite produces haematite and sulphuric acid which would be neutralised by the addition of lime. On going kinetic test work on the waste rock material containing pyrrhotite, indicates that the pyrrhotite may oxidise in the order of weeks. Kinetic test work on low sulphur tailings has also commenced and kinetic test work for the floated tailings is planned to commence shortly.

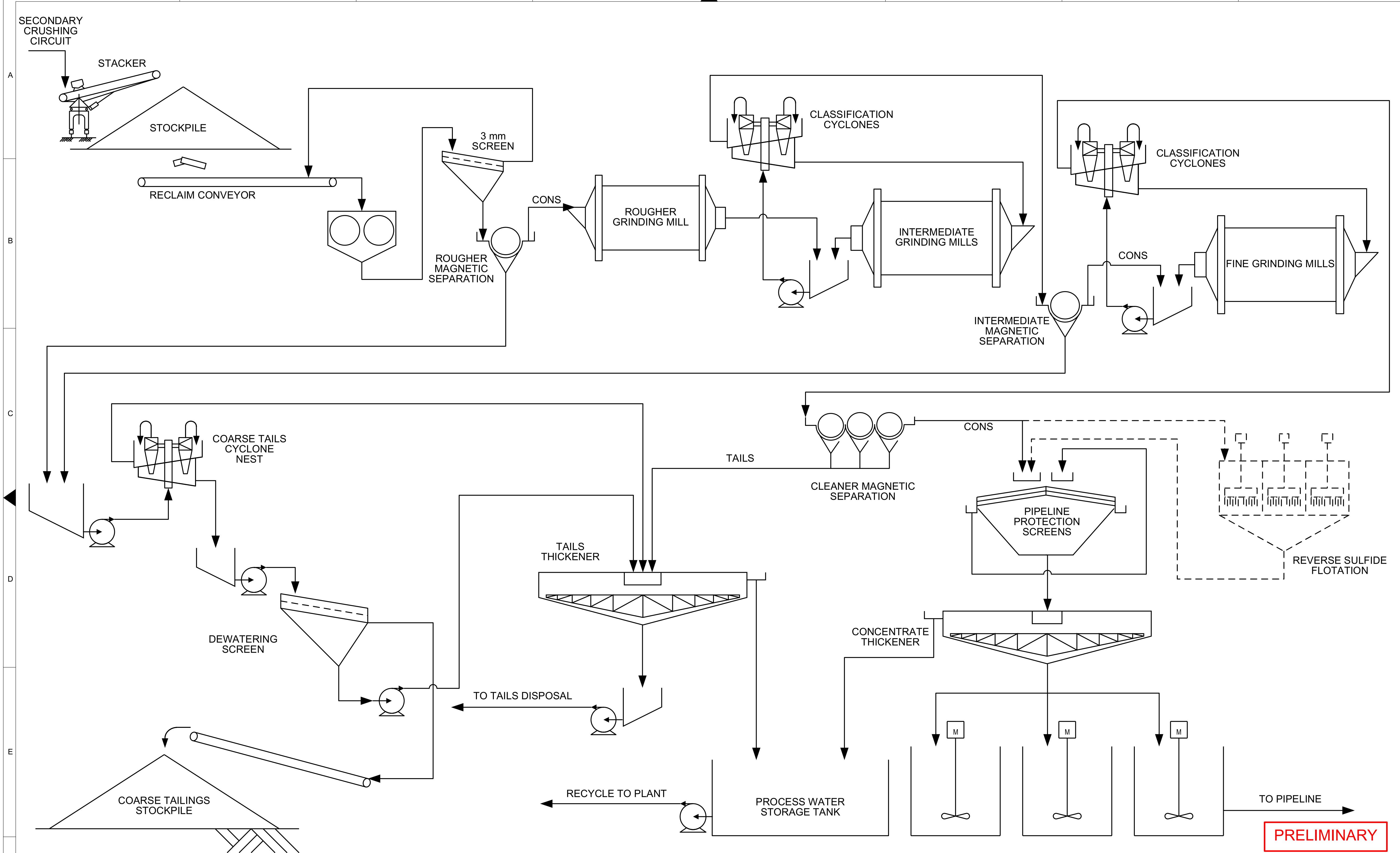
If the investigations into rapid oxidation of pyrrhotite, neutralisation of acid liquor and recovery of valuable magnetite are not successful the following alternatives for storage of the floated sulphur-rich tailings will be considered:

- Co-disposal with waste rock containing pyrrhotite that is proposed to be encapsulated in cells within the external or in-pit waste rock dumps. The waste rock containing pyrrhotite may require management strategies such as lime addition. Co-disposal of tailings with waste rock will reduce pore space, thereby reducing oxidation in the waste rock.

- Sulphur-rich tailings may be dewatered and mixed with the low sulphur conveyed tailings (nominally at 13% moisture) that will be transported to the TSF. This product will undergo treatment as described in Section 5.1.7.
- Storage within a dedicated synthetically lined facility, possibly located within the external TSF. It is envisaged that the dedicated lined facility would be operated in a similar fashion to a conventional paddock-style TSF with the sulphur-rich tailings being pumped to the facility in the form of a slurry, from where it would be discharged from a number of spigots around the perimeter. Treatment of these sulphur-rich tailings may be required using lime to neutralise acid, should it be generated from oxidation of the sulphides.

The reagents used in the reverse flotation process include a Xanthate collector, a frother (methylisobutylcarbinal MIBC) and the activator ($CuSO_4$). Relatively small amounts of the reagents will pass into the magnetite concentrate product as only sufficient quantities of the reagents are added as part of the process and they will generally pass into the flotation tailings.

The storage of tailings containing low amounts of sulphur is described in Section 5.1.7.



DRAWING NUMBER	TITLE
REFERENCE DRAWINGS	

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
P3	07.10.05	T.v.B	PELLET PLANT REVISION	C.S		
P2	29.06.05	T.v.B	CIRCUIT REVISION	B.P		
P1	26.05.05	T.v.B	INITIAL ISSUE	B.P		

DRAWING REVISION

	DATE	NAME
DRAWN BY	26.05.05	Tim van Bockxmeer
CHECKED BY		
APPROVED BY		

SCALE

Figure 5.2

ProMet Engineers

C5161

GRANGE RESOURCES - SOUTHDOWN
7.0 MTPA MAGNETITE CONCENTRATOR
OVERALL PROCESS

DRAWING No:	FORMAT SIZE	REV.
C5161-PFD-BLOCK 2	A3	P3

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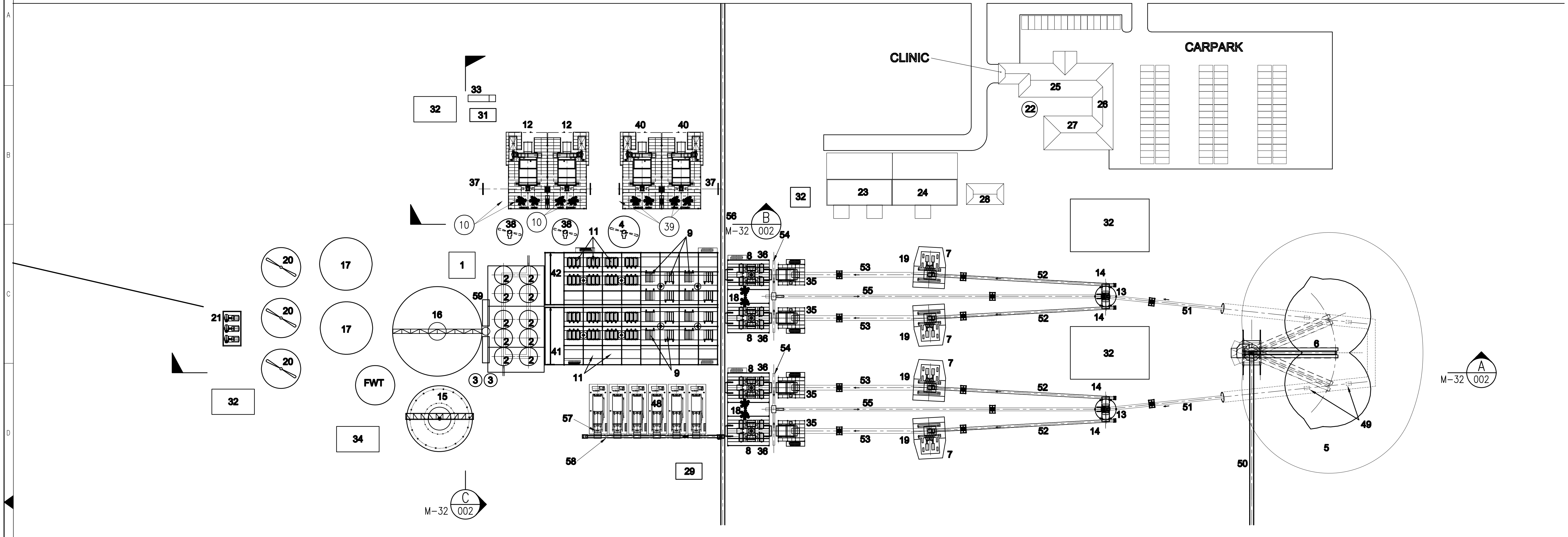

ISSUED FOR INFORMATION

21	–	PIPELINE PUMPS	3	–	42	–	MAG. SEP. AREA GANTRY CRANE	1	–					
20	–	AGITATED STORAGE	3	–	41	04-CN-002A	MAG. SEP. AREA GANTRY CRANE	1	–	–	–	–	–	
19	02-CH-008A-F	HPGR FEED CHUTE	4	–	40	04-ML-002A/B	SECONDARY GRINDING MILL	2	–	–	–	–	–	–
18	08-SN-007A-F	COARSE TAILS DEWATERING SCREEN	4	–	39	04-CY-002A-D	SEC. GRINDING CLASSIFICATION CYCLONE NEST	4	–	60	–	FRESH WATER TANK	1	–
17	–	PROCESS WATER TANKS	2	–	38	03-TK-010A/B	IMS CONS AGITATED TANK	2	–	59	–	PIPELINE PROTECTION SCREEN	2	–
16	06-TN-001	CONCENTRATE THICKENER	1	–	37	03-CN-001	BALL MILL MONORAIL	1	–	58	09-CV-030	FILTER TAILINGS COLLECTION CONVEYOR	6	–
15	08-TN-002	TAILINGS THICKENER	1	–	36	02-SD-004A-F	RMS SCREEN DECK	4	–	57	09-CV-029A-H	FILTERED TAILINGS CONVEYOR	1	–
14	01-FE-006A-F	LINE FEEDERS	4	.	35	02-SD-003A-F	HPGR SCREEN DECK	4	.	56	08-CV-028	COARSE TAILINGS DISPOSAL CONVEYOR	1	
13	02-BN-09A,B,C	SECTION FEED BIN	2	–	34	–	EMERGENCY GENERATOR	1	.	55	02-CV-027A-C	O/S RECYCLE CONVEYOR	2	–
12	03-ML-A,B,C	BALL MILL	2	–	33	–	EMERGENCY GENERATOR	1	–	54	02-CV-026A-F	SCREEN O/S CONVEYOR	4	–
11	04-MS-A-P	CLEAN MAGNETIC SEPARATOR	16	.	32	–	SWITCH ROOMS	5	.	53	02-CV-025A-F	HPGR PRODUCT CONVEYOR	4	.
10	03-CY-001A-F	INT. MILL CYCLONE CLUSTERS	4	.	31	–	CONTROL ROOM	2	.	52	02-CV-024A-F	HPGR FEED CONVEYOR	4	.
9	03-MS-A-P	INTERMEDIATE MAGNETIC SEPARATORS	16	.	30	–	–	–	.	51	01-CV-023A,B,C	LINE FEED CONVEYOR	2	.
8	02-MS-002A-AD	ROUGHER MAGNETIC SEPARATORS	24	.	29	–	COMPRESSORS	2	.	50	01-CV-018	STACKER FEED CONVEYOR	1	.
7	02-GR-001A-F	HPGR	4	.	28	–	LABORATORY	1	.	49	01-FE-004A/I	VIBRATING FEEDERS	6	.
6	01-SK-001	STACKER	1	.	27	–	ABLUTIONS	1	.	48	09-FL-001A-H	PRESSURE FILTERS	6	.
5	–	SECONDARY ORE STOCKPILE	1	.	26	–	CRIBROOM	1	.	47	09-TK-033	AGITATED STORAGE TANK	1	.
4	03-TK-007	IMS AGITATED STORAGE TANK	1	.	25	–	ADMINISTRATION	1	.	46	05-TK-021	CuSO4 STORAGE TANK	1	.
3	–	FILTRATION FEED TANKS	2	.	24	–	STORE AND YARD	1	.	45	05-TK-020	XANTHATES STORAGE TANK	1	.
2	–	FLOTATION TANKS	10	.	23	–	MAINTENANCE	1	.	44	05-TK-019	MIBC STORAGE TANK	1	.
1	–	REAGENT STORAGE MIXING	1	.	22	–	POTABLE WATER TANK	1	.	43	05-TK-016A/B	REVERSE FLOTATION CONDITIONING TANK	2	.
	EQUIP. No.	DESCRIPTION	QTY.	REMARKS		EQUIP. No.	DESCRIPTION	QTY.	REMARKS		EQUIP. No.	DESCRIPTION	QTY.	REMARKS

REFERENCE DRAWINGS

DRAWING NUMBER	TITLE
C5161-M-33-0003	MINESITE-SECONDARY CRUSHED ORE-ELEVATIONS
C5161-M-32-0001	MINESITE-CONCENTRATOR-SECTIONS
C5161-M-33-0001	MINESITE-SECONDARY ORE STOCKPILE-PLAN

DRAWING REVISION

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
C	02.02.06	T.K.	GENERAL REVISION	E.G.P.	H.S.	
B	11.01.06	G.B.	STOCKPILE AND STACKER AND TUNNELS ALTERED	E.G.P.	H.S.	
A	23.12.05	T.K.	ISSUED FOR ESTIMATE	E.G.P.	H.S.	
P2	23.11.05	T.K.	DRAWING No WAS C5161-SKM-3003	E.G.P.		
P1	21.11.05	T.K.	ISSUED FOR PER	E.G.P.		

	DATE	NAME
DRAWN BY	12.09.05	T. KUTLE
CHECKED BY	21.11.05	E.G.P.
APPROVED BY		

Figure 5.3

SCALE 1:750

ProMet Engineers

SOUTHDOWN MAGNETITE PROJECT
MINESITE PLANT
CONCENTRATOR
GENERAL ARRANGEMENT

DRAWING No: C5161-M-32-0001 | FORMAT SIZE: A1 | REV. C

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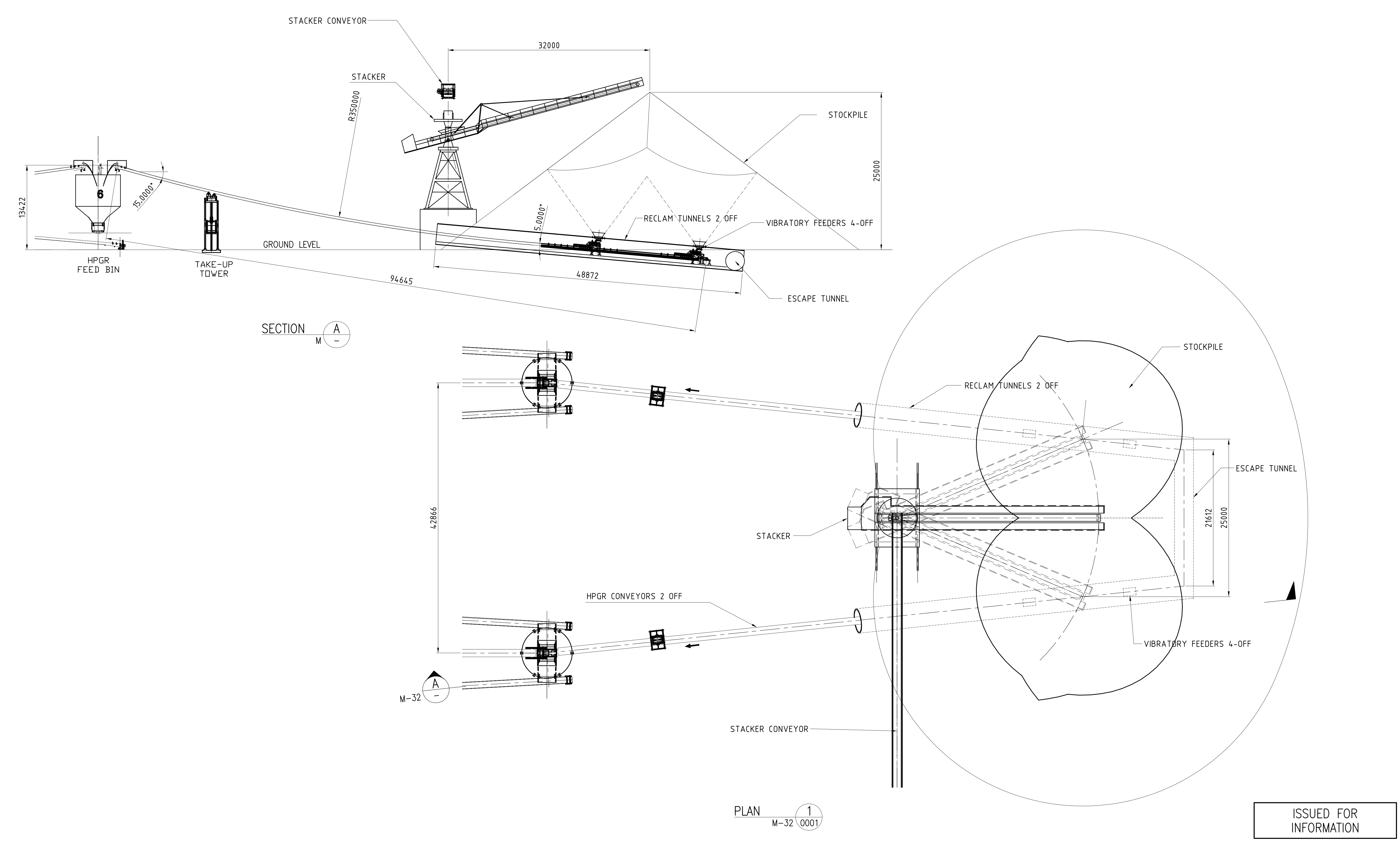

ISSUED FOR INFORMATION

DRAWING NUMBER	TITLE
C5161-M-33-0002	MINESITE-SECONDARY CRUSHED ORE STOCKPILE-ELEVATION
C5161-M-32-0001	MINESITE-CONCENTRATOR-GENERAL ARRANGEMENT

REFERENCE DRAWINGS

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
D	08.02.06	T.K.	REDRAWN, ISSUED FOR ESTIMATE			
C	10.01.06	G.B.	TUNNELS AND STOCKPILE MODIFIED, ISSUED FOR ESTIMATE			
B	14.12.05	T.K.	TUNNELS AND STOCKPILE MODIFIED, DRG No WAS C5161-M-33-0001, ISSUED FOR ESTIMATE	E.G.P.	H.S.	
A	24.11.05	T.K.	ISSUED FOR TENDER	E.G.P.	H.S.	
P1	22.11.05	T.K.	ISSUED FOR PER	E.G.P.	H.S.	

DRAWING REVISION

	DATE	NAME
DRAWN BY	22.11.05	T. KUTLE
CHECKED BY	22.11.05	E.G.P.
APPROVED BY		

SCALE 1:500

Figure 5.4

ProMet Engineers

SOUTHDOWN MAGNETITE PROJECT
MINESITE PLANT
SECONDARY CRUSHED ORE STOCKPILE
PLAN AND ELEVATIONS

DRAWING No: C5161-M-32-0009 FORMAT SIZE: A1 REV. D

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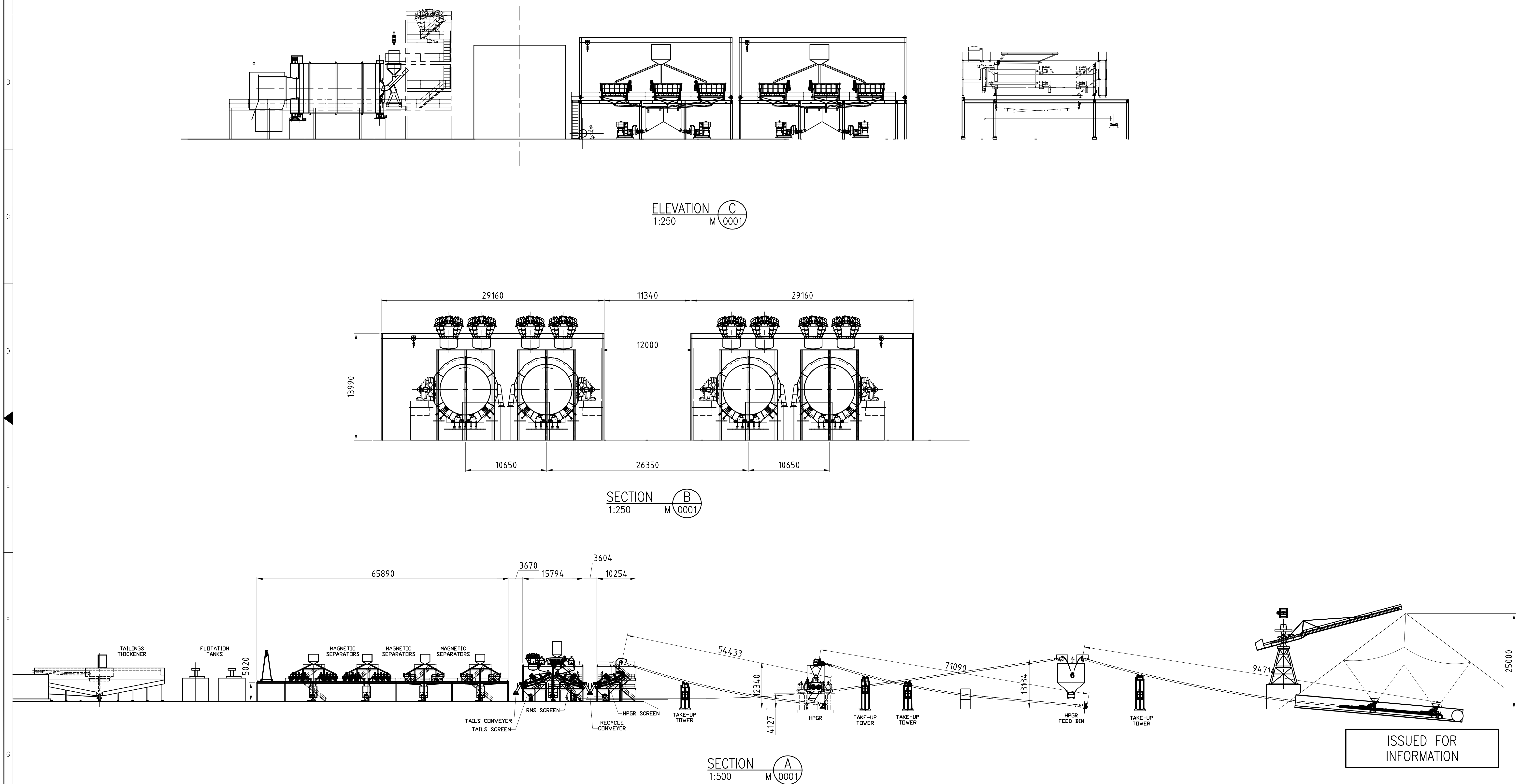

ISSUED FOR INFORMATION

PRELIMINARY
NOT FOR CONSTRUCTION

DRAWING NUMBER	TITLE
C5161-M-32-0001	MINESITE-CONCENTRATOR-GENERAL ARRANGEMENT

REFERENCE DRAWINGS

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
C	08.02.06	T.K.	SECTIONS B & C ALTERED	E.G.P.	H.S.	
B	11.01.06	G.B.	STOCKPILE AND STACKER ALTERED	E.G.P.	H.S.	
A	23.12.05	T.K.	ISSUED ESTIMATE	E.G.P.	H.S.	
P1	21.11.05	T.K.	ISSUED FOR PER	E.G.P.		

DRAWING REVISION

	DATE	NAME
DRAWN BY	12.09.05	T. KUTLE
CHECKED BY	21.11.05	E.G.P.
APPROVED BY		

Figure 5.5

SCALE
AS SHOWN

ProMet Engineers

SOUTHDOWN MAGNETITE PROJECT
MINESITE PLANT
CONCENTRATOR
SECTIONS

DRAWING No: C5161-M-32-0002
FORMAT SIZE: A1
REV. C

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DRAWING NUMBER	TITLE
REFERENCE DRAWINGS	

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
E	8.6.06	J.B.	SHIFTED PIT & PIPELINE, CHANGED TAILS DAM & BUILDINGS. ADDED WATER DAMS	E.G.P.	H.S.	T.A.
D	08.02.06	T.K.	PRIMARY & SECONDARY CRUSHING, CONCENTRATOR & PIPELINE ALTERED	E.G.P.	H.S.	T.A.
C	11.01.06	G.B.	FACTORY LOCATION ALTERED	H.S.	T.A.	
B	23.11.05	T.K.	DRAWING No WAS C5161-SKC-1001	H.S.	T.A.	
A	14.10.05	T.K.	ISSUED FOR ENVIROMENTAL STUDY	H.S.	T.A.	

DRAWING REVISION

	DATE	NAME
DRAWN BY	05.10.05	T. KUTLE
CHECKED BY	14.10.05	H.S.
APPROVED BY	14.10.05	T.A.

Figure 5.6

SCALE 1:20000

ProMet Engineers

SOUTHDOWN MAGNETITE PROJECT

MINESITE
LAYOUT
PLAN

DRAWING No: C5161- M-31-0001 | FORMAT SIZE: A1 | REV. E

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Section 5.1.7 Tailings Storage

Design Requirements

A preliminary design for tailings management has been conducted, which addresses the following design requirements:

- Tailings production is 268.5 Mt (equivalent to 12.2 Mtpa or 33,000 t/day) over the life of mine (22 years).
- The tailings stream (well graded, ranging from clay/ silt to sand/ gravel sized particles) will be transported to the TSF on a conveyor system. The tailings will be mixed together to form a co-mixed product at 13% moisture content.
- At its discharge point, the main conveyor system will be supplemented by mobile "grass-hopper" conveyors that will be able to distribute the tailings around the facilities.
- An external TSF will store the first six years of production (73.2 Mt or 37.5 Mm^3, assuming an average compacted dry density of 1.95 t/m^3), after which tailings (195.3 Mt or 100 Mm^3) will be directed to the pit as backfill.
- The management strategy will address acid mine drainage in the tailings. The tailings material has been classified as potentially acid forming, due to the presence of trace sulphides (pyrite and pyrrhotite) and a "gutless" gangue (i.e. lack of carbonate minerals). It is anticipated that the material will be deposited and distributed by mechanical means, as opposed to the slurry deposition method. The latter will result in the tailings being handled and deposited in unsaturated conditions, hence allowing the ingress of oxygen into the tailings mass (potentially oxidising to produce acid) if left untreated.
- Management of surface water and dust is required to reduce the infiltration of water into the tailings mass and the movement of tailings (from wind or water erosion) from the facility.

Preliminary Design – External TSF

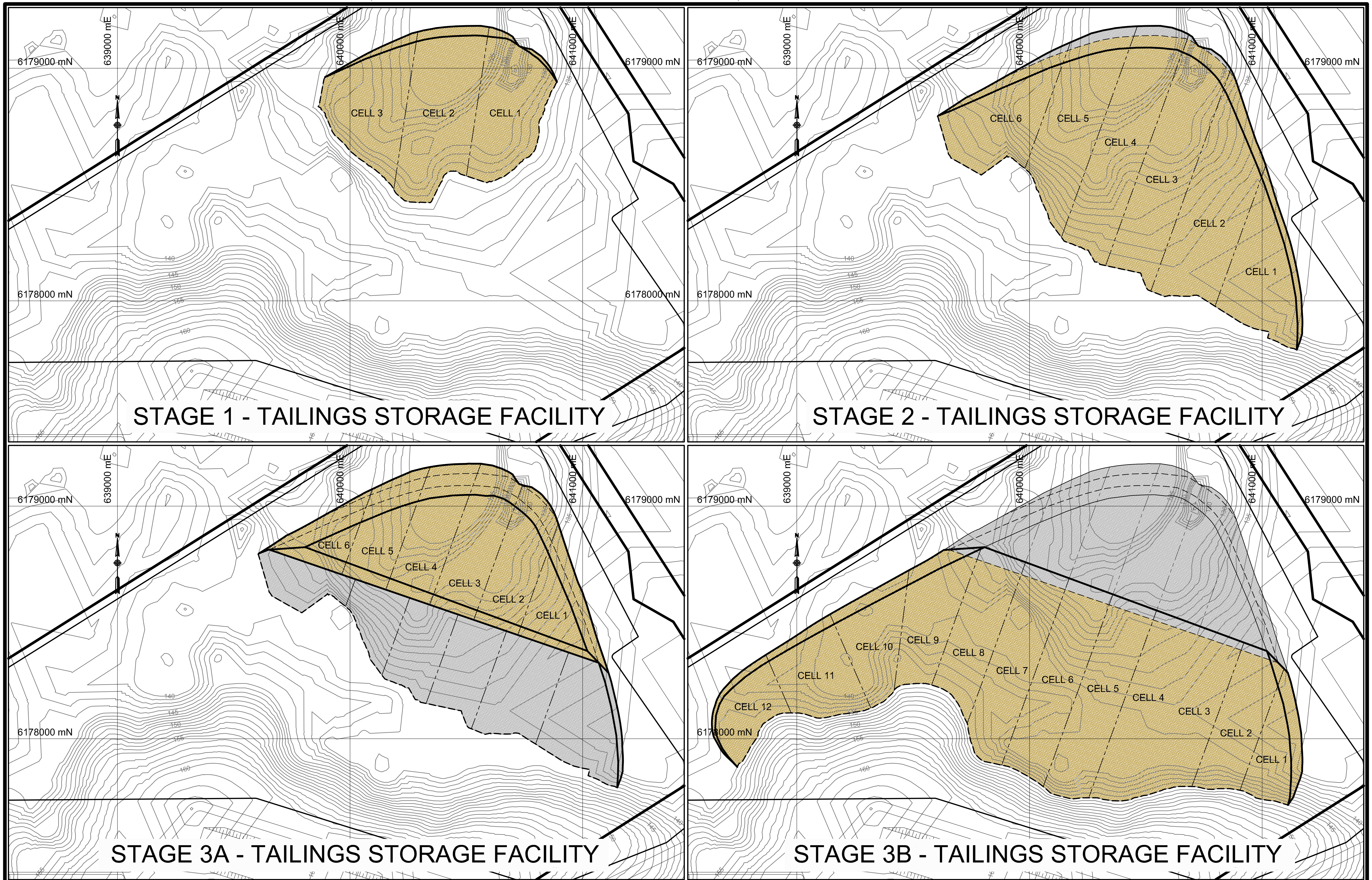
Based on the design requirements above, the preliminary design (Figure 5.7 and Figure 5.8) has been developed and includes the following features:

- Discrete storage cells will be constructed to contain (nominally) one to two months of production (between 0.5 to 1 Mm^3, assuming an average dry density of 1.95 t/m^3). The cells will be arranged around the facility in a number of stages or layers to reach the full height of the facility.
- The final landform will have overall 1V:4H side slopes, but contoured appropriately to manage surface water runoff from the slopes in the long term. The top surface will slope down towards the natural ground to the south (adjacent to the pit) thereby directing runoff water to this area. From years 7 to 22, a surface water drain will collect this runoff and direct it to the impacted water facility. After closure, a drain will be constructed in the natural ground adjacent to the TSF to direct the water to the pit void that remains after mining.
- The cells will be constructed with an initial perimeter starter embankment of inert waste. Tailings will be discharged, using the conveyor system, into the cell from where it will be distributed around the immediate area and traffic compacted by bulldozers and a heavy roller. The traffic compacted tailings will have smaller pore spaces (compared with uncompacted tailings) that will reduce the flow of oxygen and water and, thus, the potential for acid generation. It is estimated that a dry density of 1.95 t/m^3 could be achieved using traffic compaction (SG solids = 2.98). The mobile conveyors will be moved regularly, which, in combination with the bulldozers and roller, will assist in forming a tailings surface suitable for directing rainfall runoff to the surface water drainage system.

- Raising of the perimeter embankments surrounding the active cell will be achieved using compacted, inert mine waste and constructed in the upstream direction (with 1V:4H side slopes). Once one cell is filled, it will be capped with compacted, inert mine waste, while tailings deposition is directed to the next cell.
- Each cell will be covered, either by;
    - a shell of engineered fill (inert mine waste) that, once compacted, will form a barrier to reduce the infiltration of water and oxygen to the tailings; or
    - a store and release cover system for the acid forming or potentially acid forming material, using an inert sandy silt to encapsulate these facilities and reduce the ingress of water and/or oxygen. Alternatively, inert waste rock could be crushed to a suitable grain size for use in a store and release cover system, or inert waste rock or oxide/clayey material could be used to cover the tailings, followed by a layer of inert tailings that would act as the store/release layer. The tailings are of a suitable grain size for potential use as a store-release cover material. Tailings resulting from processing of low-sulphide ore could be selectively stockpiled during mining for later re-use.

  The use of the cells will reduce the amount of untreated tailings exposed to potential oxidation and, hence, acid formation.
- During operations, surface water drains will collect rainfall runoff from the active and covered cells and discharge the water to the impacted water facility for use in the processing plant.

Figure 5.7 presents the schematic layout of the TSF, and shows four proposed stages of cell arrangement, with the surface water drains for each stage. Figure 5.9 shows a schematic cross-section through the facility at final height.



LEGEND:

ACTIVE STAGE - TAILINGS PLACEMENT

PREVIOUS STAGE(S) - TAILINGS PLACEMENT

Golder Associates

CLIENT: Promet Engineers		PROJECT: Southdown Magnetite Project	
DRAWN: TJP	DATE: Feb. 06	TITLE: SCHEMATIC LAYOUT OF EXTERNAL TSF	
CHECKED:	DATE:		
SCALE: 1:15,000	A3	PROJECT No: 05641386-L03	Figure 5.7

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DATE: PLOT SCALE: 1:1

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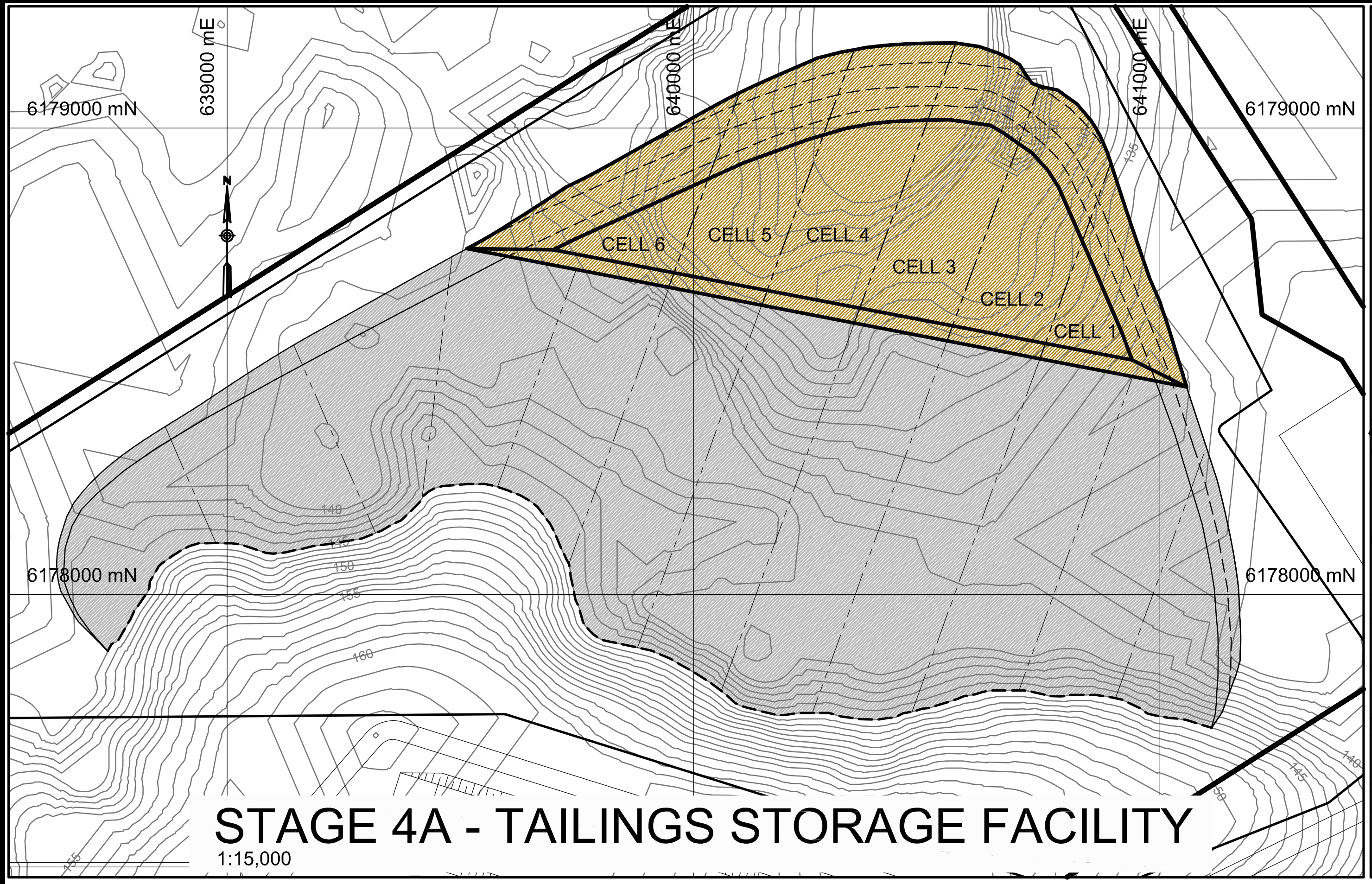
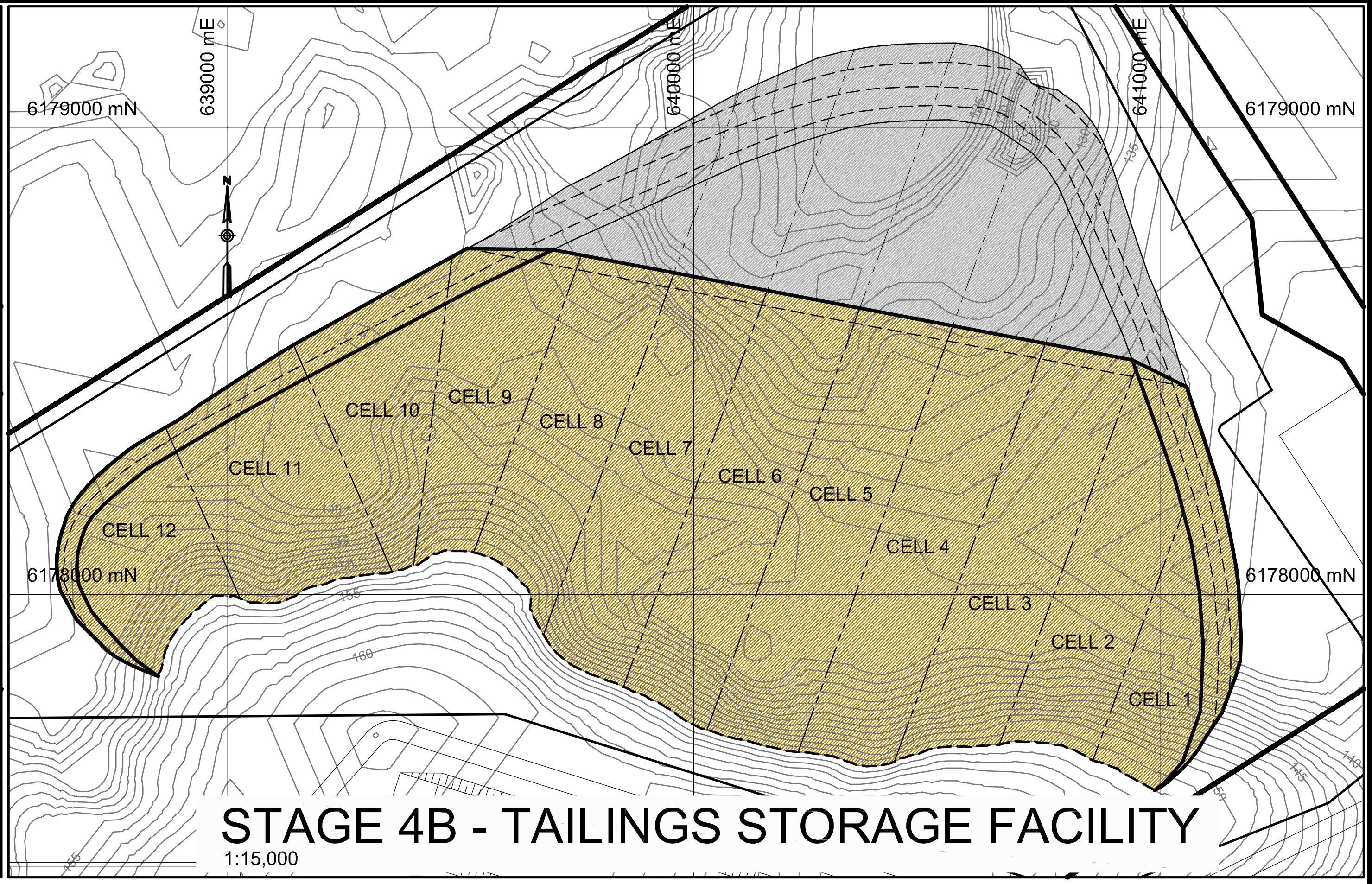
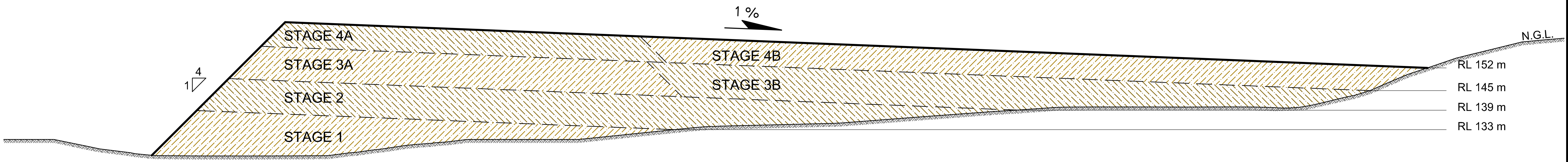


STAGE 4A - TAILINGS STORAGE FACILITY
1:15,000



STAGE 4B - TAILINGS STORAGE FACILITY
1:15,000



TYPICAL LONGITUDINAL SECTION - (VERTICALLY EXAGGERATED)
SCALE: H - 1:5000, V - 1:1250

LEGEND:

- ACTIVE STAGE - TAILINGS PLACEMENT
- PREVIOUS STAGE(S) - TAILINGS PLACEMENT

Golder Associates

CLIENT PROMET ENGINEERS		PROJECT Southdown Magnetite Project	
DRAWN TJP	DATE Feb. 06	TITLE SCHEMATIC LAYOUT & SECTION OF EXTERNAL TSF	
CHECKED	DATE		
SCALE As Shown	A3	PROJECT No 05641386-L03	Figure 5.8

J:\Jobs405\MINING\05641386-Southdown Tailings\CAD\Figures\05641386-TM05-F01.dwg
DATE:15-02-06 PLOT SCALE: 1:1

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Preliminary Design – In-Pit TSF

Static water conditions within the pit have been shown to be between RL 120 and RL 130. This is the maximum level to which groundwater is anticipated to return following mining and dewatering. Management strategies have been developed assuming the worst case conditions for acid mine drainage formation; of the water table being below the tailings cell level. Management may include treatment of the tailings (in a similar way to the tailings in the external TSF) for the in-pit TSF to reduce the acid mine drainage potential.

The in-pit tailings concept is summarised as follows:

- Backfilling of the pit void will commence in years 5 to 6 using waste rock.
- From year 7, there will be a tailings storage facility prepared within the backfilled waste rock to allow backfilling of tailings to commence (Figure 5.9). Four separate in-pit tailings storages will be constructed within the backfilled waste rock as mining progresses (Figure 5.10).
- It is envisaged that all of the tailings from year 7 onwards (195 Mt or 100 Mm^3) can be stored within the in-pit TSF, with each stage being about 75 m deep.

Similar to the external TSF, cells will be constructed in the in-pit TSFs to manage the tailings in discrete areas to reduce the ARD potential. The in-pit waste backfill will only likely use inert waste rock. The starter walls for each cell will be constructed using compacted inert mine waste rock, and raised (using mine waste rock) during on-going tailings placement.

The cells will be sequentially filled with tailings, likely to be potentially acid forming, then capped with inert mine waste rock, which will effectively encapsulate the tailings within the cell. The depth of placement of the in-pit tailings storage facilities will be dependant on the groundwater table; both during operations when the groundwater level will be lowered for pit dewatering and at closure when the groundwater level will rebound. Consideration will be given to the potential for the formation of acid mine drainage, and whether the tailings will be inundated with water / saturated (such as the possible lake that will form in the pit void at closure), or be well above the groundwater level after closure. The design of the storage facilities and their internal storage cells will consider the restriction of the movement of surface and groundwater within the tailings material, both during operations and post-closure, thereby reducing the potential for acid generation for the range of groundwater conditions expected during and after the life of mine.

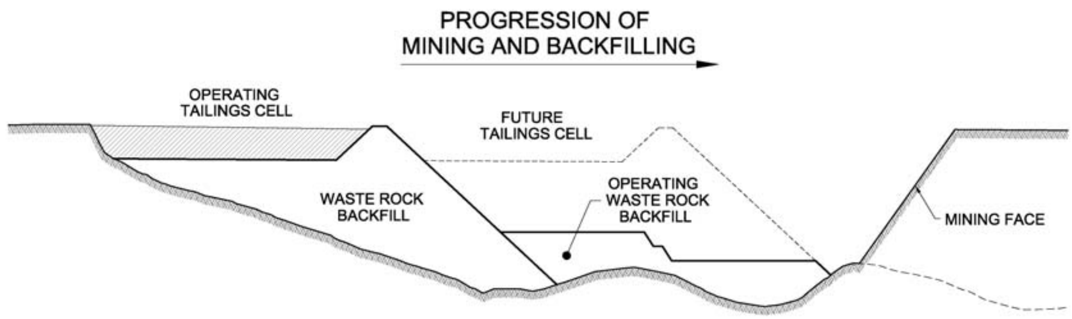

Figure 5.9 Schematic Cross-Section through In-Pit Facility.

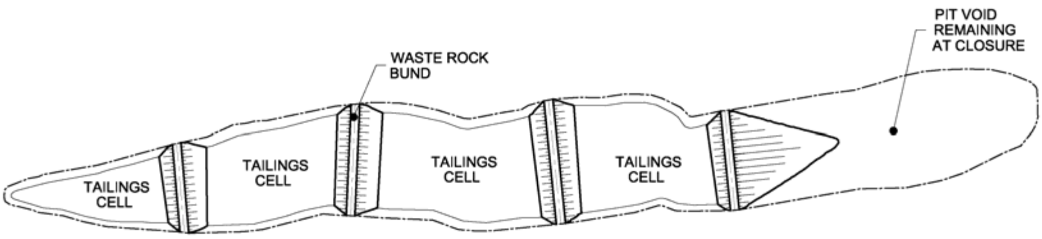

Figure 5.10 Plan of Final In-Pit Facility.

Section 5.1.8 Mine Site Infrastructure and Facilities

It is anticipated that the on site infrastructure will consist of the following, the layout is illustrated in Figure 5.6:

- gate house and security;
- mining equipment maintenance area, stores and spare parts storage;
- washdown area;
- fuel storage and re-fuelling facility;
- ammonium nitrate storage;
- detonator Store
- booster Store;
- ablutions block;
- package sewage plant;
- crib room;
- car parking and access roads;
- electrical substation;
- laboratory;
- emergency power generators;
- process Plant;
- administration;
- waste dumps;
- tailings storage facility; and
- water storage areas.

Although required plant equipment has not yet been finalised, a typical heavy earthmoving fleet for an 80 Mtpa hardrock open pit mining operation will be utilized.

Section 5.1.9 Hydrocarbon Use and Storage

Hydrocarbons and detergents will be required for mobile plant operation and maintenance. These will be secondarily contained in licensed facilities compliant with AS 1940 - 2004. Bulk fuel storage facilities will be designed and maintained to prevent environmental pollution and the formation of new contaminated sites.

Section 5.1.10 Explosives Use and Storage

Standard mining explosives and accessories will be required for blasting in the pit. These will be contained in licensed facilities and managed according to requirements of the *Explosives and Dangerous Goods Act 1961*.

Section 5.2 Pipelines

Two pipelines are required for this proposal; firstly, the slurry pipeline that transports magnetite concentrate from the mine to the Port and secondly, the return water pipeline which transports recycled process water from the Port to the mine together with any make-up water. These two pipelines will have the same route between the mine and port.

Section 5.2.1 Location

The proposed pipeline route is described in Section 5.2.5 and illustrated in Figure 2.1, Figure 2.2 and Figure 2.3. The co-ordinates for the approximate pipeline route are listed in Appendix 12- 1.

Section 5.2.2 Tenure and Zoning

The pipelines traverse private land, commercial properties, council land, Albany Port Authority land, major and minor roads and a railway reserve. Land access will be sought by permission and agreement with landholders. An easement and construction Right of Way will be acquired over the pipeline route.

No amendment to a regional planning scheme or town planning scheme is required for the pipeline. The pipeline route traverses land that is predominantly zoned rural under the City of Albany Town Planning Scheme No 3 (Section 5.2.2, Figure 2.5 and Figure 2.6). Other Zoning types include Local Roads, Important Regional Roads, Major Highways, Parks and Recreation and Public Use (railway reserve).

No subdivision or development approval is required from the City of Albany or Western Australian Planning Commission for this proposed pipeline development.

Section 5.2.3 Slurry Pipeline

The magnetite concentrate from the concentrator is produced in slurry form. The water content of this slurry will be adjusted to a level appropriate for long distance pumping. Apart from the flotation reagents that are consumed in the flotation process and pass into the flotation tailings; no other chemicals are used in the concentrator. The flotation process will remove most of the sulphur bearing material from the concentrate prior to pumping.

To control internal corrosion the pipe will either be fitted with a high density polyethylene (HDPE) liner or the slurry will be dosed with additives. The decision as to which method to use will depend on the final water and slurry properties. For dosing, before pumping, the pH of the slurry will be adjusted using lime, and an oxygen scavenger, usually sodium bisulphite is added. These prevent acid generation and corrosion of the pipeline. Sodium bisulphite is used extensively in minerals and food processing for this purpose.

The magnetite concentrate slurry will be pumped approximately 104 km through a buried pipeline from the Southdown mine to the Albany Port. No final sizing of the pipeline has yet been carried out however it will be approximately 400 mm in diameter. The pipe will be buried at a minimum depth of 750 mm below the surface where possible, or at a depth appropriate to the land use and ease of excavation. The slurry pipeline will have a pumping station located at the Southdown mine. The pipeline will be made of steel and will be monitored by proven leak detection hardware and software.

Section 5.2.4 Return Water Pipeline

The return water pipeline is proposed to carry make-up water, together with recycled water from dewatering the slurry at the Albany Port concentrate storage facility back to the mine site. The return water pipeline will be laid in the same easement as the slurry pipeline, with the return water pumping station located at the Port.

The return water pipeline will be made partly of steel and partly of HDPE, and will be up to about 560 mm in diameter. The steel may be epoxy lined. Air valves and scour valve pits may be required at high and low points respectively, at locations determined by assessment of the topography and water pipeline design.

Section 5.2.5 Proposed Pipeline Route

Aspects for consideration of the pipeline route have included:

- land holder access agreements;
- most direct route;
- avoiding remnant native vegetation;
- avoiding areas of acidic or water logged soils;
- available underground space for pipeline infrastructure; and
- ease of river crossings.

Grange has engaged a local Liaison Officer to assist with negotiations with land holders. The preferred pipeline route (Figure 2.1, Figure 2.2 and Figure 2.3) crosses 62 land titles, of which thirteen are held by corporations and 49 are privately owned, together with two leasehold titles which are government owned. In addition the pipeline route traverses a number of road reserves including Albany Highway, South Coast Highway and Chester Pass Road and the Rail Corridor into Albany Port. The pipeline will require three river crossings at the Kalgan River and Napier Creek over Vacant Crown Land and the King River over private property. The King River and the Kalgan River and all tributaries are listed on the Permanent Register of Aboriginal Sites (Site ID 5746). The pipeline crossing of the Kalgan River at any point therefore may require approval to disturb an aboriginal site under provisions of Section 18 of *Aboriginal Heritage Act 1972*. Grange has been in consultation with the Department of Indigenous Affairs (DIA) with regards to this matter and will obtain appropriate approvals as required.

The preferred alignment for the pipeline as it enters the City of Albany from the west is along or parallel to the Rail Corridor. If this can not be negotiated, an alternate route along Cuming Road will be utilised.

The proposed pipeline route includes two sections adjacent to the northern foreshore of Princess Royal Harbour. An area of approximately 0.025 ha (250 m^2), approximately 80 m length will be reclaimed west of Point Melville. Eastwards from Point Melville, an area of 0.4 ha (4,000 m^2), approximately 1,100 m long will be reclaimed adjacent to existing reclaimed land carrying the main road named Princess Royal Drive.

The proposed pipeline corridor west of Point Melville lies between the existing Rail Corridor and the foreshore. In this section for approximately 80 m length, the separation between the Rail Corridor and the High Water Mark is less than the 10 m width of the proposed pipeline corridor. Minor reclamation will be conducted in this area to facilitate pipeline construction. Approximately 0.025 ha (250 m^2) of the intertidal zone of the foreshore will be reclaimed. The depth of water in this area is typically 0.2 m with the area completely drying out at periods of low tide.

The proposed pipeline corridor east of Point Melville extends 10 m out from the top of the existing rock armour protecting the existing Princess Royal Drive reclamation. The amount of seabed to be reclaimed for the pipeline corridor will be up to 4 m width, over a length of 1,100 m. In total the reclamation area will be approximately 0.4 ha (4,000 m^2). The reclamation area location and a typical cross-section of the pipeline corridor are shown in Figure 5.11. The depth of water in this area ranges from 0.64 m to 1.0 m at high tide.

Overall a total of about 11,000 m^3 of fill will be required for both sections of the pipeline reclamation. The Port of Albany has stockpiled dredge material from previous dredging programmes that may be suitable for this requirement.

The pipeline corridor traverses Point Melville Reserve along the northern foreshore of Princess Royal Harbour. The preferred option is to install the pipeline through this area using horizontal directional drilling beneath the reserve. Alternative construction methods, if required will be conducted in consultation with the DIA.

If access issues are resolved, it is anticipated that the pipelines will run for approximately 104 km, and result in 220 ha of temporary ground disturbance during the construction process.

Section 5.2.6 Pipeline Construction

Site Preparation

Before commencing construction the pipeline route will be surveyed to identify soil types and locate environmental features, public/private utilities and agricultural infrastructure to prevent accidental damage during pipeline construction. The pipeline's centreline and the exterior right-of-way boundaries will be staked, with the right-of-way typically 15 m to 25 m wide in total. The right-of-way will be cleared of any vegetation as well as any rocks or other material that may restrict access or construction activities. The surface will then be graded and silt fences installed along the edges of creeks, rivers and wetlands to prevent erosion of disturbed soil. Where available, topsoil will be stripped to a predetermined depth and stockpiled along the sides of the right-of-way.

The pipe trenches will be dug using a wheel trencher or excavator, with removed material stockpiled along side the trench. The trench widths will be about 1000 mm, and the trench depths required will generally be 1200 – 1600 mm for rural areas and 1350 – 1700 mm for suburban areas. The pipes may be buried even deeper at stream and road crossings. If large quantities of solid rock are encountered during trenching it may be necessary to use special equipment or explosives to remove the rock. The contractor will only use explosives in accordance with statutory guidelines to ensure a safe and controlled blast.

Pipeline Installation

The pipes will be transported by truck to a pipe storage yard in the vicinity of the pipeline location. A stringing crew will move the pipe (lengths are typically six to 12 m long) from the storage yard to the pipeline right-of-way.

Where necessary the pipe will be bent to account for changes in the pipeline route and to conform to the topography. Semi-automatic welding units may be used in conjunction with qualified welders to weld the sections of the pipeline into one continuous length. X-rays of the pipe welds will be taken to ensure the completed welds meet the prescribed quality standards.

After welding, the pipe will be lowered into the trench using a series of side-boom mobile cranes. In rocky areas, sandbags or foam blocks may be placed at the bottom of the trench prior to lowering-in to protect the pipe and coating from damage. Once the pipe has been placed in the trench, the trench will be backfilled using a backhoe or other suitable machine depending on the soil makeup. The soil will be returned to the trench in reverse order to ensure the topsoil is returned to its original position.

5. PROJECT DESCRIPTION

Pipeline construction is anticipated to take approximately six months during the summer and autumn seasons. Safety and environmental management strategies for terrestrial fauna are outlined in Section 8.9.4.

Before the pipelines are put into service, the entire length of the pipelines will be pressure tested using water. The hydrostatic test is the final construction quality assurance test.

Road and Rail Crossings

The pipeline route crosses a number of roads and the rail line into the Albany Port. Unsealed roads and some minor sealed roads may be crossed by conventional open trench depending on traffic, however it is anticipated that the some sealed roads and the rail line may require horizontal directional drilling.

Plantations and Firebreaks

Significant portions of the proposed pipeline route run along access tracks and firebreaks within blue gum plantations. Management practices and the associated machinery used to maintain and harvest the forests (for example rippers) may necessitate a deeper trench depth.

River and Creek Crossings

The engineering of proposed river and creek crossings will be determined by the site topography, existing infrastructure, water flow and degree of social disturbance. Engineering options considered for river crossings included attaching the pipeline to existing bridges, horizontal directional drilling for sites with steep topography or pristine vegetation and conventional trench crossings.

Conventional trench crossings will be achieved by digging a trench across the river bed and installing the pipeline in one to two days. It is proposed to undertake the works during summer where possible, when there is little water flow. Installation of the pipeline across the riverbed is not expected to affect the natural drainage pattern of the river and will be managed in accordance with the Department of Water (DoW) guidelines *Stream Stabilisation* (2000).

Albany City and Port Area

Design and location of the pipeline as it enters the City of Albany and Port areas will depend on stakeholder feedback as well as the potential presence of existing contaminated sites.

Rail crossings (existing and proposed) and wharf road access crossing locations over the pipeline potentially require a minimum 2000 mm top of pipe depth and additional pipe wall thickness. A trench depth of 900 mm to top of pipe and additional pipe wall thickness may also be required within the Albany Port area due to location class.

The proposed route passes through two small workshops controlled by the APA which may require removal as advised by the port engineer.

In the City of Albany controlled area of the Princess Royal Harbour waterfront, it is proposed that the pipes be buried on new reclaimed ground up to four metres wide along Princess Royal Drive.

Pipeline Reclamation

The proposed method of construction of the pipeline reclamation area adjacent to Princess Royal Drive will involve:

- Existing culverts and pipelines under Princess Royal Drive will be extended into Princess Royal Harbour.
- Existing rock armour will be progressively removed from its current position and used as part of the new rock armour seawall.
- A geo-fabric cloth will be laid on the new reclamation area bed and the inner face of the rock armour wall to prevent the loss of clean fill into Princess Royal Harbour during placement and by subsequent wave action.
- Suitable fill material will be trucked in and progressively deposited into the void and compacted using appropriate machinery.
- The rock armour wall and clean fill will be progressively placed and compacted so as to lift the new reclamation up to the existing road level or as specified by Main Roads Western Australia (MRWA) and the City of Albany.

Pipeline construction within the new reclamation area will occur at a later date as part of the overall pipeline construction programme.

Intertidal Habitat

Approximately 0.425 ha of intertidal zone of the foreshore will be reclaimed to create space for the pipeline south of the existing Princess Royal Drive road easement.

Contamination to waters of Princess Royal Harbour from the deposition of fill will be minimal as most of the fill will be placed above the High Water Mark. Construction methods such as the use of a geo-fabric membrane and a suitable clean fill will also assist in minimising the contamination of waters during deposition.

Rehabilitation

Rehabilitation will be undertaken to restore the land as closely as possible to its original condition. This process includes, but is not limited to; de-compacting the surface of construction work areas, replacing topsoil, removing large rocks that may have been brought to the surface, repairing any irrigation systems or drainage lines, restoring fences and seeding and mulching to restore original vegetation where appropriate. In hilly areas, the right-of-way will be graded with erosion-prevention measures (such as interceptor dikes) installed.

Section 5.2.7 Pipeline Design and Operation

An internationally experienced pipeline company will be engaged to design the pipeline system. As there are no Australian standards for slurry pipelines, the pipelines will be designed to American Society of Mechanical Engineers B31.11 2002 Slurry Transportation Piping Systems (ASME, 2002) standards. This is a stringent code derived from the oil industry. The high density polyethylene pipelines will also be designed to the International Standard Organisation 9080 Plastics Piping and Ducting Systems.

Design

The pipes will be corrosion resistant. The pipes are internally and externally coated prior to delivery, with a small area at the ends left uncoated for the welding process. Once the welds are made and inspected, the field joint is coated before the pipeline is lowered into the trench.

Detailed design will ensure that adequate allowance has been made for any internal corrosion and erosion over the life of the pipelines. Actual levels will be monitored during operation and the appropriate measures taken to adjust for any deviation from that predicted from the design analysis and modelling.

Cathodic protection is an extremely effective method of protecting large buried or submerged structures such as pipelines. A structure can be indefinitely protected provided the system is properly designed, operated, and maintained. Maintenance does not require access to the entire structure so systems on buried pipelines can be practically maintained. Impressed current systems, rather than sacrificial systems, are usually used when the current requirement is relatively high. The anodes in impressed current systems are made from materials that can tolerate high current discharges for extended periods of time with little resultant consumption of the anode material.

To cater for electrical storms the pipelines will be electrically insulated from the steel structures at the pump stations and terminals, and “earthed” at these locations by ground rods.

For environmentally sensitive areas such as major river crossings, the pipeline design safety factors and trench depths are further increased. Instances of pipeline ruptures are extremely uncommon.

Monitoring

During operation the pipelines will be continuously monitored by state-of-the-art control systems. These include sophisticated leak detection software and hardware to alert, locate and limit the amount of spill. A buried fibre optic cable will be the basis for communications and data transfer along the pipeline. Station rupture discs will also be installed to provide overpressure protection. There are shut-off valves at the ends of the pipelines. No intermediary valves are required.

In the unlikely event of a pipeline breach, detection would be rapid, the location accurately determined and the pipeline quickly shut down. A containment wall would be put around the leak and the material would be collected for return to the mine. As the pipelines are buried, the impacts of a pipeline breach would be very localised. Emergency response in the rare event of a spill is included in the Pipeline Construction and Operation Management Plan (Technical Appendix 13.1).

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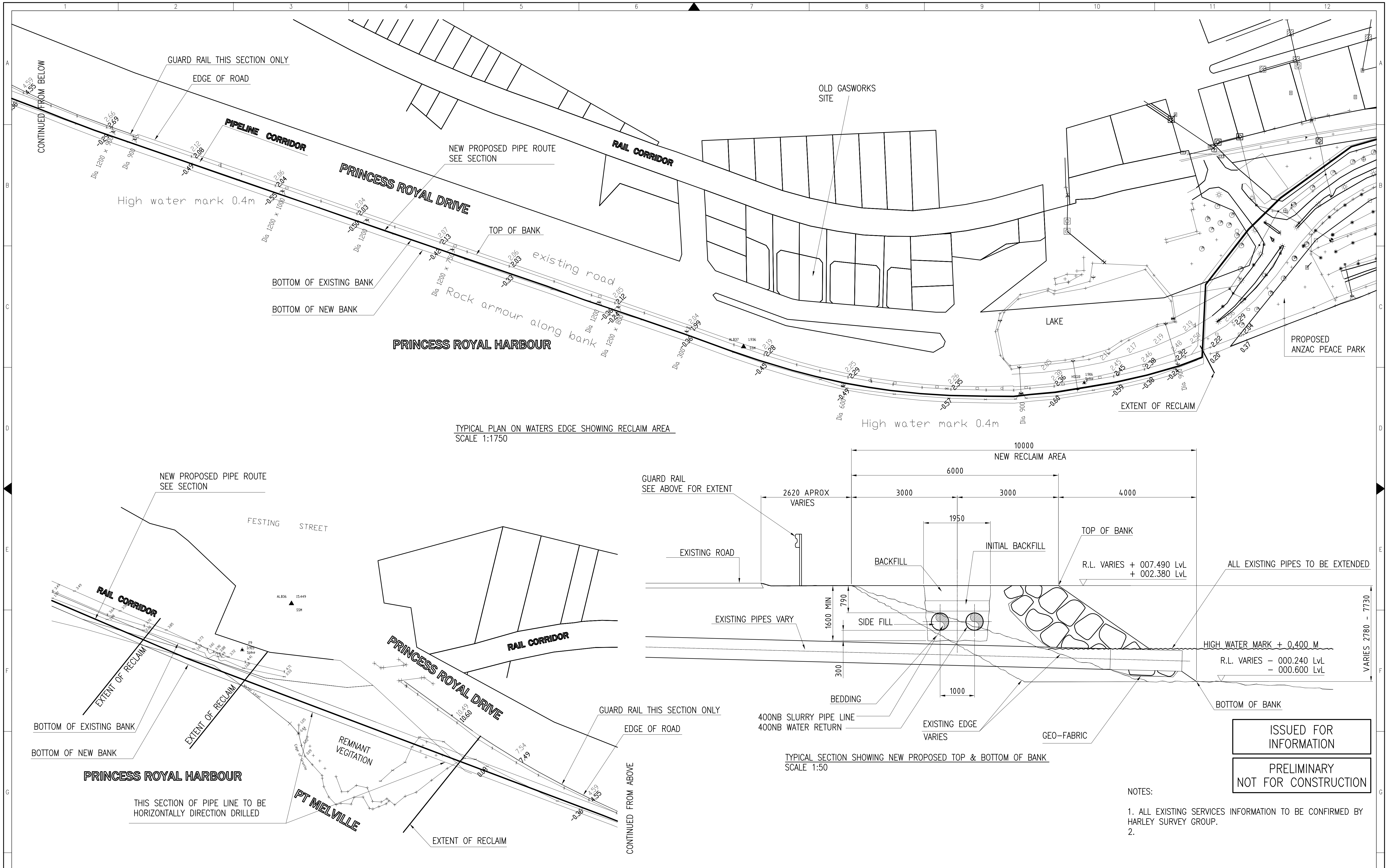

DRAWING NUMBER	TITLE
C5161–M–53–0001	GENERAL ARRANGEMENT–PLAN

REFERENCE DRAWINGS

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
C	14.03.06	G.B.	NOTES ADDED	A.E.	H.S.	
B	08.03.06	G.B.	NOTES ADDED RECLAIM AREA EXTENDED	A.E.	H.S.	
A	12.02.06	G.B.	ISSUED FOR INFORMATION	A.E.	H.S.	

DRAWING REVISION

	DATE	NAME
DRAWN BY	06.02.06	G.BEWLEY
CHECKED BY	28.10.05	A.E.
APPROVED BY	04.11.05	H.S.

Figure 5.11

SCALE –

ProMet Engineers

SOUTHDOWN MAGNETITE PROJECT
ALBANY PORT
TYPICAL CROSS SECTION ACROSS ROADWAY
RECLAIM AREA PRINCESS ROYAL DRIVE

DRAWING No: C5161–C–58–0001 FORMAT SIZE: A1 REV. C

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Section 5.3 Port Infrastructure and Process

Section 5.3.1 Port Infrastructure

The land reclamation is the responsibility of the APA as described in the Albany Port Expansion Proposal PER (EPA Assessment No 1594). Up to 9.0 ha of land will be reclaimed for the Albany Iron Ore Project. This land is required to provide landbacking for the new Berth 7 and accommodate Project infrastructure. The existing port layout is illustrated in Figure 5.12. The infrastructure to be owned by Grange at the new berth 7 within the Port will consist of the following (Figure 5.13).

- A concentrate thickener tank, an agitated storage tank, an emergency storage tank, a process water storage tank, a return water storage tank, a filter plant and. a return water pumping station.
- A 350,000 tonne concentrate storage shed with reclaim facilities.
- A ship loader capable of loading concentrate into Cape size vessels.
- Related conveyors and other material handling equipment.
- Stormwater management infrastructure.
- Ancillary equipment such as air compressors, fire water booster and storage, electrical substation, maintenance workshops, administration offices and a control room.

Section 5.3.2 Port Process

Magnetite Slurry Properties

The slurry arriving at the Port is 30% by volume Magnetite Iron Ore concentrate and 70% process water. The slurry is chemically inert, does not leach, is not dangerous or carcinogenic and settles quickly. Apart from feedstock for Iron production, magnetite is used in the coal industry in coal washeries and has been used as a filter material in water treatment plants using the Sirofloc process developed by CSIRO. The concentrate particle size will be 80% below 42 micron. The process water is regarded as grey water and will be recycled.

Slurry Reception and Thickening

Slurry from the Southdown mine concentrator will be pumped by underground pipe to the Albany Port at a rate of 850 tph of solids. It will be received in a thickener tank, thickened and then stored in an agitated tank. The thickened slurry will then be pumped to the filter plant for dewatering, while the excess slurry water is pumped to the water storage tank for return to the mine. Areas where the slurry is handled and processed will be contained within a bund wall.

An emergency storage tank will be able to receive slurry from the pipeline for up to four hours in the event of a power failure in Albany. This represents sufficient time to shut down the pipeline pumping operations in a controlled manner.

Filter Plant

A series of vacuum or pressure filters will further remove moisture from the thickened slurry to produce a concentrate filter cake with up to 9% moisture. The filter cake will be transported by conveyor to the concentrate storage shed or loaded directly onto a ship. The dewatering filters will be in an enclosed building to reduce noise and to maintain the correct moisture content independent of weather conditions. The remaining moisture content of the filter cake will prevent dust generation. The water recovered from the filter plant will be returned to the thickener for recovery of any residual magnetite.

Water recovery

The water recovered from the thickener will be stored in the return water storage tank and pumped back to the mine site in the return water pipeline. This pipeline will be installed in the same easement as the slurry pipeline.

Storage Shed

The concentrate filter cake will be transferred on a fully enclosed conveyor to the storage shed where it will be stockpiled. This involves a conveyor and tripper running under the ridge line, with a reclaim conveyor running inside along the length of one wall. Reclamation will be by means of a mechanical reclaimer loading the concentrate filter cake onto a conveyor for transport to the ship loader. While minimal dust generation is expected, the shed will be fully enclosed, under negative pressure and fitted with dust extraction plants. The storage capacity in the shed will be approximately 350,000 tonnes.

Ship loader

From the shed, the concentrate filter cake will be transported on a fully enclosed conveyor to a mobile ship loader of nominal capacity of 4,500 tonnes per hour. Typically, the ship loader will traverse on a dolphin berth, with a 300 m ground level wharf conveyor and tripper located on the quay. The two will be linked by a traversing inclined transfer conveyor. For ship loading there will be one transfer station over the sea. This transfer will be sealed and internal spillage will be controlled. The ship loader will have chutes directing the concentrate into the ship's hold to minimise dust generation. The facility will be capable of loading Cape size vessels of up to 170,000 tonne capacity for shipping to the pellet plant at Kemaman in Malaysia.

Conveyors

All plant conveyors will be fully enclosed to eliminate dust emissions, with the stringers suspended to allow for easy cleaning. Any spillage within the enclosed conveyors will be cleaned by mobile vacuum plant, which connects to a series of permanent hoses within the structure. The material will then be returned to the product stockpile for shipping.

Shipping

The Albany Port berthed 120 trading vessels in 2005 and 116 trading vessels in 2004. The Southdown Magnetite Proposal will require approximately one Cape size vessel per week to meet export requirements, increasing the current vessel traffic through King George Sound and Princess Royal Harbour by approximately one half.

Site Stormwater Management

Stormwater at berth 7 is proposed to be managed as two separate systems. These systems are outlined in Figure 5.13. The filter plant and tank farm will be bunded with run-off channelled into a 'Contained Area Drainage System' and designed for a 1 year Average Recurrence Interval (ARI) and a 24 hour storm event duration. Run-off from the stockpile shed roof, roadways and hardstands will be channelled in to a separate 'General Drainage System', which will be collected in sumps and directed to a central gross pollutant trap before exiting a marine outfall.

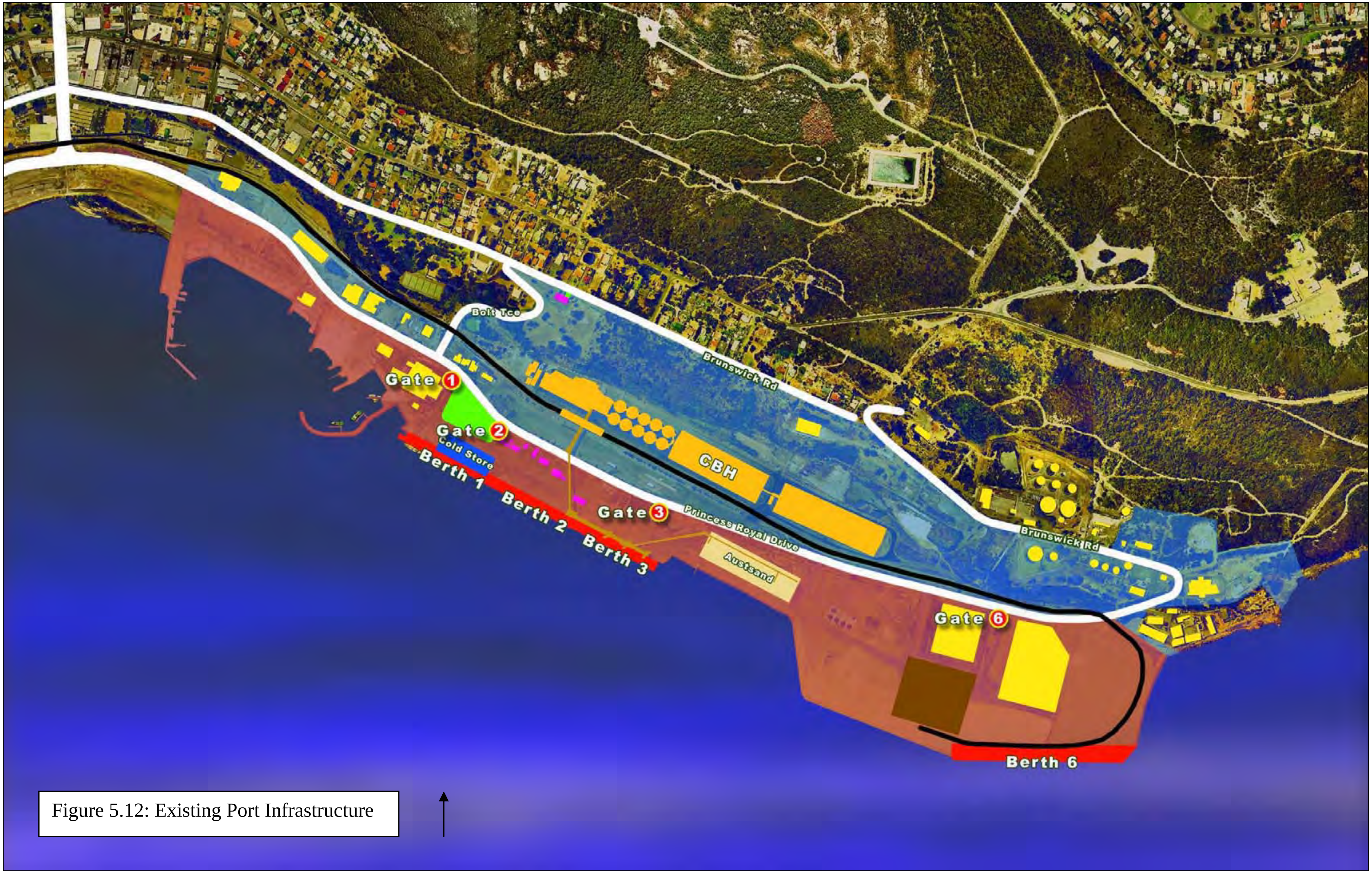

Figure 5.12: Existing Port Infrastructure

Not to Scale

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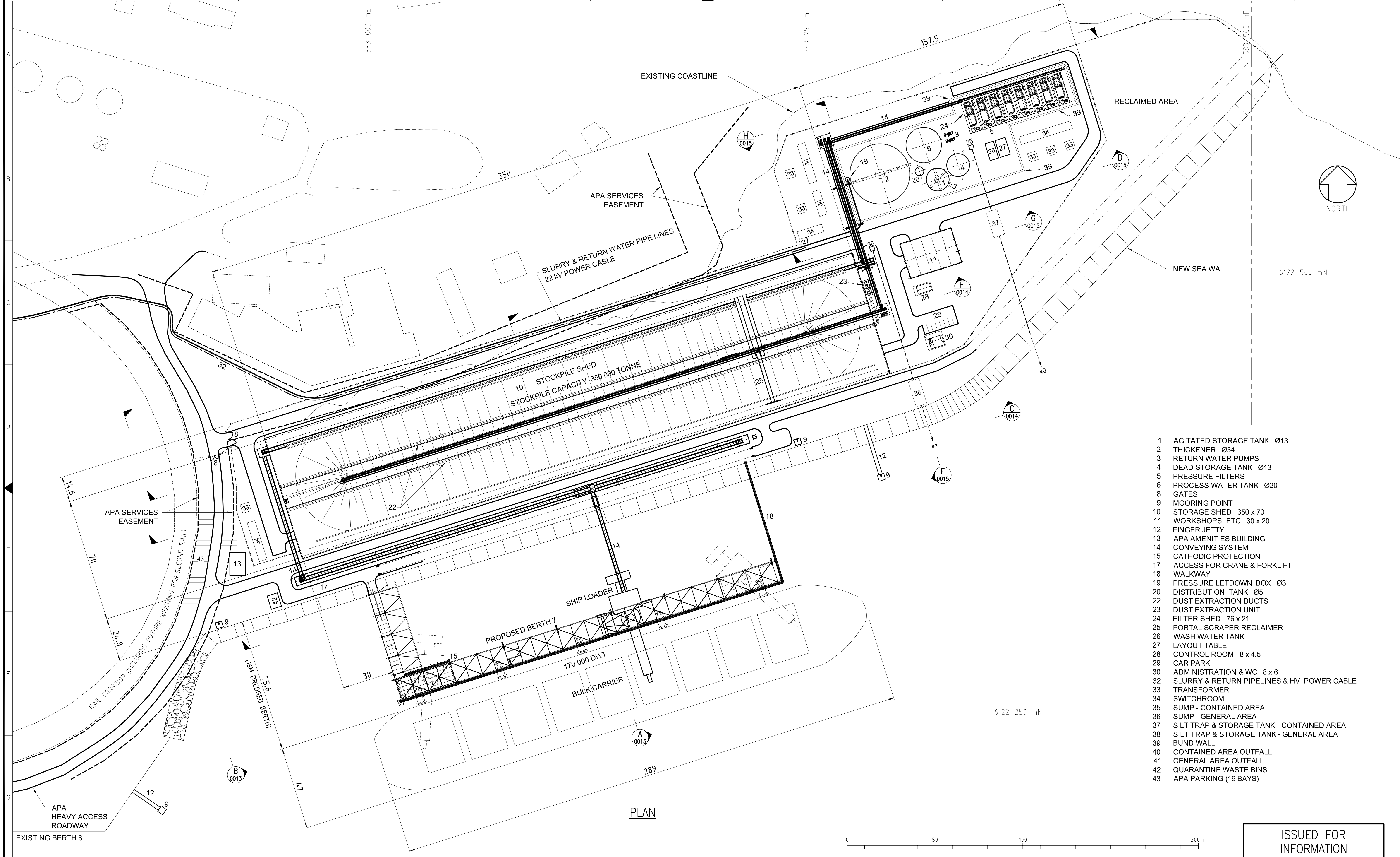

1 AGITATED STORAGE TANK Ø13
2 THICKENER Ø34
3 RETURN WATER PUMPS
4 DEAD STORAGE TANK Ø13
5 PRESSURE FILTERS
6 PROCESS WATER TANK Ø20
8 GATES
9 MOORING POINT
10 STORAGE SHED 350 x 70
11 WORKSHOPS ETC 30 x 20
12 FINGER JETTY
13 APA AMENITIES BUILDING
14 CONVEYING SYSTEM
15 CATHODIC PROTECTION
17 ACCESS FOR CRANE & FORKLIFT
18 WALKWAY
19 PRESSURE LETDOWN BOX Ø3
20 DISTRIBUTION TANK Ø5
22 DUST EXTRACTION DUCTS
23 DUST EXTRACTION UNIT
24 FILTER SHED 76 x 21
25 PORTAL SCRAPER RECLAIMER
26 WASH WATER TANK
27 LAYOUT TABLE
28 CONTROL ROOM 8 x 4.5
29 CAR PARK
30 ADMINISTRATION & WC 8 x 6
32 SLURRY & RETURN PIPELINES & HV POWER CABLE
33 TRANSFORMER
34 SWITCHROOM
35 SUMP - CONTAINED AREA
36 SUMP - GENERAL AREA
37 SILT TRAP & STORAGE TANK - CONTAINED AREA
38 SILT TRAP & STORAGE TANK - GENERAL AREA
39 BUND WALL
40 CONTAINED AREA OUTFALL
41 GENERAL AREA OUTFALL
42 QUARANTINE WASTE BINS
43 APA PARKING (19 BAYS)

ISSUED FOR INFORMATION

DRAWING NUMBER	TITLE
C5161-M-53-0015	GENERAL ARRANGEMENT-SECTIONS
C5161-M-53-0014	GENERAL ARRANGEMENT-SECTIONS
C5161-M-53-0013	GENERAL ARRANGEMENT-SECTIONS

REFERENCE DRAWINGS

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
L	12.10.06	JB	REVISED STORM WATER DRAINAGE (ITEMS 36 TO 38)	HS		
K	14.9.06	JB	ADDED DRAINAGE (35-38) & REVISED AS PER APA COMMENTS	HS		
J	1.9.06	JB	ADDED SWITCHROOMS & TRANSFORMERS (ITEMS 33 & 34)	HS		
I	12.6.06	JB	ISSUED FOR INFORMATION	HS		
H	1.3.06	GB	ISSUED FOR INFORMATION	EGP		

DRAWING REVISION

	DATE	NAME
DRAWN BY	1.3.06	G.BEWLEY
CHECKED BY	1.3.06	E.G.P.
APPROVED BY	4.11.05	H.S.

SCALE 1:1000

Figure 5.13

ProMet Engineers

SOUTHDOWN MAGNETITE PROJECT
ALBANY PORT
GENERAL ARRANGEMENT
PLAN

DRAWING No: C5161-M-53-0012 | FORMAT SIZE: A1 | REV. L

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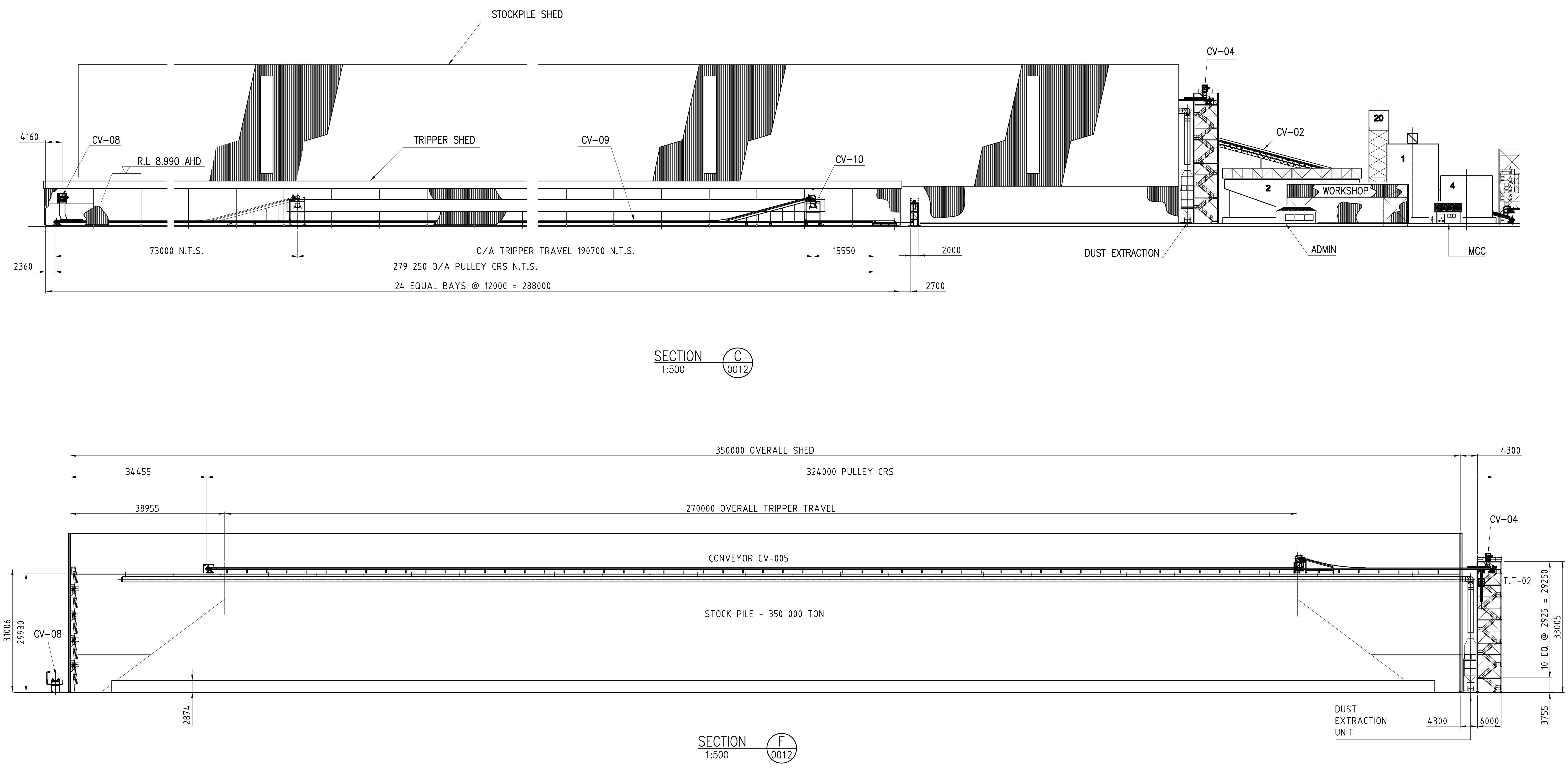

ISSUED FOR INFORMATION

DRAWING NUMBER	TITLE
C5161-M-53-0007	ALBANY PORT-CONVEYORS - LAYOUT PLAN

REFERENCE DRAWINGS

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
E	01.03.06	G.B.	EQUIPMENT POSITIONS ALTERED	EP	H.S.	
A	20.01.06	G.B.	DRAWING No WAS C5161-M-5003	EP	H.S.	

DRAWING REVISION

	DATE	NAME
DRAWN BY	26.10.05	SURESH
CHECKED BY	28.10.05	E P
APPROVED BY	04.11.05	H.S.

SCALE 1:500

Figure 5.14

ProMet Engineers

SOUTHDOWN MAGNETITE PROJECT
ALBANY PORT
CONVEYORS
ELEVATIONS

DRAWING No: C5161-M-53-0014 FORMAT SIZE: A1 REV. E

5. PROJECT DESCRIPTION

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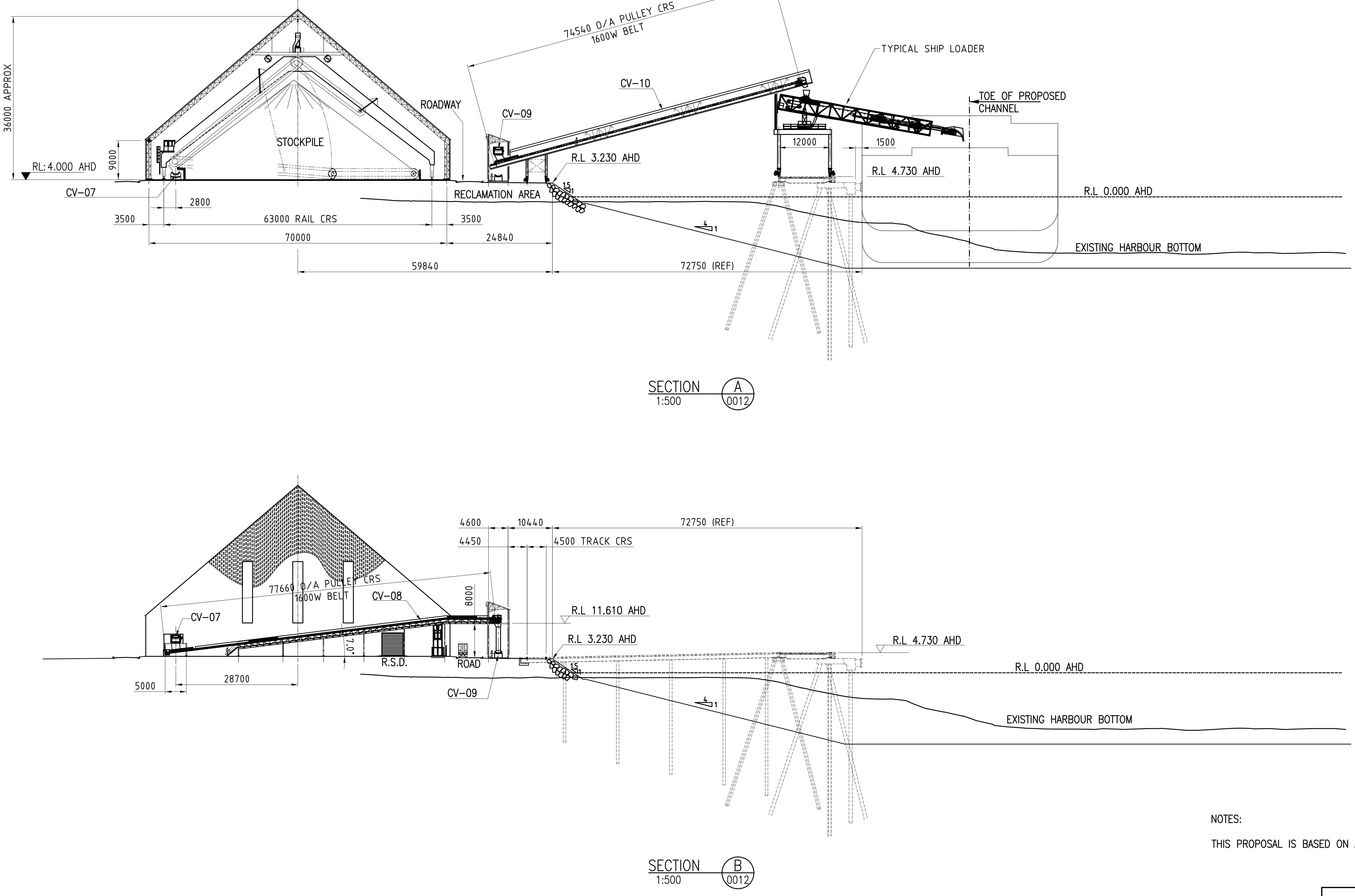

NOTES:

THIS PROPOSAL IS BASED ON A MAX 15M DRAFT VESSEL

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DRAWING NUMBER	TITLE
C5161-M-53-0012	GENERAL ARRANGEMENT-PLAN

REFERENCE DRAWINGS

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
C	01.03.06	G.B.	R.L's ADDED, DIMENSIONS ADDED	EP	H.S.	
B	24.01.06	G.B.	CONVEYOR CV-09 LOWERED TO ROAD	EP	H.S.	
A	20.01.06	G.B.	DRAWING No WAS C5161-M-5002	EP	H.S.	

DRAWING REVISION

	DATE	NAME
DRAWN BY	25.10.05	T. KUTLE
CHECKED BY	28.10.05	E. P.
APPROVED BY	04.11.05	H.S.

Figure 5.15

SCALE 1:500

ProMet Engineers

SOUTHDOWN MAGNETITE PROJECT
ALBANY PORT
GENERAL ARRANGEMENT
ELEVATION

DRAWING No: C5161-M-53-0013 FORMAT SIZE: A1 REV. C

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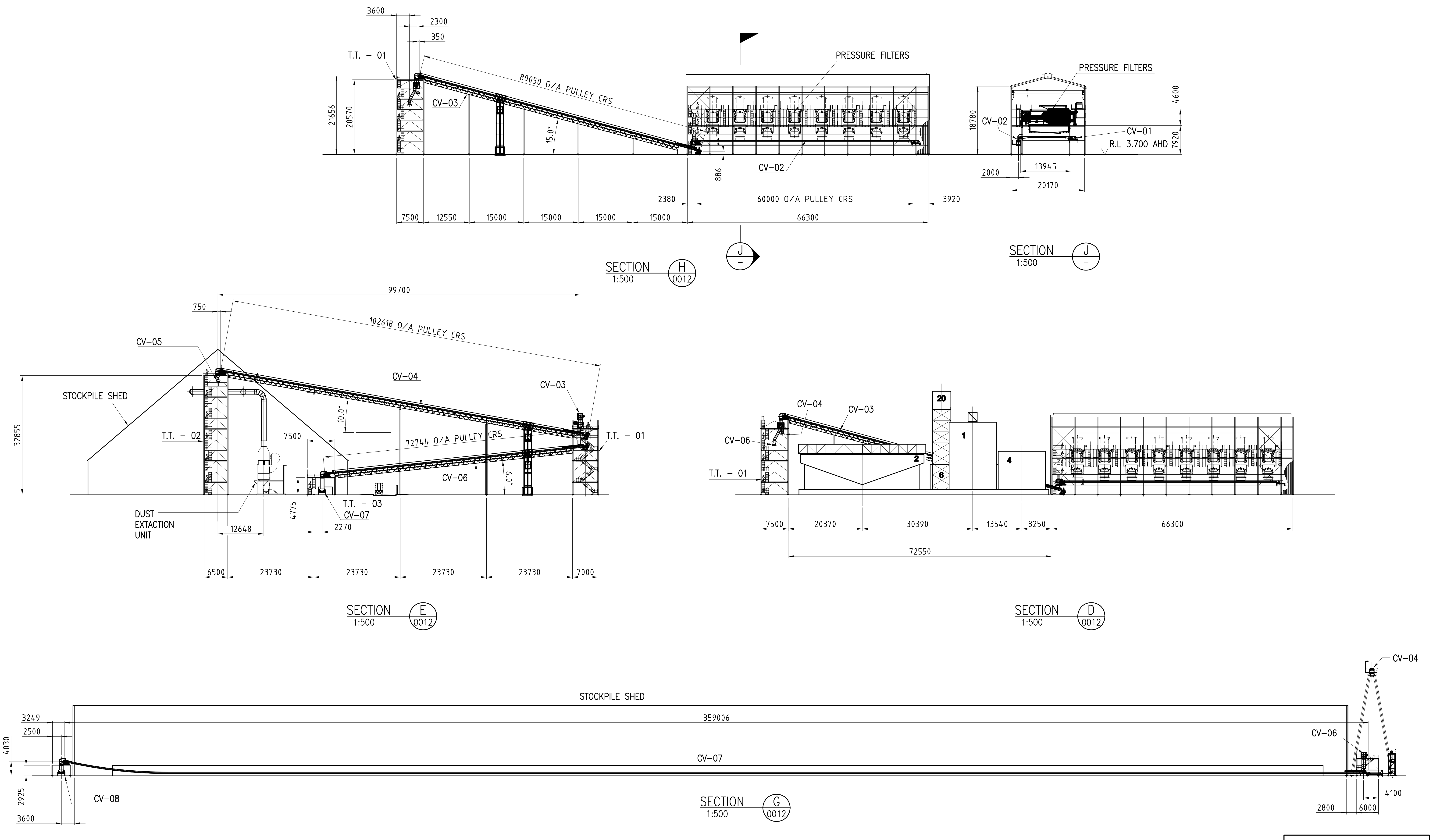

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DRAWING NUMBER	TITLE
C5161–M–53–0001	ALBANY PORT–GENERAL ARRANGEMENT–PLAN

REFERENCE DRAWINGS

REV	DATE	DRN	DESCRIPTION	CHKD	APPR	PROJ
D	02.03.06	G.B.	EQUIPMENT RELOCATED	EP	H.S.	
C	30.01.06	G.B.	CONVEYOR VC–08 RELOCATED TO WEST END	EP	H.S.	
B	24.01.06	G.B.	CONVEYOR VC–09 AND CV–08 ALTERED	EP	H.S.	
A	20.01.06	G.B.	DRAWING No WAS C5161–M–5004	EP	H.S.	

DRAWING REVISION

	DATE	NAME
DRAWN BY	27.10.05	T. KUTLE
CHECKED BY	28.10.05	EP
APPROVED BY	04.11.05	H.S.

SCALE 1:500

Figure 5.16

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SOUTHDOWN MAGNETITE PROJECT
ALBANY PORT
GENERAL ARRANGEMENT
ELEVATIONS

DRAWING No: C5161–M–53–0015 FORMAT SIZE: A1 REV. D

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Section 5.4 Ancillary Infrastructure

Section 5.4.1 Power Supply

The total projected power consumption for the Southdown Magnetite Proposal is approximately 625 GWh pa, comprised of approximately 550 GWh pa for the mine site and 85 GWh pa for the port facilities. Power for the mine site will be supplied via a new 220 kV power line to be constructed by Western Power Corporation to service the Project and to supply power to the surrounding region. Power for the Port will be supplied from the existing Western Power transmission network.

Due to the significant amount of power required by the Project and the much higher unit cost of generation using alternatives such as a stand alone diesel fired powerhouse, the Project is not considered commercially viable if it is not connected into the South West Integrated System of the Western Power network. Accordingly, should Western Power or an alternative electricity producer not be able to supply all the required power, or within the required time frame, the commencement of the Project will be delayed until these supplies are available.

Section 5.4.2 Water Supply

Potable Water

Operation of the mine and port facilities will require a small amount of potable water for ablutions, crib room and the laboratory. Potable water may be sourced from local treated groundwater or trucked in to the mine as required, and will be part of the facilities provided by the APA at the Port.

Process Water

Process water is required for construction activities, dust suppression, process plant operations and slurry production. Recycling of both process and slurry water are high priorities of the Project design philosophy. The Project will require approximately 1 GL during Project start-up including construction and commissioning. The processing plant is anticipated to require 304 m^3/hr make-up water, which is 59 GL over the 22 year mine life. The estimated total Project water requirement therefore, is 60 GL for the duration of the mining operations.

Water Balance Study

A site-wide water balance study was conducted (Golder, 2006b, Technical Appendix 13.4) to estimate the water harvesting potential from the site, considering the possible use of groundwater flowing into the mine and surface runoff. A water balance model was developed for the site (Golder, 2006 b) using GoldSim software and included the development of a meteorological data set relevant to the site, a process flow diagram and results from a hydrogeological study of the site (Golder, 2006 b).

The water balance model was used to estimate the availability of water throughout the mining operations considering a range of meteorological scenarios for the site. A range of water management strategies were assessed to maximise water availability during mining operations and minimise the risk of water overflowing into the open pit. Groundwater management is discussed in Section 8.5.4.

The model forecasts that there is a 95% probability that water harvested from the site would provide more than 87% of the process water requirements.

The site-wide water balance study indicated that approximately 56 GL of water (93% of amount required) can be harvested from rainfall runoff and pit dewatering during the 22 year mine life. This estimate takes into consideration transmission, evaporation, off-site discharge and other losses. The study did not include alternative water supplies at the site including;

- Additional water storage facilities, for example surface depressions to store storm runoff on adjacent catchments.
- Rainfall runoff harvesting from catchments adjacent to the mine site.
- Long-term groundwater supply from aquifers identified on-site.

Preliminary investigations indicate that water harvested from these alternative sources will be adequate for contingency water supply.

Water Management Plan

A water management plan has been developed to provide a strategy for segregating two streams of water defined as either non-impacted (clean) or impacted water.

Impacted water refers to water that may have low pH (acidic) or contain elevated levels of naturally occurring metals (Golder, 2005c) mobilised by oxidation and pH changes, which may not be suitable for off-site discharge. The impacted water system will comprise the following:

- Water pumped from the dewatering wells and the in-pit sumps (including groundwater inflow, pit slope run-off and seepage from the backfilled in-pit waste rock dump).
- Rainfall runoff from the un-rehabilitated TSF.
- Rainfall runoff from the un-rehabilitated waste rock dumps.
- Rainfall runoff from the mine-affected catchment.
- Seepage water collected from the perimeter of the TSF.
- Seepage water collected from the perimeter of the waste rock dumps.

Impacted water from the site would be collected and directed or pumped to an Impacted Water Storage Facility for processing purposes. Impacted water will be contained, and excess water, during extreme rainfall events will be directed into the pit and managed on-site.

Non-impacted water is not expected to contain elevated levels of naturally occurring metals (which could be mobilised by oxidation or pH change) and/or low pH, and would be harvested from the site and directed to the Fresh Water Storage Facility for processing purposes. Non-impacted water that meets environmental criteria may be discharged off-site. The non-impacted water system would comprise the following:

- Rainfall runoff from the rehabilitated TSF.
- Rainfall runoff from the rehabilitated waste rock dumps.
- Rainfall runoff from the rehabilitated in-pit waste rock dump.
- Rainfall runoff from the non-affected catchment on the mine site.

The design and size of water structures to be constructed is dependent on whether runoff is harvested (requiring larger structures to retain water from high rainfall events), or the water supply is supplemented from other sources.

The proposed locations of the water storage facilities are shown in Figure 5.6. Initial surface water storage facility designs are outlined in Figure 5.17. The surface water storage facilities will be constructed based on criteria outlined in the Erosion and Sediment Control Guidelines (IEAust (Qld), 1996) and the NSW Department of Conservation and Land Management Urban Erosion and Sediment control (now the NSW Department of Land and Water Conservation, 1992) used in the Eastern states, and commonly used in WA projects. The conceptual design of the facilities contains a cut-off key to restrict seepage underneath the facilities. The approximate combined capacity of the facilities is 1.1 Mm^3 and the combined area is approximately 0.33 Mm^2.

Section 5.5 Workforce

Grange is committed to direct local employment for this proposal, particularly during the operational phase. Approximately 1000 and 200 people will be required during the construction and operation phases of the proposal respectively.

The construction workforce will be based in temporary camps located on the mine footprint, or nearby at Wellstead. The permanent workforce will commute from surrounding townships. A permanent workforce camp facility will be constructed off-site to allow workers the option of not commuting to and from the site on a daily basis. Relevant permits for the mine camp during operations will be applied for from the City of Albany. Grange does not intend to have a fly in fly out arrangement.

Section 5.6 Sewerage

Sewerage facilities for the construction workforce are likely to consist of a Package Treatment Plant. The detailed design for sewerage management will be included as part of the site works approval application for the facilities operating license, in consultation with relevant authorities and in compliance with relevant guidelines. An *Application to Construct or Install An Apparatus for the Treatment of Sewage* will also be lodged through the City of Albany, for approval by the Executive Director of Public Health (if required) prior to construction.

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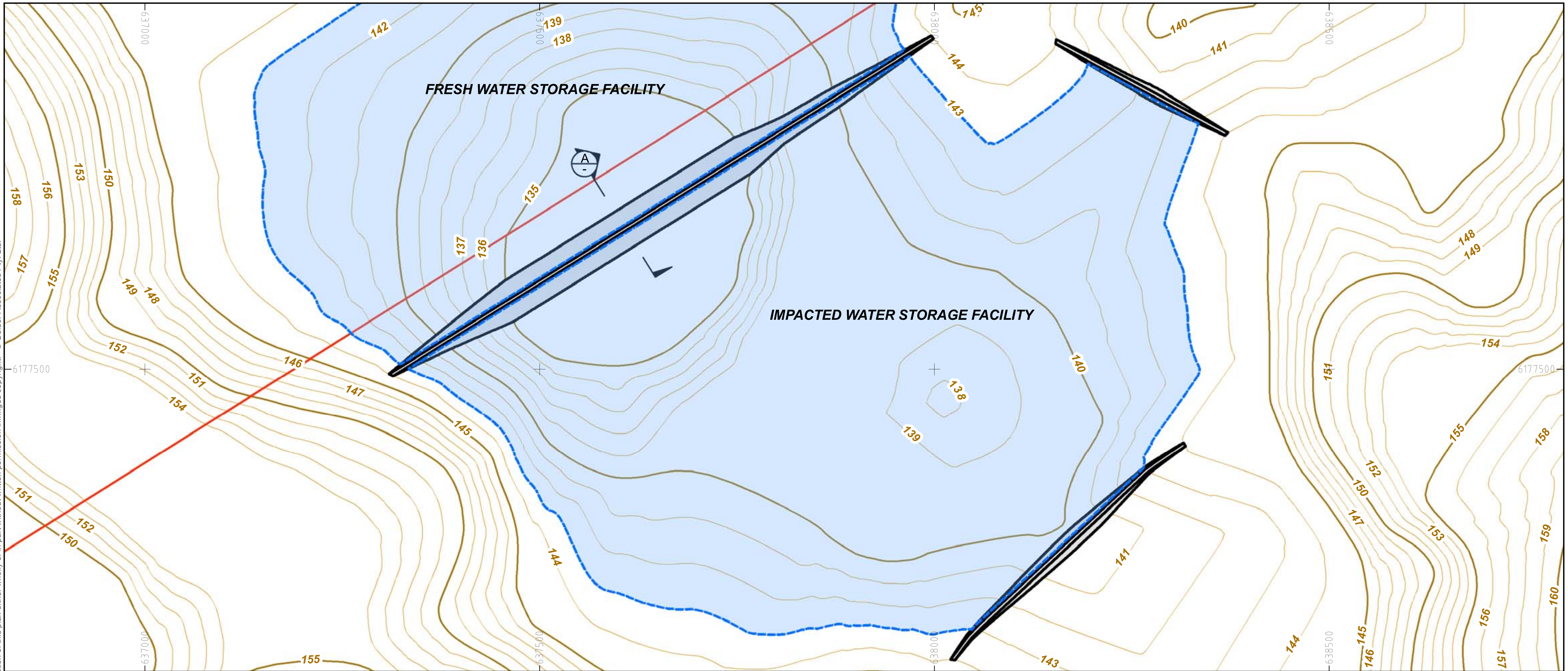

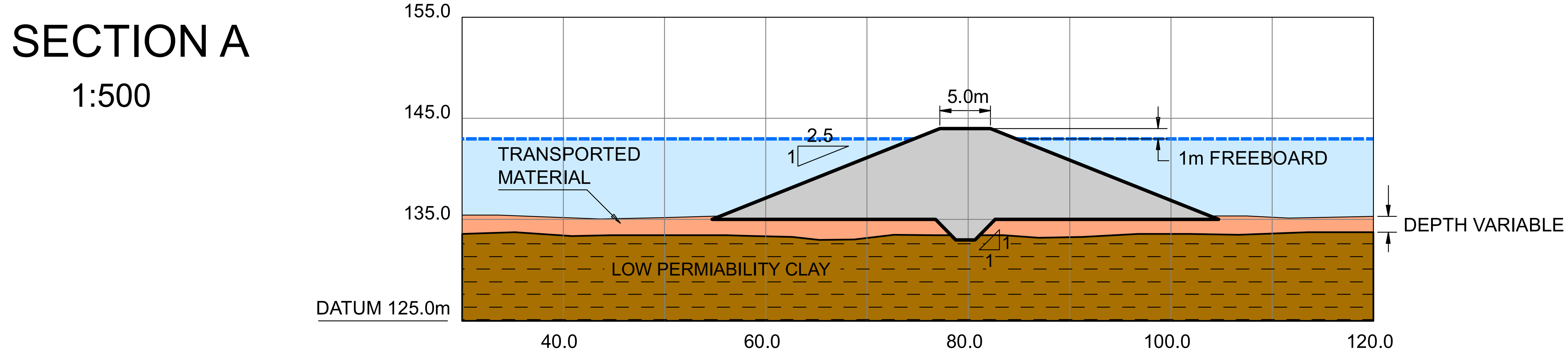

NOTE:
1. Datum GDA94, Projection MGA94, Zone 50.

CLIENT GRANGE RESOURCES Ltd		PROJECT Southdown Iron Ore Project	
DRAWN SR	DATE 03/10/2006	TITLE CONCEPTUAL WATER STORAGE FACILITY DESIGN	
CHECKED JJV	DATE 03/10/2006		
SCALE 1:5,000	A3	PROJECT No 05641009-8000-TM03	Figure 5.17

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Section 5.7 Legal Requirements

Section 5.7.1 Federal Government Assessment

The Albany Iron Ore Project is subject to Federal Government environmental approvals (in conjunction with State Government approvals) if rare and / or protected flora and fauna are impacted by the Project. Rare and/ or protected flora and fauna species are protected under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)* for the Commonwealth of Australia and the *Environmental Protection Act 1986* for the Western Australian Government. This is discussed further in Section 2.1.3.

The Southdown Magnetite Proposal has been referred to the Department of Environment and Heritage (DEH) under Part 3 of the *EPBC Act 1999* as it has the potential to interface with two listed threatened fauna species, the Carnaby's (Short-billed) Black Cockatoo (*Calyptorhynchus latirostris*) listed as Endangered under the *EPBC Act 1999*, and the Western Ringtail Possum (*Pseudocheirus occidentalis*) listed as Vulnerable under the *EPBC Act 1999*. The referral was considered under the *EPBC Act 1999* and the Southdown Magnetite Proposal was deemed to be a controlled action for Carnaby's Cockatoos on the 16th February 2006. Approval is therefore required under Part 9 of the *EPBC Act 1999* before actions potentially impacting Carnaby's Black Cockatoo can proceed.

Section 5.7.2 State Government Assessment

The Southdown Magnetite Proposal has been formally referred to the Western Australian Environmental Protection Authority as part of the Albany Iron Ore Project under *Part IV* of the *Environmental Protection Act 1986*, to undergo formal environmental impact assessment. The Project is subject to approval from the Minister of State Development, and the Director Environment under provisions of the *Mining Act 1978.*

Subsequent to approval from the State Minister of Environment, various works approvals and licenses will be required for construction and operation of prescribed premises under *Part V* of the *Environmental Protection Act 1986.* These are outlined below for different components of the Project.

Mine processing plant, tailings storage facilities, sewerage facilities

Works approvals may be required for the following work dependent on scale:

- mineralised material processing;
- mine dewatering;
- screening and crushing of mineralised material;
- bulk material loading with a closed materials loading system (at Port facilities);
- class II or III putrescible landfill sites (if required); and
- bulk storage of chemicals.

A licence to operate will also be required for the ore processing works.

A Mining Proposal will be submitted to the DoIR under the *Mining Act 1978* to obtain the written approval of the Director Environment. The Mining Proposal will assess the environmental impacts that may arise from the Project, determine their significance and detail management strategies. The Mining Proposal is a comprehensive environmental management document embodying all aspects of environmental risk and impact assessment, and environmental planning and management associated with the proposed Project.

Other approvals that will be required include:

- Application for a Licence to Store Explosives (Magazine Licence)/ Notification of Explosives Magazine Relocation.
- Application for a Licence to Store Dangerous Goods.

As vegetation clearing will be addressed as part of the *Part IV* of the *Environmental Protection Act 1986* EIA process, a clearing permit for the Project is not required.

Groundwater

The mine site and the pipeline route are not located within any Drinking Water Catchments, groundwater or surface water management areas proclaimed under the *Rights in Water and Irrigation Act 1914*.

Pipeline Construction

Construction and operation of the slurry and return water pipelines will come under the provisions of the *Mining Act 1978.*

As the proposed pipeline route crosses Vacant Crown Land, native title may exist in which case the relevant provisions of the *Native Title Act 1993* will apply. Under Section 253 of the *NTA* a pipeline is defined as an infrastructure facility in which case the proposal will be processed in accordance with Section 24MD(6A) and (6B) of the *Native Title Act 1993*.

Heritage

Heritage sites are protected at a Federal level under the *Australian Heritage Council Act 2003*, and at a State level under the *Heritage of Western Australia Act 1990.* No registered heritage sites will be removed, damaged or altered; however the *Heritage of Western Australia Act 1990* requires that any development matter pertaining to a place adjacent, behind or across the road from a registered place be referred to the Heritage Council as a development application.

The WA *Aboriginal Heritage Act 1972* requires that a Section 18 notice be lodged for any aboriginal sites to be impacted. Grange will lodge Section 18 applications in respect to the pipeline route once formal agreement with each landowner for the pipeline easement has been reached. Grange, on behalf of the existing landowners, will lodge Section 18 applications in respect to Lots 6832 and 6833 as soon as practicable.

Section 5.7.3 Local Government Assessment

An *Application to Construct or Install an Apparatus for the Treatment of Sewage* will be lodged through the City of Albany for approval by the Executive Director of Public Health (if required) prior to construction and installation of a package sewage plant.

An Application to Construct is not required for the mine site, however will be obtained for the gatehouse and ablutions at the administration area, plant and workshop.

Section 5.7.4 Land Use and Ownership

The various land uses in the area include residential, sheep and cattle farming, broad acre cropping, timber plantations, roads/road reserves, firebreaks, railway lines, rivers/creeks, national parks and nature reserves.

Mine Site

The proposed mine site is situated over freehold Crown Grant Lots 6832 and 6833, the property of Peter Morrell Diprose and Marlene Diprose. A Consent and Option Agreement dated 18 October 2004 has been made between Grange and the Peter and Marlene Diprose. Under the terms of the agreement Grange has an option to purchase the land.

Pipeline

Land access has been sought by permission and agreement with landholders. Negotiations for pipeline easement are currently in progress. Grange will provide compensation to land owners as appropriate to the extent of land affected.

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Section 6 The Project Environment

Section 6.1 Climate

The closest meteorological recorded station to the Southdown Magnetite Deposit is at Mettler, approximately 7 km to the south-east of the deposit. The proposed slurry pipeline passes within one kilometre of another meteorological station at the Albany Airport. Regular climatic conditions recorded at Albany Airport and Mettler are considered representative of the Project area and are summarised in Table 6.1and Table 6.2.

Albany has a Mediterranean-type climate with generally warm summers and cool, wet winters. Situated on the southern coast of WA, a major factor influencing Albany's climate is the Southern Ocean which imparts a moderating influence via sea breezes in the warmer months and more generally through the effects of a relatively mild and moist air-mass at any time of the year (Bureau of Meteorology, 2005).

The mean maximum temperature at Albany Airport peaks in summer with January and February averaging almost 25°C. Northerly summer winds can also result in daily temperatures above 35°C. Albany's mean minimum temperature also peaks in summer at 14.3°C. Winter daily maximum temperatures average approximately 16°C, while the average minimum is approximately 7.5°C in July and August. Daily minimum temperatures below 5°C can be expected about once or twice a month in winter (Bureau of Meteorology, 2005). Temperature ranges at Mettler do not vary significantly to those experienced at Albany.

The average annual rainfall at Albany Airport is around 800 mm. This varies throughout the Albany region, associated with topography and proximity to the coast. Mean monthly rainfall varies at Albany from 23.3 mm in February to 122.5 mm in July. Rainfall at Mettler is markedly lower than at Albany, with almost 200 mm less precipitation and 15 less rain days.

Table 6.1 Climate Averages for Mettler.

Lat: -34. 5961 S				**Long: 118.5519 E**			**Commenced: 1966**		**Last record: 2004**			**Elevation: 120.0m**	
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Mean daily max. temp (deg C)													
	25.2	24.9	24.0	22.0	19.3	17.0	16.2	16.4	17.8	19.7	21.7	23.8	20.7
Mean daily min. temp (deg C)													
	13.1	13.8	12.5	10.5	8.5	6.9	6.3	6.1	6.7	8.1	9.9	11.7	9.5
Mean Rainfall (mm)													
	28.2	29.3	38.7	44.3	66.3	63.8	71.8	70.0	60.5	56.0	44.0	30.3	603.0
Mean no. of rain days													
	7.0	8.3	9.8	13.3	14.9	17.8	18.6	19.5	17.4	14.7	11.2	8.3	160.7

(Bureau of Meteorology, 2005)

Table 6.2 Climate Averages for Albany Airport.

Lat: -34.9414 S				**Long: 117.8022 E**			**Commenced: 1942**		**Last record: 2004**			**Elevation: 68.0m**	
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Mean daily max. temp (deg C)													
	24.8	25.0	24.0	21.9	18.9	16.6	15.8	16.0	17.3	18.7	20.8	23.2	20.2
Mean daily min. temp (deg C)													
	13.6	14.3	13.4	11.7	9.8	8.2	7.5	7.4	8.0	9.0	10.7	12.5	10.5
Mean Rainfall (mm)													
	24.2	23.3	31.8	56	95.2	103.2	122.5	109.3	87.2	74.6	45.1	26.6	798.9
Mean no. of rain days													
	8.3	8.1	10.8	13.8	17.2	19.1	20.6	20.7	18.4	15.7	12.8	9.5	174.9

(Bureau of Meteorology, 2005)

Section 6.2 Bioregions and Major Physiographic Units

Section 6.2.1 Bioregions

The Project area occurs in the South-west Botanical Province and is situated within two biogeographic regions (Environment Australia, 2000). The mine site will be located within the Western Esperance Plains (ESP-1) Fitzgerald IBRA (Interim Biogeographic Regionalisation for Australia) sub region, and the pipeline infrastructure traverses both this sub region and the Southern Jarrah Forest (JF 2) region (Figure 6.1). The JF 2 region is described by Thackway and Cresswell (1995) as:

"a duricrusted plateau of Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by Marri-Wandoo woodlands on clayey soils. Eluvial and alluvial deposits support Agonis shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. The climate is warm Mediterranean."

The ESP-1 region is described by Thackway and Cresswell (1995) as:

"Characterised by Proteaceous scrub and mallee heaths on sandplain overlying Eocene sediments; rich in endemics. Herbfields and heaths (rich in endemics) on abrupt granite and quartzite ranges that rise from the plain. Eucalypt woodlands occur in gullies and alluvial foot-slopes. The climate is warm Mediterranean."

Processes threatening these regions include loss of fauna habitat due to land clearing for the purpose of agriculture, grazing, timber plantations, the introduction of predatory exotic fauna species and introduced diseases. Weed proliferation, loss of biodiversity due to extensive plantation timber production and the increased incidence of extensive wildfires caused by climate change and/ or inappropriate fire regimes are also threatening processes in the region.

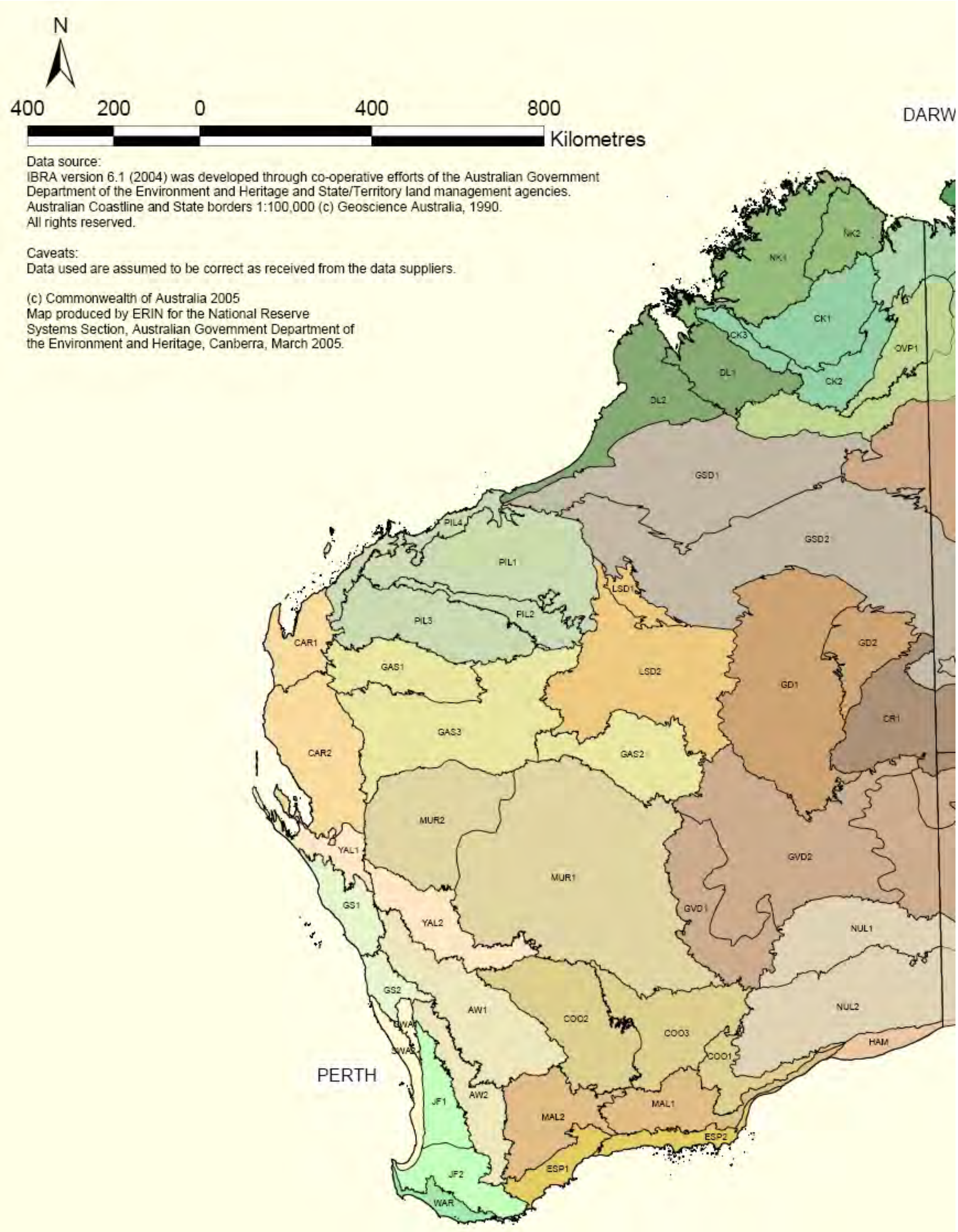

Figure 6.1 Interim Biogeographic Regionalisation for Australia (IBRA): Sub-regions of Western Australia.

6. THE PROJECT ENVIRONMENT

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Section 6.2.2 Botanical Districts

Within a botanical context, the Southdown Magnetite Proposal lies within the Darling and Eyre botanical districts (Beard, 1979). These botanical districts are divided into vegetation systems in which a typical vegetation occurs. The mine is located within the Cape Riche vegetation system and the pipeline traverses the Cape Riche, East Kalgan, Narrikup and Albany vegetation systems (Figure 6.2).

The Cape Riche vegetation system is composed predominately of Mallee heath (*Eucalyptus marginata*) with large patches of Jarrah/ Marri woodland also occurring in the area. Small depressions contain *E. decipens* or *E. occidentalis* with sedges and *Hakea varia* occurring in wetter swamps (Beard, 1979).

Lying mostly east of the Kalgan River System, the East Kalgan Vegetation system is the eastern extremity of the Darling Botanical District and is transitional to the adjoining Eyre District. The landscape is a plain, mostly poorly drained and dotted with small freshwater lakes and swamps. The vegetation is a mosaic of Jarrah/ Marri forest (in western areas), Jarrah low forest (northern areas), Jarrah/ Casuarina (southern areas) and Jarrah Mallee heath (eastern areas). The northern and eastern boundaries of the system lie along a gradual transition from woodland to Mallee-heath (Beard, 1981).

Figure 6.2 Botanical Districts, Sub-districts and Vegetation Systems in the Albany Region.

The Narrikup system (Figure 6.2) extends inland of the Albany system, from Oyster Harbour and the Kalgan River continuing north-east to Mt Barker. The system lies upon a plain with few lakes and swamps. Jarrah/ Marri forest was almost continuous throughout this area prior to European settlement. Consequently Jarrah/ Marri communities dominate remnant vegetation. Small patches of Banksia woodland occur in sandier areas. Towards the Kalgan plains patches of *E. tetragona* Mallee heath occur, and towards the east and south are increasing patches of Jarrah and Jarrah/ Casuarina low forest. On the dissected country of the Kalgan River Jarrah/ Marri forests occur with swamps containing paperbark and teatree (*Melaleuca cuticularis, M. densa*) (Beard, 1979).

The Albany system stretches from the Wilson Inlet to Oyster Harbour and inland towards Narrikup, including the city of Albany. The area is a plain entrenched by streams draining south and east in flatbottomed valleys, with granite domes occurring north of Princess Royal Harbour and near the King River. The vegetation is composed of Jarrah/ Casuarina low woodland in sandy areas and Jarrah/ Marri forest on the steeper slopes of the valleys.

At the proposed mine site, vegetation within the main remnant has been described as 'mallee-heath', (Figure 6.3) defined by an open mallee canopy to approximately 2-3 m tall, above closed understorey heath. *Eucalyptus marginata*, *E. tetragona* and *E. incrassata* were represented as stunted mallees, interspersed throughout the main remnant. The understorey showed high diversity, with a variety of life forms represented. Common genera present as mid-tall shrubs included *Hakea*, *Dryandra*, *Banksia* and *Xanthorrhoea*, with myrtaceous low shrubs and sedges *(Lepidosperma)* providing the lower stratum.

Legend:

$e_{26}SZc$	Open eucalypt shrubland with heath ground layer, *E. tetragona.*
e^5_7Mi	Mallee with patches of woodland, *E. wandoo* and *E. occidentalis.*
e^c_7Mi	Mallee with patches of woodland including *E. loxophleba and E. occidentalis.*
$e^2_{35}Mi$	Marri and/or wandoo woodland *E. calophylla – E. wandoo.*
ecLi	Jarrah and Jarrah-sheoak low woodland *E. marginata – casuarina fraserana.*
e_2Li	Jarrah and Jarrah-sheoak low woodland, *E. marginata*.
$e_{27}Si$	Eucalyptus shrubland *E. redunca* with teatree understory.
$e^{37}_{38}Si$	Eucalyptus shrubland *E. cornuta and E. lehmanni* with teatree understory.
xSZc	Mixed shrubs and heathland mainly *proteaceae – myrtaceae.*
xZc	Heath associations.
xSc	Thicket
e^2_3Mc	Jarrah-marri forest *E. marginata – E. calophylla.*
ecLi/ eSZc	Jarrah and Jarrah-sheoak low woodland, *E. marginata - casuarina fraserana.*

e_2SZc	Mallee heath.
e_7	*E. occidentalis.*
$e^2{}_3$	*E. marginata – E. calophylla.*
e_{26}	*E. tetragona.*
enSZc	Mallee heath community with heath ground layer including mixed eucalyptus species.
e_{38}Lc	Low forrest *E. lehmanni.*

Figure 6.3 Vegetation Communities of the Greater Project Area (from Beard 1981).

Section 6.3 Geology and Soils

Section 6.3.1 Mine Site Geology

Regional Geology

The Southdown Deposit occurs within the Biranup Complex of the Albany-Fraser province (Figure 6.4), a belt of amphibolite to granulite facies Archaean and Proterozoic metamorphosed granites, gabbros and sediments (Myers, 1990). The quartz-magnetite gneisses and granulites that comprise the deposit are hosted by a quartz-biotite dominant meta-sedimentary and migmatite assemblage that displays strong post-deformation recrystallisation.

6. THE PROJECT ENVIRONMENT

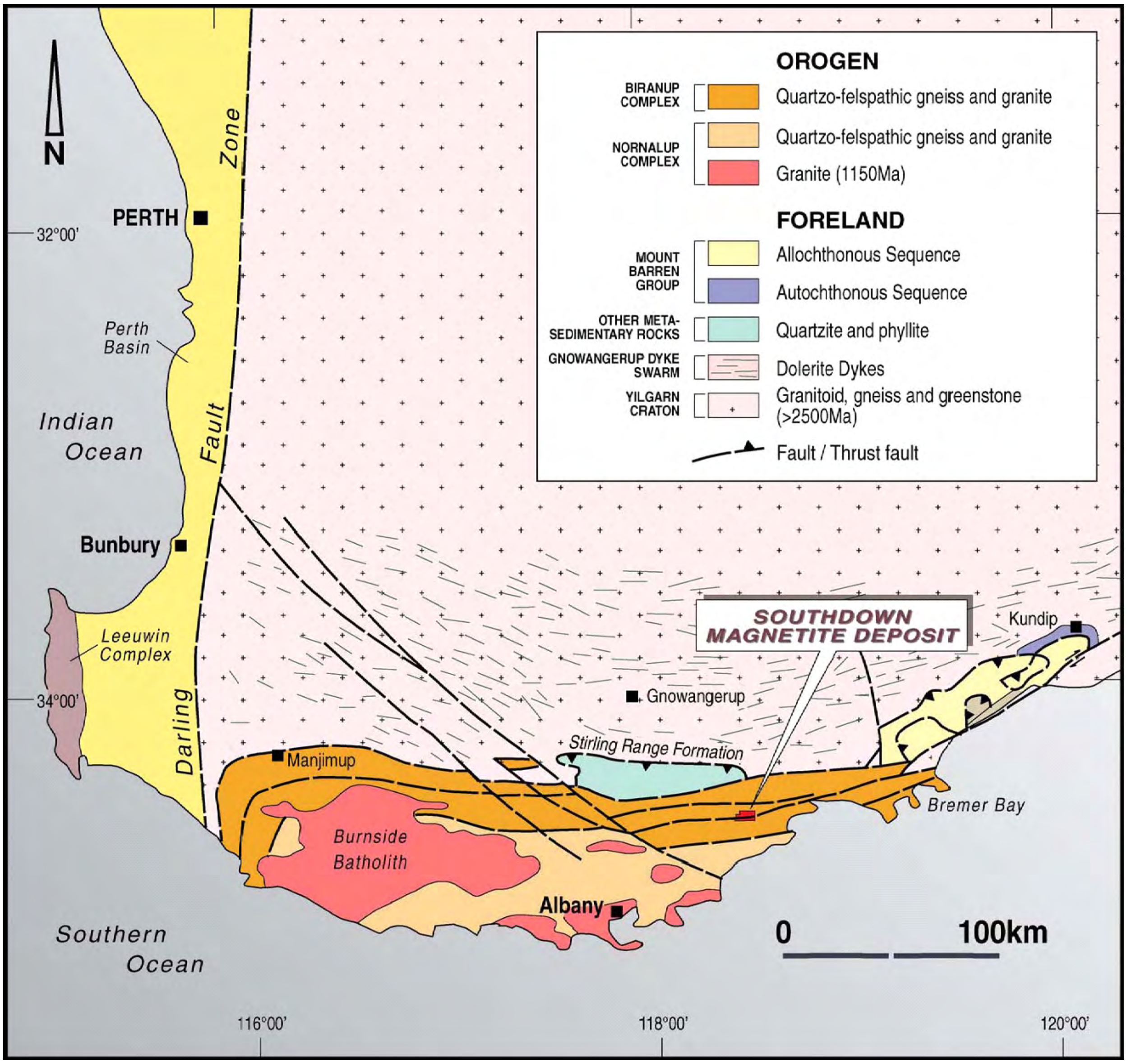

Figure 6.4 **Simplified geology of the Albany-Fraser Orogen (after Myers, 1990).**

6. THE PROJECT ENVIRONMENT

Geology of the Southdown Magnetite Deposit

The Southdown deposit consists of quartz-magnetite-clinopyroxene gneiss interbanded with feldspar-pyroxene-magnetite gneiss, quartz-garnet-orthoclase gneiss and quartz-feldspar-orthopyroxene-garnet gneiss. The deposit is hosted by quartz-feldspar-orthopyroxene-biotite gneiss interbanded with feldspar-pyroxene-magnetite gneiss. Oxidation of the deposit is typically limited to the upper 5 – 20 m. The magnetite mineralisation extends a further 6 km east of the current mining leases (Figure 6.5).

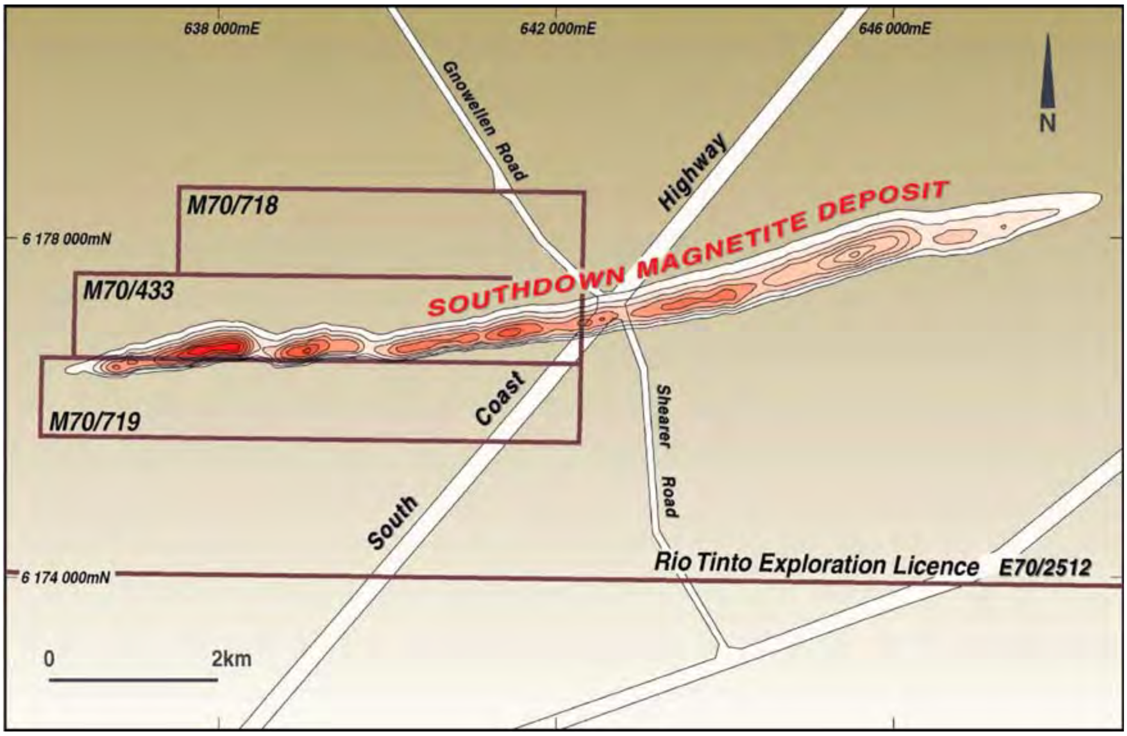

Figure 6.5 The Southdown Magnetite Deposit.

The Southdown deposit occurs within a gently east-plunging, overturned tight to isoclinal syncline with a steeply south dipping axial surface. The deposit is approximately 85 m wide and has been demonstrated to be open to depths of 460 m below surface. Southdown is offset by moderately north-east dipping dextral reverse faults and subsidiary steeply south-east dipping sinistral faults. Late brittle reactivation of the moderately north-east dipping faults has resulted in zones of dense fracturing and crushing.

The deposit is unconformably overlain by a 20 – 50 m thick sequence of siltstone, sandstone, spongolite and conglomerate ascribed to the Late Eocene Pallinup Formation.

Section 6.3.2 Soils

There are many soil types in the Albany area. Associated with numerous granite outcrops in the area are granite loams as the rock erodes. The soils of the Albany catchment are described as (WRC, 1999):

"well-drained gravels and loams in the soapstone country, with sandy gravels and hill soils. Other areas have seasonally waterlogged gravels and loams, with clay and shallow sand over clay. Waterlogged sands tend to be acidic, and peaty sands are very acidic. There are also areas of deep sands, and the catchment has laterite ridges and granite outcrops. Many of the soils have been formed on highly weathered parts of the sediments, and are very infertile."

Albany Foreshore

Soils along the Albany foreshore have been described as sand varying in coarseness and colour ranging from cream and brown to red and yellow. Some areas had brown topsoil, while shelly, gravely and clayey soil patches were also found (ERM Mitchell McCotter Pty Ltd, 1995).

Reclamation of the foreshore began in the late 1940's using fill material of varying types and quality. In general land to the west of the Albany Port consists of a mixture of industrial and domestic wastes, dredged sediments, building rubble and coal fired boiler wastes from shipping operations.

Acid Sulphate Soils

The term 'acid sulphate soil' is used to describe naturally occurring soil or sediment containing iron sulphides and/or other sulphidic minerals in low lying areas under waterlogged or highly anaerobic, reducing conditions. These soils may be at depth within the soil profile, or close to the surface. Many WA peat deposits contain sulphides and high levels of arsenic and heavy metals, and are predominantly inundated by groundwater of high iron concentrations. When these soils are oxidised through exposure to air, sulphuric acid is produced when the soil's capacity to neutralise the acidity is exceeded (DoE, 2003). Actual acid sulphate soils or sediments contain sulphidic minerals that have been oxidised and have a soil pH 4 or less (DoE, 2003). Potential acid sulphate soils contain sulphidic minerals that have not been oxidised, and are not known to be associated with environmental problems in their undisturbed state (DoE, 2003).

Developments in acid sulphate soil risk areas that involve aeration of acid sulphate soils through excavation, lowering the water table, or laterally displacing previously saturated sediments may result in soil, groundwater and/or surface water acidity and the associated release of metals and precipitates. Areas where acid sulphate soils are likely to be present include:

- land with elevation less than 5 m;
- coastal alluvial valleys;
- soil and sediment of recent geological age;
- tidal lakes and marine or estuarine sediments; and
- low lying coastal wetlands or waterlogged areas.

A desktop survey (URS, 2005) has identified portions of the pipeline route as high risk of actual acid sulphate soil and potential acid sulphate soil occurring less than 3 m from the surface (Figure 6.6). These areas are where the pipeline enters Albany townsite from the west along Hanrahan Rd and Lower Denmark Rd/ base of Roundhay Rd or the Public Transport Authority's Rail Corridor, and along the northern shore of Princess Royal Harbour. Drainage lines into the King and Kalgan Rivers have been identified as moderate to low risk of potential and actual acid sulphate soils generally occurring at depths greater than 3 m from the surface (Figure 6.6).

Section 6.3.3 Contaminated Sites

A desktop survey identified no contaminated sites within the mine site footprint. The Phase 1 Environmental Site Analysis (Technical Appendix 13.6) identified contaminated sites along the Albany foreshore and assigned risk rankings for potential impact to the pipeline corridor. The proposed pipeline route intersects Location 9, the Former and current railway depot (Westrail) to the north of Princess Royal Drive. Other contaminated sites identified are varying distances away from the pipeline corridor. The contaminated sites identified and risk rankings are summarised in Table 6.3 and mapped over the pipeline route in Figure 6.7.

Table 6.3 Contaminated Sites and Risk Rankings for Potential Impact to the Pipeline Corridor.

Location No.	Sites of Known Existing Contamination	Activities of potential concern	Potential Contaminants of Concern	Risk ranking (High, Med, Low)	Proposed Sampling Strategy and Locations
2	Vital foods facility immediately adjacent to the proposed Grange port facilities.	Production of food products for over 30 years. Although essentially a clean operation, storage of hydraulic oils and potentially solvents over a number of years increases the potential for impacts to soil and groundwater from operations. Vital foods is located immediately adjacent to the Grange port facilities and proposed pipeline route.	petroleum hydrocarbons, volatile organic carbons and metals	**Medium**	Phase 2B: 3 test pits to 3 m below ground level (bgl) at 50 m centres with allowance for 2 groundwater grab samples.
1	Caltex/ Shell Depots to the north of the Port area and associated pipelines/ pumping stations.	Storage and distribution of petroleum products over 30 years. This includes the distribution pipelines running across the easement corridor. The main tank farm appears to be unlined suggesting that any spills will drain freely into the underlying soil. Although both sites are 100-200 m from the pipeline route, both depots are located up topographic and up-hydraulic gradient from the proposed route, with the potential for sub-surface petroleum to migrate from the tank farms into the proposed easement corridor.	petroleum hydrocarbons, benzene, toluene, ethyl-benzene, xylenes, volatile organic carbons, semi-volatile organic carbons, metals, pH	**Medium - High**	Phase 2B: ten test pits to 3 m bgl at 10 m centres with allowance for 10 groundwater grab samples.
3	Former Bothwicks meat works adjacent to Belches Place.	This area is a known area of soil and shallow groundwater contamination. The area is located up-topographic and up-hydraulic gradient from the proposed pipeline route. It is not known how far the petroleum impacted groundwater extends to the south.	petroleum hydrocarbons, poly aromatic hydrocarbons and metals.	**High**	
5	Summit Fertiliser facility to the south of Princess Royal Drive.	This site is located near the proposed pipeline route, however there were no drum storage areas or areas of staining identified during site reconnaissance.	petroleum hydrocarbons, benzene, toluene, ethyl-benzene, xylenes, volatile organic carbons, semi-volatile organic carbons, metals, pH	**Medium**	

Location No.	Sites of Known Existing Contamination	Activities of potential concern	Potential Contaminants of Concern	Risk ranking (High, Med, Low)	Proposed Sampling Strategy and Locations
4	PTT and Toll woodchip facilities to the south of Princess Royal Drive.	The wood chip facilities are essentially clean operations, with moderate storage and use of hydraulic oils. The site is located to the south of the pipeline route. Although there may be some northward migration of groundwater due to tidal influences, this operation is not considered significant.	Low risk. No sampling proposed.	**Low**	No Sampling Proposed.
6	CBH facility in the Port area, to the north of Princess Royal Drive.	The CBH facility has been in existence for over 30 years. The facility is located north of the proposed pipeline easement. Although an essentially clean operation (grain storage and distribution), there is limited potential for petroleum products to have been introduced to the sub-surface from operational spillages or poor management practices over the years.	petroleum hydrocarbons, benzene, toluene, ethyl-benzene, xylenes, volatile organic carbons, polychlorinated bi-phenyls	**Low - Medium**	Phase 2B: ten test pits to 3 m bgl at 20 m centres (low frequency due to moderate likelihood of impact) with allowance for ten groundwater grab samples.
7	Cold storage and incinerator – historical fuel pumping station.	These facilities are located more than 25 m south of the proposed pipeline route and are currently disused. Historical plans show a petrol pump house located to the north of the of the cold storage facility. This is 10 m south of the proposed pipeline route. Due to the potential proximity of the petrol pump house to the easement corridor and the fact that historically pumping stations have routinely had spillages, there is potentially some contaminated material still present in the area. The likelihood is considered low due to the age of any spill (the facility appears to have been decommissioned over 30 years ago).	Low risk. No sampling proposed.	**Low**	No sampling proposed.

Location No.	Sites of Known Existing Contamination	Activities of potential concern	Potential Contaminants of Concern	Risk ranking (High, Med, Low)	Proposed Sampling Strategy and Locations
8	Former City of Albany landfill on the foreshore.	This is an area of know soil and groundwater contamination. The proposed pipeline route passes immediately to the north and potentially up-hydraulic gradient from the area of contamination. The site will be remediated as part of the planned Foreshore Redevelopment Strategy.	petroleum hydrocarbons, volatile organic carbons, semi-volatile organic carbons, metals, pH, asbestos, polychlorinated bi-phenyls	**Medium**	Phase 2B: 5 test pits to 3 m bgl at 20 m centres (low frequency due to existing contaminant [historic] information) with allowance for ten groundwater grab samples.
9	Former and current Railway Depot to the north of Princess Royal Drive.	The former Westrail depot is a known area of hydrocarbon contamination. There is also a current re-fuelling facility for diesel locomotives located adjacent to the proposed pipeline route.	petroleum hydrocarbons, benzene, toluene, ethyl-benzene, xylenes, phenols, metals, asbestos, pesticides, creosote	**High**	Phase 2A: ten test pits to 3 m bgl at 25 m centres (low frequency due to existing contaminant [historic] information) with allowance for ten groundwater grab samples.
10	Former gasworks and cannery to the west of the former Railway Depot.	This is a known area of significant soil and groundwater contamination. The investigation showed that groundwater extends to the seaward edge of Princess Royal Drive, in the proposed location of the pipeline route.	petroleum hydrocarbons, volatile organic carbons, semi-volatile organic carbons, metals and cyanide, creosote	**High**	No proposed works if reliance can be obtained on recent ERM investigation report.

<table>
<tr><th>Location No.</th><th>Sites of Known Existing Contamination</th><th>Activities of potential concern</th><th>Potential Contaminants of Concern</th><th>Risk ranking (High, Med, Low)</th><th>Proposed Sampling Strategy and Locations</th></tr>
<tr><td>11</td><td>CSBP facility located to the west of Mount Melville.</td><td>The current CSBP facility is located to the north of Lower Denmark Rd and extends from Hanrahan Rd to the east, to within 200 m of Roundhay Rd to the west. The facility has been in operation for over 50 years and has been identified as the source of significant pollution events in Princess Royal Harbour. The main areas of concern in the past have been associated with the drainage systems taking surface and grey water from the facility to Princess Royal Harbour in the south. The proposed pipeline route along the Rail Corridor is immediately adjacent to the drainage area/ ditches associated with the CSBP facility.</td><td>petroleum hydrocarbons, volatile organic carbons, semi-volatile organic carbons, pH, metals, semi-volatile organic carbons, calcium phosphate, calcium sulphate, nitrates</td><td>High</td><td rowspan="3">Phase 2B:
3 test pits to 3 m bgl at the junction of Hanrahan Road and Lower Denmark Road, with allowance for 3 groundwater grab samples.
ten test pits along Hanrahan Road to 4 m bgl at 50 m centres with allowance for 5 groundwater grab samples.
20 test pits along Lower Denmark Road at 20 m centres to between 2 to 3 m bgl, with allowance for 20 groundwater grab samples</td></tr>
<tr><td>12</td><td>Current City of Albany landfill (Hanrahan Rd landfill).</td><td>The current City of Albany landfill is a known area of contamination associated with leachate migration through the groundwater and surface water drainage issues. The landfill is located on the eastern edge of Hanrahan Rd, but extends south almost to the junction with Frenchman Bay Rd, Lower Denmark Rd.</td><td>semi-volatile organic carbons, pH, metals, organochlorine and organophosphate pesticides, calcium phosphate, calcium sulphate, nitrates</td><td>High</td></tr>
<tr><td>13</td><td>Ideal Business park to the south of Lower Denmark Rd.</td><td>The business park is located to the south of Lower Denmark Rd, with the surface water drainage ditches discharging to the main drainage ditch located on the southern edge of the road. It is not known when the park was developed, or its current use, with a number of buildings appearing vacant during the site reconnaissance. The potential for site sourced contamination to impact the pipeline route is not considered to be significant.</td><td>semi-volatile organic carbons, pH, metals, organochlorine and organophosphate pesticides, calcium phosphate, calcium sulphate, nitrates</td><td>Low</td></tr>
</table>

6. THE PROJECT ENVIRONMENT

Location No.	Sites of Known Existing Contamination	Activities of potential concern	Potential Contaminants of Concern	Risk ranking (High, Med, Low)	Proposed Sampling Strategy and Locations
14	Former Sales Yard adjacent to Roundhay Rd.	The former sales yard is located immediately to the north of the Rail corridor and to the immediate west of Roundhay Rd. Anecdotal evidence from the City of Albany suggests that this area is contaminated with nutrients. A car/ general metal scrap yard also exists to the east of Roundhay Rd, north of the proposed pipeline route. This area is also a suspected acid sulphate impacted area due to the predominating ground conditions.	petroleum hydrocarbons, metals, organochlorine and organophosphate pesticides, pH, polychlorinated bi-phenyls, volatile organic carbons	**High**	5 test pits to be advanced along Lower Denmark Road to the south of the former Sales Yard and up to 5 test pits in the region of Roundhay Road (potential pipe route) with allowance for ten groundwater grab samples.

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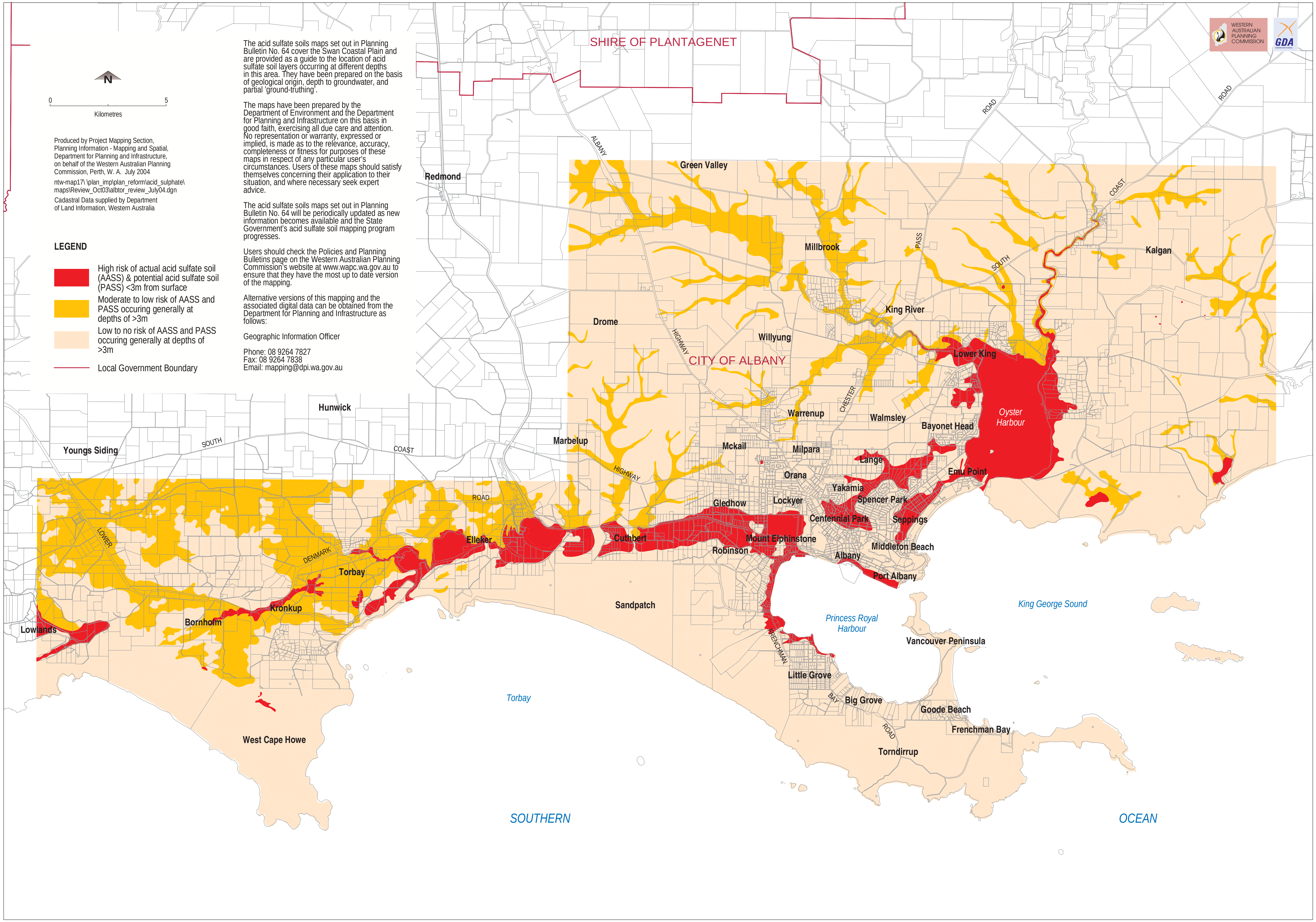

Planning Bulletin No. 64. Figure 6.6

Albany-Torbay Acid Sulfate Soils

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Proposed Pipeline Routes

Identifies Areas of Potential Concern

N

0 25 50 75 100m

(Approximate Scale)

Source: Harley Survey Group

Client	Project	Title
Grange Resources Ltd	SOUTHDOWN MAGNETITE PROJECT	IDENTIFIED AREAS OF POTENTIAL CONTAMINATION
URS	Drawn: AM / Approved: JG / Date: 7/4/2006	Figure 6.7
	Job No.: 42906009 / File No.: 42906009F3RC.dgn	Rev. C / A3

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Section 6.4 Topography and Surface Drainage

Section 6.4.1 Regional Topography and Surface Drainage

The Stirling Ranges dominate the topography of Albany-Mt. Barker District, with the rest of the area consisting essentially of a sand plain overlying a shallow basin of sedimentary strata that descends gradually from about 200 m AHD in the north-west to 50 m AHD in the south-east along the coast. Wetlands lie between the sand plain and the coastal fringe where hills of dune sand, limestone, and bedrock reach from sea level up to elevations of 100 m.

Ephemeral lakes develop in topographic depressions and provide sources of water for infiltration and aquifer recharge. Where the substrate is clayey however, the rate of infiltration would be very low (Rockwater, 2005a).

Rivers in the region generally flow in a southerly or south-westerly direction and discharge into estuaries, most of which are permanently or intermittently closed to the ocean. The Southdown Magnetite Proposal footprint passes through two water catchments, the Albany Eastern Hinterland Catchment and the Albany Harbours Catchment. Within the Albany Harbours Catchment there are two major rivers which the proposed pipeline will cross. These are the King and Kalgan Rivers. Within the Albany Eastern Hinterland Catchment the pipeline passes in the vicinity of the Sister Wetland group and associated reserves.

The King River is a freshwater drainage system flowing south-east through low pastoral land with fringes of sedges (*Juncus kraussii*) and Paperbark trees (*Melaleuca cuticularis*). The river terminates at Oyster Harbour and is estuarine for 7 km from its mouth to where it is joined by Mill Brook, an upstream freshwater tributary. There are granite outcrops in the river near the Upper King Bridge, and a wide deltaic area of salt marsh and intertidal sand flats upstream from the King River mouth (WRC, 1999). Despite heavy clearing within the catchment, the water remains fresh. Most of the main channels are either habitat rivers or agricultural drains, except for Mill Brook which is relatively natural and intact (WRC, 1999).

The Kalgan River flows all year with water quality varying from marginal to brackish. The river has an elevated salinity caused by extensive clearing in the upper catchment, although the presence of salt tolerant fringing vegetation suggests that the salinity was probably always high (WRC, 1999).

Section 6.4.2 Site Drainage

Surface water catchments at the mine site are shown in Figure 6.8. Due to the undulating topography, the catchments are localised and do not significantly extend beyond the mine site boundaries.

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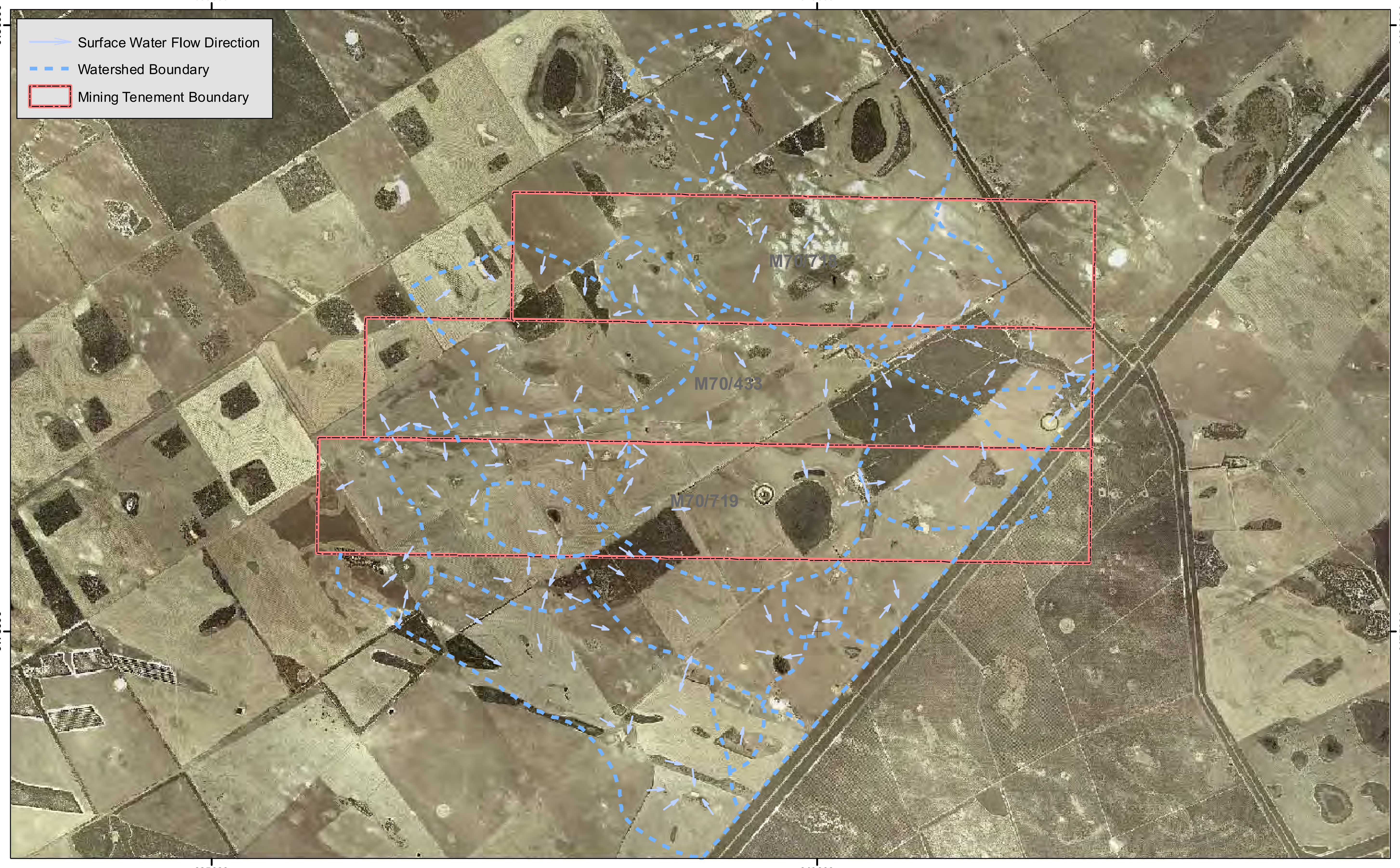

NOTE:
1. Base map copyright Mapinfo Australia Pty Ltd.
2. Datum GDA94, Projection MGA94, Zone 50.
3. Aerial photography provided by client

Golder Associates	CLIENT GRANGE RESOURCES Ltd			PROJECT Southdown Iron Ore Project
	DRAWN SR	DATE 03/10/2006		TITLE SURFACE WATER WATERSHEDS AND FLOW DIRECTIONS
	CHECKED JJV	DATE 03/10/2006		
Figure 6.8	SCALE 1:30,000		A3	PROJECT No 05641009-8000-TM03 — Figure 6.8

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Section 6.5 Hydrogeology

Section 6.5.1 Regional Hydrogeology

Aquifers

In the basement granites of the south coast, groundwater occurs in fractures in the upper parts of these rocks and also in weathered layers near the surface. Groundwater in this area occurs in small to moderate quantities and has an erratic distribution (WRC, 2001). The main aquifers in the area are the Pallinup Siltstone and the Werillup Formation of the Bremer Basin. These sediments infill a buried topography on the basement rocks and are a maximum of around 130 m thick. The basal Werillup Formation is concealed by the overlying Pallinup Siltstone (Aquaculture Groundwater Resource Atlas, 2005).

The Werillup Formation comprises dark clay, carbonaceous material, siltstone, and sand beds. It underlies the Pallinup Siltstone and extends to depths in the range 30 to 140 m. At the Southdown Magnetite Deposit, the bedrock is shallow and the superficial material would be either weathered bedrock or Pallinup Siltstone. In adjacent areas, bedrock deepens to more than 100 m and is overlain by Werillup Formation. Where the Werillup Formation contains several metres of coarse sand, in those localities where the unit is relatively deep, moderately large supplies of groundwater are available. The salinities of such groundwater in the Southdown-Werillup area exceed 5,000 mg/ L TDS. Water levels in the Werillup Formation are a few metres lower than those in the Pallinup Siltstone, and would slope downwards to the coast (Rockwater, 2005a).

Groundwater quality

The landscape is fairly flat and most of the rocks and their weathered products have low permeability, transmitting water slowly (less than 1 m/yr) regionally towards the south and locally from higher elevations before discharging into the rivers and sea (WRC, 1999). Salinity of groundwater at or below the water table (not shallow, perched groundwater) varies from fresh at the coast to extremely saline inland with levels as high as 15 000-20 000 mg/litre inland of Denmark and Albany (WRC, 2001).

High volume, fresh, reliable groundwater can be found along the southern coastal regions. This is where rainfall is the highest and various geological units sometimes occur in a combination which makes recharge, flow and storage highly effective. Coastal dunes built up on a basement high and then extending over a buried aquifer of limestone or sandstone, allow fast recharge of rain into the buried aquifer, which acts as the storage unit (WRC, 2001). The water for Albany and Bremer Bay town water supplies are extracted from such aquifers.

Section 6.5.2 Site Hydrogeology

In the vicinity of the Southdown Magnetite Proposal, two sub-basins of the Bremer Basin contain sedimentary strata including some spongolite and sand/ sandstone aquifers to depths of 140 m. The aquifers are part of the Werillup Formation and Pallinup Siltstone of the Plantagenet Group. One sub-basin is centred on Sunday Swamp, 25 km south-west of the deposit, and the other is near Wellstead, 7 km north-east of the deposit (Rockwater, 2005a).

Based on information obtained from the exploration boreholes completed within the deposit and three water wells installed at the Project site in support of the exploration programme (Golder 2005b), the water level at the Project site varies from about 9 m to 24 m below ground surface. This is consistent with the regional trend for the water levels within the sandplain area of this region. In the area of the ore body where the bedrock is near the ground surface, the main aquifer is located within the upper fractured bedrock zone, while to the north and south from the deposit the aquifer is located within the sand and spongolite deposits.

Based on the data from the three wells completed in February 2005, the shallow aquifer yields between 25 and 170 m^3/ day. The salinity in these wells was reported in the range of 3800 to 5500 mg/l TDS.

Baseline water quality data measured from bores SMB 5 to SMB 16 (Figure 8.4) is outlined in the Table 6.4.

Table 6.4 Summary of Baseline Water Quality Values at Bores SMB 5 to SMB 16.

Water Quality Parameter	Unit	Natural Range
pH Value	pH Unit	6.28 - 7.1
Electrical Conductivity @ 25°C	µS/cm	1760 - 12900
Total Dissolved Solids @180°C	mg/L	1340 - 11200
Hydroxide Alkalinity as CaCO3	mg/L	<1
Carbonate Alkalinity as CaCO3	mg/L	<1
Bicarbonate Alkalinity as CaCO3	mg/L	49 - 162
Total Alkalinity as CaCO3	mg/L	49 - 162
Sulphate as SO4 2-	mg/L	31 - 810
Sulphur as S	mg/L	10 - 270
Calcium	mg/L	18 - 257
Magnesium	mg/L	16 - 590
Sodium	mg/L	315 - 2860
Potassium	mg/L	12 - 131
Aluminium	mg/L	<0.01 - 0.05
Manganese	mg/L	0.036 - 0.681
Iron	mg/L	<0.05 - 4.74
Nitrite + Nitrate as N	mg/L	<0.010
Total Phosphorus as P	mg/L	0.04 - 1.33
Total Anions	meq/L	20 - 166
Total Cations	meq/L	20.1 - 169
Ionic Balance	%	0.18 - 3.83

Section 6.5.3 Proclaimed Water Reserves and Catchment Areas

Proclaiming Water Reserves and Catchment Areas under the *Country Areas Water Supply Act 1947* protects the quality of water sources in country Western Australia. The Act's by-laws enable the prevention or clean-up of pollution by allowing potentially polluting activities to be controlled and regulation and inspection of land use.

PDWSAs in the vicinity of the Project footprint include the Angrove Creek Catchment Area, The Marbelup Water Reserve, Lake Seppings Catchment Area and South Coast Water Reserve. The proposed Southdown magnetite mine site and Albany Port are not within any PDWSAs.

The proposed pipeline corridor is aligned adjacent to the South Coast Water Reserve however, does not enter the Reserve.

Section 6.6 Vegetation and Flora

The Project is located in agricultural land north-east of Albany. The majority of the survey area has been fully cleared of native vegetation since the 1960s for farming purposes. The flora and vegetation surveys undertaken for the Project were undertaken on the remnant blocks of native vegetation only. At the mine site, 14.8% of the proposed footprint is remnant native vegetation in 20 separate blocks. Of the 220 ha pipeline corridor, approximately 2.3% is remnant native vegetation.

Section 6.6.1 Previous Floristic Surveys

Beard (1981) mapped the pre-European vegetation of the South-west of WA (Figure 6.3) including the region comprising the Southdown Magnetite Proposal area. The mine site area lies across two vegetation communities mapped by Beard: Mallee Heath, and Jarrah/ Mallee Heath. The pipeline corridor traverses nine communities: Mallee Heath, Jarrah/ Mallee Heath, Jarrah/ Sheoak Low Woodland, Jarrah Low Forest, Jarrah/ Marri Forest, Jarrah/ Marri Low Forest, Marri Woodland, Reed Sedgeland, and Scrub Heath.

The Albany hinterland vegetation inventory (Connell and ATA Environmental, 2001) was commissioned by the City of Albany to provide strategic direction and guidelines to enhance future management of native vegetation. This study compiled a GIS database of the distribution (based largely on the broad scale mapping of Beard as detailed above) and condition of native vegetation in the area. It concluded that 43% of the original vegetation remained within the Albany hinterland. This remnant vegetation was distributed as:

- Two large upland blocks (Stirling Ranges National Park and Porongorups National Park).
- Several large coastal blocks (Torndirrup National Park, Gull Rock National Park, Two Peoples Bay Nature Reserve, Mount Manypeaks Nature Reserve and Waychinicup National Park).
- Many small isolated fragments over the central plains.

Despite the abundance of mountainous and coastal national parks and reserves, it was concluded (Connell and ATA Environmental, 2001) that about 50% of the broadscale vegetation units of the Albany hinterland were very poorly represented (<10% in ICUN reserves) in the conservation estate. A further 25% (approximately) of the vegetation complexes of the Albany hinterland were reported to be unrepresented in conservation reserves.

Apart from national park studies, fine scale vegetation mapping and flora surveys of the Albany region are limited to two studies west of the Kalgan River. These are a study of the Millbrook and Baker’s Junction Nature Reserves (Griffin, 1985) and a survey of the Parker Brook Recreational Reserve (Sandiford, 2005). East of the Kalgan River, the only systematic studies of the sandplain vegetation have been those commissioned by various tree farms to examine the small privately-owned remnant bushlands within their lands (Sandiford *pers. comm.*, 2006). The detailed data from these numerous studies are not publicly available apart from the records of the Priority Flora collections in these studies that have been lodged with the WA Herbarium and are available on the Herbarium’s public interface (FloraBase, 2006).

Section 6.6.2 Survey Methods and Constraints

Flora and Vegetation Survey

The survey methods adopted by *ecologia* were formulated in compliance with:

- Position Paper: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002).
- EPA Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys For Environmental Impact Assessment (EPA, 2004).
- Consultation with regional DEC staff and other relevant regulators.

The vegetation and flora of the proposed mine site and pipeline was surveyed in autumn, spring and summer 2005 - 2006, with fieldwork conducted in April, June, September and October, 2005 and February, March and October, 2006. A total of 77 person days was invested in the survey work (Table 6.5). During the spring, summer and autumn 2006 surveys, an assessment of the regional context of the vegetation and selected Priority Flora found within the footprint was undertaken to supplement information available from previous studies.

Table 6.5 Summary of Survey type, timing and duration.

SURVEY AREA	SURVEY DATE	# PERSON DAYS
Mine site	13-20 April 2005	16
	24-30 September 2005	10
	9 November 2005	1
Pipeline	9-14 June 2005	12
	2-5 October 2005	4
	12-13 November 2005	6
	9, 10, 12 October 2006	5.5
Regional	1 October 2005	1
	10-11 November 2005	2
	2-3 February 2006	4
	27-29 March 2006	6
	6-13 October 2006	9.5
	TOTAL	77

The objectives of the survey were to provide detailed baseline information on the terrestrial vegetation communities and flora species against which future impacts could be assessed. The field surveys involved both quadrat-based and opportunistic floristic sampling, targeted rare flora and declared weed surveys. They also involved the description and mapping of vegetation via the ground-truthing of aerial photographs and linked field traverses. The data matrix detailing the presence/ absence of species and their abundance in the quadrats was analysed by multivariate methods. This resulted in a classification of the vegetation types present on the mine site, with the vegetation types mapped. Voucher specimens of vascular flora species were collected where appropriate and identified using the current literature with reference to the WA Herbarium collection.

A regional assessment of vegetation communities within the vicinity of the mine site was conducted to determine the impact of clearing associated with the Project at a regional scale. A further targeted search was also conducted for the poorly known Priority Species *Commersonia* sp. Mt Groper (P1) within the mine site and in suitable habitat outside the mine site.

Floristic Survey Sites and Vegetation Description

The floristic survey and detailed vegetation description involved a combination of systematic flora sampling in quadrats. Linked traverses were made over the remaining areas not sampled using quadrats. Opportunistic records were also made of floristics during these traverses and additional flora specimens were collected as appropriate to supplement the inventory accumulated in the site- based survey.

Fifty-one quadrats were established within the mine site footprint, and 68 were established along the proposed pipeline footprint. The quadrat sites were chosen on the basis of topography, interpretation and ground truthing of aerial photographs and field observations of vegetation structure, floristics and condition.

At the mine site, a minimum of four replicates were sampled in each major vegetation assemblage to adequately sample the flora and vegetation structure. The entire pipeline was surveyed for flora. Due to the limited target area of the survey (50 m wide corridor), however, only one quadrat was established per vegetation type in each bushland remnant traversed by the pipeline. A 100 m^2 quadrat (nested within a 400 m^2 quadrat, the latter used to check over storey abundance) was established at each study site, and the following parameters, were recorded for each 100 m^2 quadrat:

- Location details, including GPS coordinates and a sketch map showing the position of the site to nearby landforms and roads.
- Site parameters such as topography, soils and surface lithology.
- Structural information describing the vegetation unit including the height, cover, form and dominant species within each (Muir, 1977; Keighery, 1994).
- Presence/ absence, maximum height and foliage projective cover for each species within the site, including introduced species.
- Vegetation condition based on criteria described by Keighery and Keighery (1993).
- The estimated time since the site was last burned.

Vegetation Classification and Mapping

Vegetation mapping is the delineation of plant communities into groups or associations. The distinctive characteristics that these groups or associations share include features such as species dominance, stratum structure and species composition.

Aerial photographs and topographic maps were used to interpret the vegetation patterns of the survey area, with interpretations verified using linked ground traverses and observations of dominant species and vegetation structure. Quadrat sites were selected to be representative of the vegetation types as interpreted from the photographs and field observations. Multivariate analysis of the site versus species (presence and abundance score) matrix was performed using the SYSTAT software package. The analysis provided a means of objectively verifying the patterns observed in the field in this complex and species-rich vegetation. The boundaries of the major vegetation units derived from the field observations and detailed site data analysis were then mapped onto a 1:25,000 aerial photograph of the area (Figure 6.10). This provides a visual summary of the extent of dominant floristic and structural elements over the entire mine site.

A field reconnaissance survey was conducted outside the Project footprint over the Pallinup Sandplain area between the Kalgan and Pallinup Rivers and south of the Stirling Ranges. This survey assessed the regional context and significance of the flora and vegetation types found in the Project areas, as this information was not available at an appropriate scale from previous studies of the area.

Targeted Rare and Priority Flora and Declared Weed Survey

Prior to the field survey, a search of the WA Herbarium and DEC Threatened Flora Databases was undertaken to determine the locations of flora previously recorded near the proposed development.

Areas not sampled using quadrats were surveyed using linked traverses. Linked traverses were conducted to target DRF and priority flora. These areas were traversed on foot, collecting voucher specimens of all species present not previously sampled in quadrats. The characteristics of the vegetation communities present were also noted.

Flora Survey Limitations and Constraints

An assessment of aspects potentially limiting the Southdown Magnetite Proposal flora and vegetation surveys is listed in Table 6.6 below.

The major factor constraining this survey was the lack of available contextual information with regard to the vegetation units of the Pallinup Sandplain at the fine scale needed to assess conservation significance in detail. This was overcome to some extent by drawing on local knowledge and unpublished data and by conducting additional field work outside the immediate footprint of the Project. However the special characteristics of the area (complex, species-rich vegetation fragmented over a large number of privately owned blocks) precluded a full comprehensive survey, classification, mapping and assessment of the vegetation units of the region. Additional regional vegetation assessments are in progress in consultation with DEC (Conservation Branch). Information from these assessments will be made available to the EPA before the completion of their proposal assessment. The information will also be made available on the Grange Resources Website.

Table 6.6 Flora and Vegetation Survey Constraints.

Aspect	Constraint	Comment
Scope	No	The survey scope was prepared in consultation with the DEC and other stakeholders and was designed to comply with EPA requirements.
Proportion of flora identified, recorded and/or collected	Negligible	822 taxa were recorded during the two phases of survey work (mine = 439 taxa; pipeline = 626 taxa). Approximately 3220 voucher collections were made during the two seasons of survey work, of which 3.2% could not be identified beyond genus level, and 0.1% could not be identified beyond family level. Unseasonal and high rainfall precluded collection of some wetland annuals. Species accumulation curves suggest that very high species richness and diversity in the vegetation over small distances may be a special characteristic of this vegetation but this aspect would be best explored outside the footprint (see completeness and further work below) as the footprint intensity of sampling was adequate.
Availability of contextual information (pre-existing background versus new material)	No	Note: Very few recent and systematic flora surveys and fine-scale mapping studies of vegetation have been carried out in the region outside the national parks which represent very different landforms, flora and vegetation to that of the footprint area. Previous data was often dated and thus taxonomically unreliable. More recent data was also at inappropriate scales, GIS data not always sufficiently ground-truthed and taxonomically unreliable. Some relevant privately-commissioned studies not freely available.
Completeness and further work which might be needed	Negligible	Note: Further work to map vegetation regionally at a fine scale and investigate floristic and vegetation diversity is desirable to assess the regional context of the vegetation in the footprint in more detail and provide additional information for the determination of offsets for the Project. A rare flora search of *Commersonia* sp. Mt Groper within and outside the footprint and one new population of approximately 50 to 100 plants was located in October 2006; further searching for this taxon may be required.
Timing/weather/ season/cycle	Negligible	The survey was commenced in late autumn before flowering and annual growth commenced and then continued in spring 2005 (Sept Oct Nov), late summer (early Feb), autumn (late March) and spring 2006 (early October). Unseasonal and heavy rain continued and many wetlands were inundated until late summer 2006 and beyond.
Disturbances which affected results of survey	Negligible	Some of the vegetation within the assessment area on the mine site was removed or disturbed between the autumn and spring visits by exploration and drilling works.
Intensity (in retrospect, was the intensity adequate?)	No	The intensity of the flora and vegetation survey of the footprint was adequate to significantly enhance local scale knowledge.
Resources	No	Resources were adequate for the botanical survey and vegetation mapping with investment in fieldwork totalling 77 person days.
Remoteness and/or access problems	No	Access to the footprint areas was very good given the large task involved to facilitate this with the many private landowners involved.
Competency/ experience of the consultant carrying out the survey	No	All botanists involved had significant field experience. Dr Eleanor Bennett who identified most of the specimens (collected in the autumn survey) has over 30 years experience in botanical taxonomy. Ms Cate Tauss conducted the spring survey and identified the annuals. Two other botanists were also involved to provide local fine-scale vegetation unit knowledge (Libby Sandiford) and specialist taxonomic skills in Sterculiaceae (Dr Carol Wilkins).

Key:
Significant = greater than 60% of potential flora not sampled
Moderate = 20-60% of potential flora not sampled
Negligible = less than 20% of potential flora not sampled

Section 6.6.3 Vegetation of the Region

The Botanical Districts of the Project footprint are outlined in Section 6.2.2. The majority of the survey area has been fully cleared of native vegetation since the 1960s for farming purposes. Vegetation within the survey area occurs as scattered native remnants of variable size, surrounded by cleared farmland utilised for mixed cropping, grazing and pine plantations (*ecologia*, 2006a). Vegetation across the largest remnant shows a catenary sequence moving from the ridge and upper slopes down to lower slopes and the surrounding basement (plain). This pattern is influenced largely by the variable depth of leached white/grey sands which occur over a band of ironstone pebbles (laterite). Variable depth of sand leads to variation in structure and composition of the mallee-heath. On deep white sand, expressed as low dunes, the formation changes to scrub-heath in which mainly proteaceous shrubs, e.g. *Banksia* sp., largely replace mallee. The lowest lying points of the plain are marked by numerous small, often circular depressions which become inundated in winter. Vegetation is characterised by the occurrence of Swamp yate (*Eucalyptus occidentalis*) woodland restricted to grey alkaline clay soils, often with *Melaleuca cuticularis*. On the periphery *Eucalyptus occidentalis*, *Kunzea recurva*, *Melaleuca preissiana*, *Banksia littoralis* and a number of mallees, primarily *Eucalyptus decipiens* subsp. *adesmophloia* occur. These form an open tall shrub stratum above a very open ground cover restricted to sedges, annual grasses and ephemerals (*ecologia*, 2006a). Reduced species-richness at these sites may be in part due to significant fragmentation of the remnants, uncontrolled grazing by domestic stock, altered surface drainage patterns or increased nutrient run-off.

Section 6.6.4 Mine Site Vegetation

Approximately 74.5% of the proposed mine site footprint has been historically cleared for agriculture. Of the remainder 14.8% is remnant native vegetation in 20 separate blocks and 9% is pine plantation. The remnant native vegetation of the mine site is a complex and diverse mosaic (i.e. the species-rich floristic assemblages present varied greatly in their composition over small-scale distances). It is relatively uniform in structure with thick mallee-heath to mallee-scrub dominating much of the area. The main remnant on the mine site is generally in Excellent condition (Appendix 12- 3). The site-based floristic and structural data was classified by multivariate analysis and mapped (for practical purposes) as six general units at a scale of 1:25,000. These vegetation units (Figure 6.10) were:

1a. Albany Blackbutt (*Eucalyptus staeri*) mallee-heath on lateritic ridges.

1b. Chittick (*Lambertia inermis*) and other scrub-heaths on shallow, seasonally-waterlogged laterite.

2. *Eucalyptus* spp. mixed mallee-heath on shallow sand over laterite.

3. Albany Blackbutt (*Eucalyptus staeri*) mallee-heath on deep sand.

4. Tallerack (*Eucalyptus pleurocarpa*) mallee-heath on seasonally water-logged heavy soils.

5. Swamp Yate (*Eucalyptus occidentalis*) woodland in seasonally inundated clay basins.

Classification of the sites surveyed into these six broad vegetation units is outlined in Figure 6.9 for the 51 sites at the mine site.

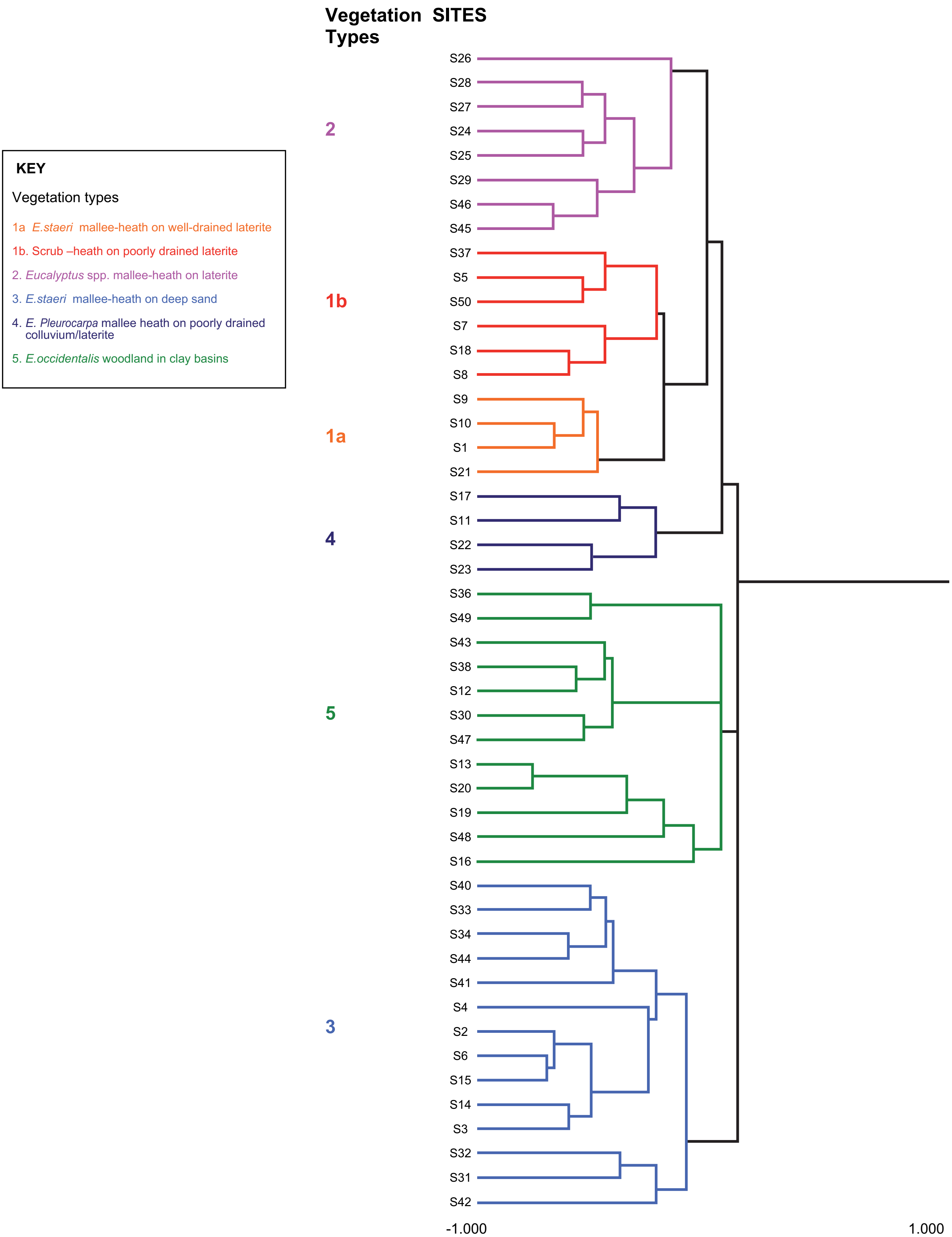

Figure 6.9 Mine Site Flora Sites Classification (SYSTAT).

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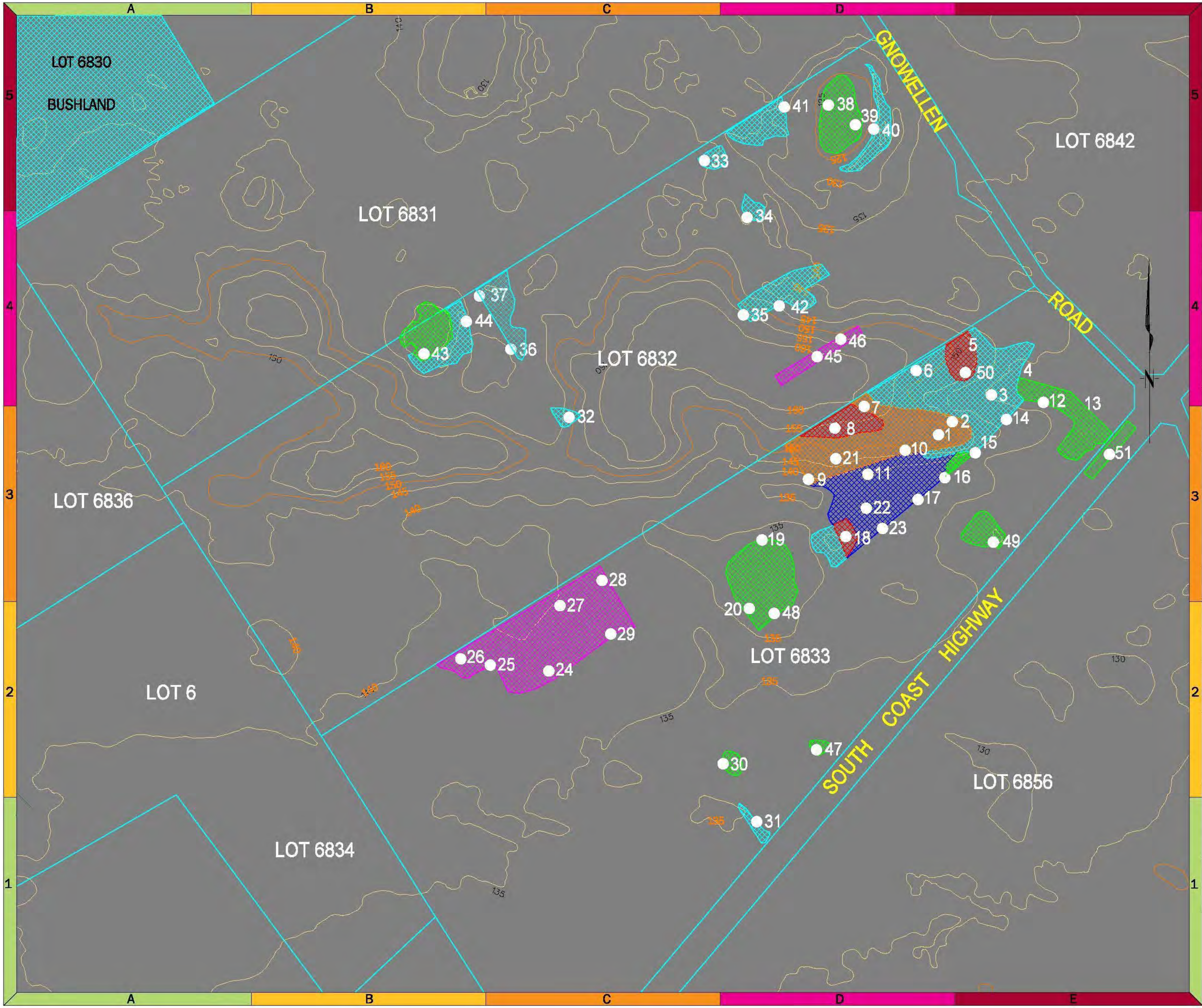

KEY

Flora quadrats

VEGETATION UNITS

- 1a. Albany Blackbutt *(Eucalyptus staeri)* mallee-heath on laterite
- 1b. Chittick *(Lambertia inermis)* scrub-heath on (seasonally waterlogged) laterite.
- 2. Mixed Eucalyptus spp. mallee-heath on laterite.
- 3. Albany Blackbutt *(Eucalyptus staeri)* mallee-heath on deep sand.
- 4. Tallerack *(Eucalyptus pleurocarpa)* on (seasonally waterlogged) sandy clay.
- 5. Swamp Yate *(Eucalyptus occidentalis)* woodland in (seasonally-inundated) clay basins.

rev	details	date
C	Site 51 added	19-01-07
B	Minor area edits	12-04-06
A	Original drawing	28-02-06

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ecologia ENVIRONMENT

survey: COMPILED	cad file: 12937-057C Vege Units.dgn
drawn: JBdS 28-02-06	checked
horiz datum: MGA 94	level datum: AHD

scale at A3: 1 : 25000 — all distances are in metres (0, 500, 1000)

client: GRANGE RESOURCES LIMITED

SOUTHDOWN MAGNETITE PROJECT MINE SITE VEGETATION UNITS

Figure 6.10

PYRMONT HOUSE ALBANY

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Plate 6.1 **Albany Blackbutt Mallee-heath on Lateritic Ridges.**

Plate 6.2 **Chittick (*Lambertia inermis*) and other Tall Shrubs Scrub-heath.**

Plate 6.3 ***Eucalyptus* spp. Mallee-heath on Shallow Laterite.**

Plate 6.4 **Albany Blackbutt Mallee Heath on Deep Sand.**

Plate 6.5 **Tallerack Mallee-heath on Heavy Soils.**

Plate 6.6 **Swamp Yate Woodland in Clay Basin.**

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Section 6.6.5 Vegetation within the Pipeline Corridor

The proposed pipeline route traverses predominantly open farmland which has been cleared of native vegetation. The pipeline corridor covers approximately 220 ha of which 5 ha contains remnant vegetation, some of which is severely degraded.

A great deal of variation exists between the remnant vegetation sites surveyed along the proposed pipeline footprint (including options that have been subsequently discounted). Much of this complexity is attributable to anthropogenic disturbance which confounded a multivariate analysis of the data. The vegetation of the pipeline sites was broadly classified into 11 units (using the dominant native species of the tallest stratum of each site as the main criterion for grouping sites). The remnant vegetation units along the pipeline are:

1. Marri (*Corymbia calophylla*) woodland to low forest (often with *Eucalyptus marginata*) over a variety of shrubs (commonly *Agonis flexuosa, Bossiaea linophylla, Pericalymma ellipticum* and *Taxandria linearifolia* in Good to Excellent condition).
2. Jarrah-Sheoak (*Eucalyptus marginata -Allocasuarina fraseriana*) low woodland to low forest generally over open heath to open scrub including *Agonis theiformis, Taxandria parviceps, Melaleuca thymoides, Dasypogon bromeliifolius* and the rush *Anarthria scabra*. On deeper sands *Banksia attenuata* and *Adenanthos cuneatus* are also often present in the understorey.
3. Jarrah (*Eucalyptus marginata*) mallee heath. This is not common and the two occurrences encountered are both in Poor to Degraded condition.
4 Albany Blackbutt (*Eucalyptus staeri*) low woodland to low forest over tall open shrubs to heath of *Taxandria parviceps, Agonis theiformis, Pericalymma ellipticum* and *Chordifex isomorphus, Anarthria prolifera* and *Mesomelaena tetragona* rushes & sedges. This unit was only noted at Reserve LR3124/121 (Parker Brook Recreational Reserve) which is no longer traversed by the proposed pipeline route.
5. *Eucalyptus staeri* mallee heath. Most of these occurrences along the pipeline are in Poor or Degraded condition. Two broad types of understorey were apparent. On deeper sands *Banksia attenuata, Adenanthos cuneatus* and abundant *Anarthria scabra* are present. On shallow laterite, another proteaceous understorey assemblage (comparable to that of Vegetation Unit 1a of the mine site, although species depauperate compared to the mine site vegetation) prevails.
6. *Eucalyptus falcata-Eucalyptus tetragona* or *Eucalyptus decipiens* subsp. *adesmophloia* mallee heath. This unit occurs at three sites and is generally in Poor condition.
7. Low open halophytic shrubs with rushes, sedges and grasses. This is only present at one site (a narrow estuarine flat adjoining Princess Royal Harbour).
8. *Taxandria juniperina-Homalospermum firmum* scrub or heath with the restiad climber *Empodisma gracillimum* in peaty wetlands.
9. *Melaleuca rhaphiophylla* low woodland to scrub. This is a wetland unit.
10. *Eucalyptus occidentalis* low woodland with *E. decipiens* subsp. *adesmophloia* mallee. All of these occurrences along the pipeline route have degraded understoreys.
11. Highly degraded vegetation dominated by invasive naturalized alien and planted taxa. There are seven sites in this category.

Explanations of conservation codes for vegetation condition are included in Appendix 12- 3.

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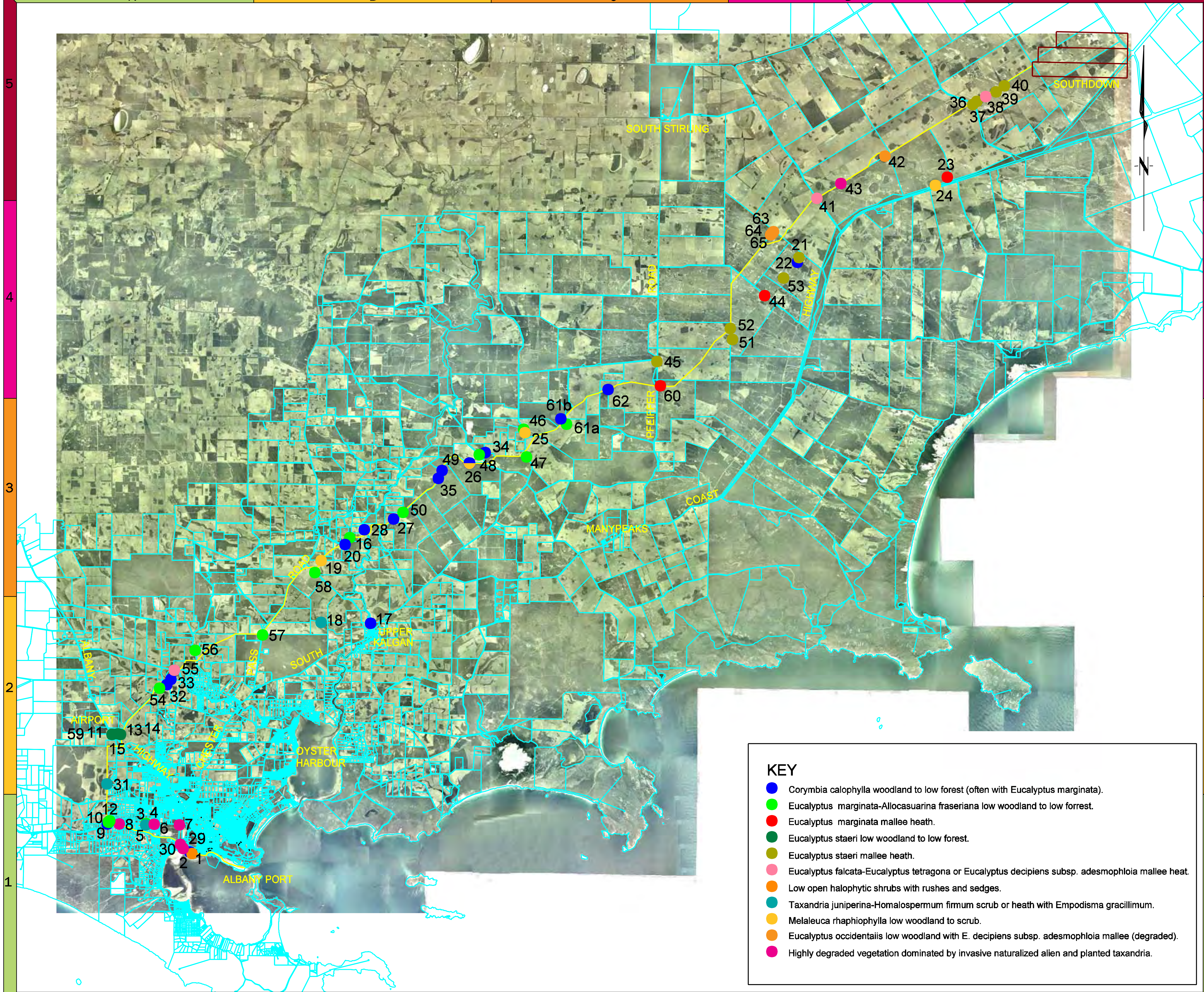

rev	details	date
A	Original drawing	06-02-07

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ecologia ENVIRONMENT

survey: COMPILED & GPS	cad file: 12937-126A.dgn
drawn: JBdS 06-02-07	checked
horiz datum: MGA 94	level datum: N.A.

scale at A3: 1 : 250000 — all distances are in kilometres (0, 5, 10)

client: GRANGE RESOURCES LIMITED

description: SOUTHDOWN MAGNETITE PROJECT VEGETATION UNITS AND FLORA SAMPLING SITES ALONG PIPELINE

drawing no: Figure 6.11

PYRMONT HOUSE
ALBANY

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6. THE PROJECT ENVIRONMENT

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Section 6.6.6 Threatened Ecological Communities

Threatened Ecological Communities are defined as:

'*naturally occurring biological assemblages that occur in a particular type of habitat… the sum of species within ecosystems and, as a whole, provide many of the processes that support specific ecosystems and provide 'ecological services'.*' (CALM, 2004)

Changes to the landscape and native habitat as a result of human activity have put many endemic species and unique habitats at risk. The Australian Government mechanism for national environment protection and biodiversity conservation is the *EPBC Act 1999* (DEH, 2006).

The *EPBC Act 1999* provides for:

- Identification and listing of threatened species and Threatened Ecological Communities.
- Development of Recovery Plans for listed species and ecological communities.
- Recognition of Key Threatening Processes; and where appropriate.
- Reducing these processes through Threat Abatement Plans.

A desktop search (February 2005) was conducted of the DEC Threatened Ecological Community Database of the region from Albany, east to Cape Riche and north including the Stirling Range National Park. None of the Threatened Ecological Communities currently listed occur within the proposal's clearing footprint. The nearest Threatened Ecological Community is the 'Eastern Stirling Range Montane Heath and Thicket', approximately 25 km north-west of the proposed mine site. This Threatened Ecological Community will not be impacted by the Southdown Magnetite Proposal.

No nationally Threatened Ecological Communities have been recorded within the proposal area during the vegetation and flora survey.

Section 6.6.7 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are defined as a community of organisms for which groundwater is a key element required for consumptive use, biophysical processes or as habitat (SKM 2001). The role of groundwater in controlling and maintaining ecosystems is poorly understood, however, consideration of water requirements of GDEs has become a recent addition to water allocation decisions.

GDEs include:

- Terrestrial ecosystems that show seasonal or episodic reliance upon groundwater.
- River base flow systems, which are aquatic and riparian ecosystems in or adjacent to watercourses dependent upon groundwater base flows (i.e. seeps or springs), especially during dry seasons in seasonally dry climates or perennially in arid zones.
- Aquifer and cave ecosystems, often containing diverse and unique fauna.
- Wetlands dependent upon groundwater influx for all or part of the year.
- Estuarine and near-shore marine ecosystems that use groundwater discharge (Murray *et al*., 2003).

GDEs vary from being marginally or only episodically dependent on groundwater (e.g. some terrestrial vegetation) to being entirely groundwater dependent (e.g. mound springs and the aquatic ecosystems of caves and aquifers) (SKM, 2001). Ecological processes in GDEs are threatened by the use or abstraction of groundwater and changes in land use or management.

Groundwater Dependent Ecosystem Survey

A search was conducted of the DEH Australian Wetlands Database for Internationally and Nationally Important wetlands occurring within WA. No Ramsar Internationally Important wetlands, or Nationally Important wetlands were found to occur within the proposal footprint. A desktop search and literature review (September 2005) was also conducted for the presence of GDEs in the vicinity of the mine site. No GDEs were identified within the mine site drawdown footprint.

The vegetation and flora surveys (*ecologia*, 2006a) included vegetation mapping and an assessment of the groundwater dependence of the vegetation units identified.

Groundwater Dependent Ecosystems at the Mine Site

The groundwater table generally lies 17 to 27 m below the surface in the vicinity of the mine site however there are localised perched aquifers where the sand has been replaced by clay. The mine site footprint contains nine areas of wetland vegetation (Units 4 and 5, classified as drainage depressions; see Figure 6.10) which likely reflect the surface expression of these perched aquifers.

Perched aquifers are generally seasonal and are recharged by winter rainfall. With the progression of summer months, the water levels within the perched aquifers is used up by vegetation or lost through evaporation. However some perched aquifers; may be perennial, and are likely to be impacted by drawdown of the aquifer.

Vegetation Unit 5 (*ecologia*, 2006a) at the mine site was described as Swamp Yate (*Eucalyptus occidentalis*) woodland or low woodland in seasonally-inundated clay basins. Vegetation Unit 4 (*ecologia*, 2006a) at the mine site was described as Tallerack (*Eucalyptus pleurocarpa*) mallee-heath on seasonally-waterlogged, heavy soils at base of ridge. There is no evidence to suggest that any vegetation units at the mine site are groundwater dependent.

Section 6.6.8 Flora of the Region

A combined total of 822 vascular flora taxa (including 128 naturalized alien taxa or weeds) from 79 families was recorded during the survey work on the proposed mine site and in remnant bushland traversed by the proposed pipeline.

A total of 439 species (55 families) of vascular plants (including 38 naturalized alien taxa) was recorded in the bi-seasonal flora survey within the 252.6 ha of native vegetation proposed to be cleared during the 22 year life of the proposed mine site (Figure 6.10, Table 6.7).

A total of 626 species (71 families) of vascular plants (including 112 naturalized alien taxa) was recorded in the bi-seasonal flora survey within the 5 ha of native vegetation surveyed along the 104 km long pipeline corridor (Table 6.7).

Table 6.7 General Flora Statistics for Southdown Project Flora Survey.

	Mine site (approx. 282.6 ha)	Pipeline corridor (5 ha)
Families	55	71
Species Total	439	626
Weed species	38	112
Largest families (no. of species)	Proteaceae (56) Myrtaceae (46) Cyperaceae (35) Papilionaceae (34)	Myrtaceae (71) Proteaceae (62) Papilionaceae (53) Cyperaceae (43)
Largest genera (no. of species)	*Hakea* (13) *Stylidium* (13) *Schoenus* (13) *Eucalyptus* (12) *Acacia* (11)	*Acacia* (19) *Leucopogon* (18) *Hakea* (16) *Stylidium, Melaleuca* (14) *Drosera* (15)

To test sampling adequacy, species accumulation curves were constructed for each of the six vegetation units that were identified at the broadest level of classification by the multivariate analysis. The rate of species accumulation (Figure 6.12) was high for all of the vegetation units so defined.

The *Eucalyptus occidentalis* woodland unit of the wetland basins (Unit 5) was considerably less species-rich than the four mallee- heath units. The rate of accumulation of species continued at a high rate in this vegetation unit despite multiple replicates. The *Eucalyptus occidentalis* woodlands were inundated with water during the spring and summer surveys. For this reason it is probable that a number of annual species (that are only evident in this habitat when waters recede) were not recorded in the current survey despite three or four visits to these wetlands.

The rate of accumulation of species remained high despite intensive survey (multiple replicates) in all of the other vegetation units (and inundation was not a limiting factor in the sampling of the latter). For example, even after sampling 14 quadrats in Unit 3 (*Eucalyptus staeri* mallee heath on deep sand) the rate of species accumulation in this vegetation was still high. This may have suggested that there could have been considerable species richness in the vegetation that was not captured by the methods used in the survey. Alternatively, the distinctive pattern of species accumulation in the species-rich vegetation of the mine site may have been due to the high diversity of the vegetation assemblages over small distances, rather than under-sampling. This view is supported by the multivariate classification of the floristic data.

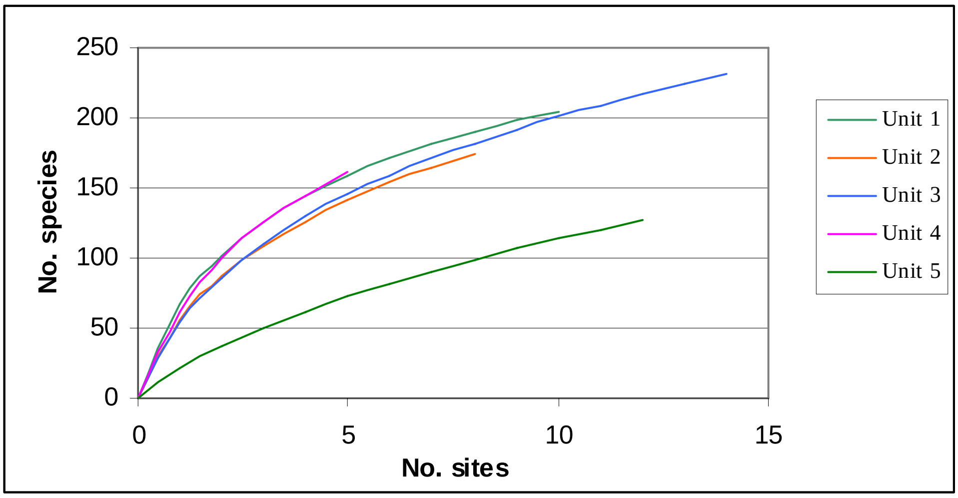


Figure 6.12 Mine Site Flora Species Accumulation Curves.

The pipeline corridor was adequately sampled as the entire area to be impacted at each site where the pipeline intersected native vegetation was traversed.

Section 6.6.9 Flora of Conservation Significance

While all native flora is protected under the *Wildlife Conservation Act 1950*, a number of plant species are assigned an additional level of conservation significance based on the limited number of known populations and the perceived threats to these locations.

Environment Protection and Biodiversity Conservation Act

At a national level, flora is protected under the *Environment Protection and Biodiversity Act 1999* (*EPBC Act (1999)).* The *EPBC Act 1999* contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependent, Extinct or Extinct in the Wild. An explanation of conservation codes under the *EPBC Act 1999* is provided in Table A3.1 in Appendix 12-3.

There are 41 species of nationally-listed (*EPBC Act 1999*) threatened flora known from the region. None of these species was recorded in either the proposed mine site or pipeline corridor surveys.

Additionally, an undescribed species (*Commersonia* sp. Mt Groper pn R.G. Cranfield & D. Kabay 9157) was collected from the mine site in September 2005. It was subsequently nominated to the Western Australian Threatened Species Scientific Committee for listing as Declared Rare Flora (critically endangered) by Dr C. Wilkins of the University of Western Australia, School of Plant Biology. The committee has since recommended that this species be listed as Priority One Flora (poorly known rare flora in need of further exploration). *Commersonia* sp. Mt Groper was first collected in 1993, approximately 30 km east of the mine site off the Boat Harbour Rd near Mt Groper, and re-collected on the proposed mine site in the course of the Southdown Magnetite Project flora survey. Extensive searches of the two known population areas, the mine site and regional wetlands have been conducted.

In October 2006, one population of *Commersonia* sp. Mt Groper was found at a wetland outside of the Project impact area. The population consists of between 50 to 100 plants, constituting approximately 2-10% of the vegetation of the wetland. The plants are between 0.5 m and 1.0 m tall, and there is evidence of a fire having occurred at the wetland within the last five years; this probably explains the density and height of the plants.

The project is anticipated to impact 33% of known *Commersonia* sp. Mt Groper population areas.

Wildlife Conservation Act

Declared Rare Flora (DRF) is also protected under the Western Australian *Wildlife Conservation (Rare Flora) Notice 2005* of the *Wildlife Conservation Act 1950*. The notice lists flora taxa that are extant and considered likely to become extinct or rare. These taxa are legally protected and removal or impact to their surroundings cannot be conducted without ministerial approval obtained specifically on each occasion for each population. The DEC also maintains a list of taxa which are considered to be poorly known, uncommon, or under threat, but for which there is insufficient justification on the basis of known distribution and population sizes for inclusion on the DRF schedule. Priority Flora is assigned to one of four Priority categories (Atkins, 2005) definitions of which are provided in Appendix 12- 3.

Priority Flora currently known from the DEC and WA Herbarium databases (Atkins, 2005) to occur in the region of the Southdown Magnetite Proposal area comprise 17 DRF taxa and 88 Priority taxa.

No DRF were recorded from the Project footprint in the current survey. A total of 11 taxa of conservation significance was recorded during the vegetation surveys, of which seven taxa (Table 6.8) were recorded within the mine site and the pipeline corridor alignment. Most of the populations of the significant taxa recorded in the survey were in previously undocumented locations. Six species were recorded within the proposed mine site only and one species was recorded within both the proposed mine site and the pipeline footprint (Table 6.8). The number of populations known outside of the footprint, and the approximate percentage of known populations to be impacted by the Project is also presented in Table 6.8. The number of individual plants per population is not known due to the paucity of information in the region.

Descriptions of priority flora identified during the spring and summer surveys of 2005/2006 within the proposed mine site and pipeline corridor are included in Appendix 12- 4. Descriptions of flora of conservation significance as defined under the EPA Guidance Statement 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, are included in Appendix 12- 6.

Table 6.8 Flora of Conservation Significance Recorded During the Flora Survey.

SPECIES	PRIORITY	NO. OF POPULATIONS			
		MINE SITE	PIPELINE	OUTSIDE FOOTPRINT	% KNOWN POPS IMPACTED
Commersonia sp. Mt Groper (RG Cranfield & D. Kabay 9157)	1	1 population area (0 extant)	-	1 population and 1 population area	33% population/ areas
Chordifex leucoblepharus	2	2	-	1 <10	15%
Microcorys lenticularis	2	1	-	2 10	8%
Monotoca aristata	2	2	-	1 7	20%
Calectasia obtusa	3	2	1	14	18%
Dryandra calophylla	3	2	-	4 28	6%
Goodenia filiformis	3	3	-	22	12%
Chordifex isomorphus	4	-	1 previous alignment	14	0%
Amperea protensa	3	-	1 previous alignment	37 +	0%
Boronia crassipes	3	-	1 previous alignment	17	0%
Drosera fimbriata	4	-	2 previous alignment	15	0%

Key:
Green: Flora of conservation significance recorded during the 2005/2006 survey on the mine site.
Orange: Flora of conservation significance recorded during the 2005/2006 survey along the proposed pipeline route.
Blue: Flora of conservation significance recorded during the current survey outside footprint.
Red: Flora of conservation significance otherwise known from FloraBase 2006 (not including those found in the current survey)

Section 6.6.10 Vegetation of Conservation Significance

Total Remaining Vegetation

The total remaining vegetation in the Albany Hinterland for each sub-catchment of the region has been documented using GIS methods (Connell and ATA Environmental, 2001). From this source of information, it can be calculated that the extent of the total vegetation (of any type and in any condition) remaining in the three sub-catchments either traversed by the pipeline or in the proposed mine site on the Pallinup Sandplain (Sandplain West, Mountains to Coast and East Sandplain) (Table 6.9, Figure 6.13) is approximately 20.6%.

Table 6.9 Unreserved Remnant Vegetation in Three Relevant Sub-Catchments of the Pallinup Sandplain.

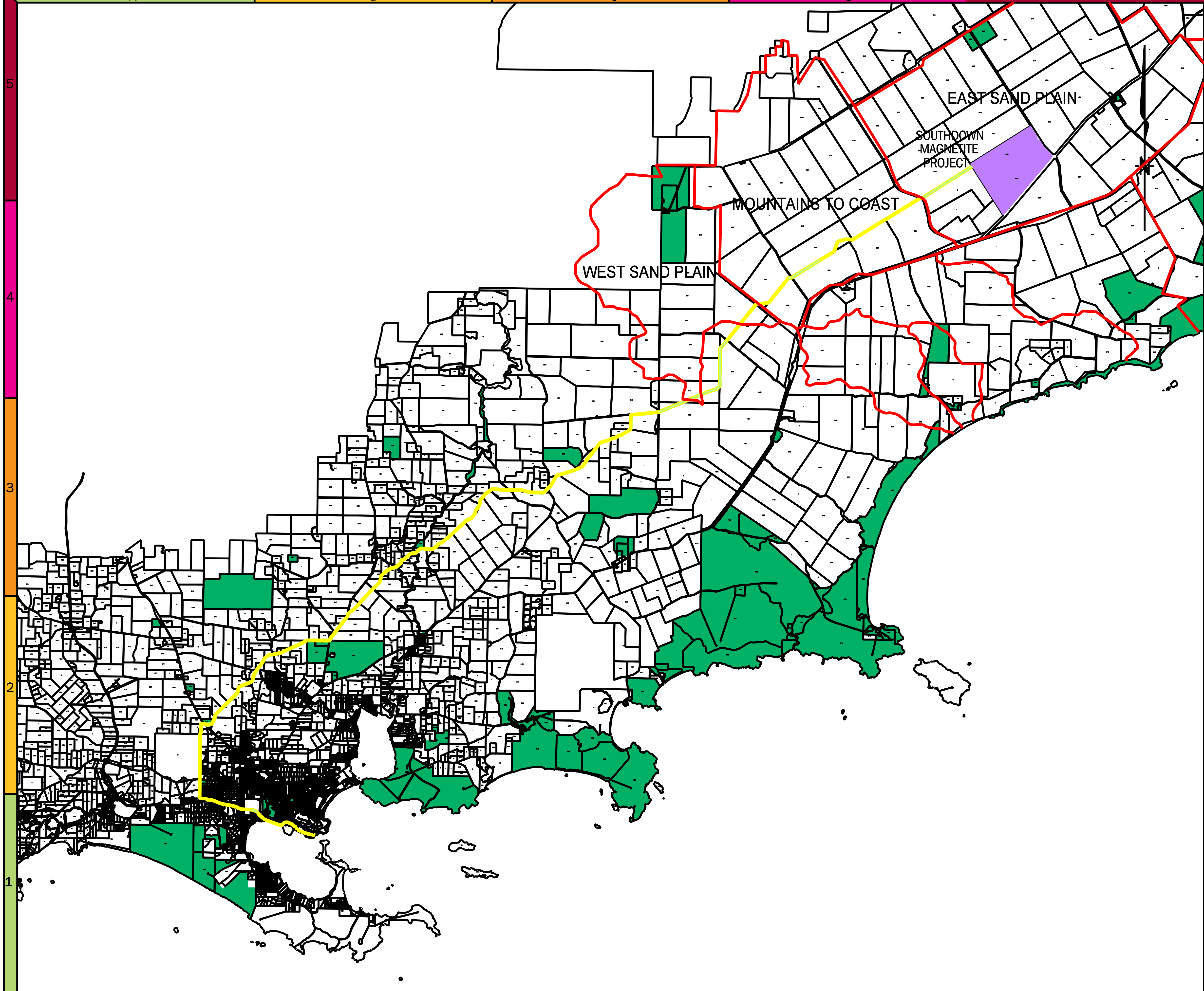
SUB-CATCHMENT*	AREA OF REMNANT VEGETATION	AREA OF SUB-CATCHMENT	% OF CATCHMENT VEGETATED (REMNANT VEGETATION) *
Sandplain West (traversed by pipeline)	3,953 ha	15,239 ha	25.8%
Mountains to Coast (traversed by pipeline)	3,910 ha	25,942 ha	15.1%
East Sandplain (mine site location)	8,431 ha	37,824 ha	22.3%
Total area of remnant vegetation remaining in the 3 sub-catchments	**SUM: 16,294 ha**	**SUM: 79,005 ha**	**20.6%**

*Information sourced from Table 9, Connell and ATA Environmental, 2001.

The 20.6% total unreserved remnant vegetation in the three sub-catchments falls below the threshold level of 30%, below which species loss is considered to accelerate exponentially at the ecosystem level (EPA, 2000).

The remnant vegetation at the mine site (282.6 ha) is about 2.8% of the total remaining vegetation (reserved and unreserved) of the East Sandplain sub-catchment; comprising 8,431 ha (Connell and ATA Environmental, 2001) remnant vegetation cover, and 684.7 ha in Nature Reserves. Grange intends to retain a minimum of 30 ha of Albany Blackbutt (*Eucalyptus Staeri)* mallee heath vegetation at the mine site. Clearing of 282.6 ha at the mine site represents a decrease of 0.68% in total native vegetation for the sub-catchment, resulting in a total of 23.42% native vegetation remaining in the East Sandplain sub-catchment.

Additional regional vegetation assessments are in progress in consultation with DEC (Conservation Branch). Information from these assessments will be made available to the EPA before the completion of their proposal assessment. The information will also be made available on the Grange Resources Website.



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survey JBdS 30-06-06	cad file 12937-109A Sub Catchments.dgn
drawn COMPILED	checked
horiz datum MGA 94	level datum N.A.

scale at A3 1 : 300000 — all distances are in metres

client: GRANGE RESOURCES LIMITED A.C.N. 009 132 405

description: SOUTHDOWN MAGNETITE PROJECT SUB CATCHMENTS AND CROWN RESERVES

Figure 6.13

PYRMONT HOUSE
ALBANY

harley survey group

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Reservation Status of Remaining Vegetation

The reservation status (as a percentage) of much of the vegetation remaining in the Sandplain West, Mountains to Coast and East Sandplain sub-catchments is lower than the total remnant vegetation (Table 6.10), as there are only three reserves within these sub-catchments. These are the South Stirling Nature Reserve (1,710.5 ha), the Hassell National Park (1,264.6 ha) and Crown Reserve 28325 (253.1 ha). Mettler Lake Nature Reserve (401.6 ha) is in the north of the adjacent Willyung sub–catchment of the Hassell Beach to Bremer Bay Coastal Zone but is somewhat comparable in vegetation to the East Sandplain sub-catchment and has been included with the latter in calculations for Table 6.10 below.

The Sandplains West sub-catchment traversed by the pipeline is poorly reserved for conservation purposes. The total vegetation area reserved in the Mountains to Coast sub-catchment is encompassed by the South Stirling Nature Reserve and most of the Hassell National Park (Table 6.10) and together these contain about 11% of the original vegetation of this sub-catchment. Reservation of the total original vegetation (Table 6.10) in the East Sandplain sub-catchment (where the mine site is located) is 1.8%. The latter percentage includes the part of the Hassell National Park (about 30 ha of road reserve) that lies in the sub-catchment, Crown Reserve 28325 and Mettler Lake Nature Reserve (401.6 ha).

The total area of original vegetation reserved in these three sub-catchments (in any class of reserve) is 4.6% as outlined in Table 6.10.

Table 6.10 Reservation of Vegetation in Three Relevant Sub-Catchments of the Pallinup Sandplain.

SUB-CATCHMENT	AREA OF NATURE RESERVES	AREA OF SUB-CATCHMENT	VEGETATION RESERVED (ALL TYPES OF VEGETATION, ALL TYPES OF RESERVES) *
Sandplain West (traversed by pipeline)	1,710.5 ha	15,239 ha	11.2% (S. Stirling NR)
Mountains to Coast (traversed by pipeline)	1,234.6 ha	25,942 ha	4.8% (most of Hassell NP)
East Sandplain (mine site location)	684.7 ha	37,824 ha	1.8% (Mettler NR, Reserve 28325 and the remainder of Hassell NP are included)
Total area of vegetation reserved (in any class reserve) in the 3 sub-catchments	**SUM: 3,629.8 ha**	**SUM: 79,005 ha**	**4.6%**

*Information sourced from Table 9, Connell and ATA (2002) and CALM (1992).

Vegetation of Conservation Significance

A field reconnaissance of nature reserves and other remnant bushland on the Pallinup Sandplain between the Kalgan River and the Pallinup River, south of the Stirling Ranges was conducted in late 2005 and early 2006 (*ecologia*, 2006a). These surveys were carried out beyond the immediate footprint of the Southdown Magnetite Proposal area to provide a better understanding of the regional context of the proposed mine site and pipeline route vegetation.

Areas of regional conservation significance along the proposed pipeline route are; the Kratochvill Wetland, Point Melville, Reserve LR3037/810 (Granite Hill Reserve), River crossings (King, Napier, Kalgan north), Fuller Road reserve, Penn Road reserve, the J. Pyle remnant and the Kingscliffe Tree Farm wetland.

Whilst 98% of the proposed pipeline route traverses an extensively cleared and degraded rural landscape, some of the remnant bush and wetlands within this route are still in Good to Excellent condition (Appendix 12- 3) or are where the vegetation has a role in supporting ecosystem function and were assessed as having, at least, local conservation significance. The sites where there were occurrences of Priority Flora Species were rated at a higher level of significance. These sites were usually rated as significant at the regional level, especially if the Priority Flora in question was narrowly endemic, poorly reserved and vulnerable to threats, or the site had additional ecosystem function values. Vegetation units that are uncommon or poorly-reserved (especially where this vegetation was in Good or Excellent condition and contained Priority Flora) were also ranked as significant at the regional level. There were no EPBC-listed DRF or TECs identified in these locations.

Areas where the proposal will impact sites of local conservation significance are Melville Point, Fuller Rd reserve, the Kratochvill wetland, the Penn Rd reserve and Kingscliffe Tree Farm. The vegetation at the river crossings ranges from good to degraded, however, vegetation at these sites should be conserved wherever possible to maintain fauna corridors, the ecological functions of these watercourses and for catchment management.

Avoidance of remnant native vegetation was a key consideration during selection of the pipeline route. Where vegetation cannot be avoided, the Project Pipeline Construction and Operation Environmental Management Plan (Technical Appendix 13.18) outlines mitigation and rehabilitation strategies to minimise impacts of pipeline construction on native vegetation.

Section 6.6.11 Introduced Flora Species

A total of 128 naturalized alien taxa (weeds) was recorded during the Southdown Magnetite Project flora and vegetation survey. Of these weeds, 38 taxa were recorded in the mine site area and 112 taxa were recorded within the pipeline corridor.

City of Albany Weeds Strategy

The City of Albany Environmental Weeds Strategy (2001) has identified 15 priority environmental weeds for the Albany municipality (Table 6.11). The Southdown Magnetite Proposal area lies completely within this area. Six weed species are listed as high priority, three species of moderate priority, one species of mild priority, four species of low priority and one species requiring ranking. Weed species were prioritised according to their distribution (current or potential), invasiveness (ability to invade bushland in Good to Excellent condition), and environmental impacts (ability to change the structure, composition and function of ecosystems). Eleven weeds listed as Priority weed species for the Albany municipality were recorded within the pipeline route; however none were recorded within the mine site (Table 6.12).

Table 6.11 Albany Municipality Priority Environmental Weed Species.

Priority	Species
High	Pampas Grass (**Cortaderis selloana*)
High	Watsonia (**Watsonia sp*)
High	Victorian Tea Tree (**Leptospermum laevigatum*)
High	Rose Pelargonium (**Pelargonium capitatum*)
High	Bridal Creeper (**Asparagus asparagoides*)
High	Arum Lily (**Zantedeschia aethiopica*)
TBA	Sweet Pittosporum (**Pittosporum undulatum*)
Moderate	Purple African Daisy (**Senecio glastifolius*)
Moderate	Sydney Golden Wattle (**Acacia longifolia*)
Moderate	Blackberry, Bramble (**Rubus spp.*)
Mild	Taylorina (**Psoralea pinnata*)
Low	Dolichus Pea (**Dipogon lignosis*)
Low	Gorse (**Ulex europaeus*)
Low	Cootamundra Wattle (**Acacia baileyana*)
Low	Agapanthus (**Agapanthus praecox*)

Table 6.12 Locations of Albany Priority Weed Species Identified on the Pipeline Route Survey.

Species	Pipeline (sites) and location names
Pampas Grass (**Cortaderia selloana*)	Melville Point (1), Cuming Rd reserve to George St (6,7,8) and Site (29) on harbour.
Watsonia (**Watsonia* sp.)	Melville Point (1, 2), Drawbin Rd reserve (45).
Victorian Tea Tree (**Leptospermum laevigatum*)	Cuming Rd reserve (8).
Rose Pelargonium (**Pelargonium capitatum*)	Melville Point (1,2), Cuming Rd reserve (6,7), Fuller Rd reserve (16), Site 29 on harbour, Wesfarmers firebreak on Hanrahan Rd (30), Site 54, Millbrook Rd road reserve (56).
Bridal Creeper (**Asparagus asparagoides*)	Melville Point (1,2), Cuming Rd reserve (6,7), Kalgan R crossing south option (17), Napier Creek crossing (20), Kalgan R crossing north option (28), Site (29) on harbour, Wesfarmers firebreak on Hanrahan Rd (30), Palmdale Rd road reserve (46).
Arum Lily (**Zantedeschia aethiopica*)	Site (29) on harbour, Wesfarmers firebreak on Hanrahan Rd (30), Kratochvill wetland (31).
Sweet Pittosporum (**Pittosporum undulatum*)	Cuming Rd powerline reserve (6).
Sydney Golden Wattle (**Acacia longifolia*)	Cuming Rd reserve (6, 8), Gravel hill reserve (9,10), Wimbush Tree Farm east (21), Wesfarmers firebreak on Hanrahan Rd (30), Jorden Rd reserve off Deep Creek Rd (50), Drawbin Rd reserve (44), Pfeiffer Rd reserve (45).
Blackberry, Bramble (**Rubus* spp.)	Cuming Rd reserve (6,7), Kratochvill wetland (31).
Taylorina (**Psoralea pinnata*)	Gledhow Rd Reserve (4), Walmsley wetland (5), Cuming Rd reserve to George St (6, 7, and 8), Site (29) on harbour, Wesfarmers firebreak on Hanrahan Rd (30), Kratochvill wetland (31), Millbrook Rd road reserve (56).
Gorse (**Ulex europaeus*)	Old road reserve between Block 6202 and 2240 south-east of Corimup Rd (62)

Declared Weeds

Weeds that are, or have the potential to become, pests to agriculture may be formally declared under the *Agriculture and Related Resources Protection Act, 1976 (ARRP Act 1976*). These weeds are listed with Standard Control Codes that outline the requirements for weed management. There are five Priority groupings (P1, P2, P3, P4 or P5), and more than one Priority may be placed on a weed species. Landholders who have declared pests on their property are obliged to control them at their own expense and are encouraged to follow the Standard Control Codes. Details of these priority groupings and codes are included in Table A3.2, Appendix 12-3.

A search was conducted of the Declared Plants List under the *ARRP Act 1976* for any Declared Weed species potentially found in the Albany-Wellstead region *(ecologia* 2006a). The search identified 49 Declared Weeds for the Albany region, 41 of which are Declared Weeds for the whole state.

No species listed under the *ARRP Act 1976* were recorded within the mine site; however four species were recorded within the pipeline corridor. The Arum Lily (**Zantedeschia aethiopica*) was recorded at three sites between Melville Point and the Kratochvill Wetland. The Blackberry (**Rubus ulmifolius*) was recorded at three sites between the Cuming road reserve and Kratochvill Wetland. Gorse (**Ulex europaeus*) was recorded at one site on the old road reserve east of Corimup Rd, and Patersons Curse (**Echium plantagineum*) was recorded at Kingscliffe Tree Farm.

Weeds of National Significance

The National Weeds Strategy defines a weed as "a plant which has, or has the potential to have, a detrimental effect on economic, social or conservation values" (ARMCANZ, ANZECC and Forestry Ministers, 1997). Weeds that have proliferated in bushland without direct human intervention or assistance are also referred to as naturalised alien species.

The Weed Plan for Western Australia (State Weed Plan Steering Group, 2001) outlines three Weeds of National Significance as occurring in the Albany region. These are Blackberry (**Rubus fruticosus*), Bridal Creeper (**Asparagus asparagoides*) and Gorse (**Ulex europaeus*). Blackberry is wide-spread throughout the south-west of WA and Bridal Creeper and Gorse are naturalised around Albany.

No weeds of national significance were recorded within the mine site footprint; however the Blackberry (**Rubus ulmifolius*, one of the taxa recognized in the *R. fruticosus* group), Bridal Creeper and Gorse were recorded within the proposed pipeline corridor (Table 6.12).

Section 6.6.12 Dieback

Dieback is a plant disease caused by the introduced, soil-borne pathogen *Phytophthora,* which is a water mould spread by the movement of soil, plant material and water. Several species of *Phytophthora* are present in native vegetation in the south-west of WA, but by far the most widespread and destructive is *Phytophthora cinnamomi* (CALM, 2003b).

In the native plant communities of south-western Australia three distinct syndromes have been recognised due to disease caused by *P. cinnamomi*. The first two are evident with infestation by the pathogen, while the third is expressed years later in the plant community that has replaced the original vegetation. The three syndromes are characterised as follows.

- Most highly susceptible species in heathlands, *Banksia* woodlands and in the understorey and ground layers of a number of forest types are killed in uniform progression, with readily observable effects.
- The death of the overstorey of Jarrah trees. The extent and frequency of this death is highly variable, being very sensitive to site conditions.
- Where the former Banksia understorey and most Jarrah trees have been long dead and the forest has been replaced by a woodland of the resistant Marri (*Corymbia calophylla*) and Parrotbush (*Dryandra sessilis*), *P. cinnamomi* behaves as a native pathogen, attacking *D. sessilis* in wet years, but with little or no impact on the Marri (CALM, 2003b).

6. THE PROJECT ENVIRONMENT

In general, *P. cinnamomi* is restricted to areas in the south-west of WA receiving at least 400 mm of average annual rainfall. Between the 400 mm and 700 mm isohyets the pathogen is restricted to stream zones and water-gaining sites (CALM, 2003b). The proportion of different vegetation communities which are infested by *P. cinnamomi* is dependent on several factors, including the length of time the disease has been present, the history of land use, species susceptibility and landscape and soil factors.

Around 60% of the montane shrublands and *Banksia* and mallee woodlands of the 116 000 ha Stirling Range National Park has been infested by *P. cinnamomi*, as well as 15-20% of the Jarrah (*Eucalyptus marginata*) forest with the proportion considerably higher in the wetter, north-western part of the forest.

Dieback survey

Dieback disease is as an important environmental issue with regard to any land clearing associated with the Southdown Magnetite Proposal. It is assumed that the proposal footprint is comprised of both dieback infected and dieback free vegetation. As dieback mapping is only valid for one year prior to land disturbance activities (DEC communication, October 2005), Grange will conduct a dieback disease assessment of the mine site and the selected pipeline route to Albany Port within a year of any groundworks occurring. A dieback disease management plan will be developed after the dieback survey, in consultation with the DEC (Albany Region) and other authorities for the mine site and pipeline construction works. Dieback disease management hygiene protocols also will be established during survey work, especially during wet periods, inundated areas and on DEC managed lands.

Section 6.7 Fauna

Section 6.7.1 Previous Fauna Surveys

The proposed Southdown Magnetite Proposal area passes close to a number of blocks of remnant vegetation listed on the Australian Heritage Database, which include the Chester Pass Nature Reserve, Hassell National Park and adjacent Road Reserves, Mettler Lake Nature Reserve and the North Sister and South Sister Nature Reserves. These reserves support significant fauna species which may also rely on smaller remnants of vegetation occurring in the vicinity of the Southdown Magnetite Proposal.

The North Sister Nature Reserve was surveyed by the Royal Australian Ornithologists Union (RAOU) between 1981 and 1985 and is noted as having the second-largest Little Grassbird (*Megalurus gramineus*) population of any southern Western Australian reserve surveyed in this time period (Jaensch *et al*., 1988). Several Migratory Bird species were also recorded as breeding in the area including some species listed on the Japan Australia Migratory Bird Agreement (JAMBA) and the China Australia Migratory Bird Agreement (CAMBA).

Mettler Lake Nature Reserve is an important water bird habitat, extensively used by nomadic and migratory species (Jaensch *et al*., 1988). The reserve provides habitat for a number of rare bird species, including the Little Bittern (*Ixobrychus minutus*) and Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). Mettler Lake Reserve is situated approximately 7 km south-east of the mine site.

DEC has recorded a number of threatened species in the region. These include the Western Whipbird (*Psophodes nigrogularis*), Noisy Scrub-bird (*Atrichornis clamosus*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), Carnaby's Black Cockatoo (*Calyptorhynchus latirostris)*, Western Bristlebird (*Dasyornis longirostris*), Carpet Python (*Morelia spilota*), Western Quoll (*Dasyurus geoffroyii*), Quokka (*Setonix brachyurus*), Gilbert's Potoroo (*Potorous gilbertii*) and Western Ringtail Possum (*Psuedocheirus occidentalis*). These species have been recorded in remnants within approximately 15 km from the Project area at Two Peoples Bay Nature Reserve.

Hearn *et al*. (2002) and Comer *et al.* (2001) have conducted inventories of the threatened fauna occurring within the Southern Jarrah Forest Subregion and the Fitzgerald Subregion.

The Wellstead Land Conservation District community conducted a native mammal survey of the Wellstead area between 1994 and 1996 (Leighton, 1996). The survey was conducted across a wide area bordered by the Pallinup River in the north, the Stirling Range National Park in the west and the Southern Ocean to the south and east. Eight species of native mammal, comprising the Yellow-footed Antechinus or Mardo (*Antechinus flavipes*), Southern Brown Bandicoot or Quenda (*Isoodon obesulus fusciventor*), Grey-bellied Dunnart (*Sminthopsis griseoventor griseoventor*), Ash Grey Mouse (*Pseudomys albocinereus*), Western Mouse (*Pseudomys occidentalis*), Western Pygmy Possum (*Cercartetus concinnus*), Bush Rat (*Rattus fuscipes*), and Water Rat (*Hydromys chrysogaster*), were trapped. Additional sightings of a further eight species of native mammal, the White-striped Freetail Bat, (*Tadarida australis*), Lesser Long-eared Bat (*Nyctophilus geoffreyi*), Chocolate Wattled Bat (*Chalinolobus morio*), Echidna (*Tachyglossus aculeatus*), Western Grey Kangaroo (*Macropus fuliginosus*), Common Brushtail Possum (*Trichosurus vulpecula*), Tammar Wallaby (*Macropus eugenii*), and Western Brush Wallaby (*Macropus irma*) were also recorded in the Wellstead district. A number of threatened (nationally and State listed) species historically known from the area were not recorded during the survey, including the nationally vulnerable Quokka (*Setonix brachyurus*) and the Chuditch or Western Quoll (*Dasyurus geoffroyii*). Additionally the Dibbler (*Parantechinus apicalis*), gazetted in WA as rare, is known from areas east of Wellstead.

The Wellstead Community Bird Watch programme commenced in 1987 and has since been recording bird species richness and abundance within the Wellstead District (Wellstead Historical and Heritage

Committee, 1991). Birds were recorded across seven habitats, including those habitats represented within the Southdown mine site area. A number of significant bird species occurring within those habitats listed above were recorded during the programme. These include nationally listed species such as Carnaby's (Short-billed) Black Cockatoo (*Calyptorhynchus latirostris*), Malleefowl (*Leipoa ocellata*), and Western Whipbird (*Psophodes nigrogularis*). State listed species recorded during the survey included the Australasian Bittern (*Botaurus poiciloptilus*). Additionally 5 species of international significance (under CAMBA and JAMBA treaties) were recorded within the Wellstead district (Cattle Egret, *Ardea ibis*, Eastern Reef Egret, *Ardea sacra*, White-bellied Sea-eagle, *Haliaeetus leucogaster*, Greenshank, *Tringa nebularia*, and Bar-tailed Godwit, *Limosa laponica*).

Section 6.7.2 Vertebrate Fauna Survey

Survey Methods and Constraints

A vertebrate fauna survey was conducted for the Southdown Magnetite Proposal (*ecologia* 2006b). Survey methods were aligned with the EPA's Guidance Statement No. 56 (EPA 2004), and developed in consultation with DEC and regional experts. The vertebrate fauna assessment for the Southdown Magnetite Proposal was divided into two survey areas: the proposed mine footprint and the proposed pipeline corridor.

The magnitude of the development in combination with the location of the Project area dictated a two season survey. An autumn survey was conducted in April and June 2005, with a spring survey of the pipeline conducted in October and November 2005. Additional surveys of the mine site were conducted in January and February 2006 due to wet conditions at the mine site during spring 2005.

Following preliminary reconnaissance, survey areas were chosen on the basis of their:

(i) representation of vegetation associations;

(ii) conservation value or ecological sensitivity; and

(iii) representation of past or proposed environmental impact relating to mining activity.

In an effort to broaden survey scope and to accurately assess an optimal range of fauna habitats occurring within the disturbance footprint, additional sites were identified and opportunistically assessed.

Work carried out in the field included:

- Systematic Sampling using pit traps and drift fence, Elliot box traps, funnel traps and cage traps.
- Opportunistic searching, involving raking leaf and bark litter drifts, raking bulldozer spoil heaps along existing tracks and survey lines, overturning logs and stones, searching under bark of dead trees, breaking open old logs, stumps and dead free-standing trees, investigating burrows and recording tracks, diggings and scats.
- Opportunistic trapping of freshwater fish in drainage lines.
- Microhabitat searching.
- Nocturnal searching.
- Systematic bird censusing.
- Bat recording using an ANABAT II system to detect echolocation calls.

The total survey effort for the two phases of surveying is outlined in Table 6.13, with the number of person days expended (184) in each field survey outlined in Table 6.14.

Table 6.13 Total Fauna Survey Effort for the Project.

Location	Pit Trap Nights	Elliot trap nights	Funnel Trap nights	Cage Trap Nights	Bird Census (min)	Bat Survey (min)	Night Survey (min)	Hand Search (min)
Mine site	1330	2260	2126	535	4085	925	2420	4295
Pipeline	462	1235	885	429	3075	565	1890	4195
Total	**1792**	**3495**	**3011**	**964**	**7160**	**1490**	**4310**	**8490**

Table 6.14 Survey Timing and Duration.

Area	Timing	No person days	Survey Type
Mine	19th-30th April 2005	46	Trapping Survey
Mine	24th-26th October 2005	3	Rare Fauna Habitat Assessment
Mine	10th – 19th January 2006	31	Trapping Survey
Mine	9th – 15th February 2006	14	Trapping Survey
Pipeline	8th-19th June 2005	46	Trapping Survey
Pipeline	27th-31st October 2005	5	Rare Fauna Habitat Assessment
Pipeline	7th – 18th November 2005	39	Trapping Survey

An assessment of aspects potentially limiting the Southdown Magnetite Proposal vertebrate fauna survey is detailed in Table 6.15 below.

Sampling adequacy at proposed mine site

Species accumulation curves for trapping data (excluding reptile captures during autumn due to low capture rates) and bird censusing have been calculated and are provided in Technical Appendix 13.9. All the curves are reaching an asymptote suggesting a point of diminishing return in terms of new species for sampling effort. Consequently, it can be surmised that sufficient sampling has been undertaken within the mine site for mammals, frogs and birds.

Sampling adequacy for the proposed pipeline corridor

Species accumulation curves for trapping data and bird censusing have been calculated and are provided in Technical Appendix 13.9 (Appendix E). All the curves are reaching an asymptote suggesting a point of diminishing return in terms of new species for sampling effort. Consequently, it can be surmised that sufficient sampling (with respect to trapping and bird censusing) has been undertaken within the pipeline. Due to the linear disturbance footprint and the usually small and isolated nature of remnant vegetation impacted by the pipeline (either directly or indirectly), a large component of surveying for the pipeline comprised opportunistic sampling, with a focus particularly on the presence of rare fauna habitat.

Table 6.15 Fauna Survey Constraints.

Aspect	Constraint (yes/no)	Comment
Competency/experience of the consultant carrying out the survey	No	All members of the survey team have appropriate training, experience and mentoring in fauna identification and fauna surveys.
Scope	No	The survey scope was prepared in consultation with the DEC and the EPA and has been designed to satisfy the requirements of EPA Guidance Statement No. 56 (See Section 6.7.2).
Proportion of fauna identified, recorded and/or collected	No	Over 50% of potential fauna species from within each taxonomic group within the mine site and pipeline corridor were recorded during surveying. Over 80% of trappable fauna at the time of surveying were recorded from within each taxonomic group.
Sources of information e.g. previously available information vs. new data	No	Museum records are comprehensive and additional data was available from the Wellstead area.
The proportion of the task achieved and further work which might be needed	No	Surveying is complete.
Timing/weather/season/cycle	No	Cooler than average temperatures and above average rainfall during spring/ summer 2006 resulted in reduced reptile captures during the January survey. Consequently additional surveying was undertaken in February 2006 within the mine site to acquire additional reptile data. As a result it is anticipated that weather is not a constraint on survey data quality.
Disturbances which affected results of survey	No	N/A
Intensity (in retrospect was the intensity adequate)	No	Species accumulation curves (Technical Appendix 13.9 (Appendix E)) indicate that survey intensity was adequate.
Completeness	No	Surveying is complete.
Resources	No	Seven surveys and 184 person days were invested in this assessment.
Remoteness and/or access problems	No	There were no access problems during surveying. The length of the pipeline and location of remnants large enough to support trapping grids dictated that pipeline trapping sites were placed in the vicinity of Albany; however as habitat near the mine site is similar to the eastern section of pipeline this is unlikely to have significantly impacted on results.
Availability of contextual (e.g. biogeographic) information on the region	No	Data was sourced from the WA Museum fauna database, DEC lists, Birds Australia databases, and biological surveys of the Wellstead area. The literature review revealed no surveys of similar scope have been conducted in the Wellstead area.

Key: Significant = greater than 60% of potential fauna not sampled
Moderate = 20-60% of potential fauna not sampled
Negligible = less than 20% of potential fauna not sampled

Mine Site Fauna

Three major fauna habitats occur within the mine site; (1) Mallee–Heath, (2) Seasonally inundated wetlands and (3) Low sand dunes (Figure 6.14).

One hundred and forty nine species of vertebrate fauna were recorded from nine Systematic Sites and four Opportunistic Sites within the mine site (Figure 6.15). Fauna was comprised of 15 native and six introduced species of mammals, 97 species of birds, 20 species of reptiles and 11 species of frogs. Twenty four of these species are endemic to the south-west of the State.

Mine Site Fauna: Mammals

Fifteen native species and six introduced species of mammal were recorded during the mine site survey (Appendix 12- 7). This inventory comprised six ground dwelling mammal species; the Bush Rat (*Rattus fuscipes*), Ash Grey Mouse (*Pseudomys albocinereus*), Southern Brown Bandicoot (*Isoodon obesulus fusciventor*), Honey Possum (*Tarsipes rostratus*), Western Pygmy Possum (*Cercartetus concinnus*) and the Western Grey Kangaroo (*Macropus fuliginosus*), the arboreal Common Brushtail Possum (*Trichosurus vulpecula*) and eight bats. The bats recorded were the White-striped Freetail Bat (*Tadarida australis*), the Southern Freetail-bat (*Mormopterus planiceps*) Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Western False Pipistrelle (*Falsistrellus mackenziei*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Gould's Long-eared Bat (*Nyctophilus gouldii*) and the Southern Forest Bat (*Vespadelus regulus*).

Western Brush Wallabies (*Macropus irma*) are reported to occur in the area (Leighton, 1996), however, none have been observed in the mine site either during surveying or by the landholders. Additional species that may occur in the area include the Mardo (*Antechinus flavipes leucogaster*), the Chuditch (*Dasyurus geoffroyii*), Grey-bellied Dunnart (*Sminthopsis griseoventor griseoventor*) and the Gould's Long-eared Bat (*Nyctophilus goudii*).

Six introduced mammal species were recorded during the mine site survey. These were the Cow (**Bos taurus*), Sheep (**Ovis aries*), Cat (**Felis catus*), Fox (**Vulpes vulpes*), House Mouse (**Mus musculus*) and Rabbit (**Oryctolagus cuniculus*).

Mine Site Fauna: Birds

Of the 151 bird species potentially occurring in the area, 97 species from 34 families were recorded within the proposed mine site (Appendix 12- 7). The most commonly recorded families were Meliphagidae (Honeyeaters; 12 species), Anatidae (Ducks; seven species) and Accipitridae (Kites, Hawks, Eagles; seven species). The most common species include the Regent Parrot (*Polytelis anthopeplus*), the Yellow-rumped Thornbill (*Acanthiza chrysorrhoa*), the Red Wattlebird (*Anthochaera carunculata*), the New Holland Honeyeater (*Phylidonyris novaehollandiae longirostris*) and the Silvereye (*Zosterops lateralis*).

Mine Site Fauna: Reptiles

Twenty species of reptile were recorded within the proposed mine site (Appendix 12- 7). The reptile assemblage comprised one gecko (Gekkonidae), three legless lizards (Pygopodidae), one Varanid (Varanidae), 11 skinks (Scincidae) and four elapid snakes (Elapidae).

An additional 16 species may occur in the vicinity of the mine site; however this includes a number of species such as the Western Heath Dragon (*Rankinia adelaidensis*) and Western Stone Gecko (*Diplodactylus granariensis*), which, if present will be at the extreme limits of their current known range. Species that were not recorded during surveying, but are likely to occur in the area include the Western

Blue-tongue (*Tiliqua occipitalis*) and *Lerista distinguenda*. There are reports from local landholders that Carpet Pythons (*Morelia spilota imbricata*) occur within the vicinity of the mine site, with very irregular sitings near homesteads and on the Mettler Lake Road.

Mine Site Fauna: Amphibians

Eleven of the potential 13 frog species known to occur in the area were recorded during surveying (Appendix 12- 7). This comprised of three Hylids (tree frogs) and eight Myobatrachids (ground-dwelling or burrowing frogs). The two species not recorded were the Moaning Frog (*Heleioporus eyrie*) and the Humming Frog (*Neobatrachus pelobatiodes*).

The abundance of standing water and wetlands and the presence of deep sands provide excellent habitat for frog species in the area, and consequently resulted in the large number of frog species and individuals recorded during surveying.

During the autumn survey the most common species observed were the Spotted-thighed Frog (*Litoria cyclorhyncha*), the Banjo Frog (*Limnodynastes dorsalis*) and White-footed Trilling Frog (*Neobatrachus albipes*). During the summer survey, large numbers of juvenile frogs were present in the mine site, with many in the wetlands not yet completing metamorphosis from tadpoles into frogs. The most commonly recorded species during the survey was the Banjo Frog, with over 1,800 capture records. Adult frogs were very rare (an estimated less than 1% of total captures) during the summer survey.

6. THE PROJECT ENVIRONMENT

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LEGEND

- Drainage depressions
- Low dunes with deep white sands
- Mallee Heath
- Plantation & degraded vegetation

rev	details	date
C	Areas added	11-10-06
B	Additional areas shown	30-06-06
A	Original drawing	15-06-05

note: this drawing is the property of harley survey group pty ltd it may not be copied or altered without the consent of the owner

ecologia ENVIRONMENT

survey: COMPILED
cad file: 12937-051C.dgn
drawn: JBdS 03-02-06
checked:
horiz datum: MGA 94
level datum: AHD
scale at A3: 1 : 25000
all distances are in metres
0 200 400 600 800 1000 120

client: GRANGE RESOURCES LIMITED

SOUTHDOWN MAGNETITE PROJECT

description:

FAUNA HABITATS
MINE SITE

Figure 6.14

PYRMONT HOUSE
ALBANY

harley survey group

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rev	details	date
E	FAUNA TRAP SITE 7 8 & 9 ADDED, SITE F DELETED	03-02-06
D	FAUNA TRAP SITE Nos ADDED	20-09-05
C	ADDITIONAL TRAP SITES A to E and OPP WETLAND	20-09-05
B	POSITIONAL CORRECTION TO FAUNA TRAPS	13-07-05
A	Original drawing	15-06-05

note: this drawing is the property of harley survey group pty ltd it may not be copied or altered without the consent of the owner

Harley Survey Group Pty Ltd
116 Serpentine Road. ALBANY WA 6330
T: 08 9841 7333 F: 08 9841 3643
E: hsgalb@harleygroup.com.au

survey: GPS Locations
cad file: 12937-011E.dgn
drawn: JBdS 03-02-06
checked:
horiz datum: MGA 94
level datum: AHD
scale at A3: 1 : 25000
all distances are in metres
0 200 400 600 800 1000 120

client: GRANGE RESOURCES LIMITED A.C.N. 009 132 405

SOUTHDOWN MAGNETITE PROJECT

description:
FAUNA SURVEY SITES
MINE SITE

TRAP SITES 1 - 9
OPPORTUNISTIC SITES A - D

Figure 6.15

PYRMONT HOUSE
ALBANY

harley survey group

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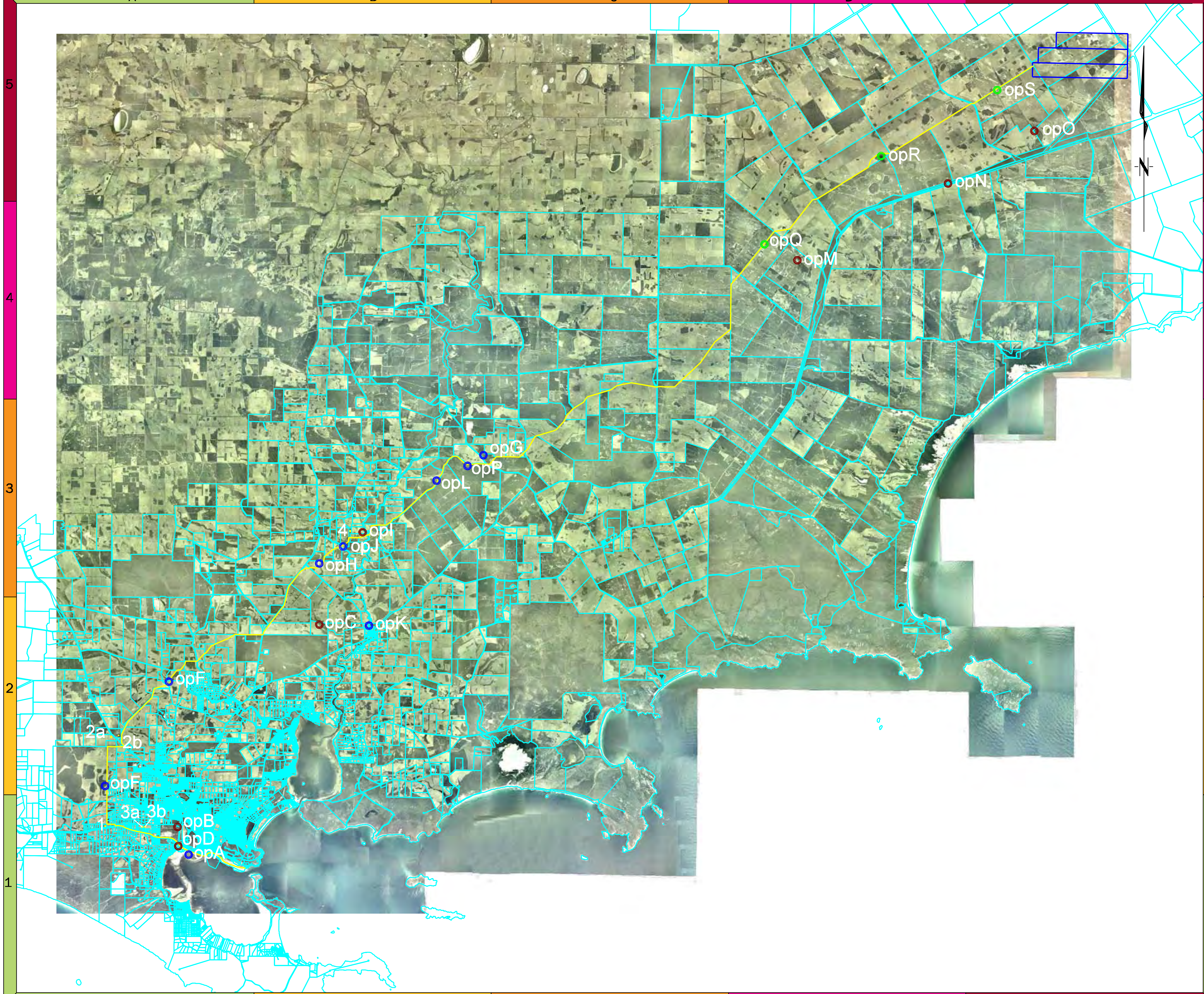

LEGEND

- SPRING SURVEY
- AUTUMN & SPRING SURVEY
- AUTUMN SURVEY
- TRAP SITES
- PIPE ROUTE
- MINING LEASE

rev	details	date
C	PIPE ROUTE CURRENT AS AT	20-10-06
B	FLORA SITES UPDATED	22-12-05
A	Original drawing	02-05-05

note: this drawing is the property of harley survey group pty ltd. it may not be copied or altered without the consent of the owner.

Harley Survey Group Pty Ltd
116 Serpentine Road. ALBANY WA 6330
T: 08 9841 7333 F: 08 9841 3643
E: hsgalb@harleygroup.com.au

survey: COMPILED & GPS	cad file: 12937-029C.dgn
drawn: JBdS 09-12-05	checked
horiz datum: MGA 94	level datum: N.A.

scale at A3: 1 : 250000 — all distances are in kilometres (0, 5, 10)

client: GRANGE RESOURCES LIMITED

description: SOUTHDOWN MAGETITE PROJECT PIPELINE FLORA SITES

Figure 6.16

PYRMONT HOUSE
ALBANY

harley survey group

6. THE PROJECT ENVIRONMENT

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6. THE PROJECT ENVIRONMENT

Pipeline Corridor Fauna

The proposed pipeline corridor crosses six major fauna habitats; (1) Jarrah woodland, (2) Jarrah/ Marri/ Sheoak woodland, (3) Peppermint woodland, (4) Mallee-Heath, (5) Estuarine, and (6) Rivers, creeks and other wetlands.

One hundred and thirty four species of vertebrate fauna were recorded within the proposed pipeline corridor, from four Systematic Sites and 19 Opportunistic Sites (Figure 6.16). Fauna was comprised of 14 native and six introduced species of mammals, 83 species of birds, 19 species of reptiles, 12 species of frogs and four species of freshwater fish. Thirteen of these species are endemic to the south-west of the State.

Pipeline Corridor Fauna: Mammals

Fourteen native mammal species were recorded during the proposed pipeline route survey (Appendix 12-7), including the Southern Brown Bandicoot (*Isoodon obesulus fusciventor*), Western Ringtail Possum (*Pseudocheirus occidentalis*), Common Brushtail Possum (*Trichosurus vulpecula*), Honey Possum (*Tarsipes rostratus*), Grey-bellied Dunnart (*Sminthopsis griseoventor griseoventor*), Bush Rat (*Rattus fuscipes*) and the Western Grey Kangaroo (*Macropus fuliginosus*).

Six introduced mammal species were recorded during the proposed pipeline route survey. These were the Black Rat (**Rattus rattus*), Fox (**Vulpes vulpes*), House Mouse (**Mus musculus*), Rabbit (**Oryctolagus cuniculus*), Sheep (*Ovis aires*) and Cattle (*Bos taurus*).

Bats accounted for half the mammal species recorded during the proposed pipeline route survey (six species); these were Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Gould's Long-eared Bat (*Nyctophilus gouldi*), White-striped Freetail Bat (*Tadarida australis*) and the Southern Forest Bat (*Vespadelus regulus*). The record of Gould's Long-eared Bat (*Nyctophilus gouldi*) from the Fuller Rd reserve is of local significance as this record occurs on the eastern extremity of its range in WA.

Pipeline Corridor Fauna: Birds

Eighty three species from 37 families were recorded during the proposed pipeline route survey. The most numerous bird families recorded in the survey were Meliphagidae (Honeyeaters; 7 species), Accipitridae (Hawks, Kites and Eagles; 6 species) and Acanthizidae (Thornbills, Scrubwrens; 6 species). The most abundant species in the pipeline route (based on number of records) include the New Holland Honeyeater (*Phylidonyris novaehollandiae longirostris*), the Grey Fantail (*Rhipidura albiscapa preissi*), the Australian Magpie (*Gymnorhina tibicen dorsalis*) and the Silvereye (*Zosterops lateralis chloronotus*).

Pipeline Corridor Fauna: Reptiles

Nineteen reptile species were recorded during the proposed pipeline route survey (Appendix 12- 7). The recorded reptile assemblage comprised of one gecko (Gekkonidae), two legless lizards (Pygopodidae), 11 skinks (Scincidae), one goanna (Varanidae) and three snakes (Elapidae). The most commonly recorded species in the survey included the skinks *Hemiergis peronii, Egernia kingii* and *Egernia luctuosa,* and the marbled gecko *Christinus marmoratus.*

Species not recorded during surveying that are expected to be widespread within the proposed pipeline route include the Dugite (*Pseudonaja affinis*), and the skinks *Cryptoblepharus virgatus* and *Lerista microtis.*

Pipeline Corridor Fauna: Amphibians

Twelve species of frog were recorded during the proposed pipeline route survey, comprising two tree frogs (Hylidae) and ten ground dwelling/ burrowing frogs (Myobatrachidae). The most commonly recorded species during surveying were the Banjo frog (*Limnodynastes dorsalis*) and the Quacking frog (*Crinia georgiana*).

Above average rainfall and lower than average temperatures during spring resulted in local flooding within the vicinity of much of the proposed pipeline route providing ideal conditions to support frog populations. Consequently, frogs were frequently observed and heard calling during both seasons of surveying.

Pipeline Corridor: Fishes

Four species of fish were recorded during surveying from within the King and Kalgan Rivers; the Western Minnow (*Galaxias occidentalis*) and Western Pygmy Perch (*Edelia vittata*) – both endemic to south-west Western Australia – the Swan River Goby (*Pseudogobius olorum*) and the introduced Gambusia (**Gambusia holbrooki*).

Section 6.7.3 Fauna of Conservation Significance

Fauna species that have been formally recognised as rare, threatened with extinction, or as having high conservation value are protected by law under Commonwealth and State legislation. At the national level, fauna are protected under the *EPBC Act 1999*. Within WA, rare fauna are listed under the *Western Australian Wildlife Conservation Act 1950: Wildlife Conservation (Specially Protected Fauna) Notice 2005*.

International Agreements include the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), the April 1991 Australian and New Zealand Environment and Conservation Council (ANZECC) Convention and the IUCN Red List (International Union for the Conservation of Nature and Natural Resources). An explanation of conservation codes is presented in Appendix 12- 3.

Rare and Specially Protected Fauna

A search of the DEC Threatened Fauna Database and the DEH Protected Matters Database using the following co-ordinates (north-west and south-east corners) was undertaken to determine species of conservation significance previously recorded or likely to occur in the Project area.

- Area 1: 653000mE 6190000mN / 625000mE 6164000mN;
- Area 2: 625000mN 6173000mE / 613000mE / 6146000mN;
- Area 3: 613000mE 6160000mN / 601000mE 6136000mN;
- Area 4: 601000mE 6155000mN / 587000mE 6132000mN; and
- Area 5: 587000mE 6145000mN / 570000mE 6122000mN.

All available published and unpublished literature was reviewed to determine likely species assemblages present within the proposed mine site and pipeline route. The species identified from the Southdown Magnetite Proposal area summarised in Table 6.16.

Fifteen bird species listed under international agreements (CAMBA/ JAMBA), 30 fauna species listed under Federal legislature, 24 fauna species listed under State legislature and 15 fauna species listed as DEC Priority potentially occur in the Southdown Magnetite Proposal area (Table 6.16).

Table 6.16 Fauna of Conservation Significance Known to Occur In and Around the Southdown Proposal Area.

Note: MS = Mine site; PL = Pipeline; CAMBA = China-Australia Migratory Bird Agreement; JAMBA = Japan-Australia Migratory Bird Agreement; EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*; WCA = *Wildlife Conservation Act 1950*.

Family	Species	Common Name	Potentially occurs		CAMBA	JAMBA	EPBC Act	WCA	DEC Priority	Endemic to SW WA	Habitat	Likelihood of Occurrence
			MS	PL								
Mammals												
Dasyuridae	*Dasyurus geoffroyii*	Western Quoll, Chuditch	✓	✓			VU	S1		Y	Formerly distributed across semi-arid southern Australia, it is now restricted to the south-west of WA. Its habitat includes Jarrah forest, drier woodlands and mallee shrublands.	Low
Dasyuridae	*Macrotis lagotis*	Bilby	✓	✓			VU	S1			Grasslands on Clayey and stony soils.	Low
Dasyuridae	*Parantechinus apicallis*	Southern Dibbler		✓			VU	S1		Y	Restricted to the South West of Australia and a few small islands off the coast.	Low
Dasyuridae	*Phascogale calura*	Red-tailed Phascogale		✓			EN	S1			Dense patches of *Casuarina huegeliana* and where *Euclayptus wandoo* occur.	Low
Macropodidae	*Macropus irma*	Western Brush Wallaby	✓	✓					P4		Occurs in areas of forest and woodland supporting a dense shrub layer.	Moderate

Family	Species	Common Name	Potentially occurs		CAMBA	JAMBA	EPBC Act	WCA	DEC Priority	Endemic to SW WA	Habitat	Likelihood of Occurrence
			MS	PL								
Macropodidae	*Setonix brachyurus*	Quokka	✓	✓			VU	S1			Mainland populations are restricted to densely vegetated coastal heaths, swamps and riverine vegetation.	Low
Muridae	*Hydromys chrysogaster*	Water Rat		✓					P4		Occurs in waterways and wetlands that support its main prey items.	Moderate
Myrmecobiidae	*Myrmecobius fasciatus*	Numbat		✓			VU		S1		Eucalyptus forest and woodland.	Low
Otariidae	*Neophoca cinerea*	Australian Sea Lion		✓			VU	S4			Sandy beaches and rocky shores	Low
Otariidae	*Arctocephalus forsteri*	New Zealand Fur Seal		✓			MA	S4			Prefers rock platforms and boulder filled beaches.	Low
Peramelidae	*Isoodon obesulus fusciventor*	Southern Brown Bandicoot	✓	✓					P5	N	Sandy soil with scrubby vegetation	**Recorded**
Pseudocheiridae	*Pseudocheirus occidentalis*	Western Ringtail Possum		✓			VU	S1		Y	Near coastal areas and the Eucalypt forests of the Warren catchment. Resident population occurs in Albany.	**Recorded**
Vespertilionidae	*Falsistrellus mackenziei*	Western False Pipistrelle	✓	✓					P4	Y	Mature Karri forest and also wetter stands of other Eucalypts.	**Recorded**
Birds												

Family	Species	Common Name	Potentially occurs		CAMBA	JAMBA	EPBC Act	WCA	DEC Priority	Endemic to SW WA	Habitat	Likelihood of Occurrence
			MS	PL								
Acanthizidae	*Calamanthus campestris montanellus*	Rufous Fieldwren (western wheatbelt)	✓	✓					P4	Y	Lives in low, sparse heath, saltmarsh or samphire, with or without emergent trees.	Low
Accipitridae	*Haliaeetus leucogaster*	White-Bellied Sea Eagle	✓	✓	✓		MA, MI				Large rivers, fresh and saline lakes.	Moderate
Apodidae	*Apus pacificus*	Fork-tailed Swift	✓	✓	✓	✓	MA				Varied.	Low
Ardeidae	*Ardea sacra*	Eastern Reef Egret		✓	✓					N	Intertidal zone.	Low
Ardeidae	*Botaurus poiciloptilus*	Australiasian Bittern	✓	✓				S1			Inhabits beds of tall dense reeds and sedges in freshwater swamps.	Low
Ardeidae	*Ardea alba*	Great Egret	✓	✓	✓	✓	MA				Wetlands, intertidal mudflats, floodlands.	**Recorded**
Ardeidae	*Ardea Ibis*	Cattle Egret	✓	✓	✓	✓	MA				Pastures, shallow fresh wetlands.	Moderate-High
Atrichornithidae	*Atrichornis clamosus*	Noisy Scrub Bird	✓	✓			VU	S1		Y	Coastal vegetation.	Low
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	✓	✓			EN	S1		Y	Proteaceous scrubs and heaths, adjacent Eucalyptus woodlands and forests and pine plantations.	**Recorded**
Cacatuidae	*Calyptorhynchus baudinii*	Baudin's Cockatoo		✓			VU	S1		Y	Humid and sub-humid forests of south-western WA. North to the Darling Range and east to Albany; commonly visiting apple orchards.	High

Family	Species	Common Name	Potentially occurs		CAMBA	JAMBA	EPBC Act	WCA	DEC Priority	Endemic to SW WA	Habitat	Likelihood of Occurrence
			MS	PL								
Cacatuidae	*Calyptorhynchus banksii nasi*	Forest Red-tailed Black-Cockatoo	✓	✓				S1		Y	Occur in Jarrah-Marri-Blackbutt forests in south-west WA. Feeds predominantly on Jarrah and Marri seeds.	**Recorded**
Charadriidae	*Pulvialis squatarola*	Grey Plover		✓	✓	✓	MA MI				Beaches and mudflats	**Recorded**
Cinclosomatidae	*Psophodes nigrogularis nigrogularis*	Western Whip Bird (Western Heath)	✓	✓			EN	S1		Y	Dense coastal heath.	Low
Cinclosomatidae	*Psophodes nigrogularis oberon*	Western Whip Bird (Western Mallee)	✓	✓			VU		P4		Dense coastal heath.	Low
Falconidae	*Falco peregrinus*	Peregrine Falcon	✓	✓				S4		N	Distributed across much of Australia.	**Recorded**
Laridae	*Catharacta skua*	Great Skua	✓	✓			MA				Coastal , oceanic.	Low
Laridae	*Sternia caspia*	Caspian Tern	✓	✓	✓	✓	MA MI				Coastal and inland water courses.	Moderate
Megapodiidae	*Leipoa ocellata*	Malleefowl	✓	✓			VU	S1		N	Mainly scrubs and thickets. Attracted to fallen wheat in stubbles and along roads.	Low
Meropidae	*Merops ornatus*	Rainbow Bee-eater				✓	MA				Varied, drainage lines, woodlands.	High
Otitidae	*Ardeotis australis*	Australian Bustard	✓	✓					P4	N	Occurs in grassland, grassy woodland, pastoral land and crops throughout much of Australia.	**Recorded**

Family	Species	Common Name	Potentially occurs		CAMBA	JAMBA	EPBC Act	WCA	DEC Priority	Endemic to SW WA	Habitat	Likelihood of Occurrence
			MS	PL								
Pachycephalidae	*Falcunculus frontatus leucogaster*	Crested Shrike-tit	✓	✓					P4	Y	Woodlands, scrubs and more open forests.	Moderate
Pachycephalidae	*Oreoica gutturalis gutturalis*	Crested Bellbird (southern)	✓	✓					P4		Inhabits drier mallee woodlands and heaths.	Low
Pardalotidae	*Dasyornis longirostris*	Western Bristle Bird	✓	✓			VU	S1		Y	Dense coastal heath; taller swamp/stream thicket.	Low
Procellariidae	*Halobaena caerulea*	Blue Petrel	✓	✓			VU MA				Oceanic.	Low
Procellariidae	*Macronectes giganteus*	Southern Giant Petrel		✓			EN MA MI	S1			Oceans and bays.	Low
Procellariidae	*Macronectes halli*	Northern Giant Petrel		✓			VUN MA MI				Oceans and bays.	Low
Procellariidae	*Puffinus carneipes*	Flesh-footed Shearwater		✓		✓				N	Coastal.	Low
Procellariidae	*Puffinus tenuirostris*	Short-tailed Shearwater		✓		✓				N	Coastal.	Low
Psittacidae	*Pezoporus wallicus flaviventris,*	Western Ground Parrot		✓			EN	S1		Y	Low shrub-lands, particularly those containing low *Banksia* and *Hakea*. Attracted to *Daviesia pachyphylla* regenerating after fire. May occur towards the coastal extreme of the proposed pipeline route.	Low

Family	Species	Common Name	Potentially occurs		CAMBA	JAMBA	EPBC Act	WCA	DEC Priority	Endemic to SW WA	Habitat	Likelihood of Occurrence
			MS	PL								
Psittacidae	*Platycercus icterotis xanthogenys*	Western Rosella (mallee)	✓	✓				S1		Y	Open forest, woodland, farms.	Low
Scolopacidae	*Tringa nebularia*	Common Greenshank	✓	✓	✓					N	Sheltered estuaries, inlets, saltmarsh.	Moderate – Low
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper		✓	✓	✓				N	Banks, rocks and sandy beaches.	**Recorded**
Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper	✓	✓	✓	✓				N	Fresh or saltwater	Low
Scolopacidae	*Calidris ruficollis*	Red-necked Stint		✓	✓	✓				N	Coastal and estuarine inland shores.	Moderate – High.
Scolopacidae	*Arenaria interpres*	Ruddy Turnstone		✓	✓	✓				N	Rocky shores with seaweed.	Low
Scolopacidae	*Calidris alba*	Sanderling		✓	✓	✓				N	Sandy coastal beaches.	Low
Scolopacidae	*Calidris acuminata*	Sharp-tailed Sandpiper		✓	✓	✓				N	Coastal and interior wetlands.	Moderate
Scolopacidae	*Tringa glareola*	Wood Sandpiper	✓	✓	✓	✓				N	Freshwater, and occasionally brackish waters.	Low
Tytonidae	*Tyto novaehollandiae novaehollandiae*	Masked Owl (SW ssp)		✓					P3	Y	Inhabits forests and woodlands, nesting in tree hollows.	Low
Reptiles												
Boidae	*Morelia spilota imbricata*	South-western Carpet Python	✓	✓				S4		Y	A wide variety of semi-arid coastal and inland habitats	Moderate
Cheloniidae	*Caretta caretta*	Loggerhead Turtle		✓			EN	S1			Tropical and warm temperate waters occassionally venturing down south of Australia.	Low

Family	Species	Common Name	Potentially occurs		CAMBA	JAMBA	EPBC Act	WCA	DEC Priority	Endemic to SW WA	Habitat	Likelihood of Occurrence
			MS	PL								
Dermochelyidae	*Demochelys coriacea*	Leatherback Turtle		✓			VU	S1			North west and south east of Australia's coastline occasionally venturing to the south west.	Low
Freshwater Fish												
Galaxiidae	*Galaxiella munda*	Western Mud Minnow		✓					P4	Y	Most common in small flowing streams near submerged vegetation, occasionally in still water of ponds, swamps and roadside drains.	Low
Galaxiidae	*Galaxias truttaceus*	Trout Minnow		✓				S1	P4	Y	.Occurs in the margins of rivers, streams and lakes, most commonly at lower elevations close to the coast.	Low
Percicchthyidae	*Nannatherina balstoni*	Balston's Pygmy Perch		✓					P4	Y	Acidic, tannin-stained freshwater pools, streams and lakes in sandy areas within 30 km of the coast.	Low
Percicchthyidae	*Nannatherina balstoni*	Balston's Pygmy Perch		✓					P4	Y	Acidic, tannin-stained freshwater pools, streams and lakes in sandy areas within 30 km of the coast.	Low

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Seven fauna species of conservation significance were recorded during the fauna survey of the mine site and pipeline corridor. These species are listed and discussed below:

- Western Ringtail Possum (*Pseudecheirus occidentalis*);
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*);
- Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*);
- Western False Pipestrelle (*Falsistrellus mackenzei*);
- Australian Bustard (*Ardeotis australis*);
- Peregrine Falcon (*Falco peregrinus*); and
- Southern Brown Bandicoot (*Isoodon obesulus fusciventor*).

Rare and Specially Protected Fauna: Western Ringtail Possum

The Western Ringtail Possum *(Pseudecheirus occidentalis)* is currently listed as Vulnerable under the *EPBC Act* and is listed as Schedule 1, Division 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2005 issued subject to section 14(2) (ba) of the *Wildlife Conservation Act 1950.*

It is relatively common and abundant on the Swan Coastal Plain near Busselton, with viable populations in some of the urban areas. Pertinent to the Southdown proposal, Jones *et al.* (1994) noted populations of Ringtail Possums at Two People's Bay, and in urban Albany itself.

The Western Ringtail Possum generally shelters in dreys constructed in the canopy of Peppermint trees. Populations further from the coast, however, tend to shelter in hollow Eucalypts, probably due to a lack of Peppermint trees (Jones, 1995). They have small home ranges (usually less than 3 ha), although this is smaller in Peppermint woodlands. Individuals, however, are quite mobile, using up to eight shelters in a year. Adjacent home ranges may also overlap quite extensively (Jones, 1995).

No habitat suitable to support Western Ringtail Possums occurs in the mine site.

Within the proposed pipeline route, only three of the remnants surveyed are likely to support breeding habitat or refuges for Western Ringtail Possums. These are the south end of the Fuller Rd reserve, extending into the Johnston property, the remnant at the corner of Cuming Road and the Point Melville remnant in central Albany.

Two Western Ringtail Possums were recorded in each season survey at the Cuming Road reserve (Site 1), adjacent to the extreme south-western point of the pipeline route. It cannot be determined whether the same individuals were recorded during both surveys, or if more than two individuals occur at this site. The site comprises a Jarrah (*Eucalyptus marginata*) and Sheoak (*Allocasuarina fraseriana*) woodland with a dense understorey of sedges and herbs, dominated by *Dasypogon bromeliifolius.* There are few Peppermint (*Agonis flexuosa*) trees present at this site; but those present are at the southern and western edges of the site. The area is relatively small (less than 5 ha) and surrounded on all four sides by rural residential properties. During the spring survey an adult was recorded on the 11th November 2005, which was observed feeding in a Jarrah tree during a nocturnal survey. The second individual was a subadult observed during a nocturnal survey on the 13th November 2005, and was feeding in a Sheoak tree. No dreys were observed here, suggesting that the resident population may shelter in hollows of the mature Jarrah trees at this site.

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Two dreys were recorded in Peppermint trees in the Point Melville remnant. No individuals were recorded during the trapping regime or night-spotting, and the lack of secondary evidence at this site suggests that this area is currently not utilised by Western Ringtail Possums.

No individuals were observed within the Fuller Rd reserve, and the lack of any secondary evidence at this site suggests that this area is currently not utilised by Western Ringtail Possums.

Rare and Specially Protected Fauna: Carnaby's Black Cockatoo

The Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the *EPBC Act* and Schedule 1 under the WCA. The Carnaby's Black Cockatoo Recovery Plan (Cale, 2003) includes the following reasons for its classification as endangered:

- Much of its habitat within the wheatbelt has been cleared or fragmented.
- Clearing of heathland surrounding breeding sites has reduced food availability for breeding birds and juveniles.
- Lack of eucalypt regeneration and deterioration of tree hollows has reduced the availability of nesting hollows.

Carnaby's Black Cockatoos rely on seeds from many species, but most commonly those of kwongan heath including *Banksia* sp., *Hakea* sp. and *Dryandra* sp. (Frith, 1976). It also feeds on the commercial plantations of *Pinus* spp. that are present in its range (Cooper, 2000; Saunders, 1974).

The cockatoos nest mainly in smooth-barked eucalypts (primarily Salmon Gums *Eucalyptus salmonophloia* and Wandoo *E. wandoo*), but are also known to utilise York Gum *E. loxophleba*, Marri *Corymbia calophylla* and Tuart *E. gomphocephala* (Johnstone and Storr, 1998). Nests are built in tree hollows, ranging in size from 23 to 30 cm in diameter and generally between 2.5 and 12 metres above ground. Outside the breeding season, Carnaby's Black Cockatoos are nomadic, moving towards the coast. They usually occur in pairs or small flocks; however during the off season (late spring to mid-winter) they may occur in large flocks of up to 2,000 individuals, which are often observed feeding in pine plantations.

Carnaby's Black Cockatoos were recorded in low numbers and low frequency within the mine site and pipeline corridor during both phases of surveying. It was most commonly observed flying overhead.

The remnant blocks within the mine site area do not support any habitat that could facilitate breeding for any Black Cockatoo species as the trees are not large enough to provide nesting hollows, and no kwongan heath was noted. However, the cockatoos are known to feed and breed at the Stirling Range National Park (DEH, 2006), approximately 13 km north-west of the site.

Along the pipeline route, only two of the remnants surveyed are likely to support breeding habitat for Black Cockatoos; the far end of the Fuller Rd reserve, extending into the Johnston property, and a remnant on private land on Hazzard Road. Neither of these areas will be cleared for construction of the pipeline.

Rare and Specially Protected Fauna: Forest Red-tailed Black Cockatoo

Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) is currently listed as Schedule 1 under the *Wildlife Conservation Act 1950*.

Forest Red-tailed Black Cockatoos were recorded from a number of locations within the proposed pipeline route; usually flying overhead, while no individuals were recorded from within the mine site.

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Similar to the Carnaby's Black Cockatoo, vegetation within the mine site does not support any habitat that could facilitate breeding for the Forest Red-tailed Black Cockatoo, as the trees are not large enough to provide nesting hollows.

While feeding habitat occurs in a number of areas adjacent to the pipeline, only a small amount is likely to be cleared (less than 5 ha of native vegetation) for construction of the pipeline. No breeding habitat will be cleared for construction of the pipeline.

Forest Red-tailed Black Cockatoos roost in Jarrah-Marri-Blackbutt habitat on the edge of roads, forest blocks or paddocks (Johnstone and Kirkby, 1999). Approximately 90% of its diet comprises seeds from Marri *Corymbia calophylla* and Jarrah *Eucalyptus marginata* fruits (Johnstone and Kirkby, 1999). It also feeds on Blackbutt *E. patens*, Albany Blackbutt *E. staeri*, Sheoak *Allocasuarina fraseriana* and Snottygobble *Persoonia longifolia* (Johnstone and Kirkby, 1999; Johnstone and Storr, 1998). They feed in small family groups of up to ten birds, usually within 1 - 4 km of the roost (Johnstone and Kirkby, 1999).

All Black Cockatoos are monogamous and pairs probably form a lifetime bond (Smith and Saunders, 1986, Higgins, 1999). Breeding generally commences between four and six years of age (Shephard 1989). The Forest Red-tailed Black Cockatoo nests in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirkby, 1999). In Marri, the nest hollows of the Forest Red-tailed Black Cockatoo range from 8 m to 14 m above ground, the entrance is 12 cm to 41cm in diameter and the depth is 1 m to 5 m (Johnstone and Storr, 1998).

Rare and Specially Protected Fauna: Western False Pipestrelle

The Western False Pipestrelle (*Falsistrellus mackenzei*) is listed as DEC Priority 4 (taxa in need of monitoring). The primary threat to this species is removal of habitat due to logging of old growth forest. It occurs in several nature reserves, including the D'Entracasteaux National Park where it is secure (Strahan, 1995).

This species is a specialist which forages in the 'inside stand/ open' foraging microhabitat found under the canopy of mature trees. It nests in colonies within dead branches, with sexes believed to segregate for roosting and foraging (Strahan, 1995).

The Western False Pipistrelle was recorded within the mine site during the February 2006 survey. It was recorded from Site 5, adjacent to a permanent farm dam. This record is from the eastern limits of its known range. Very little habitat suitable to support this species is present in the proposed mine site, and its record here was not anticipated.

Rare and Specially Protected Fauna: Australian Bustard

Australian Bustard (*Ardeotis australis*) is listed as DEC Priority 4. It is distributed throughout the State, with the exception of the heavily wooded areas in the south. It occurs in open or lightly wooded grasslands, chenopod flats and plains, low heathlands and farming country. It is nomadic, with its abundance varying spatially and temporally depending on the availability of food resources (Johnstone and Storr, 1998).

Three Bustards were recorded opportunistically from within the mine site during the summer survey. The birds were feeding in harvested paddocks in the northern section of the site. One individual was observed on the 13th January 2006 and two individuals were recorded on the 17th January 2006.

The Bustard was not recorded during the pipeline surveys.

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Rare and Specially Protected Fauna: Peregrine Falcon

The Peregrine Falcon (*Falco peregrinus*) is listed as Schedule 4 under the *Wildlife Conservation Act 1950.* It is mostly rare throughout its range, but is moderately common in the Stirling Ranges. It has recently begun to colonise the wheatbelt (Johnstone and Storr, 1998).

The Peregrine Falcon is widespread throughout WA, with the exception of most deserts and the Nullarbor Plain (Johnstone and Storr, 1998). It most commonly occurs near cliffs along coasts, rivers and ranges and around wooded water courses and lakes. It nests primarily on ledges on cliffs, granite outcrops and in quarries; however may also nest in tree hollows in wetlands or old nests in the wheatbelt.

One Peregrine Falcon was observed on the 10th January 2006 hovering above Site 9. There is little to no suitable nesting habitat within the proposed mine site. No individuals were recorded during the pipeline survey.

Rare and Specially Protected Fauna: Southern Brown Bandicoot

The Southern Brown Bandicoot, or Quenda, *Isoodon obesulus fusciventor* is currently listed as DEC Priority 5. Major threats to the Southern Brown Bandicoot include predation by foxes, cats and dogs, loss of habitat and habitat fragmentation and fire in fragmented habitat.

The West Australian subspecies of the Southern Brown Bandicoot, is widely distributed near the south west coast of WA between Guilderton in the north to east of Esperance. It occurs in dense shrubland, often in swampy areas, and often feeds in adjacent forest and woodland that is burnt on a regular basis.

Southern Brown Bandicoots nest in shallow depressions, usually concealed under logs, shrubs or piles of debris. They will also use old rabbit burrows. Home ranges vary according to sex; males have a home range of two to seven hectares, while females have a home range of one to three hectares. Individuals are usually solitary, although home ranges may overlap.

Southern Brown Bandicoots were recorded at all trapping sites in the pipeline with 12 records during autumn surveying and 56 records during spring. Anecdotal and secondary evidence suggests that this species is present and common in suitable habitat in the vicinity of Albany.

Only two individuals were recorded within the mine site, both of which were captured during the summer survey. Secondary evidence (diggings) observed during the autumn survey suggests that they are present in most habitats within the proposed mine site.

Rare Fauna Habitat Assessment

In addition to the fauna survey as per methods outlined in Section 6.7.2, the Project footprint was assessed for fauna habitat of rare fauna listed under the *EPBC Act*: the Western Ringtail Possum and Carnaby's Black Cockatoo.

<u>Mine Site:</u> Assessment of the habitats within the mine site and surrounding areas (including the Mettler Lake Nature Reserve) for use by Black Cockatoos (*Calyptorhynchus* spp.) was made between October 24th and 26th 2005. During this period remnants were assessed for tree hollows that maybe used as breeding sites and for floristics representative of kwongan heath.

Assessments of remnants on the proposed mine site were made by walking across the area and noting the presence of large trees with hollows of appropriate dimensions to support breeding cockatoos. Assessments of the surrounding area were also made, including bushland in Mettler Lakes Nature Reserve.

The remnant blocks within the mine site area do not support any habitat that could facilitate breeding for any Black Cockatoo species as the trees are not large enough to provide nesting hollows, and no kwongan heath was noted. Some good foraging habitats were noted, however, these are well-represented outside the impact area, for example in the Hassell National Park immediately south of the mine site and the Stirling Range National Park approximately 13 km north-west of the mine site. Black Cockatoos are also known to feed on commercial plantation of *Pinus* spp, which are abundant in the Albany area.

<u>Pipeline:</u> Assessment of remnant vegetation along the proposed pipeline route was made between October 27th and 31st 2005. Suitable sites were assessed by foot traverses with records made of:

- the presence of large trees with hollows;
- presence or absence of Peppermint trees (*Agonis flexuosa*); and
- presence of possum dreys.

Along the proposed pipeline route, two of the remnants surveyed are likely to support breeding habitat for Black Cockatoos; the south end of the Fuller Rd reserve, extending into the Johnston property, and a remnant on private land on Hazzard Road. Neither of these areas will be cleared for construction of the pipeline.

Three of the remnants surveyed are likely to support breeding habitat or refuges for Western Ringtail Possums. These are the south end of the Fuller Rd reserve, extending into the Johnston property, the remnant at the corner of Cuming Road and the Point Melville remnant in central Albany.

Section 6.7.4 Short-range Endemic Invertebrate Fauna

Short-range endemics (SRE) are organisms (generally invertebrates) found only in a small area (< 10,000 km^2). They are typically relict species, often Gondwanan elements, that have been confined to habitats that were once more widespread, but through geological time have seen their preferred habitats contract. Typically, they have poor powers of dispersal, specific habitat requirements, low fecundity and long life-spans. They are therefore unable to move between their preferred habitats, resulting in a cessation of gene flow and speciation between isolated populations.

SRE's tend to occur in distinct, isolated and often relictual habitats. The native vegetation around the proposed Southdown mine site footprint was continuous with the surrounding landscape until the 1960s. After this time vegetation clearance for agriculture, followed by further habitat fragmentation, has resulted in a small number of remnant patches of native vegetation remaining in the Project area.

Aquatic habitats in south-western Australia are also known to support SRE species such as Phreatoicid Isopods. However the presence of rare and endemic fauna is often very difficult to detect and relatively undisturbed aquatic habitat should be afforded some management and protection (Horwitz and Rogan, 2003).

Short-Range Endemic Fauna Assessment and Constraints

A preliminary desktop survey (*ecologia*, 2006c) for SRE species potentially occurring in the Southdown Magnetite Proposal footprint was followed by a field survey targeting faunal groups most likely to contain SRE taxa. Following a preliminary reconnaissance, survey areas were chosen based on their:

(i) Potential to harbour short-range endemics taxa, chiefly areas with features/processes which are able to retain the moisture required by relictual fauna such as Mygalomorph spiders, Molluscs and Isopods.

(ii) Representative vegetation structure / association.

(iii) Conservation value or ecological sensitivity.

(iv) Representation of the proposed environmental impact relating to mining activity.

The SRE fauna assessment was divided into two survey areas: the proposed mine site footprint and the pipeline corridor. Survey timing and duration for each component is detailed in Table 6.17 below.

Table 6.17 Short-range endemic Survey Dates.

Area	Timing	Survey Type
Mine	24th-25th October 2005	Pitfall trapping
Mine	10th – 19th January 2006	Opportunistic Surveying
Pipeline	26th-28th October 2005	Opportunistic Surveying and Systematic Aquatic Fauna Surveying.

A range of techniques were employed to facilitate a comprehensive survey of potential SRE taxa at both the mine site area and along the proposed pipeline route. Survey methods took into account the limited availability of literature and data concerning short-range endemic taxa in the study area and the potential for both aquatic and terrestrial short-range endemic taxa.

Work carried out in the field included:

- Systematic surveys of terrestrial habitat at the proposed mine site using invertebrate pitfall traps.
- Systematic surveys of aquatic ecosystems through all depths and micro-habitats at the proposed mine site and along the pipeline corridor, using an standard invertebrate sweep net.
- Opportunistic searching of vegetation associations considered most likely to harbour SRE fauna at the proposed mine site and significant remnants potentially impacted by the pipeline. Searching involved the raking leaf litter, overturning of logs and stones and searching under bark of larger trees. Leaf litter samples were also collected (~ 500 g) from each of the five major vegetation associations during the January 2006 survey
- Opportunistic searching of aquatic sites both at the mine site and along the pipeline route for burrows of the freshwater crayfish genus *Engaewa*.

Pitfall traps and aquatic invertebrate sweeps were also conducted at Lake Mettler Nature Reserve, located several kilometres south-east of the mine site. These surveys were conducted so that in the event that conservation significant SRE taxa were confirmed at the mine site, the important taxa might also be recorded at the nearby reserve.

All major vegetation types were sampled using both systematic (October 2005) and opportunistic (October 2005 and January 2006) techniques. Terrestrial surveys (systematic and opportunistic) targeted Mygalomorph trap-door spiders, scorpions, pseudoscorpions, millipedes, centipedes, worms and snails. The aquatic surveys (systematic and opportunistic) targeted the freshwater crayfish genera *Engaewa* and Phreatoicid Isopods.

An assessment of aspects potentially limiting the Southdown Magnetite Proposal SRE fauna survey (EPA Guidance Statement No. 56 for Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA, 2003)) is detailed in Table 6.18 below.

Table 6.18 Short Range Endemic Fauna Survey Limitations and Constraints.

Aspect	Constraint (yes/no)	Comment
Competency/experience of the consultant carrying out the survey	No	All members of the survey team have appropriate training, experience and mentoring in SRE fauna identification and SRE fauna assemblage surveys.
Scope	No	The survey scope was prepared in consultation with the DEC and WAM. It has been designed to satisfy the requirements of EPA Guidance Statement No. 56.
Proportion of fauna identified, recorded and/or collected	No	This survey represents a first for the region and thus at this stage it is difficult to determine the proportion of potential SRE fauna recorded by the two surveys. The number of opportunistic sites and hours completed in January 2006, however, was in excess of those discussed with the DEC in pre-survey discussions and three rarely collected species were obtained, highlighting the need for additional survey work in the area..
Sources of information e.g. previously available information vs. new data	Yes	Museum records of SRE fauna east of Albany are scarce.

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Aspect	Constraint (yes/no)	Comment
The proportion of the task achieved and further work which might be needed	No	This survey was satisfactorily completed. WAM and UWA staff have suggested that further surveys of areas outside the mine site need to be completed to further understand SRE distribution in the area.
Timing/weather/season/cycle	No	SRE fauna are usually more active in the months either side of, and through out winter months. Fortunately, late rains and unseasonal conditions resulted in large areas of the mine site being inundated or damp in January 2006. Overcast and rainy conditions at the time of survey also may have aided in the collection of numerous Mygalomorph spiders, Pseudoscorpions and Scorpions.
Disturbances which affected results of survey	Yes – Moderate	Stock activity and rising groundwater levels resulted in the bulk of the pitfall traps being displaced and their data rendered unviable.
Intensity (in retrospect was the intensity adequate)	Yes – Moderate	It is considered that sufficient effort was completed to accurately determine the distribution and abundance of potential SRE fauna in both the mine site and on the pipeline route. Significantly more time was spent surveying the mine site in January than was negotiated with the DEC in pre-survey discussions.
Completeness	Yes - Negligible	Due to the unseasonal rains that flooded the pitfall traps and therefore eliminated the data, there is some level of incompleteness. However, this is considered to be absorbed by the extensiveness of the January 2006 opportunistic survey.
Resources	No	Potentially significant SRE taxa were identified by staff of the Western Australian Museum (Mark Harvey: Scorpions, Pseudoscorpions and Millipedes; and Mrs Shirley Slack-Smith: Terrestrial Gastropods). Dr Simon Judd identified the Isopods and Barbara York-Main confirmed the identification of the Mygalomorph spiders.
Remoteness and/or access problems	No	The mine site was on a major SW highway, 90km east of Albany. The proposed mine site has been an active wheat and cattle farm for many years, therefore there were many good condition tracks. Access to sites on the proposed pipeline was more difficult due to the large number of private properties it crossed. However, all potential SRE sites were visited and all landowners were very helpful in this regard.
Availability of contextual (e.g. biogeographic) information on the region	Yes - Significant	Very limited available information regarding SRE fauna east of Albany.

Key
Significant = greater than 60% of potential fauna not sampled
Moderate = 20-60% of potential fauna not sampled
Negligible = less than 20% of potential fauna not sampled

Summary of Taxa Collected

A total of 91 taxa were identified from both the proposed mine site and the pipeline survey sites (Table 6.19). This equated to ten Classes, 27 Orders and 68 Families of aquatic and terrestrial invertebrates. Arachnids were the most diverse group recorded, with 4 Orders and up to 25 families present. Mygalomorph spiders were found in 10% of sites, pseudoscorpions were found in 14.4% of sites and Theridiidae spiders were found in 18.9% of sites. However, both the relatively great diversity and presence of these three arachnid groups is considered a result of the targeting of Arachnids, which are known to contain a number of short-range endemic taxa (Mygalomorph spiders, scorpions and pseudoscorpions); not because Arachnids are particularly diverse in the area. The Dipteran subfamily Chironominae, at 13.3%, was the only other group to attain a presence above 10%. Other relatively diverse and widespread groups were generally aquatic organisms such as Coleoptera particularly the diving beetles Dytiscidae, mites (Acarina) and two families of 'true bugs' (Corixidae and Notonectidae).

Table 6.19 Summary of the Total Number of Taxa Recorded and the Number of Taxa Recorded From Each Major Vegetation Association at the Mine site.

Survey Type	Vegetation Association / Habitat	Total No of Taxa
Terrestrial Surveys	Lower rises on undulating plain and skeletal sand over laterite.	20
	Low dunes with deep white sands.	23
	Middle and lower slopes with deep white sands.	12
	Basement surrounding lower slopes.	20
	Drainage depression on undulating plains, seasonally inundated.	20
	Heath / Open Paperbark forest at edge of Lake Mettler Nature Reserve.	N/A
	Terrestrial fauna sites.	9
Aquatic Surveys	Heath / Open Paperbark forest at edge of Lake Mettler Nature Reserve.	40
	Aquatic Samples: Drainage depression on undulating plains, seasonally inundated.	35
Terrestrial and Aquatic Surveys	Lentic Wetlands, Creeks and Rivers and their riparian vegetation.	39

Potential SRE Taxa

A total of 151 potential SRE specimens were recorded from within the proposed mine site footprint and from within the proposed pipeline corridor. All specimens are listed in Table 6.20 and their recorded locations mapped in Figure 6.17 and Figure 6.18. The specimens represented seven potential SRE fauna groups. These included Mygalomorph spiders, Pseudoscorpions, Scorpions, Isopods, Millipedes (Diplopoda), Centipedes (Chilopoda) and Bothriembryon land snails. They were recorded at both the proposed mine site and within the proposed pipeline corridor.

Of the potential SRE species recorded, two trap-door spider species C*henistonia "paludigena" ms nom. BYM* and *Yilgarnia currycomboides* Main are considered to be in need of further distributional determination (B. Main, *pers.comm.*, 10/05/2006). *Chenistonia "paludigena"* has not previously been recorded from east of Albany hence additional specimens (including a female) are required. This record, from the east of Albany along the pipeline corridor is not unexpected, but is presently considered a range extension.

The Bothriembryon land snail species collected from the mine site is undescribed and is known from only two specimens. Both were opportunistically collected in the Wellstead area and were sent to the Museum in 1971 and 1974. The genus Bothriembryon is a typical SRE group, displaying strong genetic divergence between even close neighbours and thus, locating additional specimens would be necessary to accurately determine the impact of the proposal on this species.

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Table 6.20 Summary of the Potential SRE Fauna Recorded From Sites With in the mine site and along the Pipeline Corridor.

Taxa	No. of Specimens	No of Sites	Vegetation Associations/ Habitats	Vegetation/ Landform Types	
Centipedes • *Cormocephalus hartmeryeri* • *Cryptops australis* • *Austaloschendyla albanyensis*	6	6	2	Low Rises on Skeletal Sands, Wetlands (Mine site and Pipeline Sites)	Six individuals were recorded, two from the mine site and four from the pipeline route..
Isopods • *Philosciidae Laevophiloscia* • *Porcellio scaber* • *Armadillidium vulgare*	50	4	2	Wetland / Creeks (Pipeline Sites) and Low Rises on Skeletal Sands	Isopods were common along the pipeline, especially under the bark of large rotting logs on the banks of the Kalgan River and at Weir's wetland and the remnant at the Kratochvill property, meters away from seasonally inundated heath.
Millipedes • *Antichiropus sp.*	1	1	1	Wetland (Pipeline Site)	Just a single millipede was recorded from the Jarrah / Marri / She-oak woodland at the Kratochvill property.
Molluscs • *Ancylidae Ferrissia sp.* • *Bothriembryon brazieri* • *Bothriembryon new species "Wellstead"*	4	3	3	Wetlands, Mid Basement and Pipeline Site	A number of specimens of *Ancylidae: Ferrissia* (Walker, 1903) were recorded) at the mine site. The family Ancylidae and the Genus Ferrissia are widespread across Australia, being most abundant in southeastern and southwestern Australia. A single live specimen of *Bothriembryon brazieri* (Angas, 1871) was recovered from the pipeline, under a large rock in Jarrah /Marri woodland and no others were evident in the area. The species, though not common, is widespread in the lower slopes west, east and south of the Stirling Ranges
Mygalomorph Spiders • Idiopidae *Eucyrtops sp.* • Nemesiidae *Chenistonia tepperi* • Nemesiidae *Chenistonia "paludigena" ms nom. BYM* • Nemesiidae *Aname mainae* • Nemesiidae *Aname Wellstead sp.1* • Nemesiidae *Yilgarnia? Currycomboide*	12	12	3	Wetlands, Mid Basement and Low Rises on Skeletal Sands + Pipeline Sites	Mygalomorph (Mygalomorphae) spiders were relatively common with 12 individuals from 12 sites. The spiders were widespread on the mine site, and were recorded at two sites along the pipeline corridor.
Pseudoscorpions • *Oratemnus curtus* • *Conicochernes sp. 1*	50	13	4	Lower Basement, Low Rises on Skeletal Sands and Wetlands + Pipeline sites	Pseudoscorpions found at the mine site were both widespread and abundant, being found in the majority of the vegetation associations present.
Scorpions • *Urodacus novaehollandiae* • *Lychas sp.1*	5	5	3	Lower Basement and Pipeline Sites	Scorpions were relatively rare at both the mine site and within the pipeline corridor. Four true scorpions were recorded, three from the mine site and one from a site on the pipeline route.
	128	**44**			

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rev	details	date
B	Aditional Species	17-05-06
A	Original drawing	01-03-06

note: this drawing is the property of harley survey group pty ltd. it may not be copied or altered without the consent of the owner.

ecologia ENVIRONMENT

survey COMPILED	cad file 12937-0588 SRE F Minesite.dgn
drawn JBdS 01-03-06	checked
horiz datum MGA 94	level datum AHD

scale at A3 1 : 25000 — all distances are in metres (0, 500, 1000)

client GRANGE RESOURCES LIMITED A.C.N. 009 132 405

description
SOUTHDOWN MAGNETITE PROJECT
POTENTIAL SRE FAUNA FOUND
AT THE MINESITE

Figure 6.17

PYRMONT HOUSE
ALBANY

harley survey group

6. THE PROJECT ENVIRONMENT

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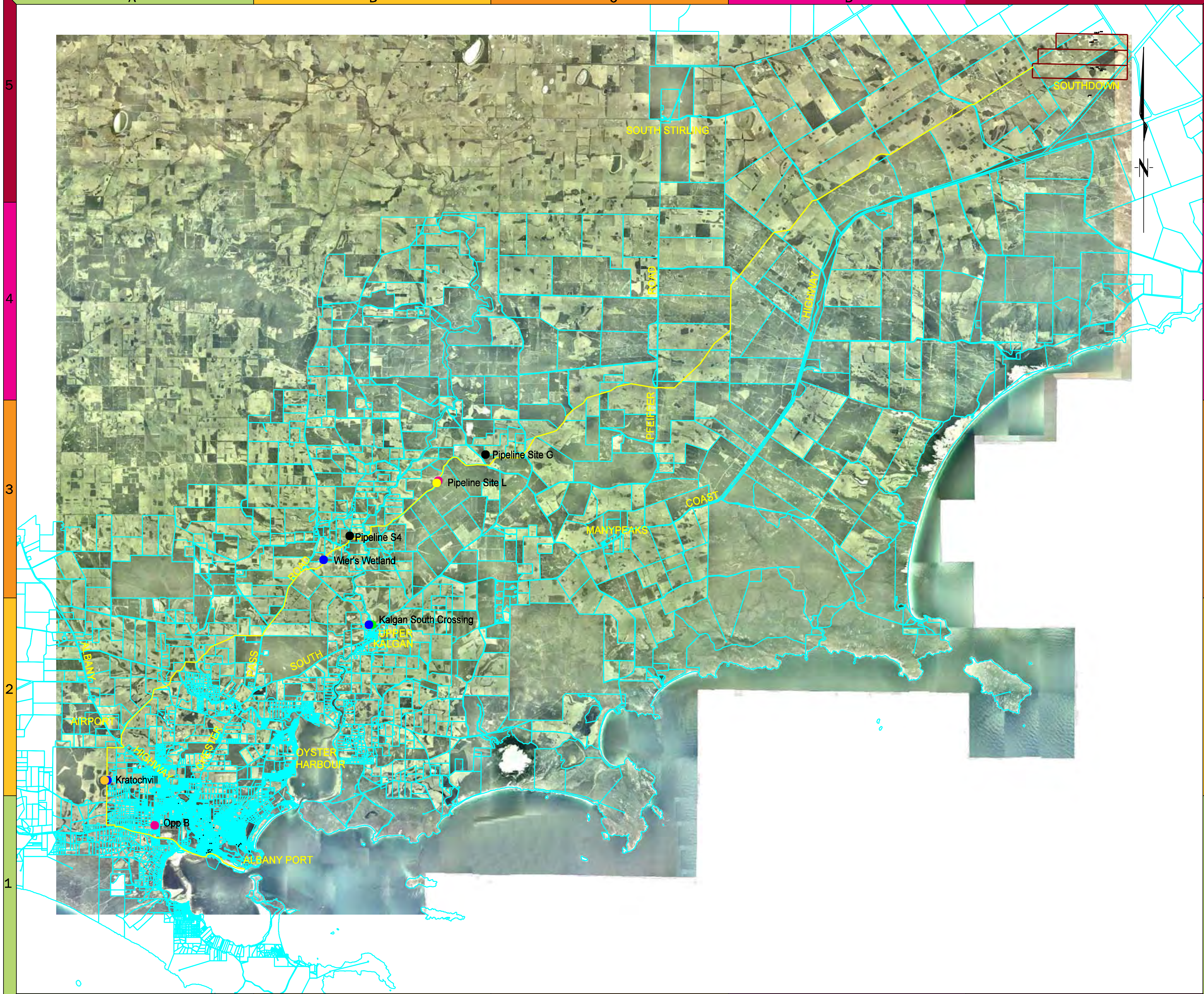

LEGEND

PIPELINE ROUTE

MINING LEASES

- Mygalomorph Spiders
- Scorpions
- Millipedes
- Centipedes
- Isopods
- Bothriembyron

rev	details	date
B	PIPE ROUTE UPDATED AND CURRENT AS AT	19-10-06
A	Original drawing	02-05-05

note: this drawing is the property of harley survey group pty ltd. it may not be copied or altered without the consent of the owner.

ecologia ENVIRONMENT

survey: COMPILED & GPS
cad file: 12937-059B.dgn
drawn: JBdS 01-03-06
checked:
horiz datum: MGA 94
level datum: N.A.
scale at A3: 1 : 250000
all distances are in kilometres
0 5 10

client: GRANGE RESOURCES LIMITED A.C.N. 009 132 405

description: SOUTHDOWN MAGNETITE PROJECT POTENTIAL SRE FAUNA FOUND ALONG PIPE ROUTE

drawing no: Figure 6.18

PYRMONT HOUSE
ALBANY

harley survey group

6. THE PROJECT ENVIRONMENT

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Section 6.7.5 Stygofauna

Stygofauna are aquatic obligate subterranean invertebrates found in a variety of groundwater systems. The richest group of stygofauna are crustaceans (Ostracoda, Syncarida, Copepoda, Amphipoda). However, insects (Coleoptera: Dytiscidae) and Malacostracans (Isopoda) may also be present. Stygofauna comprise a significant component of biodiversity and play an essential role in ecosystem processes by recycling nutrients through the food web in much the same way as aquatic macro invertebrates do in wetlands and lakes on the surface. They may also play an important role in maintaining groundwater quality through bioturbation and are important indicators of water quality and drawdown effects (Eberhard, 2004).

Factors influencing the distribution of stygofauna include the dispersal ability of the fauna, redox status of the groundwater, supply of organic matter, geological structure, rock and sediment types. Stygofaunal habitat is best developed in karstic aquifers, formed by the solutional erosion of rock such as limestone, dolomite and calcrete. Stygofaunal habitat may also occur in non-karstic rocks (fissured aquifer) and unconsolidated sediments (porous aquifer) (Eberhard, 2004). In non-karstic rocks natural voids may be associated with structural features, whereas in unconsolidated sediments the water-filled pores between the grains of sediment form an extensive habitat. Few invertebrates penetrate more than 1 m to 10 m down in non-karst environments. Stygofauna therefore may be present in aquifers in alluvial or other sediments as well as gravels alongside and beneath watercourses (Eberhard, 2004).

Stygofauna communities are thought to be totally dependent on the preservation and maintenance of the aquifer system as a whole. The shallow groundwater habitats and fauna occupy a narrow vertical range close to the watertable and are therefore potentially vulnerable to fluctuating groundwater levels and changes in the water regime that may alter energy and oxygen fluxes. Other threatening factors include groundwater contamination and impacts to areas above the aquifer where food resources are derived and carried into caves or groundwater zones with rainfall.

The EPA Guidance for the Assessment of Environmental Factors: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia No. 54 (EPA, 2003) states that proposals will be subject to formal EIA under the *Environmental Protection Act 1986* if they will potentially have a significant impact on stygofaunal habitat by:

- Lowering the water table sufficiently to dry out the zone in which some species live, or otherwise artificially changing water tables.
- Changing water quality (e.g. increasing salinity levels or altering haloclines, increasing nutrient levels or the availability of organic matter, or introducing other pollutants).
- Destroying or damaging caves (including changing their temperature and humidity).

The dispersion of stygofauna within karstic or fissured aquifers is often confined to subterranean cavities and fissures. The inherent patchiness of stygofauna habitat can result in sampling anomalies as stygofauna will only be detected when drill holes directly penetrate natural cavities containing stygofauna.

Stygofauna Sampling Programme

The stygofauna sampling programme for the proposed Southdown mine site was undertaken in compliance with EPA Guidance Statement No 54 and in consultation with the DEC. Basic water quality data including temperature, salinity, pH and dissolved oxygen were measured at each sampled bore using water quality meters.

6. THE PROJECT ENVIRONMENT

The sampling programme was undertaken between September 2005 and July 2006. Sampling was undertaken at 74 sites in total (89 samples), across two general localities in three phases. The two localities sampled were; the Southdown Magnetite area near Albany in the south coast region of WA, and the Redmond – King River area. Results from Redmond – King River area were used to provide important information on the regional distribution of taxa. The bores sampled included farm bores, domestic bores, and bores constructed between 2005 and 2006 for groundwater exploration, numerical modelling, and geotechnical investigations for the project. All the new bores were allowed to settle for at least six months before sampling was undertaken. The three phases of stygofauna sampling involved:

- Phase one included regional farm and domestic bores in both the Wellstead/Southdown and Redmond to Green Valley areas (Rockwater, 2006a).
- Phase two focused on additional groundwater exploration areas along the borefield alignment in December 2005 and is the subject of a separate report (Rockwater, 2006b).
- Phase three investigated in-pit areas at Southdown and regional areas surrounding both the Southdown mine site and the earlier borefield option in July 2006 (Rockwater, 2006c). Both the Pallinup and the underlying Werillup aquifers were sampled for stygofauna during this phase of sampling.

Collected taxa (Table 6.21 and Table 6.22) were grouped by their degree of groundwater dependence (where known or inferred by morphological examination) and assigned to a broad ecological category as follows:

A - Recognised stygobite (groundwater dependence confirmed).

N - Taxon not confined to the groundwater environment.

U - Uncertain dependence on groundwater (obligate groundwater taxa, facultative groundwater taxa, or temporary groundwater inhabitants).

A broad code for conservation status was also assigned to each taxon based on known distributions from the regional sampling programme and other available records (Table 6.21 and Table 6.22). Stygofauna were categorized as either:

W - Known to be locally common and/or of widespread distribution.

X - Likely to have a restricted distribution range.

U - Conservation status unknown (U).

Stygofauna in the Project Footprint

The Southdown Magnetite Proposal stygofauna sampling programme has shown that stygofauna are present in the Southdown area; representing the first reported identification of stygofauna near Albany in WA. This, however, probably reflects the lack of sampling undertaken to date rather than a paucity of stygofauna in the south coast region (Eberhard, 2005).

The survey has confirmed that there are no stygofauna of conservation significance in the vicinity of the planned mine pit. The most significant taxa recorded by the survey are understood to be the syncarids and a candonid ostracod that are known to be obligate groundwater taxa (stygobites). The stygobites have a higher conservation significance because they are restricted to the groundwater environment and typically have restricted distribution ranges. They have been recorded from at least four sites (WST2, RED22, and DB13 - Syncarida, and RED2 - Candonidae) (Figure 6.19, Figure 6.20).

Table 6.21. List of taxa, their groundwater dependence, conservation status and occurrence across sampling sites in the Southdown area.

TAXON	Groundwater Dependence*	Conservation Status	Site Code SWB1	SWB2	SWB3	PMS 50	SPWL1	SPWL2	SPWL3	WST1	WST2	WST3	WST4	WST5	GSP	SMB10	SMB11	SMB12	SMB13	SMB14	SMB15	SMB16	SMB17	SMB19	SMB5	SMB7	SMB9	Tyler 1 (TFB?)	Tyler 2 (TBB?)	WSD1	WSD3	WSD6	WSD7	COMMENTS
Distance (km) from 1.0 m drawdown contour			Z	<1	<1	Z	<1	2.5	1.5	3	<1	<1	1	4	3.5	Z	2	<1	<1	Z	Z	<1	Z	1	1.5	Z	Z	<1	7	3.5	2	7	8.5	
CRUSTACEA																																		
Copepoda																																		
Harpacticoida: Canthocamptidae																																		
Australocamptus sp. 5 (CALM SAP)	N	-						1			1																							Taxon known from the Murchison region and is widely distributed throughout WA wheatbelt.
Australocamptus cf. nr. sp. 5 (CALM SAP)	N	-						1																										Taxon similar to *Australocamptus* sp. 5 (CALM SAP) from Pilbara region.
Australocamptus cf. sp. B (CALM SAP)	N	-						1																										Taxon also known from surface waters in the WA wheatbelt.
Phyllognathopodidae																																		
Phyllognathopus viguieri	A1	W																																
Parastenocaridae																																		
Parastenocaris sp.	U8	U									1																							
Cyclopoida																																		
Australocyclops australis	A2	W		1				1																										Widespread and common species over most of Australia.
Paracyclops chiltoni	N	W														1			1		1													
Mesocyclops brooksi	N	W																		1														
Meridiecyclops sp. - juveniles possibly *M. baylii* (Fiers 2001)	N	W																																
Calanoida																																		
Calanoida sp.	U1	U																																
Syncarida																																		
Parabathynellidae sp.	A4	X									1																							Unidentified groundwater-dependent species. Site is 1 km NW of Southdown deposit.
Bathynellidae sp. 1	A3	X									1																							Unidentified groundwater-dependent species. Site is 1 km NW of Southdown deposit. Taxonomy and distribution of Syncarida poorly known in WA.
Bathynellidae sp. 2	A6	X																																
Bathynellidae sp. indet.	A7	X																																
Ostracoda																																		
Candonidae sp. indet.	A5	U																																
Darwinulidae sp. indet.	N	U																																
Cladocera																																		
Chydoridae sp. Indet.	N	U																							1									
Cyprididae																																		
(?) *Sarscypridopsis* sp.	N	-																																
OLIGOCHAETA																																		
Enchytraeidae																																		
Enchytraeus sp.	U2	W			1			1	1	1	1	1	1																1					Recorded from nine Southdown sites (locally common) and three sites in the Redmond-King River area.
Fredericia sp.	U3	U																																
Oligochaeta sp. indet.	N	U																					1							1				
APHANONEURA																																		
Aeolosoma sp.	U4	W								1																								Specimen collected 4.5 km SW of Southdown deposit. Taxon also known from the Pilbara.
NEMATODA																																		
Nematoda sp. 1	U5	W									1																							Taxon recorded from Southdown and the Redmond-King River area.
Nematoda sp. 2	U6	U						1			1	1					1																	Taxon recorded from one location, 2.8 km E of Southdown deposit.
Nematoda spp. indet.	U7	U							1																									
PLATYHELMINTHES																																		
Turbellaria sp. indet.	N	U																																
GASTROPODA																																		
Planorbidae																																		
(?) *Pygmanisus* sp.	N	-								1																								Non-stygal taxon (i.e. Surface aquatic or terrestrial invertebrate)
ACARIFORMES																																		
Oribatidae sp. indet.	N	-									1																							Non-stygal taxon (i.e. Surface aquatic or terrestrial invertebrate)
Trombidioidea sp. indet.	N	-								1		1			1																			Non-stygal taxon (i.e. Surface aquatic or terrestrial invertebrate)
Mesostigmata sp. indet.	N	U																																
Acariformes spp. indet.	N	U		1						1	1		1								1				1		1							Non-stygal taxon (i.e. Surface aquatic or terrestrial invertebrate)
INSECTA																																		
Diptera: Chironomidae spp. indet.	N	U																																
Diptera spp. indet.	N	U										1																						
TOTAL TAXA			0	2	1	0	0	6	2	5	9	4	2	0	1	1	1	0	1	1	2	0	1	0	2	0	1	0	1	1	0	0	0	

Legend/Explanation of Codes

(yellow shading)	Southdown Project Site
A	Recognised stygobite (groundwater dependence confirmed)
N	Taxon not confined to the groundwater environment
U	Uncertain dependence on groundwater (obligate groundwater taxa, facultative groundwater taxa, or temporary groundwater inhabitants)/ conservation status unknown
*	Numerical identifier for Figure 1
W	Taxon locally common and/or of widespread distribution
X	Taxon likely to have a restricted distribution range
Z	Site within 20 year modelled 1 m drawdown contour

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Table 6.22. List of taxa, their groundwater dependence, conservation status and occurrence across sampling sites in the Redmond – King River area.

TAXON	Groundwater Dependence*	Conservation Status	Site Code																																									COMMENTS
			RED1	RED2	RED3	RED4	RED5	RED6	RED7	RED8	RED9	RED10	RED11	RED12	RED13	RED14	RED15	RED16	RED17	RED18	RED19	RED20	RED21	RED22	RED23	RED24	RED25	RED26	RED27	DB13	DB16	DB17	DB5a	DB8A	RWB13	RWB21	RWB48d	RWB40d	RWB40s	RWB45d	RWB45s	RWB46s	RWB47d	RWB47s	
CRUSTACEA																																													
Copepoda																																													
Harpacticoida: Canthocamptidae																																													
Australocamptus sp. 5 (CALM SAP)	N	-																							1																		Taxon known from the Murchison region and is widely distributed throughout WA wheatbelt.
Australocamptus cf. nr. sp. 5 (CALM SAP)	N	-																		1																						Taxon similar to *Australocamptus* sp. 5 (CALM SAP) from Pilbara region.
Australocamptus cf. sp. B (CALM SAP)	N	-																																									Taxon also known from surface waters in the WA wheatbelt.
Phyllognathopodidae																																													
Phyllognathopus viguieri	A1	W										1																															
Parastenocaridae																																													
Parastenocaris sp.	U8	U																																									
Cyclopoida																																													
Australocyclops australis	A2	W																																									Widespread and common species over most of Australia.
Paracyclops chiltoni	N	W																																									
Mesocyclops brooksi	N	W																																									
Meridiecyclops sp. - juveniles possibly *M. baylii* (Fiers 2001)	N	W																						1	1																		Incomplete identification. *M. baylii* is a widespread species known from 53 site records, ranging from surface waters in the WA wheatbelt, to Eneabba Tumulus Springs and the Carnarvon Basin.
Calanoida																																													
Calanoida sp.	U1	U												1																													
Syncarida																																													
Parabathynellidae sp.	A4	X																																									Unidentified groundwater-dependent species. Site is 1 km NW of Southdown deposit.
Bathynellidae sp. 1	A3	X																																									Unidentified groundwater-dependent species. Site is 1 km NW of Southdown deposit. Taxonomy and distribution of Syncarida poorly known in WA.
Bathynellidae sp. 2	A6	X																				1																					
Bathynellidae sp. indet.	A7	X																										1															
Ostracoda																																													
Candonidae sp. indet.	A5	U		1																																							
Darwinulidae sp. indet.	N	U		1																																							
Cladocera																																													
Chydoridae sp. Indet.	N	U																																									
Cyprididae																																													
(?) *Sarscypridopsis* sp.	N	-		1																																							
OLIGOCHAETA																																													
Enchytraeidae																																													
Enchytraeus sp.	U2	W				1					1			1										1																			Recorded from nine Southdown sites (locally common) and three sites in the Redmond-King River area.
Fredericia sp.	U3	U			1																																						
Oligochaeta sp. indet.	N	U																						1								1												
APHANONEURA																																													
Aeolosoma sp.	U4	W																																									Specimen collected 4.5 km SW of Southdown deposit. Taxon also known from the Pilbara.
NEMATODA																																													
Nematoda sp. 1	U5	W									1		1		1															1															Taxon recorded from Southdown and the Redmond-King River area.
Nematoda sp. 2	U6	U																												1															Taxon recorded from one location, 2.8 km E of Southdown deposit.
Nematoda spp. indet.	U7	U																												1								1							
PLATYHELMINTHES																																													
Turbellaria sp. indet.	N	U																														1												
GASTROPODA																																													
Planorbidae																																													
(?) *Pygmanisus* sp.	N	-																																									Non-stygal taxon (i.e. Surface aquatic or terrestrial invertebrate)
ACARIFORMES																																													
Oribatidae sp. indet.	N	-	1					1			1		1					1	1									1																	Non-stygal taxon (i.e. Surface aquatic or terrestrial invertebrate)
Trombidioidea sp. indet.	N	-				1					1				1						1							1																	Non-stygal taxon (i.e. Surface aquatic or terrestrial invertebrate)
Mesostigmata sp. indet.	N	U																			1																	1							
Acariformes spp. indet.	N	U		1							1								1										1									1		1					Non-stygal taxon (i.e. Surface aquatic or terrestrial invertebrate)
INSECTA																																													
Diptera: Chironomidae spp. indet.	N	U																	1															1											
Diptera spp. indet.	N	U						1																																			
TOTAL TAXA			1	4	1	2	0	2	0	0	5	1	2	2	2	0	0	1	3	0	2	1	0	3	0	1	2	2	1	4	0	2	0	1	0	0	0	3	0	1	0	0	0	0	

Legend/Explanation of Codes

A	Recognised stygobite (groundwater dependence confirmed)
N	Stygofauna present (taxon not confined to the groundwater environment)
U	Uncertain dependence on groundwater (obligate groundwater taxa, facultative groundwater taxa, or temporary groundwater inhabitants)/ conservation status unknown
*	Numerical identifier for Figure 2
W	Taxon locally common and/or of widespread distribution
X	Taxon likely to have a restricted distribution range
Z	Site within 20 year modelled 1 m drawdown contour

6. THE PROJECT ENVIRONMENT

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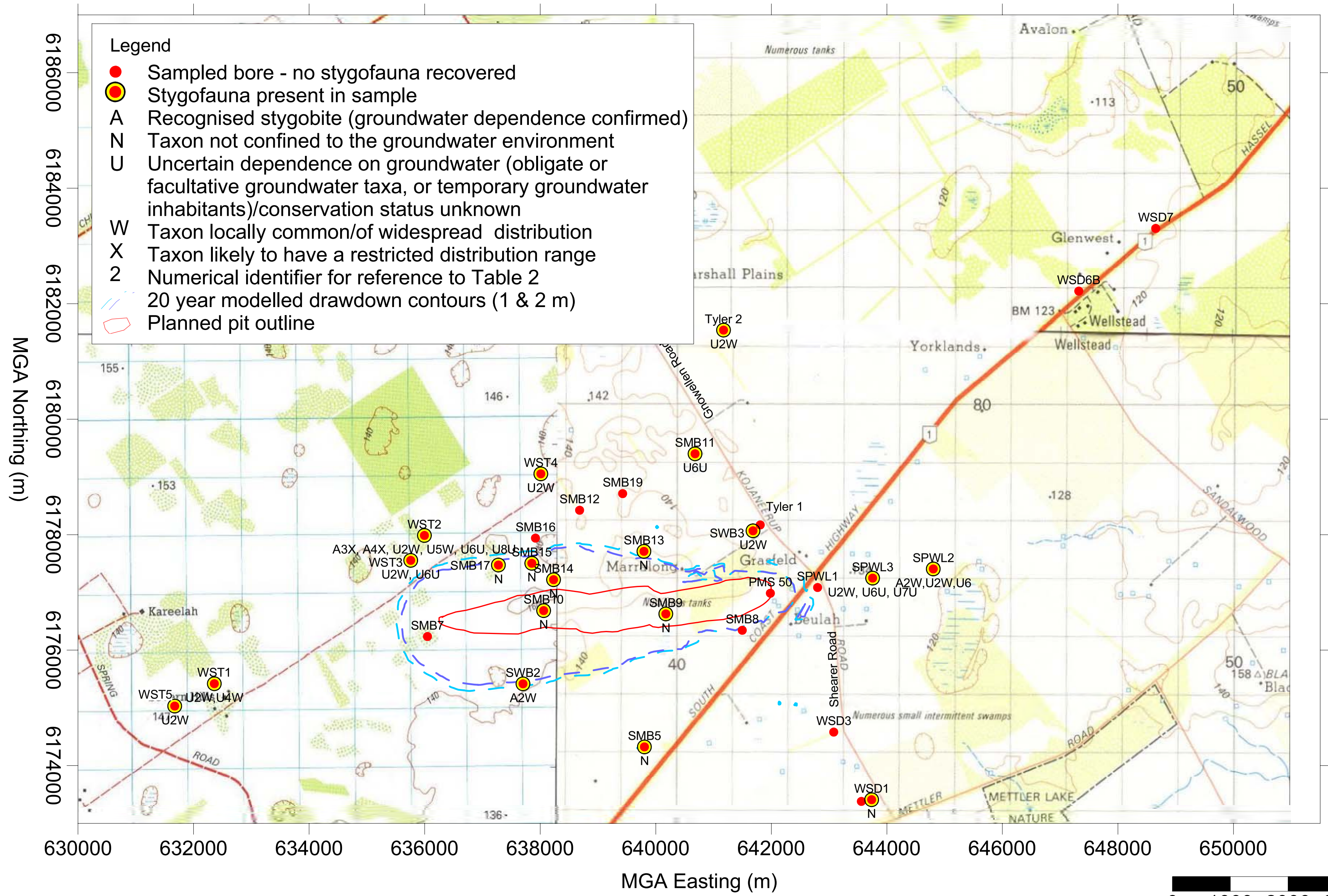

I: 216.2/Surfer/Wellstead Stygo Sampling Sites with presence.srf

CLIENT: Grange Resources Ltd

PROJECT: Southdown Magnetite

DATE: September 2006

Dwg. No: 216.2/06/3-1

STYGOFAUNA SAMPLING SITES
SOUTHDOWN AREA

Figure 6.19

Rockwater Pty Ltd

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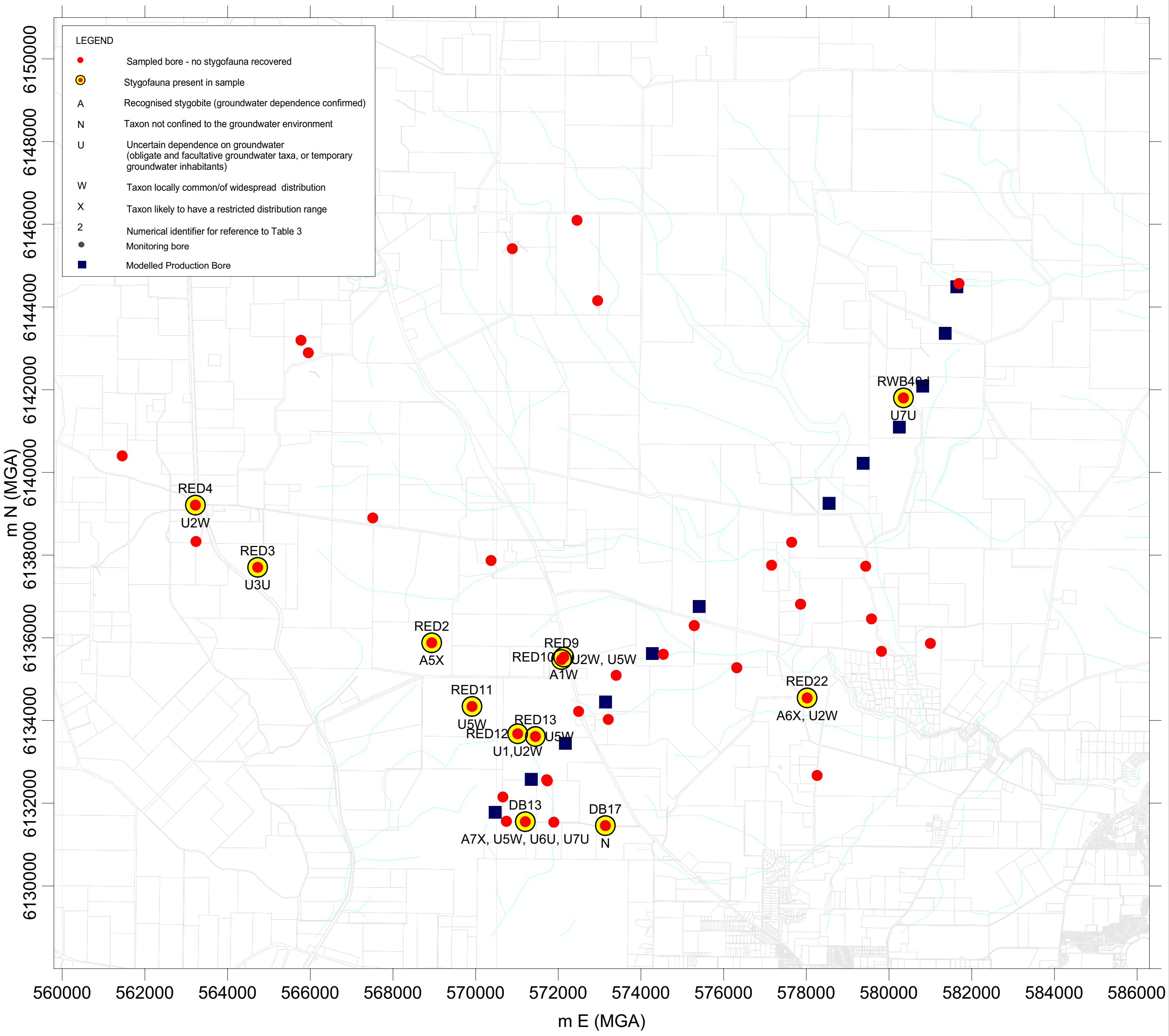

SCALE
0 1 2 3 4 km
1 : 125,000

I:/216-2/Surfer/Redmond Stygofauna July 2006.srf

CLIENT: Grange Resources Limited

PROJECT: Southdown Magnetite

DATE: September 2006

Dwg. No: 216.2/06/3-2

STYGOFAUNA DISTRIBUTION
IN PALLINUP SILTSTONE AND
WERILLUP FORMATION,
REDMOND - KING RIVER AREA

Figure 6.20

Rockwater Pty Ltd

6. THE PROJECT ENVIRONMENT

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Section 6.8 Social and Cultural Environment

Section 6.8.1 Non-Indigenous Heritage

A desktop search has been conducted of the region between Wellstead and Albany (Appendix 12- 8), through the following sources to identify any heritage sites within the vicinity of the Project that may potentially be impacted:

- Register of the National Estate Database – Australia's national inventory of natural and cultural heritage places compiled by the Australian Heritage Commission, the Commonwealth Government adviser on the National Estate.
- Register of Heritage Places - Heritage Council of WA. The Register of Heritage Places focuses on places, buildings and sites. Places of cultural heritage significance may be entered in the Register on the advice of the Heritage Council or at the direction of the Minister for Heritage.
- City of Albany Municipal Inventory List –This is a non-statutory list maintained by the Local Government, which focuses on events and developments in Western Australian history since the arrival of European settlers. The inventory also includes buildings and sites associated with present day activities in the area.

Register of National Estate Database

A search of the Register of the National Estate Database revealed five sites within one kilometre of the Project footprint, potentially impacted by Project works. Under the National Heritage List, the legal status of heritage places listed can be Indicative, or Nominated (Table 6.23).

Table 6.23 Definitions of Legal Status Under the National Heritage List.

Legal Status	Definition
Indicative place	Data provided to or obtained by the Australian Heritage Council or the former Australian Heritage Commission has been entered into the database and the place is at some stage in the assessment process. A decision on whether the place should be entered in the Register has not been made.
Registered place	The place is in the Register of the National Estate. Although some places may be legally registered because they are within a larger registered area they may not necessarily possess intrinsic significance.

The sites within one kilometre of the Project are all listed as Indicative under the Register of the National Estate. The sites are; the East Kalgan Wetland System, the Hassell National Park and Adjacent Reserves (Table 6.24). In addition, one Indicative and two Registered buildings are within 100 m of the proposed pipeline.

Register of Heritage Places - Heritage Council of Western Australia

A search conducted by the Heritage Council of Western Australia identified four heritage sites (Table 6.25) potentially in the Project footprint. One of these sites, (highlighted in blue) is listed on the State Register of Heritage Places and is legally protected under the *Heritage of Western Australia Act 1990*. The Project will not directly impact any of these sites, however the Act requires that any development matter pertaining to a place adjacent, behind or across the road from a registered place be referred to the Heritage Council as a development application.

City of Albany Municipal Inventory List

A search conducted of the City of Albany Municipal Inventory List further identified the Albany Deep Water Jetty however this jetty was demolished during previous dredging and land reclamation activities for berths 5 and 6 undertaken by APA in 2000 to 2001.

6. THE PROJECT ENVIRONMENT

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Table 6.24 Heritage Sites Potentially Within the Project Footprint Listed on the Register of National Estate Database.

Site Name	Place ID	Class	Legal Status	Distance from Project works.	Site Significance
Hassell National Park and Adjacent Reserves, South Coast Hwy, Manypeaks, WA	18032	Natural	Indicative	<1km from Southdown 0 to 5 km from proposed Pipeline	This National Park along the South Coast Highway serves a very important conservation and aesthetic function, and is important for the maintenance of ongoing ecological processes. The site: • Is an important inland vegetation and wildlife corridor from the Waychinicup and Mt Manypeaks area to the Cheyne Bay and Pallinup River areas; and • Contains plant association and complexes which are representative of the plateau, drainage lines and wetland landforms of the Green Range-Cape Riche region.
East Kalgan Wetland System, Hassell Rd, Manypeaks, WA	18034	Natural	Indicative	<1km from proposed Pipeline	The area contains a range of wetland types in Good to Excellent condition representative of the east Kalgan system. They are an important water bird habitat and are extensively used by nomadic and migratory species, including several trans equatorial migrant species, listed in the JAMBA and CAMBA treaties.
Residency (former), Residency Rd, Albany, WA	9312	Historic	Registered (21/10/1980	Within 100 m of the proposed pipeline corridor	This building was originally the superintendent's residence and administration block of a convict hiring depot (1852-60). In 1873 these were converted to the official residence of the town magistrate.
Old Gaol, 2-4 Parade St, Albany, WA	9320	Historic	Indicative	Within 100 m of the proposed pipeline corridor	
Old Gaol, 2-4 Parade St, Albany, WA	9295	Historic	Registered (21/03/1978)	Within 100 m of the proposed pipeline corridor	Originally part of the convict hiring depot, Reserve 41 (which included the residency). The gaol was completed in May 1873 at a cost of 1,230 pounds. In September 1886 the railway track cut through the block and separated the residency from the gaol. The gaol, the third of the five which the town has had, was the only one built by private contract.

Table 6.25 Heritage Sites Potentially within the Project Footprint Listed on the Heritage Council of Western Australia Register of Heritage Places.

Place No	Place Name	St No	Street Name	Suburb or Town	SRHP Interim	SRHP Permanent	Other Listing Type
40	Major Lockyer Memorial		Princess Royal Dr	Albany			HCWA Assess Programme
40	Major Lockyer Memorial		Princess Royal Dr	Albany			Municipal Inventory
3238	Albany Deepwater Jetty		Princess Royal Harbour	Albany			Municipal Inventory
3607	Albany Town Jetty		Princess Royal Dr	Albany	28/06/1996	13/12/1996	Municipal Inventory

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Section 6.8.2 Indigenous Sites and Heritage

Prehistory

A considerable amount of research has been conducted in the south west corner of WA (see Dortch, 1977, Hallam, 1986; Ferguson, 1985; Pearce, 1982) and as a consequence the archaeological patterning of the region is well developed.

The most comprehensive archaeological work in the Albany region was undertaken by Ferguson (1985) in a PhD thesis. Ferguson concluded that movements of Nyungars, while random were centred on a focal point in circumscribed areas and along established routes. Over time these routes became well worn tracks that followed corridors of easy movement along riverbanks or through mountain passes which connected camp sites, resource areas and fresh water sources. Camps were moved after several days for social and hygiene reasons. The pattern of constant movement, short durations and dispersed camps suggests the archaeological signature will be sparse and widely scattered. Prime campsites where tracks dissect or a focal resource point will have experienced disturbance from frequent usage in the general area. If the campsite coincides with a quarry and reduction area a dense artefact scatter would have collected over time.

Previous Surveys

The lack of registered archaeological sites within a 20 km radius around the Southdown Magnetite mine site is indicative of a paucity of previous surveys that have focussed on this area. This survey is one of (if not) the first detailed survey undertaken on freehold land in the Wellstead/ Cape Riche area. Within the wider south-west region surrounding the Project area, many archaeological sites have been previously recorded. These sites consist mainly of artefact scatters and are mostly located around water sources including swamps, dams, creeks, rivers or devegetated sand dunes. Artefact scatters containing small assemblages are typical of the region. A common site may contain from several artefacts up to a hundred pieces of quartz flakes and chips. The presence of a small number of flakes and chips suggests an ephemeral tool maintenance site, a hunting and gathering event or short term campsite where food processing and cooking occurred. A large number of artefacts suggest a long term camp or a camp used continuously over a long period of time.

Registered Sites

A search of the DIA - Aboriginal Site Register, held under Section 38 of the State's *Aboriginal Heritage Act 1972* on 26th July 2005 (Appendix 12- 9) revealed the presence of five previously recorded Ethnographic Aboriginal Heritage sites within 200 m of the Project footprint. The Southdown Magnetite Proposal will potentially impact two of these sites (Table 6.26), requiring clearance under Section 18 of the *Aboriginal Heritage Act 1972* prior to commencement of works:

Site ID 21837 Creek 3 (Willyung Creek): All the watercourses that flow through this area and are tributaries of the Kalgan River are components of this important mythological site. The proposed pipeline intersects both Willyung Creek and the Kalgan River.

Kinjarling: This site consists of the Kalgan and King Rivers, and the Napier and Willyung Brooks. The central elements of this story are recorded as places of significance, protected by the *Aboriginal Heritage Act 1972*, while the broader areas that represent the path of the travels of the mythical beings depicted in the story are defined as areas of cultural value. The proposed pipeline will impact this site at the Kalgan River crossing, (in the vicinity of 591380mE 6138891mN or 590985mE 61452119mN), the King River crossing (in the vicinity of 577965mE 6135145mN) and the crossing of Willyung Brook (Creek 3), a tributary of the King River (in the vicinity of 574751mE 6131698mN).

Table 6.26 Aboriginal Heritage Sites on the Aboriginal Sites Register Potentially Occurring in the Area.

Site ID	Status	Access	Site Name	Site Type	Co-ordinates	Impacted by Project
5746	Permanent Register	Open	Kalgan River	Mythological, Fish Trap	34 53’26”S / 118 0’10”E, 591641mE / 6138647 mN Zone 50 Unreliable	No
15111	Interim Register	Open	Yungup	Camp	584641mE / 6139647mN	No
21837	Interim Register	Open	Creek 3 (Willyung Brook)	Natural Feature, Water Source	34.9594 S / 117.8301 E, 575788mE 6131146mN Zone 50 Reliable	Yes
17474		Closed	Yoolberup	Mythological	615353mE / 6137822mN	No
NYR	NYR	Open	Kinjarling	Mythological	NYR	Yes

Site ID 5746 Kalgan River: A possible pipeline route option intersected this site’s buffered extent within the area of mythological significance. This route option has subsequently been abandoned on engineering grounds.

Site ID 15111 Yungup: This historical campsite will not be affected by the Project as the campsite is located north of Chesterpass Road, whereas the pipeline is to the south.

Site ID 17474 Yoolberup: This site, as it was originally recorded, will not be impacted by the proposal. The site was re-recorded during a recent survey upon behalf of the City of Albany and the DIA. The central elements of the re-recorded component of this site will not be impacted by the pipeline corridor. The broader area of cultural value associated with the site however, will be traversed by the pipeline, but will not require consideration under Section 18 of the *Aboriginal Heritage Act 1972* as the pipeline will not impact the cultural value associated with the site.

Aboriginal Heritage Survey Methods

The field survey was undertaken in August 2005 and March 2006 by qualified archaeologists and assisted by members of the local indigenous community (Technical Appendix 13.16). The survey design comprised a combination of predictive and systematic transects over the Project area. A systematic survey strategy was designed to inspect a 30% sample of the mining Project area and 60% of the pipeline corridor, extensions and harbour. During the systematic survey, a predictive survey was conducted on opportunistic occasions to features identified from a 1:25 000 aerial map.

At the mine site pedestrian transects were performed at 50 m intervals by five to six persons covering a sweep of some 250 m to 350 m. Each transect covered a distance of one to two kilometres. Along the pipeline route transects were conducted at 10 m to 20 m apart by two or three persons for a distance of two to three kilometres. At the harbour the coastline was inspected with meandering transects by two persons.

In addition, a series of intensive transects were conducted along the banks of rivers and creeks, lakes, swamps, clearings or any other designated feature. Surface visibility in woodland was around 10%, 20% in pasture and 60% in reclaimed land.

Site Significance

The significance of an archaeological site is determined by its ability to address regional and site-specific research questions and by its representativeness (Bowdler, 1984). Significance is a mutable quality, changing as more sites are recorded, research questions are answered or new research directions arise. Broad research questions that sites in the south west may address include:

- The antiquity of colonisation of the southwest zone.
- Social and technological changes that may have occurred in the mid-Holocene.
- Specific patterns of occupation in regional zones.
- Dating of industrial sequences in the region.

Ethnographic and Archaeological Sites

As a result of the Aboriginal Heritage Survey one new ethnographic site was recorded (Goode, 2005). This site was a historical campsite and water source located within urban Albany at Point Melville.

Seven archaeological sites were also located and recorded at the Southdown mine site (Greenfeld *et al.*, Unpublished, 2005) (Table 6.27, Figure 6.22). Five sites; Southdown 1, 2, 5, 6 and 7 are situated within cleared areas affected by wind erosion. The five sites are large and dense artefact scatters which all contain examples of grinding material. The other two archaeological sites, Southdown 3 and 4 are situated within low lying depressions. The depressions have been also created by the action of wind erosion after the land was cleared.

Table 6.27 Archaeological sites identified within the Southdown Magnetite Proposal footprint.

Site	Description	Size	Nature of Site	Current Significance*
Southdown 1	Artefact Scatter, Grinding Material	20m x 65m	Estimated that site contains at least 1000 stone artefacts.	High
Southdown 2	Artefact Scatter, Grinding Material	80m x 20m	Estimated that site contains over 1000 stone artefacts	High to Very High
Southdown 3	Artefact Scatter	7m x 35m	Contains at most 50 artefacts.	Low to Medium
Southdown 4	Artefact Scatter	10m x 10m	Contains at most 50 artefacts.	Low to Medium
Southdown 5	Artefact Scatter, Grinding Material	35m x 22m	Estimated that site contains at least 1000 stone artefacts.	High to Very High
Southdown 5a	Artefact Scatter, Grinding Material	37m x 50m	Estimated that site contains at least 1000 stone artefacts.	Medium
Southdown 6	Artefact Scatter, Grinding Material	35m x 40m	Estimated that site contains over 2000 stone artefacts.	Very High
Southdown 7	Artefact Scatter, Grinding Material	37m x 50m	Estimated that site contains over 2000 stone artefacts.	Very High

*** For determination of significance, refer to paragraph on 'Site Significance' above**

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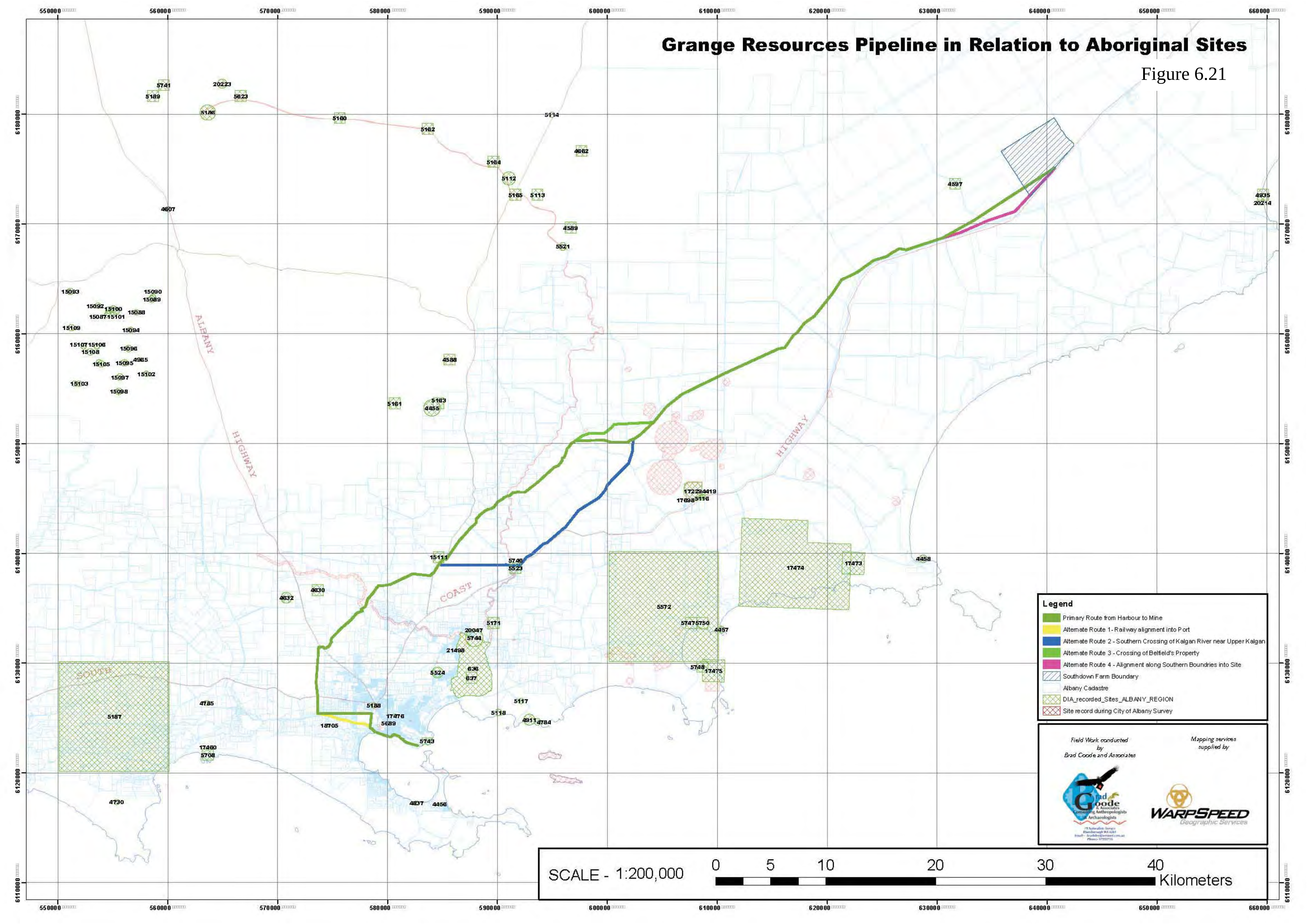

Grange Resources Pipeline in Relation to Aboriginal Sites
Figure 6.21
Legend
Primary Route from Harbour to Mine
Alternate Route 1 - Railway alignment into Port
Alternate Route 2 - Southern Crossing of Kalgan River near Upper Kalgan
Alternate Route 3 - Crossing of Belfield's Property
Alternate Route 4 - Alignment along Southern Boundries into Site
Southdown Farm Boundary
Albany Cadastre
DIA_recorded_Sites_ALBANY_REGION
Site record during City of Albany Survey
Field Work conducted by Brad Goode and Associates
Mapping services supplied by
WARPSPEED Geographic Services
SCALE - 1:200,000
0 5 10 20 30 40
Kilometers
ALBANY HIGHWAY
SOUTH COAST HIGHWAY

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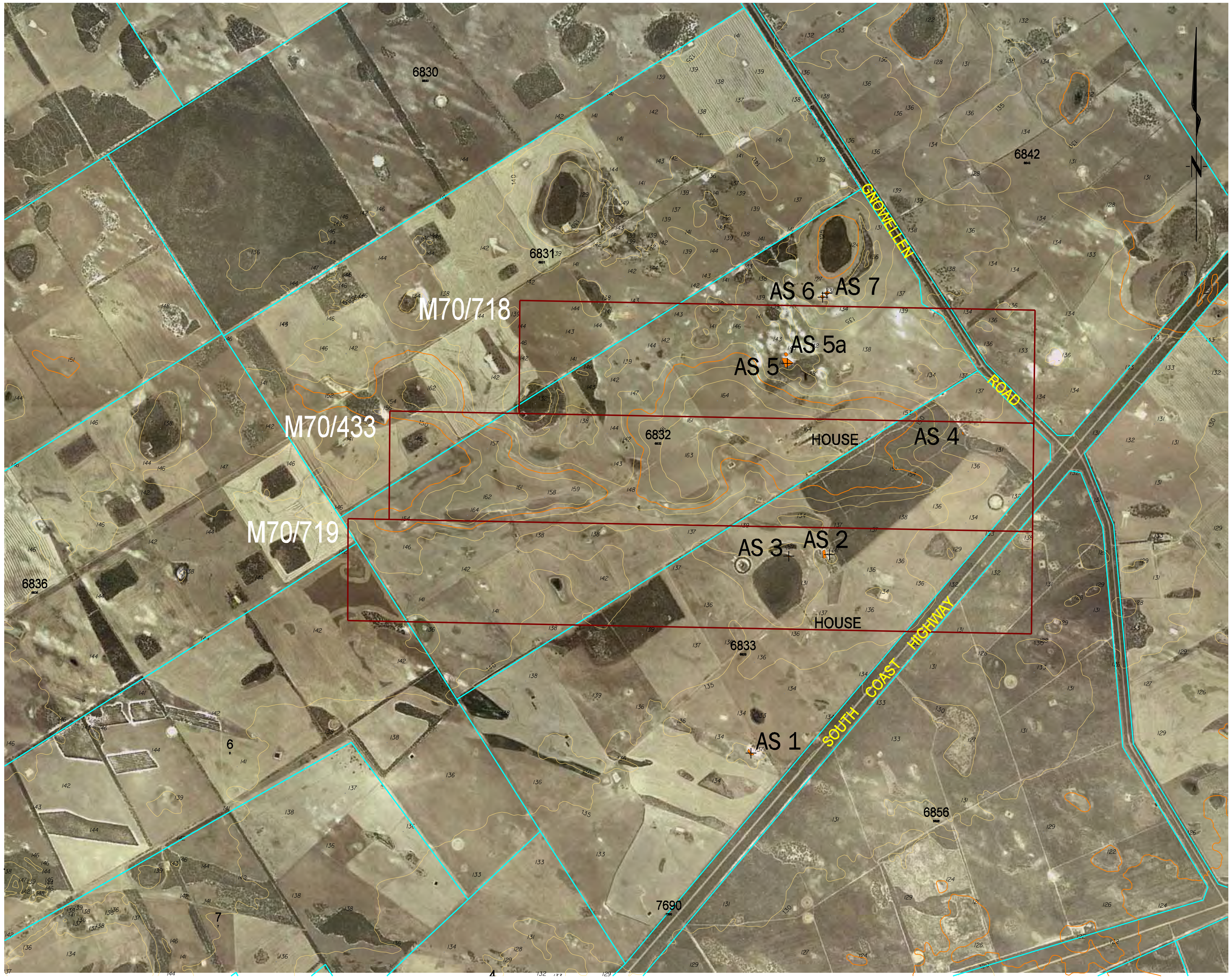

LEGEND

MINING LEASES	ARCHAEOLOGICAL SITES

rev	details	date
D	Archaeological Sites Only	05-06-06
C	Archaeological Sites Added	22-11-05
B	Pipe Route Edit and Mining Lease Numbers	01-11-05
A	Original drawing	13-08-05

Harley Survey Group Pty Ltd
116 Serpentine Road. ALBANY WA 6330
T: 08 9841 7333 F: 08 9841 3643
E: hsgalb@harleygroup.com.au

survey: Compiled	cad file: 12937-021D
drawn: ABS 05-06-06	checked
horiz datum: MGA 94	level datum: AHD

scale at A3: 1 : 40000 — all distances are in metres (0, 500, 1000, 1500, 2000)

client: GRANGE RESOURCES LIMITED A.C.N. 009 132 405

description:

SOUTHDOWN PROJECT

ARCHAEOLOGICAL SITES

Figure 6.22

PYRMONT HOUSE
ALBANY

harley survey group

6. THE PROJECT ENVIRONMENT

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Section 6.8.3 Native Title

Grange has contacted the National Native Title Tribunal and identified two Native Title claims over the Project footprint. The details of the Southern Noongar and Wagyl Kaip claims are summarised in Table 6.28, with the claim areas outlined in Appendix 12- 10.

Table 6.28 Native Title Claims over the Project Footprint.

Name	Application Type	Tribunal Number	Fed Court Number	Registration Date	Reg Test Status
Southern Noongar	Claimant	WC96/109	WG6134/98	18/11/1996	Accepted
Wagyl Kaip	Claimant	WC98/070	WG6286/98	29/09/1998	Accepted
Single Noongar Claim (Area 1)	Claimant	WC03/006	W6006/03	Application filed: 06/10/2003	Not Accepted
Wom-Ber	Claimant	WC96/105	WG6130/98	Application filed: 28/10/1996	Not Accepted

For the Southdown Magnetite Proposal footprint:

- There is no overlap with any registered indigenous land use agreements as per the Register of Indigenous Land Use Agreements (ILUA's); and
- There is no overlap with any indigenous land use agreements notified (but not registered) by the Tribunal.

The Representative Aboriginal and Torres Strait Islander Body for the area is the South West Aboriginal Land and Sea Council Aboriginal Corporation.

The Kalgan River and Napier Creek crossings will trigger Native Title as these sites are within Vacant Crown Land. However as the pipeline falls under the definition of infrastructure under Section 253 of the *Native Title Act, 1993* the Right to Negotiate provisions of the *Native Title Act, 1993* do not apply but notification and consultation provisions do apply. The pipeline crosses the King River on private property.

Section 6.8.4 Demography

The City of Albany, the first settlement in Western Australia, is situated 403 km south of Perth overlooking Princess Royal Harbour. The City has a population of about 30,000, supported by a diverse range of local industries. The Albany area is one of Australia's richest agricultural areas, with other major industries including tourism, forestry, export abattoir, wine production and fishing. Albany Port berthed over 100 vessels in 2004. The main exports from the area are wheat, barley, canola and woodchips.

The town of Wellstead is situated between Albany and Bremer Bay and Jerramungup. It has a population of about 170 people mainly reliant on farming and farming services.

6. THE PROJECT ENVIRONMENT

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Section 7 Environmental Sustainability and Offsets

Grange Resources Limited has embraced the EPA's principles of environmental protection as part of Project engineering and design as outlined in Table 2.2. The environmental objective of the Project's design, in order of priority, is to:

- Completely avoid the impact if possible.
- Substitute with a lesser impact.
- Include rehabilitation and engineering solutions to reduce the degree and risk of impact.
- Design operational controls and emergency response around reduction of impact consequences.
- Provide primary environmental offsets for the impact.

The decision framework for the use of environmental offsets (EPA, 2006) is outlined below.

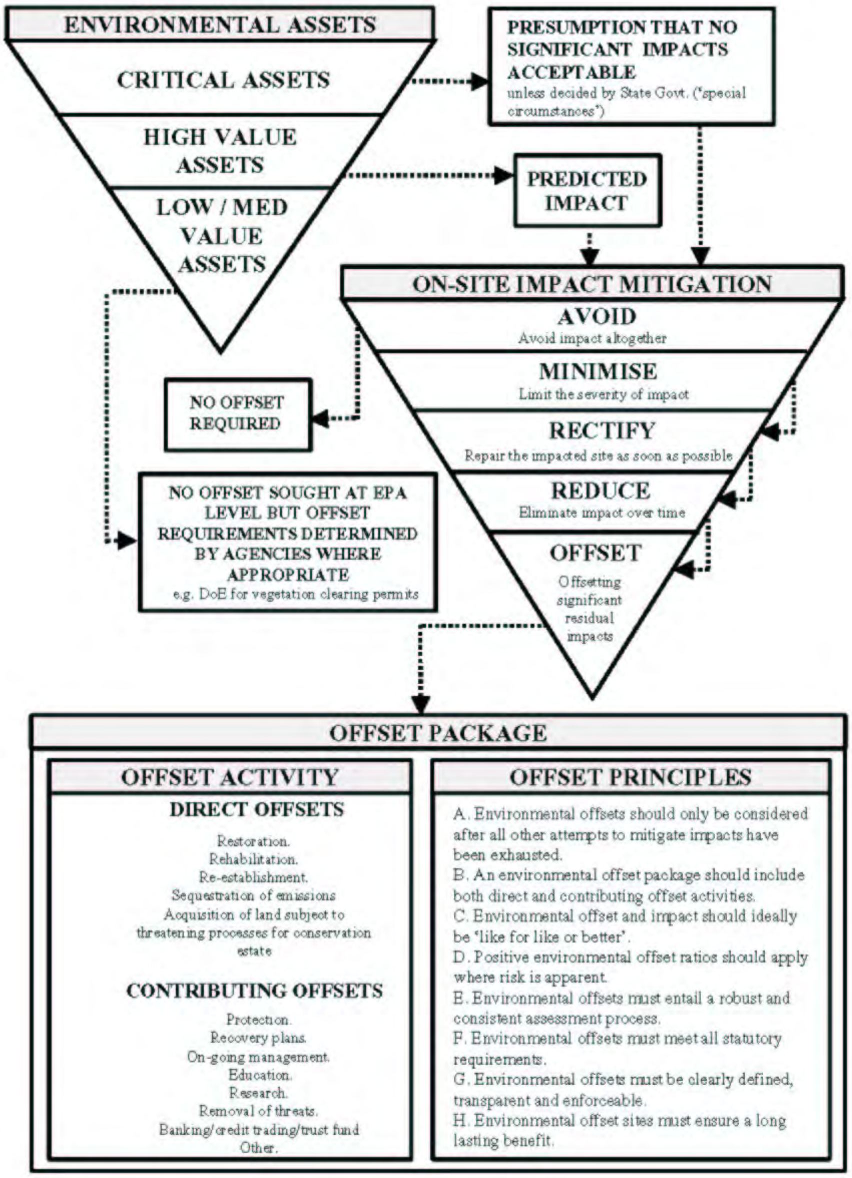

Figure 7.1 Decision Framework for the use of Environmental Offsets.

7. ENVIRONMENTAL SUSTAINABILITY AND OFFSETS

Investigations have been conducted by Grange for all aspects of the Project to gather baseline data and to determine the types and degree of environmental impacts of the Project. Agreement from relevant agencies was obtained for the investigation methods as part of the proposal's consultation process.

Several opportunities for impact avoidance and minimisation have been identified and implemented to various degrees as part of the proposal's design phase. These have been described in previous sections of this document and include:

- Design of mine plan to include progressive backfilling of pit void.
- Water harvesting on the mine site as primary water source to minimise impacts to ground water.
- Use of slurry pipeline provides a low impact solution for transport of magnetite concentrate.
- Selection of pipeline route to best avoid road side remnant vegetation and conservation estates.
- 100% rehabilitation to previous land use (or better) of pipeline footprint immediately after construction.

Additionally, Grange will seek to provide appropriate environmental offsets for residual impacts that cannot be avoided. Selection of environmental offsets will be in accordance with EPA Position Statement No 9 – Environmental Offsets and with advice from the DEC.

The offset package for the Southdown Magnetite Proposal will include both direct and contributing offsets to offset the environmental impacts of:

- clearing of native vegetation;
- clearing of Carnaby's Black-Cockatoo feeding habitat; and
- impacts to biodiversity.

Direct Offsets

Direct offsets will include rehabilitation or restoration of an existing degraded ecosystem. This rehabilitation will aim to re-establish biodiversity corridors and preserve vegetation units represented at the mine site through seeding with species similar to that cleared at the mine site. Grange will prioritise the selection of site/s that will contribute to the aims of the Carnaby's Black-Cockatoo (*calyptorhynchus latirostris*) Recovery Plan 2002-2012 (Cale, 2003) through connecting breeding sites with potential feeding sites, expanding the size of existing feeding habitat or improving the quality of an existing feeding site. Vegetation blocks, and total area to be rehabilitated will be determined in consultation with the DEC.

Contributing Offsets

Contributing offsets may include the acquisition of land containing similar vegetation assemblages to the vegetation cleared at the mine site. Using aerial photographs, suitable blocks of land in the vicinity of the mine site will be surveyed (additional to those already surveyed in the area) as part of additional regional assessments being conducted in consultation with the DEC. This information will be used for the determination of the most suitable areas of vegetation to be used as offsets. Vegetation blocks, and total area to be rehabilitated will be determined in consultation with the DEC.

Grange will also consult with the local catchment community to identify ecological corridors for preservation/restoration. Corridors for preservation will be selected in consultation with DEC.

Section 8 Potential Environmental Impacts and Management

The management of environmental impacts associated with the proposal is based on a risk management framework aligned to Australian Standard 4360. This involves the identification of activities that can result in environmental impacts, implementing controls to reduce the risk, and monitoring the effectiveness of controls.

The procedures for risk control and reduction will be documented in Environmental Management Plans and communicated to Project personnel. As the construction and operation phases of the proposal differ in scale and type of impacts, separate management plans will be developed and implemented.

In addition, a management system aligned with the international standard ISO 14001 will be developed and implemented for the Project. This will enable the Project to systematically comply with legal and other requirements, identify and control environmental risks, provide adequate and appropriately competent resources for environmental management, monitor performance and correct non-conforming situations. This process is also designed to promote continual improvement in performance.

Commitment 1: Prior to construction, a Project Construction Environmental Management Plan will be developed. The plan will set out procedures to minimise and manage the environmental impacts of construction activities.

Commitment 2: The plan will be implemented during construction and communicated to Project personnel through training and induction sessions.

Commitment 3: Prior to operations, an Operation Environmental Management Plan will be developed. The plan will set out procedures to minimise and manage the environmental impacts of operational activities.

Commitment 4: The plan will be implemented throughout the life of operations and communicated to Project personnel through training and induction sessions.

Commitment 5: Prior to construction, a Project Environmental Management System (EMS) will be developed consistent with the principles of ISO 14001:2004.

Commitment 6: The Project EMS will be implemented throughout the life of the Project.

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Section 8.1 Geology and Landform

Section 8.1.1 Management Objectives

The objectives for the management of geology and landform are to:

- Maintain the integrity, ecological functions and environmental values of geology and landform.
- Minimise permanent landform alterations and establish stable, sustainable landforms that will not compromise post-disturbance land uses.
- Ensure that rehabilitation achieves an acceptable standard compatible with the intended post – disturbance land use, and is consistent with appropriate completion criteria.

Section 8.1.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Guidelines on the Safe Design and Operating Standards for Tailings Storage (DME, 1999);
- The Strategic Framework for Tailings Management (DoIR, 2003);
- Environmental Notes on Mining Waste Rock Dumps (DME, 2001);
- Mine Void Water Issues in WA (WRC, 2003);
- Landform Design for Rehabilitation (Environment Australia, 1998); and
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006).

Section 8.1.3 Potential Impacts

An overview of the geological characteristics of the area is provided in Section 6.3. The potential impacts of the Project on the geology and landform resources would be associated with the following:

- Mining of approximately 18 - 20 Mt of mineralised material and 40 -55 Mt of waste rock per annum over a 22 year mine life.
- Permanent landform modification as a result of mine pit.
- Permanent new landforms as a result of the TSF and waste rock stockpiles.
- Possible construction of berms up to 20 m in height as noise buffers.
- Short to medium term changes to the landscape as a result of pipeline construction, processing plant, offices, workshop, powerlines, pumping stations and laydown areas.
- Increased ponding through alterations in topography that enhance retention of rainwater..
- Reclamation of 0.425 ha of land adjacent to existing reclaimed land along the northern shore of Princess Royal Harbour to facilitate construction of the pipeline.

The proposed mine site is located in gently undulating farmland with scattered blocks of remnant vegetation. The proposed mine pit will be approximately 6 000 m long, 600 m wide and 300 m deep. Mining will begin on the western end of the deposit with progressive backfilling of waste rock beginning at Year 5 and co-disposal of tailings into the mine pit beginning at Year 7. The proposed external waste dump, located on the southern side of the pit will have a footprint of 620 ha, a height of 45 m (RL 180) and 11° slopes.

At Year 22, on completion of mining, approximately 1,600 m of the mine deposit will be left open. It is anticipated this void will fill up with water.

Section 8.1.4 Management

Mine Site

Grange will endeavour to minimise the footprint of the Southdown Magnetite Proposal to reduce the environmental impact. Approximately 54% of the waste rock and 73% of the tailings will be progressively backfilled into the mine void. The external TSFs and waste dumps will be shaped to mimic local landforms where possible. Final land use will be taken into account throughout Project planning and operation. The mine footprint, including processing plant, offices, workshop, access roads and laydown areas will be rehabilitated upon mine closure as outlined in Section 8.21.

Tailings will be managed to prevent groundwater contamination, and the TSF constructed for long term stability in compliance with the 'Guidelines on the Safe Design and Operating Standards for Tailings Storage' (DME, 1999), and 'The Strategic Framework for Tailings Management' (DoIR, 2003).

Waste rock stockpiles will be constructed in accordance with the 'Environmental Notes on Mining Waste Rock Dumps' (DME, 2001) and 'Landform Design for Rehabilitation' (Environment Australia, 1998). These documents specify minimum technical criteria that should be met in mining landform construction and take into account the potential for erosion and progressive revegetation and rehabilitation of waste rock stockpiles.

Berms up to 20 m in height may be constructed at strategic locations around the mine site perimeter as noise barriers to ensure operation noise complies with regulations at the nearest sensitive receptors.

A conceptual mine closure plan has been developed to the ANZMECC/ MCA (2000) standard and will be maintained during the life of mine (Section 8.21). At the completion of mining:

1. Infrastructure will be removed, unless determined otherwise by DoIR or other stakeholders.
2. Compacted surfaces will be ripped to promote water penetration and vegetation regrowth.
3. Rehabilitation activities will continue beyond mine closure to enable final waste rock storage areas to be stabilised.
4. Remaining surfaces of waste rock storage areas and TSF will be battered down to slope angles that will be stable over the long term.
5. The surface of in-pit storage areas will be contoured to blend with the surrounding landform.
6. Previously stripped topsoil and vegetation will be returned to rehabilitation areas where practicable.
7. Stabilisation techniques will be applied to exposed surfaces.
8. Safety bunds will be constructed around the decommission pit with appropriate fencing and signage.

Pipeline

The pipelines will be buried and therefore have only transient landform impacts during the construction phase. Areas disturbed by pipeline construction activities will be rehabilitated immediately after construction to the pre-existing land use and landforms. Alterations to topography as a result of the pipeline, excess spoil from the trenches and wheel ruts and other depressions caused by heavy machinery in low-lying and wetland areas will be rehabilitated in a way that does not affect existing drainage patterns.

Along the Princess Royal Harbour waterfront, the pipes will be buried in new reclaimed ground (Section 5.2.6). Reclamation work to the west and east of Point Melville will be an incremental widening of the existing road reclamation. The pipeline reclamation will provide space for construction in the future by the City of Albany of a dual use path (above the buried pipelines). It is anticipated that the path will extend from the Albany Peace Park west along the foreshore to Point Melville then beyond to link up with the existing dual use path situated along Frenchman's Bay Road.

Section 8.1.5 Predicted Outcome

The mine site will modify existing landforms and result in permanent new landforms. These landforms will be rehabilitated to establish stable, sustainable landforms that will not compromise post-disturbance land uses.

There will be an incremental widening of the existing road reclamation along the northern shore of Princess Royal Harbour.

Section 8.2 Soils

Section 8.2.1 Management Objectives

The objectives for general management of soils are to:

- Maintain the integrity, ecological functions and environmental values of soils.
- Maximise the retention and viability of topsoil resources for future rehabilitation.
- Ensure that rehabilitation achieves an acceptable standard compatible with the intended post – disturbance land use, and is consistent with appropriate completion criteria.

The objectives for the management of acid sulphate soils are to:

- Identify potential acid generating material.
- Selectively handle potential acid generating material.
- Store potential acid generating material so that leachate is not generated.

Section 8.2.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Identification and Investigation of Acid Sulphate Soils (DoE, 2004);
- General Guidance on Managing Acid Sulphate Soils (DoE, 2003); and
- Acid Sulphate Soils Planning Bulletin No. 64 (WAPC, 2004).

Section 8.2.3 Potential Impacts

Soil impacts will occur as a result of land clearing, stockpiling, mining and placement of infrastructure at the mine site, and land clearing and trenching along the pipeline route. Topsoil will be stockpiled as mining progresses. Assuming a stripping depth of 0.3 m, the amount of topsoil to be stockpiled is outlined in Table 8.1.

Table 8.1 Quantity of soil to be stockpiled from the mine site.

Area	Quantity of Topsoil
Pit	1.0 Mm^3
Waste dump	1.8 Mm^3
Process residue	2.1 Mm^3
ROM pad and stockpiles	0.1 Mm^3
Total topsoil	5.0 Mm^3

An estimated 70-100 ha could be required for stockpile storage, as topsoil will be stockpiled in various parts of the leases to avoid unnecessary haulage costs.

The potential impacts of the Project on the soil resource would be associated with the following:

- Increased soil erosion by both wind and water due to clearing of vegetation.
- Alteration to soil structure, changes in soil chemistry, and changes to the natural soil forming processes caused by stripping and stockpiling.
- Reduced viability of seeds, nutrients, organic matter and micro-organisms due to inappropriate

stockpiling of topsoil.

- Alteration of soil structure and/or chemistry beneath infrastructure items, hardstand areas and roads (e.g. through compaction, spillage of hydrocarbons or chemicals).
- Alteration of soil structure through trenching and trench filling associated with pipeline burial.
- Release of acid and mobilisation of metals as a result of the disturbance of acid sulphate soils.
- Contamination from inappropriate management of dewatering during pipeline construction.

Acid Sulphate Soils

The mine site is located in an area classified as having low to no risk of acid sulphate soils generally to depths greater than 3 m (WAPC Albany- Torbay Acid Sulphate Soils Map, 2004). It is not anticipated that topsoil stockpiles will need to be managed to prevent acid generation.

The King River, Kalgan River and their tributaries are classified as having moderate to low risk of actual acid sulphate soils and potential acid sulphate soils occurring at depths greater than 3 m. Construction of the pipeline will involve trenching of the river bed. Exposure of potential acid sulphate soils could lead to localised oxidation of the soils. Acid created from oxidised soil could potentially be flushed downstream.

The pipeline traverses areas of high risk for acid sulphate soils in the City of Albany where it runs adjacent to the rail corridor and Lower Denmark Road. The reclaimed land along the Albany foreshore including the Albany Port is also categorised as high risk of actual acid sulphate soil and potential acid sulphate soil less than 3 m from the surface.

Potential impacts arising from excavating high risk sites include spread of existing acidic material and creation of actual acid sulphate soil through exposing sulphidic material to oxidation. Inappropriate management of these soils and the acid generated may lead to contamination of surrounding groundwater, surface waters and ecosystems. These areas may also have perched water tables. Should such areas be identified along the pipeline route, construction activities may necessitate temporary dewatering or horizontal directional drilling (HDD) as outlined in Section 8.2.4. Inappropriate disposal of potentially acidic water can result in degradation of surrounding vegetation, impacts to surrounding land use and contamination of surface waters.

Acidic soils will not compromise the integrity of the pipeline which will be corrosion resistant.

The potential impacts and proposed management of the sulphides associated with the sulphidic shear zone identified within the Southdown Magnetite deposit are outlined in Section 8.3.

Dewatering

It is not anticipated that there will be any dewatering associated with the pipeline construction. This will be clarified after a geotechnical assessment of the pipeline route has been conducted.

Section 8.2.4 Management

Areas with native vegetation that will be totally removed (e.g. the native remnant block on the mine site) contain important genetic resources in the form of the soil seed bank, the canopy-stored seed bank, vegetative cuttings that can be propagated in a nursery, rhizomatous monocotyledon plants that can be divided and propagated and soil fungi that can be harvested prior to vegetation removal.

Prior to clearing, a seed salvage plan will be developed to appropriately store and utilise valuable genetic resources from the sites to be cleared. Native flora seed collection and storage for revegetation purposes will be outlined in the Threatened Flora and Conservation Management Plan which will be developed in consultation with the DEC. Topsoil and vegetation debris will be salvaged from the mine site and pipeline footprint prior to commencement of works and used in rehabilitation. Topsoil will be stripped and utilised in rehabilitation at locations consistent with their natural distribution wherever feasible. To optimise post-disturbance soil organic matter development, stockpiling will be avoided where possible. Cleared vegetation will be used as mulch for rehabilitation of disturbed sites, to establish vegetated buffer zones around the mine, or to assist the planting of ecological corridors. Contouring, terracing and establishment of groundcover vegetation will be undertaken to reduce erosion from surface runoff, and promote stability of rehabilitated landforms.

Where storage is unavoidable, topsoil will be stored separately from overburden to preserve the seed store for re-spreading during rehabilitation. Germination of seedlings on the stockpiles will be promoted and monitored to ensure continuity of organic inputs and to maximise the micorrhizal fungi activity within the stockpile.

Acid Sulphate Soils

Management of acid sulphate soils along the pipeline route will be in compliance with the 'General Guidance on Managing Acid Sulphate Soils' (DoE, 2003), the 'Acid Sulphate Soils Guideline Series' (DoE, 2004) and the Acid Sulphate Soils Planning Bulletin No. 64 (WAPC, 2004).

Grange's approach to managing acid sulphate soils along the proposed pipeline are, in order of priority, to:

- Define the location and maximum amount of potential and existing acidity.
- Avoid disturbance to the acid sulphate soil where possible.
- Mitigate impacts where acid sulphate soil disturbance is unavoidable.
- Rehabilitate acid sulphate soil and acid drainage.

This approach will be applied on a risk basis to protect areas of environmental significance from acid drainage impacts. Factors influencing the risk associated with disturbance of acid sulphate soils include the quantity of sulphidic material, depth of excavation and proximity to sensitive sites. The texture of the soil also influences the risk associated with disturbance as coarse textured sulphidic sands oxidise more readily than fine textured soil due to the higher permeability and faster lateral movement of water through coarse textured soil.

A targeted acid sulphate soil survey will be conducted as part of geotechnical testing of the pipeline route for construction purposes. The survey will involve site investigation followed by sample collection and laboratory analysis. The acid sulphate soil sampling programme will focus on the proposed pipeline route and areas of risk identified in previous surveys to:

- Determine the presence or absence of acid sulphate soils in areas to be disturbed by the pipeline.
- Define the location and maximum amount of potential and existing acidity.

Field data on soil profiles and pH at the sampling sites will be collected, with samples submitted for laboratory analysis to determine the existing and potential acidity of the soil. Should laboratory results indicate high risk associated with disturbance of soils along the pipeline route, a detailed investigation will be conducted. This will involve mapping of acid sulphate soil, determining concentrations of sulphide material present and, the depth of sulphide materials and groundwater in the vicinity of sensitive sites. This information will be used to plan construction methods suitable for the ground conditions. Site specific management plans will be prepared where required to address site specific soil characteristics of high risk acid sulphate soils

Site specific Acid Sulphate Soil Management Plans will be developed as part of the Pipeline Construction and Operation Management Plan (Technical Appendix 13.18). These management plans will be in compliance with the relevant guidelines. Management plans will include management of dewatering activities (if required), and outline contingency measures to demonstrate that disturbance of acid sulphate soils in the vicinity of sensitive sites along the pipeline route will be adequately managed. Several avoidance and mitigation strategies outlined by the DEC (DoE, 2003) are outlined below.

Avoidance: Potential measures to avoid acid sulphate soils include:

- shallow disturbance to avoid acid sulphate soils;
- covering of acid sulphate soils with clean fill or reburial under water to prevent oxidation of sulphide and disturbance as soon as possible; and
- avoid activities that may cause excessive water table fluctuations.

Mitigation: Potential management strategies to be implemented during pipeline construction include:

- minimisation of stockpiling where possible; and
- neutralisation of acid sulphate soils at impact site.

The installation period will be during the summer months where rainfall is minimal and the soil is not saturated. It is anticipated that acid sulphate soils will constitute a minor portion of the total trench volume.

In areas of known acid sulphate soils where the trench does not intercept the water table, the required excavation depth will be approximately 1.2 m below surface level. Excavation, construction and backfilling in these areas will comply with the short term stockpiling guidelines of 2.5 days for fine and medium textured range of untreated acid sulphate soils in accordance with 'Treatment and management of disturbed Acid Sulphate Soils '(DOE, 2004). Contaminated soil will be removed if required and replaced with engineered fill.

Stockpiling acid sulphate soils will be minimised where possible as significant quantities of acid can build up, especially in porous sandy stockpiles if left in oxidising conditions for even short periods of time. A detailed earthworks strategy documenting the timing of soil volumes to be moved, treatment locations and capacity, and contingencies for wet weather will be developed prior to construction activities. This will form part of the site specific Acid Sulphate Soil Management Plans.

Neutralisation of acid sulphate soils is the least preferred management option due to the difficulty and cost of mixing lime with acid sulphate soils, the low reactivity of lime and reduced neutralising capacity over time as iron, aluminium and gypsum coat the neutralising agent. Neutralisation will be conducted in consultation with relevant authorities if required.

In areas where the water table is above the base of the excavation and where conventional trenching techniques would be inappropriate, horizontal directional drilling (HDD) may be used for pipeline installation. HDD is a 'trenchless' technique of installing pipelines, with bentonite used as the drilling fluid. Bentonite aids in consolidating the walls of the drilled hole, acts as a lubricant and carries the spoil from the hole before being recycled. It is anticipated that HDD will not require dewatering, thus preventing the creation of acidified "hotspots" in the soil profile which have the potential to leach acidity, toxic metals and nutrients to groundwater after construction has been completed.

Section 8.2.5 Predicted Outcome

Potential acid sulphate soil impacts associated with pipeline construction and dewatering (if required) will be managed through site specific Acid Sulphate Soil Management Plans, developed as part of the Pipeline

Construction and Operation Management Plan (Technical Appendix 13.18) to prevent impacts to sensitive sites such as waterways and conservation areas. Measures will be implemented during pipeline construction to prevent spread of existing acid sulphate soils, creation of acid sulphate soils and acid contamination of groundwater.

Section 8.2.6 Environmental Management Commitments

Commitment 7: Prior to construction, a targeted acid sulphate soil survey will be conducted along the route of the pipeline. Survey methods and design will be compliant with relevant guidelines and developed in consultation with regulators.

Commitment 8: Prior to construction Acid Sulphate Soil Management Plan/s will be developed, as required, for the pipeline. The plan/s will set out procedures to minimise the creation and spread of acid sulphate soils, monitor the effectiveness of control measures, and ensure that effective rehabilitation can be achieved along the pipeline route.

Commitment 9: The Acid Sulphate Soil Management Plan/s will be implemented during construction of the pipeline.

Section 8.3 Dewatering, Waste Rock and Tailings

Section 8.3.1 Management Objectives

Management of waste rock stockpiles and TSF landform construction is outlined in Section 8.1. Potential environmental impacts and proposed strategies for managing sulphidic material and contaminants of environmental concern within waste rock and tailings are outlined in this section.

The objectives for the management of material containing sulphides and contaminants of concern are to:

- Clearly identify potentially acid generating material, selectively handle this material and store the material so that leachate is not generated.
- Ensure that waste is contained and isolated from ground and surface water surrounds and treatment or collection does not result in long-term impacts on the surrounding environment.

Section 8.3.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Guidelines on the Safe Design and Operating Standards for Tailings Storage (DME, 1999);
- Strategic Framework for Tailings Management (MCMPR, Minerals Council, 2003);
- Mine Void Water Issues in WA (WRC, 2003); and
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2005).

Section 8.3.3 Potential Impacts

The proposed waste rock and tailings storage and landform design are outlined in Section 5.1.4 and Section 5.1.7. The proposed method of mineralised material processing and concentration is outlined in Section 5.1.6.

Dewatering, Acid Rock Drainage and Contaminants of Environmental Concern

A sulphidic shear zone has been identified within parts of the Southdown Magnetite Deposit. When sulphidic material is disturbed and exposed to air, the sulphides within the soil/ rock are oxidised by a group of bacteria known as chemolithoaototrophes that use sulphur for energy, forming sulphuric acid as a by-product. Leachate from acid forming waste rock either drains into waterways or reacts with carbonates and clay minerals in soils and sediments, liberating dissolved aluminium, iron, manganese and heavy metals such as copper and arsenic (CSIRO, 2004). The acid and liberated metals have the potential to contaminate surface and groundwater and cause vegetation dieback.

Dewatering at the mine site could result in lowering of the water table, allowing oxidation of acid generating materials. The modelled extent of groundwater drawdown, and flow directions at 22 years of mine life is provided in Figure 8.2, and is largely contained within the mining leases. Potentially impacted water from acid mobilised within the drawdown cone will flow towards the open pit where it will be pumped to the impacted water storage facility and used as process water.

Waste rock

The total volume of waste rock is estimated to be 1050 Mt. A study (Technical Appendix 13.2) to determine the geochemical characterisation of this waste rock identified certain waste materials that have the potential to produce acid leachate. These rock types form a small proportion (7%) of the total waste rock and can be adequately managed using conventional waste rock management practices. Static testing has been expanded to a total of 324 samples covering some 1300 m of core. Six kinetic leaching studies, including two tailings and four waste rock kinetic tests on rock types believed to present the highest risk are also being undertaken.

The rocks were classified based on their nett acid producing potential, with the classification summarised in Table 8.2.

Table 8.2 Waste rock classification scheme.

Classification	Nett Acid Producing Potential
Acid forming waste	> 20 kg H_2SO_4 per tonne
Potentially acid forming waste	< 20 to >6 kg H_2SO_4 per tonne
Non-acid forming waste	< 6 kg H_2SO_4 per tonne

Using this classification, the study showed that the overall waste is:

- 93% Non acid forming;
- 4% Acid forming; and
- 3% Potentially acid forming.

The study showed that there is a low potential for leachate to contain environmentally toxic elements, however, the leachate from waste rock that is poorly managed has the potential to contain elevated concentrations of aluminium and iron. The study also showed that there is little potential for long term acid neutralisation in the waste rock.

Tailings

The sulphidic material will be processed in the concentrator, with the sulphur removed from the magnetite into the tailings through reverse flotation. The tailings material has been classified as potentially acid forming due to the presence of trace sulphides and lack of carbonate materials. As outlined in Section 5.1.7, tailings will be conveyed to the storage facilities, compacted and encapsulated with inert waste or covered with a store and release cover system to prevent oxidation of potentially acid forming material. Environmental contamination could potentially occur through the following:

- sulphidic material transport and handling;
- processing plant spills;
- tailings storage;
- dust generation from TSF; and
- inappropriate leachate and stormwater management.

Section 8.3.4 Management

Mine site landforms and infrastructure will be located a minimum of 100 m back from adjacent properties and roads such as the South Coast Highway. Drains, sediment traps and settling ponds will be constructed around the perimeter of waste dumps and TSF's to control runoff and ensure no sediment loss impacts to adjacent land.

Waste rock

Waste rock stockpiles will be planned and constructed in compliance with the Environmental Notes on Mining Waste Rock Dumps (DME, 2001) to ensure construction of a cost efficient and effective rehabilitation to a safe, stable, non polluting landform, with an agreed post mining land use. Waste rock will initially be placed in an external dump. After Year 5, waste rock will be placed in the pit backfill to minimise the quantity of sulphidic material stored at the surface and the associated potential acid rock drainage impacts to the surrounding environment.

Acid rock drainage from waste dumps will be managed primarily through reducing the ingress of oxygen or infiltrating waters. Oxidation of potentially acid forming waste rock will be minimised through encapsulation with inert waste rock above ground, use of a store release cover system, or by backfilling waste into the mine void that will ultimately be below the rebounding groundwater levels post mine closure. Discharge of leachate from the waste rock dumps will be minimised through engineering cover systems that limit the infiltration of water into, or through the waste rock dump areas.

Oxide and Pallinup material which is characteristically leached of sulphur will be used as an encapsulation material for the ARD waste, which will be enclosed in cells and sealed as dumping progresses (Figure 8.1).

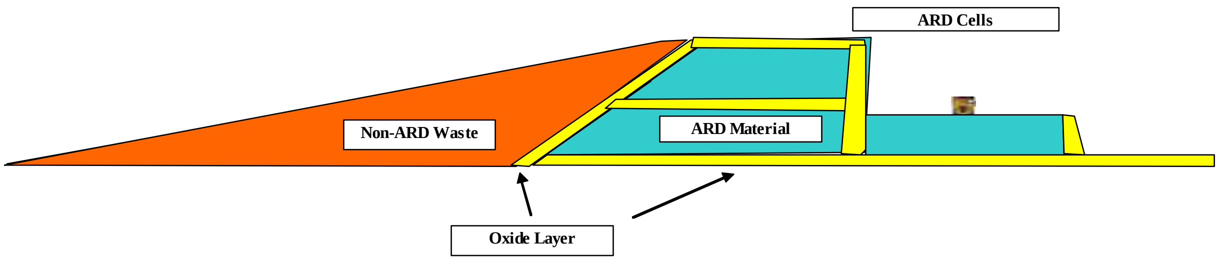

Figure 8.1 Waste ARD containment.

Tailings

The TSF will be designed in compliance with the Department of Consumer and Employment Protection (DoCEP, Resources Safety Division) 'Guidelines on the Safe Design and Operating Standards for Tailings Storage' (1999) to achieve efficient, cost effective and safe long term storage of tailings with minimal environmental impact.

An external TSF will store the first 6 years of production, after which tailings will be directed to the pit as backfill.

The tailings material has been classified as potentially acid forming, due to the presence of trace sulphides (pyrite and pyrrhotite) and a lack of carbonate minerals in the gangue. It is anticipated that the material will be deposited and distributed by mechanical means, resulting in the tailings being handled and deposited in unsaturated conditions. This will allow the ingress of oxygen into the tailings mass (potentially oxidising to produce acid) if left untreated. Management strategies for the flotation product are outlined in Section 5.1.6.

The external TSF will have a perimeter embankment constructed with inert waste rock. Tailings in the cells constructed within the TSF will be compacted, and surrounded by a shell of engineered fill (inert mine waste), or encapsulated using a store and release cover system (Section 5.1.7) that will form a barrier to reduce the infiltration of water and oxygen to the tailings. The use of the cells will reduce the amount of untreated tailings exposed to potential oxidation and, hence, acid formation. During operations, surface water drains will collect rainfall runoff from the active and covered cells, and discharge the water to the impacted water facility for use in the processing plant.

The in-pit TSF will contain cells, similar to the external TSF, to manage the tailings in discrete areas to reduce the ARD potential. The starter walls for each cell will be constructed using compacted inert mine waste rock, and raised (using mine waste rock) during on-going tailings placement. The cells will be sequentially filled then capped with inert mine waste rock, which will effectively encapsulate the tailings within the cell. The depth of placement of the in-pit tailings storage facilities will be dependant on the groundwater table during operations (when the groundwater will be lowered for pit dewatering) and at closure (when the groundwater level will rebound). The final design will ensure that the tailings will either be inundated with water and permanently saturated, or well above the groundwater level after closure. This will reduce the potential for acid generation for the range of groundwater conditions expected during and after the life of mine.

Surface water and dust will be managed to reduce the infiltration of water into the tailings mass and the movement of tailings (from wind or water erosion) from the facility.

A management plan for the handling, storage, rehabilitation and monitoring of potentially acid generating material will be developed.

Dewatering, Acid Rock Drainage and Contaminants of Environmental Concern

It is anticipated that any acid generated from dewatering activities at the mine site will be localised at the mine site. Modelling (Figure 8.2) indicates that potentially impacted water from acid mobilised within the drawdown cone will flow towards the open pit where it will be pumped to the impacted water storage facility and used as process water.

Potential ARD and groundwater contamination associated with the pit and mine site infrastructure will be monitored through the ongoing Groundwater Monitoring Programme to ensure minimal impacts to the quality of groundwater in the region. The locations of proposed monitoring bores around the mine site infrastructure are depicted in Figure 8.2, and relevant trigger levels will be included in the Groundwater Monitoring Programme. Should groundwater drawdown associated with mine dewatering or water extraction for the Project potentially result in the creation of acid sulphate soils outside of the modelled footprint, the DEC, Department of Agriculture and the DPI will be consulted to identify impact mitigation and minimisation opportunities.

After consultation with DOW Albany, the agreed approach regarding trigger values relevant to groundwater management at the site, is to include these trigger values in the Groundwater Management Plan. These values will be dependent on the existing environment in the vicinity of the mine site. Parameters for the trigger values will be determined according to the potential impacts of contamination around the site, such as impacts to surrounding vegetation, impacts to surrounding lad use and contamination of surface and/or groundwater.

Section 8.3.5 Predicted Outcome

Groundwater quality in the vicinity of the mine site will be monitored through a series of monitoring bores surrounding major infrastructure within the site (Figure 8.2).

Acid rock drainage will be managed through prevention of oxidation of potentially acid forming material, and through treatment of acid rock drainage where necessary.

Section 8.3.6 Environmental Management Commitments

Commitment 10: Prior to mining, potentially acid forming material at the mine site will be investigated, and an Acid Rock Drainage Management Plan will be developed in consultation with regulators to ensure potentially acid forming waste rock and tailings are adequately managed. The plan will set out procedures to minimise the generation of acid rock drainage, control and containment of acid rock drainage, monitor the effectiveness of control measures, and ensure effective rehabilitation can be achieved on closure.

Commitment 11: The Acid Rock Drainage Management Plan will be implemented throughout the life of mine.

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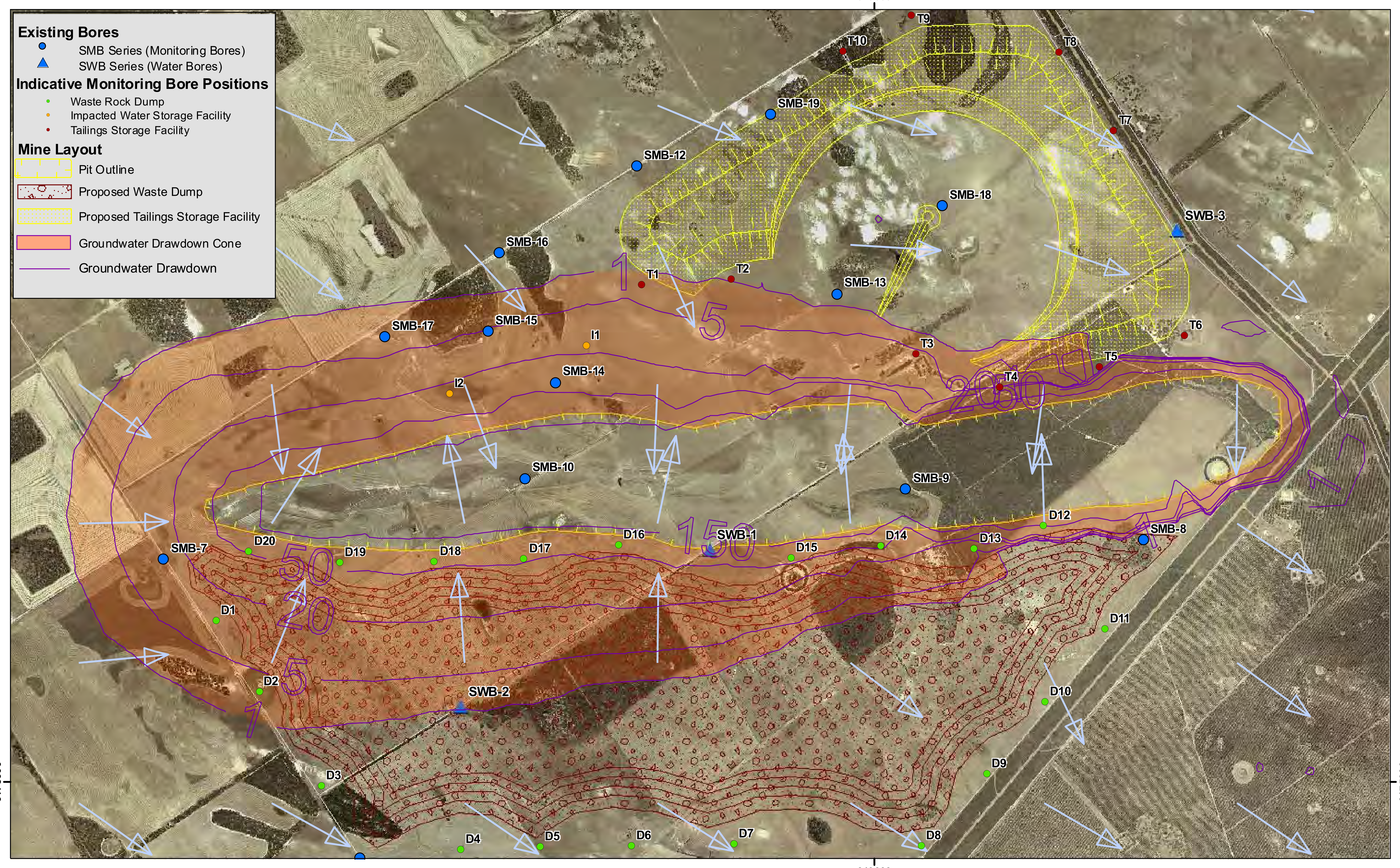

NOTE:
1. Base map copyright Mapinfo Australia Pty Ltd.
2. Datum GDA94, Projection MGA94, Zone 50.
3. Aerial photography provided by client

Figure 8.2

Golder Associates

CLIENT GRANGE RESOURCES Ltd		PROJECT Southdown Iron Ore Project	
DRAWN SR	DATE 27/09/2006	TITLE ESTIMATED GROUNDWATER DRAWDOWN AND FLOW DIRECTIONS AFTER 22 YEARS	
CHECKED JJV	DATE 27/09/2006		
SCALE 1:20,226	A3	PROJECT No 05641009-8000-TM03	Figure 8.2

File Location: J:\Jobs405\MINING\05641009-Grange_Southdown_BFS\GIS\Projects\TM03\05641009-8000-TM03-FIG02.mxd

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Section 8.4 Contaminated Sites

Section 8.4.1 Management Objectives

The objectives for management of contaminated sites are to:

- Prevent any extension of, or increase in severity of existing contaminated sites.
- Reduce the risk of impact on the health and safety of personnel from existing contaminated sites.
- Prevent the development of new contaminated sites.

Under the *Contaminated Sites Act 2003* a site is considered to be contaminated if it has a substance present at above background concentrations that presents, or has the potential to present, a risk of harm to human health, the environment or any environmental value.

Section 8.4.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- *Draft Contaminated Sites Regulation 2004;*
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006);
- Contaminated Sites Management Series (DoE), including:
- Reporting of Site Assessments (DoE, 2001); and
- Development of a Sampling and Analysis Programme (DoE, 2001).

Section 8.4.3 Potential Impacts

Since the settlement of King George Sound in the early 1800's, the Albany foreshore has been the focus of a number of industrial activities. Reclamation of the foreshore began in the late 1940's using fill material of varying types and quality. In general, land to the west of the current Albany Port consists of a mixture of industrial and domestic wastes, dredged sediments, building rubble and coal fired boiler wastes from shipping operations. Redevelopment of the Albany foreshore began in 1996, with Port expansion land reclamation (berths 4, 5 and 6) using clean calcareous quartzose sand from local sand quarries. To obtain an understanding of the potential impacts to the environment and human health from past and current contaminating activities and wastes, a Phase 1 Environmental Site Analysis of the Contaminated Sites Survey was conducted in compliance with DEC guidelines (URS, 2005, Technical Appendix 13.6).

The Phase 1 Environmental Site Assessment (Technical Appendix 13.6) identified 14 potential or actual contaminated sites along the Albany foreshore (Table 6.3). The proposed pipeline corridor intersects one contaminated site, with all other identified sites at varying distances away from the pipeline corridor. Locations of the contaminated sites in relation to the pipeline corridor along the Albany foreshore are displayed in Figure 6.7.

The site of the former and current railway depot (Westrail) to the north of Princess Royal Drive (Location 9) will be directly impacted by excavation for the proposed pipeline corridor. The potential for this area to be contaminated is high. It is a known area of hydrocarbon contamination and there is a re-fuelling facility for diesel locomotives located adjacent to the proposed pipeline route. Potential contaminants of concern at the site include petroleum hydrocarbons, benzene, toluene, ethyl-benzene, xylenes, phenols, metals, asbestos, pesticides and creosote. Excavation for pipeline construction at the contaminated site will be minimised to 1 m to 2 m wide, and 1.5 m to 2 m deep. There will be no additional soil disturbance associated with vegetation clearing, as this site is currently cleared.

Disturbance to existing contaminated sites along the Albany foreshore during pipeline construction could potentially release existing contaminants, extend or increase the severity of existing contamination and impact on the environment and the health and safety of the public and Project personnel. Contamination of groundwater, surface water and the surrounding environment can occur through inappropriate storage or handling of waste rock or tailings containing acid generating material. Sulphidic material and its management is outlined in Section 8.3.

The potential also exists for new contaminated sites to be created during the life of the Project due to the handling and storage of hydrocarbons and chemicals. This potential will be minimised by ensuring hydrocarbons and chemicals are stored in secondarily contained areas and that spills are cleaned upon occurrence.

Section 8.4.4 Management

Contaminated sites have been taken into account during the planning of the pipeline route and avoided where possible. Unavoidable disturbance of existing contaminated sites is anticipated to be highly localised as the excavation will only be approximately 1 m to 2 m wide, and 1.5 m to 2 m deep. At the contaminated site Location 9 (Rail Depot) where disturbance cannot be avoided, a Phase 2A Intrusive Investigation of the Contaminated Sites Survey will be conducted prior to EPA assessment of the PER (Table 6.3). This investigation will be conducted according to the Sampling and Analysis Plan outlined in the Phase 1 Environmental Site Analysis Report (Technical Appendix 13.6) and in consultation with regulators. Results of the investigation will be made publicly available through the Grange Resources Website.

A Phase 2B Intrusive Investigation for other contaminated site locations (Table 6.3) potentially impacted by the pipeline route (as identified in the Phase 1 Environmental Site Assessment (Technical Appendix 13.6)) will be conducted prior to pipeline construction in compliance with DEC guidelines (DoE, 2001). It is anticipated that the sampling will be conducted within the proposed trench area using a series of test pits and 3 m deep slit trenches. This will provide a detailed picture of ground conditions. Results of the investigation will be made publicly available through the Grange Resources Website.

Prior to construction of the pipeline, a Contaminated Site Management Plan detailing site specific management strategies and monitoring (where required) will be developed in consultation with the DEC, approved and implemented to protect the health and safety of personnel and the public, prevent the spread of contaminated materials and where practicable provide remediation for the area impacted by the proposal. It is anticipated that excavated material within the pipeline easement will be remediated on site, or removed to an approved landfill site with the pipeline channel filled with clean fill.

The development of new contaminated sites will be prevented by implementation of management procedures outlined in Section 8.1 (Geology and Landform), Section 8.3 (Waste Rock and Tailings) and Section 8.17 (Waste). Both the Construction and Operational Management Plans will ensure all chemicals and hydrocarbons are stored in secondarily contained areas. Spill management procedures will also be implemented where all spills are cleaned up as soon as possible and any contaminated soil is removed to an appropriate disposal or bioremediation site.

The proposal will reclaim land over the current Vital Foods outfall pipeline. Currently Vital Foods has only been granted a short term licence by the DEC and it is likely that Vital Foods will not have long term use of the pipeline due to environmental concerns about the discharge of high levels of nutrients into the harbour. In addition, the Port advised Vital Foods in September 2006 that it has withdrawn the seabed licence for the pipeline, and the pipeline is to be removed.

To confirm that contamination has not occurred due to the Albany Iron Ore Project, investigations will be undertaken as part of the site closure. The contaminated sites assessment process will be undertaken as per the Contaminated Sites guidelines (DoE), as outlined in the Mine Closure Plan (Technical Appendix 13.19).

Section 8.4.5 Predicted Outcome

Disturbance of existing contaminated sites is anticipated to be much localised, with no range extensions of the existing sites. Contaminated sites formed as a result of the Project (TSF and waste dumps) will be encapsulated and managed to prevent further contamination.

Section 8.4.6 Environmental Management Commitments

Commitment 12: Prior to the completion of the EPA's assessment of this proposal, a Phase 2A Intrusive Investigation will be conducted for the contaminated site Location 9 which the pipeline directly intersects.

Commitment 13: Prior to the construction of the pipeline, a Phase 2B Intrusive Investigation will be conducted for other contaminated site locations potentially impacted by the pipeline route.

Commitment 14: Prior to construction of the pipeline, a Contamination Site Management Plan/s will be developed in consultation with the DEC. The plan will set out procedures to manage construction activities so as to prevent impacts to human health and the environment.

Commitment 15: The Contamination Site Management Plan/s will be implemented during construction of the pipeline.

Section 8.5 Hydrogeology

Section 8.5.1 Management Objectives

The objectives for management of groundwater are to:

- Maintain the quality and quantity of groundwater so that existing and potential environmental values, including ecosystem maintenance, are protected.
- Maintain the integrity, ecological functions and environmental values of wetlands.
- Minimise impacts to groundwater resources during mining.

Section 8.5.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Australian New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ ARMCANZ, 2000);
- Environmental Water Provisions for Western Australia; Statewide Policy No. 5 (WRC, 2000); and
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006).

Section 8.5.3 Potential Impacts

Management of the groundwater within the Project footprint is essential as the Project is located in an area of the south-west where the underlying inland groundwater supplies are poorly understood.

Mine Site

Potential impacts to groundwater that may arise at the mine site include:

- Disturbance to natural groundwater flow patterns from the mine pit.
- Ecological impacts from the drawdown as a result of the pit dewatering.
- Degradation and contamination of groundwater sources from hydrocarbon or chemical spills.
- Degradation and contamination of groundwater sources from inappropriately constructed and managed TSF and waste rock stockpiles (Section 8.3).

The hydrological setting of the mine site is characterised by having very few well defined waterways. Groundwater probably recharges along natural drains or ponds in low lying regions in the wet season. Dewatering is anticipated to lower groundwater, however after the mine has closed, groundwater levels are expected to recover post mine closure and the section of the pit not backfilled will fill up with water. Dewatering therefore is not anticipated to impact regional waterways or impact groundwater flow patterns in the long term.

A groundwater model of the Southdown mine site has been developed as a predictive tool to assess the response of the hydrogeological system to various dewatering and decommissioning scenarios. Using the parameters outlined in Technical Appendix 13.3, the model indicates that the drawdown cone after 20 years of mining and dewatering will be 12.2 km^2. Drawdown impacts to vegetation are not anticipated as the footprint is largely localised to the mining leases (Figure 8.4) and adjacent farmland where existing vegetation blocks will have already been cleared for mining operations.

As outlined in Section 8.3, only 7% of the waste rock is potentially acid forming. The chemistry of extracted groundwater is expected to change with time as a consequence of geochemical processes, in particular sulphide oxidation as the fresh bedrock is dewatered and oxidation begins. Water could also potentially seep from the proposed waste rock dumps and TSFs into the groundwater, affecting groundwater quality. Strategies to prevent groundwater contamination from the proposed waste rock dumps and TSFs are outlined in Section 8.3.4.

Mine Site Groundwater Model Development

The development of a groundwater model for the Southdown Magnetite mine site (Golder, 2005c) to predict groundwater inflows, levels and drawdown associated with the mine site involved:

- Water level survey comprising a regional water well survey, site well survey and water level surveys in selected geotechnical drill holes.
- Hydraulic conductivity testing of selected geotechnical drill holes.
- Development of conceptual and numerical hydrogeologic models.

Water Level Survey: A water well census was carried out within a five kilometre radius of the proposed mine site using a government database. Twenty one wells were identified within the set radius; however only four of these contained information on static water level measurements and an additional three wells provided information on interception of water table during drilling. The limited survey data indicate that the static water table within a five kilometre radius around the Project site varies from approximately 17 m to 27 m below ground surface (111 m to 124 m elevation).

The site well survey assessed several old stock water supply wells and three new wells, completed at the mine site in 2005 by Grange as part of the exploration drilling programme to depths ranging from 33 m to 40 m. The poor conditions of the stock well casings did not allow a proper water level survey and no information on water table elevation is available for these locations. Water levels from the new wells measured in February 2005 indicate depths to water table between 16 m and 23 m (112 m and 119 m elevation).

Water level measurements were collected from selected geotechnical drill holes completed in the western part of the deposit in August 2005 as part of the in situ hydraulic testing programme. The vertical depth to groundwater was between 10 m and 20 m (125 m to 148 m elevation) in five open holes at four locations in the western end of the proposed mine pit.

Based on the water level survey outlined above, the static water table around the Project site varies from approximately 17 m to 27 m below ground surface. With a topographic relief around the pit area varying from about 123 m to 162 m ASL, the range of water table elevations is expected to be between 125 m and 148 m in the immediate pit area, and between 111 m to 124 m in the wider radius around the proposed pit. Due to lack of long-term data it is unclear whether the differences in water table elevations are representative of the actual groundwater conditions or are the result of seasonal fluctuations at the time of measurement.

Hydraulic Conductivity Testing: Hydraulic conductivity testing was conducted in four selected geotechnical drill holes over the period of 19th to 25th August 2005 as part of the geotechnical drilling programme carried out at the mine site. Test hole selection was based on their location and orientation with respect to the proposed pit walls, or their orientation towards the brittle crosscutting structures identified at the Project site. Hydraulic testing was carried out using single pneumatic packer suspended on a wireline through HQ size drill rods. Falling head tests consisting of adding water to the drill rods above the isolated test interval and monitoring the recovery to the pre-test level over time were used to obtain data required for calculation of hydraulic conductivity. Hvorslev (1951) time-lag analyses were used to calculate hydraulic conductivity of the individual test intervals.

The results of the August 2005 testing programme showed that the near surface hydrostratigraphic unit of saturated waste rock and shallow weathered bedrock above +60 m elevation has relatively high bulk hydraulic conductivity of about $1x10^{-6}$ m/s. In the area of the proposed open pit the hydraulic conductivity decreases with depth to about $1x10^{-9}$ m/s in the lower fresh bedrock below -60 m elevation. The hydraulic conductivity of the brittle crosscutting structures was estimated from a test conducted in one of the geotechnical drill holes over an interval of 150 m to 260 m along the borehole axis (+20 m to -80 m elevation). As this structure is approximately 10 m to 20 m wide, the majority of the material within the test interval was represented by the relatively tight lower fresh bedrock hydrostratigraphic unit (Golder, 2005c).

Hydrogeologic Model: The hydrogeologic model for the proposed Southdown Magnetite mine pit was constructed using a three-dimensional finite-element groundwater flow model, widely used for simulating groundwater flow, including dewatering and drawdown (FEFLOW version 5.1 (WASY 2004) modelling software).

The model represents an area of approximately 552.8 km^2, which incorporate several catchment areas around the proposed open pit. The model incorporates parts of the Willyung Creek and Eyre River catchments and extends to the coastline. The modelled proposed pit has a length of ~6000 m, width of ~600 m and depth of ~300 m. The ground surface layer was prepared based on the topography map available for the Project site.

Results from the hydrogeologic model indicate that groundwater inflows into the proposed Southdown open pit after one year of mining are expected to reach about 35 L/s. After five years of mining, the groundwater inflows are expected to increase gradually to approximately 53 L/s as the pit is developed over a length of approximately 2,000 m without backfill. After the initial five year mining period the total groundwater inflows into the proposed pit are expected to decrease as a result of in-pit deposition of waste rock, before increasing to about 65 L/s at year ten. This increase is due to the additional inflow contribution from the fracture zones that will be intercepted by the pit during that mining period. After a stabilization period of about one year, the total groundwater inflows are expected to gradually decrease to about 35 L/s at the end of the 22 year mine life.

Water table elevations and corresponding drawdown contours were estimated for five year time segments over a 20 year life of mine period. Current groundwater levels and drawdown contours for Year 20 of mining are provided in Figure 8.3 and Figure 8.4.

A sensitivity analysis has not been carried out for the parameters used in the model. The 20 year scenario presented represents the end of proposed mine life groundwater conditions and as such reflect the maximum expected impacts to the groundwater system based on the parameters used in the model and applying experience-based judgement.

Slurry and Return Water Pipeline

As the pipeline is buried and carrying water, magnetite concentrate and potentially ameliorants outlined in Section 5.2.3 only, the unlikely event of a breach will have minimal, transient impacts to surface and groundwater resources. Potential impacts of a breach in the slurry or return water pipeline include:

- contamination of groundwater in the vicinity of the breach;
- negative impacts to surrounding ecosystems from contamination with contents of pipeline; and
- negative impacts to public amenity.

Port Infrastructure

The land reclamation area will interface with the rocky shore line east of the existing Port. Construction and operation of infrastructure associated with Grange operations at the Port could result in hydrocarbon groundwater contamination in the vicinity of the Port.

Section 8.5.4 Management

Mine Site

Groundwater modelling indicates that mining of the ore body will cause groundwater in the vicinity of the mine site to flow into the mine pit (Figure 8.4). Water from the mine pit will be pumped to the impacted water storage facility and utilised as process water. To maintain the quality of the groundwater resource:

- The mine will be designed to ensure the safe storage and handling of hazardous materials (such as hydrocarbons) to prevent contamination.
- Emergency procedures will be established for handling accidents involving hazardous substances.
- On site landfill sites (if required) and waste rock dumps will be constructed with sufficient vertical separation from the groundwater table (with considerations to hydroconductivity of the geology) to minimise the potential for groundwater contamination.
- Environmental Management Plans for construction and operation works will be developed and implemented to minimise the risk of spills and contamination to groundwater.

A Groundwater Management Plan will be developed, and implemented to ensure groundwater quality in the vicinity of the mine site is maintained. A monitoring programme will be implemented during the mining operations to monitor groundwater quality and measure the groundwater level (i.e. pressure) and inflow rates. These will be compared to the modelled predicted values, with the model recalibrated and re-run. Based on refinement of the model, adjustments to the dewatering strategy will be made as required. A Groundwater Operating Strategy will be developed in consultation with the DoW to protect the integrity and diversity of the ecosystem. This document will address drawdown impacts and potential contamination of groundwater.

Investigations into potential impacts to groundwater dependant ecosystems will be conducted as necessary.

Slurry and Return Water Pipeline

The pipelines have a very low risk of failure. Nonetheless the pipelines will be monitored via a control system and pressure gauges located at the pumping and receival stations. The control system will include leak detection software and hardware to alert, locate and reduce the amount of spillage.

For corrosion control, the outside surface will be treated with a protective coating. The need for internal protective coating will be determined during the final design phase. Extra precautions such as increasing the thickness of the pipe in sensitive areas will be implemented.

During operations, the condition of the pipeline will be routinely checked internally to identify any areas where the pipeline may be degrading. This procedure does not require exposure of the pipeline and allows preventative maintenance and repair to take place. In the case of a spill the following will take place:

- The pipeline will be shut down on detection of a pressure change. The monitoring systems will enable the spill site to be identified quickly and an emergency response team dispatched to the site.

- Affected landowners and appropriate authorities including the DEC, the City of Albany's Environmental Health Officers will be notified.
- Any soils impacted by the spill will be excavated and fed into the process plant at the mine site.
- Pipeline will be repaired.
- The ground surface will be restored and rehabilitated.
- Pipeline brought back into service.

An Emergency Response Plan has been developed as part of the Pipeline Construction and Operation Management Plan (Technical Appendix 13.18) and will be implemented in the unlikely event of a breach.

Port Infrastructure

Management of hydrocarbons to prevent potential impacts from operation and construction of the Grange port-side facilities to the groundwater in the area will be managed as part of the Project Construction Environmental Management Plan.

Section 8.5.5 Predicted Outcome

Mine Site

Drawdown associated with dewatering at the mine site is predicted to result in a drawdown cone area of 12.2 km^2 over the life of mine period which could cause oxidation of the fresh bedrock.

As the mining will start at the western end of the proposed pit, the impact of pit dewatering will be most pronounced in this area. With the additional pit development to the east, the drawdown cone is expected to reach about 1,100 m distance from the pit crest at the end of the 22 year life of mine period. Development of the drawdown cone however will be slower than the rate of mining, resulting in a limited impact on the pre-mining groundwater conditions in the eastern end of the proposed pit.

Groundwater monitoring bores have been constructed and will assist with monitoring of the expansion of both the drawdown cone as mining progresses and potential impacts on the groundwater regime adjacent to the mining operation. The model does not address post closure issues or the rate at which the groundwater levels will return to their pre-mining levels.

Slurry and Return Water Pipeline

The pipelines have a very low risk of failure, however, should a breach occur, it will be detected, and managed in accordance with the Pipeline Construction and Operation Management Plan to minimise environmental impacts.

Port Infrastructure

Groundwater will not be contaminated as a result of Project activities as operational controls will minimise the risk of spills, and engineering controls such as bunding and sumps will prevent any spills causing adverse environmental impacts.

Environmental Management Commitments

Commitment 16: Prior to dewatering activities, a Groundwater Management Plan will be developed in consultation with the DEC and DoW. The plan will set out procedures to model the short and long term hydrogeological impacts of dewatering and surface water harvesting, develop a Groundwater Operating

Strategy and a monitoring programme, and minimise the impacts to groundwater aquifers.

Commitment 17: The Groundwater Management Plan will be implemented throughout the life of mine.

Commitment 18: Prior to construction, a Pipeline Construction and Operation Management Plan will be developed. The plan will set out procedures to minimise and manage the environmental and social impacts of construction and operation of the pipeline.

Commitment 19: The Pipeline Construction and Operation Management Plan will be implemented during construction and throughout the operational life of the pipeline.

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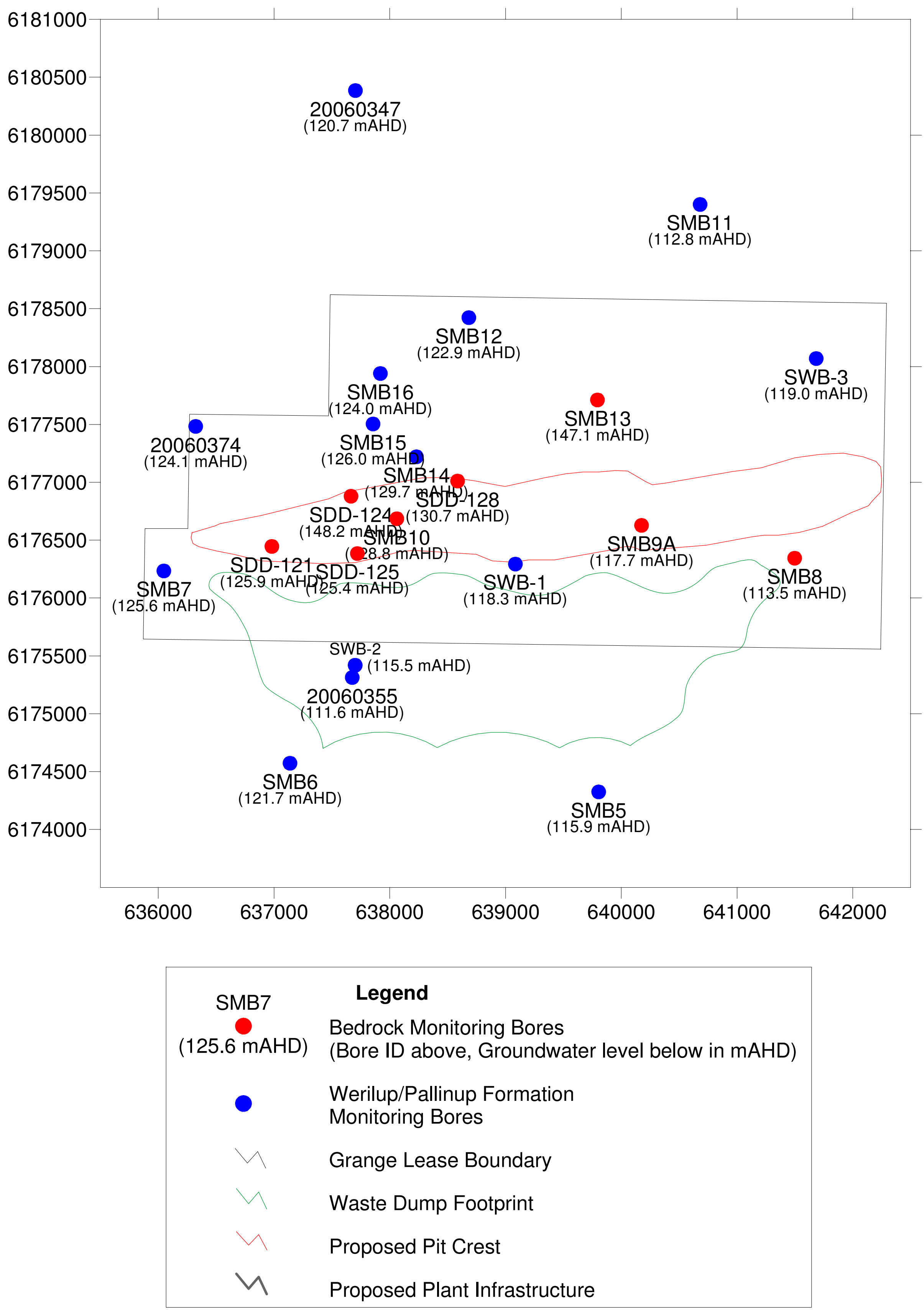

Golder Associates	CLIENT Grange Resources Ltd		PROJECT Southdown Project	
	DRAWN CMC	DATE May 06	TITLE PRE-MINING GROUNDWATER LEVELS (mAHD)	
	CHECKED	DATE		
	SCALE 1:50,000	A4	PROJECT No 04641009-8000	Figure 8.3

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NOTE:
1. Base map copyright Mapinfo Australia Pty Ltd.
2. Datum GDA94, Projection MGA94, Zone 50.
3. Aerial photography provided by client

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Golder Associates

CLIENT GRANGE RESOURCES Ltd		PROJECT Southdown Iron Ore Project	
DRAWN SR	DATE 26/09/2006	TITLE ESTIMATED GROUNDWATER LEVELS AND FLOW DIRECTIONS AFTER 22 YEARS	
CHECKED JJV	DATE 26/09/2006		
SCALE 1:35,000	A3	PROJECT No 05641009-8000-TM03	FIGURE No Figure 8.4

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Section 8.6 Surface Hydrology and Water Harvesting

Section 8.6.1 Management Objectives

The objectives for management of potential Project impacts to surface hydrology are to:

- Maintain the quality and quantity of surface water so that existing and potential environmental values, including ecosystem maintenance, are protected.
- Maintain the integrity, ecological functions and environmental values of wetlands and drainage systems.
- Minimise adverse impacts to surface water quality and natural drainage pattern during pipeline construction.
- Control and contain contaminated water on site to prevent entry into the natural drainage system and surrounding vegetation.
- Contain surface water on site where possible.

Section 8.6.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Australian New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ ARMCANZ, 2000);
- Position Statement No. 4. Environmental Protection of Wetlands (EPA, 2004);
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006);
- Erosion and Sediment Control Guidelines (IEAust (Qld), 1996);
- NSW Department of Conservation and Land Management Urban Erosion and Sediment Control (NSW Department of Land and Water Conservation, 1992);
- AS 3500: 1 2003 Plumbing and Drainage;
- Australian Drinking Water Guidelines (2004); and
- Guidance No. 40 Management of Mosquitoes by Land Developers (EPA, 2000).

Section 8.6.3 Potential Impacts

Mine Site

The Southdown Magnetite Deposit lies in undulating country, with the mineral deposit forming a low rounded ridge of about 25 m height. The drainage lines are poorly defined, with no perennial rivers within the Project footprint. Surface water collects temporarily in broad depressions that are characteristic of the area. To the south and east of the Project area, ephemeral creeks and minor drainage lines carry surface water southerly to the coast. Impacts to wetlands in the area are not anticipated as the groundwater drawdown footprint is localised to the mining leases and adjacent farmland (Figure 8.4) where existing wetland areas and vegetation blocks have already been cleared or will be cleared for mining operations.

A site-wide water balance study (Technical Appendix 13.4) of the proposed Southdown mine site was undertaken to estimate the water harvesting potential from the site (Section 5.4.2). It is proposed to use the groundwater flowing into the pit void and surface runoff harvested from the site for processing plant make-up water. The water harvested from the TSF, waste rock dumps, dewatering wells, in-pit sumps and catchment of the mine footprint will be managed as two streams; the non-impacted (clean) water stream and the impacted water stream. Management of these two streams is outlined in Section 5.4.2.

Surface water in the vicinity of the mine site could potentially be impacted by;

- Overflow of water storage facilities into the surrounding environment during flood events.
- Un-intentional discharge of impacted water.
- In-appropriate management of acid mine drainage and leachate from waste dumps and TSF.

Mosquitoes breed in fresh, brackish, salt and polluted water in natural and artificial situations. Large exposed water retention / storage areas have the potential to become mosquito breeding grounds, as well as constructed landforms suitable for ponding water such as wheel ruts from heavy machinery, deep contour lines and the pipeline trench.

Pipeline

The proposed pipeline corridor impact footprint passes through two water catchments, the Albany Eastern Hinterland Catchment and the Albany Harbours Catchment. The pipeline corridor is within the Albany Eastern Hinterland Catchment and crosses the King River, Kalgan River and Napier Creek. No long term impacts to these waterways are anticipated from the pipelines. Potential impacts from the pipelines include:

- Temporary disturbance of drainage patterns and watercourses during pipeline construction.
- Temporary increased levels of turbidity due to soil erosion and changed surface water flows during pipeline construction.
- Potential contamination of surface water associated with construction activities and pipeline failure.

Port

Storm water runoff from port infrastructure may impact the marine environment if not suitably contained or managed.

Section 8.6.4 Management

Mine Site

Localised groundwater drawdown at the mine site will not impact surface water flows outside of the mine footprint due to the lack of perennial rivers and the localised nature of the surface watersheds.

Surface runoff and groundwater flowing into the mine will be harvested and utilised as process water. Mine site infrastructure will be designed to collect and store surface runoff and stormwater with minimum erosion of the landscape. Excess non-impacted (clean) water is anticipated to be suitable for off-site discharge where necessary, subsequent to flowing through sedimentation ponds to reduce total suspended solids to acceptable levels. Excess impacted water from exceptional rainfall events, if any, will be directed to overflow into the open pit for on-site management.

Hydrocarbons and chemicals on site will be stored according to ‘Australian Standard 1940-2004: The storage and handling of flammable and combustible liquids’. Operational controls will be developed to minimise the impacts of accidental minor spillages of hydrocarbons.

Minimisation of mosquito breeding sites will be taken into account during the design phase of water storage infrastructure. Mosquito management strategies will be developed and implemented in consultation with the DoH and the City of Albany. Management strategies may include:

- Holding tanks for water to be designed so as to permanently prevent the entry of mosquitoes.
- Water storage facilities to be constructed with steep sides to minimise shallow mosquito breeding areas.
- Regular monitoring of open water storage areas to identify the presence of mosquito larvae to allow physical or chemical control procedures to be undertaken.
- Use of larvicides suitable for water storage requirements.

Mosquito management outside of water holding infrastructure will focus on the reduction or elimination of mosquito breeding grounds through designing sites and roads to be free draining to minimise ponding.

Pipeline

The Pipeline Construction and Operation Management Plan (Technical Appendix 13.18) has been developed to eliminate potential impacts to surface water quality and decrease long term impacts to river banks and natural drainage lines. The proposed construction methods for river and creek crossings are outlined in Section 5.2.6. An Application for a 11/17/21A Permit to interfere with Bed and Banks under Section 17 SC of the *Rights in Water and Irrigation Act 1914* will be submitted and approval obtained from the DoW prior to undertaking works at river crossings.

Traditional custodians will also be consulted prior to Project works where appropriate. Potential contamination of surface water from pipeline breaches will be minimised and managed as described in Section 8.4.4.

Port

Approximately 90% of the slurry water arriving at the Port will be separated from the magnetite and returned to the mine site to be re-used. The remaining 10% will stay as moisture in the filter cake.

Stormwater at the Port will be managed as two separate systems; 'contained' and 'general', through bunding, sumps, gross pollutant traps or silt traps and storage tanks.

The filter plant and tank farm will be bunded with run-off channelled into a 'Contained Area Drainage System'. The run-off from the Contained Area will be collected in a central sump. The sump contents will be pumped to the thickener for re-use in the process. During a large storm event or in the unlikely event that there is a large slurry spill, any over flow from the sump will gravitate to a gross pollutant trap or silt trap and to a large storage tank to be pumped to the thickener for reuse. Any overflow above the design conditions will be to a marine outfall. The design parameters for the Contained Area Drainage System will be a 1 year Average Recurrence Interval (ARI) and a 24 hour storm event duration.

Run-off from the stockpile shed roof, roadways and hardstands will be channelled into a separate 'General Drainage System'. The General Area Drainage System run-off will be collected in sumps and directed to a central gross pollutant trap to a storage tank before exiting a marine outfall. When conditions allow, the water from this system will be opportunistically harvested by pumping to the thickener for re-use. The design parameters for the General Area Drainage System will be a ten year ARI and a 24 hour storm event duration.'

Section 8.6.5 Predicted Outcome

Mine Site

Harvesting of surface water at the mine site will not impact surface water flows in the surrounding area, as the surface water watersheds are naturally highly localised and largely contained within the proposed mining footprint (Figure 6.8).

No permanent impacts to surface water quality in areas surrounding the mine site are anticipated as all water runoff within the site will be harvested as process water. Should exceptional rainfall events necessitate discharge to the environment, excess water from the non-impacted water stream will be passed through settling ponds to ensure water is of acceptable quality prior to discharge to the environment. In exceptional rainfall events, excess water from the impacted water system will be directed into the pit and managed on-site.

Pipeline

Pipeline construction through creeks and rivers will result in short term increased turbidity in these waters. No long term impacts to wetlands or waterways are anticipated from the pipeline.

Port

No impacts to surface water in the vicinity of the Port are anticipated as stormwater from the Contained Area Drainage System will be diverted through a gross pollutant trap or silt trap and then stored in a storage tank where water will be harvested for use in the process. Any overflow from this storage tank will discharge from a marine outfall. Water from the General Area Drainage System will be collected in sumps and pass through a gross pollutant trap or silt trap prior to a storage tank where water will be opportunistically harvested by pumping to the thickener for re-use when conditions allow. The overflow from the storage tank will discharge to the marine outfall.

There will be no release of process water into the environment from the Port facilities during operation.

Section 8.6.6 Environmental Management Commitments

Commitment 20: Prior to mining, a Surface Water Management Plan will be developed in consultation with the DEC and DoH. The plan will set out procedures to minimise the human health and environmental impacts of surface water harvesting and discharge, minimise the impacts of mining and processing to surface water quality, and monitor the effectiveness of management procedures.

Commitment 21: The Surface Water Management Plan will be implemented throughout the life of mine.

Section 8.7 Vegetation and Flora

Section 8.7.1 Management Objectives

The objectives for the management of flora and vegetation are to:

- Maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.
- Minimise the loss and adverse impacts to native vegetation and plant habitats.
- Protect Rare and Priority Flora species that occur within the proposal area.

Section 8.7.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Position Statement No. 2 Environmental Protection of Native Vegetation in WA (EPA, 2000);
- Position Statement No. 3. Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002);
- Position Statement No. 9 Environmental Offsets (EPA, 2006);
- Guidance Statement No. 3. Separation Distances between Industrial and Sensitive Land Uses (EPA, 2005);
- Guidance Statement No. 51. Terrestrial Flora and Vegetation Surveys Environmental Impact Assessment in WA (EPA, 2004); and
- Policy Statement No 9, Conserving Threatened Species and Ecological Communities (CALM, 2003).

Section 8.7.3 Potential Impacts

The potential impacts to flora and vegetation resulting from the proposal include:

- Clearing of native vegetation.
- Fragmentation and degradation of vegetation communities.
- Spread of dieback through movement of soils and vehicles.
- Weed infestations in newly cleared bushland.
- Increased dust deposition on vegetation from mining activities and increased exposed ground.
- Disturbance to threatened flora populations.

Vegetation Clearing

The Southdown Magnetite Proposal will require land clearing involving the removal of vegetation and topsoil for pre-defined areas including the mine pit area, waste rock stockpiles, TSFs and pipeline. It is estimated that 252.6 ha of remnant vegetation will be cleared for mining activities over the 22 year life of the mine at Southdown, leaving a minimum of 30 ha for conservation purposes. The total remaining extent of vegetation on the Pallinup Sandplain is outlined in Section 6.6.3. Clearing associated with the mine site is anticipated to reduce the total reserved and un-reserved native vegetation within the East Sandplain sub-catchment from 24.1% to 23.42%. This clearing will result in the loss of vegetation and a corresponding area of fauna habitat.

The corridor required for the slurry and return water pipeline installation is 10 m to 25 m wide, which will require some clearing of native and remnant vegetation. Up to 2.3% of the alignment, an estimated 5 ha, of which 20% is degraded, will require clearing of native vegetation. The alignment will not pass through any conservation estate areas and where possible will be confined to existing firebreaks, open farm land and access tracks.

Fragmentation and Degradation of Vegetation Communities

Vegetation at the proposed mine site and pipeline route occurs as scattered native remnants of variable size, surrounded by cleared farmland utilised for mixed cropping and grazing. Between 20% and 40% of the City of Albany remains uncleared, however many of the small uncleared patches on agricultural land have been degraded through uncontrolled grazing by domestic stock, altered surface drainage patterns, clearing for fire breaks, increased nutrient run-off, vegetation fragmentation and the introduction of weed species.

Clearing of the remnant bushland on the mine site will further decrease the proportion of bushland remaining in the East Sandplain sub-catchment by 0.68%. Currently, approximately 24.1% of native vegetation (reserved and unreserved) remains in this sub-catchment. This is well below the threshold level of 30% below which species loss is considered to accelerate exponentially at an ecosystem level (EPA, 2000).

Although some of the vegetation types of the mine site are distributed widely through the region, none of the vegetation types are abundant and few significant areas of these vegetation types are protected in nature reserves or other reserves. Vegetation within the East Sandplain sub-catchment is poorly conserved, with approximately 1.8% reserved within the Mettler Nature Reserve, Reserve 28325 and parts of Hassell National Park.

Increased activity associated with mining operations and pipeline construction may also introduce weeds and promote the spread of both weeds and dieback across the Project footprint, causing further degradation to surrounding remnant bushland. Project works can also promote the spread of dieback as vehicles move from dieback disease areas to dieback free areas, especially during the wet season promotes the spread of dieback and the associated plant deaths. This is addressed further in Section 8.8.

Clearing of vegetation promotes the spread of weed species that have evolved a life strategy of rapid growth and dispersal. Weeds will also be spread by machinery if proper hygiene measures are not implemented. The invasive nature of weeds in disturbed environments means that they can dominate an area at the expense of native species and reduce the habitat value of any adjacent native vegetation. These factors are addressed further in Section 8.8.

Ground disturbance during the clearing process can generate large amounts of dust which may deposit on adjacent native vegetation, leading to a decrease in the health and vigour of these plants. Initial dust modelling of mining activities indicates that dust generated by the proposal is unlikely to cause environmental impact (Section 8.13).

Rare and Priority Flora

Flora species identified at the mine site and along the pipeline corridor are listed in Appendix 12- 4. No DRF were recorded during the flora surveys, although seven species of Priority Flora were recorded (Appendix 12- 5). Six species were recorded within the mine site only and one species was recorded at both the mine site and the pipeline corridor. These species are outlined in Table 6.8.

Both direct and indirect impacts to Priority flora can potentially occur during the construction and operation phases of the mine and can include removal of individuals and partial loss of populations of species of Priority status or taxa of conservation significance. Clearing for mining operations and pipeline construction will be the principal impact to Priority Flora.

Groundwater Dependent Ecosystems

Several wetlands within the mine footprint will be removed as part of mining activities. The drawdown footprint associated with dewatering from mining activities (Figure 8.4) will not impact groundwater dependent ecosystems including rivers, wetland ecosystems, conservation areas and threatened ecological communities outside of the proposal footprint.

The impacts of water harvesting at the mine site to the surrounding area are anticipated to be minimal as the surface water catchments are largely confined to the mine site footprint (Figure 6.8). The groundwater model water balance indicates that net rainfall recharge in the drawdown cone amounts to 1400 m^3/yr, in comparison to average groundwater flow into the pit from aquifer storage which is estimated at 1.3 million m^3/yr. The change in rainfall recharge, therefore, represents 0.1% of groundwater inflows and is not anticipated to impact groundwater levels regionally.

Section 8.7.4 Management

Vegetation Clearing

Grange is committed to addressing the key principals of native vegetation protection listed in Schedule 5 of the *Environmental Protection Act 1986*. This has been addressed as part of flora surveys and the Project Construction Environmental Management Plan (Technical Appendix 13.17).

Grange is committed to retaining a minimum of 30 ha of Albany Blackbutt (*Eucalyptus Staeri)* mallee heath and chittick scrub-heath on the mine site. This block, to the north of the proposed pit will be fenced and retained for conservation purposes.

To decrease the footprint of the Project and minimise environmental impacts, Grange has proposed backfilling of approximately 70% of the tailings and 50% of waste rock into the pit. The dimensions of the mine pit and above ground storage facilities however necessitate the use of all three mining leases and the associated clearing of vegetation within the leases.

Fragmentation and Degradation of Vegetation Communities

Progressive rehabilitation will be conducted throughout the Project life with revegetation continued after mine closure.

Potential spread of dieback and weeds will be managed through hygiene measures developed in compliance with the DEC. This is addressed further in Section 8.8.

Dust management strategies are summarised in Section 8.13.4 and included in the Project Construction Environmental Management Plan (Technical Appendix 13.17).

Rare and Priority Flora

Grange will comply with the requirements of the *Wildlife Conservation Act 1950* and *EPBC Act 1999* by undertaking the following:

- Rare Flora baseline surveys have been conducted for all disturbance areas. No DRF were found. The locations of identified Priority Flora taxa have been incorporated into an Environmental Geographical Information System (GIS) and plotted onto maps.

- Where possible, impact to species of Priority flora or Conservation Significance will be avoided by using information from flora surveys conducted in the area.
- Measures to limit the extent of vegetation clearing, e.g. marking clearing limits, will be implemented.
- Areas will be re-surveyed if information from the existing surveys does not provide sufficient information about the location of such species.
- Liaise with the DEC regarding the management of Priority and Significant Flora.
- Grange will prepare and implement a Threatened Flora and Conservation Management Plan for the Project to address management of Threatened Flora impacted by the proposed development.

As the Project will impact one of the known population areas of *Commersonia* sp. Mt Groper (Table 6.8) a Threatened Flora and Conservation Management Plan will be developed, outlining propagation and management strategies for this species. The Management Plan may include further investigations to locate additional populations in conservation, state lands, or private properties. Additional recovery techniques will be explored and determined by DEC in consultation with Kings Park Botanical Gardens, the Threatened Flora Seed Centre, and the University of WA School of Plant Biology. Appropriate action will be taken to manage impacts to the population and ensure survival of the species.

Table 8.3 Legislated Principles for Clearing Native Vegetation; Schedule 5 *Environmental Protection Act 1986.*

Principle; Native vegetation should not be cleared if-	Project Relevance	Management Objective	Management Action
a) It comprises a high level of biological diversity;	The implementation of the Project will result in local biodiversity loss (primarily in the reduction of the gene pools of flora species and the reduction of flora habitat) and contribute to regional ecosystem decline.	No nett loss of biodiversity.	1. Offsets – areas of equivalent vegetation to those that are to be cleared will be purchased or otherwise covenanted for conservation. 2. Recovery strategies for *Commersonia* sp Mt Groper. will include: • Further investigations to locate additional populations in conservation or state lands. • Propagation strategies, such as an autumn burn at one of the known population areas, in consultation with DEC, to encourage seed potentially stored in the soil seed bank to germinate. • Appropriate action will be taken to ensure survival of the species; including management of impacts to the population, propagation by cuttings and, harvesting of seeds from mature plants. 3. Genetic resources of areas to be cleared collected and appropriately stored or used for replanting other areas.
b) It comprises the whole or part of, or is necessary for the maintenance of, a significant habitat or fauna indigenous to W.A.;	Clearing of vegetation at the mine site has been classified as a controlled action as much of the vegetation is feeding habitat for Carnabys Cockatoos. Clearing of mine site vegetation will result in a decrease of feeding habitat in the region. The vegetation does not contain suitable breeding habitat for Carnaby's Cockatoo.	No nett loss of feeding habitat for Carnabys Cockatoos in the long term.	Potential impacts of vegetation clearing at the mine site will be offset through rehabilitating degraded bushland and purchasing native vegetation for conservation. Progressive rehabilitation at the mine site will be undertaken with native species with genetic material salvaged from the mine site.
c) It includes, or is necessary for the continued existence of, rare flora;	*Commersonia* sp Mt Groper has been collected from three locations. One of the three known population areas of *Commersonia* sp Mt Groper is located at the mine site. There is one known extant population of this species.	No nett loss of rare flora.	Management actions to recover *Commersonia* sp Mt Groper will be implemented as outlined under 'Management Actions' under Principle a).

Principle; Native vegetation should not be cleared if-	Project Relevance	Management Objective	Management Action
d) It comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community;	No TECs occur within the Project footprint.	NA.	NA.
e) It is significant as a remnant of native vegetation in an area that has been extensively cleared;	The Project is located in agricultural land north-east of Albany. The majority of the survey area has been fully cleared of native vegetation since the 1960s for farming purposes. At the mine site, 14.8% of the proposed footprint is remnant native vegetation in 20 separate blocks. Of the 220 ha pipeline corridor, approximately 2.3% is remnant native vegetation.	No nett loss of significant vegetation in the long term.	1. Offsets • Direct offsets will include rehabilitation or restoration of an existing degraded ecosystem. This rehabilitation will aim to re-establish biodiversity corridors and preserve vegetation units represented at the mine site through seeding with species similar to that cleared at the mine site. • Vegetation will be purchased or otherwise covenanted for conservation estate. Blocks will be selected in consultation with the DEC, and where possible, this vegetation will be equivalent to that vegetation being cleared at the mine site. 2. Genetic resources of areas to be cleared will be collected and appropriately stored or used for replanting other areas. 3. Areas identified as having high conservation values will be avoided where possible, such as diverting the pipeline to avoid Parker Brook Reserve.
f) It is growing in, or in association with, an environment associated with a watercourse or wetland;	No RAMSAR Internationally Important Wetlands or Nationally Important Wetlands occur within the Project footprint. Mine site: The mine site footprint contains nine areas of wetland vegetation (Units 4 and 5, classified as drainage depressions) which likely reflect the surface expression of perched aquifers. No GDEs were identified within the drawdown footprint at the mine site. Pipeline: The pipeline route is in the vicinity of several wetlands of various conditions.	No nett loss of wetland vegetation in the long term.	An acid sulphate soil survey will be conducted prior to pipeline construction. Site specific acid sulphate management plans will be developed and implemented during construction. Impacts to wetlands will be included in the offset package as outlined above.
g) The clearing of the vegetation is likely to	The Project is located in agricultural land	NA	NA

8. POTENTIAL ENVIRONMENTAL IMPACTS AND MANAGEMENT

Principle; Native vegetation should not be cleared if-	Project Relevance	Management Objective	Management Action
cause appreciable land degradation;	north-east of Albany. The majority of the survey area has been degraded as it has been fully cleared of native vegetation for farming purposes. The additional clearing associated with the Project will not cause appreciable land degradation.		
h) The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;	Mine site is isolated from other conservation areas so it is not likely that clearing will impact the environmental values of nearby conservation areas. However, the regional gene pool of species found on the mine site is small and additional clearing will exacerbate this. Potential groundwater contamination from disturbance of acid sulphate soils during pipeline construction may impact adjacent environmentally sensitive areas.	Minimize impact on gene pools of local species. No deterioration in water quality or run off in areas of potentially acid forming soils.	Salvage genetic resources of cleared areas. Develop and implement site specific acid sulphate soil management plans to ensure groundwater is not contaminated with acid generated during pipeline construction.
i) The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or	As Above.	No deterioration in water quality	As above.
j) The clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The site is naturally flooded three months of the year regardless of clearing.	NA	NA

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Section 8.7.5 Predicted Outcome

Up to 252.6 ha of vegetation will be cleared for activities associated with the Southdown Magnetite Proposal over the 22 year life of the Project. Populations of all of the flora of conservation significance recorded within the Southdown Magnetite Proposal have been recorded outside of the footprint.

Based on the biseason vegetation and flora surveys (*ecologia*, 2006; Section 6.6.2), no DRF species will be impacted by the Project. The following populations of Priority Flora identified within the Project footprint during the biseason vegetation and flora surveys will be cleared:

Mine:

- The population of Priority 1 *Commersonia* sp. Mt Groper (RG Cranfield & D. Kabay 9157) identified at the mine site only.
- Two populations of Priority 2 *Chordifex leucoblepharus,* identified at the mine site only.
- One population of Priority 2 *Microcorys lenticularis,* identified at the mine site only.
- Two populations of Priority 2 *Monotoca aristate,* identified at the mine site only.
- Two populations of Priority 3 *Calectasia obtusa* found at the mine site.
- Two populations of Priority 3 *Dryandra calophylla* found at the mine site.
- Three populations of Priority 3 *Goodenia filiformis* found at the mine site.

Pipeline:

- One population of Priority 3 *Calectasia obtusa* found along the pipeline alignment.

The total number of known populations of flora of conservation significance, and the percent of the known populations to be impacted by the proposal are summarised in Table 6.8.

Section 8.7.6 Environmental Management Commitments

Commitment 22: A Threatened Flora and Conservation Management Plan will be developed in consultation with the DEC prior to mine and pipeline construction works. The plan will set out procedures to maintain the abundance, diversity, distribution and conservation status of threatened flora species.

Commitment 23: The Threatened Flora and Conservation Management Plan will be implemented throughout the life of mine.

Commitment 24: Management of *Commersonia* sp. Mt Groper (RG Cranfield & D. Kabay 9157) will be included in the Threatened Flora and Conservation Management Plan to be developed and approved by the DEC prior to impacts to the potential seed reserve at the mine site.

Commitment 25: During construction and operation a minimum of 30 ha of Albany Blackbutt (*Eucalyptus Staeri)* mallee heath and chittick scrub-heath vegetation at the mine site will be fenced off and retained for conservation purposes.

Commitment 26: Grange will purchase and protect, or otherwise contribute towards the protection of, remnant bush areas of similar conservation value to that being impacted by the Project. Where possible, Grange will achieve a net environmental benefit in this regard. On closure, these areas will be divested to the state government or other appropriate conservation body, or otherwise covenanted to protect remnant bush areas.

Section 8.8 Terrestrial Weeds and Dieback

Section 8.8.1 Management Objectives

The objectives for management of weeds and dieback are to:

- Avoid introduction of terrestrial weeds and disease.
- Reduce the spread of existing weeds and disease within the Project area.

Section 8.8.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- The National Weeds Strategy (ARMCANZ, ANZECC);
- Environmental Weed Strategy for Western Australia (CALM, 1999);
- A Weed Plan for Western Australia (State Weed Plan Steering Group, 2001);
- Environmental Weeds Strategy (City of Albany, 2001);
- Albany Port Authority: Weed Management Strategy (Denmark Weed Action Group);
- Threat Abatement Plan for Dieback Caused by the Root-rot Fungus *Phytophthora cinnamomi* (EPA, 2001); and
- Policy Statement No.3, Management of Phytophthora and Disease Caused by it (CALM, 1998).

Section 8.8.3 Potential Impacts

Weeds

No weeds classified as significant under the current national, state or City of Albany weeds strategies were found during surveys of the mine site. Four species of WA declared weeds and 11 species listed as Priority environmental weeds by the City of Albany were recorded during the vegetation and flora survey of the proposed pipeline corridor.

The spread of terrestrial weeds can arise as a result of earthmoving activities and vehicle movements associated with the Southdown Magnetite Proposal. Weeds can be a major cause of disturbance to native vegetation because they compete with native species for space, nutrients and water, and alter the composition and structure of vegetation communities. These problems may be particularly acute in the ground layer where introduced grasses and herbs invade and then preclude other species. In some cases weeds may carpet the ground, thereby minimising opportunities for seedlings to establish.

Construction of the pipeline will involve the movement of vehicles, people and earth moving equipment across farm property boundaries. The potential spread of weeds associated with this movement may cause weed infestations on previously weed free properties, decreasing crop yields and increasing the cost for farmers to manage weed outbreaks.

Dieback

Dieback disease is as an important management issue with regard to any land clearing associated with the Southdown Magnetite Proposal. Caused by the pathogen *P. cinnamomi* (Section 6.6.12), dieback disease is a serious threat to the native vegetation in the south-west. As many as 2 000 of the estimated 9 000 native plant species in the south-west are susceptible to and often killed by dieback disease (CALM, 2003a). The movement of soil through earthmoving activities and vehicles associated with the Project can potentially spread dieback into sensitive areas. It is assumed that the proposal footprint is comprised of both dieback infected and dieback free vegetation.

Section 8.8.4 Management

Weeds

During pipeline construction, Grange will comply with applicable weed and dieback management policies and implement hygiene strategies to minimise the spread and invasion of introduced species and dieback. Should target species be found to be present, weed and dieback control programmes will be implemented to prevent their spread within and beyond the proposal footprint. Weed hygiene will be addressed for both the pipeline construction and the mine site in the Project Construction Environmental Management Plan in liaison with the DEC.

Applicable weed management policies for the weeds recorded are;

- The Weed Plan for Western Australia (State Weed Plan Steering Group, 2001) in regards to Blackberry, Bramble (*Rubus* spp.), Bridal Creeper (*Asparagus asparagoides*) and Gorse (*Ulex europaeus*).
- The *ARRP Act 1976* in regards to P1, P4 Arum Lily (*Zantedeschia aethiopica*), Blackberry, Bramble (*Rubus* spp.), Patersons Curse (*Echium plantgineum*) and P1, P3 Gorse (*Ulex europaeus*).
- The City of Albany Environmental Weeds Strategy (2001) in regards to Pampas Grass (*Cortaderis selloana*), Watsonia (*Watsonia* sp), Victorian Tea Tree (*Leptospermum laevigatum*), Rose Pelargonium (*Pelargonium capitatum*), Bridal Creeper (*Asparagus asparagoides*), Arum Lily (*Zantedeschia aethiopica*), Sweet Pittosporum (*Pittosporum undulatum*), Sydney Golden Wattle (*Acacia longifolia*), Blackberry, Bramble (*Rubus* spp.), Taylorina (*Psoralea pinnata*) and Gorse (*Ulex europaeus*).
- The Albany Port Authority: Weed Management Strategy (Denmark Weed Action Group) is applicable to APA lands.

Dieback

As dieback mapping is only valid for one year prior to land disturbance activities (CALM communication, October, 2005), Grange will conduct a dieback disease assessment of the mine site and the selected pipeline route to Albany Port within a year prior to ground disturbance activities.

At present, eradication of *P. cinnamomi* at either local or regional scales is not feasible, necessitating an on going programme of management. Two key management strategies have been identified; constraining the spread of the pathogen and reducing its impact.

- Spread resulting from human activity can be reduced by limiting access to certain areas (quarantine) and ensuring that when infected areas are entered the potential to transfer infected material to uninfected areas is minimised (hygiene) (Environment Australia, 2002).
- Reducing *P. cinnamomi's* activity can be achieved by biological control and by reducing its food base. Other approaches to reducing the pathogen's impact is to alter the physical conditions in the soil to encourage the host root systems' regenerative capacity, and to reduce the pathogen's pathogenic capacity through chemical treatment of the soil (Environment Australia, 2002).

A Dieback Disease Management Plan will be developed in consultation with DEC (Albany Region) and other authorities for the mine site and pipeline construction works. The management plan will detail quarantine and hygiene management strategies compliant with DEC and EPA requirements to be implemented where appropriate. These strategies will include the provision and use of clean-down facilities and ensuring that earth moving equipment is free of dirt and plant materials prior to entry and exit of sensitive and/or dieback quarantine areas.

Section 8.8.5 Predicted Outcome

No weeds will be introduced to the mine site by Project activities. Existing weed infestations within the pipeline corridor footprint will be managed where required, and the spread of weeds from one property to another controlled during pipeline construction.

There will be no spread of dieback associated with Project activities. Implementation of the Dieback Disease Management Plan will ensure no introduction of dieback into the remnant vegetation and conservation areas adjacent to the Project footprint.

Section 8.8.6 Environmental Management Commitments

Commitment 27: Prior to ground disturbing activities a Dieback Disease Management Plan will be developed for the mine site and pipeline construction works in consultation with the DEC. The plan shall set out procedures to identify the dieback status of Project areas, demarcate hygiene boundaries, prevent the spread of dieback through appropriate hygiene practices and monitor the effectiveness of dieback control measures.

Commitment 28: The Dieback Disease Management Plan will be implemented during construction and throughout the life of the Project.

Section 8.9 Terrestrial Fauna

Section 8.9.1 Management Objectives

The objectives for management of terrestrial fauna are to:

- Maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.
- Minimise Project impacts to fauna.

Section 8.9.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Guidance Statement No. 56. Terrestrial Fauna Surveys for Environmental Impact Assessment in WA (EPA, 2004); and
- Position Statement No. 3. Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002).

Section 8.9.3 Potential Impacts

Mine Site

One hundred and fifty six species of vertebrate fauna were recorded from within the mine site, comprising fifteen native and six introduced species of mammals, 97 species of birds, 27 species of reptiles and 11 species of frogs. Twenty four of these species are endemic to south-west WA.

The principle impact on fauna arising from the development of the Southdown Magnetite Proposal will be the further loss and degradation of fauna habitat through the clearing of native vegetation. Clearing will occur in the mine area for the mine pit, stockpile areas, TSF's, processing infrastructure, workshops and roads. Habitat degradation has the potential to occur through factors associated with the mining process, and increased human activity in the area. These include introduction of weed and feral fauna species, dust generation and changes to groundwater. The initial impact from habitat loss will be immediate on non-mobile poorly dispersing fauna unable to move from the area. Direct impacts to fauna include:

- Disturbance - Activity associated with the establishment and operation of the mine may affect nearby fauna, including noise and vibrations from blasting activities and general mining operations.
- Road deaths - Road fauna deaths are likely to increase with increased road traffic.
- Loss of Habitat - Apart from the direct loss of fauna due to clearing, removal of fauna habitat reduces the availability of shelter and foraging areas, and causes displacement of local fauna populations. Loss of fauna may result in reduced species diversity in an area, influencing ecosystem functioning.

The localised loss of all fauna due to direct mortality arising from clearing and construction activities will occur across most of the mine site. Ongoing impacts in adjacent areas may arise from more frequent vehicle movements, and machinery operation.

Indirect impacts through habitat degradation have the potential to occur through factors associated with the mining process, pipeline construction and increased human activity in the area. These include introduction of weed and feral fauna species, dust generation, changes to groundwater and habitat fragmentation. Indirect impacts to fauna include:

- Human presence and activity is often associated with a change in fire regimes leading to degradation of natural ecosystems.
- Contamination of habitat from mining activities.
- Injury to fauna from mining infrastructure such as uncapped drill holes.
- Introduced Species - Introduced flora may alter habitat, while introduced fauna may compete aggressively with native fauna for habitat and resources.
- Clearing of remnant bushland in extensively cleared farmland can result in the fracture of important environmental corridors for fauna.

Vegetation clearing at the mine site will impact fauna populations within the mine site footprint, but is not anticipated to have significant impacts at a regional level. The fauna present within the proposed mine site are mostly wide-ranging with no species reliant on habitat within the site, and thus is likely to be present in areas to the north and south of the proposed mine site which are well reserved in national parks. Furthermore, all terrestrial mammals and most birds listed as being species at risk in the Esperance – 1 subregion are found within DEC's conservation estate (Comer *et al.,* 2002).

Pipeline

One hundred and thirty six species of vertebrate fauna were recorded from within the proposed pipeline corridor, comprising 13 native and seven introduced species of mammals, 83 species of birds, 19 species of reptiles, ten species of frogs and four species of freshwater fish. Thirteen of these species are endemic to the south-west of WA. It is not anticipated that fauna will be impacted by the pipeline construction.

It is unlikely that fish will be impacted by the construction of river crossings during pipeline construction. The exposed trench during pipeline construction has the potential to entrap animals.

Section 8.9.4 Management

Disturbed areas will be rehabilitated as soon as possible, with ongoing rehabilitation throughout the mine life to facilitate habitat restoration. Topsoil management and rehabilitation has been addressed in the Project Construction Environmental Management Plan (Technical Appendix 13.17). Both topsoil and cleared vegetation will be returned to contoured landforms to minimise erosion and promote vegetation regrowth.

General management strategies to decrease both the direct and indirect impacts to native fauna include:

- Site personnel will be familiarised with potential species of conservation significance, such as the Carpet Python (*Morelia spilota imbricata*), and report all sightings to environmental personnel.
- The use of barbed wire on site will be prohibited to reduce bat mortality.
- Southern Brown Bandicoots (*Isoodon obesulus fusciventor*) may be trapped and relocated outside of the mine footprint in consultation with DEC.
- Remnant vegetation will be retained as much as possible within the mine site.
- Wherever possible, mature trees containing hollows will be retained as they provide habitat for a large number of mammal and bird species present within the area.
- Rehabilitation will comprise the distribution of mulched vegetation across rehabilitation areas, the planting of native vegetation used by local fauna, and the placement of hollow logs on the ground as refuge for fauna.

- Putrescible waste hygiene measures will be implemented and enforced to reduce the likelihood of foxes being attracted to the area.

Management strategies to prevent animal deaths associated with water storage ponds on the mine site may include:

- Creation of fauna egress points in steep sided dams in the corners and at strategically placed points.
- For areas of free standing water where water quality may pose a risk to fauna, gas cannons, or bird balls may be used as deterrents.

A detailed management strategy to prevent animal deaths associated with the pipeline construction has been included in the Pipeline Construction and Operation Management Plan. Pipeline construction specific management strategies will include:

- The pipeline trench will remain open for the shortest period of time possible, particularly in the vicinity of bush land.
- Fauna will be removed from the pipeline trench daily by suitably qualified zoologists.
- Fauna refuge points will be placed in the pipeline trench at distances determined in consultation with DEC that will provide protection from the sun or flooding of the trench.
- Habitat corridors will be retained wherever possible; including the avoidance of severing continuity within a corridor. If this is unavoidable, the trench will remain open for as short a time possible and be rehabilitated immediately.
- Mature trees containing hollows will be retained wherever possible, as they provide habitat for a large number of mammal and bird species present within the area.
- In order to reduce the impacts of clearing at Fuller Road reserve, the proposed pipeline will be constructed within (if possible), or adjacent to cleared areas and will be immediately rehabilitated.

Section 8.9.5 Predicted Outcome

The mine development requires progressive clearing of fauna habitat which will result in the associated loss of fauna individuals and populations. This fauna loss is not anticipated to have regional significance as the fauna present within the proposed mine site are mostly wide-ranging and are likely to be present within the surrounding national parks and conservation estate.

It is anticipated that there will be no significant impacts to fauna associated with the pipeline construction.

Section 8.10 Fauna of Conservation Significance

Section 8.10.1 Management Objectives

The objectives for management of fauna of conservation significance are to:

- Maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.
- Avoid Project impacts to threatened species.

Section 8.10.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Guidance Statement No. 56. Terrestrial Fauna Surveys for Environmental Impact Assessment in WA (EPA, 2004); and
- Draft Policy Statement Number 9. Conserving Threatened Species and Ecological Communities (CALM, 2003).

Section 8.10.3 Potential Impacts

Fauna of conservation significance may be directly impacted upon by the proposal through individual animal deaths, or indirectly impacted upon through habitat loss, degradation and fragmentation of ecosystems and isolation of populations, noise pollution and increased predation pressure.

Seven species of conservation significance were recorded in the vertebrate fauna assessment (*ecologia*, 2006). These species are protected under the *Commonwealth EPBC Act 1999*, *WA Wildlife Conservation Act 1950* and/ or listed in the IUCN Red Book and DEC Priority Fauna List (Appendix 12- 3). The fauna recorded within the Project area were the Western Ring-tailed Possum, Carnaby's Black Cockatoo, Forest Red-tailed Black Cockatoo, Western False Pipestrelle, Australian Bustard, Peregrine Falcon and Southern Brown Bandicoot. These species are discussed in Section 6.7.3 and the potential impacts of the Southdown Magnetite Proposal outlined in Table 8.4.

The Southdown Magnetite Proposal required referral to the DEH under Part 3 of the *EPBC Act 1999* as it has the potential to interface with two listed threatened fauna species, the Short-billed (Carnaby's) Black Cockatoo (*Calyptorhynchus latirostris*) listed as Endangered under the *EPBC Act 1999*, and the Western Ringtail Possum (*Pseudocheirus occidentalis*) listed as Vulnerable under the *EPBC Act 1999*. The referral was considered under the *EPBC Act 1999* and the Southdown Magnetite Proposal was deemed to be a controlled action, requiring approval from the Federal Minister for the Environment and Heritage for any actions associated with the Project potentially impacting Carnaby's Black Cockatoos.

Table 8.4 Potential Impacts to Threatened Fauna.

Species	Status	Potential Impact
Western Ringtail Possum (*Pseudecheirus occidentalis*)	Vulnerable (*EPBC Act 1999*) Schedule 1 *(WC Act 1950)*	No Western Ringtail Possums were recorded at the mine site. The mine site vegetation does not contain trees with hollows large enough to provide suitable nesting habitat or refuge. The vegetation may provide foraging sites for this species; however the remnant is not essential for their survival. The proposed pipeline route is adjacent to the Cuming Road reserve, a foraging site for Western Ringtail Possums. The pipeline corridor does not directly impact the vegetation supporting the possums; rather it follows the southern and western border of the reserve. Pipeline construction along the southern border of the reserve may disrupt habitat connectivity to vegetation south of the reserve; however this area backs on to rural residential properties and is unlikely to be a major habitat corridor. Pipeline construction, therefore, is not anticipated to impact this species.
Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)	Endangered (*EPBC Act 1999*) Schedule 1 (*WC Act 1950*)	The vegetation at the mine site does not contain trees with hollows large enough to provide suitable nesting habitat or refuge. The mine site vegetation is a foraging site for this species; however the site is not essential for their survival. Impact to Carnaby's Black Cockatoo has been deemed a controlled action by the DEH. Potential impacts and management strategies are discussed in detail below.
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	Schedule 1 (*WC Act 1950*)	No suitable nesting habitat for Forest Red-tailed Black Cockatoos will be cleared for construction of the mine site or pipeline. The mine site vegetation may provide foraging sites for this species; however the remnant vegetation is not essential for their survival.
Western False Pipestrelle (*Falsistrellus mackenzei*)	Priority 4 (DEC)	Very small areas of planted Eucalypts adjacent to dams within the mine site are the only areas likely to provide habitat for this species. Clearing for construction of the mine site is likely to result in the loss of this population, unless individuals are able to move once clearing commences and find suitable habitat in adjacent farm blocks. This species is believed to be widespread within its range. Consequently, there will be an impact to this species at a local level only, but is unlikely to have an impact on the species sustainability as a whole.
Australian Bustard (*Ardeotis australis*)	Priority 4 (DEC)	Being nomadic and wide-ranging, the Bustard is not reliant on habitat within the mine site or pipeline corridor. It is unlikely to be impacted by the development.
Peregrine Falcon (*Falco peregrinus*)	Schedule 4 (*WC Act 1950*)	The Peregrine Falcon is unlikely to be impacted by the development as no suitable breeding sites occur within the mine site.
Southern Brown Bandicoot (*Isoodon obesulus fusciventor*)	Priority 5 (DEC)	Construction for the mine site will result in the loss of up to 252.6 ha of native vegetation, of which more than half provides suitable habitat for bandicoots. Loss of habitat through clearing will result in the loss of this population of Southern Brown Bandicoots. While this will be an impact at a local scale; the development will not impact on this species at a regional scale. A bandicoot translocation programme may be undertaken prior to commencement of clearing.

WC Act 1950: *Wildlife Conservation Act 1950*

Carnaby's Black Cockatoo

Carnaby's Black Cockatoo was recorded in low numbers and low frequency within the mine site and pipeline corridor during both phases of vertebrate fauna survey. No suitable breeding habitat will be impacted by construction of the mine site or pipeline. Construction of the mine site will result in the clearing of 215 hectares of feeding habitat for the Carnaby's Black Cockatoo.

Critical habitat is defined in the *EPBC Act* as habitat critical to the survival of a listed threatened species or community. Habitat is defined as the biophysical medium or media:

(a) occupied (continuously, periodically or occasionally) by an organism or group of organisms; or

(b) once occupied (continuously, periodically or occasionally) by an organism, or groups of organisms, and into which organisms of that kind have the potential to be reintroduced.

Critical habitat for the Carnaby's Black Cockatoo is yet to be determined; however Cale (2003) lists the following which should be considered critical habitat:

1) remaining woodland breeding sites in the south west of WA, and feeding and watering areas used during the breeding period;

2) woodland sites known to have supported breeding in the past and which could be used in the future if new food resources are established; and

3) coastal kwongan (heath) and other areas where the cockatoos feed when not breeding,

Approximately 215 ha of the 252.6 ha of remnant vegetation to be cleared at the mine site is rich in banksias, dryandra and hakea which are potential foraging habitat for the Carnaby's Black Cockatoo. Based on the criteria above, the proposed Southdown mine site contains approximately 215 ha critical habitat for the Carnaby's Black Cockatoo (as defined by item 3 above).

Foraging habitat for the Carnaby's Black Cockatoo is well-represented in the conservation estate in the vicinity of the mine site; including the Hassell National Park immediately south of the mine site and the Stirling Range National Park (1159 km^2) approximately 13 km north-west of the mine site. In addition, an 800 ha privately owned block immediately north of the mine site contains very similar vegetation to that which is in the mine site and pine plantations in the area are also likely to provide foraging habitat for Carnaby's Black Cockatoo in the vicinity of the mine site.

Section 8.10.4 Management

General Management

Grange will comply with the requirements of the *Wildlife Conservation Act 1950* and *Environment Protection and Biodiversity Conservation Act 1999* by undertaking the following:

- Implementation of management measures as detailed in Section 8.9.4 for Terrestrial Fauna.
- Rare fauna baseline surveys, which have been conducted for all disturbance areas and locations of any fauna of conservation significance. Survey information has been incorporated into an Environmental Geographical Information System (GIS) and plotted onto maps.
- DEC has been, and continues to be consulted regarding the management of fauna of conservation significance identified in the area.
- Impacts to species and habitats of fauna of conservation significance will be avoided using information from fauna surveys conducted in the area.
- Operational control procedures and employee training programmes will be implemented to protect native fauna from intentional harm, and to appropriately manage injured fauna if found.

- Death of fauna of conservation significance will be reported to DEC, if required.
- Bandicoot translocation may be undertaken prior to commencement of clearing.

Carnaby's Black Cockatoo

As breeding habitat will not be impacted by the Project, management strategies for Carnaby's Black Cockatoo will focus on habitat management of non-breeding areas. Strategies include:

- Promoting the retention of existing feeding habitat through conservation offsets.
- Re-establishment of feeding habitat for Carnaby's Black Cockatoo in the long term through mine site rehabilitation with appropriate vegetation species. This will be outlined in the mine closure plan.

Section 8.10.5 Predicted Outcome

Fauna of conservation significance identified in the Vertebrate Fauna Survey will not be adversely affected by the Project as the remnant vegetation to be cleared at the mine site and in places along the pipeline represents a marginal part of the species habitat. Pipeline construction in the vicinity of the Cuming Road reserve may temporarily disturb Western Ringtail Possums foraging in the vegetation, however, there will be no clearing of vegetation or possum habitat, and therefore no significant impact to this species.

Breeding habitat for Carnaby's Black Cockatoo *(Calyptorhynchus latirostris)* will not be impacted by construction of the mine site or pipeline. As foraging habitat is well represented in the vicinity of the proposed mine site, it is anticipated that offset measures, such as land acquisition and protection, will reduce the impact of clearing at the mine site to the species. Commitment 29 will also contribute to the retention of existing feeding habitat for the Carnaby's Black Cockatoo. The Project Threatened Flora and Conservation Management Plan outlined in Commitment 22 will detail categories requiring offsets, and outline the corresponding offsets.

Section 8.10.6 Environmental Management Commitments

Commitment 29: Throughout the life of the mine, parts of the mine site will be rehabilitated with appropriate vegetation species to re-establish feeding habitat for Carnaby's Black Cockatoo.

Section 8.11 Short Range Endemic Invertebrate Fauna

Section 8.11.1 Management Objectives

The objectives for management of SRE invertebrate fauna are to:

- Maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.
- Minimise Project impacts to fauna.

Section 8.11.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Guidance Statement No. 56. Terrestrial Fauna Surveys for Environmental Impact Assessment in WA (EPA, 2004); and
- Position Statement No. 3. Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002).

Section 8.11.3 Potential Impacts

Potential impacts to SRE invertebrate fauna from the proposed development include:

Direct Impact

- Habitat loss and further fragmentation through clearing of native vegetation.

Secondary Impacts

- Increased risk of wildfire associated with Project activities.
- Degradation of fauna habitat due to invasion of weeds and spread of dieback.
- Disruption to resident fauna due to increased noise and dust pollution.

The Project will result in the clearing of up to 252.6 ha of native vegetation for construction of Project infrastructure. This will result in the loss of SRE invertebrate fauna within the clearing footprint and the majority of invertebrate fauna that do not have aerial dispersal abilities.

Construction of the pipeline from the Southdown Mine site to the Albany Port will comprise progressive clearing, trench excavation, pipe laying, backfilling, and restoration. During pipeline construction there is the potential for injury to or death of fauna, if they come into contact with machinery or fall into the open trench.

Habitat fragmentation is a primary effect of land clearing in the south-west, the consequences of which include limitations to fauna dispersal, local extinctions and increased 'edge' effects. Edge effects include physical changes, such as different levels of exposure to the sun and wind and changes in water cycles and the local air temperature, and biotic changes, such as invasion by weeds and feral animals (Saunders *et al.*, 1991). All of these changes are especially pertinent to SRE invertebrate fauna, which are defined by narrow ecological requirements and poor dispersal abilities (Harvey, 2002). Some groups however, such as the trap-door spiders are capable of existing in small and often degraded remnant bushlands (Main, 1987).

The Mygalomorphae trap-door spider species *Chenistonia paludigena* ms.nom. BYM, was recorded by the vertebrate fauna team during their survey of the Fuller Rd reserve. The species may be impacted by pipeline construction where it traverses the road reserve.

One dead undescribed *Bothriembryon* snail species (new species "Wellstead") was recorded from the mine site. The vegetation is described as Mallee Heath on the lower slope of the main ridge with deep white sands. This old and bleached shell was collected from turned over soil on a track leading to a drill pad in the larger eastern remnant. Only two other specimen of this species exist in the WA Museum collection. The specimens were collected in 1971 and 1974. In the absence of more detailed information it is difficult to determine the impact of the proposed clearing of vegetation at the mine site, on this species.

Section 8.11.4 Management

A risk assessment to determine potential impacts arising from the development on invertebrate fauna and the residual impacts following the implementation of management strategies identified that all impacts, with the exception of vegetation clearing within the mine site, will have a residual risk rating of low (managed by routine procedures) to medium (specific management and procedures must be specified). As the clearing footprint within the mine site will remove a large proportion of the remnant vegetation, limited clearing controls are available.

The Mygalomorphae trap-door spider species *Chenistonia paludigena* ms.nom. BYM, was recorded in the Fuller Rd reserve. Where possible, pipeline construction across the Fuller Rd reserve will be within or adjacent to one of the two cleared areas present at the reserve. Ground disturbed by pipeline construction will be immediately rehabilitated.

Additional surveys to ascertain the distribution and fully determine the conservation status of the spiders *Yilgarnia currycomboides* and *Chenistonia* "*palludigena*" ms., and the mollusc *Bothriembryon* sp. *"Wellstead"* will be conducted prior to ground disturbance activities.

Section 8.11.5 Predicted Outcome

Populations of SRE invertebrate fauna within the clearing footprint and the majority of invertebrate fauna that do not have aerial dispersal abilities will be lost due to clearing of up to 252.6 ha of native vegetation for construction of Project infrastructure.

Section 8.12 Stygofauna

Section 8.12.1 Management Objectives

The objectives for management of stygofauna are to:

- Maintain the abundance, diversity, geographic distribution and productivity of subterranean fauna at the species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge;
- Minimise Project impacts to stygofauna and stygofauna habitat; and
- Maintain the quantity of groundwater so that the existing and potential uses, including ecosystem maintenance, are protected.

Section 8.12.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Guidance Statement No. 54. Consideration of Subterranean Fauna in Groundwater and Caves during EIA in WA (EPA, 2003); and
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006).

Section 8.12.3 Potential Impacts

Potential impacts from excavation and dewatering of the mine pit to stygofauna include:

- Direct removal of subterranean habitat from excavation of habitat strata.
- Modifications and removal of stygofauna habitats through alterations to groundwater levels from dewatering.
- Contamination of groundwater from mining and associated activities.

Mining activities have the potential to impact on stygofauna communities by impacting on aquifer quality and quantity through activities such as clearing (which lead to increased sediment in groundwater), modifications to groundwater recharge areas, groundwater pollution, groundwater abstraction and mine dewatering.

Stygofauna communities are linked by underground aquifers that facilitate the movement and exchange of organisms and genes between semi-disjunct populations. Groundwater drawdown to facilitate open pit mining may influence the dynamics of subterranean ecosystems by changing the connectivity or flow rate of aquifers and therefore the capacity for exchange of organisms and genes between areas and/ or populations. This may lead to an overall decrease in diversity and disruption to the current ecosystem, potentially already disturbed through the effects of agricultural land clearing and the subsequent rise in the water table within the proposal footprint.

A survey of bores in the Wellstead/ Southdown has been conducted to assess if stygofauna are present in the groundwater potentially impacted by dewatering for the mine (Technical Appendix 13.11). The three phase survey confirmed that there are no stygofauna of conservation significance in the vicinity of the planned mine pit. The most significant taxa recorded by the survey were the syncarids and a candonid ostracod that are known to be obligate groundwater taxa (stygobites). The stygobites have higher conservation significance because they are restricted to the groundwater environment and typically have restricted distribution ranges. They have been recorded from at least four sites (WST2, RED22, and DB13 - Syncarida, and RED2 - Candonidae) (Figure 6.20).

The nearest site to the Southdown mine site with stygobite fauna is WST2, approximately 1.4 km north-west of the proposed mine pit (Figure 6.20). Based on numerical modelling, the drawdown in the aquifer at this site would be about 0.5 m. This drawdown is unlikely to have an impact on the conservation of these taxa as the Pallinup Siltstone that comprises the aquifer is fine-grained in nature and has at least 8 m saturated thickness. The remaining three sites where stygobites were recorded (DB13, RED22 and RED2) are in the Redmond area and will not be impacted by Southdown Magnetite Proposal.

The two Syncarida recorded from site WST2 (*Parabathynellidae sp*. and *Bathynellidae sp. 2*) were not recorded from groundwater in the Redmond area by this study (Table 6.21 and Table 6.22). The limited knowledge of Syncarida in WA prevents further assessment of the taxonomy and distribution of both species at this stage. Descriptions of syncarids from the Kimberley and Pilbara regions are currently in progress (S. Eberhard, *pers. comm*.) and may assist with future determination.

Section 8.12.4 Management

The following steps have been undertaken in compliance with EPA Guidance Statement No 54 (2003) to demonstrate that the development poses no threats to stygofauna:

- Sampling conducted to show that species within the potential impact zone also occur outside this area (i.e. no species is restricted to the impact zone).
- Characterisation of subterranean fauna habitats undertaken in areas to be impacted by groundwater drawdown, and identification of similar subterranean fauna habitats outside the affected area.
- Biological information on species collected during the sampling recorded and preserved.

Two stygofauna species were identified in the modelled drawdown footprint, with the drawdown anticipated to be less than 10% of the aquifers saturated thickness. Management strategies for stygofauna in the vicinity of the Southdown Magnetite mine site include:

- Regular testing of regional groundwater levels and water quality.
- Site infrastructure and operational controls implemented to prevent contamination of ground water as described in preceding Sections. These include appropriate management of tailings, hydrocarbons and chemicals, and waste water, and emergency response in the event of a pipeline failure.
- Stygofauna sampling will be conducted as part of the groundwater monitoring programme. Parameters measured will be sufficiently sensitive to give adequate warning of a decline in species numbers well prior to any threat of extinction.

Section 8.12.5 Predicted Outcome

It is anticipated that stygofauna identified in the Southdown area will not be significantly impacted by groundwater drawdown of up to 0.5 m at the mine site due to the fine-grained nature of the aquifer and its saturated thickness of at least 8 m. Potential sources of contamination at the mine site will be managed to prevent contamination of the surrounding groundwater and further water and stygofauna monitoring strategies will be implemented to ensure no significant project related impacts to stygofauna.

Section 8.13 Air Quality - Dust

Section 8.13.1 Management Objectives

The objectives for the management of dust emissions are to:

- Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
- Minimise dust associated with the construction and operation of the mine, pipeline and Port facilities.
- Minimise exposed surfaces through clearing minimisation, staged clearing and progressive rehabilitation.

Section 8.13.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Guidance Statement No. 18 Prevention of Air Quality Impacts from Land Development Sites (EPA, 2000);
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006); and
- National Environmental Protection Measure for Ambient Air Quality (NEPC, 1998).

There are no regulatory guidelines for dust deposition prescribed for use in WA. Regulation of dust impacts have instead focussed on the impacts of inhalable particulate matter (PM_{10}) on human health, and on the nuisance value of total suspended particulate matter (TSP).

The Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999 ("the Kwinana EPP") prescribes limits and standards for air quality in the industrial and residential areas around Kwinana. The Kwinana EPP defines limits, which are not to be exceeded, and standards, which it is desirable not to exceed. The limit and standard to be applied in residential areas for TSP, averaged over 24 hours, are 150 $\mu g/m^3$ and 90 $\mu g/m^3$ respectively. For short term impacts, a limit of 1000 $\mu g/m^3$ averaged over 15 minutes is also defined.

The Queensland EPA applies a guideline level for dust deposition at residences of 4 g/m^2/month, which is equivalent to 120 mg/m^2/day.

The National Environmental Protection Measure for Ambient Air Quality (NEPC, 1998) prescribes an ambient air quality standard for inhalable airborne particulate matter (PM_{10}) of 50 $\mu g/m^3$ averaged over 24 hours. This is to protect human health and well-being, and applied in WA at population centres and places where people live or congregate.

In the absence of equivalent standards for the protection of vegetation, for the purposes of this assessment reference has been made to these environmental guidelines for protection of the human population, as these are expected to be highly conservative with respect to protecting vegetation health. Selected criteria are presented in Table 8.5.

Table 8.5 Relevant Dust Assessment Criteria.

Quantity	Criteria	Averaging Period	Source	Comment
TSP	1000 µg/m^3	15 minutes	Kwinana EPP	Limit (never to be exceeded)
TSP	150 µg/m^3	24 hours	Kwinana EPP	Limit (never to be exceeded)
TSP	90 µg/m^3	24 hours	Kwinana EPP	Standard (desirable not to exceed)
Deposition	120 mg/m^2 /day	Daily	Queensland EPA	Assessment guideline
PM_{10}	50µ/m^3	24 hours	Ambient Air Quality National Environmental Protection Measure	Standards for protection of human health

Section 8.13.3 Potential Impacts

Dust Impact Assessment

Dust impacts were estimated using the Gaussian plume dispersion model, AUSPLUME (version 6) to calculate concentrations and depositions of dust over a 31 km by 41 km grid using a 500 m grid mesh. Estimates of the emissions from a mining operation of similar size were used in the model to approximate potential dust impacts. Modelling outputs do not include specific operation details or dust control management strategies.

Twenty five representative sensitive receptors were identified in proximity to the Project footprint. Local sensitive receptors included in the Southdown mine site dust assessment (Technical Appendix 13.12) with locations depicted in Figure 8.5.

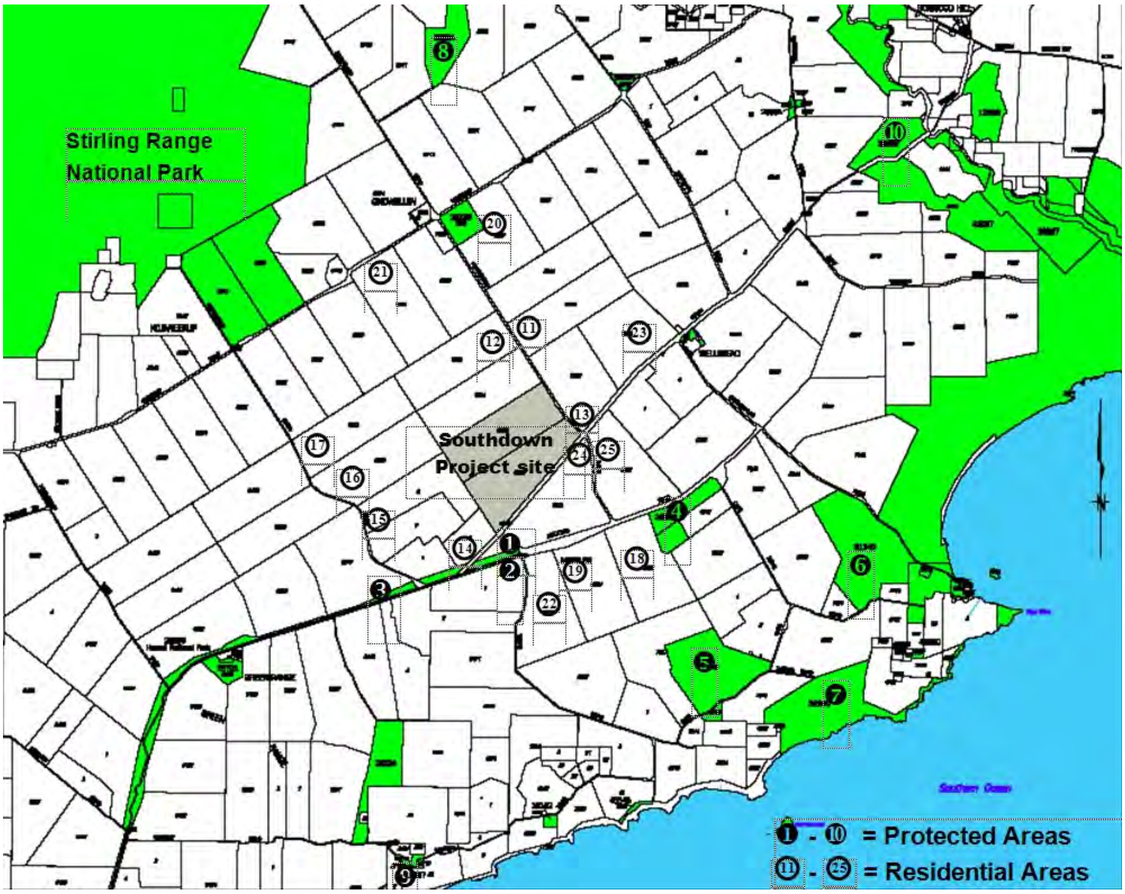

Figure 8.5 Locations of Receptors for Southdown Magnetite Proposal Mine Site Dust Assessment.

Wind data from the Bureau of Meteorology automatic weather station at Mt Barker, WA, was analysed to determine that winds for 2004 were typical of the period 2001-2004. Local wind data was then generated for the Project site using the TAPM meteorological model (Technical Appendix 13.12). Dust emissions for the Project were estimated by reference to dust emissions from similar operations, as reported to the National Pollutant Inventory (NPI).

The Southdown Magnetite Proposal has a forecast mining rate of 17.8 Mtpa. Emissions of particulate matter (PM_{10}) from similarly sized mining operations, as reported to the NPI for the year 2003-2004 are presented in Table 8.6.

Table 8.6 Particulate Emissions from Similarly Sized Mining Operations as Reported to the NPI, 2003-2004.

Mining Operation	Production (Mtpa)	PM_{10} Emission (tpa)
Robe River West Angelas	20	6 300
Hamersley Iron Yandicoogina	16	2 300

These operations are located in Pilbara region, in the north-west of WA. The Southdown magnetite mine site is located in the south coastal region where greater rainfall, and therefore greater rock and soil moisture, is expected to cause dust emissions to be lower. As such, total annual PM_{10} emissions are estimated at 2300 tpa. The PM_{10} fraction of TSP is estimated to be 30%, for a total dust emissions rate of 7600 tpa.

Figure 8.6, Figure 8.7 and Figure 8.8 show contour lines of emissions from the Southdown mine site are presented as TSP (15 min and 24 hr), TSP deposition and PM_{10} (24 hr) respectively, with relation to sensitive receptors.

Mine Site Impacts

Dust generated from the Southdown mine site will be generated from the ore body (average 37% magnetite) and surrounding waste rock (ratio of waste to ore is 2.6:1) during:

- blasting;
- excavation and stockpiling of non-magnetite waste rock;
- handling of magnetite ore on the Run of Mine stockpile;
- crushing and processing of the magnetite ore at the processing plant; and
- vehicular use of unsealed roads.

At all local conservation reserves, TSP concentrations attributable to the Southdown Magnetite Proposal are well below criteria relevant to human amenity. Deposition of TSP from the mine is also well below the selected criteria, and no adverse impacts are expected. PM_{10} concentrations are below the NEPM standard at most nearby residences except at Grasfeld, Beulah and Nymann. These three residential receptors are located within 2 km of the Project site. Estimated PM_{10} concentrations at Grasfeld, Beulah and Nymann are 141, 187 and 117 µg/m^3 respectively, representing 282%, 374% and 234% of the NEPM standard.

The Stirling Range National Park is located at approximately 13 km, north-west of the Project site, approximately five kilometres west of Receptor 21 (see Figure 8.5). Inspection of Figure 8.6, Figure 8.7 and Figure 8.8 shows that air quality impacts at sensitive sites within the National Park, including the Eastern Stirling Range Montane Heath and Thicket Threatened Ecological Community will be less than those at all other receptors. Specifically:

- Maximum 24-hr average TSP concentrations at Stirling Range National Park are less than 11% and 18 % of the relevant air quality criteria , respectively.
- Maximum 24-hr average PM_{10} concentrations at Stirling Range National Park are less than 32 % of the relevant air quality criteria.

Modelling results indicate that peak dust concentrations and deposition rates at the sensitive receptors occur during winter. The simple emissions estimation technique employed in the assessment however, made no allowance for temporal variations in emissions or the effects of rainfall on wet deposition. The modelling results are therefore believed to be conservative over-estimates.

High dust emissions are expected to be restricted to short-term events such as blasting, and on high wind days in summer. Wind data suggests that peak impacts during summer months will be directed away from the nearest receptors in the Hassell National Park, and the closest residences immediately to the east of the mining leases.

Seasonal rainfall and wind variations may occur during the estimated 22 year mine life. During drier and/ or windier periods the potential for additional dust to be generated at the mine site may arise.

Pipeline Impacts

The pipeline crosses numerous private properties however dust will only potentially be generated during the brief construction phase and will not require long-term management.

Port Impacts

Concentrate storage and ship loading are potentially dust generating activities, however dust is not anticipated to be a problem at the Port as all operations will be fully contained as outlined in Section 5.3 and the material will have a moisture content of up to 9%.

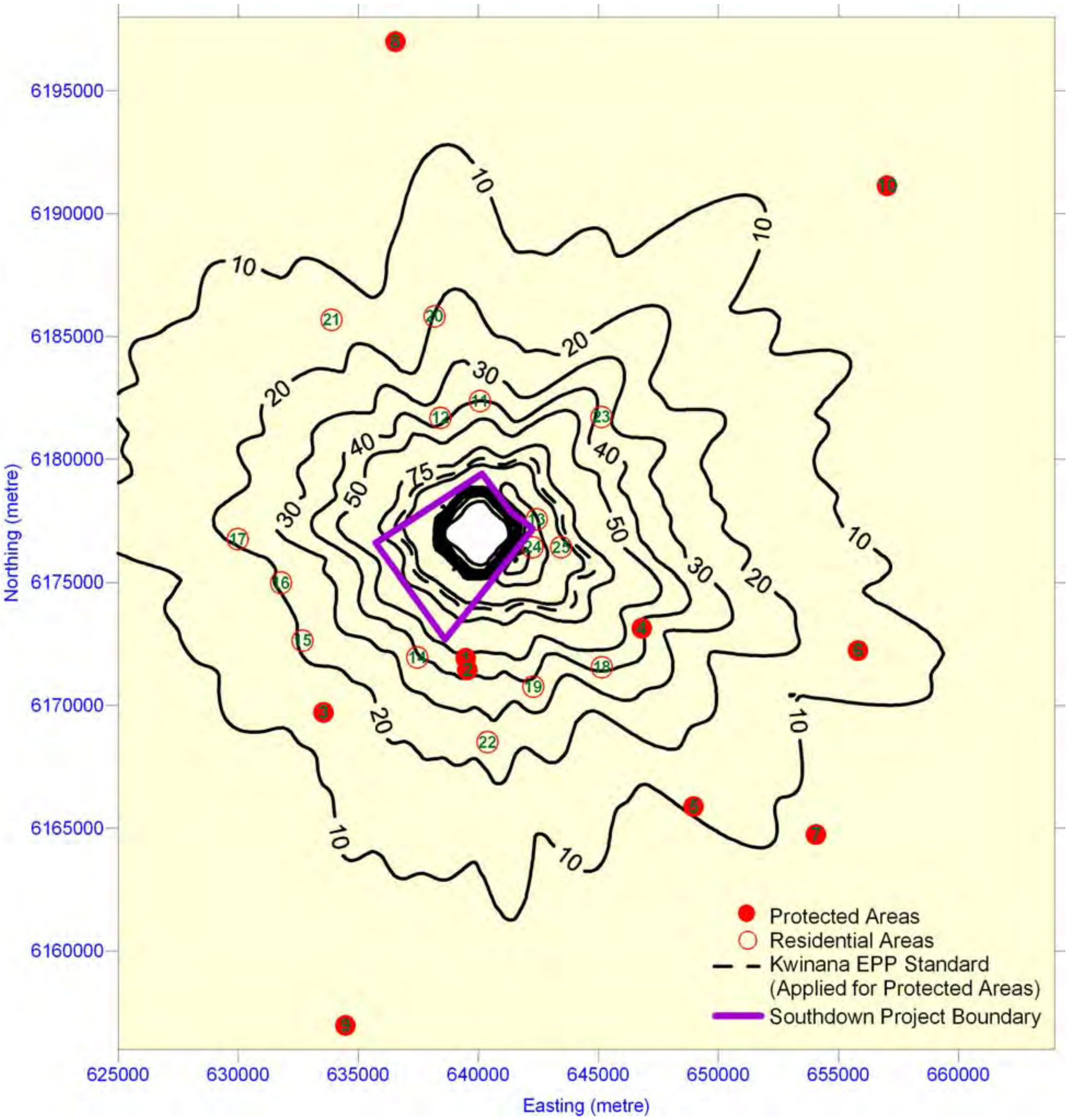

Figure 8.6 Predicted Maximum Daily Average TSP Concentrations.

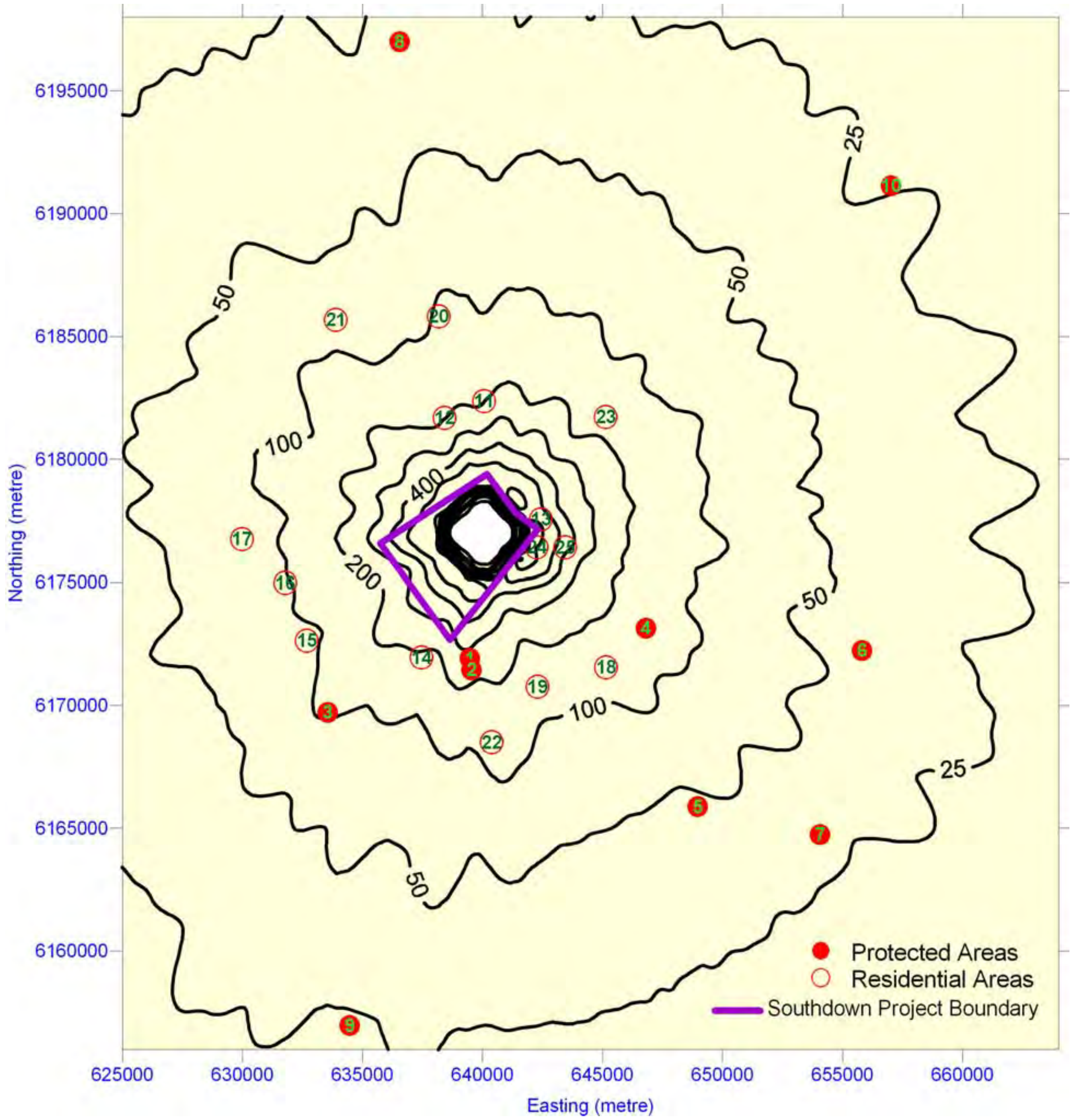

Figure 8.7 Predicted Maximum 15 Minute Average TSP Concentrations.

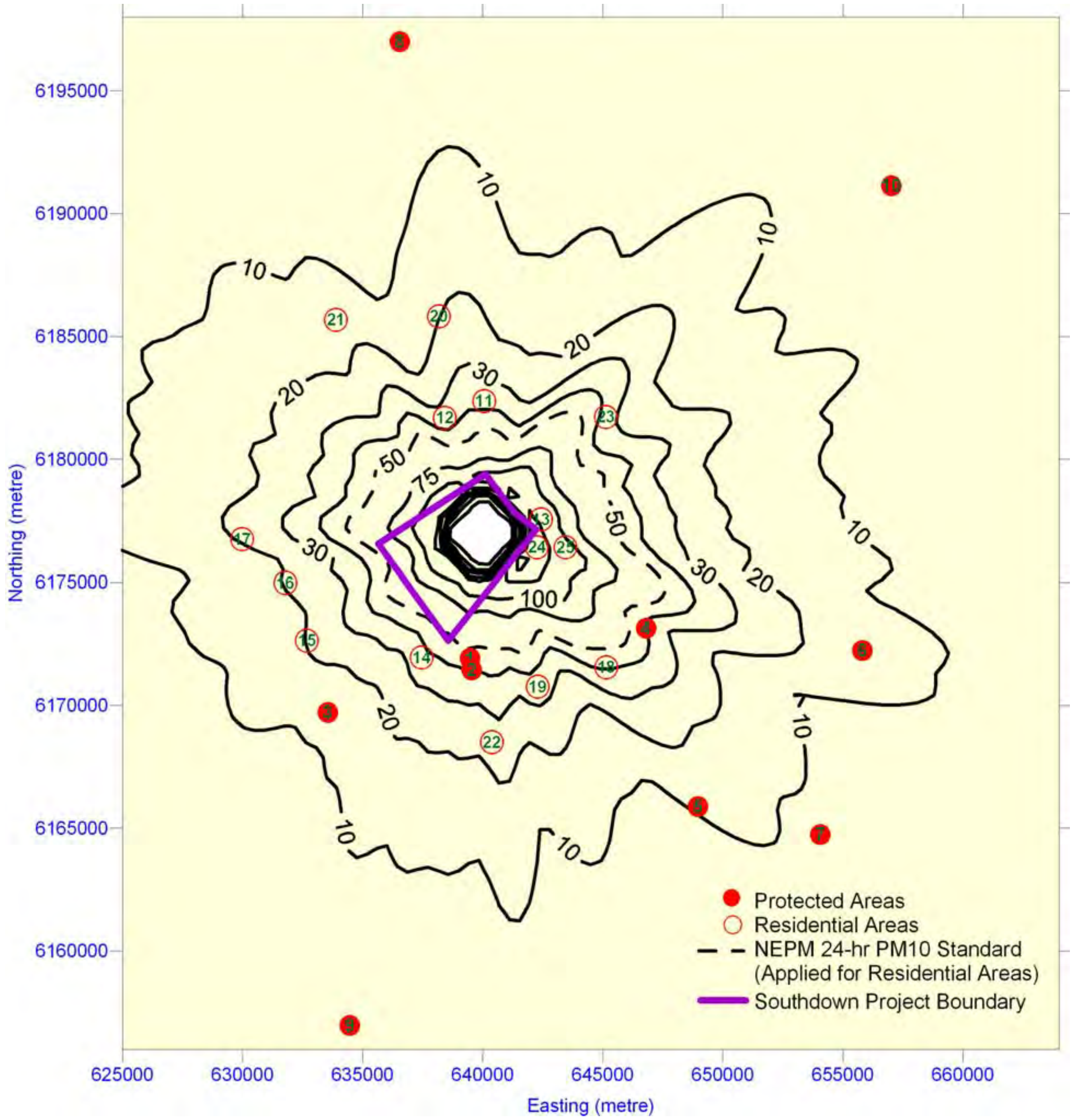

Figure 8.8 Predicted Maximum Daily PM $_{10}$ Concentrations.

Section 8.13.4 Management

Grange intends to keep dust to a minimum during construction and operation of the mine, pipeline and port facilities. Conventional dust suppression measures and management practises common to the mining industry in WA are expected to be sufficient to prevent adverse environmental impacts at the majority of nearby sensitive receptors. Proposed monitoring during construction will involve periodic visual dust assessments implemented by the Site Manager as part of routine site inspections. A Dust Management Plan will be incorporated into the Project Construction Environmental Management Plan (CEMP), directed at keeping dust generation on site as low as practicable. The CEMP identifies specific management measures to minimise dust generation from all aspects of the Project including:

- Incorporation of dust control measures into Project design such as enclosed port processing areas and stockpile sheds where dust emissions are significant.

- Use of dust suppression measures in high dust emission areas.
- Minimisation of vegetation clearing.
- Staged clearing and progressive rehabilitation to minimise exposed areas.
- Regular inspections to visually assess dust generation.
- Ambient dust monitoring where appropriate.

The Dust Management Plan will also include dust monitoring at nearby locations representative of those sites where the highest impacts may occur, and incorporates adaptive management practices to respond proactively to conditions likely to generate dust. The commitments are consistent with the amount of dust expected to be generated in various aspects of the Project and the environmental and social values to be protected in those areas.

Limits and impact of dust in regard to workers will be addressed in the Project Management Plan which will detail appropriate on site mitigation and monitoring regimes in compliance with the requirements of the *Mines Safety and Inspection Act 1994*.

Seasonal variations during the estimated 22 year mine life will be managed through implementation of appropriate dust control measures, and will be outlined in an Operation Environmental Management Plan to be developed in consultation with the DEC and DoH.

Section 8.13.5 Predicted Outcome

Environmental guidelines for dust relevant to human amenity are unlikely be approached at the nearby nature reserve areas. These guideline levels are considered to be conservative with respect to vegetation, and hence highly protective of local vegetation health.

Although predicted PM_{10} concentrations exceed NEPM standards in preliminary modelling at the three residences closest to the mining operation, the implementation of dust management measures and monitoring will ensure that the Southdown Magnetite Proposal will not adversely affect environmental values or human health.

Section 8.13.6 Environmental Management Commitments

Commitment 30: Dust Management Plans will be developed in consultation with the DEC, prior to construction and will include procedures for dust monitoring at sensitive receptors.

Commitment 31: The Dust Management Plans will be implemented during construction (Project Construction EMP) and operation (Operation EMP).

Section 8.14 Noise and Vibration

Section 8.14.1 Management Objectives

The objectives for the management of noise and vibrations are to:

- Minimise the noise associated with the construction and operation of the mine, construction of the pipeline, land reclamation and port construction and operation.
- Protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable levels.

Section 8.14.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- *Environmental Protection (Noise) Regulations 1997;*
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006);
- AS2670:2001 Evaluation for human exposure to whole body vibration;
- AS2436-1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites; and
- Proposed Town Planning Scheme Policy – Albany Port Noise Buffer Area Policy (City of Albany, Draft Policy Adopted 2003).

Criteria for assessing environmental noise are defined by *Environmental Protection (Noise) Regulations 1997*. The regulations are a 'prescribed standard' under Schedule 4 of the *Environmental Protection Act 1986*. Noise emissions that exceed the prescribed standard can be regarded as 'pollution' and 'unreasonable noise' under Section 3 of the Act. The regulations prescribe noise levels for noise-receiving locations. These relate to residential and commercial premises. Assigned noise levels are summarised in Table 8.7. The 'IF' represents an influencing factor which increases along with the number of busy roads, and commercial and industrial areas that surround the noise sensitive premises.

Table 8.7 EPA Assigned Noise Levels.

Type of Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises at locations within 15 m of a building directly associated with a noise sensitive use.	0700 to 1900 hours Monday to Saturday	45 + IF	55 + IF	65 + IF
	0900 to 1900 hrs Sun and Public Holidays	40 + IF	50 + IF	65 + IF
	1900 to 2200 hrs All days	40 + IF	50 + IF	55 + IF
	2200 hrs on any day to 0700 hrs Mon to Sat and 0900 hrs Sun and Public Holidays.	35 + IF	45 + IF	55 + IF
Noise sensitive premises at locations further than 15 m from a building.		60	75	80
Commercial premises.		60	75	80

Type of Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Industrial and utility premises.		65	80	90

The Albany Port Noise Buffer Area Policy (City of Albany, Draft Policy adopted 2003) seeks to:

- Control the construction and siting of residential developments within the buffer area to minimise noise impacts from the port activities on dwelling occupants; and
- Ensure new developments within the Port do not increase noise levels within existing residential buildings.

As the policy is not an exemption under Section 17 of the *Environmental Protection (Noise) Regulations 1997*, the Albany Port, and all new developments within the Port jurisdiction are required to ensure that all operations are conducted in accordance with the Regulations.

Section 8.14.3 Potential Impacts

Noise Assessment

The potential noise impacts of the proposed operations of the Southdown Magnetite mine site (Technical Appendix 13.13A) and foreshore pipeline reclamation (Technical Appendix 13.13B) and the operation of Grange facilities at the Albany Port (Technical Appendix 13.13C) were assessed.

Actual noise levels may vary from those estimated in the investigation and the major noise sources will be modified or treated to fall within the conditions of the noise analysis. The noise investigation was conducted with the following assumptions:

- ‘Worst case’ meteorological conditions: CONCAWE category 6: 50% RH, 3 m/s, 20°C.

Mine site

- Noise levels of primary and secondary crushers, conveyors and conveyor drives based on similar equipment measured at other sites (Technical Appendix 13.13A).
- Fixed plant noise concentrated at location 639200 (E), 6177200 (N) (approximate plant site location shown in Figure 8.9).
- Noise levels of haul trucks and front end loaders based on similar equipment measured at other sites (Technical Appendix 13.13A).
- No shielding was allowed for between the fixed plant and nearby residences.
- For mobile plant, one haul truck and a front end loader were assumed to be operating continuously. This was modelled with and without a 20 m barrier.

Pipeline Reclamation

- Assumed use of excavator, haul truck and dozer with noise levels based on similar equipment measured at other sites (Technical Appendix 13.13B).
- No shielding due to topographical effects or between different items of equipment was taken into account.

Operation of Grange Port Facilities

- Assumptions of sound power and noise emission at the source based on equipment summary and layout outlined in Technical Appendix 13.13C.
- Use of (generic) best estimates of sound power related to electrical power of drives with gearboxes and pumps.
- Where plant is clearly defined as enclosed in masonary or steel, a calculated spectrum attenuation assuming thicknesses of 0.6 mm and 90 mm for steel and masonary respectively was used.
- Assumed conveyors and ship loader are not enclosed.
- Assessment is based on machinery operating in good condition, with no faults causing tonal, or modulating noise emissions.
- Assumed that the proposed machinery will emit only broad-band noise with no tonality.

Mine Site

The construction and operation of the mine will increase the ambient noise levels in areas adjacent to the operations. Noise will be generated by construction equipment, blasting, mobile plant and the processing plant. As the mine will be operated 24 hrs a day, the night time noise criteria were considered to be the most critical. Noise contours modelled for fixed and mobile plant at the mine site is shown in Figure 8.9.

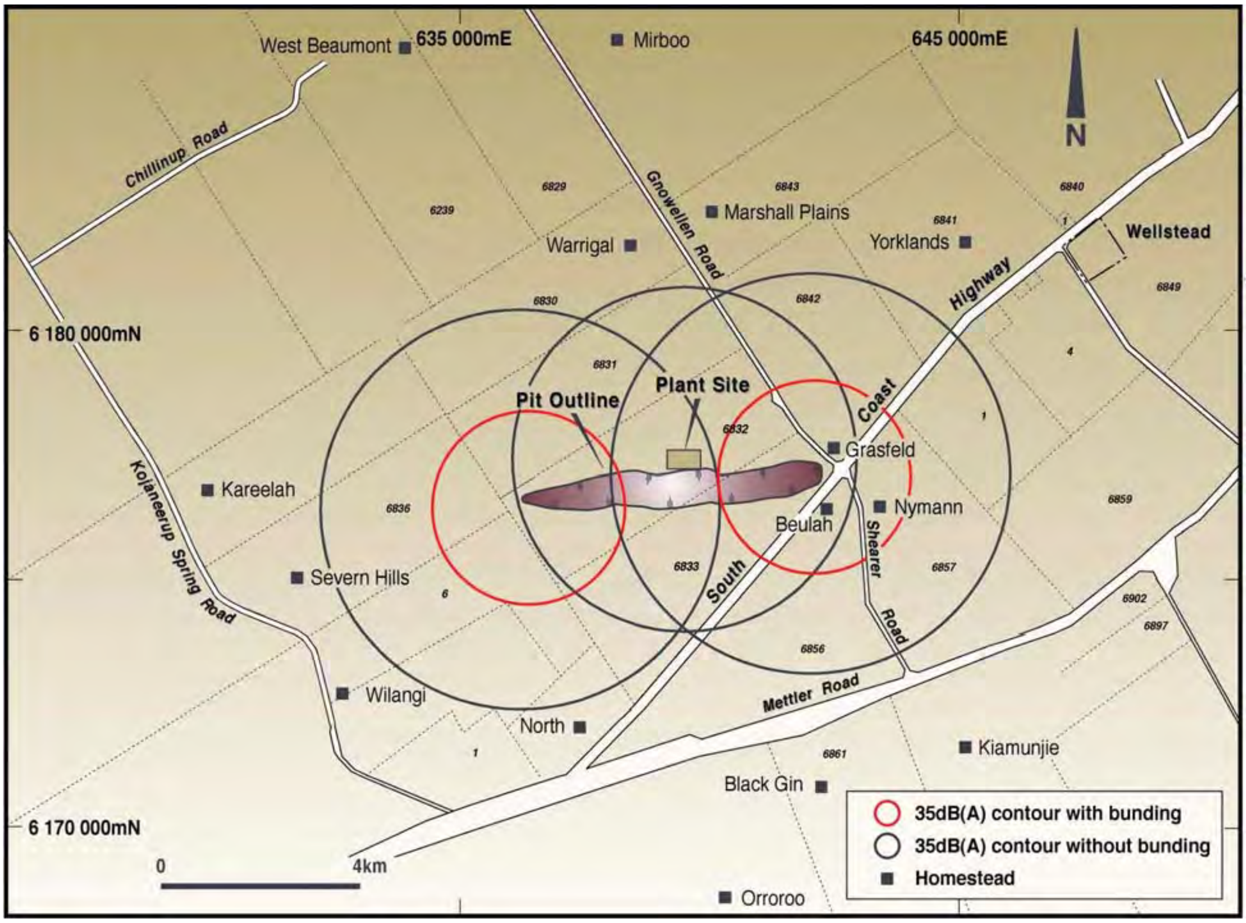

Figure 8.9 Noise Propagation from Fixed and Mobile Plant at the Mine Site.

The fixed plant will be located at the centre of the proposed mine pit on the northern side. Noise generated from the fixed plant, including Primary and Secondary crushers, conveyors and conveyor drives is shown in Figure 8.9. Noise generated by the fixed plant is not anticipated to exceed noise regulations at any sensitive premise in the vicinity of the mine site.

Mobile plant will operate at the western end of the proposed pit at the beginning of the mine life and move to the eastern end as mining progresses. Residences nearest to the mine site that may be impacted by the noise and vibrations generated by the construction and night time operation of the mine are shown in Figure 8.9. The nearest neighbours are the Grasfeld and Beulah residences, both 500 m away, the Nymann residence 1,600 m to the east and Severn Hills 4,800 m to the west. Neighbours to the mine site are rural residential and L_{A10} assigned levels would be 35 dB at night.

Combined noise from fixed plant and mobile plant at the Southdown Magnetite mine site is likely to exceed the night-time assigned levels at residences within approximately 4.5 km of mining operation's mobile plant. This should not affect any residences when mining is at the western end of the proposed open pit. As the mining operations approach the eastern end, residents nearby (Beulan, Nymann and Grasfeld) will be affected (Figure 8.9).

As the mine camp is associated with the proposed mine, it is considered an industrial premises under the Regulations and the assigned noise level is therefore L_{A10} 65 dB. To ensure assigned night-time noise levels are not exceeded, the operational mine camp will be located off-site.

Once requirements for mobile plant and fixed plant have been established, the noise model for mine site operation will be refined and control measures implemented to ensure operation noise emissions are acceptable.

Pipeline Construction and Reclamation

The pipeline route from the Southdown Magnetite mine site to the Albany Port largely traverses open farmland. Pipeline construction noise will be managed through communication with owners of the freehold properties traversed by the pipeline.

Construction of the pipeline and associated land reclamation along the northern shore of Princess Royal Harbour will result in noise emissions and impacts on residents and business in the surrounds generated by trucks and earth moving equipment. The location of the nearest commercial noise sensitive premises (R3) and residential noise sensitive premises (R4) are shown in Figure 8.10.

Figure 8.10 Nearest Noise Sensitive Premises to the Foreshore Pipeline Construction.

Commercial noise sensitive premises have an L_{10} criterion of 60 dB(A) for all hours.

For the residential noise sensitive premises, the criterion depends on the time of day and the value of IF. The value of IF was estimated from the Albany Town Planning Scheme as:

IF = 5 (40% commercial premises within 100 m and within 450 m, 10% industrial within 450 m)
ie L_{A10} Criterion = 40dB (night), 45dB (evening) and 50dB (day)

Assuming day time operation only, the predicted exceedences at the nearest commercial and residential premises are outlined in Table 8.8.

Table 8.8 Predicted Noise Exceedences For Pipeline Reclamation Along the Foreshore.

Noise Sensitive Premises	dB	Exceedence
Commercial Premises (R3)	67.1	7.1
Residential Premises (R4)	59.23	9.2

Construction of Port Facilities

Construction activities undertaken at the Port will be approximately 3 km south east of the main township, near to the existing port. The nearest residential noise sensitive premises to construction activities at the Port are shown in Figure 8.14. Sources of construction noise and the nearest Commercial noise sensitive premises is outlined in Figure 8.11.

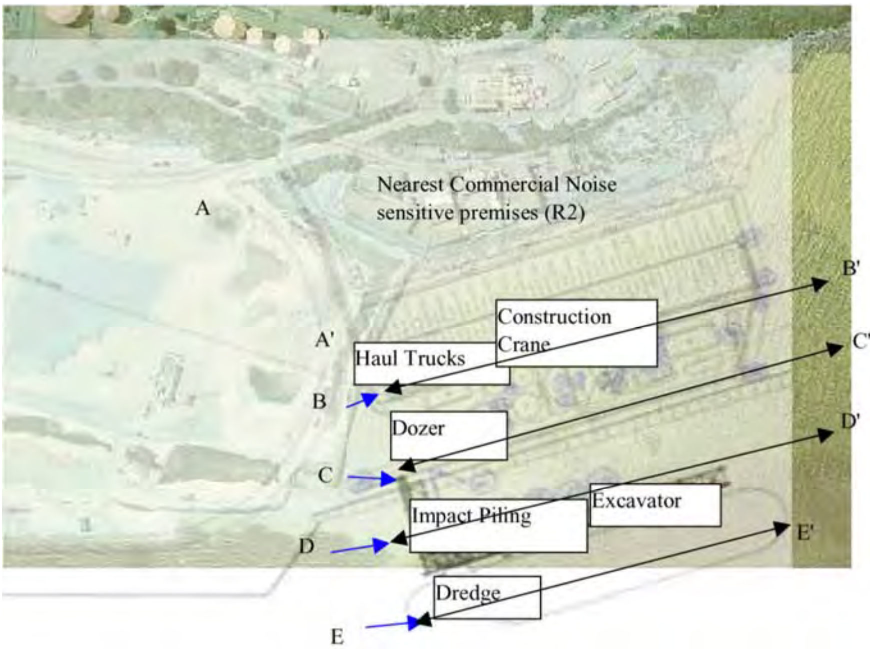

Figure 8.11 Construction Noise at the Port.

Construction noise was divided into three stages for modelling purposes:

Stage 1: 'Lay Down Area' pile driving, construction crane, haul truck, excavator, dozer, dredger (Albany Port Expansion Proposal).

Stage 2: Pile driving, dredger, haul truck (Albany Port Expansion Proposal).

Stage 3: Construction (no piling or dredging), bob cat, power tools etc (Southdown Magnetite Proposal).

Modelling assumptions have been outlined in Technical Appendix 13.13, with modelled exceedences (assuming day time operation only) for Stage 3 construction outlined in Table 8.9. Construction noise for Stage 1 and 2 is addressed in the Albany Port Expansion PER EPA Assessment No 1594).

Table 8.9 Sound Pressure Noise Levels at Nearest Residential and Commercial Premises From Construction Activities.

	R1 (Residential)		R2 (Commercial)	
	SPL	**Exceedence**	**SPL**	**Exceedence**
Stage 3	50.3	-6.7	68.0	8.0

Initial assessment of the noise from construction of the port facilites indicates that noise generated will be less than the assigned levels at the nearest residential site, however exceed the assigned level at the nearest commercial premises.

Operation of Port Facilities

Operation of the Grange facilities at the Albany Port will generate noise from motors, pumps and operation of conveyors and the ship loader. The approximate position of the Grange facilities at the Albany Port is shown in Figure 8.12. Existing Port operations generate noise levels that exceed assigned levels at the nearest neighbours.

The nearest industrial premises to the proposed Grange facilities at the Albany Port is shown in Figure 8.13 and Figure 8.12 represented by a blue dot. This site represents the worst case position for noise as it is closest to the proposed positions of most of the noise sources. The criterion for industrial premises is 60dB(A) at the boundary at all times.

The nearest residential noise sensitive premise is shown in Figure 8.12, represented by a red dot. The 100 m and 450 m influencing circles are shown in Figure 8.14. The boundary between residential provided by the City of Albany Town Planning map indicates the industrial land represents between 50 and 55% of the influencing circles.

Initial assessment of the noise from the slurry and ship loading operations at Albany Port is 47 dB(A) at the nearest noise sensitive site and is thus just above the assigned level. Table 8.10 shows the calculated sound pressure at 2 m based on assumed noise emissions and the resultant noise emissions at the receiver.

Table 8.10 Sound Pressure Noise Levels at Nearest Residence From Operations of Proposed Plant.

	Assigned level L10 night time dB(A)	Sound Pressure from Plant dB (A)	Exceedences dB (A)
At nearest Residence	45	47.2	2.17
At nearest Industrial	60	60.7	0.72

In the initial assessment none of the drives on the ship loader are treated and are considered to be the major sources of noise impacting the nearest noise sensitive site.

Figure 8.12 Position of the Proposed Grange Facilities at the Albany Port.

(nearest industrial premise marked with blue and nearest residence marked with red)

Figure 8.13 Nearest Industrial Noise Sensitive Premises.

Figure 8.14 Nearest Residential Noise Sensitive Premises and Influencing Circles.

Section 8.14.4 Management

Mine Site

Noise and vibrations exposure levels will be monitored against the compliance requirements of the *Mines Safety and Inspection Act 1994.* All practicable measures will be implemented to minimise noise emissions generated by mining and processing activities. A range of noise management measures will be combined to ensure that noise generated by mining operations is compliant with *Environmental Protection (Noise) Regulations 1997*.

For occupied residences within 4.5 km of the mine site, Grange will double glaze the windows and install air conditioning units or implement other appropriate strategies to ensure interior noise amenity meets the relevant Australian Standard after treatment.

To alleviate mobile plant (haul truck) noise, barriers up to 20 m high will be constructed between the mine, road areas and local houses where required, using waste rock from mining operations.

Additional management measures may include:

- Design and layout of mine site, including noise bunds and strategic placement of stockpiles to create barriers between mobile plant noise and nearby residence for night-time operation.
- Night-time operational limits to haul trucks outside the pit.
- Purchase of plant and equipment with reduced Sound Pressure Levels.
- Blasting during daylight hours and modification of blasting practices to reduce noise emissions.

Noise generated by mining operations will be minimised at night by scheduling trucks to work below the top of the dump, ensuring a physical barrier between the trucks and the nearest sensitive premises (Figure 8.15).

Backfilling of the mine void further reduces noise as equipment is operating below surface level. The mining schedule will utilise backfilling from Year 5 onwards which will aid in minimising noise generation.

Reversing alarms are an essential safety feature of mine equipment, however, can be noisy and intrusive for neighbours. Noise will be minimised by using multi-alarm, multi-tone systems located low on the body of the equipment.

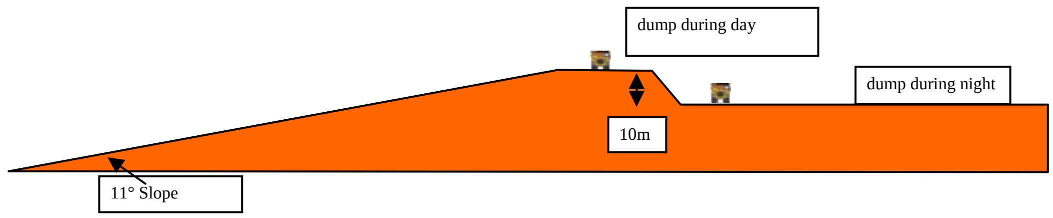

Figure 8.15 Dump Strategy for Mine Site.

Management of employee noise exposure will be in compliance with the *Mines Safety and Inspection Act 1994*. This will include engineering plant design solutions to minimise noise generation and/ or propagation, on-going monitoring of noise exposure levels, use of personal protective equipment, and appropriate operational practices.

Location of the mine camp off-site will ensure that noise levels within sleeping quarters comply with EPA assigned noise levels.

Pipeline Construction and Reclamation

Temporary pipeline construction noise will be managed through the Noise Management Plan and communication with owners of the freehold properties traversed by the pipeline.

Pipeline reclamation and construction along the foreshore and in the vicinity of the city centre will be limited to daylight hours where possible. As the dozer is the dominant source of noise for the pipeline reclamation, Grange will investigate the use of a similar vehicle with noise emissions less than the 118 dB(A) assumed in the noise modelling.

Construction of Port Facilities

Construction activities will be carried out in compliance with the noise practises set out in Section 6 of Australian Standard 2436-1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites'. Measures include:

- Construction work will be carried out between 7 am and 7 pm on any day (which is not a Sunday or public holiday) where possible;
- Equipment used for construction will be the quietest reasonably available; and
- Noise associated with the construction of port facilities will be managed through a Noise Management Plan developed prior to construction to reduce noise emissions through design and operational controls.

Should it be necessary to undertake construction work outside of these hours Grange will implement additional controls including:

- Show that it is reasonably necessary for the work to be conducted out of hours;
- Advise all nearby occupants or sensitive receptors who are likely to receive noise levels which fail to comply with the standard under Regulation 7, of the work to be done at least 24 hours before it commences;
- Equipment used for construction will be the quietest reasonably available; and
- Submit a specific Noise Management Plan to the regional DEC for approval at least seven days before the commencement of works. The plan will include details of:
    - The need for work to be done out of hours;
    - Types of activities that could be noisy;
    - Predictions of noise levels;
    - Control measures for noise and vibration;
    - Procedures to be adopted for monitoring noise emissions;
    - Complaint response procedures to be adopted; and
- Noise associated with the construction of port facilities will be managed through a Noise Management Plan developed prior to construction to reduce noise emissions through design and operational controls.

Operation of Grange Port Facilities

Noise modelling of port operations indicated that the noise exceedences, without treatment are within approximately 2dB (A) of the relevant EPA criteria. This indicates that the regulations can be readily met with a small amount of additional shielding. As the drives on the ship loader are the major source of noise impacting the nearest noise sensitive site, enclosing all the drives will reduce their collective sound pressure at the receiver to below 45 dB(A), meeting the requirements of the Regulations. Enclosures may be of colour bond steel sheeting, but should be well sealed from openings to the west-north-west to prevent breakout in the direction of the nearest neighbour. Noise emissions will be re-calculated prior to construction, taking enclosures on the drives into account, once equipment and cladding has been selected, to ensure that Grange port operations comply with noise regulations.

Additional management strategies include purchasing specifications to exclude equipment that may have impulsive, tonal or modulation characteristics and purchasing specifications to aim for minimal noise emission levels.

Section 8.14.5 Predicted Outcome

Management strategies will be implemented through a Noise Management Plan to ensure that noise associated with the mine and port operations comply with *Environmental Protection (Noise) Regulations 1997.*

Mine Site

Combined noise from fixed plant and mobile plant at the Southdown Magnetite mine site if unmanaged is likely to exceed the night-time assigned levels at residences within approximately 4.5 km of mining operation's mobile plant. Bunding to reduce noise, and operational controls to ensure mobile plant work below the top of dumps at night will significantly reduce noise emissions to surrounding sensitive sites.

Grange will ensure that interior noise amenity at residences surrounding the mine site meets the relevant Australian Standard after treatment.

Construction of Port Facilities

Construction activities will be carried out in compliance with the noise practises set out in Section 6 of Australian Standard 2436-1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites'.

Pipeline Construction and Reclamation

Works associated with land reclamation for the pipeline construction will be scheduled to occur during day-light hours where possible. Construction noise is anticipated to exceed day time limits by between 7 and 9 dB (A) unless a dozer or similar vehicle with noise emissions less than the 118 dB (A) is used.

Operation of Grange Port Facilities

Noise from the Southdown Magnetite Proposal operations at the Albany Port will just meet the assigned levels for nearest noise sensitive premises, by shielding the drives associated with the ship loader.

Section 8.14.6 Environmental Management Commitments

Commitment 32: Prior to construction and operation a Noise Management Plan will be developed for the Southdown Magnetite mine site and port facilities and approved by the DEC. The management plan will ensure the Project complies with *Environmental Protection (Noise) Regulations 1997* and AS2436-1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites. The plan will also set out procedures to reduce noise emissions through design and operational controls and monitor the effectiveness of these controls.

Commitment 33: The Noise Management Plan will be implemented throughout the life of the mine.

Section 8.15 Odour Emissions

Section 8.15.1 Management Objectives

The objectives for the management of odour are to:

- Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

Section 8.15.2 Applicable Standards and Guidelines

Applicable guidelines and standards include:

- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006); and
- Guidance Statement No. 3. Separation Distances between Industrial and Sensitive Land Uses (EPA, 2005).

Section 8.15.3 Potential Impacts

No part of the Southdown Magnetite Proposal is anticipated to generate odour.

Section 8.16 Gaseous Emissions

Section 8.16.1 Management Objectives

The objectives for management of gaseous emissions are to:

- Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
- Minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.

Section 8.16.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Guidance Statement No. 12. Guidance Statement for Minimising Greenhouse Gas Emissions (EPA, 2002);
- Guidance Statement No. 18 Prevention of Air Quality Impacts from Land Development Sites (EPA, 2000);
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006);
- Australian methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2002 Series (DEH, 2006); and
- National Environmental Protection Measure for Ambient Air Quality (NEPM, 1998).

Section 8.16.3 Potential Impacts

Greenhouse Gas Emissions

Greenhouse gases in the Earth's atmosphere play a role maintaining global temperature by absorbing infra-red radiation. The International Panel on Climate Change has determined that it is likely that increases in greenhouse gas in the Earth's atmosphere are implicated in the observed changes in the Earth's climate. Australia, with 0.3% of the world's population contributed 1.4% of global greenhouse gases in 1995 (Government of Western Australia, 1997; Department of Foreign Affairs and Trade, 1997 and Government of Western Australia, 1998). WA contributed around 11% of national emissions in 1990 and approximately 12% in 1995 (National Greenhouse Gas Inventory Committee, 1998).

The six greenhouse gases specifically covered by the Kyoto Protocol are carbon dioxide (CO_2), methane (CH_4), perfluorocarbons (CF_x), hydrofluorocarbons (HFC), sulphur hexafluoride (SF_6) and nitrous oxide (N_20). To give a common base for considering the impact of the various gases, they are usually expressed in terms of carbon dioxide equivalents, where the potential of each to lead to heating in the atmosphere is expressed as a multiple of the heating potential of carbon dioxide.

The proposal will release greenhouse gases, predominantly carbon dioxide either directly or indirectly from fossil fuel consumption and biomass decomposition. Direct contributions include:

- combustion of diesel fuel used in vessels, heavy and light vehicles;
- detonation of explosives used in blasting; and
- decomposition of cleared vegetation and release of carbon dioxide from the soil.

Indirect proposal contributions to greenhouse gas emissions include the combustion of gas or coal at the relevant power station to meet the proposal's power requirements.

An assessment was made (Technical Appendix 13.14) of the greenhouse gas emissions likely to be associated with the proposal. The following activities were included in the assessment:

- construction of the mine infrastructure, including the concentrator plant;
- construction of the pipeline;
- construction of the port infrastructure in Albany, including the concentrate filter plant;
- vegetation clearing associated with the mine and pipeline construction;
- revegetation of cleared areas as part of the mine's rehabilitation programme;
- operation of the mine, pipeline and port facilities;
- transport of personnel and materials during construction and operational phases; and
- shipping of concentrate to Malaysia.

A greenhouse gas emissions inventory was developed to calculate the likely quantities of greenhouse gas emissions based on a 22 year mine life and the current level of understanding of the proposal. The calculations were in accordance with methods and standards recommended by the Commonwealth DEH, and the Australian Greenhouse Office. Sources of greenhouse gas are; direct fossil fuel consumption, indirect fossil fuel consumption and biomass decomposition (Appendix 12- 2).

Direct Fossil Fuel Consumption: Nearly all mobile equipment used during the construction and operational phases will be diesel-powered. This includes light vehicles, haul trucks, face shovels, dozers, dredges and concentrate ships. Estimates were made on the quantity of diesel to be consumed each year by the anticipated number of pieces of equipment, their respective duties and approximate fuel efficiency. Annual diesel consumption for the proposal during full operation is estimated to be 51,760 kL. This equates to greenhouse gas emissions of 139,740 t CO_2-e/yr.

Greenhouse gas emissions are also expected from the blasting activities during mining. The proposal is expected to use approximately 16,670 tonnes of ANFO (a mix of ammonium nitrate and diesel) for blasting, contributing approximately 2,790 t CO_2-e annually.

Indirect Fossil Fuel Consumption: During full operation, the proposal is expected to consume approximately 624,150 MWh of electricity annually, sourced from the WA grid. This electricity is generated at various power stations around WA through the combustion of fossil fuels (e.g. coal, natural gas). Although the emissions occur beyond the proposal boundaries, the emission of 598,000 t CO_2-e associated with proposal electricity requirements is still attributable to the Southdown Magnetite Proposal.

Biomass Decomposition: The proposal requires the clearing of approximately 413.2 ha of native vegetation and pine plantations. The decomposition of this vegetative matter results in emissions of CO_2. Greenhouse gas emissions associated with land clearing were calculated using the National Carbon Accounting Toolbox (Australian Greenhouse Office, 2005). Emissions associated with land clearing are estimated to peak at 14,200 t CO_2-e per annum in 2009, then gradually reduce so that only 4,700 t CO_2-e are expected in 2015. The model predicts that it will take approximately 30 years after revegetation for the equivalent quantity of emissions associated with land clearing to be fully sequestered.

Total Greenhouse Gas Emissions: Under full production, the proposal is expected to generate approximately 750,000 tonnes of CO_2-e per annum. This compares with the 20,000 to 23, 000 tonnes of CO_2-e per annum during the construction phase. Figure 8.16 indicates that the majority of emissions during the proposal's production phase are associated with electricity consumption, contributing 80% of total emissions. Diesel consumption contributes nearly 20%, while land clearing and explosives both contribute less than 1%.

It is predicted that approximately 16.4 million tonnes of CO_2-e will be emitted over the proposal's anticipated 22 year life.

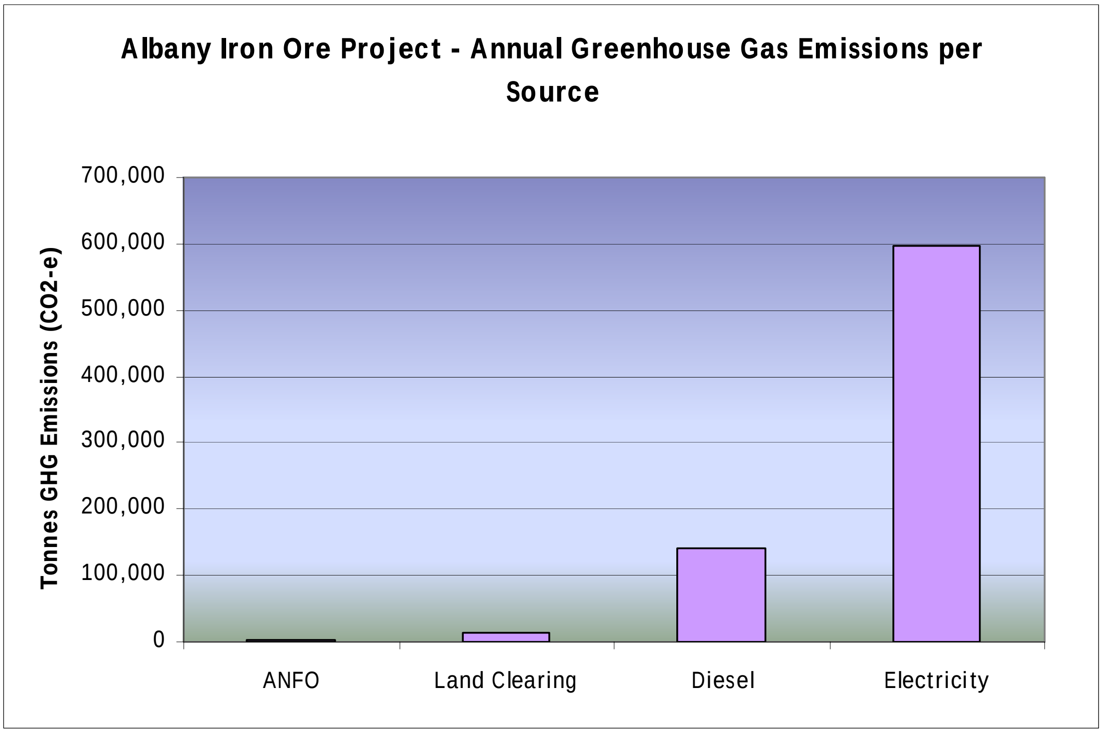

Figure 8.16 Southdown Magnetite Proposal Annual Greenhouse Gas Emissions per Annum, per Source during Operation.

Other Gaseous Emissions

A range of pollutants other than greenhouse gas emissions are associated with industrial processes. These are outlined in Table 8.11. The majority of these gaseous emissions are associated with the production of electricity for the Project (Figure 8.17). As the proposal does not involve refining of the magnetite, gaseous emissions are anticipated to result through activities such as fuel combustion and use of paints and solvents.

An emissions inventory was developed for the Albany Iron Ore Project to calculate the likely quantities of polluting gases emitted, based on a 20 year mine life and the current level of understanding of the proposal. The calculations were in accordance with methods and standards recommended by the National Pollution Inventory (NPI). Various NPI Emissions Estimation Manuals were used, combined with several reasonable assumptions, to roughly predict the potential impact of this proposal.

Activities of different natures evolve different types and magnitudes of polluting gases. The assessment was divided into construction and operational phases due to the different nature of their component activities. A further division was made between transport of goods and personnel to and from sites, and transport specifically conducted on-site.

8. POTENTIAL ENVIRONMENTAL IMPACTS AND MANAGEMENT

Table 8.11 Gaseous Emission sources and potential environmental impacts.

Emission	Source	Potential Environmental Impact	Emissions (t/yr)
NO_x	The oxides of nitrogen (nitric oxide and nitrogen dioxide) are formed by the direct combination of oxygen and nitrogen during a variety of thermal processes. These include operation of internal combustion engines, thermal power generating plants, and from oxidising flames such as electric arc or gas torches.	Oxides of nitrogen increase the amount of other greenhouse gases (methane), and eventually oxidises into the greenhouse gas, carbon dioxide.	165864
SO_2	Fossil fuel combustion sites particularly coal burning power plants; particularly from sulphide containing ores, emit sulphur dioxide to the atmosphere.	Even low concentrations of sulphur dioxide can harm plants and trees and reduce crop productivity. Higher levels, and especially the acidic deposits from acid rain, will adversely affect both land and water ecosystems.	550548
CO	Sources include industrial plant exhaust to air and incomplete combustion of carbon containing fuels.	Carbon monoxide increases the amount of other greenhouse gases (methane), and eventually oxidises into the greenhouse gas, carbon dioxide.	17955
PM_{10},	Industry sources include releases from bulk material handling, combustion and minerals processing. Industries using these processes include mining (ie dust) and fossil fuel power plants.	PM_{10} can potentially effect the health of flora and fauna. Dust in general affects the aesthetics and utility of areas through visibility reduction and may effect buildings and vegetation. The specific effects of the dust depend on its composition, concentration and the presence of other pollutants.	3171
VOCs : Volatile Organic Carbons	VOCs are released from a wide range of industrial processes, particularly processes involving solvents, paints or the use of chemicals as well as fuel storage. VOCs include: Formaldehyde; released from vehicular exhaust. Catalytic cracking, coking operations, and fuel combustion are major sources of formaldehyde from refineries. Benzene: Releases to air from industries producing, using or handling benzene and evaporation of fuels. 1,3 Butadiene: Motor vehicles emit 1,3-Butadiene to air.	The major environmental significance of VOCs is in relation to their role in the formation of photochemical smog. Other environmental effects depend on the composition of the VOCs, the concentration and the length of exposure. As with humans some VOCs can have serious effects on animals and also plants.	2770

Source: National Pollution Inventory, 2005

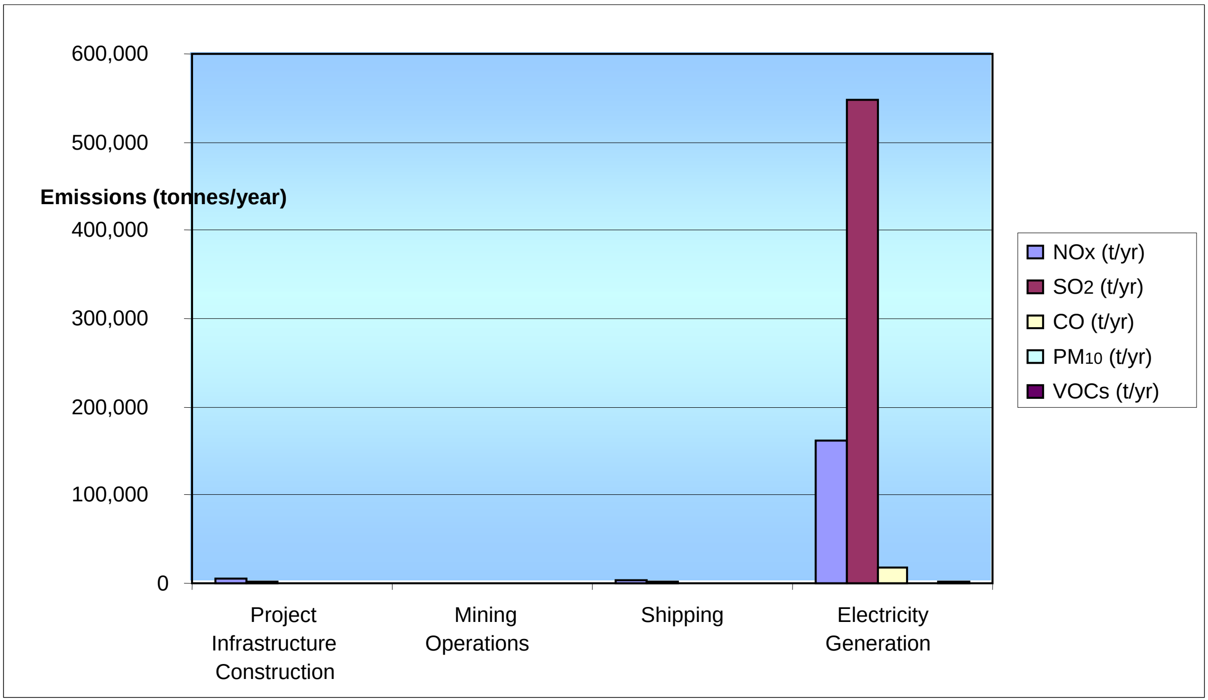

Figure 8.17 Southdown Magnetite Proposal Annual Gaseous Emissions per Annum, per Source during Construction and Operation.

Construction phase: Polluting gases will be emitted from transport of personnel and equipment to and from the pipeline, the port, the Southdown mine site, and from on-site based activity in these areas. Some gases will also be produced during construction by stationary equipment such as generators and the use of dredging equipment.

Operational phase: The greatest contribution to polluting gases will be from the external power generation required for the Project. Polluting gases will be emitted through on-site and off-site vehicle use at both the mine and the port. Polluting gases are also emitted from fugitive ore emissions (dust) and operation of Cape size vessels.

Under full production, the proposal is expected to generate approximately 550,500 tonnes of SO_2 and 166,000 tonnes of NO_x per annum (Table 8.11). This compares with 3,000 tonnes of SO_2 and 5,000 tonnes of NO_x per annum during the construction phase.

Calculation Restrictions

- Calculations of pollutants other than greenhouse gas emissions did not include the impact of land clearing and ANFO usage.
- Calculations assumed that a typical construction and mining vehicle fleet will be used, that is solely diesel based.
- CO, NOx, PM_{10}, SO_2, and VOCs emissions will all be produced during both the construction and operational phases of the Project, and by all potential sources examined. Fugitive emissions have only been defined for PM_{10}.
- VOCs (volatile organic hydrocarbons) can be speciated into several gases, of which only Benzene, 1,3 Butadiene and Formaldehyde have been included in this assessment.

- Benzene and 1,3 butadiene were only measured for transport activity to and from site, not during site construction or operational work, as required by NPI EETM for combustion engines. Similar restrictions existed for 1,3 Butadiene and shipping and electricity generation, as no emissions factors were available for this gas in the appropriate manuals.

Section 8.16.4 Management

Greenhouse Gas Emissions

Greenhouse gas emission minimisation has been incorporated into Project planning in accordance with EPA Guidance Statement for Minimising Greenhouse Gas Emissions (2002). The decision to transport concentrate from the mine site to Albany by pipeline rather than by rail or road significantly reduces diesel use over the mine life. Construction and operation phases of the proposal will be designed to minimise vehicle movements and duplication of activities to reduce cost, greenhouse gas emissions and increase efficiency. Grange will also transport the majority of the construction and operational workforce from Albany to the mine site by bus to reduce the number of vehicles used in association with the Project. In the detailed design phase of the proposal, Grange will also consider:

- selection of the most energy efficient technology available where practicable; and
- energy consumption as criterion in equipment selection.

Vegetation clearing has been minimised where practicable during selection of the pipeline route. Only 5 ha of remnant vegetation will be cleared along the pipeline route. Vegetation to be cleared at the mine site (a total of 438.2 ha, of which 252.6 ha is remnant vegetation and 155.6 ha is pine plantation) will be cleared progressively and stockpiled for use in rehabilitation. Progressive rehabilitation of open areas will result in partial offsets of emissions over the life of the Project. Other carbon sequestration options include purchase and conservation of existing remnant bushland in the south-west and forestry or other revegetation methods.

Grange will apply to participate in the Greenhouse Challenge Plus programme. Once operational, Grange will also report energy efficiency and greenhouse gas emissions annually to the Australian Greenhouse Office as required under the Greenhouse Challenge Plus programme and WA Strategy. Regular (e.g. triennial) energy efficiency audits will also be conducted for the Project as required under the Energy Efficiency Opportunities programme and WA Strategy.

Other Gaseous Emissions

In addition to the management strategies and reporting related to greenhouse gas emissions, mobile and plant equipment associated with the Project, including Cape size vessels used for magnetite transport will be maintained to reduce cost, gaseous emissions and increase efficiency.

Grange will meet relevant air quality standards and requirements of Section 51 of the *Environmental Protection Act 1986* (that all reasonable and practicable measures are taken to minimise pollutant discharge). Grange will also comply with National Environment Protection Measures and relevant state legislation through reporting all emissions that trigger reporting thresholds to the National Pollution Inventory. Table 8.12 presents a summary of the National Environment Protection Measure air quality standards.

Table 8.12 National Environment Protection Measure Relevant Air Quality Standards.

Pollutant	Averaging period	Maximum (ambient) concentration	Goal within ten years (maximum allowable exceedences)
Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year none
Sulphur dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year none
Carbon monoxide	8 hours	9.0 ppm	1 day a year
Particles as PM_{10}	1 day	50 $\mu g/m^3$	5 days a year

Section 8.16.5 Predicted Outcome

Once operational, the Southdown Magnetite Proposal will generate greenhouse gases, mainly from the consumption of electricity and diesel fuel. Emissions of greenhouse gas and other gaseous emissions from the Southdown Magnetite Proposal will be kept as low as practicable.

Section 8.16.6 Environmental Management Commitments

Commitment 34: Grange will apply to participate in the Greenhouse Challenge Plus programme and WA Strategy.

Commitment 35: Grange will comply with National Pollution Inventory reporting requirements for emissions that trigger reporting thresholds.

Section 8.17 Waste (general and hazardous waste)

Section 8.17.1 Management Objectives

The objectives for waste management are to:

- Reduce the volume of waste through product selection, reuse and recycling.
- Ensure that waste is contained and isolated from groundwater and surface water, and that storage, treatment or collection does not result in long term impacts on the surrounding environment.
- Minimise the environmental impacts of hydrocarbons/chemicals (solvents, cleaning fluids etc.) through appropriate storage, handling and disposal.

Section 8.17.2 Applicable Standards and Guidelines

Applicable Standards and guidelines include:

- Water Quality Protection Guidelines No. 10 Mining and Mineral Processing Above-ground fuel and chemical storage (WRC, 2000);
- Australian Standard 1940-2004 : The storage and handling of flammable and combustible liquids;
- Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006);
- Guidance Note S301, Storage of Dangerous Goods Licensing and Exemptions (DoCEP, 2006);
- Guidance Note MH401, Dangerous Goods in Ports- Guidelines for the Development of a safety management system (DoIR, 2003);
- Australian Code for the Transport of Dangerous Goods by Road and Rail (National Road Transport Commission, 2005); and
- Water Quality Protection Note; Irrigation with nutrient rich wastewater (DoE, 2004).

Section 8.17.3 Potential Impacts

Construction and operation activities associated with the mine and Port will generate waste materials and require the transport, storage and handling of hydrocarbons and chemicals. If not adequately handled, stored or disposed of these materials can contaminate local soil, groundwater or surface waters. Contamination can arise from the escape of leachate containing hydrocarbons, chemicals, elevated nutrients, or heavy metals.

Types of waste generated by the Project include the following:

General Waste:

- Domestic waste (e.g. plastic, paper, workshop wastes and domestic solid wastes)
- Construction waste (e.g. wood, scrap metal, tyres, rubber, batteries)
- Sewage and grey water.

Approximately 4000 t/yr of domestic and construction waste will be produced by the Project.

Hazardous Substances:

- Hydrocarbons – approximately 200 kL/yr of waste hydrocarbons will be produced by the Project.
- Plant maintenance related chemicals (insignificant outside of waste hydrocarbons above).

Section 8.17.4 Management

General Waste:

Waste reduction will be a priority for the Project. Domestic and construction waste will be minimised through reuse and recycling where appropriate. General waste will be disposed of in an approved landfill. The Project may utilise the Wellstead landfill, or construct an on-site landfill. If an on site landfill is required, the landfill will be constructed in compliance with regulations; with sufficient surface to groundwater table distance (with considerations to hydroconductivity of the geology) to minimise the potential for groundwater contamination.

The sewage facility for the mine operations is likely to be an on-site package sewage treatment plant, operated in compliance with the *Health Act 1911* and relevant shire regulations.

Sewage and grey water from the Port will be connected to the City of Albany sewerage system or directed into a septic system. The site will be assessed for suitability for a septic system (soil conditions, distance above groundwater and separation distance from water courses) in compliance with the *Health Act 1911* and consultation with the City of Albany.

Liquid effluent generated at the site includes laboratory waste, oils and water from the workshop will be managed in an appropriate manner in accordance with relevant legislation.

Hazardous Substances:

During construction and operations, hazardous substances will be stored according to Australian Standard 1940. Storage of bulk fuel will be in above ground tanks within bunded, impermeable enclosures, or in double skinned tanks.

Hazardous substance management is addressed in the Project Construction Environmental Management Plan, with procedures for the correct handling, storage, spill management and clean up. Contaminated material will be removed and bio-remediated (if biodegradable) or disposed at a licensed facility. Spill response equipment will be located in the vicinity of work areas, with site personnel trained in spill response management.

Storage of explosives will be in a remote magazine in accordance with the *Explosives and Dangerous Goods Act 1961*.

Hazardous waste will be removed from site by a licensed contractor for disposal in an approved facility in accordance with the requirements of the controlled waste regulations.

Section 8.17.5 Predicted Outcome

The management of general and hazardous waste is expected to result in negligible environmental impacts.

Section 8.17.6 Environmental Management Commitments

Commitment 36: Grange will ensure that spill response equipment will be readily accessible in each work area, and that spills will be controlled at the source, contained and cleaned up as soon as they occur. Contaminated material will be removed and bio-remediated (if biodegradable) or disposed at a licensed facility.

Section 8.18 Electromagnetic Radiation

Section 8.18.1 Management Objectives

The objectives for management of electromagnetic radiation are to:

- Ensure that radiological impacts to the public and environment are kept as low as reasonably achievable and comply with acceptable standards.

Section 8.18.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- EPA Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006).

Section 8.18.3 Potential Impacts

Improper management of electromagnetically radioactive material may result in long term health issues for employees as well as residents in the vicinity of the operations. Accumulation of electromagnetically radioactive material may also result in the formation of new contaminated sites, the inability to meet closure criteria and impacts to health and well being of flora and fauna in the area.

The processing operations will include the use of density gauges, which use a radioactive source material. These gauges are routinely used in process operations. If sources of significant electromagnetic radiation are identified, management strategies for each point source will be developed and implemented

Section 8.18.4 Management

Management of electromagnetically radioactive material will be detailed in the Project Management Plan to be approved by DoIR as part of the *Mines Safety and Inspection Act 1994*.

Section 8.18.5 Predicted Outcome

Electromagnetic radiation will be managed so as to have negligible environmental impacts.

Section 8.19 Visual Amenity, Landscape and Geo-heritage

Section 8.19.1 Management Objectives

The objectives for management of visual impact, landscape and geo-heritage are to:

- Minimise Project impacts to community use and access of significant environmental features.
- Ensure that aesthetic values and public experience of the landscape are considered and measures are adopted to reduce the visual impacts on the landscape.
- Maintain and protect significant landscape and geo-heritage values and maintain the integrity, ecological functions and environmental values of the soil and landform.

Section 8.19.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- EPA Guidance No. 33 Environmental Guidance for Planning and Development (EPA, 2006);
- State Planning Strategy and associated policies (WAPC, 1997); and
- Town of Albany Town Planning Schemes No. 1A and No 3 (Shire) District Schemes, (City of Albany, 2004).

Section 8.19.3 Visual Impact Assessment

The human experience of a physical environment is based on what is perceived (landscape) and the enjoyment derived from what is perceived (aesthetics). Enjoyment, or amenity is a function of personal values. Components of a person's amenity of a view location can be view based and non-view based.

The objective of the Visual Impact Assessment was to identify and document view based and non-view based components of amenity, identify potential impacts to these values and propose potential mitigation measures. Interpretation of the data was done in consultation with John Cleary (John Cleary Planning, 2002) to evaluate landscape values and assess the potential Project impacts on all the values across the study area.

Non-view based components of amenity that were assessed comprised significant features, wilderness quality and community use and access (measure of community sensitivity).

- Landscape significance was determined through the identification and assessment of significant features within the vicinity of the mine site and Port. These features were identified according to descriptive criteria based on scientific research (Brabyn, 1996) and public perception.
- Wilderness quality was defined based on remoteness and disturbance of the use area.
- Community use and access sensitivity of the proposed Project landscape was assessed using the method developed by CALM (1989a) and adapted by John Cleary Planning (2002) which gives a measure of an area's relevance to landscape values, regardless of current visibility.

Assessment of view based components of amenity involved assessment of landscape character (content of view), views (the ability to view) and significance of view locations. This information was used to determine potential impacts of the infrastructure associated with the Southdown Magnetite mine site Project to community amenity in order to identify objectives for mitigation of impacts.

View locations assessed during the field assessment conducted for the Albany Port and mine site on the 23th - 24th June 2005 (ecologia, 2006) were chosen to represent use areas where amenity may be impacted by the Project. Determination of the sensitivity levels of use areas provided an indication of the importance of these areas to people's experience. The sensitivity levels of view locations were determined based on the number of users, and the type of use of the area; categorised as non-recreation use, recreation, tourism and settlement (Technical Appendix 13.15). The viewer sensitivity levels were combined with project visibility distance zones (foreground, middle ground and background) to determine the sensitivity zone of the use area (Technical Appendix 13.15). The management objectives associated with each sensitivity zone (CALM (1989), Cleary (2002)) were used to assess the acceptability of the impacts and prioritise mitigation measures.

Section 8.19.4 Potential Impacts

Mine Site

The proposed mine site is located in rural land approximately 10 km from the small community of Wellstead on land of relatively flat relief, adjacent to the South Coast Highway. The mine will result in highly visible, medium to permanent changes to the landscape. Aerial views of the mine site from the south-east and south-west at the end of the mine life are provided in Figure 8.18 and Figure 8.19.

Although existing roadside vegetation provides an effective visual screen to ground level operations, large infrastructure such as the processing plant and waste rock dumps may be visible above the vegetation line. Views of the mine site from South Coast Highway and Gnowellen Road at the end of the mine life are provided in Figure 8.20 and Figure 8.21. The mine site is also potentially visible from the Stirling Range National Park, though only in the far distance as the mine is approximately 25 km from Bluff Knoll. The Project is not anticipated to impact geo-heritage values.

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Figure 8.18 Computer Generated Image; Aerial View of Mine Site from the South –East at the end of Mine Life.

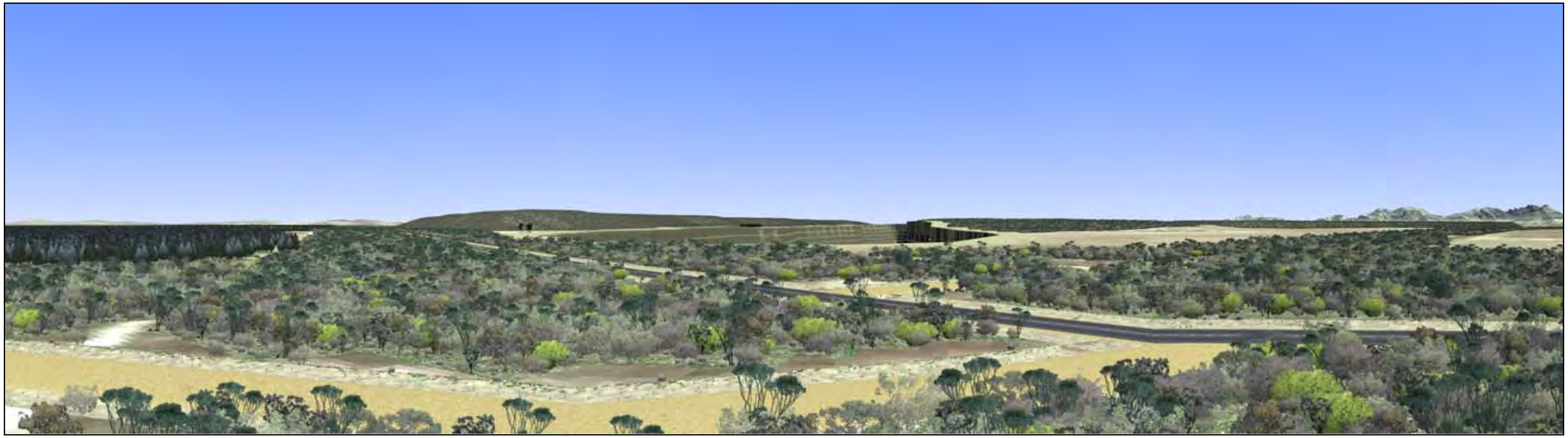

Figure 8.19 Computer Generated Image; Aerial View of Mine Site from the South-West at the end of Mine Life.

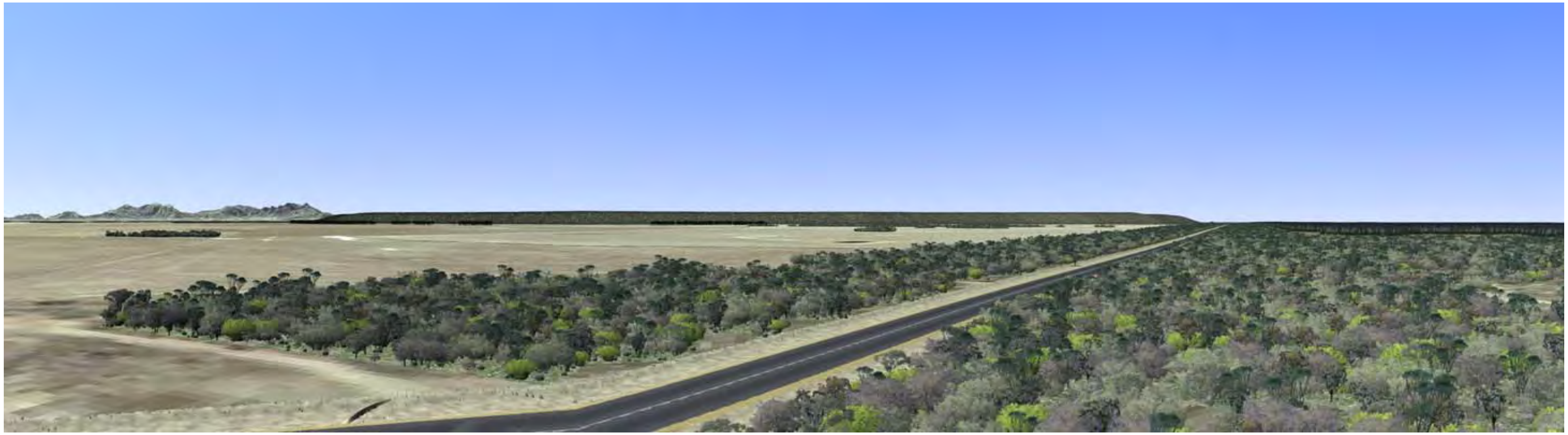

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Figure 8.20 Computer Generated Image of Mine Site from South Coast Highway at the end of Mine Life.

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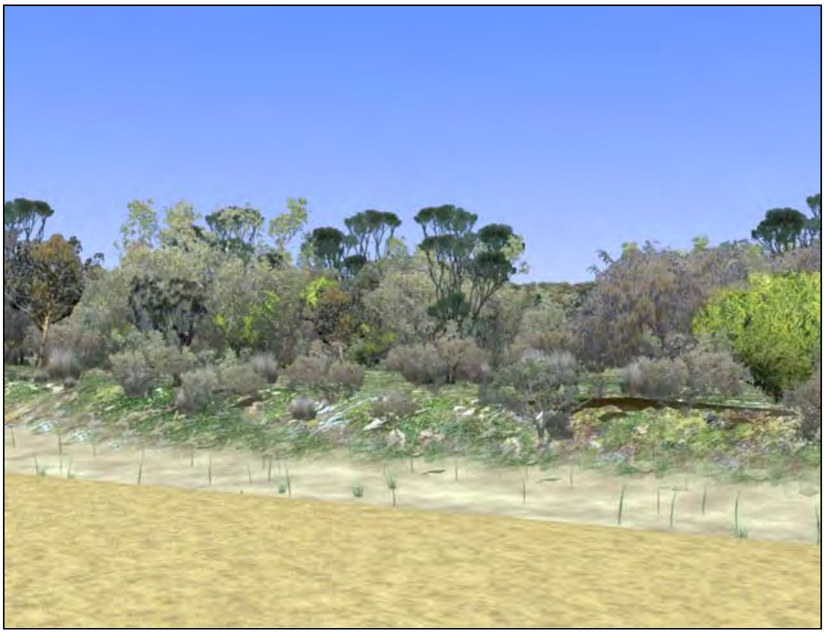
Figure 8.21 Computer Generated Image of Mine Site from Gnowellen Road at the end of Mine Life.



Pipeline

The slurry pipeline will be buried and, following rehabilitation will be un-noticeable.

Port Infrastructure

The proposed port facilities will be located adjacent to an existing industrial area at the Port, along the northern shore of Princess Royal Harbour. The port facilities will be visible from local recreational areas, significant indigenous and historical sites, tourist lookouts, residential areas and boats in Princess Royal Harbour and King George Sound. Project construction and operation will restrict public access and alter the existing coastline. The facilities are not anticipated to significantly decrease the visual amenity of the area in the long term, as the Project is an expansion of the existing Port and industrial area, and substantial parts of the infrastructure will be enclosed.

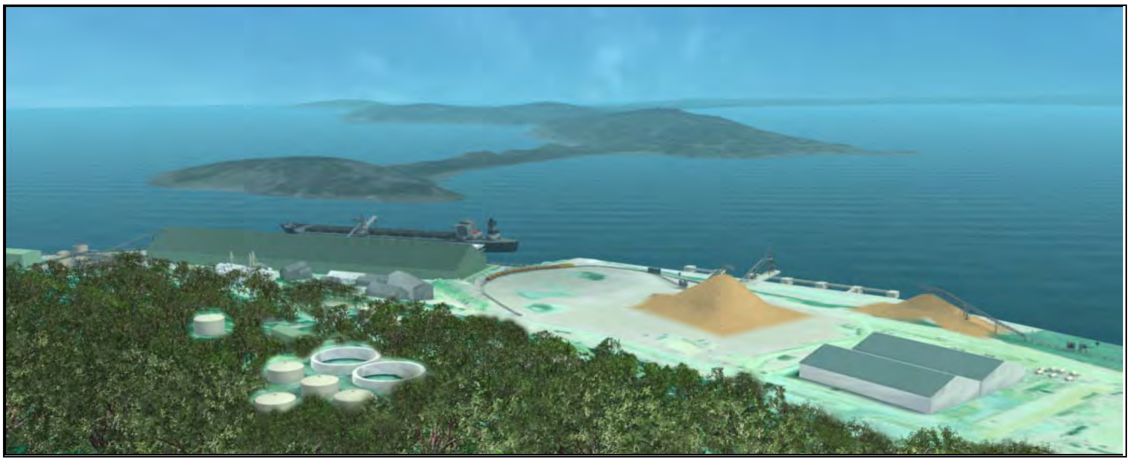


Figure 8.22 Computer Generated Image of Port Facilities from Mt Clarence Lookout.

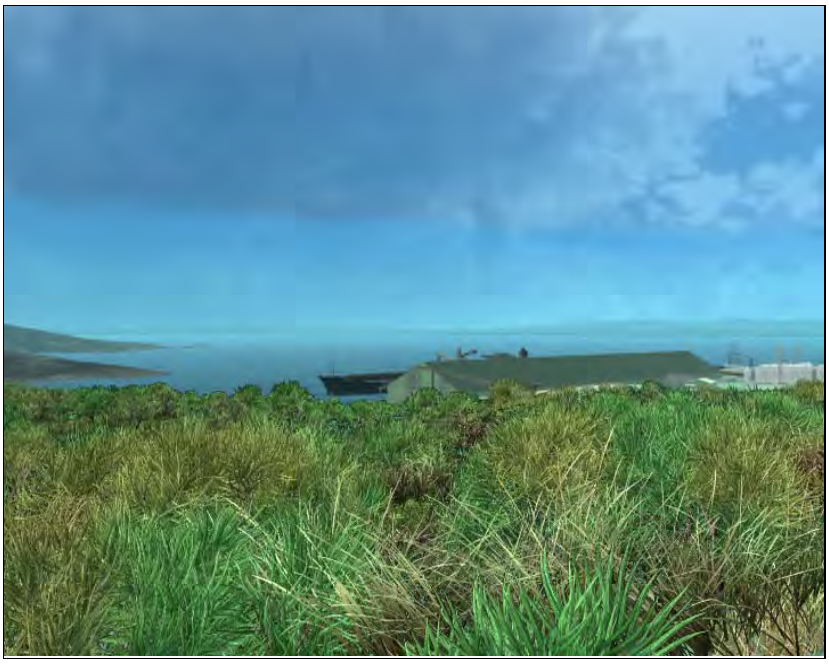


Figure 8.23 Computer Generated Image of Port Infrastructure from Marine Drive.

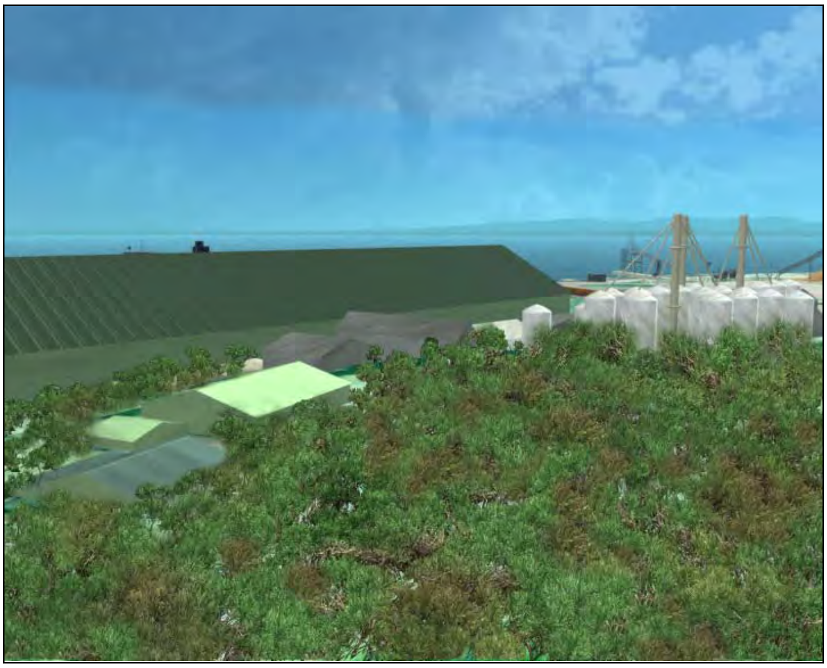


Figure 8.24 Computer Generated Image of Port Infrastructure from the Boardwalk.

Figure 8.25 Computer Generated Image of Port Facilities from the Entrance to Princess Royal Harbour.

Figure 8.26 Computer Generated Image of Port Facilities from Possession Point.

Section 8.19.5 Management

Grange is undertaking extensive public consultation throughout the planning stage of the proposal, and construction will be in compliance with the Albany Town Planning Scheme where relevant.

Mine Site

To minimise the size and impact of the TSF and waste dumps, the mine pit will be progressively backfilled and TSF's and waste dumps will be shaped to mimic local landforms where possible. Considerations of final landform will be incorporated into the Mine Closure Plan (Technical Appendix 13.19).

Visual screening around the mine site with fast growing, tall, plantation/eucalyptus trees combined with the use of neutrally coloured, non-reflective building materials will minimise the visual impact of the mine site and associated infrastructure during construction and mine operation. Once mining commences, the the plant infrastructure will be largely blocked by the TSF to the north-east and the waste dump to the south, which will be progressively rehabilitated and revegetated throughout the mine life. The mine pit will be progressively backfilled, leaving a final pit void. Upon closure, infrastructure will be removed and the mine site rehabilitated to final land use requirements.

The mine site is also potentially just visible from the Stirling Range National Park. Tree screening combined with non-reflective construction materials will minimise the visual impact of the mine site to the scenic view sheds from the National Park.

Port Infrastructure

Several feasibility and conceptual investigations into the expansion of Albany Port operations have been conducted over the past twelve years. A discussion of the investigations into these options is included in the Albany Port Expansion PER (EPA Assessment No. 1594), however, it was found that expansion of existing facilities will result in the smallest possible impact to the environment along with lower operation and maintenance costs for the port and its users. Land reclamation is consistent with the existing foreshore, and locating the new berth next to an existing industrial area will result in a smaller environmental footprint overall.

Landscape and visual impacts will be minimised through the construction of an enclosed storage shed at the port to reduce the visibility of stockpiling and ship loading operations. Port side infrastructure, including the storage shed will be constructed using neutrally coloured, non-reflective material. It is proposed to construct the shed in a green construction material to blend in with surrounding vegetation.

Ongoing public communication and consultation in regards to project design, construction and operation will be undertaken to ensure public awareness of the potential impacts.

Section 8.19.6 Predicted Outcome

The management objectives for the mine site will be achieved with ongoing rehabilitation and tree screening.

At the Albany Port, the management objectives for several view locations representative of travel routes and use areas in the vicinity of the port may not be fully achieved. View locations 15-16 (Desert Mounted Corp Memorial and Mt Clarence), 26-28 (Ataturk's Memorial and Pagoda and Point King), and 31 (the entrance to Princess Royal Harbour) were all categorised as sensitivity zone A with the objective of maximum retention of visual quality. Implementation of mitigation measures as recommended will provide moderate retention of visual quality from these view locations. The greatest visual and landscape impact will be at use areas represented by view locations 13 (Marine Drive), 22-25 (the Boardwalk) and 20 (Possession Point). These view locations are all categorised as sensitivity zone A, and visual quality will not be retained, even with implementation of mitigation measures, due to proximity to the proposed infrastructure.

Section 8.19.7 Environmental Management Commitments

Commitment 37: Prior to construction, a Visual Impact Management Plan shall be developed for the mine and port facilities in consultation with the DPI, DEC, DoIR and the City of Albany.

Commitment 38: The Visual Impact Management Plan will be implemented from the commencement of construction.

Section 8.20 Social and Cultural Environment

Section 8.20.1 Management Objectives

The objectives for management of the social and cultural environment are to:

- Avoid disturbance to maritime, cultural and heritage sites.
- Ensure compliance with relevant legislation including the *Heritage of Western Australia Act 1990* and the *Aboriginal Heritage Act 1972*.
- Respect the rights of all land owners.

Section 8.20.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Guidance Statement No. 41. Assessment of Aboriginal Heritage (EPA, 2004);
- Guidelines for Consultation with Indigenous People by Mineral Explorers (DoIR, 2004); and
- Pipeline Easement Guidelines (APIA/ VFF, 2004).

Section 8.20.3 Potential Impacts

Non-Indigenous Heritage

The Project is in the City of Albany, the site of WA's first European settlement and the main international port of WA between 1852 and 1900. The pipeline that traverses the city potentially interfaces with several sites of local significance, including a former residency on Residency Road, the Old Gaol, the Major Lockyer Memorial and the Albany Town Jetty. No registered heritage sites will be removed, damaged or altered.

Indigenous Heritage

The proposed pipeline route will impact Creek 3 (Willyung Brook) (Site ID 21837), a site registered on the Aboriginal Sites Register. This site is protected and can not be impacted without approval under Section 18 of the *Aboriginal Heritage Act 1972.* Additional sites that have been identified but are not yet listed on the Aboriginal Sites Register include Kinjarling (this site consists of the Kalgan and King Rivers, and the Napier and Willyung Brooks) and a historical campsite and water source located within urban Albany at Point Melville.

Excavation and construction works for the mine site and pipeline could potentially uncover and damage currently unidentified aboriginal sites.

Seven archaeological sites were also recorded within the proposed Southdown mine site footprint during archaeological and ethnographic surveys of the Project footprint in 2005 (Technical Appendix 13.16). These sites will be removed as required prior to mining activities.

All Aboriginal sites are protected and can not be impacted without approval under Section 18 of the *Aboriginal Heritage Act 1972.*

Private Land Owners

The pipeline route will traverse numerous private properties and become a long term underground fixture on these properties. Initial investigations, construction activities and events of pipeline failure or external maintenance may impinge on the privacy and convenience of land owners.

Section 8.20.4 Management

Non-Indigenous Heritage

Should any part of the proposal occur adjacent, behind or across the road from a registered place, the works will be referred to the Heritage Council as a development application under the *Heritage of Western Australia Act 1990*.

Indigenous Heritage

Grange will lodge an application under Section 18 of the *Aboriginal Heritage Act 1972* to remove or interface with Aboriginal sites for the seven rock scatters found at the mine site and for the pipeline footprint which traverses two registered sites and two sites of significance not yet listed on the Aboriginal sites register.

Aboriginal community representatives and elders have been and will continue to be consulted as part of the planning process for mining and construction activities. Heritage management plans will be discussed and agreed upon, and a traditional custodian or monitors will be present during pipeline construction. Any significant sites identified during ethnographic and archaeological surveys or construction will not be removed, damaged or altered without approval under Section 18 of the *Aboriginal Heritage Act 1972.*

Training will be provided to all personnel detailing the importance of avoiding heritage sites and reporting of any suspected heritage sites. Exclusion zones will also be identified and clearly communicated to Project personnel.

Private Land Owners

Concerns raised by land owners will be addressed and resolved as part of securing tenure for the pipeline, with on-going community liaison.

Section 8.20.5 Predicted Outcome

Significant European Heritage will not be removed, damaged or altered by the Albany Iron Ore Project.

Significant sites identified from the Aboriginal Sites register and during ethnographic and archaeological surveys and construction will not be removed, damaged or altered without approval under Section 18 of the *Aboriginal Heritage Act 1972.*

Section 8.20.6 Environmental Management Commitments

Commitment 39: A Community Liaison Officer will be engaged by Grange for the construction phase of the Project. During the operational phase of the Project, Grange will nominate an appropriately competent person who, irrespective of other duties, will be responsible for liaising with the community.

Commitment 40: Prior to ground disturbance activities, approvals relevant to the *Heritage of Western Australia Act 1990* and the *Aboriginal Heritage Act 1972* will be obtained for disturbance to heritage sites.

Commitment 41: Prior to disturbance of sites of indigenous and non-indigenous heritage significance, a Heritage Site Management Plan will be developed in consultation with the appropriate custodians. The plan will set out procedures to protect sites from unplanned disturbance and manage disturbance to sites in a manner that is aligned with traditional values.

Section 8.21 Decommissioning and Rehabilitation

Section 8.21.1 Management Objectives

The objectives for decommissioning and rehabilitation are to:

- Ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.
- Fulfil commitments made to stakeholders and regulators regarding closure outcomes.

Section 8.21.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- AMEC Mine closure Guidelines (AMEC, 2000);
- Strategic Framework for Mine Closure (ANZMECC, 2000);
- Mine Closure Guideline for Minerals Operations in WA. (DoIR ,2000); and
- Mine Void Water Issues in WA (WRC, 2003).

Section 8.21.3 Potential Impacts

Certain environmental values of the area will be impacted as a result of the proposed development due to the construction of mine pits, waste dumps, TSF, pipeline and land reclamation. Most of the impacts will be localised at the mine site and the existing port, with minimal disturbance anticipated from the pipeline.

Section 8.21.4 Management

A conceptual closure plan (*ecologia*, 2006) has been developed to comply with AMEC Mine Closure Guidelines (2000) and ANZMECC Strategic Framework for Mine Closure (2000), to return the mine site to a self-sustaining ecosystem that is consistent as far as possible with the natural surrounding area. All activities will be adequately financed, implemented and monitored to achieve the agreed targets.

Decommissioning will comprise the safe dismantling and removal of infrastructure, the appropriate disposal of waste materials and the impacted areas returned to an array of vegetation types and fauna habitats that reflect the pre-disturbance state as closely as possible. Where the removal of non-visible infrastructure, or features that have been incorporated into the natural landscape may cause more environmental damage than if left *in situ*, then its retention will be discussed with the DEC and DoIR at the time. Unless approval is obtained to do otherwise, the pipeline will be decommissioned on mine closure.

Rehabilitation will occur progressively where possible as disturbed areas are no longer required. Should Grange not undertake further operations upon the completion of mining of the Southdown Magnetite Deposit, all sites impacted by the Project will be rehabilitated. Rehabilitation activities will include:

- Ripping of compacted areas.
- Re-establishment of stable landform with erosion protection for long term stability,
- Replacement of topsoil.
- Spreading of vegetation debris to return organic matter to the area and provide additional seed source.

A Threatened Flora and Conservation Management Plan will be developed, outlining the timing and monitoring of the success of rehabilitation. Rehabilitation will be undertaken with native flora species of local provenance. Rehabilitation will also include efforts to re-establish Priority Flora, and research will be undertaken into the re-establishment of recalcitrant species. Revegetation targets will be set at a density, complexity and diversity of base-line data to replicate remnants vegetation, in consultation with the DEC. The rehabilitation programme will also include development of completion criteria to determine when rehabilitation can be considered self sustaining.

Following rehabilitation, areas will be monitored and treated for weed invasion as seedling establishment of native woody species is significantly reduced in the presence of annual weed species in the south-west of Western Australia (Hobbs, 2001).

Section 8.21.5 Predicted Outcome

Rehabilitation of portions of the TSF, waste dumps and other impacted areas will commence as early as possible in the mining phase.

Mine site infrastructure will be removed at the end of mining and waste dumps and TSF rehabilitation completed to support self-sustaining ecosystems. The majority of the pit will be backfilled with waste and tailings during mining operations (Figure 5.10), with a portion left open as agreed with regulators.

Section 8.21.6 Environmental Management Commitments

Commitment 42: A Conceptual Mine Closure Plan (Technical Appendix 13.19) has been developed in alignment with AMEC Mine Closure Guidelines (2000) and ANZMECC Strategic Framework for Mine Closure (2000). During the life of mine, the plan will be reviewed and updated as required to ensure information remains current.

Commitment 43: Twenty-four months prior to mine closure, a Mine Closure Plan will be finalised in consultation with the DEC and DoIR. The plan will define appropriate closure criteria necessary for the establishment of safe landforms and self sustaining ecosystems, and set out procedures for monitoring in order to meet compliance with the closure criteria.

Section 8.22 Ship Loading

Section 8.22.1 Management Objectives

The objectives for ship loading are to:

- Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards;
- Maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

Section 8.22.2 Applicable Standards and Guidelines

Applicable standards and guidelines include:

- Australian New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC / ARMCANZ, 2000); and
- National Ocean Disposal Guidelines (Commonwealth of Australia, 2002).

Section 8.22.3 Potential Impacts

Increased loading of vessels in Princess Royal Harbour associated with the Southdown Magnetite Proposal may increase the potential for water and sediment contamination through potential spills of oil, grease or hydrocarbons, or spillage of magnetite during ship loading.

Section 8.22.4 Management

Shiploading operations will be subject to pollution prevention requirements under Part V of the Environmental Protection Act 1986. This will be regulated by DEC as part of Grange's permit to construct and license to operate the facility.

Potential contamination associated with spills of oil, grease or hydrocarbons will be managed as part of current port management procedures under the Albany Port Authority Oil Spill Contingency Plan. This plan was developed in collaboration with the Marine Environment Protection Unit in DPI who are the nominated decision making authority for oil spill response in WA.

Potential operational spillages during ship loading in the Port will be mitigated through engineering controls. The ship loader will have enclosed conveyors to capture any spilt material, which will be recovered either by a vacuum system, or by washing down the ship loader in its storm position and capturing the material. The berth will also be constructed with a concrete bunded area on the western most dolphins that is long enough to capture the entire length of the ship loader in its storm position. This will allow waste from the bunded area to be pumped back to a landside holding tank for incorporation into the process; and ensure all water for maintenance, servicing and clean down of the ship loader is contained.

The loading process will be monitored to ensure no significant spillages of magnetite occur.

Section 8.22.5 Predicted Outcome

Shipping operations will be conducted with no adverse environmental impacts.

Section 8.22.6 Environmental Management Commitments

Commitment 44: Shipping operations will comply with APA requirements.

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Section 9 Conclusion

The Grange Southdown Magnetite Proposal will be undertaken in line with the Environmental Protection Authority's Principles of Environmental Protection. The objectives and principles set out in s4A of the *Environmental Protection Act 1986* have been incorporated into project planning and development through:

- The Project has been designed to minimise the environmental footprint through initiatives such as; backfilling of the pit void, selection of pipeline corridor to avoid remnant vegetation and burial of the pipeline.
- Baseline surveys have been undertaken to assess the environmental values of areas that could be impacted by the Project.
- Specialist surveys and modelling to assess the existing project environment and determine potential impacts have been conducted.
- Specific Management Plans will be developed and implemented as part of risk based impact avoidance and management.

Grange has made a range of formal commitments with respect to the Project mine site, pipeline and port infrastructure to show their commitment to constructing and operating in an environmentally responsible manner. The formal commitments will be implemented to the satisfaction of the DEC (Audit Section).

The key environmental issues associated with the development of the mine, pipeline and port infrastructure have been identified as; acid rock drainage, acid sulphate soils, contaminated sites, groundwater, vegetation clearing, impacts to the Priority 1 *Commersonia sp.* Mt Groper (RG Cranfield and D.Kabay 9157), impacts to feeding habitat for Carnaby's Cockatoo and visual impacts of the port infrastructure. Management and mitigation measures have been incorporated into the Project to reduce impacts to as low as reasonably practicable. It is believed that the proposed measures are sufficient to ensure the Project complies with relevant legislation and does not have significant environmental impacts.

Grange is committed to minimising, mitigating and offsetting environmental impacts that cannot practicably avoided. Grange will ensure potential impacts associated with construction and operation of the Southdown Magnetite Proposal will be managed through a range of Environmental Management Plans to be developed for the Project. Grange will consult and comply with relevant authorities to achieve improved environmental standards wherever practicable.

The development of the Southdown Magnetite Proposal will provide a number of significant benefits including:

- Power upgrades to the Albany and Great Southern Region.
- Improved regional community support through local employment opportunities, including meaningful vocational training and employment for local indigenous people.
- Funding to locate and re-establish populations of *Commersonia sp*. Mt Groper (RG Cranfield and D.Kabay 9157).
- Rehabilitation of degraded bushland.
- Acquisition of remnant vegetation for future conservation estate.

Grange's intent to achieve net environmental benefits through its offset package will further contribute to the amount of native vegetation acquired for conservation purposes in the region. Grange believes that the construction and operation of the Southdown Magnetite Proposal will result in net economic, social and environmental benefits to the local and regional community and the State as a whole.

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Section 11 Glossary of Terms and Abbreviations

AHD – Australian Height Datum
ANZECC – Australian and New Zealand Environment and Conservation Council
APA – Albany Port Authority
ARMCANZ – Agricultural and Resource Management Council of Australia and New Zealand
ARRP Act – Agriculture and Related Resources Protection Act, 1976
BF – Blast Furnace
CALM –Department of Conservation and Land Management
CAMBA – Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment
CSIRO –Commonwealth Scientific and Industrial Research Organisation
DEC – Department of Environment and Conservation
DIA – Department of Indigenous Affairs
DEC - Department of Environment and Conservation
DoE – Departmetn of Environment
DoIR – Department of Industry and Resources
DR –Direct Reduction
DRF – Declared Rare Flora
DEH – Department of Environment and Heritage
EIA – Environmental Impact Assessment
EMP – Environmental Management Plan
EPA – Environmental Protection Authority
EPBC Act – Environment Protection and Biodiversity Conservation Act, 1999
GL - gigalitres: 1 x 10^6 m^3
HDD – horizontal directional drilling
HPGR – High Pressure Grinding Roll
ILUA – Indigenous Land Use Agreement
JAMBA – Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment
Mbcm – Million bank cubic metres (volume of consolidated material)
Mlcm – Million loose cubic metres (volume of unconsolidated material)
PER – Public Environmental Review
PDWSA – Public Drinking Water Source Area
Ramsar – The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
RL – Relative Level
ROM – Run of Mine
TDS –Total Dissolved Solids
TEC –Threatened Ecological Community
tph – tonnes per hour
TSF – Tailings Storage Facility

11. GLOSSARY OF TERMS AND ABBREVIATIONS

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Section 12 List of Appendices (Attached Disk)

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Section 13 List of Technical Appendices (Attached Disk)

Technical Appendix 13.1	**Grange Resources Limited Southdown Magnetite Scoping Study for PER (Mine Planning), Golder Associates, 2005.**
Technical Appendix 13.2	**The Geochemical Assessment of Major Rock Types and Proccess Residue for the Southdown Magnetite Deposit Western Australia, Golder Associates, 2005.**
Technical Appendix 13.3	**Technical Memorandum Re: Predictions of Groundwater inflows and Drawdown Estimates, Southdown Iron Ore Feasibility Study, Golder Associates, 2005.**
Technical Appendix 13.4	**Preliminary results of Site-Wide Water Balance; Southdown Magnetite Project, Golder Associates, 2006.**
Technical Appendix 13.5	**Geochemical Characterisation of Process-Tailings Samples [Static-testwork] Implications for Process –Tailings Management, Graeme Campbell and Associates Pty Ltd, 2006.**
Technical Appendix 13.6	**Phase 1 Environmental Site Assessment and Sampling and Analysis Plan – Slurry Pipeline Southdown Magnetite Project Albany, Port Section, URS, 2005.**
Technical Appendix 13.7	**Groundwater Evaluation for Process Water Supplies, Rockwater Proprietary Limited, 2005.**
Technical Appendix 13.8	**Southdown Magnetite Proposal Assessment of the Flora and Vegetation of the Proposed Mine Site and Pipeline Corridor, ecologia Environment, 2006.**
Technical Appendix 13.9	**Southdown Magnetite Proposal Terrestrial Vertebrate Fauna Assessment, ecologia Environment, 2006.**
Technical Appendix 13.10	**Southdown Magnetite Proposal Short Range Endemic Invertebrate Survey Report, ecologia Environment, 2006.**

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Technical Appendix 13.11	**Regional Stygofauna Sampling Programme ; Redmond – King River Area and Proposed Southdown Mine(Phase Three Results and Final Report), Rockwater Proprietary Limited, 2006.**
Technical Appendix 13.12	**Grange Resources Ltd Southdown Magnetite Proposal Preliminary Dust Impact Assessment, Sinclair Knight Merz, 2006.**
Technical Appendix 13.13	**A: Short Technical Report: Noise Assessment of the Proposed Operations at the Southdown Magnetite Project, VIPAC, 2006.** **B: Short Technical Report: Noise Assessment of the Proposed Albany Port Development, VIPAC, 2006.** **C: Short Technical Report: Noise Assessment of the Grange Resources Operations at Albany Port, VIPAC, 2006.**
Technical Appendix 13.14	**Greenhouse Gas Emissions Assessment – Albany Iron Ore Project, Kewan Bond Pty Ltd, 2006.**
Technical Appendix 13.15	**Albany Iron Ore Project Visual Impact Assessment, ecologia Environment, 2006.**
Technical Appendix 13.16	**An Aboriginal Heritage Survey for Grange Resources Limited, and Albany Port Authorities, Southdown Magnetite Project, Great Southern Region, Western Australia, Green Iguana, 2005 and** **Report on an Aboriginal Heritage Survey for Grange Resources Limited, and Albany Port Authorities, Southdown Magnetite Project, Great Southern Region, Western Australia, Greenfeld, Harris and Webb, 2005.**
Technical Appendix 13.17	**Draft Construction Environmental Management Plan, ecologia Environment, 2006.**
Technical Appendix 13.18	**Draft Pipeline Construction and Operation Management Plan, ecologia Environment, 2006.**
Technical Appendix 13.19	**Draft Mine Closure Plan, ecologia Environment, 2006.**

Technical Appendix 13.20 **Draft Environmental Management System, ecologia Environment, 2006.**

Technical Appendix 13.21 **Maps of the Mine Site and Proposed Pipeline Route, with Delineation of Natural versus Plantation Vegetation.**

Technical Appendix 13.22 **Albany Port Authority Oil Spill Contingency Plan**