



North Perth Basin Heavy
Mineral Project

Environmental
Scoping
Assessment

Prepared for:
Image Resources NL

April 2012

● people ● planet ● professional

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Executive Summary

Image Resources NL (Image) has commissioned 360 Environmental Pty Ltd (360 Environmental) to undertake an Environmental Scoping Assessment (the assessment) of the Atlas Tenement area.

The environmental scoping assessment has been undertaken to inform Image's multidisciplinary feasibility study including information on engineering, occupational safety and health, and finances.

The following summarises the findings of the environmental scoping assessment:

- **Zoning:** The northern half of the Site is zoned as rural whilst the southern portion is zoned as Public Purposes. This zoning is to provide for public purpose, such as airports, hospital, schools and public utilities. Re-zoning may be required for this portion of the site.

Further, the Shire of Dandaragan shows the 'Bassendean Sand Special Control Area covers portions of the Site. This special control area has been set to provide protection to the important wetland and groundwater resources found in these areas.

- **Geology and Soils:** The Site is predominantly comprised of pale deep Bassendean sands with minor components of yellow deep sand, gravelly sands, sandy duplexes and wet soils (Department of Agriculture and Food, 2012a).
- **Acid Sulfate Soils:** The Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australian Soil Resource Information System (ASRIS) database indicates an extremely low probability of Acid Sulfate Soils (ASS) occurring within the Site (CSIRO, 2012). Examples of land units that are considered an ASS risk (wetland areas and creeklines/rivers) are however present within the Site and a soil investigation may be required due to the large amounts of proposed excavation.
- **Surface Water:** Two significant watercourses, Mount Jetty and Bibby creeks, are within or near the Site and flow into the Nambung River. The Nambung River flows from east to west into the Nambung National Park. The flow then moves into a cave system before filtering westward through underground channels and discharging into the Indian Ocean (Lowry, 1974; Department of Conservation and Land Management, 1998; NACC 2002).
- **Wetlands:** The Department of Environment and Conservation (DEC's) geomorphic wetland mapping shows the Nambung Wetlands cover a portion of the northern and central extent of the Site. The Nambung Wetlands have not yet been assigned a management category by the DEC.

- **Groundwater:** There is no readily available groundwater mapping information for the Site. However, the Hydrogeological Atlas of Western Australia (DoW, 2012b) indicates the Site is located in an area typified by shallow aquifers.
- **Conservation Areas:** No National Parks, Conservation Reserves, Environmentally Sensitive Areas (ESAs) or wetlands of conservation significance were found to be listed within the Site. The conservation status of the wetlands will need to be assessed.
- **Flora and Vegetation:** The Site lies within an area of the Drummond Botanical Sub District and is mapped by Beard (1979, 1981) as “Banksia low woodland on coastal plain white sand” with “numerous patches of heath in swamps”.

No Declared Rare Flora were recorded during the field survey, however eleven Priority species were recorded within the Site (determinations for two taxa to be confirmed) (360 Environmental, 2012a).

A search of the DEC’s TEC and PEC database found that there were no TECs or PECs recorded within a 10 kilometre radius of the survey area.

A number of Banksia deaths were noted in the *Banksia attenuata* - *Banksia menziesii* low woodlands vegetation unit during the field survey. *Phytophthora cinnamomi* (Dieback) is known to be in the region and it is recommended that a dieback survey by accredited ‘dieback interpreters’ be undertaken to determine if Dieback is present.

- **Fauna:** Three species of conservation significance were recorded on the Site during the 2011 vertebrate field survey and a further 29 may potentially occur on Site based on the results of DEC and EPBC database searches (360 Environmental, 2012b). Targetted survey for the Graceful Sunmoth (GSM) has been undertaken – no GSM were observed however habitat is present. A targeted survey is recommended for Black Cockatoos. Discussions are underway with the Museum of Western Australia regarding the need for surveys for subterranean fauna and terrestrial invertebrates.
- **Contamination:** A search of the DEC’s contaminated Sites database indicates there are no Sites within the investigation areas that are listed as contaminated.

360 Environmental recommend that Image engage with relevant regulatory authorities, including (but not limited to) the Department of Mining, the Environmental Protection Authority (EPA), Department of Sustainability, Environment, Water, Population and Communities (SEWPAC), the DEC and the Department of Water as early as possible in the planning phases of the application. This will facilitate an efficient approvals process by providing comment from these authorities on the necessary environmental investigations.

The following approvals are likely to be required:

- Mining Proposal (Mining Act);

- S38 Referral and PER (Part IV EP Act);
- Works Approval and Licence (Part V EP Act);
- Water abstraction licences (Rights in Water and Irrigation [RIWI] Act); and
- Bed and Banks Permit (RIWI Act).

A risk assessment workshop identified the following key risks associated with the Atlas project:

- Lack of knowledge on hydrology and hydrogeology of the area;
- All activities concerning terrestrial invertebrate fauna and short range endemic fauna (SRE) are currently categorised as 'High', however this is due to the current lack of knowledge of their distribution across the Site rather than their confirmed presence on Site;
- Emission of greenhouse gases (likely under the Carbon Tax cap at present – but this needs to be confirmed);
- No signed agreement between Image and potential Native Title claimants;
- Radiation caused by radioactive minerals – suggest risk assessment and reporting to provide comfort and confidence to regulators and the public;
- Uncertainty surrounding implementation of the 2011 Mine Closure Plan guidelines;
- Insufficient financial provisioning for closure issues can result in delays of relinquishment and approvals; and
- Extreme weather conditions such as droughts and floods are possible and can therefore stifle the rehabilitation process.

A number of environmental investigations are recommended to be undertaken at Atlas. A proposed schedule for these investigations is as follows:

PROGRESS TO DATE	TIMING
<u>Biological</u>	
Level 2 Fauna – Seasonal Phase	Winter 2012
SRE Fauna	Immediate
Subterranean Fauna (Karst)	Immediate
Level 2 Flora and Veg – Seasonal Phase	Winter 2012
Dieback	Immediate
Black Cockatoo (NES)	Spring 2012
Flora and vegetation water use (review)	August 2012
<u>Physiographic</u>	
Geochemistry	Immediate
Materials characterization – production	Immediate
Materials characterization – waste (ASS)	Immediate
Geomorphology	Immediate
Surface Hydrology	Winter 2012
Hydrogeology	Immediate
Hydrological connectivity to Karst	Winter 2012
Air quality	2012

Table of Contents

1	Introduction	3
1.1	Background	3
1.2	Objectives	3
1.3	Scope of Work	3
1.4	Establishing Environmental Opportunities and Constraints	4
1.5	Environmental Approvals.....	4
1.6	Report Format	4
2	Site Description and Preliminary Assessment.....	6
2.1	Site Location	6
2.2	Climate.....	6
2.3	Property and Zoning Information.....	7
2.4	Surrounding Land Use	7
2.5	Topography	7
2.6	Physiography.....	7
2.7	Regional Geology and Soils.....	8
2.8	Acid Sulfate Soils	9
2.9	Surface Water.....	9
2.10	Wetlands	9
2.11	Groundwater	10
2.12	Conservation Areas.....	11
2.13	Flora and Vegetation.....	11
2.14	Fauna	14
2.15	Contamination.....	19
3	Approvals	20
3.1	Environmental Approvals.....	20
3.2	Mining Approvals	21
3.3	Other Approvals and Permits	21
4	Risk Assessment	22
5	Gap Analysis	25
5.1	Fauna Surveys (Level 2 Seasonal phase)	25
5.2	Flora Surveys (Level 2 Seasonal phase)	25
5.3	SRE (Short-range Endemic) Fauna	26
5.4	Subterranean Fauna.....	26
5.5	Matters of National Environmental Significance (NES)	27
5.6	Dieback	27
5.7	Physical Data	27
6	Opportunities and Constraints.....	33
7	Conclusions and Recommendations.....	35
8	Limitations.....	37
9	References	38

List of Tables

Table 1 - Soil profiles across Site.....	8
Table 2 - Likelihood of predicted conservation significant species occurring in Site.....	15
Table 3 – Proposed Schedule of Environmental Investigations	29
Table 4 - Environmental Opportunities and Constraints	33

List of Figures

Figure 1 – Site Location	43
Figure 2 – Regional Location	44
Figure 3 – Surrounding Land Use – Regional Conservation Reserves	45
Figure 4 – Soil Subsystems	46
Figure 5 – Constraints Map	47
Figure 6 – Vegetation Condition	48

List of Appendices

Appendix A - Shire of Dandaragan Local Planning Scheme
Appendix B - Department of Agriculture Soil Data
Appendix C – Risk Assessment Likelihood and Consequences Tables

1 Introduction

1.1 Background

Image Resources NL (Image) has commissioned 360 Environmental Pty Ltd (360 Environmental) to undertake an Environmental Scoping Assessment (the assessment) of the Atlas Tenement area (the Site; Figure 1).

The Atlas Tenement covers approximately 950 hectare (ha) and is proposed to be the first of numerous mineral sands deposits mined as part of the North Perth Basin Project (NPBP).

It is anticipated the environmental approvals for the project will follow the path of a Public Environmental Review (PER), which is a formal assessment under Part IV of the *Environmental Protection Act 1986* (EP Act) of Western Australia. This Environmental Scoping Assessment report has been written to better understand the information gaps that exist and likely additional studies or information required to be collected throughout the approvals process.

1.2 Objectives

The objectives of the environmental scoping assessment are:

- Provide a review of current existing information;
- Identify gaps in information that would be required for progression of formal environmental assessment processes; and
- Provide advice for the environmental approvals required to facilitate development of the Site.

1.3 Scope of Work

The following scope of work was undertaken for this environmental scoping assessment:

- Analysis of existing information;
- Establish opportunities and constraints based on currently available information; and
- Identify the required approvals for the Project, based on current information.

1.4 Establishing Environmental Opportunities and Constraints

The following information has been updated to reflect currently available information for the Site as below:

- Desktop and field (2011) assessment of flora, vegetation and vertebrate fauna;
- Desktop assessment of conservation areas such as Bush Forever Sites, Regional Conservation Parks and Environmentally Sensitive Areas (ESA) and an assessment on the implications these may have on the future development of the Site;
- Desktop review of geology, surface hydrology and groundwater information using databases and digital mapping information;
- Desktop Site assessment of contamination including a search of the Department of Environment and Conservation's (DEC) Contaminated Sites database and a review of historical and current land uses;
- Desktop Acid Sulfate Soils (ASS) assessment including a search of Australian Soil Resource Information System (ASRIS) online mapping;
- Desktop heritage (Aboriginal and non-Aboriginal) assessment of the Site and implications for future development;
- Desktop review of surrounding land uses; and
- Identification of environmental constraints and opportunities associated with the proposed development of the Site.

1.5 Environmental Approvals

The opportunities and constraints identified in this report determine the statutory environmental approvals required for the project. This report:

- Identifies the primary environmental approvals that will be required for the project, as well as key agencies and key contacts for the approval process; and
- Outlines relevant secondary project environmental approvals that may be required.

1.6 Report Format

The remainder of this report comprises the following components:

- Section 2 – Site Description and Preliminary Assessment;
- Section 3 – Environmental Approvals;
- Section 4 – Risk Assessment;

- Section 5 – Gap Analysis;
- Section 6 – Opportunities and Constraints;
- Section 7 - Conclusions and Recommendations;
- Section 7 – Limitations; and
- Section 8 – References.

2 Site Description and Preliminary Assessment

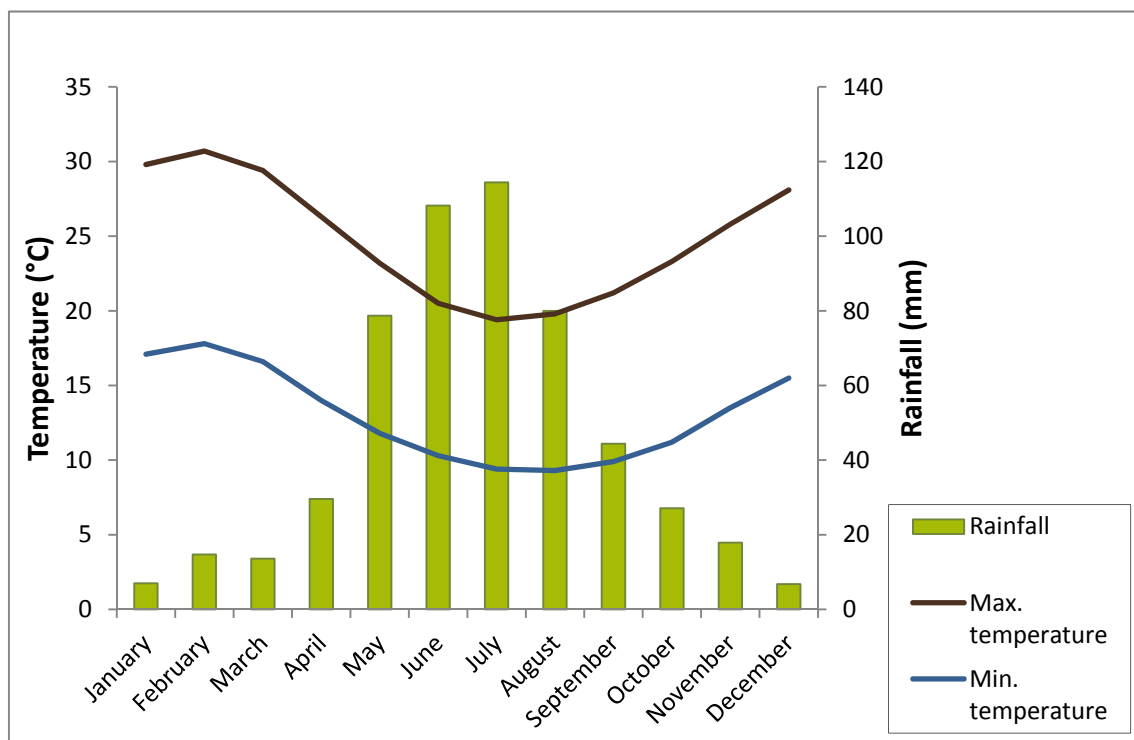
2.1 Site Location

The Site is located approximately 17 km to the east of Cervantes within the Shire of Dandaragan (Figure 1). Cervantes is located approximately 245 km north of Perth.

The Site lies in the Interim Biogeographic Regionalisation of Australia (IBRA) Swan Coastal Plain biogeographic region and the Perth biogeographic subregion (Figure 2).

2.2 Climate

Cervantes is within the Temperate climate zone, characterised by cool winters and warm summers (Bureau of Meteorology [BoM], 2012a). The closest official BoM weather station currently operating is Jurien Bay, where climate data dates back to 1968. The annual average rainfall within the Site is approximately 536.3 mm per annum (based on the average annual rainfall at Jurien Bay, approximately 33 km north-west of the Site) (BoM, 2012b). Recorded climate information is summarised below (Graph 1).



Graph 1: Mean rainfall and temperature for Jurien Bay recorded between 1968 and 2011 (Bureau of Meteorology, 2012b).

2.3 Property and Zoning Information

The Site is located in the Shire of Dandaragan. There is multiple zoning across the Site under the Shire of Dandaragan Local Planning Scheme (Map No.3 of 11) (Appendix A). The northern portion of the Site is zoned as Rural (Department of Planning, 2011). The southern portion of the Site, which is predominantly unvested crown land, is zoned as Public Purpose.

Land zoned as Public Purpose is classed under Local Scheme Reserves under the Local Planning Scheme No 7 (Sc 3.4) and requires planning approval from the Shire of Dandaragan (Department of Planning, 2011) prior to development.

The northern portion of the Site is also located within the Bassendean Sand Special Control Area (Department of Planning, 2011). The Bassendean Sand Special Control Area is a planning area that is considered to have special environmental values due to the deep porous sands and hydrological connectivity to a number of wetlands in the area. Planning approvals are likely to be required for mining activities within this area and any development application will be referred to the Department of Environment and Conservation (DEC) (Department of Planning, 2011).

2.4 Surrounding Land Use

The Site and surrounding areas that are not remnant bushland are predominantly utilised for grazing and agricultural purposes. This greater agricultural area is located between the Badgingarra and Nambung National Parks (Figure 3). Nambung National Park is located approximately 1.5 km to the west of the Site and Badgingarra National Park is located approximately 16.5 km to the north-east of the Site.

2.5 Topography

Topography at the Site is undulating, with elevation ranging between 37 to 48 mAHD, and a marginal overall slope from east to west (Landgate, 2012). The undulating topography is due to the movement of sand, low dune formation and dune system blowouts (Shire of Dandaragan, 2011).

2.6 Physiography

The Site is located within the Swan Coastal Plain geomorphic region. The term Swan Coastal Plain (SCP) has been variously applied to all or parts of the biogeographic coastal plain unit that extends from Dunsborough north to approximately Jurien Bay (Beard 1981; Environment Australia, 2010; Schoknecht et. al., 2004).

The geomorphology of the SCP consists of a series of geomorphological elements which are sub parallel to the present coastline (McArthur and Bettenay, 1960; Churchward and McArthur, 1980). Each of these geomorphic elements has distinctive geology, vegetation, topography and soils.

Within the SCP the Site lies in the Bassendean Dune System (Lowry, 1974). The Bassendean Dune System consists of low dunes with numerous inter dunal swamps or swampy flats underlain by a calcareous hardpan (Lowry, 1974; Beard, 1979). The Bassendean Dune System slopes gently seaward and is drained by small seasonal streams which generally terminate into large swamps or lakes near the coast or, in the case of Nambung River, drains into caves beneath the coastal limestone (Beard, 1979).

2.7 Regional Geology and Soils

The Site is predominantly comprised of pale deep Bassendean sands with minor components of yellow deep sand, gravelly sands, sandy duplexes and wet soils (Department of Agriculture and Food, 2012a).

The Department of Agriculture and Food (DAF) Shared Land Information Platform (2012a) indicates that the Site contains five different subsystem soil profiles (Table 1; Figure 4):

Table 1- Soil profiles across Site

SOIL NAME	SOIL DESCRIPTION
Bassendean 1 Subsystem	Undulating to flat sandplain, with minor low dunes and swampy depressions on unconsolidated sand, aeolian and alluvial in the Coastal plain north of Perth inland from coastal limestone. Pale deep sand dominate; minor areas of yellow deep sand, gravelly sands, sandy duplexes and wet soil. Banksia woodland; heathland or melaleuca scrub in wetter areas.
Bassendean 4 Subsystem	Plain, often poorly drained and with numerous closed depressions on unconsolidated sand, aeolian and alluvial in the Site. Semi-wet soil, grey deep sandy duplex and deep sands, usually pale. Heath of melaleucas with occasional woodland of eucalypts and banksias.
Bassendean 5 Subsystem	Complex pattern of dunes or low sandy rises, poorly drained plains, saline depressions and swamps in the Site. Pale deep sands on rises, semi-wet to wet soils and grey sandy duplexes on flats.
Bassendean 6 Subsystem	Seasonally wet plain and depressions, often saline. Wet or waterlogged soils and grey sandy duplexes; pale deep sands on isolated low rises. Salt tolerant vegetation or salt pans devoid of vegetation.
Bassendean 9 Subsystem	Permanent or semi-permanent swamps on in the Site. Wet soils.

The DAF (2012a) mapping of the area indicates that the soil may be prone to water logging due to the existence of water repellent soils. (Appendix B). The mapping also indicates that the Site has a potentially high risk of wind erosion (Appendix B).

2.8 Acid Sulfate Soils

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australian Soil Resource Information System (ASRIS) database indicates an extremely low probability of Acid Sulfate Soils (ASS) occurring within the Site (CSIRO, 2012).

Examples of land units that are considered an ASS risk (wetland areas and creeklines/rivers) are however present within the Site and a soil investigation may be required due to the large amounts of proposed excavation.

2.9 Surface Water

The Department of Water's (DoW) Geographic Data Atlas (2012a) indicates that the Site is located within the Minyulo sub-catchment of the Nambung/Cataby surface water management area.

Watercourses in this catchment terminate in large swamps or lakes in inter-dunal depressions (NACC, 2002). The surface drainage pattern is towards the west reflecting the general slope of the landscape of the sedimentary basin, however little surface drainage occurs on the coastal belt further west of the Site where there are extensive subsurface flows through limestone caves towards the sea (NACC, 2002).

Two significant watercourses, Mount Jetty Creek and Bibby Creek, are within or adjacent to the Site and flow into the Nambung River. The Nambung River flows from east to west into the Nambung National Park (Figure 5). The flow then moves into a cave system before filtering westward through underground channels and discharging into the Indian Ocean (Lowry, 1974; Department of Conservation and Land Management, 1998; NACC 2002).

2.10 Wetlands

The DEC maps wetlands based on their geomorphic structure and assigns a management category which reflects condition and environmental values. There are three categories wetlands are assigned, 'Conservation Category', 'Resource Enhancement' and 'Multiple Use' depending on their condition and environmental values, with 'Conservation Category' wetlands being those with the highest level of ecological attributes and functions, then 'Resource Enhancement' then 'Multiple Use' (EPA, 2008).

Until specific consultation with the DEC can be undertaken the Environmental Protection Authority's (EPA) draft Guidance Statement No. 33 – Environmental Guidance for Planning and Development (EPA 2008) is the primary document of reference. This document states the following:

The EPA's position is that it is preferable to avoid direct, indirect and cumulative impacts that may adversely affect the environmental values and functions of wetland areas. In all cases where some loss of any wetland value or function is unavoidable, the EPA recommends that compensatory

actions are implemented, with a view to achieving “no net loss of wetland values and functions”.

Guidance Statement 33 (EPA, 2008) states the following about each of the wetland categories:

- Conservation Category Wetlands (CCW)
The EPA urges that all CCW and their buffers are fully protected. Schemes and proposals that are likely to lead to a significant adverse impact on these wetlands are likely to be formally assessed by the EPA;
- Resource Enhancement Wetlands (REW)
The EPA urges that all reasonable measures are taken to minimise the potential impacts on resource enhancement wetlands and their buffers. These wetlands have the potential to be restored to CCW, and rehabilitation is encouraged; and
- Multiple Use Wetlands (MUW)
In the case of MUW, the EPA urges that all reasonable measures are taken to retain the wetland’s hydrological functions (including on-Site water infiltration and flood detention) and, where possible, other wetland functions.

The DEC’s Geomorphic Wetland Mapping was conducted in 2006 in the Cervantes South area. Wetlands in this area were classified using the geomorphic wetland classification system in 2010 but have not yet been assigned management categories (DEC 2012b). The mapping identified the following classification of wetlands, within the greater Nambung Wetlands, as occurring within the Site boundary (Figure 5):

- Dampland- basin, seasonal waterlogging;
- Floodplain- flat, seasonal inundation;
- Lake- basin- permanent inundation;
- Palusplain- flat, seasonal waterlogging; and
- Sumpland- basin, seasonal inundation.

A search using the SEWPAC Protected Matters Search Tool (2012b) indicated that there are no Ramsar wetlands or Directory of Important Wetlands in or within ten kilometres of the Site (SEWPAC, 2012b).

2.11 Groundwater

There is no readily available groundwater mapping information in the region of the Site, however, the Hydrogeological Atlas of Western Australia (DoW, 2012b) indicates the investigation areas are located in an area typified by shallow aquifers.

WIN is the Department's Water Information System and records hydrological and hydrogeological data at sites throughout WA. WIN Sites within or nearby to the Site indicate groundwater is very close to the surface. Examples indicate depth to

groundwater at the southern side of the Site varies between 0-0.5 m below ground level (mbgl) (WIN Site ID: 20007276, at ground level; WIN Site ID: 20007277, at 0.46 mbgl – both soaks) to approximately 5.5 mbgl (WIN Site ID: 8651668, 5.54 m below top of casing (mTOC)). Examples from the northern side of the Site indicate depth to groundwater is also shallow (WIN Site ID: 10332726, 1.23 mTOC - borehole).

The Site is approximately 3.8 km to the east of the Cervantes Water Reserve Public Drinking Water Source Area (PDWSA) and is within the Nambung/Cataby Coastal Tributaries surface water management area (DoW, 2012a). Significant off-Site impacts to the PDWSA should be avoided.

2.12 Conservation Areas

Databases were searched for conservation significant areas such as wetlands, native vegetation, conservation estate and Environmentally Sensitive Areas (ESA). There were no areas of conservation significance found to occur within the boundaries of the Site (Figure 3).

There are no Environmentally Sensitive Areas (ESAs) within the boundary of the Site.

The Nambung National Park is the closest DEC managed conservation area to the Site and lies approximately 1.5 km west of the Site. Significant off-Site impacts to the National Park should be avoided.

The Australian Heritage Database (SEWPAC, 2011a) identified that a large portion of the Site is within the Northern Bassendean Dunes Area which is listed on the Register of the National Estate. This area is classed as 'Natural' due to the area having important conservation values with high species diversity.

2.13 Flora and Vegetation

A single phase Level 2 flora and vegetation survey of the Site was undertaken by 360 Environmental in 2011. The following sections summarise findings from the flora and vegetation report (360 Environmental 2012a).

2.13.1 Flora

A search of Threatened species listed under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) using the online 'protected matters search tool' was undertaken in November 2011 for an area centred on a point in the Site, with a 10 kilometre radius. The search determined the following species may potentially occur on Site:

- *Andersonia gracilis* - Vulnerable;
- *Anigozanthos viridis* subsp. *Terraspectans* - Vulnerable;
- *Macarthuria keigheryi*- Endangered;

- *Patersonia spirifolia* - Endangered;
- *Banksia serratulooides* subsp. *Perissa* - Endangered;
- *Centrolepis caespitosa* - Critically Endangered;
- *Darwinia foetida* - Endangered;
- *Epiblema grandiflorum* var. *cyaneum* - Endangered;
- *Eucalyptus balanites* - Endangered;
- *Eucalyptus impensa* - Endangered;
- *Eucalyptus leprophloia* - Endangered;
- *Grevillea batrachioides* - Endangered; and
- *Hemiandra gardneri* - Endangered.

A search of the DEC rare flora databases (DEFL and WAHERB) was undertaken in November 2011 for an area centred on a point in the Site, with a 10 kilometre radius. DEC records showed that four Threatened taxa and twenty three (23) Priority taxa had been previously recorded within the greater search area. Two of these taxa, *Isopogon panduratus* subsp. *palustris* (P2) and *Schoenus griffinianus* (P3), had been previously recorded within the Site (Figure 5).

No Declared Rare Flora were recorded during the 2011 field survey, however eleven Priority species were recorded within the Site (determinations for two taxa to be confirmed). The eleven Priority taxa recorded were:

- One Priority 1 taxon (*Grevillea thelemanniana* subsp. *Cooljarloo* (B.J. Keighery 28 B));
- Three Priority 2 taxa (*Isopogon panduratus* subsp. *palustris*, *Schoenus badius* and *Stylidium aceratum*);
- Six Priority 3 taxa (*Angianthus micropodioides*, *Conospermum scaposum*, *Hensmania stoniella*, *Melaleuca clavifolia*, *Onychosepalum nodatum* and *Stylidium longitubum*);
- One Priority 4 taxon (*Banksia platycarpa*); and
- *Schoenus griffinianus* (P3) was not recorded during the 2011 survey, however it is listed by DEC as being previously reported from the survey area.

2.13.2 Vegetation Communities

The Site lies within the Drummond Botanical Sub District and is mapped by Beard (1979, 1981) as “*Banksia* low woodland on coastal plain white sand” with “numerous patches of heath in swamps”. Beard (1979) noted that the “heath of the swampy patches varies locally”, with abundant taxa including *Banksia sphaerocarpa*, *Calytrix aurea*, *Calytrix*

flavescens, *Verticordia densiflora* and *Verticordia drummondii*, with *Frankenia* and samphire occurring in salty patches.

The survey (360 Environmental, 2012a) identified and mapped thirteen vegetation units within the remnant bushland across the Site. These vegetation units could be grouped into the following five (5) broad groups:

- Banksia low woodlands on plains and low rises;
- *Banksia telmatiaea-Regelia ciliata* heaths on seasonal damplands;
- Melaleuca shrublands along flowlines and flow areas and on dampland flats;
- Samphire low shrublands; and
- Other vegetation.

The dampland area within the Site is classified as 'Completely Degraded', however the majority of the Site is in 'Excellent to Pristine' condition with low weed cover and a species rich herb layer (Figure 6).

2.13.3 Threatened and Priority Ecological Communities

The Department of Environment and Protection (predecessor to the current DEC) developed a procedure for identifying 'Threatened Ecological Communities' (Department of Environmental Protection 2000b; English and Blythe 1997). Threatened Ecological Communities (TECs) are assigned to one of four categories: 'Presumed Totally Destroyed'; 'Critically Endangered'; 'Endangered' or 'Vulnerable' (Department of Environmental Protection, 2000b). This procedure and its definitions are in current use.

Priority Ecological Communities (PECs) include 'possible threatened ecological communities that do not meet survey criteria or are not adequately defined' (DEC, undated). These are added to the DEC's PEC list under Priorities 1, 2 and 3. Priority 4 status is given to "Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list". Conservation Dependent ecological communities are placed in Priority 5 (DEC, undated).

A search of the DEC's TEC and PEC database found that there were no vegetation-based TECs or PECs recorded within a 10 kilometre radius of the survey area. According to the DEC search the nearest recorded TEC to the Site was approximately 18 km west of the Site and is described as Thetis microbialite TEC: 'Stromatolite community of stratified hypersaline coastal lakes' located at Lake Thetis.

2.13.4 Dieback

A number of Banksia deaths were noted in the *Banksia attenuata-Banksia menziesii* low woodlands vegetation unit during the 2011 field survey. *Phytophthora cinnamomi*

(Dieback) is known to be in the region and it is recommended that a dieback survey by accredited 'dieback interpreters' be undertaken to determine if Dieback is present.

2.13.5 Weeds

A total of forty six (46) non-native species (weeds) were recorded within the Site during the field survey. None are currently listed as Declared weeds (DAF, 2010). The list of non-native species in the survey area is comprehensive (for the bushland area), but not exhaustive.

2.14 Fauna

DEC and SEWPAC desktop database searches identified twenty six (26) bird, five (5) native mammal and one (1) reptile species of conservation significance, under State and/or Commonwealth legislation, as potentially occurring within the Site (DEC, 2012d and SEWPAC, 2012b).

A single phase Level 2 Vertebrate Fauna Survey was commenced by 360 Environmental in spring 2011. Level 2 Vertebrate Fauna Surveys are usually conducted over two seasons. Results of the spring survey conducted in November, 2011 have been documented by 360 Environmental (2012b) and are summarised in this section.

A total of ten (10) survey Sites were established to monitor five (5) broad fauna habitat types. Intensive trapping and passive detection methods were implemented to identify vertebrate fauna species across the survey area. Emphasis was placed on detecting fauna species of conservation significance that may occur within the Site.

During the survey a total of sixty three (63) bird species, fourteen (14) mammal species, twenty two (22) reptile and seven (7) amphibians were recorded within the Site.

The survey confirmed the on-Site presence of one mammal species and two bird species of conservation significance (Figure 5). The species of conservation significance recorded on Site during the survey were:

- Western Brush Wallaby (*Macropus irma*) recorded in *Banksia* woodland within the south of the Site – two sightings;
- Australian Bustard (*Ardeotis australis*) recorded in open samphire within the north-west of the Site – single sighting; and
- Rainbow Bee-eater recorded within the heath habitat – single sighting.

A further 29 may potentially occur on Site based on results of DEC and EPBC database searches. An assessment was conducted to determine the likelihood of each of the predicted conservation significant species that identified during desktop searches (Table 2) occurring within the Site. This involved determining background and habitat preference for each of the fauna species, along with the likelihood of each occurring within the Site (Table 2).

Table 2 - Likelihood of predicted conservation significant species occurring in Site

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Australian Bustard (<i>Ardeotis australis</i>)	IUCN: Near Threatened DEC: Priority 4	Found in grasslands, especially tussock grassland, <i>Triodia</i> hummock grassland, grassy woodland, low shrublands, Spinifex, open dry woodland of mulga, mallee, heath (Pizzey and Knight, 1997; Morcombe, 2003).	Small amounts of this habitat occur within the samphire habitat. Grassland habitat is extensive within the pasture area.	Confirmed One individual Australian Bustard was observed during the survey
Brown Goshawk (<i>Accipiter fasciatus</i>)	EPBC: Migratory marine	Occurs in open forests, woodlands, scrublands and margins, farmlands, parks, and sewage farms (Pizzey and Knight, 1997).	Woodland, Scrublands and farming land occurs within the Site.	Moderate
Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>)	IUCN: Endangered WCA: Schedule 1 EPBC: Vulnerable	Forests, woodlands, heathlands, farms. It feeds on banksias, hakeas, dryandras (often on ground) and also exploits pine plantations (Morcombe, 2003).	No forests occur within the study area. However they may make use of the Woodland or farmland for foraging. No nesting habitat is present.	Moderate May visit Site sporadically
Carpet Python (<i>Morelia spilota subsp. imbricate</i>)	WCA: Schedule 4	This carpet python is found in temperate areas in the south-west of Western Australia. It inhabits semi-arid coastal and inland <i>Banksia</i> woodland, eucalypt woodland and grasslands.	The bottom third of the Project area contains extensive areas of suitable <i>Banksia</i> woodland.	Moderate This species may occur within the Site
Cattle Egret (<i>Ardea ibis</i>)	EPBC: Migratory marine. Migratory wetland	Inhabits paddocks, pastures, croplands, wetlands, tidal mudflats and drains (Pizzey & Knight, 1997). Occurs in tropical and temperate grasslands, woodlands and terrestrial wetlands (SEWPaC, 2011b).	The Site does not contain a significant amount of suitable wetland habitat. This may occur with the pasture habitat to the north	Moderate
Fork-tailed Swift (<i>Apus pacificus</i>)	EPBC: Migratory marine	The Fork-tailed Swift makes use of low to very high airspace over varied habitat, rainforest to semi-desert; most active just ahead of summer storm fronts (Morcombe, 2003).	Due to the species broad habitat preference it is possible the Site contains suitable habitat for the species.	Moderate
Painted Button-quail (<i>Turnix varius</i>)	EPBC: Vulnerable	Occurs in scrublands, open woodlands, heathlands, farm regrowth and mallee woodlands (Pizzey and Knight, 1997).	The Site contains suitable heathlands and open <i>Banksia</i> woodlands.	Moderate May occur in Site

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Rainbow Bee-eater (<i>Merops ornatus</i>)	EPBC: Migratory JAMBA	Occurs in open forests and woodlands, shrublands, sandridges, sandspits, riverbanks, mangroves and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins, 1999).	The species has a broad habitat preference. The Site contains suitable foraging habitat for the species. However it does not contain the preferred open woodland with riverbanks required for nesting.	Confirmed One Rainbow bee-eater was observed during the survey
Red-tailed Black-Cockatoo (<i>Calyptorhynchus banksii</i>)	WCA: Schedule 1 EPBC: Vulnerable	Inhabits tall open forests, woodlands, grasslands, scrublands, floodplains, river margins, wetlands and river red gums on water courses (Pizzey and Knight, 1997).	No forests occur within the study area. However they may make use of the Woodland or farmland for foraging. No nesting habitat is present.	Moderate May visit Site sporadically
Western Brush Wallaby (<i>Macropus irma</i>)	DEC: Priority 4	This species inhabits dry sclerophyll forest and woodland in the south-west of Western Australia, including some mallee areas (Menkhorst & Knight, 2004). The preferred habitat type for this species is open forest or woodland.	The southern third of the Site contains extensive areas of suitable Banksia woodland. However high fox activity in the area it is likely to suppress the population within the area is low due to predation.	Confirmed This species was sighted on two occasions during the survey
Western Corella (<i>Cacatua pastinator</i>)	EPBS: Vulnerable, Migratory marine	Inhabits sheep farming country with remnant native forest, woodland, scrubland and sand plain heath (Pizzey and Knight, 1997).	The Site contains woodland, scrubland and sandplain heath. The Site does not contain any suitable nesting habitat due to the lack of hollows or cropping habitat for foraging.	Moderate May visit Site sporadically
Australasian Gannet (<i>Morus serrator</i>)	EPBC: Migratory marine	This species inhabits oceans and bays (Simpson & Day, 1996)	This habitat does not occur with the study area.	Low
Baudin's Cockatoo (<i>Calyptorhynchus baudinii</i>)	IUCN: Endangered WCA: Schedule 1	Inhabits forests, woodlands, pine plantations and orchids. Occasionally recorded in farmland, and grassland (Pizzey & Knight, 1997; SEWPaC, 2011b).	No forests occur within the study area. However they may make use of the Woodland or farmland for foraging. No nesting habitat is present	Low The Site is in the northern extent of the species range
Black-tailed Godwit (<i>Limosa limosa</i>)	IUCN: Near Threatened WCA: Schedule 3 EPBC: Migratory marine	Inhabits tidal mudflats, estuaries, sandspits, shallow river margins, sewage ponds and inland on large shallow fresh or brackish waters (Pizzey and Knight, 1997).	This habitat does not occur with the study area.	Low
Brush-tailed Bettong, Woylie (<i>Bettongia penicillata subsp.</i>)	IUCN: Critically Endangered WCA: Schedule 1 EPBC: Endangered	This species is restricted to remnant patches of habitat in the south-west of WA. Its main habitats are dry sclerophyll forest with dense understorey (Menkhorst & Knight, 2004). This species makes use of dense	The Site contains some habitat that may be suitable for Woylie. However with the Woylies recent dramatic decline and high fox abundance within the Site it is very	Low

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
<i>ogilbyi</i>)		undergrowth including <i>Gastrolobium</i> thickets, logs and rock-cavities for shelter during the day (SEWPaC, 2011b).	unlikely the species occurs within the Site.	
Buff-banded Rail (<i>Gallirallus philippensis</i>)	EPBC: Endangered	Occurs in fringes of rainforest, swamps, marshes, creeks, wet paddocks, scrubby woodlands, heathland and crops (Pizzey and Knight, 1997).	The Site does not contain any suitable swamp habitat. However there is suitable woodland heathland and crop.	Low
Chuditch, Western Quoll (<i>Dasyurus geoffroii</i>)	IUCN: Near Threatened EPBC: Vulnerable	This species is able to exist in a variety of environments from denser eucalypt forests and open woodlands to sparser, semi-arid and low-lying scrub (Van Dyck & Strahan, 2008). The only remaining habitat suitable for supporting Chuditch numbers is through the cooler south-west corner of the state, in areas with significant concentrations of prey and sufficient logs and hollows for nests (Van Dyck & Strahan, 2008).	The Site contains little suitable habitat, with low numbers of suitable hollows within the Banksia woodland. The species may have previously occurred in the area. However high fox numbers is likely to have eliminated the species from the Site.	Low
Glossy Ibis (<i>Plegadis falcinellus</i>)	WCA: Schedule 3 EPBC: Migratory marine	Occurs in well vegetated wetlands, wet pastures, rice fields, floodwaters, floodplains, brackish wetlands, mangroves and mudflats (Pizzey and Knight, 1997).	The Site does not contain suitable wetlands.	Low
Great Egret, White Egret (<i>Ardea alba</i>)	EPBC: Migratory marine. Migratory wetland	Swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight, 1997).	The Site contains few suitable permanent wetlands.	Low
Hooded Plover (<i>Thinornis rubricollis</i>)	IUCN: Near Threatened EPBC: Migratory marine	Occurs on broad sandy ocean beaches, adjacent dune wilderness, tidal flats, and coastal and inland salt lakes (Pizzey and Knight, 1997).	The Site does not contain any beaches, tidal flats or Inland salt lakes.	Low
Malleefowl (<i>Leipoa ocellata</i>)	IUCN: Vulnerable WCA: Schedule 1 EPBC: Vulnerable	Malleefowl occur within mallee, <i>Acacia</i> , paperbark, sheoak, and other scrubs; eucalypt woodland; coastal heaths; mostly on sand or gravel soils with abundant litter and low scrub (Pizzey and Knight, 1997; Morcombe, 2003).	The Site does contain coastal heaths with sandy soils. However it contain very little of the species preferred habitat of Mallee, <i>Acacia</i> or Eucalypt.	Low
Nankeen Night-Heron (<i>Nycticorax caledonicus</i>)	EPBC: Migratory marine	Inhabits the shallow margins of rivers, wetlands, mangrove-lined estuaries and floodwaters (Pizzey and Knight, 1997).	The Site contains little suitable wetland habitat.	Low

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Peregrine Falcon (<i>Falco peregrinus</i>)	WCA: Schedule 4	Rocky ledges, cliffs, watercourses, open woodland or margins with cleared land (Pizzey and Knight, 1997).	The Site contains patches of suitable foraging habitat. However it does not contain suitable nesting habitat such as rocky ledges, cliffs or large hollows.	Low May visit Site sporadically for foraging
Southern Brown Bandicoot (<i>Isoodon obesulus subsp. fusciventer</i>)	DEC: Priority 5	Southern Brown Bandicoots inhabit heathy forest, heath, and coastal scrub (Menkhorst & Knight, 2004). The southern brown bandicoot often feeds in forest and woodland that is burnt on a regular basis and also in areas of pasture and cropland adjacent to dense cover.	There is suitable heath area within the Site. However without a regular feral predator control program this species is unlikely to occur within the Site	Low
Spotless Crake (<i>Porzana tabuensis</i>)	EPBC: Migratory marine	Occurs in well vegetated freshwater wetlands, reeds, saltmarsh and mangroves (Pizzey and Knight, 1997).	The Site contains few permanent wetlands	Low
Stubble Quail (<i>Coturnix pectoralis</i>)	EPBC: Migratory marine	Inhabits overgrown pastures and grasslands, saltbush, bluebush, Spinifex, weedy margins of wetlands, irrigation channels and roadsides (Pizzey and Knight, 1997).	The Site contains little suitable habitat for the species.	Low
Tammar (<i>Macropus eugenii subsp. derbianus</i>)	DEC: Priority 5	This species inhabits dense coastal heath and scrub, sometimes inhabiting dry sclerophyll forest with dense cover (Menkhorst & Knight, 2004). This species makes use of dense, low vegetation for shelter during the day and open grassy areas for feeding.	There is suitable vegetation within the Site. However without a regular feral predator control program this species is unlikely to occur within the Site.	Low
Western Rosella (<i>Platycercus icterotis</i>)	WCA: Schedule 1	Inhabits open forest, woodland with grassy clearings, trees on watercourses, farmlands, crops and roadsides (Pizzey and Knight, 1997).	The Site does not contain any grassy clearings or crops. It contains a limited amount of suitable habitat.	Low
Whistling Kite (<i>Haliastur sphenurus</i>)	EPBC: Migratory marine	Occurs in open forests and foothills, timbered watercourses, lakes, swamps, tidal inlets, estuaries and mudflats (Pizzey and Knight, 1997).	The Site does not contain suitable habitat for the species.	Low
White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>)	EPBC: Migratory terrestrial	This species occurs mainly around coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs (Pizzey and Knight, 1997). This species is also found around terrestrial wetlands in tropical and temperate regions (SEWPAC, 2011b).	The Site does not contain any suitable habitat for the species.	Low
Wood Sandpiper (<i>Tringa glareola</i>)	WCA: Schedule 3 EPBC: Migratory marine	Occurs in muddy margins of wetlands, tidal mangroves, margins of tidal mudflats, saltmarshes and sewage ponds (Pizzey and Knight, 1997).	The Site does not contain any suitable habitat for the species.	Low

2.15 Contamination

The DEC administers the *Contaminated Sites Act 2003*. All known or suspected contaminated Sites reported to the DEC are classified into one of seven contamination categories. There are no reported contaminated Sites listed on the database within the Site (DEC, 2012c).

3 Approvals

The following approvals are anticipated to be required prior to the commencement of mining activities. Other approvals may also be required and can be confirmed as the scope of the Atlas project is further clarified.

3.1 Environmental Approvals

3.1.1 EP Act Approvals

It is anticipated the environmental approvals for the project will follow the path of a Public Environmental Review (PER), which is a formal assessment under Part IV of the EP Act.

The following approvals under Part V of the EP Act will also likely be required if the Site will be a Prescribed Premise under Part 1 of Schedule 1 of the *Environmental Protection Regulations 1987*:

- Works Approval – Prior to Construction; and
- Licence – Prior to Operation.

3.1.2 EPBC Act Approvals

The flora and vegetation survey at the Site (360 Environmental, 2012a) confirmed the presence of habitat for several species that are protected at the Commonwealth level under the EPBC Act (Black Cockatoos and Graceful Sun Moths [GSM]). The survey also confirmed the presence of the EPBC-listed Rainbow Bee-Eater. SEWPAC typically requires targeted survey work for species under their jurisdiction to elucidate the extent and potential impact to these species. Survey work for GSM was undertaken in March 2012, no individuals were observed. Survey work for Black Cockatoos is likely to be required by SEWPAC. As the Rainbow Bee-Eater is a globally distributed species and the Site does not support prime breeding habitat it is unlikely that further survey work will be required.

If SEWPAC deem the proposal to be a 'controlled action', the preferred method for impact assessment will be via a bilateral assessment between State and Commonwealth to minimise duplication in the approvals process. As the environmental approvals process at the State level has recently changed (EPA, 2010) the previous bilateral agreement between the State and Commonwealth is no longer valid. This does not invalidate the bilateral process, but means that there will need to be an exchange of letters and individual validation of the State process by the Commonwealth rather than the 'automatic' bilateral process under the previous bilateral agreement.

3.2 Mining Approvals

The mine will require an approved Mining Proposal (or multiple, depending on the staging of construction) and an approved Mine Closure Plan. Note that the Mining Proposal will not be approved until the Mine Closure Plan is approved. Mine Closure Plans are required to meet the detail required in DMP (2011). The content required for an approved Mine Closure Plan is much higher than previously required, particularly for mines that will have a short operating life such as Image's operations at the Site.

3.3 Other Approvals and Permits

Approvals and permits may also be required under other State Legislation including:

- *Rights in Water and Irrigation Act 1914* (RIWI Act);
 - 5C Licence - Groundwater abstraction licence and/or licence to take water from surface water sources;
 - 26D Licence – Licence to construct or alter wells;
 - Section 17 Permit – Permit to interference or obstruction of the bed and banks of a watercourse or wetland;
- *Wildlife Conservation Act 1950*:
 - Licence to take Declared Rare Flora; and
 - Licence to take Specially Protected Fauna.

Approvals and re-zoning may also be required with regard to the:

- Bassendean Sand Special Control Area; and
- Public purpose re-zoning.

4 Risk Assessment

A formalised and detailed risk assessment process for the development of the Atlas resource was initiated by 360 Environmental as Image Resources NL progressed through the feasibility analysis, prior to commencing the formal environmental assessment process under Part IV of the EP Act and EPBC Act. The risk assessment process has been based on the principles and methodology outlined in HB 203:2012 – Managing Environmental-Related Risk and AS/NZS ISO 31000:2009 Risk management - Principles and guidelines. The primary aim has been to identify potential environmental consequences to all activities and to assign an appropriate response to reduce environmental risk. As risk assessment is not a one-off process, Image Resources NL will regularly re-assess environmental risks and mitigation strategies throughout the life of the NPBP.

The formal risk assessment process for Atlas began in February 2012 with a risk identification workshop attended by Image Resources NL and 360 Environmental staff involved in the exploration phase, design, environmental impact assessment and/or environmental management of activities for Atlas. The risk workshop attendees were selected to provide technical understanding of the proposed project and /or the environmental setting, and to facilitate the identification of environmental aspects, specific activities or events and their potential consequences.

The workshops included the following topics:

- Project Delivery;
- Air Quality;
- Land;
- Water Quantity and Quality;
- Wetlands and Watercourses;
- Social Issues;
- Amenity;
- Rehabilitation;
- Decommissioning/Closure;
- Fauna; and
- Flora and Vegetation.

In addition to the internal risk workshop, feedback from key stakeholders (DEC, DMP, NGOs) on their view on what the key environmental risks are for the Project will be obtained. This information will be incorporated into the project risk register and risk rankings on an ongoing basis.

Almost 200 activities or events associated with an environmental risk were identified (note that many of these are relatively minor in nature, and/or are readily managed by standard procedures/mitigations). Once the specific activities and events were identified, a qualitative risk analysis ensued with consequences and likelihoods assigned (Likelihood and Consequences Tables - Appendix C). A qualitative analysis was selected rather than a quantitative – primarily because of the difficulty in establishing a justifiable environmental quantification of consequence for some of the more complex impacts. For example, the environmental consequence of contaminating Mount Jetty Creek might have flow on impacts to the Nambung River and therefore on the caves the river flows into – quantifying this risk is not a simple calculation.

This initial assessment progressed under the assumption that typical environmental management controls were successful. Therefore, the calculated risk is the environmental risk of the activity or event after control measures were put in place. If the residual risk was still medium to extreme, additional investigations or management procedures are recommended. Control options, in order of priority, included:

- Avoidance/elimination: e.g. resiting infrastructure to avoid conservation significant flora;
- Substitution: e.g. replacing a more hazardous substance with a less hazardous substance capable of filling the same role;
- Engineering: e.g. install emission filters to minimise the production of greenhouse gases;
- Administrative: e.g. establishing and communicating written procedures; and,
- Separation: e.g. bunding for the storage of chemicals.

Activities and events with a residual risk rating of High included:

- There is currently uncertainty around the hydrology and hydrogeology of the area. Therefore under the precautionary Principle the alteration of flow regimes or hydrology of wetlands or watercourses on Site is considered to be a High risk. This can be ameliorated by undertaking appropriate studies to better understand the water environment and then managing accordingly;
- Disposal of excess dewatering water is a High risk for similar reasons (uncertainty around the hydrology and hydrogeology of the area). This can be ameliorated by undertaking groundwater and drawdown assessments and then revising the dewatering plan or otherwise managing accordingly;
- Lack of a signed agreement between Image and potential Native Title claimants might lead to a delay of mining. Ameliorated by continuing to negotiate until an agreement is put in place;

- Radiation caused by radioactive minerals can potentially result in health impacts for humans and animals but is however classified as a 'Rare' event. This could be ameliorated by stakeholder consultation and a health/ spread assessment;
- Extreme weather conditions such as droughts and floods are possible and can stifle the rehabilitation process. A flexible rehabilitation and closure plan is required together with an understanding of climate predictions for the area;
- Insufficient financial provisioning for closure issues can result in delays for approvals and delays in relinquishment and bond return. Thorough planning and up front consideration of closure costs can minimise this risk;
- An inappropriate and unapproved mine closure plan could delay approvals and therefore delay the start of mining. The mine plan and mine design should consider closure opportunities early rather than late in the feasibility and impact assessment process;
- All activities concerning terrestrial invertebrate fauna and short range endemic fauna (SRE), is categorised as 'High' due to the current lack of knowledge regarding the likelihood of their presence on Site or in the downstream environment; and
- As the Atlas tenement has existing signs of disturbance (e.g. fenceline tracks and altered creek banks) and the mineral sand mining process itself is a disturbing factor, locally restricted vegetation communities might be adversely affected (e.g. the samphire and heath communities). However, by extending the known range of locally restricted communities into the wider area, the consequence category could decrease.

5 Gap Analysis

The Risk Assessment Workshop facilitated the identification of gaps in the existing information/data associated with the Atlas resource (Table 3). This section details the additional information/data required to progress the proposed environmental impact assessment and approvals schedule. In most instances, the information required may need to be obtained through completion of further field investigations. The following sections are summarised in Table 3 at the end of Section 5.

5.1 Fauna Surveys (Level 2 Seasonal phase)

The first phase of the terrestrial fauna surveys were completed in November 2011 and have been reported accordingly, with due consideration given to potential impacts on fauna habitats and threatened species of elevated conservation significance (having specific protection under State or federal legislation). This work was conducted in accordance with the relevant EPA Guidance Statements as far as possible, and the results are considered to have captured the primary issues likely to be associated with impacts to fauna. However, EPA Guidance 56 (2004b) states the preference for baseline surveys to be carried out over two sampling periods (seasonal surveys) to ensure that species that may be characterised by seasonally dependent activity are recorded. In areas considered to be characterised by high biodiversity values, of specific interest due to the availability of habitats/occurrence of fauna species that are otherwise restricted or have suffered declines or in which only limited data is available, the EPA is likely to adhere more strictly to the preferences indicated in their Guidance. The Atlas resource is characterised at least in part, by all of the features listed above and the approval application is consequently likely to benefit from a second seasonal survey phase.

It may be possible to mount a case for the adequacy of the conclusions drawn from the single phase survey (in terms of species recorded) based on a 'risk-of-presence' approach. This would need to be agreed in the Environmental Scoping Document phase of a Public Environmental Review.

5.2 Flora Surveys (Level 2 Seasonal phase)

The initial flora and vegetation surveys completed were conducted in accordance with the relevant EPA Guidance as far as was possible. The surveys yielded comprehensive results that facilitated an adequate assessment of the potential impacts of the project on the flora and vegetation of the area.

Similar to the general guidance provided to terrestrial fauna survey, EPA Guidance Statement 51 (2004a) clearly identifies the need for multiple seasonal survey phases to enable a comprehensive capture of flora species which may flower and be actively growing (and identifiable) in different seasons. The survey completed at Atlas is unlikely to have recorded all species present on the tenement, particularly species that are active

and identifiable in early Spring. It is likely that the EPA will expect a second phase of survey at Atlas. It may be possible to reduce the requirement from a full repeat of the 2011 survey effort to a survey targeted to the species most likely to have been inactive or unidentifiable in the 2011 survey.

5.3 SRE (Short-range Endemic) Fauna

Short-range endemic fauna comprise taxa that occupy small distributions or restricted habitats, and may otherwise be characterised by poor dispersal, limited fecundity and longer life spans. Taxonomic groups that include species currently recognized as short-range endemics are typically invertebrate groups such as trap-door spiders (Mygalomorphae), millipedes (Diplopoda), terrestrial snails (Gastropoda) and pseudoscorpions (Pseudoscorpionida). These fauna, while abundant on the Swan Coastal Plain, are taxonomically poorly understood and it is therefore uncertain whether any short-range endemics may occupy areas such as the Atlas Project area.

One such species, the Graceful Sun Moth (GSM) has been the subject of survey activities at Atlas in accordance with the DEC guidelines for GSM surveys. While suitable habitat plants were located, the species itself was not recorded.

Given the current limitations regarding the taxonomy of many other potential SRE groups, the EPA generally adopts a risk-based assessment to evaluate impacts possibly resulting from project developments across Western Australia. This typically involves searches of available records in the literature and in databases maintained by the Western Australian Museum and other authorities, assessment of the habitats available in the project area and their distribution throughout the local and broader landscape. The propensity for these taxa to inhabit very small areas and their subsequent susceptibility to impacts associated with even small scale developments indicates that the EPA is likely to require their consideration prior to approval can be granted.

5.4 Subterranean Fauna

Subterranean fauna in Western Australia are typically confined to groundwaters and phreatic zones associated with palaeodrainages and karstic systems, such as those found on the Swan Coastal Plain. They often exhibit high levels of endemism and tend to be ecologically specific, with even small changes in the physical values of microhabitats yielding significant changes in habitat suitability for a range of species. This is detailed in EPA Guidance 54 (2003), which identifies proposals that may affect subterranean habitat as those altering the quantity or quality of groundwater or in other ways affect karst environments.

Information relevant to the subterranean fauna of the Swan Coastal Plain Karst systems is limited, although EPA Guidance 54 makes allowance for the impact of this uncertainty on proposal assessments. It is likely that approval of the Atlas project would be dependent upon greater definition of the subterranean habitats and/or faunal

assemblages associated with the karst system downstream of the site on the Nambung River (as a minimum), and demonstration that those environments can be protected from changes in surface hydrology and groundwater quality and quantity that may be associated with development of the site.

5.5 Matters of National Environmental Significance (NES)

Two Matters of National Environmental Significance associated with the Atlas project have been identified as requiring consideration. Surveys for the GSM have demonstrated that while suitable habitat for the species occurs on-site, no individual animals were recorded during surveys. Additionally, no Black Cockatoos have been recorded during the surveys completed, however potential habitat is present on site (e.g. foraging species including Banksia). It should be noted however, that the completed 2011 terrestrial fauna survey was a general fauna survey and therefore not specifically targeted at Black Cockatoos, so their absence from the survey records should not be considered as absence from the area.

Given that the tenement lies within the known distribution of at least one species of Black Cockatoo, it is highly likely that surveys for potential nesting or foraging habitat for Black Cockatoos and an assessment of potential impacts will be required prior to the granting of Federal approval for the Project.

5.6 Dieback

Phytophthora dieback was first recognized as a disease affecting large areas of native bushland in Western Australia in the 1920s. Since the 1990s DEC has developed and maintained a working group that provides for the ongoing monitoring and management of *Phytophthora* in native bushland across the state. Access to native bushland areas known and susceptible to the proliferation of dieback is strictly controlled and managed to prevent the spread of the disease.

Current data does not indicate whether *Phytophthora* occurs on the Atlas tenement or not, although at least one occurrence has been documented to the east. Additionally, numerous trees across the project area exhibited signs of ill health during the flora and vegetation survey completed in November 2011, and it is possible that these signs were a result of infection with the fungus. It is therefore prudent to undertake a survey for *Phytophthora dieback* to be completed prior to development to ensure that the appropriate management measures are in place prior to mining and construction activities.

5.7 Physical Data

A range of additional physical data is required to facilitate the environmental impacts of the project to be adequately assessed. Data sets ranging in size from regional to

hydrological catchment spatial scales are available in the publicly available literature including research papers, management plans and government department reports. However while these provide a guide to the physical conditions that might be encountered on site, they do not provide sufficient detail at a site-based spatial scale to adequately assess the impacts that may arise from their disturbance or to inform the management and rehabilitation measures that will need to be implemented to address these impacts.

The data required in this respect may include, but will not necessarily be limited to:

- The potential for currently buried sediments/substrates to form Acid Sulfate Soils on exposure to air;
- Geochemical investigations to facilitate assessment of substrate sodicity, salinity and metaliferous content, and production and waste materials characterisation;
- Geomorphological investigations to inform the possibility of underlying subterranean fauna habitats, aquifers and hydrogeological features;
- Surface hydrological studies to inform Wetland Function and Value assessments;
- Investigation of hydrological and/or geological connectivity to the karst environments to the west; and
- Air quality surveys to inform local impact mitigation during operations.

Table 3 – Proposed Schedule of Environmental Investigations

PROGRESS TO DATE	CURRENT PROGRESS / STATE OF KNOWLEDGE	INFORMATION REQUIRED	PREFERRED TIMING
Completed Studies and Investigations			
Level 2 Fauna – Single Phase (360 Environmental)	Completed	Seasonal /2 nd Phase (to meet EPA Guidance)	November 2011
Level 2 Flora and Veg – Single Phase (360 Environmental)	Completed	Seasonal /2 nd Phase (to meet EPA Guidance)	November 2011
GSM (NES)	Field survey completed Reporting is in progress		Autumn 2012 (survey) Reporting due mid-May 2012
Proposed Studies and Investigations -			
<u>Biological</u> Level 2 Fauna – Second Phase	Single-phase has been completed	Second survey is required to meet EPA Guidance, can attempt to mount a case in the ESD that current results	Winter/ early Spring 2012

PROGRESS TO DATE	CURRENT PROGRESS / STATE OF KNOWLEDGE	INFORMATION REQUIRED	PREFERRED TIMING
		are adequate.	
SRE Fauna	No (to little) local information, no regional context	Required to meet EPA Guidance. Review of current knowledge and habitat assessment, pilot survey of approximately 3 days duration (possibly leading to further work)	As soon as possible to understand risk
Subterranean Fauna (Karst)	No (to little) local information, no regional context	Required to meet EPA Guidance Review of current knowledge and downstream habitat assessment, pilot survey of approximately 3 days duration (possibly leading to further work)	As soon as possible to understand risk
Level 2 Flora and Veg – Second Phase	Single-phase survey	Required to meet EPA Guidance Required for non-perennial species / communities. May be able to reduce scope from a full repeat of the first phase to a targeted search for specific species.	Winter/ early Spring 2012
Dieback	Local data available	Site-specific survey	As soon as possible to understand risk

PROGRESS TO DATE	CURRENT PROGRESS / STATE OF KNOWLEDGE	INFORMATION REQUIRED	PREFERRED TIMING
Black Cockatoo (NES)	Regional data available	Site-specific required to meet Federal (EPBC) requirements	As soon as possible to understand risk
Rehabilitation Review	Tiwest (Cooljarloo), Iluka (Eneabba)		As soon as possible to inform rehabilitation planning and the impact assessment
Flora and Vegetation nutrient and water use	Being studied independently of Image (UWA)	Review of UWA work and assessment for inclusion in rehabilitation planning and consideration of groundwater dependent ecosystems (root depth)	August 2012
<u>Physiographic</u>			
Geochemistry	Regional data available	Site-specific required (PSD, conductivity, sodicity, salinity, acidity)	As soon as possible to understand risk
Materials characterization – production	Tiwest, Iluka	Volumes, differential handling and replacement etc.	As soon as possible to understand risk

PROGRESS TO DATE	CURRENT PROGRESS / STATE OF KNOWLEDGE	INFORMATION REQUIRED	PREFERRED TIMING
Materials characterization – waste (ASS)	Tiwest, Iluka	Volumes, differential handling and replacement etc.	As soon as possible to understand risk
Geomorphology	Regional data available,	Site specific for backfilling of pits. Karst locality	As soon as possible to understand risk
Surface Hydrology – Site	Regional data available	Site specific for seasonal values / characteristics, wetland classification	Winter 2012
Hydrogeology	Regional data available	Quality, Quantity (+ changes), drawdown predictions	As soon as possible to understand risk
Hydrological connectivity to Karst	Trace survey (and regional data)	Site specific may be required (dependent on Karst ecology)	Winter 2012
Air quality	Unknown	Site-specific baseline required	As soon as possible to understand risk

6 Opportunities and Constraints

Table 4 summarises the potential environmental opportunities and constraints associated with the development of the Atlas resource.

Table 4 - Environmental Opportunities and Constraints

ASPECT	CONSTRAINTS	OPPORTUNITIES
Zoning	<p>Land zoned as Public Purpose in the southern portion of the lot is likely to require specific planning approval from the Shire of Dandaragan prior to development.</p> <p>Planning approvals, from the Department of Planning, are likely to be required for mining activities within the “Bassendean Special Control Area” across the northern portion of the site. The development application is likely to be referred to the Department of Environment and Conservation (DEC).</p>	<p>Opportunity to undertake early stakeholder management with DEC, Department of Planning and the Shire, to minimise risk of delays to the project schedule.</p>
Geology and Soils	<p>Project activities may increase chance of flooding or broad-scale erosion impacts due to the soil characteristics on site. Comprehensive management measures are likely to be required to be documented to accompany approvals applications.</p>	<p>Potential to develop and implement new techniques for dealing with soils of this nature for future projects.</p>
Acid Sulfate Soils	<p>While the CSIRO ASRIS database indicates an extremely low probability of Acid Sulfate Soils (ASS) occurring within the Site a soil</p>	

	<p>investigation may be required due to the large amounts of proposed excavation and the presences of wetland areas and watercourses within the Site.</p>	
<p>Downstream Receptors – Surface Water and Groundwater</p>	<p>Comprehensive management measures are likely to be required to be documented and put in place to ensure no indirect downstream impacts to the Nambung River, Nambung National Park and the Nambung karst system.</p>	<p>Opportunity exists to contribute to the scientific knowledge of the downstream environment (Nambung karst system).</p>
<p>Wetlands</p>	<p>The Nambung wetlands were classified using the geomorphic wetland classification system in 2010 by DEC but have not been yet been assigned management categories.</p>	<p>Potential exists for Image to drive classification of the wetlands rather than accept DEC's likely default status of conservation category.</p>

7 Conclusions and Recommendations

The purpose of this assessment was to describe the current information available for the Site and identify information still required to progress the approvals process.

The key factors that may require further consideration, identified from the desktop analysis include:

- **Zoning:** The northern half of the Site is zoned as rural whilst the southern portion is zoned as Public Purposes. Further, the Shire of Dandaragan shows the “Bassendean Sand Special Control Area” covers portions of the Site. This special control area has been set to provide protection to the important wetland and groundwater resources found in these areas.
- **Surface Water:** Two significant watercourses, Mount Jetty and Bibby creek, are within the tenement and flow into the Nambung River. The Nambung River flows from east to west into the Nambung National Park. The flow then moves into a cave system before filtering westward through underground channels and discharging into the Indian Ocean (Lowry, 1974; CALM, 1998; NACC 2002).
- **Wetlands:** The DEC’s geomorphic wetland mapping shows the Nambung Wetlands cover a portion of the northern and central extent of the Site. The Nambung Wetlands have not yet been assigned a management category.
- **Groundwater:** There is no readily available groundwater mapping information in the region of the investigation area, however, the Hydrogeological Atlas of Western Australia (DoW, 2012b) indicates the investigation areas are located in an area typified by shallow aquifers.
- **Downstream Impacts:** No National Parks, Conservation Reserves, ESAs or conservation significant wetlands were found to be listed within the Site. Two significant watercourses, Mount Jetty and Bibby creek, are within the Site and flow into the Nambung River which flows into the adjacent Nambung National Park. Potential downstream impacts will need to be considered.

There are both potential constraints and opportunities associated with these key factors.

A risk assessment workshop identified the following key risks associated with the Atlas project:

- Lack of knowledge on hydrology and hydrogeology of the area:
 - disposal of excess dewatering water;
 - Alteration of flow regimes or hydrology of wetlands or watercourses on the tenement and off the tenement;

- All activities concerning terrestrial invertebrate fauna and short range endemic fauna (SRE), is categorised as 'High' due to the current lack of knowledge around their presence on the tenement;
- Emission of greenhouse gases (likely under the cap at present – but this needs to be confirmed);
- No signed agreement between Image and potential Native Title claimants ;
- Radiation caused by radioactive minerals – suggest health assessment and stakeholder engagement to provide comfort to regulators and the public;
- Uncertainty surrounding implementation of the DMP's (2011) Mine Closure Plan guidelines;
- Insufficient financial provisioning for closure issues can result in delays of relinquishment and approvals; and
- Extreme weather conditions such as droughts and floods are possible and can therefore stifle the rehabilitation process.

Further investigations are anticipated to be required for inclusion in approvals submission documentation. A proposed schedule of the investigations already completed and those recommended to be undertaken is identified in Table 3.

It is considered necessary to commence the additional investigations as early as possible. To adequately plan, implement and obtain results, some of the investigation timeframes span 12 months. Undertaking initial consultations with the relevant regulatory authorities and management of the timing of the initial investigations will ensure efficient project scheduling is maintained.

The following approvals are likely to be the minimum that is required:

- Planning approval;
- Mining (Mining Act);
- S38 Referral and PER (Part IV EP Act);
- Works Approval and Licence (Part V EP Act);
- Licence to disturb protected flora or fauna (WC Act);
- Water abstraction licences (RIWI Act); and
- Bed and Banks Permit (RIWI Act).

8 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the Site that is the subject of this report. However, due to the characteristics of the Site, including natural variations in Site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole Site at all points.

It is important to recognise that Site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the Site may be necessary.

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9 References

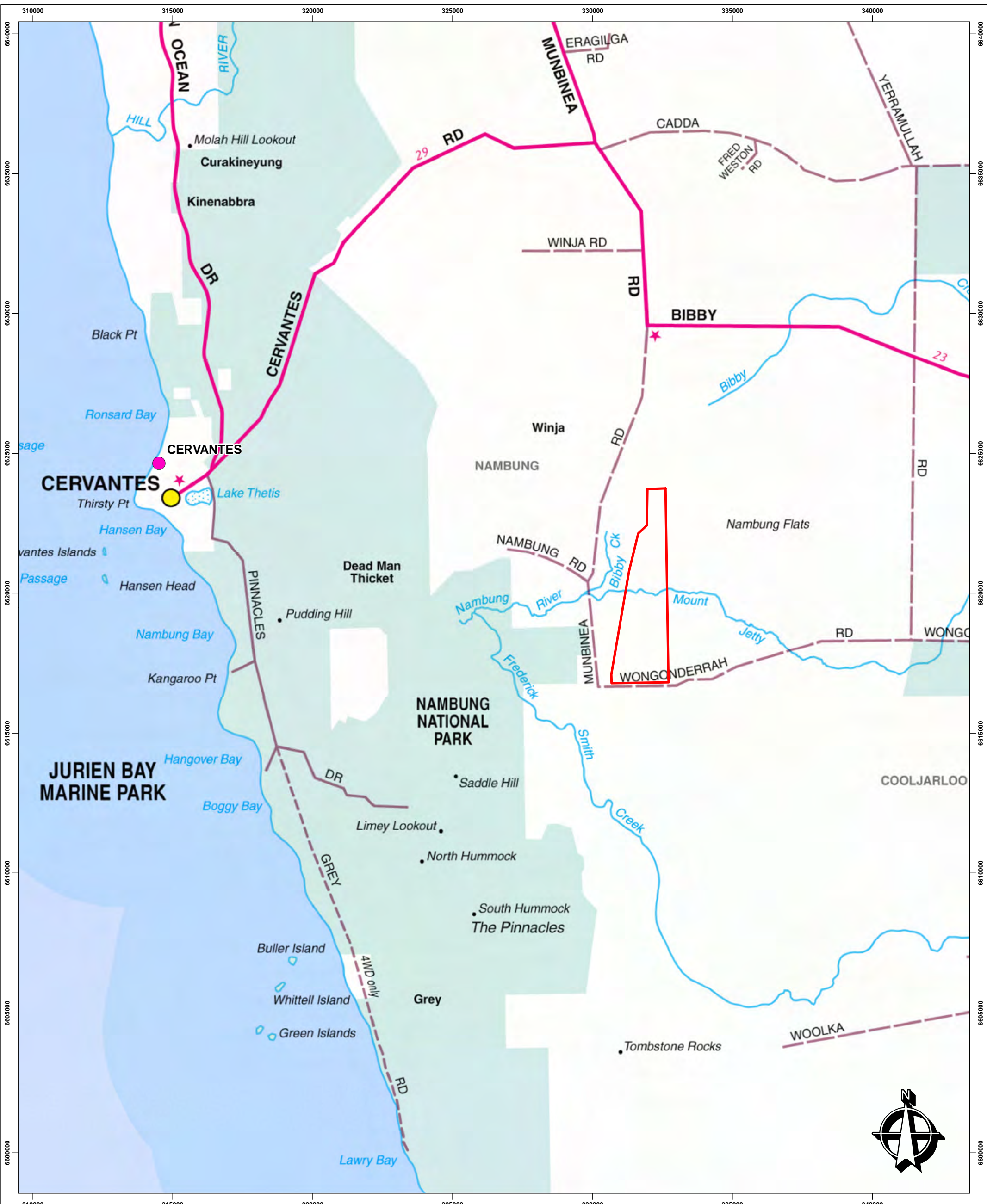
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FIGURES



Legend
 Site Boundary

1 centimeter = 1,250 meters

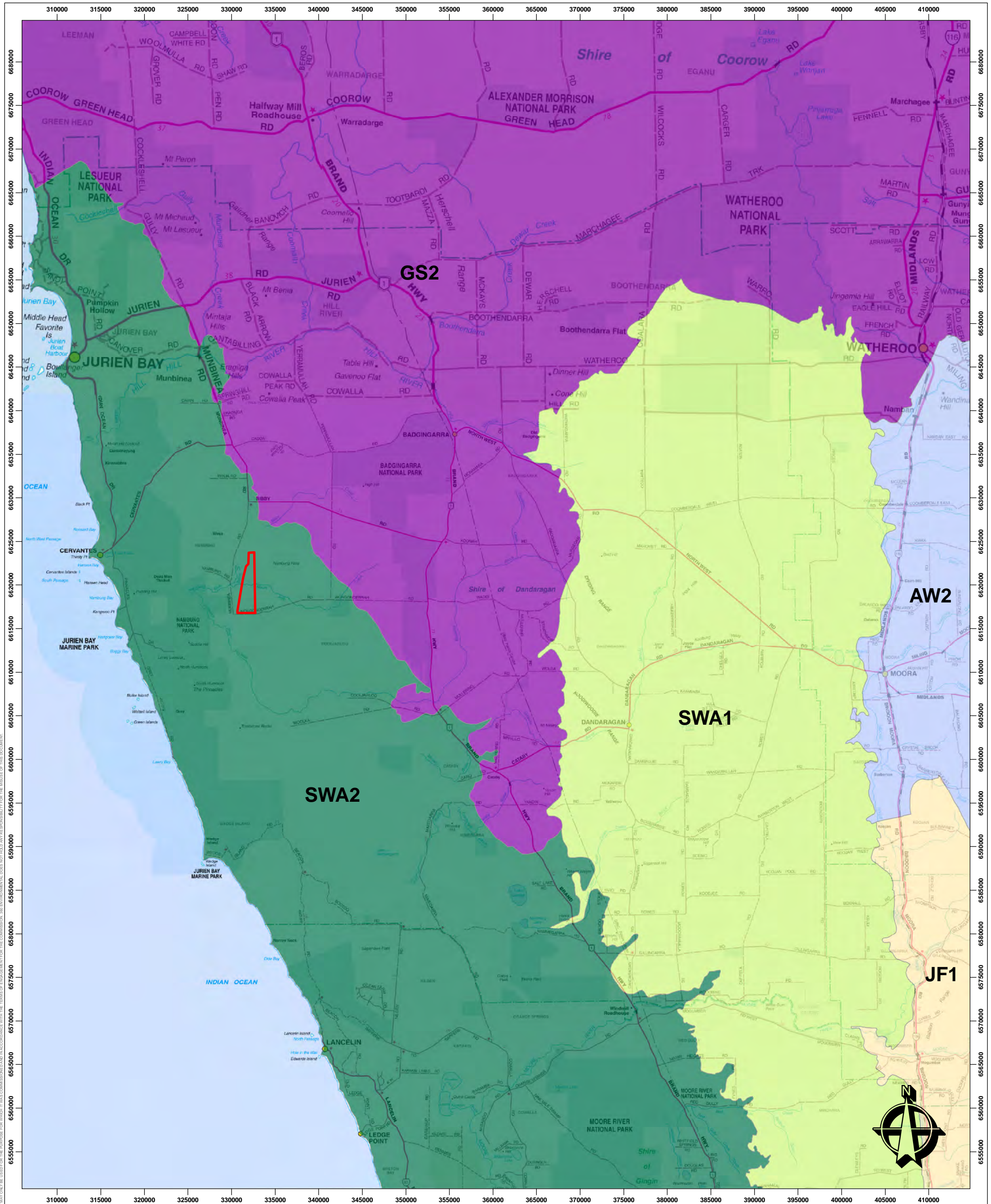
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 - TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2007



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Atlas Mineral Sands Mine Site
Environmental Scoping Assessment
Cervantes

Regional Site Location
Figure 1



Legend

- Site Boundary
- IBRA Subregion
- Subregion Name - Region Name
 - Avon Wheatbelt P2 - Avon Wheatbelt
 - Dandarragan Plateau - Swan Coastal Plain
 - Leseur Sandplain - Geraldton Sandplains
 - Northern Jarrah Forest - Jarrah Forest
 - Perth - Swan Coastal Plain

1 centimeter = 4,000 meters

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
 - IBRA SUBREGIONS SOURCED FROM D.O.E. 2008
 - LOCALITY MAP SOURCED FROM LANDGATE 2006



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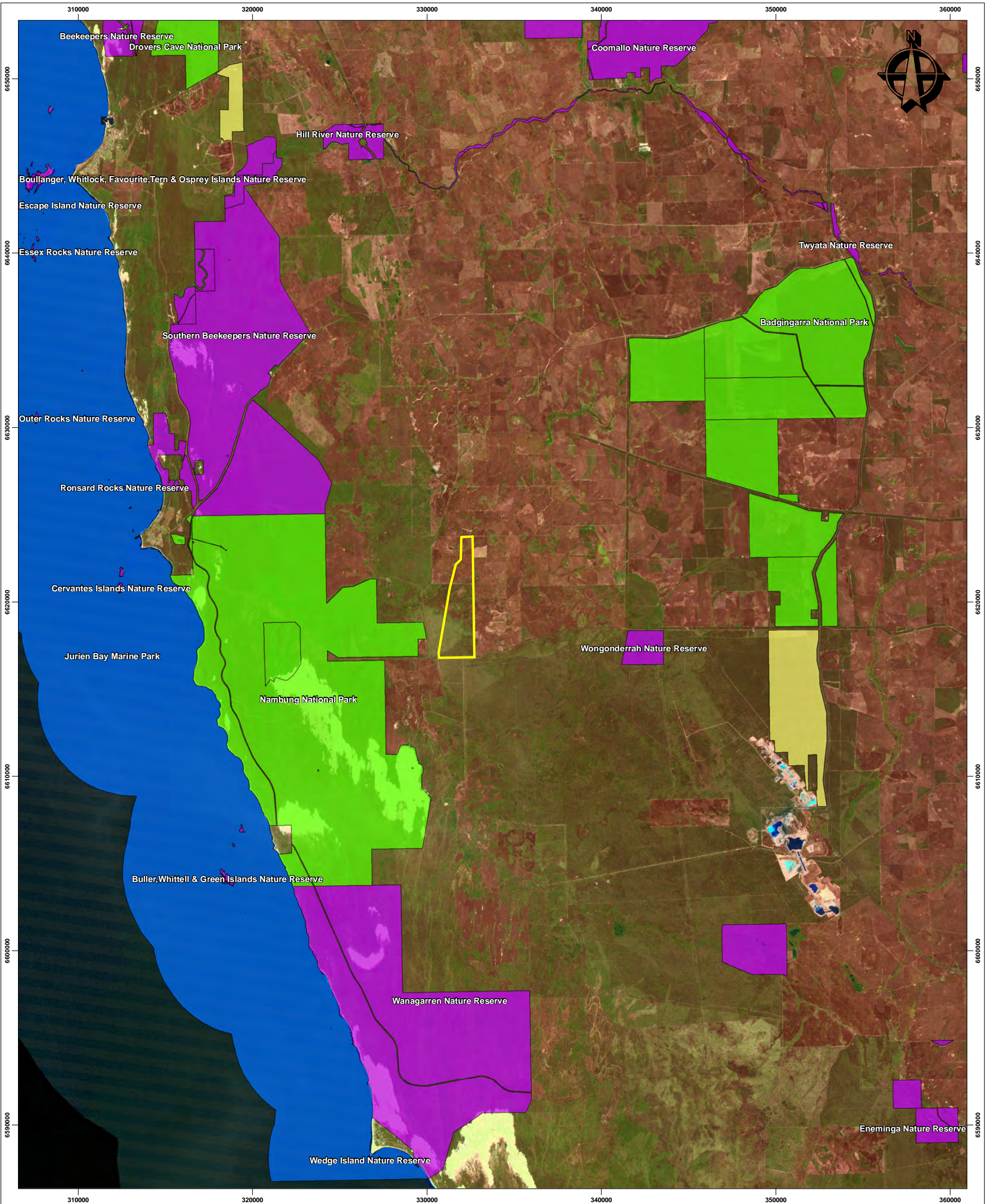
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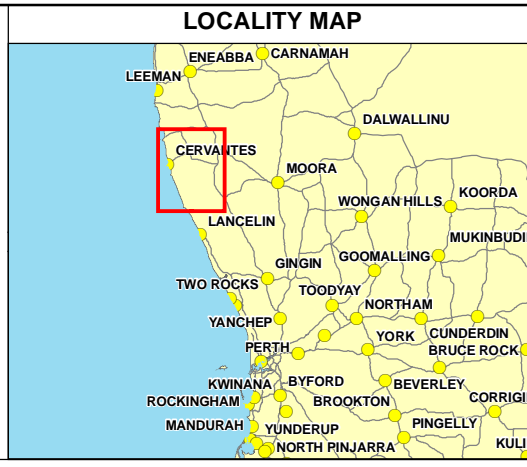
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Environmental Scoping Assessment
Cervantes

IBRA Subregions
Figure 2



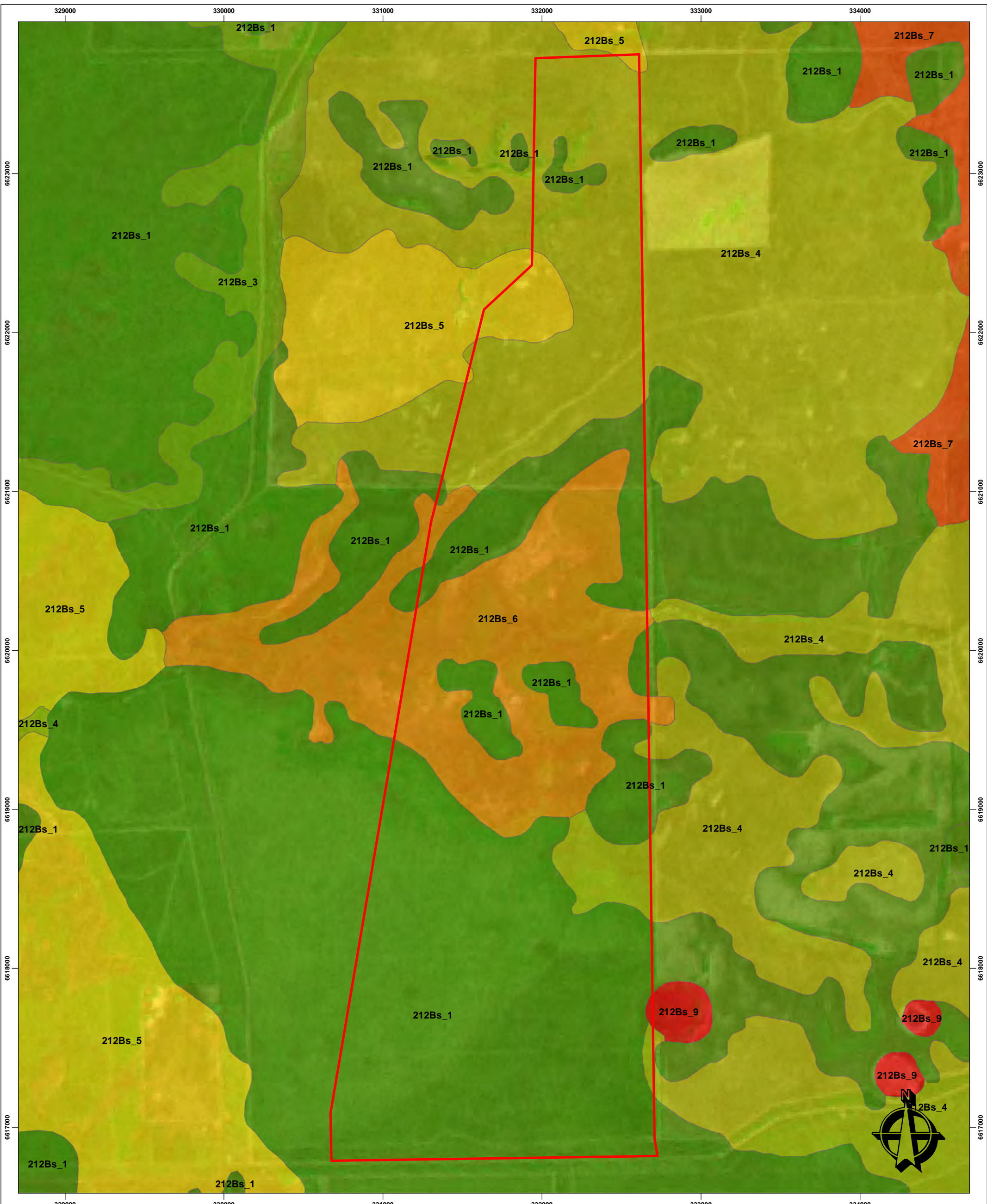
- Legend**
- Site Boundary
 - Conservation Reserves**
 - Conservation Park
 - Marine Park
 - National Park
 - Nature Reserve



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National Parks & Nature Reserves Figure 3			

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
 - AERIAL IMAGERY SOURCED FROM GOOGLE EARTH 2011
 - LOCALITY MAP SOURCED FROM LANDGATE 2006
 - CONSERVATION RESERVES SOURCED FROM DEC 2009

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Legend

Site Boundary

Soil Name

- Bassendean 1 Subsystem (212Bs_1)
- Bassendean 3 Subsystem (212Bs_3)
- Bassendean 4 Subsystem (212Bs_4)
- Bassendean 5 Subsystem (212Bs_5)
- Bassendean 6 Subsystem (212Bs_6)
- Bassendean 7 Subsystem (212Bs_7)
- Bassendean 9 Subsystem (212Bs_9)

1 centimeter = 220 meters

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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 - SOIL TYPES SOURCED FROM DAFWA2007

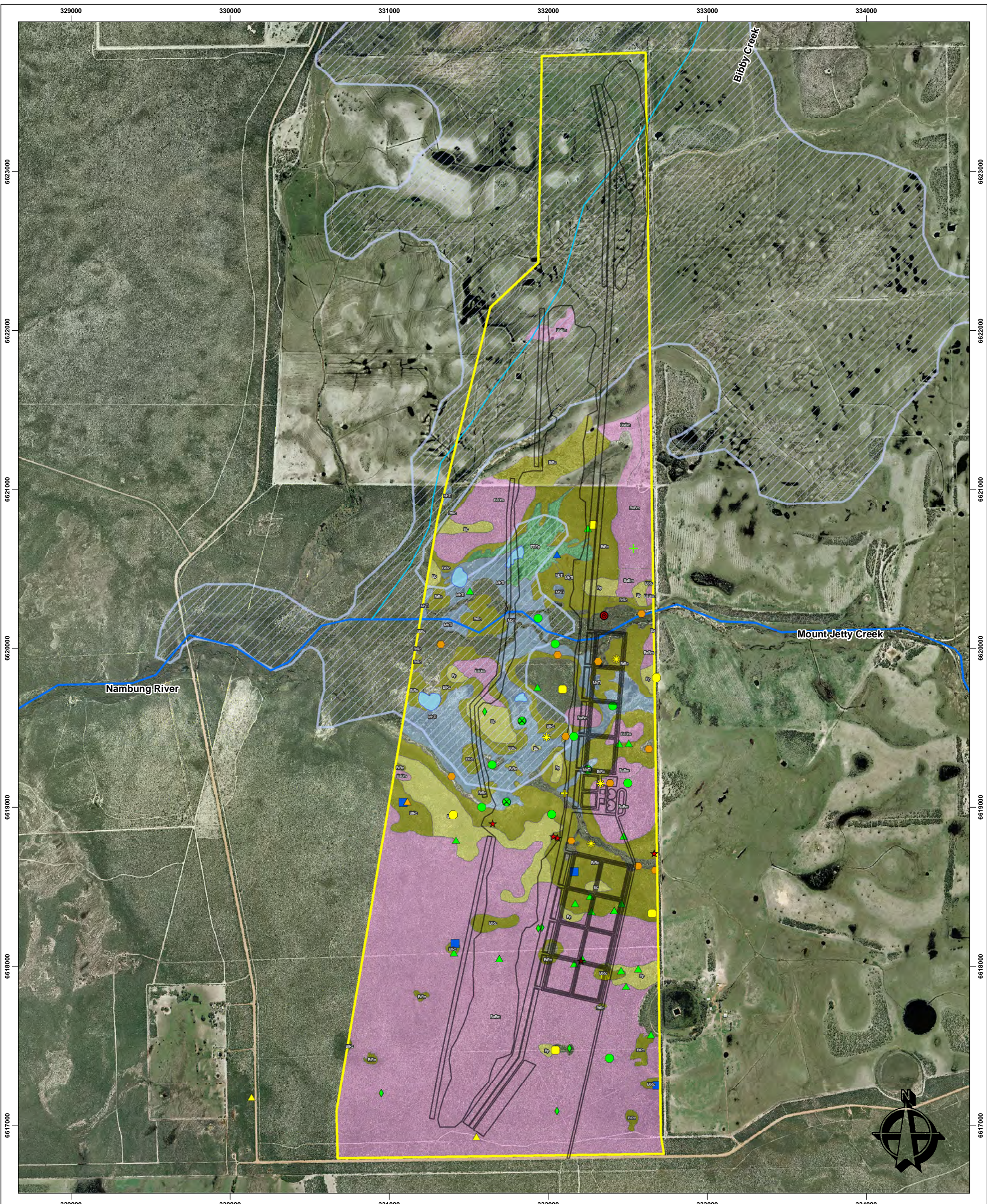


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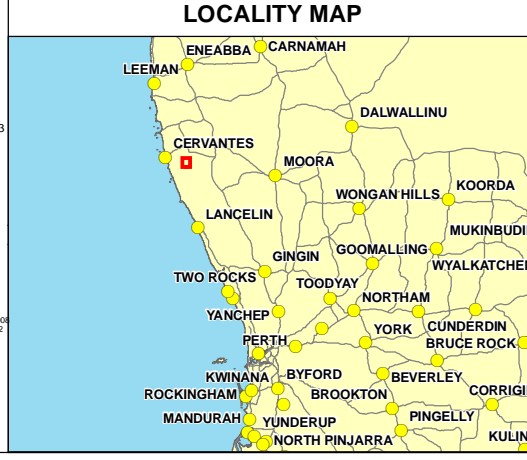
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Soil Subsystems
Figure 4



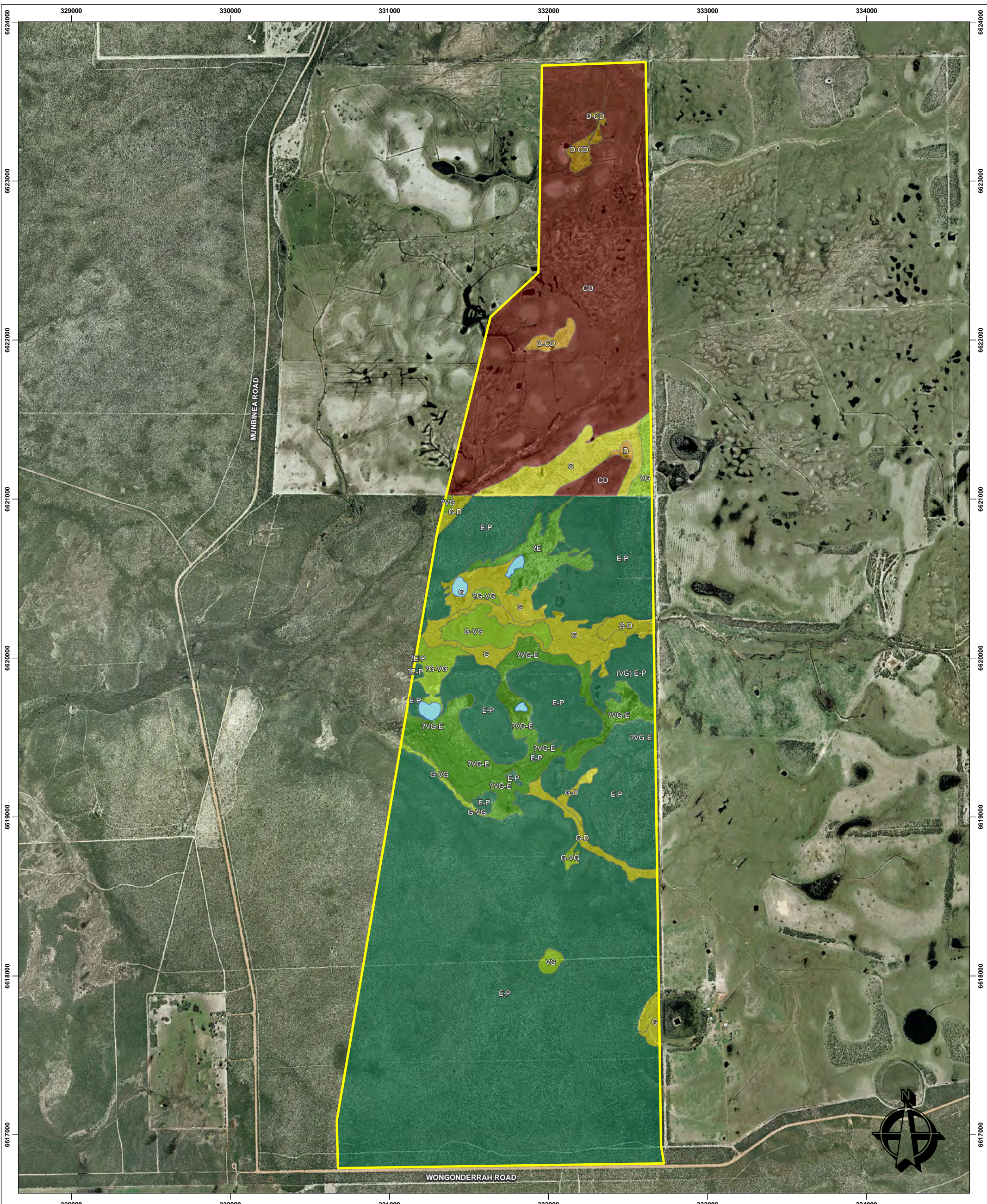
Legend

Site Boundary	Conservation Significant Fauna	Rare Flora	<i>Hensmania stoniella</i> , P3
Atlas Mine Concept Design	Species Name	Name, Status	<i>Melaleuca clavifolia</i> , P3
Nambung Wetlands	Australian Bustard	<i>Grevillea thelemanniana</i> subsp. <i>coojaroo</i> (B.J. Keighery 28 B), P1	<i>Onychosepalum nodatum</i> , P3
Seasonal Waterbody	Rainbow Bee-eater	<i>Isopogon panduratus</i> subsp. <i>palustris</i> , P2	<i>Stylidium longitubum</i> , P3
hydrography_linear_hierarchy	Western Brush Wallaby	<i>Schoenus badius</i> , P2	<i>Banksia platycarpa</i> , P4
LEVEL_EST		<i>Stylidium aceratum</i> , P2	<i>Levenhookia preissii</i> , RS
Significant Stream		<i>Angianthus micropodioides</i> , P3	<i>Microtis albovindis</i> , RS
Major Tributary		<i>Conospermum scaposum</i> , P3	
Vegetation Units			
BtRc - <i>Banksia telmatiaea-Regelia ciliata</i> heaths on seasonal damplands			
BaBm - <i>Banksia</i> low woodlands on plains and low rises (<i>Banksia attenuata</i> , <i>Banksia menziesii</i>)			
Bp - <i>Banksia</i> low woodlands on plains and low rises (<i>Banksia prionotes</i>)			
MbTi - <i>Samphire</i> low shrublands (<i>Melaleuca brevifolia</i> scattered shrubs) over <i>Tecticornia indica</i> subsp. <i>bidens</i> , (<i>Lawrenzia squamata</i>)			
TTIFp - <i>Samphire</i> low shrublands (<i>Tecticornia ?syncarpa</i> , <i>Frankenia pauciflora</i> , <i>Tecticornia indica</i> subsp. <i>bidens</i>)			



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HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
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<p>Image Resources Pty. Ltd. Atlas Mineral Sands Mine Site Environmental Scoping Assessment Cervantes</p> <p>Constraints Map Figure 5</p>			

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Legend

Vegetation Condition

- P - Pristine
- E - Excellent
- VG - Very Good
- G - Good
- D - Degraded
- CD - Completely Degraded

Site Boundary

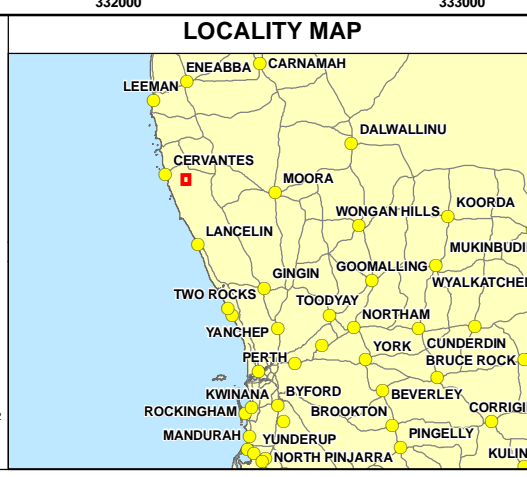
Seasonal Waterbody

NB: ranges of vegetation condition (e.g. 'G-VG') indicates the vegetation condition in that area varies between the indicated classes.

vegetation conditions that have some uncertainty as to what condition they may be are indicated with a ? (e.g. ?E-P).

1 centimetre = 220 meters

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
 - RARE/PRIORITY FLORA DATA SOURCED FROM D.E.C. 2011
 - LOCALITY MAP SOURCED FROM LANDGATE 2006
 - WATER BODIES & VEGETATION CONDITION SOURCED FROM B.MORGAN 2012



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0 125 250 500 750 1,000 Metres

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HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
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Cervantes

Vegetation Condition
Figure 6

360
 environmental

K:\Projects\1.0 EBS\1.33 Cervantes_L2 Flora_L2 Fauna\Figures\Flora

APPENDIX A

Shire of Dandaragan Local Planning Scheme

APPENDIX B

Department of Agriculture Soil Data

APPENDIX C

Risk Assessment Likelihood and Consequences Tables