CAZALY RESOURCES LIMITED

PARKER RANGE IRON ORE PROJECT

MT CAUDAN DEPOSIT

PUBLIC ENVIRONMENTAL REVIEW
RESPONSE TO PUBLIC SUBMISSIONS

June 2011

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This report also includes contributions provided by a range of supporting consultants including (in alphabetical order) Botanica Consulting, Ecotech Pty Ltd, Keith Lindbeck And Associates, Greenbase Pty Ltd, Herring Storer Acoustics Pty Ltd, HWE Mining Pty Ltd, Independent Metallurgical Operations Pty Ltd, Rockwater Pty Ltd and Runge Limited. The assistance and contributions of these supporting consultants is acknowledged and appreciated.

PARKER RANGE (MT CAUDAN) IRON ORE PROJECT
RESPONSE TO PUBLIC SUBMISSIONS
TABLE OF CONTENTS

1.0	**DEFINITIONS AND ABBREVIATIONS**		**1**
	1.1	Definitions	1
	1.2	Abbreviations	1
2.0	**INTRODUCTION**		**3**
	2.1	Purpose of the Document	3
	2.2	Public Review Period	3
	2.3	Advertising of Public Review	3
	2.4	Document Availability	3
	2.5	Targeted Stakeholder Review	4
3.0	**ADDITIONAL INFORMATION AND AMENDMENTS**		**6**
	3.1	Independent Statistical Analysis of Vegetation Communities	6
	3.2	Amendments to Priority Flora Information	7
	3.3	Revised Project Infrastructure Requirements	8
	3.4	Baseline Dust Survey Results	13
	3.5	Targeted Survey for Fauna Species Western Rosella	14
4.0	**PUBLIC SUBMISSIONS**		**17**
5.0	**RESPONSE TO PUBLIC SUBMISSIONS**		**17**
6.0	**COMMITMENTS**		**62**

TABLES

Table 1:	Stakeholders Specifically Invited to Make a Public Submission	4
Table 2:	Proposed Native Vegetation Disturbance for the Project	9
Table 3:	Impacts to Vegetation Communities as a Result of the Proposal within PEC	11
Table 4:	Dust Monitoring Results (Deposition) for Project Area	13
Table 5:	Dust Monitoring Results (PM_{10}) for Project Area	14
Table 6:	Summary of Number of Submissions Received and Origin	17
Table 7:	Summary of Public Submissions Received and Cazaly's Response (Submissions 1 to 8)	18
Table 8:	Summary of Office of the EPA Matters Raised and Cazaly's Response	49
Table 9:	Summary of Cazaly's Commitments for the Parker Range Iron Ore Project	62

FIGURES

Figure 1:	Flora Species *Chamelaucium* sp. Parker Range (Priority 1) at Mt Caudan Project Area	10
Figure 2:	Western Rosella Potential Habitat within the Mt Caudan Project Area	16
Figure 3:	Florabase Priority Flora Locations not within Mt Caudan Project Impact Area	45
Figure 4:	Population Locations of *Lepidosperma* sp. Parker Range at the Mt Caudan Project Area	46
Figure 5:	Population Locations of *Lepidosperma* sp Mt Caudan at the Mt Caudan Project Area	47
Figure 6:	Troglofauna Habitat Connectivity at the Mt Caudan Project Area	48
Figure 7:	Vegetation Associations for the Upper Haul Road Project Area	60
Figure 8:	Vegetation Associations for the Mt Caudan Project Area	61

APPENDICES

Appendix 1: Advertisement Inviting Public Submissions
(Cazaly Resources, November 2010)
Appendix 2: A Classification of Flora Quadrats of Vegetation of the Parker Range Region, Western Australia
(Ted Griffin, December 2010)
Appendix 3: Assessment of Independent PATN Analysis Results for the Parker Range Iron Ore Project – Mt Caudan Deposit
(Botanica Consulting, April 2011)
Appendix 4: Investigation and Assessment of *Chamelaucium* sp. Parker Range
(Botanica Consulting, May 2011)
Appendix 5: Summary of the Main Elements for Parker Range Project
(Cazaly Resources, January 2011)
Appendix 6: Air Quality Impact Assessment
(Ecotech, February 2011)
Appendix 7: Targeted Survey for Western Rosella at Mt Caudan within the Parker Range Region
(Keith Lindbeck and Associates, April 2011)
Appendix 8: Conceptual Rehabilitation and Closure Plan (Draft)
(Cazaly Resources, May 2011)
Appendix 9: Proposed Mine and Infrastructure for the Project (Detailed)
(Cazaly Resources, January 2011)
Appendix 10: Impact of the Cazaly Resources Parker Range (Mt Caudan) Iron Ore Project, Recalculated by DEC
(Extract from Submission No. 8, DEC, January 2011)
Appendix 11: Vegetation Group and Community Consolidation Summary for Parker Range Project as requested by the EPA
(Extract from Matters Raised by Office of the EPA, January 2011)
Appendix 12: Supporting Information to Cazaly's Responses (References within Tables 4 and 5)
(Cazaly Resources, January 2011 – April 2011)

TABLE OF CONTENTS

Appendix 13: Environmental Management Plan (M8521-G00-EN-PL-001)
(HWE Mining, January 2011)
Appendix 14: Environmental Monitoring Strategy
(Cazaly Resources, February 2011)

1.0 DEFINITIONS AND ABBREVIATIONS

1.1 Definitions

Project	The Parker Range Iron Ore development outlined in this proposal.
Project Area	The local area surrounding the Project impact area.
Project Region	The region in context of the Yilgarn region in Western Australia including the PEC.
Impact Area	The proposed area of clearing for the Project.
Mt Caudan Deposit	The area of iron mineralisation comprised of three areas – northern, central and southern.

1.2 Abbreviations

AMD	Acid mine drainage
ANC	Acid neutralizing capacity
ARD	Acid Rock Drainage
ARI	Assessment on Referral Information
AS	Australian Standard
ASL	Above Sea Level
AW1	Avon Wheatbelt
bcm	Bulk cubic metres
BIF	Banded Iron Formation
Cazaly	Cazaly Resources Limited
dB(A)	Decibel (A-weighting)
DAFWA	Department of Agriculture and Food (Western Australia)
DEC	Department of Environment and Conservation
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth), was formally Department of the Environment, Water, Heritage and the Arts (DEWHA)
DFS	Definitive Feasibility Study
DIA	Department of Indigenous Affairs
DMP	Department of Mines and Petroleum
DOW	Department of Water
DRF	Declared Rare Flora
EAT	Emmerson Aggregate Test
EC	Electrical Conductivity
EFA	Ecosystem Function Analysis
EIA	Environmental Impact Assessment
EIA-PER	Environmental Impact Assessment Public Environmental Review
EPA	Environmental Protection Authority
EPBC	Environmental Protection and Biodiversity Conservation
ESA	Environmentally Sensitive Area
Fe	Iron
FESA	Fire and Emergency Services Authority
GPS	Global Positioning System
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
ISA	Independent Statistical Analysis
JORC	Australasian Joint Ore Reserves Committee
K	Potassium
kg	Kilograms
lcm	Loose cubic metres
L/s	Litres per second
m^3	Cubic metre
mAHD	Mine Australian Height Datum
mE	Metres - Easting
mg	Milligrams
MGA	Map Grid Australia
ML	Mega litres
Mm^3	Million cubic metres
Mn	Manganese
mN	Metres - Northing
MRWA	Main Roads of Western Australia
NSW	New South Wales
OEPA	Office of the Environmental Protection Authority
PAF	Potential Acid Forming
PEC	Priority Ecological Community
PER	Public Environmental Review

PRCT	Parker Range Conservation Trust
RC	Reverse Circulation
RL	Relative Level
ROM	Run-of-Mine
S	Sulphur
SO_4	Sulphate
SRE	Short Range Endemic invertebrates
SWL	Standing Water Level
TDS	Total Dissolved Salts
TSF	Tailings Storage Facility
TSP	Total Suspended Particulates
WA	Western Australia
WAM	Western Australian Museum
WET	Waste Extraction Test
WRL	Waste Rock Landform

2.0 INTRODUCTION

The Parker Range Iron Ore Project – Mt Caudan Deposit (Project) is located approximately 52 km south of Southern Cross and 15 km south-east of Marvel Loch townships in the Yilgarn region of Western Australia. The Perth-Kalgoorlie rail line is approximately 60 km to the north-west of the Project, with rail services to the ports of Kwinana and Esperance.

Cazaly Resources Limited (Cazaly) has 100% iron ore development rights for the Project and proposes to develop the Mt Caudan deposit which contains an estimated 30 million tonnes of iron ore with an expected mine life of 7-10 years at a production rate of 4 million tonnes per annum. Mining is scheduled to commence in quarter 3 in 2011.

The Project includes the development, operation, decommissioning and rehabilitation of:-

- A single mine pit.
- One overburden waste landform (constructed of un-mineralised earth materials).
- Operational areas for ore stockpiles, internal mine roads, plant, infrastructure, administration facilities and amenities.
- A road train ore haulage road, consisting of an upgraded public and new private road.

In accordance with the *Environmental Protection Act 1986*, an Environmental Impact Assessment Public Environmental Review (EIA-PER) has been prepared with a four week public review period determined (Cazaly, 2010).

Preparation of the EIA-PER document was undertaken in accordance with the *Guidelines for Preparing a Public Environmental Review / Environmental Review and Management Programme* (EPA, 2009a). The EIA-PER document was prepared to provide the EPA, DSEWPaC (formally DEWHA) and other relevant government and non-government agencies and the public with details on the environmental factors and impacts associated with the proposed Project and the management strategies adopted.

The EPA authorised the EIA-PER for release for public review on 29 November 2010 with the closing date for submissions on 10 January 2011.

2.1 Purpose of the Document

In accordance with s40 (6) (b) of the *Environmental Protection Act 1986*, the EPA requested that Cazaly consider and respond to the public submissions received during the public review period. This document identifies Cazaly's response to the relevant aspects of the public submissions that have been received by the EPA in response to release of the EIA-PER.

2.2 Public Review Period

The public review period was determined as four weeks by the EPA, with a commencement date of 29 November 2010. As the Christmas holidays fall within the four week public review period, this period was extended by two weeks. Cazaly's EIA-PER document was available for a public review period of six weeks from 29 November 2010 and closed on 10 January 2011.

2.3 Advertising of Public Review

Newspaper advertisements advising the public of the review period were placed in following printed press, together with corresponding dates of the advertisements:

- The West Australian – 29 November 2010 and 27 December 2010.
- Shire of Yilgarn Crosswords – 25 November 2010 and 16 December 2010.
- Merredin Mercury – 1 December 2010 and 22 December 2010.

A copy of the advertisement inviting public submissions on Cazaly's EIA-PER document is contained in Appendix 1.

2.4 Document Availability

Cazaly's EIA-PER document was made publicly available in the following manner:

- Electronic copies could be downloaded via Cazaly's website at www.cazalyresources.com.au.
- Electronic copies on compact disc were available at no charge at Cazaly's Perth Office.
- Hard copies were available for purchase at the cost of $10 from Cazaly's Perth Office.
- Hard copies were placed for public viewing in each of the following:-

- Environmental Protection Authority, Library/Reading Room, Level 4, The Atrium, 168 St Georges Terrace, Perth WA 6000.
- Department of Environment and Conservation Merredin District Office, 33 Bates Street, Merredin WA 6415.
- Southern Cross Community Resource Centre, Canopus Street, Southern Cross WA 6426.
- Shire of Yilgarn Council Office, 23 Antares Street, Southern Cross WA 6426.
- State Library of Western Australia, 25 Frances Street, Perth Cultural Centre, Perth WA 6000.
- J S Battye Library, 25 Frances Street, Perth Cultural Centre, Perth WA 6000.

2.5 Targeted Stakeholder Review

A number of stakeholders were identified and specifically invited to participate in the public review process. These stakeholders included government bodies, conservation groups, rural landholders and traditional land owners.

Each stakeholder received at least one hard copy (with the exception of the DEC (Air Quality Branch) and one electronic copy of Cazaly's EIA-PER document for their consideration.

The stakeholders specifically invited to make a public submission are listed within Table 1.

Table 1: Stakeholders Specifically Invited to Make a Public Submission

Organisation	Copies Distributed	
	Hard Copy Format (Includes CD)	CD Format Only
Department of Environment and Conservation Perth	5	-
Department of Environment and Conservation (Wheatbelt Region)	3	1
Department of Environment and Conservation (Air Quality Branch)	-	2
Department of Environment and Conservation (Contaminated Sites Branch)	1	-
Department of Environment and Conservation (Noise Regulation Branch)	1	-
Department of Environment and Conservation (Works Approvals and Emissions Licensing Section)	1	-
Department of Water Swan Avon Region	2	1
Department of Mines and Petroleum	2	1
Department of Indigenous Affairs	1	1
Shire of Yilgarn	3	-
Department of Sustainability, Environment, Water, Population and Communities (Department of The Environment, Water, Heritage and The Arts)	2	-
Main Roads Authority	2	-
Wilderness Society of Australia Inc.	1	-
Conservation Council of Western Australia	1	-
Great Western Woodlands	1	-
Malleefowl Preservation Group Inc	1	-
Wildflower Society of Western Australia Inc.	1	-
Rural Land holder (Lot 59)	1	-
Rural Land holder (Lot 61)	1	-
Rural Land holder (Lot 638)	1	-
The Gubrun People and the Kalamaia Kabu(d)n People	1	-
The Central West Goldfields People	1	-
The Ballardong People	1	-

Organisation	**Copies Distributed**	
	Hard Copy Format (Includes CD)	**CD Format Only**
Goldfields Aboriginal Land and Sea Council	1	-
South West Aboriginal Land and Sea Council	1	-

3.0 ADDITIONAL INFORMATION AND AMENDMENTS

Following the commencement of the public review period for Cazaly's' EIA-PER document on 29 November 2010, and arising from the public submissions received by Cazaly from the EPA, additional information has been obtained and a number of minor amendments made. The additional information and amendments are summarised herein.

3.1 Independent Statistical Analysis of Vegetation Communities

The EIA-PER presented a PATN analysis of surrounding and regional vegetation assemblages to determine whether the vegetation composition of the Parker Range region is similar to that of surrounding regions (Cazaly, 2010). In conjunction with the DEC, Cazaly commissioned an independent statistical analysis to further understand the influences on time between recent survey data and previous survey data collected over 16 years ago. Botanical consultant Ted Griffin was engaged by Cazaly to complete the independent analysis.

The brief for the independent analysis report was to:

- Undertake a new PATN analysis based on the same source data from the EIA-PER analysis by Botanica Consulting and compare it against the results of the new statistical analysis. The analysis was also to include a comparison between the Botanica - Gibson and Lyons (1998) data sets and the Botanica - Newbey et al.'s (1991) data sets.
- Compare the results of Botanica Consulting's analysis to the results of the independent analysis particularly to determine whether the use of annual species within the analysis conducted by Botanica may impact the results.
- Demonstrate to what degree the numerical classification prepared by Botanica Consulting can be relied upon.
- Prepare a report summarising the methods adopted, analysis and key findings.

Analysis was to be completed in consideration with DEC's *Interim Protocol for Flora Surveys of Banded Ironstone Formations (BIF) in the Yilgarn Craton* (DEC, 2005).

Following consultation with the DEC, the Griffin report entitled *A Classification of Flora Quadrats of Vegetation of the Parker Range Region Western Australia* was completed in December 2010 (Griffin, 2010 - Appendix 2).

Botanica Consulting have reviewed the Griffin report and with this further information have prepared a supplementary report entitled *Assessment of Independent PATN Analysis for the Parker Range Iron Ore Project – Mt Caudan Deposit* (Botanica, 2011a - Appendix 3).

Following the consideration of DEC consultation and both the Griffin report and Botanica Consulting supplementary report, Cazaly presents the following key findings:

- The quadrats were highly diverse and more than 20 distinct communities were likely to be present in the combined data set and perhaps greater than 10 in local Parker Range area (7 were established by Botanica Consulting and presented in the EIA-PER).
- The different data sets appear to have "floristic communities not widely shared" although an assessment on how distinct the individual communities are or what the influence of survey methodology had on the data sets cannot be readily determined.
- Analysis suggests that some of the communities in Parker Range are highly restricted (e.g. laterite communities).
- In regards to the DEC's Recommended Interim Protocol for Flora Surveys of Banded Ironstone Formations (BIF) in the Yilgarn Craton (DEC, 2005) which stipulates the use of data for perennials only, the analysis suggests that the inclusion of annuals do not have much influence on the results. It is therefore likely that survey sampling and season differences over time between the datasets is contributing significantly.
- The Newbey et al.'s data set does not appear to provide useful context for comparison and suggested use of this data set is to be excluded from evaluation.

Further detailed findings and discussion are presented in Appendix 3 (Botanica, 2011a).

There are a variety of factors that may have contributed to the heterogeneity of the Parker Range region including a variety of disturbances and seasonal changes over time. Throughout the 16 years between Gibson and Lyons surveys and Botanica Consulting surveys a variety of disturbances have been noted, inclusive of fire affected regimes.

Over the past two years, rainfall has been low, which corresponds to the timing of Botanica Consulting's surveys. This trend of a drying semi-arid climate in the Yilgarn is a common issue in the region.

It is also suggested that further differences in heterogeneity could be due to sampling technique and the placement of quadrats along transition zones between two or more distinct vegetation communities. As a result quadrats that visually appear to belong to one distinct vegetation community are being represented as dissimilar in statistical analysis.

Although additional heterogeneity for vegetation is suggested in the Parker Range PEC, there are also several overlapping floristic communities in the region. The similarities and dissimilarities from the PATN analysis cannot be reliably used to map boundaries of vegetation communities.

It is concluded that the vegetation communities presented by Cazaly in the EIA-PER based on Botanica's surveys and analysis, represent the most current and reliable assessment of vegetation communities for further evaluation. Furthermore, Botanica's surveys and analysis have been undertaken in accordance with EPA Guidance Statement No. 51 "*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia"* (EPA, 2004) and the "*Recommended Interim Protocol for Flora Surveys for Banded Ironstone Formations (BIF) of Yilgarn Craton"* (DEC, 2005).

Following the consideration of the additional information available, Cazaly have refined the impact assessment for Project vegetation as follows:

- EIA-PER Table 26 is amended to reflect Botanica's vegetation community classification (Table 3 in this response document), replacing the previous classification used from Gibson and Lyon (1998) (Cazaly, 2010).
- EIA-PER Vegetation Impact Assessment (Section 6.2.1 page 86) statement to be amended to "Vegetation communities (….) impact <15% on any individual vegetation community is estimated within the regional area (PEC) after impact area is cleared".

The vegetation community *Eucalyptus transcontinentalis* woodland has the highest estimated impact from Project clearing being 15.0% of known regional occurrence in the PEC (Table 3).

Detailed impact analysis and discussion for each refined vegetation community are provided in Appendix 3 (Botanica, 2011a).

3.2 Amendments to Priority Flora Information

***Lepidosperma* sp Mt Caudan (P1)**

Botanica Consulting have been undertaking seasonal flora and vegetation surveys in the Marvel Loch and Parker Range area for other organisations since release of Cazaly's EIA-PER document was complete. During these surveys additional populations and plant numbers of *Lepidosperma* sp Mt Caudan have been identified.

Cazaly's EIA-PER document Section 6.2.2 page 93 and page 95 Table 28 listed known population of *Lepidosperma* sp Mt Caudan as four other populations totalling 73,144 plants within ten kilometres of the Mt Caudan impact area. Botanica Consulting's current survey information is to be revised to a total of twelve populations totalling 77,152 all within ten kilometres of the Mt Caudan impact area (including the two impact populations consisting of 3,629 plants). The additional populations were identified south-west of Parker Range Road (near Tamarin) and along Emu Fence Road adjacent to the Parker Range. The two impacted populations in the Project area consisting of 3,629 plants are unaltered.

***Cryptandra crispula* (P3)**

Cazaly would like to correct a Priority flora impact estimate of species *Cryptandra crispula* (P3) presented in EIA-PER document Section 6.2.2 page 95 Table 27. The number of plants likely to be impacted is stated as 4 plants which is to be corrected to 3 plants. The total number of known *Cryptandra crispula* (P3) plants within 10 km of the project location remains unchanged as 46 plants with an unchanged impact assessment of 6.5% of total known population.

***Chamelaucium* sp Parker Range (P1)**

On 28 March 2011, the Office of the EPA advised Cazaly that the undescribed subspecies *Chamelaucium halophilum* ms previously located by Gibson Lyons (1998) near the gravel pit at Mt Caudan was recognised as a distinct entity called *Chamelaucium* sp Parker range (BH Smith 1255) determined by taxonomical identification on 23 December 2010. On 15 February 2011, the taxon was recommended for priority listing and on 23 March 2011, the species *Chamelaucium* sp Parker Range was listed as a Priority 1 on the basis that this species is only known from a single population in the Parker Range.

The circumstances are beyond the control of Cazaly regarding the inappropriate timeframe for species re-identification, notification and recent Priority listing of this species. Cognisant of these facts, but at the request of the EPA, Cazaly provides the following information and impact assessment of species *Chamelaucium* sp Parker Range (P1) for the proposal (Botanica, 2011b – Appendix 4).

The species previously collected and identified by Botanica Consulting as *Chamelaucium halophilum ms* has been positively identified as taxon *Chamelaucium* sp Parker Range (P1) by M. Barrett (Botanical Gardens Kings Park Authority) on the 7 April 2011. Botanica Consulting have reviewed seasonal survey data from 2007 and confirmed that four populations of unknown plants numbers (only 27 plants can be reliably identified by Botanica records) as *Chamelaucium* sp Parker Range (P1) will be impacted by the project development. The impacted populations are located within the existing gravel pit and in five quadrats within vegetation community types: Mallee heath, Mallee woodlands / *Allocasuarina* shrubland on Laterite Ridge and *Allocasuarina* shrubland at the Mt Caudan Project area. These vegetation communities are well represented comprising of 7,463 ha of the total 55,960 ha within the PEC bioregion (refer Cazaly's PER document Figure 27). This taxon is known to favour disturbed ground with gravelly soils.

On 15 April 2011, Botanica Consulting completed a survey for *Chamelaucium* sp Parker Range (P1) local to the Mt Caudan area in search of prospective disturbed vegetation (Botanica, 2011b - Appendix 4). The survey identified another five populations consisting of 353 plants of *Chamelaucium* sp Parker Range (P1). Three populations of 298 plants were identified within 10 km of the Mt Caudan impact area and another 55 plants from two populations identified within 20 km of the Mt Caudan impact area (Figure 1). The population of 200 plants located near the Powerline Corridor Project Area (Figure 1 location 9) will be avoided by Cazaly's proposed project development, hence excluded from the impacted population estimate.Coordinates of these all additional populations have been submitted to the DEC by Botanica Consulting. Further populations (not known to Botanica Consulting and Cazaly) may exist within DEC database records, however Cazaly understand the recent listing of *Chamelaucium* sp Parker Range as a Priority 1 species was determined on only a single known population in the Parker Range area.

Based on current known species distribution by Cazaly, the impact assessment for *Chamelaucium* sp Parker Range (P1) is four populations (unknown plant numbers) with a further five known populations of 353 plants occurring within 20 km of the impact area. Three of these five populations are within 10 km of the impact area at Mt Caudan totalling 298 plants. This additional information is provided within Appendix 9 per DEC adopted criteria and presented as Figure 1.

In regards to indirect impacts, population at location 9 (Figure 1) is the nearest non-directly impacted population to the proposed Parker Range Road haul route (i.e. distance of 250m). Dust modelling presented in Cazaly's EIA-PER document estimates the zone of indirect dust influence to be approximately 125 m at a dust deposition of 5 g/m2/month (refer PER Section 6.2.8 page 115). Therefore, indirect dust impacts to known remaining *Chamelacium* sp. Parker Range (P1) populations are assessed as non-significant.

With the prospective disturbed gravelly soils and floristic vegetation communities widely occurring within the local Project area and the PEC bioregion, further populations of *Chamelaucium* sp Parker Range (P1) are likely to be found with increased survey intensity. Botanica Consulting have been undertaking project seasonal surveys since 2007. Unfortunately, due to the late identification and recent priority listing of this species further surveys are not possible for this assessment. Cazaly are confident further surveys would discover increased species populations and distribution, hence the impact assessment presented in this response document is considered conservative.

All revisions to Priority flora information are included in the proposal and within this response document.

3.3 Revised Project Infrastructure Requirements

Cazaly's EIA-PER document presented the requirement for 2 x 55 kL diesel self bunded storage tanks proposed for on-site fuel requirements. Subsequent estimates of fuel usage indicate that 3 x 110 kL self bunded storage tanks will be required to support the mine activities. A revision to the fuel storage requirements has now been included in the proposal by Cazaly.

Cazaly's EIA-PER document presented a TSF design which would store up to 1 Mm^3 of tailings for the estimated life of the mine and be constructed with an effective area of 350 m x 350 m x 8 m high with 4 lifts stages of 2 m per stage. Subsequent improved tailings design now confirms the proposed TSF is required to store approximately 0.8 Mm^3 of tailings, with a revised effective area of 400 m x 400 m x 11 m high. The TSF will be constructed with a starter embankment of 7 m with a subsequent 4 lift stages of nominally 2 m per stage (i.e. 5 stages in total). This revision to the TSF design has now been included in the proposal by Cazaly. The 17.4 ha estimated native vegetation clearing for the TSF development remains unchanged from Cazaly's EIA-PER document as listed within Section 4.13 Table 8 on page 34. This clearing estimate is sufficient for the revised TSF footprint.

Cazaly's EIA-PER document presented an estimate of vegetation clearing in the Upper Haul Road Project area of 6.8 ha listed within Section 4.13 Table 8 on page 34. The Upper Haul Road truck route has been selected to part occupy existing cleared farming land (approximately 2.7 ha) which involves no clearing of native vegetation. Therefore the total estimated native vegetation clearing for the Upper Haul Road is revised from 6.8 ha to 4.1 ha.

Cazaly amend the estimated native vegetation clearing for the Project from 421 ha (EIA-PER Table 8 page 34) to 418 ha determined per Table 2.

Table 2: Proposed Native Vegetation Disturbance for the Project

Element	Clearing required (ha)
Pit	58.8
Pit Edge Protection	58.4
Waste Rock Landform	119.8
Process Plant and Associated Infrastructure	89.5
Mine Haul Roads and Pipeline Corridors	42.0
Parker Range Bypass Road	10.3
Power Line	14.6
Site Access Road	2.5
TSF	17.4
Stormwater Diversion Levee	0.7
Upper Haul Road (near Moorine Rock)	4.1
TOTAL	418.1

In accordance with the revised project infrastructure requirements, the summary of the main elements of the Project (i.e. Table 4 in the EIA-PER) has subsequently been revised and is provided as Appendix 5 in this response document.

All other main elements of the Project proposal presented in Cazaly's EIA-PER document remain unchanged.

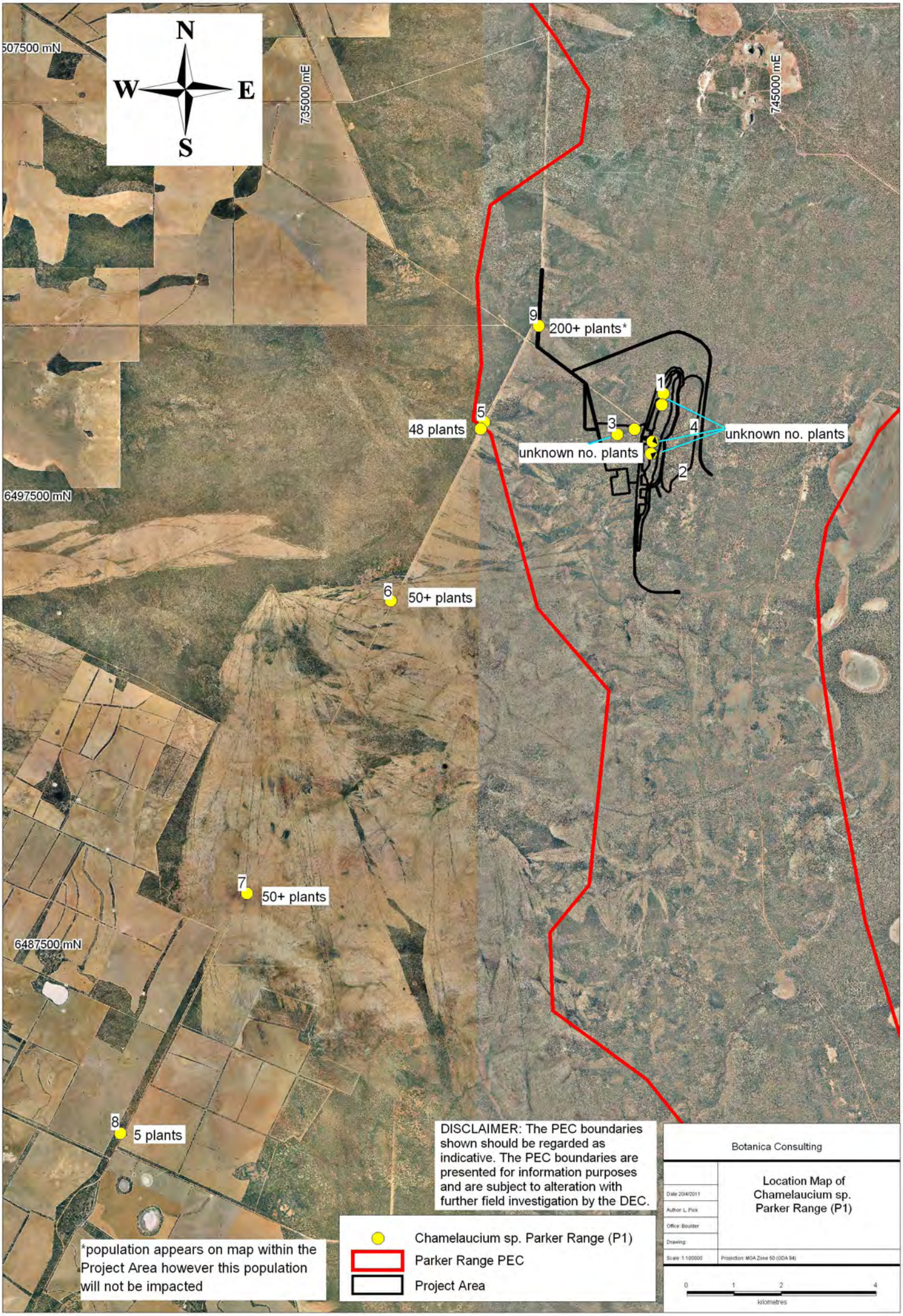


Figure 1: Flora Species *Chamelaucium* sp. Parker Range (Priority 1) at Mt Caudan Project Area

Table 3: Impacts to Vegetation Communities as a Result of the Proposal within PEC
(Update from PER Table 26 inclusive independent PATN analysis and additional information)

Vegetation communities	Parker Range PEC	Area of Parker Range PEC cleared				Mt Caudan Mine site Project area		
Vegetation group	**Vegetation community within the PEC***	**Total area (ha)***	**Total area in PEC cleared (ha)**	**% of each vegetation community cleared**	**% of cleared vegetation in PEC**	**Total area to be impacted (ha)**	**% of each vegetation community to be impacted**	**% of entire PEC to be impacted**
Tall *Eucalyptus* woodlands	*Eucalyptus salmonophloia* woodland	5,598	580	10.4	1.0	45	0.8	0.1
	Eucalyptus longicornis woodland	584	85	14.6	0.2	8	1.4	0.0
	Eucalyptus salubris woodland	4,059	618	15.2	1.1	25	1.4	0.0
	Mixed *Eucalyptus* woodland	22,147	832	3.9	1.5	149	0.7	0.3
	E. salmonophloia/E. salubris woodland	909	11	1.2	0.0	28	3.1	0.1
	Eucalyptus woodland over *Acacia steedmanii*	678	-	-	-	0.0	0.0	0.0
	Eucalyptus oleosa woodland over *Melaleuca*	5	-	-	-	0.1	2.0	0.0
	Eucalyptus salicola woodland over *Melaleuca pauperiflora*	51	-	-	-	0.0	0.0	0.0
	Eucalyptus salubris woodland over *Melaleuca pauperiflora*	556	8	1.4	0.0	0.1	0.0	0.0
	Eucalyptus transcontinentalis woodland	20	-	-	-	3	15.0	0.0
Mallee woodlands	Mallee woodland over *Acacia sp. narrow phyllode* and *Melaleuca hamata*	31	-	-	-	0.0	0.0	0.0
	Open Mallee woodland	784	-	-	-	21	2.7	0.0
	Mallee Heath	3,887	85	2.2	0.2	45	1.2	0.1
	Eucalyptus capillosa subsp. *polyclada* on Rise	216	-	-	-	0.0	0.0	0.0
	Eucalyptus capillosa subsp. *polyclada* woodland	4	-	-	-	0.4	10.0	0.0
Salt Lake vegetation	*Eucalyptus longicornis over* Samphire Vegetation	905	-	-	-	0.0	0.0	0.0
	Samphire vegetation	1,158	-	-	-	0.0	0.0	0.0
	Eucalyptus oleosa over Samphire Vegetation	317	4	1.3	0.0	0.0	0.0	0.0
Shrublands/Thickets	*Allocasuarina* shrubland	1,260	130	10.3	0.2	77	6.1	0.1
	Acacia sp. narrow phyllode and *Melaleuca eleuterostachya* shrubland	272	140	51.5	0.3	3	1.1	0.0

Vegetation communities	Parker Range PEC	Area of Parker Range PEC cleared				Mt Caudan Mine site Project area		
Vegetation group	**Vegetation community within the PEC***	**Total area (ha)***	**Total area in PEC cleared (ha)**	**% of each vegetation community cleared**	**% of cleared vegetation in PEC**	**Total area to be impacted (ha)**	**% of each vegetation community to be impacted**	**% of entire PEC to be impacted**
	Allocasuarina thicket	2,241	-	-	-	0.5	0.0	0.0
	Acacia thicket	215	-	-	-	1	0.5	0.0
Rocky outcrops	*Isopogon robustus* on decomposing Laterite/Granite	64	-	-	-	0.0	0.0	0.0
	Mallee woodland/*Allocasuarina* shrubland on Laterite ridge	75	-	-	-	8	10.7	0.0
Disturbed Vegetation	Regenerating *E. salubris/E. salmonophloia* woodland	71	-	-	-	0.0	0.0	0.0
	Burnt *Eucalyptus* woodland	4,384	152	3.5	0.3	0.0	0.0	0.0
	Burnt Mallee Woodland/*Allocasuarina* shrubland	1,261	-	-	-	1.1	0.09	0.0
	Mixed Shrub rehabilitation in gravel pit	3	-	-	-	3.0	100.0	0.0
	Unknown vegetation (along cleared roads etc)	N/A	1560		2.8	0.0	0.0	0.0
	Cleared Native Vegetation	4,205	4205	N/A	7.5	414***	N/A	0.7
	Total area in PEC (ha)	**55,960**						

*Vegetation community identifications and area are subject to change following further surveys.

**Road clearing for individual communities cannot be reliably estimated within the PEC.

***Area 414 ha excludes Upper Haul Road area not within PEC.

3.4 Baseline Dust Survey Results

Cazaly's EIA-PER document presented the baseline dust survey results for the winter month of July 2010 in the Project area (EIA-PER Appendix 10). In the absence of relevant baseline monitoring data an annual background dust level of 22 µg/m^3 was adopted for dust modelling prediction. This was based on Kalgoorlie data from 2006-2007 ambient particulate matter monitoring published by the DEC.

Since Cazaly's EIA-PER document, a summer baseline dust survey has been completed in the month of January-February 2011 by Ecotech. The results are included in a revised Air Quality Impact Assessment (Ecotech, 2011 – Appendix 6) in this response. The summary of both summer and winter survey results for dust deposition measurements and continuous sampling measurements (i.e. TEOM) are presented in Table 4 and Table 5.

Table 4: Dust Monitoring Results (Deposition) for Project Area

Site Description	GPS Reference	Monitoring Period	Dust Results (mg)	Result Equivalent g/m^2/month
Winter				
DDG Site 1 – Corner Liddell Rd and Prospector Access Rd intersection.	Lat – 31 18'55.34"S Long – 119 5'5.20"E	1 to 31 July 2010	27	1.5
DDG Site 2 – Lot 638 residence, south of house	Lat – 31 13'13.54"E Long – 119 4'56.97"S	1 to 31 July 2010	29	1.6
DDG Site 3 – Haul road intersection on Moorine South road (Lot 59/61)	Lat – 31 19'55.48"E Long – 119 7'20.97"S	1 to 31 July 2010	21	1.2
DDG Site 4 – Lot 59 property, south-west of buildings	Lat – 31 19'17.84"E Long – 119 7'23.98"S	1 to 31 July 2010	46	2.6
DDG Site 5 – Lot 61 residence on Parker Range Road	Lat – 31 19'14.68"E Long – 119 7'42.31"S	1 to 31 July 2010	23	1.3
DDG Site 6 – T intersection Lot 61 private haul road and Parker Range Rd.	Lat – 31 19'53.11"E Long – 119 8'21.37"S	1 to 31 July 2010	65	3.7
DDG Site 7 – Intersection Parker Range road and Southern Cross road (Lot 272).	Lat – 31 27'1.69"E Long – 119 16'10.66"S	1 to 31 July 2010	38	2.2
DDG Site 8 –Intersection Frog Rock and Parker Range roads (Lot 401)	Lat – 31 28'10.36"E Long – 119 18'35.78"S	1 to 31 July 2010	91	5.2
DDG Site 9 – Intersection Patroni road and Parker Range road (Lot 425/426)	Lat – 31 31'58.82"E Long – 119 24'21.14"S	1 to 31 July 2010	40	2.3
DDG Site 10 –Property 200 m from bushland, Parker Range road (Lot 453)	Lat – 31 34'43.92"E Long – 119 29'2.18"S	1 to 31 July 2010	43	2.4
DDG Site 11 – Plant site at Mt Caudan	Lat – 31 37'45.68"E Long – 119 32'57.10"S	1 to 31 July 2010	350	19.8
DDG Site 12 – Plant site at Mt Caudan	Lat – 31 37'25.18"E Long – 119 33'2.80"S	1 to 31 July 2010	17	1.0
Summer				
DDG Site 1 – Corner Liddell Rd and Prospector Access Rd intersection.	Lat – 31 18'55.34"S Long – 119 5'5.20"E	1 Jan to 7 Feb 2011	81	4.6
DDG Site 2 – Lot 638 residence, south of house	Lat – 31 13'13.54"E Long – 119 4'56.97"S	1 Jan to 7 Feb 2011	85	4.8
DDG Site 3 – Haul road intersection on Moorine South road (Lot 59/61)	Lat – 31 19'55.48"E Long – 119 7'20.97"S	1 Jan to 7 Feb 2011	24*	1.4*
DDG Site 4 – Lot 59 property, south-west of buildings	Lat – 31 19'17.84"E Long – 119 7'23.98"S	1 Jan to 7 Feb 2011	46*	2.6*
DDG Site 5 – Lot 61 residence on Parker Range Road	Lat – 31 19'14.68"E Long – 119 7'42.31"S	1 Jan to 7 Feb 2011	87	4.9
DDG Site 6 – T intersection Lot 61 private haul road and Parker Range Rd.	Lat – 31 19'53.11"E Long – 119 8'21.37"S	1 Jan to 7 Feb 2011	N/A*	N/A*
DDG Site 7 – Intersection Parker Range road and Southern Cross road (Lot 272).	Lat – 31 27'1.69"E Long – 119 16'10.66"S	1 Jan to 7 Feb 2011	N/A*	N/A*
DDG Site 8 –Intersection Frog Rock and Parker Range roads (Lot 401)	Lat – 31 28'10.36"E Long – 119 18'35.78"S	1 Jan to 7 Feb 2011	130	7.4
DDG Site 9 – Intersection Patroni road and Parker Range road (Lot 425/426)	Lat – 31 31'58.82"E Long – 119 24'21.14"S	1 Jan to 7 Feb 2011	61	3.5
DDG Site 10 –Property 200 m from bushland, Parker Range road (Lot 453)	Lat – 31 34'43.92"E Long – 119 29'2.18"S	1 Jan to 7 Feb 2011	40	2.3

Site Description	GPS Reference	Monitoring Period	Dust Results (mg)	Result Equivalent g/m^2/month
DDG Site 11 – Plant site at Mt Caudan	Lat – 31 37'45.68"E Long – 119 32'57.10"S	1 Jan to 7 Feb 2011	38	2.2
DDG Site 12 – Plant site at Mt Caudan	Lat – 31 37'25.18"E Long – 119 33'2.80"S	1 Jan to 7 Feb 2011	45	2.5

* Denotes samples which were compromised during survey period.

Table 5: Dust Monitoring Results (PM_{10}) for Project Area

Site Description	GPS Reference	Monitoring Period	Dust Reading (µg/m³)	Period Average (µg/m³)
Winter				
PM 10 Teom/WS/WD* – CBH storage and rail siding (Moorine Rock)	Lat – 31 19'4.51"S Long – 119 4'24.06"E	1 to 31 July 2010	3.0 to 9.8	5.9
PM 10 Teom – Moorine Rock Primary School	Lat – 31 18'51.63"S Long – 119 7'29.94"E	1 to 31 July 2010	0.3 to 3.3	5.1
Summer				
PM 10 Teom/WS/WD* – CBH storage and rail siding (Moorine Rock)	Lat – 31 19'4.51"S Long – 119 4'24.06"E	1 Jan to 7 Feb 2011	4.8 to 108.4	22.9
PM 10 Teom – Moorine Rock Primary School	Lat – 31 18'51.63"S Long – 119 7'29.94"E	1 Jan to 7 Feb 2011	6.7 to 94.5	21.9

* PM_{10} Teom – automated dust gathering device with GSM for downloading of data daily, measuring wind speed (WS) and wind direction (WD).

Based on a monitoring survey of a typical winter and summer month snapshot, the following can be inferred regarding baseline dust levels in the Project area and validity of dust modelling presented in the EIA-PER document:

The baseline summer dust measurements are typically between two to three times greater than the winter dust measurements for sensitive dust receptors within the Project area.

The baseline PM_{10} dust levels average between 5.1 to 5.9 µg/m³ (winter month) and between 21.9 to 22.9 µg/m³ (summer month). A yearly average baseline of between 13.4 to 14.5 µg/m³ can be inferred from the winter and summer snapshot averages. This is significantly less than the assumed 22 µg/m³ yearly average assumed in the EIA-PER dust modelling results.

It is likely that the PM_{10} dust emissions modelled in Cazaly's EIA-PER document are over estimated by between 7 to 9 µg/m³ and emissions will be within NEPM criteria.

Therefore the dust modelling presented in Cazaly's EIA-PER document is considered sufficiently conservative and represents a reasonable prediction of dust impacts from the Project development.

3.5 Targeted Survey for Fauna Species Western Rosella

Cazaly's EIA-PER document presented the results of surveys and impact assessment for Western Rosella listed as a Schedule 1 species under the *Wildlife Conservation Act 1950*. Since Cazaly's EIA-PER document, Keith Lindbeck and Associates (KLA) have undertaken a targeted search within prospective habitat for the Western Rosella at the Mt Caudan Project Area (KLA, 2011 – Appendix 7).

Western Rosellas are known to favour Eucalypt woodlands due to the potential creation of hollows for breeding, particularly in Salmon Gum (*Eucalyptus salmonophloia*), Gimlet (*E. salubris*), Wandoo (*E. wandoo*), Marri (*Corymbia calophylla*), Flooded Gum (*E. rudis*) and York Gum (*E. loxophleba*). Vegetation communities within the Mt Caudan Project area include Salmon Gum Woodland, Gimlet Woodland and Mixed Eucalypt woodlands that support these two species (refer Table 3 in this response document). Thus, potential breeding hollows for the Western Rosella is expected within these vegetation communities.

Cazaly's current information regarding the Western Rosella species and potential habitat is summarised as follows:

- During all the seasonal and targeted surveys at Mt Caudan Project Area undertaken since 2008 by KLA, only two Western Rosellas have been seen or heard in the Project area (as sighted during the autumn 2009 survey).
- Potential breeding hollows in the Mt Caudan Project Area are identified in Figure 2 from the targeted survey with 681 potential hollows located within 137.7 ha of vegetation habitat surveyed.

The 137.7 ha surveyed represents 56% of the 247.1 ha identified potential habitat (i.e. Salmon Gum Woodland, Gimlet Woodland and Mixed Eucalypt woodlands). Based on extrapolation an estimated 1,222 potential hollows are located within the Mt Caudan impact area.

- A further 1,156 potential breeding hollows were recorded in 251 ha subject to targeted survey outside the Mt Caudan impact area. Based on extrapolation an estimated 175,012 potential hollows are located within the PEC alone, but outside the Mt Caudan impact area.
- The identified impacted potential habitat of 247.1 ha represents 59.7% of the total Mt Caudan impact area clearing of 414 ha.

However, Cazaly has established that potential breeding hollows are not confined to the proposed footprint of disturbance within the Mt Caudan area but exist locally outside the impact area and more widely within the Parker Range PEC and Great Western Woodlands. An estimated 38,000 ha (i.e. 68%)of the 55.960 ha of the Parker Range PEC alone comprises favoured Eucalypt woodlands habitat representing an extensive number of potential breeding hollows for Western Rosella and other hollow-breeding species.

Cazaly's EIA-PER document assessed the impact to this species and it is highly unlikely any loss of species or change in conservation status will occur from the implementation of the Project (page 98 of the PER Section 6.2.3). Further, the Western Rosella is a highly mobile species which is patchily distributed within the Western Wheatbelt and Parker Range PEC. The near absence of Western Rosella sightings in the Mt Caudan Project Area validates the species is unlikely to be occupying the area as core breeding habitat.

The clearing of 247.1 ha of potential Western Rosella habitat cannot be avoided by the proposal, however is unlikely to result in any species loss.

However, the proportions of woodlands habitat impacted remains very low (0.4%) as a proportion of the Parker Range PEC region, with wider habitat existing within the Great Western Woodlands.

Therefore Cazaly's EIA-PER predicted outcome is unaltered for the Western Rosella, in which the proposal will have a non-significant impact upon this species.

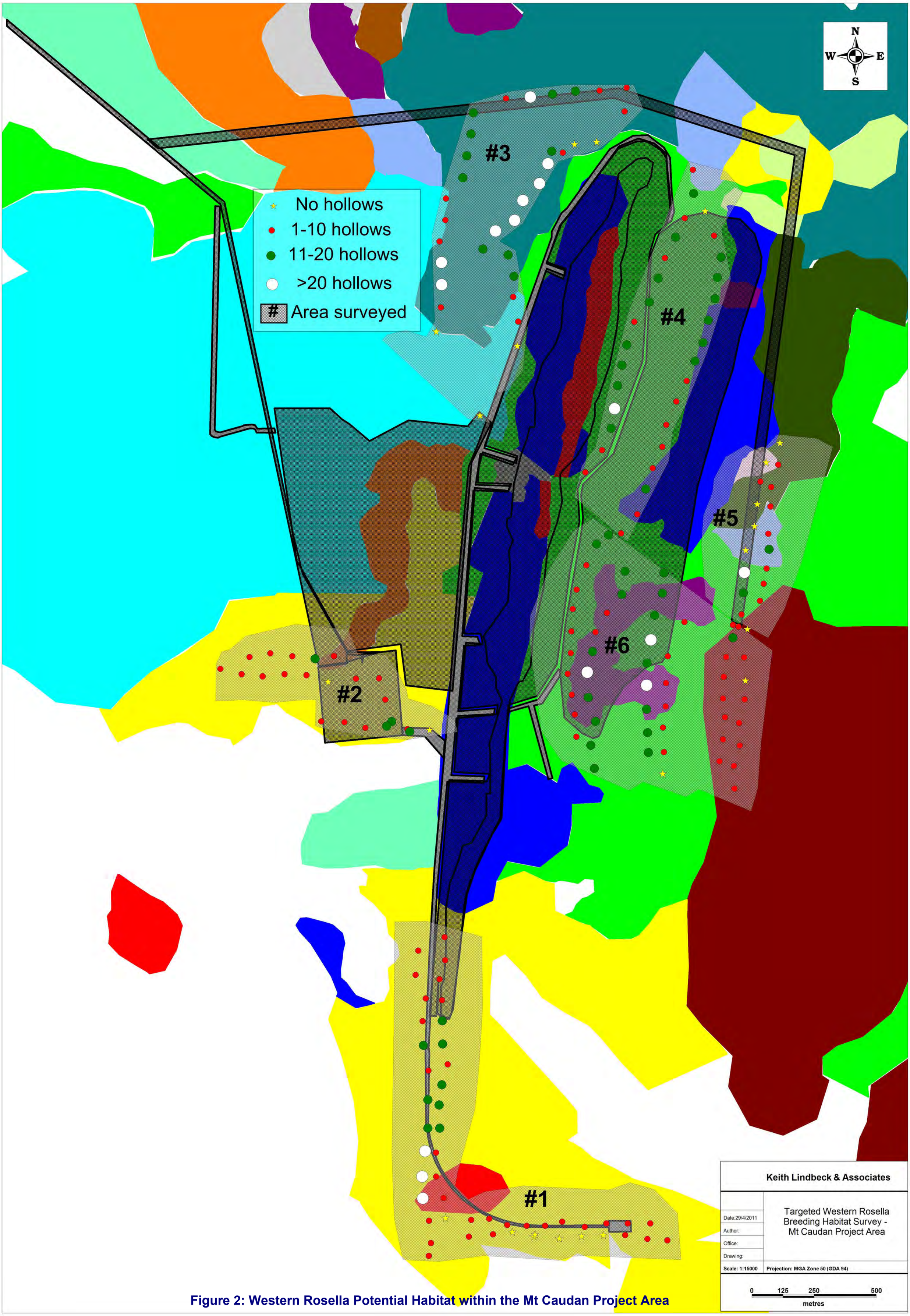


Figure 2: Western Rosella Potential Habitat within the Mt Caudan Project Area

4.0 PUBLIC SUBMISSIONS

A total of eight submissions were received by Cazaly from the EPA on 12 January 2011. Submissions were received from the following groups and individuals:

- Department of Indigenous Affairs.
- Main Roads of Western Australia.
- Department of Water.
- Anonymous public submission.
- Department of Mines and Petroleum.
- Wildflower Society of Western Australia.
- Department of Sustainability, Environment, Water, Populations and Communities.
- Department of Environment and Conservation.

In addition to the eight submissions, the Office of the EPA provided a further list of matters to be addressed in order to complete the Project assessment (referred as 'Office of the EPA Matters' herein).

Table 6 presents a summary of the number of public submissions received and origin.

Table 6: Summary of Number of Submissions Received and Origin

Submission No.	Origin of Submission
1	Department of Indigenous Affairs (DIA)
2	Main Roads of Western Australia (MRWA)
3	Department of Water (DOW)
4	Department of Mines and Petroleum (DMP)
5	Public submission (Anonymous)
6	Wildflower Society of Western Australia (WSWA)
7	Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC)
8	Department of Environment and Conservation (DEC)

The EPA requested Cazaly to review and respond to matters raised in the public submissions. In addition the EPA raised several matters to be addressed by Cazaly in the response document.

The numbering, order and grouping of public submissions and matters raised was completed by the EPA and is used in this document for consistency, with each submission identified by an issue reference numbered 1 to 53 (from submissions 1 to 8) and Office of the EPA matters raised numbered 1 to 17. A total of 70 issues and matters have been collated for response by Cazaly.

Cazaly would like to extend their appreciation to all groups that chose to forward a submission to the EPA as part of the environmental assessment and approval process.

5.0 RESPONSE TO PUBLIC SUBMISSIONS

A summary of the public submissions received and matters raised from the EPA with Cazaly's response is contained within Table 7 (Submissions 1 to 8) and Table 8 (Office of the EPA Matters Raised).

Table 7: Summary of Public Submissions Received and Cazaly's Response (Submissions 1 to 8)

The numbering and order of public submissions identified was allocated by the EPA and is used in this document for consistency.

Submission No.	Issue No.	Submission	Proponent Response
Biodiversity - Flora and Vegetation			
8	1	**Recommendation 2:** That a DRF monitoring program be developed on the advice of and in agreement with DEC. This monitoring program should: • Identify the location and size of 'impact', 'baseline' and 'control' sites; • Define monitoring frequency, timing, intensity and replication; • Define 'health or abundance'; • Identify how and what parameters will be used to measure 'decline' or 'rate of decline' in 'health or abundance'; • Define trigger levels and responses; • Identify reporting requirements in respect of monitoring results; • Be reviewed for effectiveness and revised if required at two year intervals. **Discussion:** *I. robustus* is only known from one location consisting of 1,020 mature individuals in close proximity to the mining proposal. A 350 metre exclusion zone from the closest sub-population has been committed to, and a 400 metre buffer for the remaining sub-populations. No direct impacts are proposed on this taxon, however, indirect impacts constitute a risk and need to be managed. *I. robustus* has fine hairs present on branchlets and leaves, making the species susceptible to dust impacts, similar to what has been observed in the reduced health and condition of flora with similar characteristics in the Windarling Range. Given this risk, a life of mine monitoring program is required to ensure adverse indirect impacts on this species do not occur as a result of the proposal.	Cazaly's EIA-PER document is in agreement with the submission which refers to a commitment to develop a DRF monitoring plan in consultation with the DEC (refer to the PER Appendix 13 EMP sub-plan Robust Coneflower Management). Furthermore, Cazaly have developed the Environmental Monitoring Strategy for the proposed Project which includes the monitoring program for *Isopogon robustus* (DRF) provided as Appendix 14. The submission references one location for this species; however four separate populations of *Isopogon robustus* (DRF) have been located in the southern part of the Project area totalling 1,020 plants. The populations occur on four distinctive ranges separated by distances of between 250 m to 600 m. Cazaly's EIA-PER document has modified the Project proposal to provide a 350 m buffer zone from one population and 400 m buffer zone from the remaining three populations.
8	2	**Recommendation 3:** That strategies for reducing and mitigating the impact(s) on *Lepidosperma* sp. Parker	The submission that the proposed Project may have a detrimental impact changing conservation status of species *Lepidosperma* sp. Parker Range and *Lepidosperma* sp. Mt Caudan is incorrect and not supported by Cazaly.

Submission No.	Issue No.	Submission	Proponent Response
		Range (N. Gibson and M. Lyons 2094) (Priority 1) and *Lepidosperma* sp. Mt Caudan (N. Gibson and M. Lyons 2081) (Priority 1) be developed by the proponent. **Discussion:** Adequate precautions need to be taken to avoid detrimental changes to the conservation status of priority listed flora, including those under consideration for listing as DRF. The lack of full scientific certainty should not reduce the requirement for avoiding serious, irreversible loss. Applying World Conservation Union (IUCN) criteria is an internationally accepted approach to demonstrating significant impacts. *Lepidosperma* sp. Parker Range (N. Gibson and M. Lyons 2094) is currently listed as a Priority 1 species. It is known from seven populations and 13,772 individuals. See Table 1 below for an assessment of impacts on conservation significant flora. Using the limited data provided in the PER, when *Lepidosperma* sp. Parker Range is assessed against IUCN criteria, it meets the threat category of vulnerable. With the population(s) proposed to be directly impacted in the mine footprint (see PER, Figure 30, page 67), the proposal is likely to result in a change in IUCN category to endangered and could elevate the risk of local extinction of this taxon. The proposal would thus result in assessment against IUCN criteria at a greater level of threat. The PER does not clearly indicate where the other *Lepidosperma* sp. Parker Range populations occur in the Parker Range region in relation to the project area. *Lepidosperma* sp. Mt Caudan (N. Gibson and M. Lyons 2081) is currently listed as a Priority 1 species. It is known from approximately five populations (endemic to the Parker Range Region) and 73,144 individuals. See Table 1 below for an assessment of impacts on conservation significant flora. When *Lepidosperma* sp. Mt Caudan is assessed against IUCN criteria, it meets the threat category of vulnerable. There are issues with the accuracy of the population extrapolation used in the PER, as the number of quadrats sampled and the counts in the quadrats (from one individual to 500 individuals per 10 m^2 quadrat) vary significantly. Due to this variance in plant numbers and densities, DEC also assessed the impact of the proposal on the area of occupancy of the species. The results of this preliminary	Cazaly can only assess the potential impact on any species or community based on its current conservation classification status. Submission references to IUCN criteria for species conservation are not listed in EP guidelines, policy or legislation used for this assessment. Cazaly understand this is an internal assessment criteria used within DEC Policy. It is unreasonable for Cazaly to use IUCN criteria for impact assessment. Cazaly has adopted the Parker Range PEC at a regional level for impact assessment. The PEC boundaries range from 5 to 25 km around the Mt Caudan impact area. The impacts on plant species quantities and known populations indicate a non-significant impact to species *Lepidosperma* sp. Parker Range (1.6% impact, five populations in PEC within 20 km) and *Lepidosperma* sp. Mt Caudan (4.8% impact, 12 populations in PEC within 10 km). Cazaly deem the PEC the appropriate bioregion for Project impact assessment on priority flora. Although Cazaly disagree with the submission, DEC's Table 1 has been replicated as Appendix 10 and updated with the submission information request. <u>*Lepidosperma* sp. Parker Range</u> There are five populations of *Lepidosperma* sp. Parker Range within the Parker Range region. One which is the impacted population in the Project Area (219 plants) and the other four populations within 10 km of the Project Area which contain a total of 197 plants in the north-east (one of these populations is only 2.6 km east from the impacted population containing 116 plants refer Figure 4). In total there are 416 plants within 10 km of the Project Area (including those plants in the Project Area). The submission DEC Table 1 has been replicated as Appendix 10 and amended to reflect this data. Based on a 10 km area approx 52% of the population will be impacted. However, 20 km from the impact area is a large population of 9,939 plants at Mt Palmer. Increased numbers of this species are found with increased survey intensity. It is highly likely additional populations would be found; hence the current estimate of 52% impact of the known population within 10 km is conservative. Regionally there are eight populations, including Parker Range, Mt Finnerty and Bremer Range (including Mt Palmer) with a total of 13,992 plants. The distribution of these populations range from Mt Finnerty (located 90 km north west of the Parker Range region to Maggie Hays (located 150 km south west of Parker Range region). Genetics undertaken by R. Barrett (Barrett et. al., 2010) have confirmed the inclusion of specimens from seven discrete populations: two from Mt Finnerty, one from the Parker Range, two from north east of the Parker Range (Mt Palmer) and two from the Bremer Range (refer to the PER Appendix 6). In consideration of the concerns raised in the submission, Cazaly will modify the proposal to add the following new commitment for *Lepidosperma* sp Parker Range: "**6.2.2-2 Cazaly will undertake a rehabilitation research program (within 6 months of operations commencement) for species *Lepidosperma* sp. Parker Range (P1) which will focus on shallow soil analysis, transplantation trials and seed trials for the restoration of this species post mine decommissioning, closure and rehabilitation.**" <u>*Lepidosperma* sp. Mt Caudan</u> There are twelve populations of *Lepidosperma* sp. Mt Caudan within the Parker Range region totalling 77,152 plants (all within 10 km of the Project impact area). This species is located within similar vegetation community as *Isopogon robustus* (DRF). This species is currently endemic to the Parker Range area. Regarding extrapolation methods employed, the submission is misleading. Extrapolation is accepted practice for large areas, for example, the DEC Kalgoorlie has accepted this technique with Botanica Consulting over many years. In the case of *Lepidosperma sp.* Mt Caudan, the submission reference to 500 plants was a total count for a single location, and not 500 plants per 10 m2 quadrat. The actual variation in species count per 10 m^2 quadrat was 10 to 300 plants. Actual quadrats represent about 8% of the individual extrapolated areas (across 8 locations) of the *Lepidosperma* sp Mt Caudan. In the project impact area 2,213 plants were counted of a total 3,629 plants (i.e. 61% were actual count and not extrapolated).

Submission No.	Issue No.	Submission	Proponent Response
		assessment suggest that the impact of the proposal will reduce the area of occupancy of the taxon by 22 per cent. Regardless of the assessment method (impacts on individuals or area of occupancy), the taking of *Lepidosperma* sp. Mt Caudan under this project could change the IUCN ranking to endangered due to a decline in individuals and/or habitat. The proposal is thus likely to result in assessment against IUCN criteria at a greater level of threat. Recent genetic research on the species by the Botanic Gardens and Parks Authority (Barrett, Barrett and Wallace, 2010) recommends that detailed population-level genetic studies may be required to determine the extent of variation within and between sub-populations to determine the impact on genetic diversity.	In this regard, to account for variations in species population density, an average of quadrats was used. Quadrats were selected at random; hence some variability in species density is expected. The submission that further genetic studies may be required for species *Lepidosperma* sp. Mt Caudan is noted by Cazaly as a suitable project for the PRCT.
8	3	**Recommendation 4:** The flora and vegetation information for the impact assessment has significant limitations. In particular, the surveys were not conducted consistent with the guidance outlined in Guidance Statement 51 and DEC's Recommended Interim Protocol for Flora Surveys of Banded Ironstone Formations (BIF) of the Yilgarn Craton. **Discussion:** <u>Conservation significant flora</u> A desktop analysis of DEC's database identifies 18 conservation significant flora species known to occur in the Parker Range that were not identified in the PER. For example, Gnephosis intonsa (Priority 1) and Grevillea lissopleura (Priority 1) are recorded from within the project area but were not identified in the PER. Further, the PER does not adequately examine the likelihood that conservation significant flora, although not detected in the surveys, may be present within the project area. For example, Leucopogon validus (Priority 1), a Parker Range endemic associated with BIF, is known to occur at several sites within hundreds of metres from the proposed project footprint, however there is no explanation as to why the species is considered a 'low likelihood' (PER, Table 17, page 65) of occurring within the project area. In addition, in an area with limited information and a high number of conservation significant, restricted and endemic species,	Botanica Consulting has undertaken a search of florabase at commencement of the surveys to identify prospective conservation significant flora. An assessment of these results presented in Cazaly's EIA-PER document page 65 Table 17. Florabase results in conjunction with the results from a DEC database search provided to Botanica Consulting indicate there are only three Priority Flora species listed by the DEC as occurring within the Project Area; *Hakea pendens, Acacia concolorans* and *Baeckea grandibractea* subsp. Parker Range. There are another 17 Priority and one DRF species that occur within the PEC (including PEC boundary) but not in the Project Area. The closest DEC listed location of *Gnephosis intonsa* is located approx 9 km south of the Project Area and *Grevillea lissopleura* approximately 13.5 km south east of the Project Area (refer to Figure 3). In retrospect, species *Gnephosis intonsa* (Priority 1) and *Grevillea lissopleura* (Priority 1), *Leucopogon validus* (Priority 1) would be revised to medium likelihood of occurrence (on page 65 of the PER Table 17). *Leucopogon validus* is found in the region but not in the impact area (i.e. not affected by the proposal). This species was specifically searched for in the Project Area as it occurs in close proximity and occupies similar habitat to that identified in the Project Area. Botanica Consulting are confident this species does not occur within the area given the number of searches conducted for this species. This takes into account the timing of surveys. It is not possible to know with absolute certainty the location of every species on florabase within the Parker Range which extends to the north and south over 25 km. Cazaly has undertaken multiple seasonal surveys over multiple years in the Project impact area and local area (which is well understood with a high degree of certainty). Survey limitations are inherent in all projects. Cazaly's consultants have undertaken seasonal surveys in conjunction with Guidance Statement No. 51. The submission fails to raise the practical limitations to environmental surveys in a semi-arid changing climate, common to the industry. Guidance Statement No. 51 states that in general, the primary flora and vegetation survey should be conducted following the season which normally contributes the most rainfall in the bioregion. Note the survey area is within the South-West region where winter provides the greatest rainfall. The Level 2 survey in which the primary flora and vegetation survey was conducted was in Spring. In order to sample the majority of the flora and vegetation, it is necessary to time additional surveys, with exert Guidance Statement No. 51 stating; *"according to secondary peaks in rainfall and/or the flowering period for additional suites of species or significant flora or plant*

Submission No.	Issue No.	Submission	Proponent Response
		it is unusual that there were no new species identified from the surveys. <u>Flora surveys</u> Seasonality appears to have been a significant limitation on the flora and vegetation identifications and information provided in the PER. The surveys were conducted largely outside the appropriate season for flora surveys as outlined in Guidance Statement 51 and DEC's Recommended Interim Protocol for Flora Surveys of Banded Ironstone Formations (BIF) of the Yilgarn Craton. In 2007, the Level 1 spring survey was conducted in a year where the annual rainfall was over 100 millimetres less than the average; in 2008, two of the three Level 1 surveys were conducted in summer; in 2009 the regional Level 2 surveys were largely conducted outside of spring in a year with less than average rainfall; and, in 2010 the targeted surveys were largely conducted outside of spring where the current annual rainfall (Bureau of Meteorology data to September 2010) was less than 50 per cent of the average annual rainfall for the area. <u>Data analysis – vegetation</u> The PATN analysis for the quadrat based vegetation surveys (required for development proposals on BIF ranges within the Yilgarn Craton) was reviewed by Ted Griffin. This review showed that the survey quadrats were highly diverse, some of the communities are expected to be highly restricted (particularly laterite communities) and the different datasets appear to have "…floristic communities not widely shared.", although an assessment on how distinct the individual communities are or what the influence of survey methodology had on the datasets cannot be readily determined. The impact assessment provided in the PER is based on amalgamated vegetation associations or Beard vegetation associations for the State, which is too coarse in scale for useful comparison, and does not identify impacts on the vegetation units identified as unique from PATN analysis. Notwithstanding these limitations, it has been possible for DEC to form a view, based on expert advice and on review of a supplementary report which provided	*communities".* Botanica Consulting conducted additional surveys throughout the flowering period of many priority flora species, noting that flowering periods for some species were not listed on Florabase. Additional targeted priority searches were conducted in May 2010 where rainfall had peaked for the year and was at an average level. Additionally, exert of Guidance Statement No. 51 states; *"to take into account short-term climatic fluctuation (such as drought or deluge) on the number of species present at the time of sampling. In periods of below average rainfall, there may also be justification for supplementary sampling in succeeding years to compensate for low diversity recorded during a survey (especially of ephemerals). This will be highly desirable in cases where drought is prolonged, or there are unusual circumstances such as possible pockets of significant flora and vegetation, or in the absence of a range of species or significant flora that might normally be expected in the environment."* In 2007, when surveying first began rainfall was below average. In the following year (2008) rainfall was well above average and Botanica Consulting conducted three Level 1 flora surveys where many samples to be obtained whilst conditions were desirable. In contradiction to the submission, these were conducted in Autumn, Spring and Summer and not two out of three in Summer as suggested. For the Level 2 survey in Spring although annual rainfall was below average the month preceding the survey (September) had above average rainfall and the month of the survey had almost average rainfall (2 mm less), Based on Guidance Statement No. 51 requirements above, this was deemed the most appropriate time to conduct the primary survey following above average rainfall and following winter rainfalls. Exert from the BIF protocol states: *"that surveys should be carried out at an appropriate time of the year (i.e. Spring or following seasonal rains in the arid zone)."* The Level 2 survey was conducted in Spring and the region is not considered arid rather semi-arid Mediterranean. Additionally the Interim Protocol for Flora Surveys of BIF in the Yilgarn also states: *"it is most important that the survey occurs during flowering season"* Botanica Consulting confirm this was undertaken during flowering season. The quadrats were also visited more than once. Cazaly have complied with the requirements of Guidance Statement No. 51 and Interim Yilgarn BIF Protocol. The results of the surveys provide a high level of certainty to enable the Minister of Environment, other decision-making authorities and the public to make informed conclusions about the species present and the potential impacts of the Mt Caudan deposit proposal.

Submission No.	Issue No.	Submission	Proponent Response
		quantitative data on the level of impact on vegetation units (provided by the proponent on 10 December 2010), that impacts on vegetation associations would not appear to constitute a fatal project flaw. However, DEC is not able to clearly determine if the proponent has maximised the protection of restricted BIF communities in mine site planning.	
5	4	Statements contained in Section 2.7.2 of the Botanica Consulting (2010) report include: • "Lack of botanical knowledge for the area, limited amount of specimens collected within the area." • "It has yet to be determined whether the vegetation units identified as part of the Parker Range PEC also occur on other ranges within the Yilgarn region." As there is a lack of botanical knowledge of the area and the extent to which key vegetation units fall within the mining tenements the proposal should not proceed	The submission lacks context. The lack of botanical knowledge, limited amount of specimens collected and vegetation units identified refer to limitations of survey in regard to the PEC region which is an area of 55,960 ha. These types of limitations are appropriate (for this and any other survey on similar scale) and Cazaly cannot be expected to definitively understand the botanical knowledge over such a large area. Information provided by government agencies has been used in good faith. The botanical knowledge of the PEC has been substantially increased and contributed to the conservation of threatened species following extensive survey activity. In regards to the Project impact area and local area, Cazaly has undertaken multiple seasonal surveys over several years which is well understood with a high degree of certainty when compared to the PEC region. Cazaly deem the PEC bioregion to be the appropriate area for vegetation unit-mapping. It is not necessary to understand within the wider Yilgarn as suggested in the submission. The results of the surveys provide a high level of certainty to enable the Minister of Environment, other decision-making authorities and the public to make informed conclusions about the species present and the potential impacts of the Mt Caudan deposit proposal.
6	5	A submitter is concerned about the possible impact on *Lepidosperma* sp. Parker Range, *Lepidosperma* sp. Mt.Caudan, Baeckea grandibracteata subsp. Parker Range and Hakea pendans, particularly because the number of plants of *Lepidosperma* sp. Mt.Caudan was been arrived at by extrapolation. These species should be the subject of further studies to better understand their populations. It is also of concern that taking of 12.6% of the Hakea and 13.9% of the Baeckea is seen as insignificant. Mining is another risk added to climate change and all the other pressures on restricted plant species. At the very least we would expect to see some research into this matter.	The submission raises opinion regarding impacts on four priority species of flora and links an unrelated matter of climate change associated with mining. The estimated percentage impacts need to be considered with context of the conservation status of the species (i.e. whether it is rare or threatened) and the distribution at local and regional area scale. The submission that the proposed Project will adversely impact particular identified species and affect the longer-term risk to the specified species is incorrect. Each species identified is responded as follows: <u>*Lepidosperma* sp. Parker Range</u> Five populations within 10 km of the Project Area (416 plants) represents approx 52% local area impact, however approximately 20 km NE is a large population of *Lepidosperma* sp. Parker Range with 9,939 plants (Mt Palmer). Genetic testing undertaken by Barrett, Barrett and Wallace (2010) of all six populations have confirmed the inclusion of specimens of each population as same distinct species with a further regional population at Mt Finnerty. Increased numbers of this species are found with increased survey intensity. Initially there were only 219 plants of this species known to occur within the Parker Range region and now there are 416 plants of this species identified within the Parker Range region. Regionally there are eight populations with a total of 13,992 plants (only 4,823 extrapolated over 6.8 ha due to density). Removal of 219 plants will result in 1.6% impact on total species (refer to Cazaly's response to Issue No. 2). <u>*Lepidosperma* sp. Mt Caudan</u> Impact upon 3,629 plants, with 23,288 plants within 175 ha decomposing laterite ridge (with DRF) and densely populate

Submission No.	Issue No.	Submission	Proponent Response
			occurrence extrapolated within the PEC of 77,152 total plants. Twelve populations identified, 4.7% impact (refer to Cazaly's response to Table 7 Issue No. 2). This is a relative new Priority 1 species (listed 2010) with survey intensity and knowledge intensifying in the last 12 months. Further response is also provided within Table 7 Issue No. 2. *Baeckea grandibracteata* subsp. Parker Range Impact upon 22 plants from total 158 plants (13.9%). Low rainfall complicated targeted surveys; however surveys have been completed with sufficient accuracy to be relied upon. This species occurs along the western edge of the Parker Range PEC. In a season that has sufficient winter rainfall, a spring survey would reveal increased known populations and plant number for this species, hence impact assessment is conservative. Loss of impacted species is non- significant and sufficient confidence with survey intensity is presented. *Hakea pendens* Although 630 plants (12.6%) of known population 4,974 plants within 10 km of the Project Area is suggested by the submission as a concern, this species is known to occur outside the Parker Range PEC, and Botanica Consulting has not listed all known populations. Cazaly has undertaken to collect seed which is highly likely to lead to a successful rehabilitation outcome based on previous observations. The seed from this species responds readily to disturbance as a primary colonizer of burnt areas. Cazaly cannot provide comment on the Climate Change debate and affects at a local level. Cazaly's EIA-PER presents results of seasonal environmental surveys from the local area and region with the results of the surveys providing a high level of certainty to enable the Minister for the Environment, other decision-making authorities and the public to make informed conclusions about the species presents and the potential impacts of the proposed Project.
8	6	**Recommendation 5:** That following clarification of the impacts on priority flora, the proponent be required to mitigate the residual impact on priority flora. **Discussion:** It appears that for some conservation significant flora taxa the impacts of the proposal are underestimated by being calculated at the total species level, rather than at the project or local (within 10 kilometres) level, and in some cases the impacts were determined through highly variable extrapolation methods for the population counts. This inconsistent interpretation of impacts at a local, regional and species level makes it difficult for an accurate impact assessment to be conducted. Nevertheless, DEC has attempted to recalculate the impact table (see Table 1) for the priority flora identified within the PER based on the often conflicting information presented in Section 6.2.2. Noting the limitations described above, the proposal potentially presents significant local level (approximately 10 kilometres) residual impacts on the following priority flora: • Acacia concolorans (Priority 2): 15 per cent at	Cazaly has assessed the impacts to priority flora on a regional (nominally Parker Range PEC), local and impact area level (refer to definitions page 1 of the PER Section 1.1). The submission reference to total species level is misleading. Cazaly has adopted a regional level approach within the PEC for impact assessment (boundaries range from 5 to 25 km around the Mt Caudan impact area). A total species level would represent the known extent within the State, where numbers would be higher than those identified within the region of the PEC. Cazaly's EIA-PER document has selected an appropriate regional extent (i.e. the Parker Range PEC boundary and the PEC buffer area) which provides correct context and sufficiently accurate assessment of the impacts on priority flora. The submission has proposed an additional localised method of assessment being a Project Area which is defined as: "Project Area – The area adjacent to the impact area which contains connected populations of flora species as determined by botanical assessment" Cazaly disagree that another localised definition is required for impact assessment. Although Cazaly disagree with the submission, DEC's Table 1 has been replicated as Appendix 10 and updated with information requested by the submission at a new Project Area level definition. From this information, Cazaly offer the following response in comparison to EIA-PER assessment: *Acacia concolorans* (P2): 1.3% at local level impact and 71.4% of the population impacted in the Project Area. Of the 168 total numbers of plants known within the Project Area, 120 plants will be impacted. However within 10 km of the Project area, 9,369 plants have been identified in a minimum of 11 separate populations. *Baeckea grandibracteata subsp*. Parker Range (P1): 13.9% at the local level and Project Area level impacted. The Project Area consists of 158 plants consisting of five populations, 22 plants will be impacted. A further 8 populations have been identified at a regional level. *Banksia shanklandiorum* (P4): 1.0% at local level impacted and 40.9% of the population in the Project Area level impacted

Submission No.	Issue No.	Submission	Proponent Response
		the local level (100 per cent of the population in the project area); • Baeckea grandibracteata subsp. Parker Range (K. Newbey 9270) (Priority 1): 13.9 per cent at the local level; • Banksia shanklandiorum (Priority 4): 40 per cent at the local level; • Cryptandra crispula (Priority 3): 6.5 per cent at the local level (the remaining population is susceptible to indirect impacts); • Hakea pendens (Priority 2): 12 per cent at the local level (95 per cent of the population in the project area); • *Lepidosperma* sp. Mt Caudan (N. Gibson and M. Lyons 2081) (Priority 1): 22 per cent area of occupancy for the species (45 per cent area of occupancy of the species in the project area); and • *Lepidosperma* sp. Parker Range (N. Gibson and M. Lyons 2094) (Priority 1): 52 – 100 per cent at the local level (100 per cent of the population in the project area). If consideration is given to mitigating the priority flora impacts through research or rehabilitation, DEC requests the opportunity to review and provide further comment on these proposals.	(was previously assessed within PER as 100%). Of the total 17,812 plants identified within the Project Area (all within 10 km), 7,293 will be impacted. This species is known to have a wide distribution spanning over 260 km at a wider regional level; *Cryptandra crispula* (P3): 6.5% at a local and Project Area level impacted. Of the 46 plants known to exist within the Project Area, only three plants will be impacted. No other populations have been identified within a 10 km area. From a regional context a further five populations of this species have been recorded; *Hakea pendens* (P2): 16.4% at a local level impacted and 55.8% at a Project Area level impacted. The Project Area consists of seven populations of 1,129 plants with 630 plants from three populations will be impacted. Within a 10 km area, a further 3,845 plants are known to occur. At a wider regional level a further 28 populations have been identified. *Lepidosperma* sp. Parker Range (P1): 1.6% at the local level impacted and 100% of the population at the Project Area level impacted. All of the 219 plants identified in the Project Area will be impacted. Within a 10 km area a further four known populations with 197 plants are known to occur. However locally a large population of 9,939 plants is known to exist with extent between 20 to 27 km north-east (Figure 4). Genetic testing by R. Barrett (Barrett et. al., 2010) has found these populations to be the same distinct species classification. *Lepidosperma* sp. Mt Caudan (P1): 4.8% at local level impacted and 35% at Project Area level impacted. The Project Area consists of four populations with 10,355 plants, of which two populations of 3,629 will be affected by operations. Within a 10 km area a further eight populations with approximately 66,797 plants have been identified (Figure 5). This plant is endemic to the Parker Range area. Cazaly is currently in discussions with Botanical Gardens and Park Authority and other consultants regarding restoration requirements and knowledge gaps to support shallow rooted endemics like *Lepidosperma* sp Mt Caudan and *Lepidosperma* sp Parker range. In regards to mitigating the priority flora impacts, Cazaly has undertaken a new commitment for *Lepidosperma* sp. Parker Range (P1), refer Issue No.2: "**6.2.2-2 Cazaly will undertake a rehabilitation research program (within 6 months of operations commencement) for species *Lepidosperma* sp. Parker Range (P1) which will focus on shallow soil analysis, transplantation trials and seed trials for the restoration of this species post mine decommissioning, closure and rehabilitation.**" Cazaly deem existing commitments outlined in the EIA-PER document are sufficient to mitigate impacts on other priority flora species.
6, 8	7	**Recommendation 10:** That in regard to indirect impacts: • A buffer, in which the vegetation condition and population health may decline to pre-defined limits, should be delineated around areas approved for disturbance. • Trigger levels should be provided, which specify the level of decline in vegetation condition and population health within the pre-determined buffer area, at which point contingency measures should be applied to avert further vegetation condition and health decline.	Cazaly's EIA-PER document provides commitment for annual vegetation monitoring within predicted zone of indirect impact (i.e. 250 m from mine and 125 m from ore haul route). Reference sites are included in the monitoring program for comparative purposes. Furthermore, Cazaly have developed a vegetation monitoring approach outlined in the Environmental Monitoring Strategy for the Project provided as Appendix 14. In regards to reference site establishment, it is noted the Project is orientated along a north - south axis. In consultation with the OEPA and DEC it is proposed at 500 m intervals on a north-south orientation, a transect heading on east-west direction will be installed. These transects will have quadrats at 50 m spacing. The quadrats will be 20 x 20 m in size. A species count will take place along with a health rating of 1 to 5, with 1 - dead through to 5- excellent. A soil sample will be taken quarterly and tested for iron oxide level, soil salinity and Ph. A photographic record will comprise of photographs from the corner of each quadrat each quarter. It is proposed that the buffer zone match the extent of indirect impact modelling of 250 m and the trigger levels be defined as a health decline of 50% or greater of the vegetation in comparison to the reference sites. In consideration of the submission, Cazaly will modify the proposal with a new commitment as follows:

Submission No.	Issue No.	Submission	Proponent Response
		• Limits of acceptable decline in vegetation condition and population health within the buffer area should be provided. • The proponent should develop a vegetation condition and population health monitoring program applicable to the buffer area. This program should also include analogue reference sites against which to compare data, and provide for adaptive management where the measurable change has reached the identified trigger levels. The program should be developed on the advice of and in agreement with DEC. • The proponent should report annually on the findings of the monitoring program. **Discussion:** Based on the known indirect impacts from iron ore mines on BIF ranges in the region (including, but not restricted to, dust, changed hydrology, changed microclimate, introduced species), potential increased fire risk and the potential risk of groundwater mounding from the tailings storage facility, ongoing monitoring and studies should be required.	"**6.2.1-2 Cazaly will establish a buffer zone of 250 m around the final Mt Caudan Project area of disturbance in which the vegetation condition and population health may decline up to 50% of baseline or reference site health condition, before requiring a contingency action plan to be implemented**." Cazaly do not consider vegetation monitoring is required for the Upper Haul Road, Powerline or Parker Range Bypass Road Project areas. Indirect impacts to vegetation in these Project areas are assessed as non-significant or beyond the entire control of Cazaly's operations.
4, 5, 6	8	The PER states (Sections 4.8.1) that the brine from the desalination plant will be mixed with mine water and sprayed on roads to aid with dust suppression. Concerns have been raised about the impact of saline overspray on the vegetation adjacent to the roads. The proponent should demonstrate that there will be no adverse impacts to vegetation and that sufficient attention has been given to this matter in the design, construction and operation of road infrastructure.	Saline water solution provides a suitable treatment for the minimisation of dust on in-plant mine roads due to: • Use of groundwater for dust suppression provides the most appropriate disposal method for local pit dewatering to allow dry-floor mining of the Mt Caudan pit. • The disposal of elevated salinity of desalination brine in low quantities is most appropriately diluted in pit dewatering groundwater. The combined water salinity for dust suppression (when mixed with brine) is expected to be approximately 50,000 mg/L TDS (page 27 of the PER Section 4.8.1). • The natural salinity of the groundwater varies between a brackish 20,000 mg/L TDS to a saline 60,000 mg/L TDS. The sequencing of pit dewatering bores will deliver a resultant water salinity of approximately 41,000 mg/L TDS, which is slightly higher salinity than seawater being about 35,000 mg/L TDS. The resultant water will be of a low salinity compared to groundwater salinity in the region which is generally regarded as hypersaline >150,000 mg/L TDS (page 41 of the PER Section 5.6.2). Water carts will use a dribble bar to reduce any saline water over-spray impacts to surrounding road vegetation (Page 119 of the PER Section 6.2.8). • The in-plant roads and operational areas will be constructed with drains, culverts, floodways, detention basins and sediment traps to contain saline water used in dust suppression (page 140 of the PER Section 6.3.3). Cazaly will undertake monitoring of vegetation health in predicted dust impact zones (inclusive of vegetation along in-plant roads) on an annual basis (page 120 of the PER Commitment 6.2.8-1). This monitoring is included within the Environmental Monitoring Strategy for the Project provided as Appendix 14.

Submission No.	Issue No.	Submission	Proponent Response
			Cazaly have also identified contingency actions for the use of dust surfactants with saline water in event of significant vegetation health degradation (page 120 of the PER Section 6.2.8).
Biodiversity - Fauna			
8	9	**Recommendation 6:** The proponent should develop a malleefowl monitoring program in consultation with DEC, to monitor the effects of the mine development on the local malleefowl population, and to provide for adaptive management of operations where adverse impacts are identified. **Discussion:** In addition to removing 49 hectares of mapped preferred malleefowl habitat, there is the potential for indirect and long-term impacts from the proposed development on the malleefowl population. The malleefowl population requires monitoring and mitigation measures that provide for adaptive management of the impacts on this threatened species.	Cazaly's EIA-PER document includes the EMP sub-plan Malleefowl Management provides commitment to monitor trends in Malleefowl abundance, distribution to assess threats and habitat (refer to the PER Appendix 14) which incorporates the monitoring and adaptive measures provided in the submission. Additionally, Cazaly provide Malleefowl monitoring activities, frequency and reporting triggers as outlined in the Environmental Monitoring Strategy for Project as Appendix 14. Cazaly will undertake to consult with the DEC regarding acceptance of the sub-plan for Malleefowl Management and the Environmental Monitoring Strategy. Cazaly disagree with the submission regarding indirect and long-term impacts to Malleefowl population. Cazaly's EIA-PER document has assessed the potential impacts from the Project and it is unlikely that any loss of species or change in conservation status will occur as a result of the mine development.
8	10	**Recommendation 7:** That the threatened western rosella population within the Project Area be surveyed to determine the impact of the proposal on this species. **Recommendation 8:** That the results of the western rosella survey are provided to DEC for review and comment. **Discussion:** The proponent has not adequately addressed the impact of the proposal on the threatened western rosella population recorded within the Project Area. The PER states that given the species was identified outside of the cleared agricultural area of the Wheatbelt, it "…is not threatened in the contiguous vegetation…" (page 98) and "The threatened classification of this species refers to its presence in the fragmented native vegetation within the agricultural landscape in the Western wheatbelt" (page 69). The western rosella is threatened and the Project Area may be important to the conservation of this species.	Cazaly recognise that the Western Rosella species is a Schedule 1 listed species under the Wildlife Conservation Act 1950. Cazaly also recognise that the Western Rosella is a threatened species per Wildlife Conservation (Specifically Protected Fauna) Notice 2010(2) dated 17 August 2010. Since the EIA-PER document was released, Cazaly has completed a targeted survey for the Western Rosella within the Mt Caudan Project area (refer Section 3.5 and Appendix 7). Cazaly provided a copy of the survey report (Appendix 7 within this response) to the DEC in May 2011 for review and comment. Western Rosellas are known to favour Eucalypt woodlands due to the potential creation of hollows for breeding, particularly in Salmon Gum (*Eucalyptus salmonophloia*), Gimlet (*E. salubris*), Wandoo (*E. wandoo*), Marri (*Corymbia calophylla*), Flooded Gum (*E. rudis*) and York Gum (*E. loxophleba*). Vegetation communities within the Mt Caudan Project area include Salmon Gum Woodland, Gimlet Woodland and Mixed Eucalypt woodlands that support these two species (refer Table 3 in this response document). Thus, potential breeding hollows for the Western Rosella is expected within these vegetation communities. Cazaly's current information regarding the Western Rosella species and potential habitat is summarised as follows: • During all the seasonal and targeted surveys at Mt Caudan Project Area undertaken since 2008 by KLA, only two Western Rosellas have been seen or heard in the Project area (as sighted during the autumn 2009 survey). • Potential breeding hollows in the Mt Caudan Project Area are identified in Figure 2 from the targeted survey with 681 potential hollows located within 137.7 ha of vegetation habitat surveyed. The 137.7 ha surveyed represents 56% of the 247.1 ha identified potential habitat (i.e. Salmon Gum Woodland, Gimlet Woodland and Mixed Eucalypt woodlands). Based on extrapolation an estimated 1,222 potential hollows are located within the Mt Caudan impact area. • A further 1,156 potential breeding hollows were recorded in 251 ha subject to targeted survey outside the Mt Caudan impact area. Based on extrapolation an estimated 175,012 potential hollows are located within the PEC alone, but

Submission No.	Issue No.	Submission	Proponent Response
			outside the Mt Caudan impact area. • The identified impacted potential habitat of 247.1 ha represents 59.7% of the total Mt Caudan impact area clearing of 414 ha However, Cazaly has established that potential breeding hollows are not confined to the proposed footprint of disturbance within the Mt Caudan area but exist locally outside the impact area and more widely within the Parker Range PEC and Great Western Woodlands. An estimated 38,000 ha (i.e. 68%)of the 55.960 ha of the Parker Range PEC alone comprises favoured Eucalypt woodlands habitat representing an extensive number of potential breeding hollows for Western Rosella and other hollow-breeding species. Cazaly's EIA-PER document assessed the impact to this species and it is highly unlikely any loss of species or change in conservation status will occur from the implementation of the Project (page 98 of the PER Section 6.2.3). Further, the Western Rosella is a highly mobile species which is patchily distributed within the Western Wheatbelt and Parker Range PEC. The near absence of Western Rosella sightings in the Mt Caudan Project Area validates the species is unlikely to be occupying the area as core breeding habitat. The clearing of 247.1 ha of potential Western Rosella habitat cannot be avoided by the proposal, however is unlikely to result in any species loss. However, the proportions of woodlands habitat impacted remains very low (0.4%) as a proportion of the Parker Range PEC region, with wider habitat existing within the Great Western Woodlands. Therefore Cazaly's predicted outcome is a non-significant impact on this species (i.e. unchanged from the EIA-PER assessment).
Biodiversity - Troglofauna			
8	11	**Recommendation 11:** That the proponent provides information to clarify and describe the nature, extent and continuity (connectivity) of the prospective troglofauna habitat in relation to singletons sampled from and restricted to the pit area. **Discussion:** The information provided in the PER is insufficient for DEC to adequately determine the impact risk from this proposal on troglofauna. Four species of troglofauna were identified within the proposed disturbance footprint. As the proponent has not adequately described the nature, extent and continuity (connectivity) of the prospective troglofauna habitat, additional information to clarify prospective troglofauna habitat connectivity should be provided. Without this information DEC is unable to confirm the conclusion by the proponent that "Given the range of rock types that appear to provide suitable troglofauna habitat in the region and the extent to which these have been mapped to the north and south of the Project area, there appears	Troglofauna are known to exist in above water table habitat, with the water table established at Mt Caudan at approximately 60 m below natural surface. The Parker Range area is interconnected geologically by deep banded iron formation units (orientated north-south) that occur across broad areas to depths of at least 100 to 150 m below surface. The area displays numerous faults and post-tectonic dykes (dolerite, diorite or gabbro) which cut across stratigraphic boundaries. These faults and dykes are inferred from easterly trending linear magnetic anomalies (refer to the PER Appendix 8 Figure 6 – Rockwater, 2010). Weathered and oxidized cross-cutting structures explain the lateral migratory movement of troglofauna and core habitat connectivity between adjacent greenstone belts in the Parker Range (refer Figure 6). Connectivity of troglofauna habitat is also likely to occur through other units within the greenstone succession that have been shown to provide suitable habitat for troglofauna. Sampling on the Mt Caudan deposit identified eight potential troglofauna species. Four of these species, *Philosciidae* sp. B14, *Hanseniella* sp. B5, *Tyrannochthonius* sp. B1 and *Austrochthonius* sp. B1, were identified from reference sites in other parts of the Parker Range. The reference sites sampled during regional troglofauna sampling for the Project largely comprise gold exploration holes along faults or shear zones associated with metavolcanic units or BIF. Regional troglofauna sampling to the east of Mt Caudan in the Parker Range BIF (near granitoid-greenstone contacts), and to the north of it near the Great Victoria Mine (sulfidic-metapelite-greenstone contact), yielded the vast majority of troglofauna specimens during regional sampling. To the east of Mt Caudan, the units that yielded troglofauna are associated with the contact between BIF and other metasedimentary rocks. These are mapped broadly by Bagas (1994) as graphitic and sulfidic schists, amphibolites (dolerite and gabbro; basaltic komatiite) and banded-iron formation (Parker Range BIF) (refer to the PER Figure 35).

Submission No.	Issue No.	Submission	Proponent Response
		to be a high likelihood that the Parker Range troglofauna community and its constituent species are also widespread (although in low abundance) within these habitats" (PER, page 101).	Sampling of sites to the north of Mt Caudan (along strike) has identified several of the species recorded at Mt Caudan. The St Barbara (SB) - series sites near Great Victoria are located in a lateral extension of the BIF succession present at Mt Caudan (refer to the PER Figure 35). The two general locations are separated by approximately 11 km. Aeromagnetic imagery shows the two locations are also separated by an easterly trending dolerite dyke (refer to the PER Appendix 8 Figure 6 – Rockwater, 2010). The reference sites near Great Victoria are gold exploration holes within the Mt Caudan massive sulphide unit, which extends southward through Mt Caudan for at least 25 km. Three species, *Philosciidae* sp. B14, *Hanseniella* sp. B5 and *Austrochthonius* sp. B1 were recorded at Mt Caudan and approximately 9 to 11 km to the north, near Great Victoria. The troglofauna species *Hanseniella* sp. B5 was also recorded at reference sites within the Mt Caudan BIF (0.2 km north of Mt Caudan), Parker Range BIF (3.3 km east) and graphitic and sulfidic schist (7 km north east and 10 km north). This suggests that suitable habitat exists locally in a wide range of rock types. The Parker Range BIF, to the east of Mt Caudan, has a strike length of about 20 km and forms the core of the Parker Range. The presence of at least four of the species from Mt Caudan in adjacent greenstone belts in the Parker Range shows that there is continuous habitat locally that has allowed the species to extend their spatial distributions. Given that many of the reference sites yielding troglofauna were from different geological units to those at Mt Caudan, the continuous habitat is not restricted to BIF units and includes other units in the volcanic succession as well as metamorphosed rocks along faults and shear zones. The presence of similar species at the Mt Caudan deposit/Parker Range and up to 46 km to the northwest at Mt Rankin (*Austrochthonius* sp. B1 and *Trichorhinae* sp. B6) suggests that suitable habitat exists between these locations beyond just banded iron formation habitat. Although not recorded at Mt Caudan, the isopod *Trichorhinae* sp. B6 was recorded in the Parker Range BIF and at three other reference sites, indicating a range of up to 53 km (Rockwater, 2010).The species' distributions could therefore be as a result of the favourable mobility of these species through suitable habitat between these ranges. The extent of prospective habitat and spatial distributions of taxa identified by the troglofauna investigation suggests that the four singleton species identified in the planned Mt Caudan pit are highly likely to occur in adjacent areas of the Parker Range. Cazaly provide Figure 6 further depicting the geological habitat connectivity for local troglofauna in the Mt Caudan Project area. The immature knowledge base for troglofauna species in the Yilgarn region is recognised by Cazaly. Cazaly have committed to further field surveys within suitable habitat to improve the understanding of species distribution and abundance (existing Commitment 6.2.4-1).
Biodiversity - Other			
8	12	**Recommendation 9:** The proponent's key environmental management strategies (Parker Range Environmental Management Plan) should include consultation with DEC in the development of the monitoring, management, reporting and adaptive management strategies for species of conservation significance. **Discussion:** The proposal is located in an area of high conservation value with a number of threatened, restricted and endemic flora, fauna and communities. To manage the potential direct and indirect impacts of the proposal on biodiversity and ecosystem functionality, the proponent has proposed a series of management strategies.	Cazaly will undertake to consult with the DEC regarding acceptance of the EMP and associated sub-plan's regarding conservation significant species. Cazaly have provided an Environmental Management Strategy as Appendix 14. The project is located in the Parker Range PEC, which is defined as "poorly known ecological communities". The submission that the Project impact area is of high conservation value is not supported by Cazaly's EIA-PER document. Cazaly agrees with the submission that it is likely some parts of the PEC region and local Project area would contain high conservation value communities. Cazaly's EMP document provides specific sub-plans for Malleefowl, *Isopogon robustus* and less specific sub-plans for the management of other conservation significant flora and fauna (which would include the *Lepidosperma* sp. Parker Range, *Lepidosperma* sp. Mt Caudan and the Western Rosella - refer Appendix 13). Based on potential impacts and likely outcomes, a non-significant impact to these species is predicted from the Project. Cazaly do not believe that specific management plans for *Lepidosperma* sp. Parker Range, *Lepidosperma* sp. Mt Caudan and the Western Rosella are required based in impacts assessed in the EIA-PER document.

Submission No.	Issue No.	Submission	Proponent Response
		For some conservation significant species (particularly DRF I. robustus, *Lepidosperma* sp. Mt Caudan, *Lepidosperma* sp. Parker Range, malleefowl, western rosella), the impact of the proposal is or may be significant and specific programs and strategies should be developed in consultation with DEC and these strategies should be made a condition of approval.	
5	13	It is rare to find a suitable habitat for conservation significant plants and animals at one location such as that found at Mount Caudan. Where else does the same habitat type exist for the conservation significant plants and animals? If the Mount Caudan flora types exist elsewhere they are likely to be subject to similar impacts from mining. The proponent refers to another target to the south known as Wrathschild. If other similar vegetation types are impacted by past, current and future mining what habitats will remain and will they be protected?	Cazaly's EIA-PER document outlines the results of seasonal surveys undertaken over many years in the Mt Caudan Project area and provided regional context within the Parker Range PEC. The EIA-PER document has identified and assessed the potential impacts to conservation significant plants, animals and habitat with the predicted outcome representing a non-significant impact on environmental factors. This conclusion has considered extensively the conservation significance and biodiversity of a region and is supported by the establishment of habitat for conservation significant plants and animals outside the Project impact area. It is acknowledged that the Parker Range region has a history of mining activity, including: • Centepede Interpride (Gold) • Dulce (Heap Leach) • British Hill (Gold) • Yilgarn Star (Gold) The region is synonymous with farming and mining post European settlement. The submission that Mt Caudan flora types that exist elsewhere would be subject to similar impacts from mining is a generalisation and not supported by history of mining in the region, nor the conclusions of the EIA-PER. The EIA-PER assessment is for the Mt Caudan deposit. Any other iron ore targets (e.g. Wrathschild as suggested in the submission) are excluded from this assessment. It is unreasonable for Cazaly to provide comment on any possible future proposals for iron ore targets outside the scope of the EIA-PER assessment.
5, 6	14	The mine will have a significant impact on the natural values of the Mt Caudan area of the Parker Range and result in a loss of biodiversity.	Mt Caudan impact area has no significant natural value. Mt Caudan itself may be more appropriately classified as a hill (encompassing a 500 m extent), rather than a range which may be deemed to have high natural values. Mt Caudan peak itself is distinguishable; however it is not dominant in the area at about 45 m above natural surface. Within the local Parker Range area peaks of up to 75 m above natural ground level; with extent of several kilometres are apparent and frequent. By example; Parker Range extensions to the north, British Hill to the south and Toomey Hills to the east are all more dominant (page 39 of PER Section 5.3). A communications tower is situated on one of the higher local peaks to the south west of the proposed Project. Several of these features offer more extensive natural values than Mt Caudan. Cazaly's EIA-PER document has identified and assessed the potential loss of biodiversity at Mt Caudan with the predicted outcome representing a non-significant impact on environmental factors. This conclusion has considered extensively the conservation significance and biodiversity of the region and is supported by the establishment of habitat for conservation significant species outside the Project impact area.
5	15	The Great Western Woodlands is claimed to be the largest intact low rainfall forest type in the world. Will the cumulative impacts of this project (414 ha) and other	Cazaly disagree with this submission. The environmental significance of Mt Caudan has been determined and the likely impacts assessed in the EIA-PER document,

Submission No.	Issue No.	Submission	Proponent Response
		projects impact the values of the Great Western Woodlands in the long term? Will the Great Western Woodlands become the Great Western Wasteland?	with the predicted outcome representing a non-significant impact on environmental factors. As suggested in the submission, the impact of clearing 414 ha within Great Western Woodlands represents 0.003%. Historical and cumulative impacts from future mining proposals within the Great Western Woodlands are beyond the influence of Cazaly.
6	16	The selection of truck route 5 will involve extra land clearing and the fragmentation of a large tract of bushland as shown in Figure 6. As there does not seem to be much difference between truck route 5 and 6 apart for the clearing and fragmentation aspects why was route 5 chosen?	This submission relates to the selection of truck route 5, vegetation fragmentation and differences to truck route 6 (refer to the PER Section 2.6.3). Cazaly has undertaken extensive consultation with all key stakeholders potentially impacted by the truck route selection and use of public and private roads. This included not only environmental factors, but also social factors such as public safety, noise/vibration and economic factors such as farming-trucking interaction and costs. During consultation it was evident to Cazaly that all the truck route alternatives had individual advantages and disadvantages, with any selected route requiring a compromise on one or more factors. Truck route 6 involves the use of Liddell road which has an established residence and farm infrastructure within 20 m of the proposed truck route. Although route 6 has the benefit of avoiding the Moorine Rock township and extra land clearing the social impact to the residence amenity would be significant. Further clarification of loss of amenity for the residence is provided by Ecotech and Herring Storer Acoustics (Appendix 12 letters provided as Figure D and E) summarised as follows: • Noise: based on sound modelling of 137 truck movements per day the sound level would increase by 15 dB(A) during day and by 11 dB(A) during the night. Noise spike from single truck movements will be greater than 75 dB(A). Based on EIA-PER assessment criteria the noise levels will be marginally within WAPC standards of 60 dB(A) day limit and 55 dB(A) night limit, however the noise spike will be above the 65-70- dB(A) limit which is likely effect health and wellbeing significantly. • Dust: based on dust modelling of the truck route, at a distance of 120 m the dust deposition rate is modelled to exceed the NSW EPA criteria limit of 4 g/m^2/month. AUSPLUME™ modelling has limited reliability at short distances from dust source, however it is reasonable to conclude from modelling that dust deposition will materially exceed the 4 g/m2/month limit at a residence distance of 20 m from truck route. The social impact from noise and dust will result in a material loss in amenity at residence located only 20 m from a Liddell Road truck route 6. Truck route 5 avoids this impact through separation distance. Truck route 5 will require clearing in fragmented native vegetation of approximately 4.1 ha (revised from 6.8 ha to 4.1 ha refer to Section 3.3 and Table 7 Issue No. 1 (Office of the EPA Matters)). The alignment has been selected in consultation with the landowner to minimise farming-trucking interaction, maximise use of the remaining farming land and allow mutually safe operation. Cazaly has completed environmental surveys of the fragmented vegetation within the alignment, with approximately 50% of the proposed clearing occurring over vegetation which has been heavily grazed. Cazaly have also selected an alignment which utilises in-part existing cleared fenceline access tracks. Cazaly have carefully selected a route which minimises environmental impact in an area with limited fauna and unlikely to contain any environmentally protected species of flora. Further response regarding fragmented vegetation is provided in Table 8 Issue No. 1 (Office of the EPA Matters).

Submission No.	Issue No.	Submission	Proponent Response
Biodiversity - Soil			
4	17	It is noted that 6 m high topsoil stockpiles are proposed. DMP recommends that surface area to volume ratios are maximised as much as possible to maintain biological activity and the rehabilitation value of the topsoil resource. Generally, a maximum height of 2 m is recommended; however, a maximum height of 3 m may be acceptable if the soil is truck tipped, as the resulting stockpile shape increases the surface area to volume ratio. (PER, page 133 & Appendix 14 section 9.1.2)	This submission relates to the proposed 6 m high topsoil stockpiles for the Project. The 6 m high topsoil stockpiles have been selected to minimise the amount of vegetation clearing required for temporary stockpiling of topsoil (prior to re-use in rehabilitation). Cazaly have reconsidered the point raised in the submission and will revised the stockpile height from 6 m to 3 m (truck tipped) for the Project. This has been addressed in the Mining Proposal. Cazaly have updated the CRCP and EMP included as Appendix 8 and 13 herein.
Pollution - Groundwater and Surface Water			
8	18	**Recommendation 3:** That the design of the tailings storage facility be further evaluated to consider its environmental impact. **Discussion:** Reference is made to the iron tailings facility not being lined and achieving less than 10^{-8} permeability. Standards suggest this should be less than 10^{-9} permeability. As water at the TSF/ evaporation pond will be very saline, its design should be examined in more detail.	This submission relates to the permeability of the TSF and salinity of the tailings. Cazaly can confirm that the TSF is proposed to be unlined with a permeability of less than 10^{-08} m/s specified. This permeability rate is typically achieved from unlined tailings facilities in the goldfields region. Lower permeability rates suggested by the submission could only be achieved by Cazaly in the event the TSF is fully lined – an unnecessary requirement given the chemical characteristics of the tailings will be similar to fresh rock in the mine. The water salinity at the TSF is likely to be less than 60,000 mg/L TDS inclusive of effect from evaporation. This is comparative to the salinity of natural groundwater in the local area and lower than the hyper-saline groundwater in the region (typically 150,000 mg/L TDS).
4	19	Further details will be required for the design of the Tailings Storage Facility (TSF) in the Mining Proposal. Suitable geotechnical information will be required, and the design will be assessed by the DMP's Resources Safety Division. Further characterisation information will also be required on the chemical and physical properties of the tailings in order to support the design and management objectives of the TSF. It also appears that there is a natural drainage channel in the vicinity of the TSF location. The design of the TSF will need to ensure that the natural drainage patterns are maintained as much as possible, and that the drainage in this area will not compromise the structural integrity of the TSF.	Cazaly acknowledge the request of the submission to provide further details of the TSF within the Mining Proposal administered under separate legislation of the *Mining Act 1978*. As requested, Cazaly will provide the addition detail in the Mining Proposal. No further information is therefore required for this EIA-PER Assessment.
4	20	It is noted that pipelines will be located within a 'v-trench' to enable capture of any spillage. Consideration should also be given to the use of suitable 'leak detection systems' and 'automated shut-off mechanisms' for pipelines carrying saline water or tailings material (or other environmentally hazardous materials).	This submission relates to the leak detection systems and automated shut-off mechanisms for pipelines carrying saline, tailings or environmentally hazardous materials. The proposal will be a 24 hour a day operation. Cazaly will have engineering controls and operations personnel available to detect, contain and mitigate any leaks within pipeline systems. Cazaly provide an Environmental Monitoring Strategy (Appendix 14) which further outlines monitoring activities for pipelines.

Submission No.	Issue No.	Submission	Proponent Response
			Cazaly have considered the submission and can see merit in the potential earlier detection and containment of larger pipeline systems within the Project (i.e. mine dewatering to water storage pipelines, the TSF transfer pipeline and the TSF water return pipeline). In addition to the engineering and operating administrative controls for these pipelines, Cazaly offer the following: • Differential flow measurement will be provided on the supply and discharge points of the specified pipelines. • In the event of a major pipeline failure, the plant control system will automatically shutdown / isolate the pipeline and notify the control room operator. Cazaly will include these design requirements in the Project scope for the specified pipelines.
5	21	Is there a sufficient water resource available for this project? If so what will the impact of dewatering for mining operations, including beneficiation, be on other groundwater users and deep rooted trees?	Cazaly have selected a beneficiation technology which has a low external input intensity, as opposed to a high external input intensity such as for magnetite processing. The selected beneficiation flowsheet (i.e. wet screening, cyclone sizing, and gravity separation) is similar to other iron ore operations which produce a marketable iron fines product (e.g. iron ore operations at Whyalla, South Australia and Tom Price, Western Australia). In regards to water, the beneficiation process is a wet circuit which requires approximately a further 185 kL/y for the 4 Mtpa production rate over and above a conventional dry crushing process (page 27, PER Table 6 and 7). Sufficient water resources have been identified from the deposit to support the operation with the first 5 years proven. In addition, Cazaly have designed the flowsheet with water conservation controls (i.e. dewatering thickener for tailings, TSF water reclaim system, RO plant brine recovery and captured pit rainfall dewatering). There will be no impact on water uses in the area as the nearest user is seven kilometres away, with groundwater modelling indicating drawdown impacts are limited to one kilometre from the mine pit (page 106-107 of the PER Section 6.2.6). In the presence of saline groundwater, vegetation root systems close off at depth. It is unlikely there is any groundwater dependent vegetation in the area, given the water table is about 60 m from natural surface and is saline (page 106 of the PER Section 6.2.6).
5	22	Early drilling of Mount Caudan (1900s) found only massive pyrrhotite an iron rich sulphide (Magnetic pyrites), and no other minerals of significance. It is not known to what extent pyrrhotite will be found at the base of the proposed mining pit and be discarded as sulphide waste which will ultimately break down to sulphuric acid.	Cazaly cannot comment on historical drilling from the 1900's unsubstantiated in the submission. Iron sulphides occur below the base of oxidation of the Banded Iron Formation (BIF) at depth. Cazaly have found evidence of pyrite and magnetite-rich rock types in deep drilling intersections as suggested in the submission at the Mt Caudan deposit. The iron ore to be mined is entirely within the oxidation zone of the host BIF, which extends well beyond the proposed pit depth of 135 m. Iron sulphides are excluded from planned mining as it occurs at depths beyond the extent of the proposal. In regards to sulphide waste characterisation, the oxide waste material to be mined is characterised as non-acid forming (S < 0.3%) and is highly unlikely to result in outcomes suggested in the submission. In the unlikely event that ARD or metal leaching was encountered, Cazaly have provided a contingency measure of a PAF cell to encapsulate any problematic material (page 110 of the PER Section 6.2.7).
Pollution - Dust			
8	23	**Recommendation 4:** That the proponent's dust management plan include the installation of appropriate dust monitoring and dust control systems. **Recommendation 5:** That monitoring be undertaken for a minimum period of 12 months. **Recommendation 6:** That the relevant averaging period of continuous dust (PM_{10}) sampling performed by TEOM	Cazaly's EIA-PER document presented a management strategy for dust, which includes an EMP sub-plan Dust Management and environmental monitoring stations as part of the mine infrastructure. Cazaly have also committed to a monthly dust monitoring program of sensitive dust receptors for life of mine, which is provided in the Environmental Monitoring Strategy in Appendix 14 to this response. For non-permanent monthly dust monitoring, the selection of detail sites for monitors will be determined with consultation with the sensitive dust receptors. Cazaly has committed to dust control systems (with contingency actions) which are consistent with practices for dust

Submission No.	Issue No.	Submission	Proponent Response
		be provided to DEC. **Discussion:** The duration of continuous dust measurements is not adequate, the duration of monitoring is not sufficient and the averaging period for dust monitoring (PM_{10}) is not cited in the dust section of the draft PER (Table 23). The continuous dust measurements (using TEOM) were undertaken at the CBH rail siding and primary school at Moorine Rock (1 and 31 July 2010) to determine baseline dust levels. DEC noted that TEOMs can provide short term average data (e.g. 10 minute, hourly), however, the campaign monitoring period was too short. There is also no averaging period cited for the continuous dust monitoring (PM_{10}) in the dust section of report (Table 23). These measurements are inadequate to determine accurate baseline dust levels. As a consequence, monitoring results cannot be verified and may not comply with the relevant standards. The measurements for both the dust deposition rates and continuous dust sampling, which are presented in section 5.12, have been conducted during winter time (1 to 31 July 2010) and the background concentration is expected to be significantly higher in summer due to drier conditions.	management in the iron ore industry (page 119-120 of the PER Section 6.2.8). Cazaly have committed to a monthly dust monitoring program of sensitive dust receptors for life of mine, which meets the suggested minimum period of the submission (page 120 of the PER Section 6.2.8). A baseline dust survey of 12 month duration is of limited value, but is more appropriate for emissions during operations. The averaging period adopted for the TEOM sampling was 10 minutes. The TEOM data was then averaged over a 24 h duration as required in Western Australia per Ambient Air Quality NEPM Standard (refer to the PER Appendix 10 page 9 Table 2-1). The 10 minute TEOM data is available (if needed) but experience suggests the value of this information is limited in a baseline survey (i.e. more useful in an emissions licensing context).
8	24	**Recommendation 7:** That the proponent develops a comprehensive dust management system which involves validation of dust emission rates as well as the installation of an appropriate dust monitoring and dust control system. **Discussion:** There are concerns about dust impact on sensitive vegetation communities. It should be noted that estimating fugitive particulate emissions is very complex, as there are a number of factors which result in uncertainty in the modelled concentrations. As a result, the concentrations produced in the air quality analysis are best used in a qualitative comparison of changes in modelled concentrations rather than putting too much emphasis on the absolute values of the concentrations.	Refer to response Table 6 Issue No. 23 (Submission 8). Cazaly provide an air quality monitoring strategy within the Environmental Monitoring Strategy for the Project (Appendix 14). A commitment to validate the dust emission model is included in Cazaly's EIA-PER document (page 119 of the PER Section 6.2.8). Cazaly have presented a comprehensive dust management plan, inclusive of dust modelling, commitments for monitoring, model validation and dust management controls (with contingency actions). Annual dust performance and monitoring reports will be provided to the DEC and DMP for compliance and audit. Air quality monitoring will be undertaken in accordance with current air quality management standards as applicable in Western Australia.
8	25	The modelling results presented in the air quality assessment report indicated that the dust (PM_{10}) concentrations (the maximum 24 hour concentration) at	Cazaly acknowledge issues raised in the submission; however, some statements are misleading. NEPM standard criteria was considered for baseline monitoring and dust modelling at the Upper Haul Road only where sensitive human receptors were identified. By the submission, linking the NEPM standard PM_{10} concentrations to the plant (i.e.

Submission No.	Issue No.	Submission	Proponent Response
		all sensitive receptors are significant and reach or are close to the National Environment Protection Measure (NEPM) standard. AQMB noted that these concentrations are within the plant boundary but there remains concern about further exceedances of relevant standards. DEC could not find evidence of responses to the following issues raised in previous technical advice: • As stated in the draft PER "the Mt Caudan topography is, in parts, steeply sloping (up to 48 metres above natural ground level) in the northern area of the deposit. The northern side has unfavourable topography for excavation of landform". It should be noted that AUSPLUME is principally designed for calculating impacts in regions with no complex terrain. • It is stated "there is no available monitoring data in the vicinity of Parker Range, the impact of current dust loading cannot be adequately quantified for this assessment. To include a reasonable level of background, annual averaged PM10 data from DEC's 'Ambient Monitoring of Particulate Matter in Kalgoorlie, 2006-2007' (DEC 2009) report was used. A nominal 22 µg/m3 has been used." If the real level of background is higher than nominal concentrations, it might exceed NEPM standards. • As advised on the draft of the Parker Range Iron Ore Project PER, the accommodation village has been excluded from the project environmental assessment. AQMB understands that worker accommodation should be considered as a sensitive receptor and requests that the EPA clarifies the status of worker accommodation.	Mt Caudan site) is misleading as the two locations are 57 km apart. Dust deposition monitoring and modelling was undertaken at the plant Mt Caudan site, which is not assessed per NEPM standard PM_{10} concentrations. Cazaly's EIA-PER document presented the significance and impacts of the dust modelling predictions. The modelling is considered sufficiently conservative for the proposed operations and Cazaly are likely to achieve performance within the estimated emission predictions. The elevated topography of Mt Caudan peak is localised at the site and will the removed in the six months of mining, thus not contributing to elevated dust generation for life of mine. AUSPLUME^{TM} is considered the most appropriate software tool to predict dust emissions for life of mine from the Project. Cazaly has embarked on a baseline monitoring program to obtain a winter and summer baseline estimate. In the absence of relevant baseline data, a data set from the Kalgoorlie region was adopted. Since Cazaly's EIA-PER document, a summer baseline dust survey has been completed in the month of January-February 2011 by Ecotech (refer Section 3.4 and Appendix 6 of this response document for results and summary). Based on baseline dust monitoring surveys of a typical winter and summer month snapshot, the following can be inferred regarding baseline dust levels in the Project area and validity of dust modelling presented in the EIA-PER document: The baseline summer dust measurements are typically between two to three times greater than the winter dust measurements for sensitive dust receptors within the Project area. The baseline PM_{10} dust levels average between 5.1 to 5.9 µg/m³ (winter month) and between 21.9 to 22.9 µg/m³ (summer month). A yearly average baseline of between 13.4 to 14.5 µg/m³ can be inferred from the winter and summer snapshot averages. This is significantly less than the assumed 22 µg/m³ yearly average assumed in the EIA-PER dust modelling results. The submission that the real level of background dust is higher than that assumed in the dust modelling is not supported by these recent results. It is likely that the PM_{10} dust emissions modelled in Cazaly's EIA-PER document are over estimated by between 7 to 9 µg/m³ and emissions will be within NEPM criteria. Therefore the dust modelling presented in Cazaly's EIA-PER document is considered sufficiently conservative and represents a reasonable prediction of dust impacts from the Project development. The village is within an established township of Marvel Loch which is a distance of 15 km from Mt Caudan mine and greater than 3 km from the Parker Range road ore haulage truck route. The village is not a sensitive dust receptor due to distance of separation from the dust emission sources.
6	26	The results of wind tunnel testing for simulated trucking with no treatment resulted in the loss of 2.06% dust by weight (PER Section 6.2.8). The submitter is concerned as they consider that dust management measures provided in Management Plans or procedure are not always adhered to in the mine or trucking operation. At the very least auditable standards of independent	This submission relates to auditable standards of independent monitoring, likely penalties and raises the 2.06% by weight dust loss measured on page 114 of the PER Table 29. Cazaly have recognised the indirect impacts from dust associated with the proposal and have presented extensive and varied management actions to minimise the impacts from dust on vegetation (page 116 of the PER Section 6.2.8). This includes EMP sub-plan Air Quality Management which includes dust management plan requirements and actions (refer to the PER Appendix 14). Furthermore, dust monitoring results and outcomes from vegetation health surveys will be made available for audit and review

Submission No.	Issue No.	Submission	Proponent Response
		monitoring are needed with realistic penalties attached.	to the DEC and DMP (refer to the PER Commitment 6.2.8-4). Cazaly will undertake dust monitoring in accordance with the Environmental Monitoring Strategy provided as Appendix 14. In regards to likely penalties, Cazaly do not foresee why these would be applicable for this Yilgarn based Project. The 2.06% by weight dust loss requires context. This was measured in wind tunnel testwork designed to simulate dust lift off for ore haulage operations (30 m/s for a duration of 1 h), with no dust suppression controls. Cazaly have recognised the requirement for dust suppression controls during ore haulage and estimate dust lift off will be <0.4% by weight with installation of water spray bars (and dust surfactants as required) to limit emissions. The conditions of the testwork are conservative by design and dust losses indicated by the submission are not reflected in the proposal for the Project.
5	27	Dust from the mine and transport route is likely to damage a substantial area of vegetation.	Cazaly acknowledge that there will be indirect impacts to vegetation from dust, as with any iron ore mine in industry. Cazaly have completed detailed dust modelling of both the mine and ore haulage route to quantify the likely dust impacts associated with operations. Dust modelling predicts that impacts to vegetation are limited to 250 m from the mine and 125 m from the haul road (page 116 of the PER Section 6.2.8). The decline in health of vegetation within the predicted limits of the model is not certainty – as observed dust impacts are more confined than modelling predictions based on actual performance in other Yilgarn mines. The submission suggests that the high topography of Mt Caudan is likely to spread the dust over a wide area. Cazaly dust modelling does not support this opinion. The elevated topography of Mt Caudan peak is localised at the site and will the removed in the first six months of mining, thus not contributing to elevated dust generation for life of mine. Cazaly have recognised the indirect impacts from dust associated with the proposal and have presented extensive and varied management actions to minimise the impacts from dust on vegetation (page 116 of the PER Section 6.2.8). Additionally, Cazaly provide the Environmental Monitoring Strategy as Appendix 14.
Pollution - Noise and Light			
5	28	Noise and light pollution produced by the proposal is likely to drive fauna from the area.	Cazaly partially agreed with the opinion offered in the submission as Cazaly have identified noise and light effects upon local fauna as a potential impact to terrestrial fauna. The effects of physiological and behavioural responses to light are discussed in EIA-PER Section 6.3.7 (and equally apply to noise impacts from the proposal). Artificial light (and noise) can have detrimental effects on local fauna to greater and lesser degrees depending on the proximity of the light (and noise) source to the fauna habitat surrounding the proposal. Effects on fauna tend to be species specific with some species tolerating changes better than others (PER Section 6.3.7). Given the mobility and lack of abundance of fauna in the Project area evidenced by many seasonal surveys since 2008, the impacts from light and noise will be relatively low with most fauna moving to the vast expanses of intact vegetation at the Mt Caudan area. The impacts associated with noise and light generated by the proposal is unlikely to have a detrimental impact upon or change the conservation status of local terrestrial fauna (refer to the PER Sections 6.2.3, 6.2.9 and 6.3.7).
Social Surroundings - Community Values			
5, 6	29	The proponent should address the tourism and community values of the BIF range and the impacts of the loss of these values. Some of these values include, but are not exclusive to: • Mount Caudan as a vantage point to view the	The Mt Caudan area does not have any material tourism value, and is supported by the Shire's tourism observation in the region (noting no formal records are kept). In addition, from 2007, Cazaly has maintained a part-time presence at Mt Caudan. In this time, evidence of public interest or tourism classified activities has not been observed. Mt Caudan may be more appropriately classified as a hill (encompassing a 500 m extent), rather than a range. This is evident in area photography (refer to the PER Appendix 15). The submission that a study of tourism and community values of the BIF

Submission No.	Issue No.	Submission	Proponent Response
		vista of vegetation into the distance; and • Mount Caudan as a significant landmark in the Parker Range area.	range is not required. Cazaly cannot comment as to why Mt Caudan was a selected landmark to be shown on road maps (as opposed to other features in the area), but it is understood regional road map features were based on earlier feature maps compiled by the Australian Army. Cazaly have proposed a bypass road for a new alignment of the Parker Range road to maintain public access to the area.
6	30	The legacy left for future generation following mining and closure the area could be poorer as a result of impacts including the impact on the flora as a result of the standard of revegetation and the landscape left after mining.	Cazaly has outlined measures at decommissioning, closure and rehabilitation that are consistent with current regulatory requirements and industry standards. Cazaly has undertaken several commitments to the restoration of biodiversity where performance is outcomes based against reference sites in the area. As Cazaly cannot control the vagaries of the weather and climate, it is acknowledged that similar effects upon reference sites and restoration efforts may be limited on a seasonal basis. Cazaly has committed to an ongoing monitoring of the rehabilitated landscape following closure and any remedial work identified during the monitoring to encourage revegetation will be undertaken accordingly (refer to Appendix 14 of this response). In regards to landscape, a vegetated Waste Rock Landform will be of compatible height to Mt Caudan (peak 450 mASL) and has been designed to support vegetation growth, resist erosion and be stable for the long term (page 126 PER Section 6.2.10). It is acknowledged that a pit void for the Mt Caudan north and central deposits will remain post closure, however Cazaly propose to backfill and rehabilitate the Mt Caudan south deposit (thus removing an otherwise 1.4 km pit void of a possible total 4.0 km mining pit length). The closure strategy will be reviewed every 3 years to ensure current regulatory requirements and industry best practices are incorporated (as appropriate).
Social Surroundings - Aboriginal Heritage			
1	31	It is noted that the heritage survey of the mining area and proposed bypass is estimated to have covered only 50% of the area. The heritage survey report states that ground surface visibility was generally very poor. As such, there is some possibility that current unidentified archaeological material will be identified during works conducted in the area. The proponent should be aware of this eventuality and draw all relevant employees/contractors attention to the Cultural Heritage Management Sub-plan that has been prepared to assist with the management of potentially unidentified Aboriginal heritage sites within the area. It is suggested that any induction for mine employees encompasses information on the recognition of Aboriginal cultural material (such as stone tool artefacts) and outlines specific procedures to follow in the event of the discovery of Aboriginal cultural material. It is suggested that should such a discovery occur then the proponent cease work and contact the Department of Indigenous Affairs for advice on the management of such material.	The survey method undertaken is consistent with guidelines and ground surface visibility limitations to the survey methods employed have been provided (refer to the PER Appendix 13). Cazaly outlined the Management Strategies for Aboriginal heritage awareness content in site inductions for employees and contractors (refer to page 150 of the PER Section 7.1). To further address this submission Cazaly provide an additional commitment 7-1-3 as follows: **"7-1-3 Cazaly will include Aboriginal heritage awareness and cultural material identification in site inductions for employees/contractors inclusive of reference to the Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Cultural Heritage with specific actions required in the event of discovery of any Aboriginal cultural material."** Liaison with the Department of Indigenous Affairs per *Aboriginal Heritage Act 1972* is stipulated in Sub-plan Cultural Heritage in the any cultural material is identified.
1	32	The archaeological survey investigated all caves and overhangs within the Project Area and states that "no	Cazaly's heritage consultant has undertaken a review of field notes from the December 2009 survey regarding inspection of rockshelters and overhangs within the Project Area. Of all the rockshelters and overhangs inspected with the Traditional

Submission No.	Issue No.	Submission	Proponent Response
		evidence of occupation was present and recent rockfall and erosion processes has obscured any evidence of past Aboriginal use of the area." While it is acknowledged that there is a lack of surface evidence of Aboriginal use of the area, the report on the archaeological survey does not indicate whether the caves and overhangs inspected were considered to have any potential archaeological deposit. Caves and overhangs with archaeological deposits are potential Aboriginal heritage sites and the proponent should investigate any potential archaeological deposit in order to determine whether consent under section 18 of the Aboriginal Heritage Act may be required prior to any impact to a cave or overhang.	Owners, only one of the rockshelters has the potential for sub-surface material due to a sandy floor. Other rockshelters had a rocky floor and no possibility of a sub-surface component. It is noted that debris from ceiling falls also hampered observation of the surfaces of some of the rockshelters (refer to Appendix 12 – clarification letter presented as Figure F). Cazaly do not consider the excavation of the identified rockshelter sandy floor is required (in this instance). Given the absence of cultural materials found at the other rockshelters in the Mt Caudan area, Cazaly consider it is unlikely any cultural material would be discovered from such an excavation.
1	33	In the heritage survey report a number of the Aboriginal consultants indicated that they had spent time hunting and camping in the general area. The Response to Submissions should discuss the cultural use of the area by Aboriginal peoples and discuss the impact so that the principles contained in EPA Guidance Statement No. 41 are more adequately met.	Cazaly's EIA-PER document has adequately addressed the requirements of EPA Guidance Statement No. 41. In regards to use of the area by the Traditional Owners, all of the people consulted for the survey have extensive knowledge of the area. The Traditional Owners confirmed during surveys there is little current use of the area by any of the individuals since the urbanisation era apart from the occasional passing through when travelling an alternative route to Kalgoorlie or Perth (refer to Appendix 12 – clarification letter presented as Figure F). Generally however, the Traditional Owners prefer to travel along bitumen roads where there is access to fuel, food and other refreshments and there is less possibility of being stranded if a vehicle breaks down or has a flat tyre. The Southern Cross-Forrestania road is quite remote and there is no fuel, water or other facilities between Marvel Loch and Hyden or Norseman. On rare occasion, the Traditional Owners will travel around the Wheatbelt and Goldfields at certain times of the year to collect bush tucker such as quangdong fruit or witchety grubs. Cazaly will assist the Traditional Owner's with access to non-mining areas adjacent to the mine for this purpose (if requested). There will be a non-significant impact to cultural use as a result of the Project as the area has limited non-specific cultural value to the Traditional Owner's.
Other - Assessment			
8	34	**Recommendation 2:** That assessment of the impacts of the Moorine Rock rail siding be included in the draft PER. **Discussion:** The draft PER has not assessed the impacts of noise, dust etc from the railway siding at Moorine Rock as it has been excluded from the project assessment. As this facility is not a prescribed activity it cannot be assessed under Part V of the EP Act.	This submission relates to the inclusion of the Moorine Rock rail siding into the EIA-PER assessment (Part IV *EP Act* 1986) to enable assessment under Part V of the *EP Act* 1986. Cazaly confirm that the Moorine Rock rail siding is excluded from the EIA-PER assessment. The Moorine Rock rail terminal is unrelated to this EIA-PER assessment under Part IV *EP Act* 1986 and a separate submission for works approval will be submitted by Cazaly under Part V *EP Act* 1986.
6	35	The mine should not proceed as it is small scale particularly when compared to the Pilbara area of Western Australia. BHP and Rio mine in a month what Cazaly plan to mine in 10 years.	Cazaly does not agree with the submission. The submission suggests that boutique operations should not commence due to scale of operations being less than the Pilbara, which is incorrect. The Yilgarn region has a history of small scale boutique mines in both the gold and iron ore sector. For example Koolyanobbing's Iron Ore Operations initially commenced in the 1960's and was then reopened in the 1990's on a modest

Submission No.	Issue No.	Submission	Proponent Response
			mining scale (1.5 Mtpa) in comparison to the Pilbara. Koolyanobbing Operation is now an established miner in the Yilgarn (8.6 Mtpa) and is small operation in comparison to the iron ore industry in the Pilbara. The Parker Range Project is a high quality ore deposit and Cazaly as a boutique iron ore operation of 4 Mtpa will displace other lesser quality products in the seaborne iron ore market. Pilbara scale mining is not required for viability.
6, 7, 8	36	It is noted that the PER document is peer reviewed (section 11.2); however, errors have been identified (see list below) which brings in to question the quality and accuracy of the information contained in the document. Examples of errors in PER document: • References to *Aganippe castellum* in the PER being a threatened species (ranked endangered) are not accurate. The species has been downgraded to Priority 4. • Malleefowl and native vegetation spelling in Table 37 page 158. Also native vegetation spelling second dot point under the <u>Parker Range Conservation Trust and Mandate</u> heading. • The Department of Environment, Water, Heritage and the Arts (DEWHA) is now named the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). • Construction Commencement (anticipated) is shown as January 2010 (Summary of the Main Elements for Parker Range Project page i and repeated through the PER).	Cazaly's EIA-PER document has been prepared in consultation with the OEPA and other decision making authorities. The document has undertaken multiple revisions and reviews (which included a Peer Review by Golders and Associates in August 2010). The examples of errors identified in the submission are of a minor nature and have no bearing on the impact assessment or environmental management commitments and outcomes from the EIA-PER document. In regards to specific examples listed in the submission: • *Aganippe castellum* was downgraded to a Priority 4 in 2010, after EIA-PER document submission. Cazaly welcome this change in status as a 25 m buffer zone from known locations would be difficult to administer. In this regard Cazaly modify EIA-PER Commitment 6.2.5-1 as follows: **"6.2.5-1 Cazaly will implement clearing controls to avoid (where possible) all known *Aganippe castellum* (Tree-stem Trapdoor Spider) for the management of this Priority species during mine development, operations, closure and rehabilitation"** • Noted, spelling of native vegetation. • DSEWPaC was formed in 2010 after EIA-PER document submission. All future references to DEWHA (including this Response to Submission document) have been updated. • The construction commencement date of January 2010 is incorrect. Cazaly wish to amend this anticipated date to July 2011.
8	37	**Recommendation 1:** That the proponent contacts DEC's regional office to initiate the scoping process for a works approval under Part V of the Environmental Protection Act 1986 (EP Act). Discussion: The list of prescribed activities is not complete (PER Section 2.7.4). While the prescribed activities will not be determined until an application for a Works Approval is submitted, the following activities (beyond those already listed) may be included: • Crushing and screening; • Dewatering – including the design of the "turkeys nest" referred to in section 4.4.1;	This submission relates to assessment of prescribed facilities for a works approval under Part V of the *EP Act 1986.* Cazaly has subsequently met with the DEC (Licensing Branch) on 21 December 2010. Cazaly note the further information requested in the submission and confirm that additional information will be provided with the Part V works approval application for the Project.

Submission No.	Issue No.	Submission	Proponent Response
		• Landfill; • Bulk chemical storage.	
Other – Closure and Rehabilitation			
4	38	The proponent should commit to reviewing and updating the Closure Plan for the site at regular intervals to ensure it accurately reflects the project as it develops, and to include the outcomes from the rehabilitation trials. It is noted that some commitment to do this is provided in the Conceptual Rehabilitation and Closure Plan (Appendix 14) and within section 6.2.10.	Cazaly has stated in the EIA-PER document that the Conceptual Rehabilitation and Closure Plan will be revised at 3 yearly intervals (refer to the PER Section 6.2.10 and Appendix 14 page 7 Section 3.0). In regards to rehabilitation trials, Cazaly is currently in discussions with Botanical Gardens and Park Authority and other consultants regarding restoration requirements and knowledge gaps to support shallow rooted endemics like *Lepidosperma* sp Mt Caudan and *Lepidosperma* sp Parker range. Additionally, Cazaly has amended the CRCP Section 9.0 to include a soil-vegetation tolerance analysis of native species in the Mt Caudan area (report is included as supporting CRCP provided as Appendix 8 to this response document). This soil-vegetation restoration analysis outlines the target approach for the initial rehabilitation trial. In consideration of the submission, Cazaly amend Commitment 6.2.10-3 as follows: *"6.2.10-3 Cazaly will review and update the Parker Range Conceptual Mine Closure Plan (Appendix 14) on a three-yearly basis throughout the life of the Project* ***inclusive of refinement of rehabilitation completion criteria****."*
4	39	It is noted that the PER states (p 125) that some infrastructure may be retained for future use or for access to the site (e.g. powerlines, communications, haul road and internal roads). This is in conflict with sections 8.5 and 8.8 of the Conceptual Closure and Rehabilitation Plan (Appendix 14). If some infrastructure is to remain after closure (either permanently or temporarily), this has to be clearly identified and justified in the closure plan including the reason for retention and proof of acceptance of ongoing liability and responsibility from the agency/company that will be responsible for the infrastructure.	Cazaly agrees with the submission and has updated the Project's Conceptual Rehabilitation and Closure Plan (refer to Appendix 8) to align with EIA-PER Section 6.2.10.
8	40	**Recommendation 13:** That conditions be applied to minimise the impacts on vegetation and fauna habitat from increasing grazing pressure associated with fauna (both native and introduced) attracted to the post-mining water-filled void. **Discussion:** The proposal will leave a permanent water-filled void at closure. DEC has previously highlighted concern over the potential environmental legacy associated with free water within pit voids and long-term impacts on the biodiversity of the area from increased grazing pressure. This proposal is located in an area with sensitive and significant habitats that provide habitats for a high concentration of conservation significant flora and fauna. An increase in grazing pressure could have a negative	A pit void lake will be introduced (post closure) as a result of the proposed Project. The submission of increased grazing pressure from introduced species would only likely occur from feral fauna. The Mt Caudan Project mine site is neither covered by a pastoral lease nor is freehold agricultural land. Cazaly have committed to a monitoring program for indigenous and feral fauna populations in the area and if found to materially increase will install a fauna exclusion fence around the perimeter of the pit void lake (Commitment 6.2.10-5) In consideration, Cazaly have amended the risk assessment environmental impacts to include grazing pressure as identified in the submission (refer to the CRCP Table 5, Appendix 8).

Submission No.	Issue No.	Submission	Proponent Response
		impact on these conservation significant flora species and vegetation communities. The risk assessment undertaken by the proponent did not consider the impacts of a water-filled void on surrounding flora and vegetation from increased grazing pressure.	
8	41	**Recommendation 14:** That completion criteria and objectives for rehabilitation and closure are developed to reflect the existing high conservation values of the Project Area. **Discussion:** The rehabilitation and closure outcomes for this project should reflect the conservation significance of the area.	Cazaly have committed to rehabilitation trials and an outcome based Ecosystem Function Analysis (EFA) approach for mine rehabilitation methods described by Tongway et. al. 2004. Vegetation will be surveyed at established transects using 20 m x 20 m quadrats inclusive of species density, composition and canopy cover. Cazaly will consult with the DEC for the methodology, selection and approval of quadrat location (page 127 of the PER Section 6.2.10). The final quadrats selected as reference sites for performance comparison during EFA trials and final rehabilitation are expected to reflect the conservation values of the existing area prior to impact. Specific biodiversity components (e.g. measures for individual species) are not appropriate for EFA given dependency upon biodiversity of quadrat reference sites selected. EFA Monitoring methods will be established for reference and rehabilitated areas in a similar method to those outlined in Issue No. 7 and are included within the Project's Environmental Monitoring Strategy (Appendix 14). In regards to biodiversity, Cazaly will undertake rehabilitation in accordance with EPA Guidance Statement No. 6 *Rehabilitation of Terrestrial Ecosystems* (June 2006).
6	42	It is noted that beneficiation will be used and therefore it is assumed that the quality of the ore is low. Should market value decline then the mine may close early. For this reason the EPA should impose a significant financial bond should the mine be approved. The EPA should impose this rather than leaving it to the Department of Minerals and Petroleum.	The Mt Caudan deposit is a high quality iron ore resource which is economically marketable as a Direct Ship Ore (year 1) and Iron Fines Product (Year 2+). Cazaly has selected beneficiation technology to (a) treat only approximately 25% of total mine feed and (b) to remove the impurities of silica and alumina – thus improving the marketability of the product. It is not related to the product grade. There are Australian seaborne iron ore products of lower grade than Mt Caudan currently being sold into Asia (between 52-56% Fe grade). The grade of the Mt Caudan resource of 55.4% is comparable with industry peers, (noting greater than 75% of this deposit is non-beneficiated). The target product grade for Mt Caudan is between 56-58% Fe (page 3 of the PER Section 2.1).
6	43	The EPA and the Department of Mines and Petroleum released some Draft Guidelines for Preparing Mine Closure Plans prior to the release of the PER. This draft should form the basis of the closure operations should approval be granted. One very important aspect is that material characterisation of all waste to be used in rehabilitation should take place before mining commences.	This submission relates to the DMP Draft Guidelines for Preparing Mine Closure Plans and a sub-element relating to waste material characterisation. Cazaly are aware of the new Draft Guidelines for Mine Closure, however understand the final guidelines for Preparing Mine Closure Plans will not be released until February 2011 and not in effect until July 2011. The first revision of the Project CRCP (refer to the PER Appendix 14) was submitted to OEPA for review in July 2010. Cazaly can only be assessed on current approved guidelines available at the time of assessment. In regards to waste characterisation, the waste material is characterised as non-acid forming (S < 0.3%) and is highly unlikely to result in outcomes suggested in the submission. In the unlikely event that ARD or metal leaching was encountered, Cazaly have provided a contingency measure of a PAF cell to encapsulate any problematic material (refer to page 110 of the PER Section 6.2.7).
6	44	Provide serious discussion as to why alternative 3 "No backfilling of Mt Caudan north and central, but backfilling of Mt Caudan south open pit zone" is the preferred option. Why is the entire mine void not being backfilled?	This submission relates to backfilling of Mt Caudan pits and selection of Alternative 3. Cazaly disagree with the submission. Alternative 3 is preferred based on the following rationale: • Backfilling the narrow aspect Mt Caudan south open pit will remove an otherwise pit void of dimensions 1.4 km (L) x 0.1 km (W) x 50 m (D). • Although not the lowest cost alternative, it is both technically and economically feasible to allow the proposal to be implemented.

Submission No.	Issue No.	Submission	Proponent Response
			Cazaly acknowledge the backfilling of all Mt Caudan pit voids would provide and optimum landscape outcome post closure, however the mining constraints and costs involved render these alternatives economically prohibitive for the proposal to be implemented. Cazaly have updated the CRCP (Section 8.1.3) to clarify alternative selection (Appendix 8).
Other - Offsets			
8	45	**Recommendation 15:** That DEC is consulted for advice on proposals for conservation reserve creation and research into threatened species, as proposed in the proponent's offsets. **Discussion:** The proponent's offsets proposal in Section 8.3 includes a proposed Environmental Offset Trust to create a conservation reserve and undertake research into threatened species. Further discussion with DEC is required on the detail of these matters, given the department's responsibilities for conservation reserves and threatened species.	The submission to consult further regarding PRCT, conservation reserves and research into threatened species is noted. Cazaly will continue to consult with the DEC and DSEWPaC regarding the compilation of an acceptable Environmental Offset Strategy document for the Project in accordance with EPA Position Statement 9 and Guidance Statement 19.
7	46	The Commonwealth Government aims to ensure that offsets deliver a conservation outcome that would not otherwise be achieved, for example, the purchase of existing unprotected habitat only provides a real conservation outcome if that habitat becomes protected in perpetuity and actively managed for long term conservation purposes e.g. weed and feral management. Cazaly Resources will need to provide further information regarding the offset secured by the Parker Range Conservation Trust (PRCT) prior to approval. The offsets should be clearly described and include; information on impacts and offsets in terms of comparison of similarity of vegetation communities, habitat and potential habitat (including habitat condition) ,flora and fauna present, number of hectares and location. The offset should also be clearly described in terms of how they will provide an environmental gain to mitigate the impacts on matters of National Environmental Significance.	The submission to provide further information regarding PRCT offset secured is noted. Cazaly will continue to consult with the DEC and DSEWPaC regarding the compilation of an acceptable Environmental Offset Strategy document for the Project in accordance with EPA Position Statement 9 and Guidance Statement 19.
7	47	The PER states that the Parker Range Conservation Trust (PRCT) would be established within six months of commencement of Parker Range operations. It should	Cazaly partly agree with the submission. The commitment to establish the PRCT within six months of operation commencement is nominated to allow adequate consultation and formation of Trustee Board and advisory Committee member selection.

Submission No.	Issue No.	Submission	Proponent Response
		be noted that the Commonwealth will require further information regarding the proposed offsets prior to approval. If the project is approved, it is likely that that the offset would be described in the conditions of approval and would need to be acquired and associated offset management plans approved prior to the commencement of the action. It is also noted that Cazaly will fund the PRCT for the life of the mine (inclusive for mine closure and rehabilitation). The Department requires further details on the proposed mechanism/s to protect and manage the proposed offset areas purchased by the PRCT in perpetuity and the party/parties responsible.	Cazaly would consider the acquisition of a suitable environmental offset project (on behalf of the PRCT), on the provision prior written approval and acceptance of the project was received from DSEWPaC and DEC under the *EPBC Act and EP Act.* The project acquisition would be transferred to the PRCT at establishment. The submission's request for further details on the mechanisms to protect and manage the proposed offset acquisition is noted. Cazaly will continue to consult with the DEC and DSEWPaC regarding the compilation of an acceptable Environmental Offset Strategy document for the Project.
6	48	It should be noted that the proponent has proposed a PRCT has been proposed by the proponent and has included the Wildflower Society name as a potential member; however, this matter has not yet been considered by the Management Committee. Any proposed trust could be seen as an advance on the existing Community Reference Group existing under Ministerial Statement 627 providing it had a serious budget in that it would be able to initiate actions in addition to providing advice.	Cazaly acknowledge that establishment of advisory Committee members for the PRCT will be subject to nomination and approval of each representative organisation's Management Committee (as identified in the submission). Cazaly acknowledge that there are potentially some synergies with the existing Community Reference Group (CRG) established under Ministerial Statement No. 627. Cazaly's EIA-PER document has undertaken commitments to form a Consultation Committee (with similar representation to CRG) for the transparent management of environmental and social impacts associated with the Project. Unless otherwise directed, Cazaly's intention is to establish the PRCT as a standalone entity in accordance with mandate and objectives within the EIA-PER document.
5	49	Beneficial results from offsets purchased by the PRCT are not likely to adequately compensate for the loss of habitat caused by the mine as 414 ha of native vegetation at Mount Caudan will be lost. Should fragmented vegetation be purchased this will add further demands of the resources of the Department of Environment and Conservation to manage the area. It is usual for a proponent to nominate a sum of money or land as an offset as part of the approval process, but in this case it appears that only a promise has been given.	Cazaly are currently engaged in negotiations with the State and Commonwealth authorities on environmental offsets. Identification of suitable funding and detail on land acquisition targets are both key unresolved issues. The development of Mt Caudan proposal will result in up to 414 ha of Project area clearing, however, all but the pit void will be rehabilitated (i.e. approximately 333 ha identified for rehabilitation). Cazaly has outlined measures to avoid, minimise, rectify and reduce impacts from the proposal throughout the EIA-PER. For the residual impacts, Cazaly has proposed an environmental offset strategy, with the cornerstone being the establishment of the PRCT funded by Cazaly. One of the PRCT proposed mandates will be the acquisition of fragmented vegetation within the Parker Range PEC with the view to rehabilitating and linking lands. Land acquisition and projects which target bioregions that significantly contribute to the conservation and biodiversity of the region (which would not be expected to occur without the PRCT involvement) will be a key focus. Cazaly has nominated potential land acquisition of up to 1,684 ha, which if administered appropriately by the PRCT, will provide a net gain to the environment.
Other - Miscellaneous			
8	50	**Recommendation 16:** That the proponent clarifies: • If the new alignment of the bypass road has been surveyed for flora, fauna and vegetation of conservation significance.	Cazaly provides the following response:- • Cazaly confirms that the new alignment of the Parker Range bypass road as suggested in the submission (i.e. the northern alignment as depicted on PER Figures 28 and 30) is the alignment surveyed and intended for proposed development. Conservation significance of flora, fauna and vegetation for the Parker Range bypass road is included

Submission No.	Issue No.	Submission	Proponent Response
		• Why a second access road is required (duplication) when the plant is decommissioned, rather than continuing to use the existing road. • If the entire 58.4 hectares for pit edge protection for a 58.8 hectare pit is proposed to be cleared, noting that similar pits in the region apply a non-cleared buffer. If the more northerly bypass road is the alternative proposed to be implemented on project approval, as there are two alternatives presented in the PER figures.	in PER (Mt Caudan Project Area) within surveys (Sections 5.8.4, 5.8.5, 5.8.7, 5.8.8, 5.9.2 and 5.9.3), impact assessment (Sections 6.2.1 to 6.2.3) and PER consultant reports Appendix 6 and 7. Note: The alignment provided in the EIA-PER Figure 10 is for illustrative purposes. • The existing Parker Range road (between the new proposed access road and the mine pit) will be closed and de-gazetted by Shire of Yilgarn. Use of the road represents an access safety issue interacting with mining (e.g. blasting activities) and additionally is not contained within Cazaly tenure. Cazaly has selected a new access road to mitigate these issues. Therefore the road raised by the submission will be closed and not maintained or used for the life of the mine. It is unlikely that the road will support access due to the presence of secondary regrowth vegetation (as occurs on previously disturbed tracks and gravel pits in the region with discontinued use). Cazaly cannot rely on this road for post closure access to the rehabilitated mine, without a commitment to further clear secondary regrowth. As the road will be closed by the Shire of Yilgarn as an asset of the Shire, rehabilitation of this road is excluded from Cazaly's proposal. • Cazaly have estimated the requirement for vegetation clearing using current known information. As the proposed Project is implemented other information will become available during mining which will alter the size of the ultimate final pit and pit protection zone ratio (e.g. geotechnical constraints, mine planning revisions, etc). The estimation of the final pit and pit protection zone is required to provide Cazaly with sufficient flexibility to incorporate any new eventuality and maintain a safe mining environment. Notwithstanding Cazaly will avoid unnecessary clearing (where practicable) in accordance with management strategies outlined in the EIA-PER (Sections 6.2.1 and 6.2.2) and Environmental Management Plan (refer to the PER Appendix 14). The more northerly Parker Range bypass road is correct (refer above response). Cazaly confirm that vegetation clearing estimates remain unchanged from the EIA-PER (Section 4.13 Table 8).
4	51	The following should be clarified: • Section 2.6.3 of the PER states that all personnel will be cleared from the 500m pit exclusion zone during blasting times. It is noted from Figure 10 that the proposed Parker Range Road alignment passes within this exclusion zone. Management of road traffic will be required during blasting times. • The proposed Parker Road diversion illustrated on Figure 10 has sharp corners. This could potentially cause safety risks to road users. • It is noted that a 'turkeys nest' water storage facility is proposed to store water from pit dewatering. The location of this facility is not clearly displayed in Figure 10.	Cazaly's EIA-PER document Figure 10 provides an overview of the Project for illustrative purposes. Cazaly offer a more detailed depiction of the Proposed Mine and Infrastructure for the Project as Appendix 9 herein: • The majority of the proposed Parker Range Road alignment is outside the 500 m pit exclusion zone for blasting. • The proposed Parker Range diversion road has smooth corners and intersection transitions. • The location of the water storage facility location is clearly depicted.
4	52	**Waste Rock Landform (WRL)**	Cazaly acknowledge the request of the submission to provide further details of the Waste Rock Landform within the Mining

Submission No.	Issue No.	Submission	Proponent Response
		The information provided at this stage on the WRL needs to include further details on: the batter and berm design, drainage patterns, how the WRL will be designed to manage high rainfall events whilst remaining safe, stable and non-polluting; and how the WRL will be designed to ensure long-term stability and enable the establishment of self-sustaining vegetation and habitat for local fauna. In the Mining Proposal, the pit zone of instability should be clearly illustrated in figures to demonstrate that the WRL (and other infrastructure) will be outside of this zone, including the public road. It is also noted that the berms and batters appear to be different in the vicinity of the access ramps than the rest of the WRL (Figure 10). This scenario can provide a source for erosion and scouring of the WRL surface if not appropriately managed. Further details on this design will be required, especially if this remains post-closure. DMP have concern regarding the 20 degree slope for the batters of the dump as this is the maximum gradient recommended to allow earth-moving equipment access to ensure the slopes are contour ripped in a competent fashion. DMP recommends reducing these slopes.	Proposal administered under separate legislation of the *Mining Act* 1978. As requested, Cazaly will provide the addition detail in the Mining Proposal. No further information is therefore required for this EIA-PER Assessment.
4	53	Please address the following comments relating to tenure: • Section 2.6.1 of the PER should have listed the tenements affected by the proposal. • Tenements should be labelled in diagrams such as Figure 10. • No mining tenure exists or has been applied for over the proposed 6 km haul road trough private rural property • The section of proposed mine haul road between L77/200 and the proposed pubic diversion road (Southern Cross-Forrestania Road) offtake is no covered by appropriate Mining Act tenure.	This submission requests detail of tenements to be included in Cazaly's EIA-PER document Section 2.6.1 (page 5) and labelled on Figure 10 (page 20). Cazaly have provided a list of tenements on page 16 of the EIA-PER Section 4.2, Table 3 which are further identified on Figure 9 (page 18). Due to detail presented on Figures within the EIA-PER, Cazaly believe it is not always relevant to include labels on tenement boundaries. This submission relates to an observation that no mining tenure exists for the 6 km section of the private Upper Haul Road. Cazaly note this observation and are considering the requirement for mining tenure in consultation with DMP. The road sections between L77/220 and the proposed mine bypass diversion road will remain dedicated as current Shire of Yilgarn asset, as agreed with the Shire of Yilgarn. There is no need for *Mining Act* tenure for this road section.

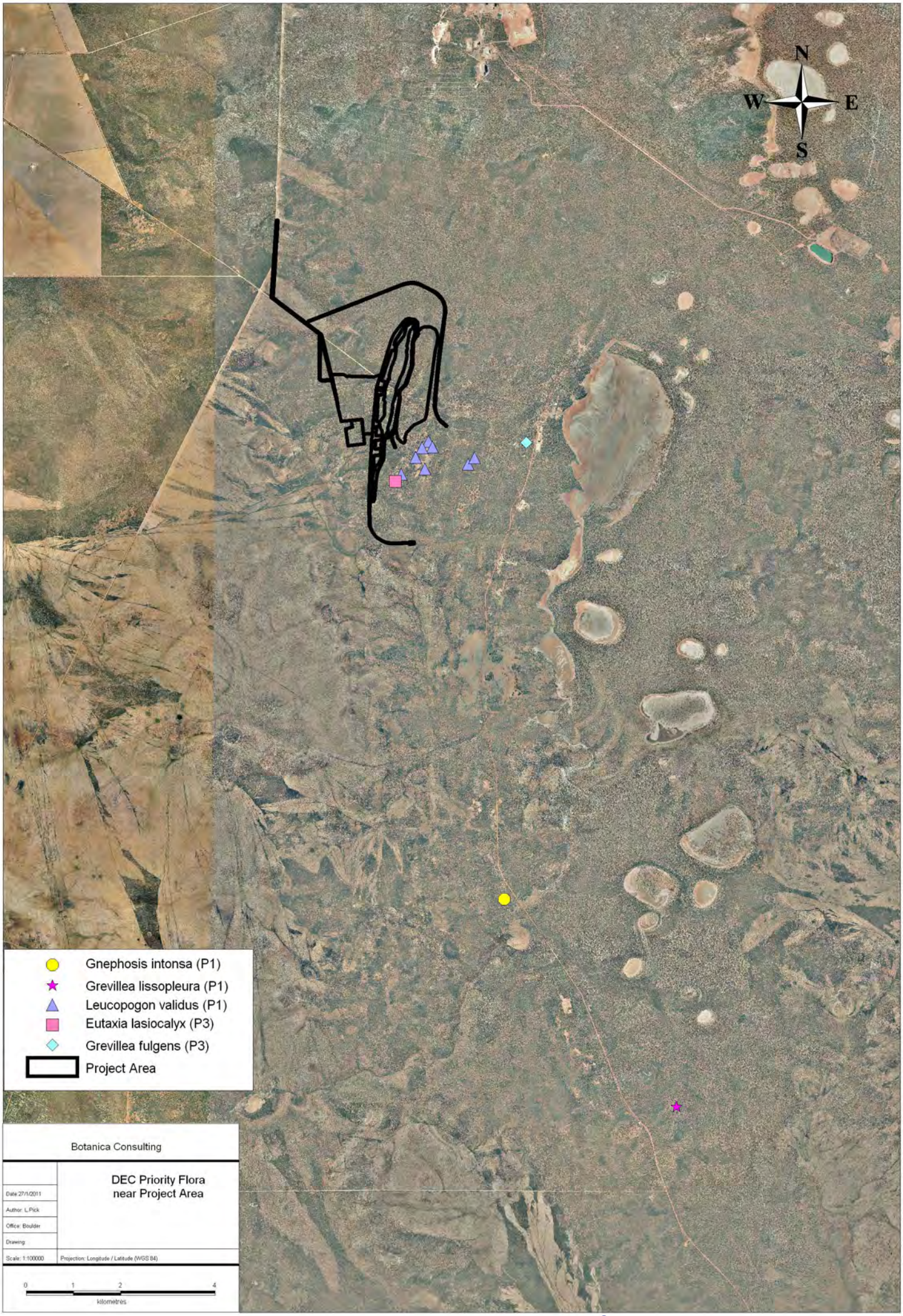


Figure 3: Florabase Priority Flora Locations not within Mt Caudan Project Impact Area

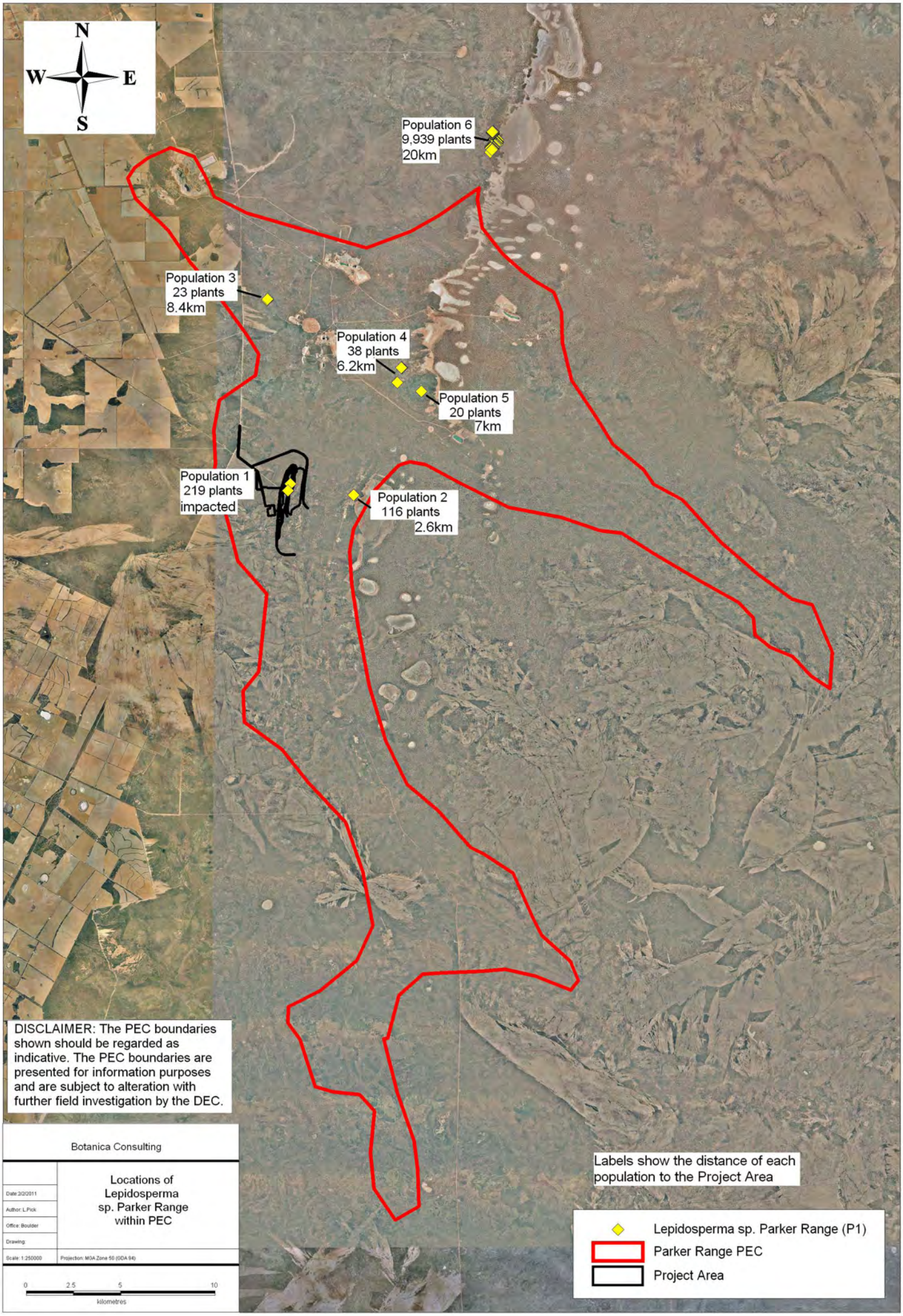


Figure 4: Population Locations of *Lepidosperma* sp. Parker Range at the Mt Caudan Project Area

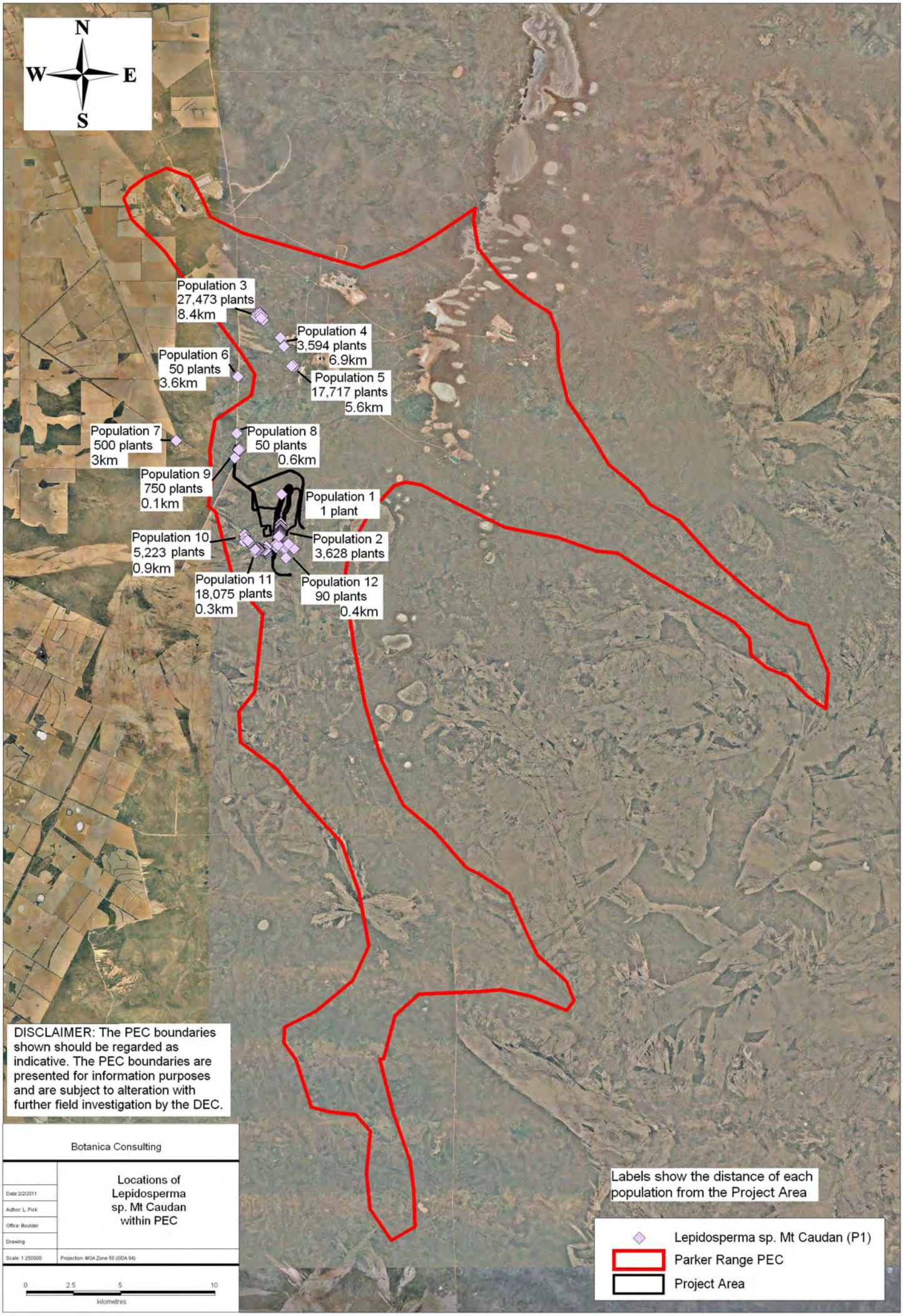
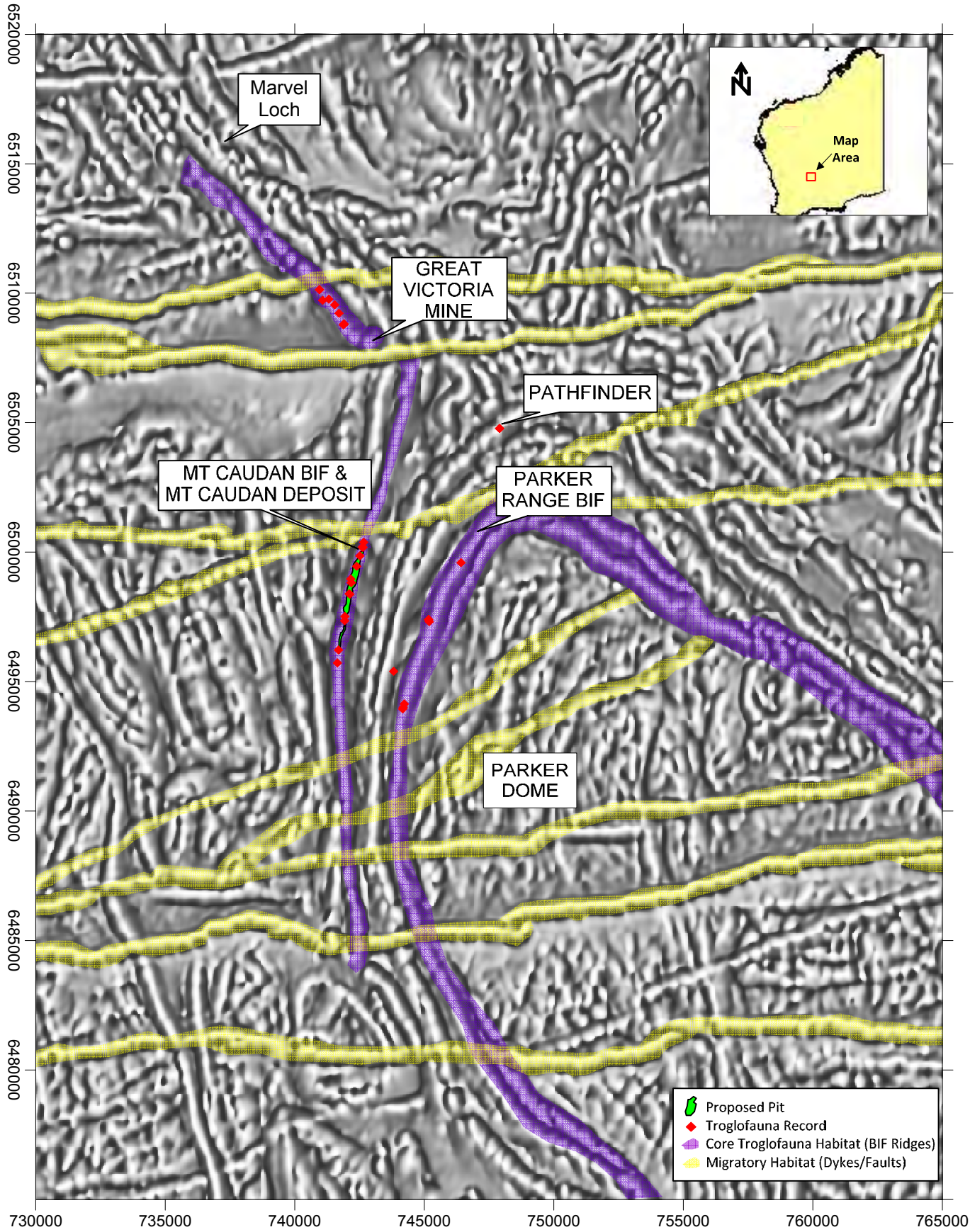


Figure 5: Population Locations of *Lepidosperma* sp Mt Caudan at the Mt Caudan Project Area



361-1/Surfer/Interpretation of Aeromagnetic Imagery.srf

CLIENT:	Cazaly Resources	TROGLOFAUNA HABITAT BASED ON GEOLOGICAL INTERPRETATION AND SAMPLING RECORDS
PROJECT:	Parker Range Subterranean Fauna Sampling	
DATE:	April 2011	
Dwg. No:	361-1/11/1-1	

Figure 6: Troglofauna Habitat Connectivity at the Mt Caudan Project Area

Table 8: Summary of Office of the EPA Matters Raised and Cazaly's Response

The numbering and order of these matters received was allocated by the EPA and is used in this document for consistency.

Issue No.	EPA Matter Raised	Proponent Response
Vegetation Communities – Botanica Consulting (2010) Report		
1	**Action:** an explanation should be provided as to why no other vegetations were subject to analysis. **Action**: analysis for all the remaining vegetation associations impacted by the proposal should be provided. **Action:** a discussion should be provided as to why clearing should be allowed when less than the 30% pre European threshold level remains and what measures will be taken to, minimise, mitigate, manage and offset this. The impact of the proposal on vegetation associations 1413 and 8 have been misunderstood and understated. The EPA requires assessment of a proposal's impact on an ecosystem in relation to the 30% and 10% remaining impact at the local and regional level. The figures quoted in the Botanica Consulting (BC) (2010) report (page 5) are related to the entire presence of the vegetation associations (VA) and are attributed to the wrong VA. According to calculations within the Botanica Consulting report VA8 has ~48% remaining and VA1413 has ~75% remaining throughout Western Australia. This area includes the Avon Wheatbelt, Coolgardie, Esperance Plains, Mallee and Murchison IBRA regions. If the analysis accounted for VA8 and VA1413 in the Moorine Rock System of the Avon Wheatbelt 1 Subregion (AW1) (local) the figures show that VA8 has 9.96% remaining with 0.61% protected in DEC estate and VA1413 has 29.74% remaining with 1.92% protected. Calculations for the remaining percentage in the Avon Wheatbelt 1 Subregion (AW1) (regional) show that VA8 is 10.32% with 8.72% in the DEC estate and VA1413 has 25.75% with 7.71% in the DEC estate. The only VAs discussed in the document related to the bypass road.	The matter raised relates to the Wheatbelt vegetation associations within the Project area. Vegetation associations by Beard (Beard J.S., 1979) were initially excluded from Cazaly's EIA-PER document as more detailed vegetation groups were identified, classified and mapped by Botanica Consulting. Cazaly's EIA-PER document Table 25 page 88 provided an impact assessment by Beard vegetation associations for the Project area. In response, this information has been updated for a local and regional level presented as Appendix 12 – Table A. The matter raised that the Upper Haul Road Project area (near Moorine Rock) is attributed to the wrong vegetation associations is incorrect. The Upper Haul Road Project area is within vegetation associations 8 and 1413 in accordance with Department of Agriculture and Food WA map file (DAFWA, 2007) and is presented as Figure 7. For completeness, Cazaly confirm vegetation associations for the Parker Range Project area (which includes the Mt Caudan mine, bypass road and powerline corridor) are correct in accordance with DAFWA map file (DAFWA, 2007) and is presented as Figure 8. In regards to the matter raised, Cazaly have undertaken a detail review of the Upper Haul Road area and now revise the clearing estimates of native vegetation from 7 ha to 4.1 ha (i.e. 0.3 ha impact upon vegetation association 8 and 3.8 ha impact upon vegetation association 1413). The total native vegetation clearing estimate is revised to 418 ha (refer Section 3.3 of this response document). In regards to guidance for vegetation association impact assessment, areas with less than 30% of their pre-European vegetation extent generally experience exponentially accelerated species loss and areas with less than 10% are considered 'endangered'. Appendix 12 – Table A highlights all vegetation associations are well above the 30% pre-European threshold, with the exception of two vegetation associations in the Upper Haul Road Project area (near Moorine Rocks): • Vegetation Association 8 (Medium woodland; Salmon gum and Gimlet) will have 0.3 ha impacted which is 0.001% of its current extent within the Moorine Rocks region of the Avon Wheatbelt subregion. At a local level, 9.28% of remaining pre-European vegetation is considered 'endangered' (i.e. less than 10%). The proposed clearing will impact upon a further 0.001% (i.e. low proportion) with the post-clearing extent of vegetation association 8 only slightly below existing 9.28% (Appendix 12 – Table A). The 0.3 ha area within the local Upper Haul Road Project area is a very low local proportion within vegetation association 8. • Vegetation Association 1413 (*Acacia*/*Casuarina* and *Melaleuca* shrublands) will have 3.8 ha impacted which is 0.004% of its current extent within the Moorine Rocks region of the Avon Wheatbelt subregion. At a local level, 29.7% of remaining pre-European vegetation is below the 30% threshold. The proposed clearing will impact upon a further 0.004% (i.e. low proportion) with the post-clearing extent of vegetation association 1413 only slightly below existing 29.7% (Appendix 12 – Table A). This vegetation association is already heavily degraded from agricultural use inclusive of stock grazing. Cazaly present the following response to the matter raised in accordance to EPA Position Statement No. 2 *Environmental Protection of Native Vegetation in Western Australia*, (December 2000), regarding 'In exceptional

Issue No.	EPA Matter Raised	Proponent Response
		circumstances the EPA could consider supporting clearing in the agricultural area if' Point 1- "*The proposed land use addresses alternative mechanisms for protecting biodiversity. Opportunities for addressing biodiversity could include rehabilitation of disturbed areas and/or acquisition of areas containing remnant native vegetation. The EPA would like to see an overall environmental benefit as a result of the proposal, such as ensuring protection and management of higher quality remnant native vegetation in the general area (not necessarily on the same property*)" • Cazaly propose an Environmental Offset Strategy for the Project (outlined in the PER Section 8.3) which will includes acquisition of remnant Wheatbelt vegetation containing similar native vegetation for fauna species within the region. Cazaly will continue to consult with the DEC and DSEWPaC regarding the compilation of an acceptable Environmental Offset Strategy document for the Project in accordance with EPA Position Statement 9 and Guidance Statement 19. Point 2- "*The area proposed for clearing is relatively small, depending on the scale over which significant biodiversity changes occur in the particular area, including the extent of vegetation in the surrounding area, and recognising that the values will vary for different ecosystems."* • The area of proposed impact to vegetation association 8 and 1413 is only 0.3 ha and 3.8 ha respectively and will only result in 0.001% and 0.004% reduction in pre-European extent. The total extent will not be measurably reduced for either vegetation association below current levels. The vegetation is highly degraded (in majority) and does not support a high level of biodiversity. Point 3- *"The proponent demonstrates that the elements set out in Section 4.3 are being met. This will require extensive local and regional biodiversity work."* In this regard, Section 4.3 requires that; "*A comparison of development scenarios, or options, to evaluate protection of biodiversity at the species and ecosystem levels, and demonstration that all reasonable steps have been taken to avoid disturbing native vegetation."* • In accordance with Table 6 Issue No. 16 response, Cazaly has consulted widely with both the Shire and Community affected by the Project truck route. To mitigate significant social impacts and allow landowner farming viability, it is necessary for clearing to occur. A route has been selected which proposes clearing within vegetation that is heavily grazed (in part) to minimise the loss of environmental assets in the area. *"No known species of plant or animal is caused to become extinct as a consequence of the development and the risks to threatened species are considered to be acceptable."* • Cazaly's EIA-PER document identified the presence of threatened fauna in the area and has modified the proposed road alignment to provide a 20 m buffer distance from White-browed Babbler nesting locations. The conservation status is unlikely to altered, with acceptable risk to the species. No other significant flora or fauna was found from environmental surveys. *"No association or community of indigenous plants or animals ceases to exist as a result of the project."* • There are no associations/communities of indigenous plants or animals that will cease to exist as a result of the project. *"There would be an expectation that a proposal would demonstrate that the vegetation removal would not compromise any vegetation type by taking it below the "threshold level" of 30% of the pre-clearing extent of the vegetation type (see Section 3)"*

Issue No.	EPA Matter Raised	Proponent Response
		• Vegetation associations 8 and 1413 in the impact area are both currently below the 30% threshold but the proposed impact of 4.1 ha will not materially reduce existing pre-European extent. *"Where a proposal would result in a reduction below the 30% level, the EPA would expect alternative mechanisms to be put forward to address the protection of biodiversity."* • Vegetation associations 8 and 1413 in the impact area are both currently subject to alternative mechanisms as both are below the 30% level. *"There is comprehensive, adequate and secure representation of scarce or endangered habitats within the project area and/or in areas which are biologically comparable to the project area, protected in secure reserves."* • The proposed impact area does not contain scarce or endangered habitats. The most important habitat is the Acacia over granite outcrops which are avoided by the proposed road alignment. The proposed clearing is of such a low level, that existing vegetation habitat will remain locally represented. In addition, vegetation association 8 and 1413 are represented within several nearby Conservation reserves including the Frog Rock Nature Reserve (Class A) located approximately 13 km south-east of the proposed impact area, Wockallarry Nature Reserve (Class A) located approximately 18 km south-east of the proposed impact area, an un-named Class C Nature Reserve located approximately 13 km south-west of the proposed impact area and an un-named Class A Nature Reserve located approximately 25 km south-west of the proposed impact area. In total there are 1,917 ha and 6,138 ha of vegetation associations 8 and 1413 respectively located within DEC managed conservation reserves. *"If the project area is large (and what is meant by large will vary depending on where in the State) the project area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity is secure and protected."* • The Project Area is not large (4.1 ha), with the majority of the proposed road corridor degraded from agricultural clearing and does not contain a high level of biodiversity. *"The on-site and off-site impacts of the project are identified and the proponent demonstrates that these impacts can be managed."* • Cazaly's EIA-PER document outlines the management strategies for indirect impacts of dust, light, noise and vibration associated with clearing and haul road operations. All identified impacts can be successfully managed at acceptable risk to the remanent environment. Point 4 - "Land degradation, including aquatic environments and threatening processes, such as dieback, salinisation or disruption of catchment processes, on-site and off-site would not be exacerbated." • The vegetation within the region is not associated with any aquatic environments or catchments and there is not an increased risk of salinisation/dieback as a result of the proposed clearing. In accordance with EPA Position Statement No. 2, Cazaly have established sufficient justification for the clearing of 4.1 ha of Wheatbelt vegetation for the truck haul road, with very low post-clearing impacts on vegetation associations 8 and 1413.
2	**Action:** impacts to vegetation type 5 should be addressed along with possible mitigation measures. The impact assessment in Table 21 of the Botanica Consulting report is questionable. Clearing of Type 5 is considered "Low 2 Impact" as it is clearing 8 hectares or 10.7% however this vegetation type has 75 hectares total known	Cazaly disagree with this matter raised. Cazaly's EIA-PER document adequately addressed the impacts to vegetation community type 5 (refer to the PER Appendix 6 Flora Survey Report), which defines Low 2 Impact as: "*Vegetation communities restricted to Laterite ridges that will have low to moderate impacts (10 to 34% of areas mapped) and which are considered to be low impacts on a local (Project) and regional scale (Parker Range*

Issue No.	EPA Matter Raised	Proponent Response
	area. Type 5 vegetation community is also described as a vegetation community of conservation significance (on page 3) due to its laterite ridge habitat and the presence of Hakea pendens (P2). This should be "High Impact" if the definitions given on Page 94 are applied.	*PEC).*" Vegetation type 5 has 75 ha of known area in the PEC with 8 ha estimated to be impacted by the Project (10.7% of known extent within the PEC). The impact classification of Low 2 is consistent with the definition of low to moderate impacts (10 to 34% of areas mapped). The presence of laterite ridge and Hakea pendens (P2) within vegetation type 5 is correct; however these are not restricted to this vegetation type nor are the proposed clearing likely to change current conservation status of this species. Therefore, Cazaly do not consider mitigation measures necessary as suggested in the matter raised.
Vegetation Communities – EIA-PER Document		
3	**Action:** Provide the correct number and names of vegetation communities within the Parker Range by pass road and upper truck haul road. The PER provides conflicting information regarding the number of vegetation communities identified for example: • Page 61 states there are 13 vegetation communities in the Parker Range bypass road although only 12 are listed, in addition page 87 states that there are 14. • Page 61 states that there are 8 vegetation communities in the upper truck haul road although only 7 are listed.	Cazaly's EIA-PER document Table 13 page 51 lists 13 vegetation communities in the Parker Range bypass road which is correct. The EIA-PER Appendix 6 Flora Survey Report lists 13 vegetation communities for the Parker Range bypass road on page 45 Table 10. Other references which contradict this information are incorrect. There are eight vegetation communities within the Upper Truck haul road (Moorine Rock) • *Acacia* woodland over granite, • *Acacia coolgardiensis* woodland, • *Allocasuarina* thicket, • *Eucalyptus capillosa/Eucalyptus salubris* Mallee woodland, • *Eucalyptus loxophleba* subsp. *lissophloia* over *Melaleuca lateriflora,* • *Eucalyptus salubris* woodland (including remanent *E.salubris* woodland along farmland boundary), • *Eucalyptus transcontinentalis* Mallee woodland and • *Melaleuca* thicket. Cazaly's EIA-PER document page 61 has omitted the eighth vegetation community "*Eucalyptus loxophleba* subsp. *lissophloia* over *Melaleuca lateriflora"* which is required for inclusion.
4	**Action:** confirm the vegetation communities and their locations within the project area (Table 1) **Action:** confirm how many vegetation communities are located within the project area and how many of these have been identified within the Parker Range PEC. Having reviewed the information provided in Section 5.8.3 of the PER it is not clear what vegetation communities are located within the project areas and also how many vegetation communities (23 or 25) of the 30 vegetation communities within the PEC have been identified within the project area and are subject to impact.	Cazaly have reproduced EPA's Table 1 from the matter raised and confirmed the vegetation communities in the locations of the Parker Range PEC and Moorine Rock area (Appendix 11). Cazaly confirm that 18 out of 30 vegetation communities identified within the Parker Range PEC will be impacted by the proposed Project at the Mt Caudan area. Cazaly confirm that an additional eight vegetation communities that will be impacted in the Moorine Rock area from the Upper haul road development.
5	**Action:** provide an explanation as to why vegetation communities discussed in the PER differ from those in the PTAN analysis. **Action:** The response to submissions document should contain and provide a summary of all new studies including the revised PTAN analysis. The following vegetation communities identified on page 61, page 57 and page 88 do not appear in PTAN Table 14:	Cazaly have completed an Independent Statistical Analysis of Vegetation Communities to further understanding of vegetation composition in the Mt Caudan Project area. The results are summarised in Section 3.1 with detailed reports by T.Griffin (Griffin, 2010 – Appendix 2) and Botanica Consulting (Botanica, 2011a - Appendix 3) provided herein. Table 7 Issue No. 3 (Submission 8) has completed a review and provided comment on the new PATN analysis studies and results. Botanica Consulting have undertaken level 1 surveys on the Parker Range bypass road and Upper Haul Road

Issue No.	EPA Matter Raised	Proponent Response
	• Acacia coolgardiensis woodland; • Acacia woodland over granite; • Eucalyptus capillosa woodland; • Melaleuca thicket; • Mixed Eucalyptus woodland; and • Eucalyptus over Acacia; and • Vegetation community 6 – decomposing laterite and granite.	which contains vegetation communities: • *Acacia coolgardiensis* woodland (Upper Haul Road) • *Acacia* woodland over granite (Upper Haul Road); • *Eucalyptus capillosa* woodland (Parker Range bypass road); • *Melaleuca* thicket (Upper Haul Road); A level 1 survey is sufficient and appropriate for these areas given the Upper Haul Road and Parker Range bypass roads will both have corridors of a width of disturbance not exceeding 20 m over an approximate 6 km road distance. No floristic quadrats were completed in this area; hence these vegetation communities are excluded from PATN analysis. In addition Cazaly further clarify: • Mixed *Eucalyptus* woodland is located within the Mt Caudan Mine and Infrastructure area and is included in PATN as subject to Level 2 survey. • *Eucalyptus* over *Acacia* is located outside the Mt Caudan Project area (but within the Parker Range PEC) and hence excluded from Level 2 surveys and PATN. • Vegetation community type 6 – decomposing laterite and granite is not impacted by the Project and hence no quadrat surveys were undertaken. Vegetation community type 6 contains the identified populations of *Isopogon robustus* (DRF).
6	**Action:** confirm whether: • Eucalyptus salubris (Gimlet) woodland (page 61 para 3) is the same as Eucalyptus salubris woodland (page 61 para 4); and • E. salmonophloia/E. salubris woodland (page 56, Table 14) is the same as Eucalyptus salubris/Eucalyptus salmonophloia woodland (page 61, para 4)	Cazaly can confirm that: • *Eucalyptus salubris* (Gimlet) woodland (page 61 para 3) is the same as *Eucalyptus salubris* woodland (page 61 para 4); and • *E. salmonophloia/E. salubris* woodland (page 56, Table 14) is the same as *Eucalyptus salubris/Eucalyptus salmonophloia* woodland (page 61, para 4)
7	**Action:** recalculate the percentage impact to any individual vegetation community based within the project area. PER sections Impact Summary and Reduction in Vegetation Communities (page 87) do not take into account the vegetations communities identified in the Upper Haul Road. The PER contains conflicting counts of communities.	The Upper Haul Road (near Moorine Rock) is not within the Parker Range PEC and hence is excluded from impact assessment presented on Page 87 of the EIA-PER. Cazaly's EIA-PER document provides the impact assessment of the Upper Haul Road (near Moorine Rock) based on Beard vegetation associations on page 88 of the EIA-PER and page 81-82 of the Flora Survey Report EIA-PER Appendix 6. Cazaly have reviewed the vegetation communities on a more local sub-region level and a revised assessment is provided in Appendix 12 - Table A. Beard vegetation associations for the Southern Cross subregion are adopted for the Mt Caudan Project area and the Avon Wheatbelt subregion adopted for the Upper Haul Road area near Moorine Rock. The impact assessment for the vegetation communities at the Upper Haul Road area will be clarified based on Pre-European vegetation associations by Beard at a local Moorine Rock level. Cazaly have undertaken a detail review of the Upper Haul Road area and now revise the clearing estimates of vegetation from 6.8 ha to 4.1 ha (i.e. 0.3 ha impact upon vegetation association 8 and 3.8 ha impact upon vegetation association 1413). Two pre-European vegetation associations occur within the proposed Upper Haul Road (near Moorine Rock) Project area:

Issue No.	EPA Matter Raised	Proponent Response
		• Medium woodland; Salmon gum and Gimlet (Vegetation association 8) will have 0.3 ha impacted which is 0.001% of its current extent within the Moorine Rock region of the Avon Wheatbelt subregion. • *Acacia*/*Casuarina* and *Melaleuca* shrublands (Vegetation association 1413) will have 3.8 ha impacted which is 0.004% of its current extent within the Moorine Rock region of the Avon Wheatbelt subregion. The 0.3 ha area of Salmon gum and Gimlet is a very low proportion of clearing. The 3.8 ha area of *Acacia*/*Casuarina* and *Melaleuca* shrublands within the local Upper Haul Road Project area is already heavily cleared for agricultural use including cropping and sheep grazing. However, there were a few small areas of remnant *Eucalyptus salubris* woodland within this area. Both vegetation associations are represented (post-impact) within the adjacent Moorine Rock fragmented vegetation communities. Refer to Table 8 Issue No. 1 (Office of the EPA Matters) for further detailed response related to this matter raised. The impact to remnant vegetation associations is non-significant. Clearing at the Upper Haul Road area near Moorine Rock. Represents less than 0.004% of any individual Pre-European vegetation association with a significant part affected from grazing.
8	**Action:** provide the names of those vegetation communities that aren't currently within conservation reserves along with a note of which vegetation communities are found in both the project area and the Jilbadji Nature Reserve. Also indicate which endemic taxa are presently unreserved. The Reduction in Vegetation Communities section also states that six vegetation communities are not in regional conservation reserves. From information on the in Section 5.8.3 it would appear that 6 vegetation communities are in Jilbadji Nature Reserve. The Botanica Consulting (2010) report (page 15) states that "three of the floristic communities have some representation in conservation reserves but four of the endemic taxa and three of the community types are presently unreserved."	Cazaly provide a list of all vegetation communities within the PEC and have clarified which are within Jilbadji nature reserve and Project area (Appendix 12 – Table B). Cazaly also provide a list of endemic taxa within the Parker Range region which are within in the Jilbadji nature reserve and Project impact area (Appendix 12 – Table C). Cazaly's EIA-PER document page 87 Section 6.2.1 Impact Assessment reads: "Six vegetation communities are not in regional conservation reserves" which for clarification should be corrected to read: "Six vegetation communities identified within the Project Area are in regional conservation reserves." The matter raised relating to endemic taxa refers to a statement from Gibson and Lyons Report (Gibson and Lyons 1998). Unfortunately the report does not specify which three of six floristic communities are represented in conservation reserves. Based on related response Table 8 Issue No. 4 (Office of the EPA Matters) Cazaly's EIA-PER document page 57 section entitled "Jilbadji Nature Reserve" should now read: "In terms of regional vegetation mapping of the Parker PEC of the 30 vegetation communities within PEC, …." in place of "… 31 vegetation communities …".
9	**Action:** provide the correct information on impacts to vegetation communities and the resulting impacts: Information contained in the PER and DC report conflicts: • Burnt Mallee/ Allocasuarina Shrubland - BC 2010 states no impact but PER states it was found in mine area, bypass road area and powerline corridor. • Mixed shrub regrowth in Gravel Pits - BC 2010 states no impact. PER states record in mine area therefore possible impact.	Cazaly's EIA-PER document presented the impacts to vegetation communities on page 90 Table 26. Based on additional information, this impact assessment has been updated and is presented as Table 3 in this response. Table 3 now identifies the impacts to vegetation communities identified by the matter raised as: • Burnt *Mallee/ Allocasuarina* Shrubland (1.1 ha impact). • Mixed shrub regrowth in Gravel Pits (3.0 ha impact).

Issue No.	EPA Matter Raised	Proponent Response
Fauna – Terrestrial Fauna		
10	**Action:** address the significance of the area in conserving populations of these species which were once wide-ranging species and whose long-term survival in the Wheatbelt is now questionable. The Parker Range area is of particular regional importance because it contains populations of vertebrate species, especially birds which previously had extensive distributions in the now largely cleared Wheatbelt to the west. For example the PER includes, as present or likely to occur, at least twenty species of birds whose conservation status was insecure in the Wheatbelt (Kitchener et al. 1982). The significance of these species is not recognised in the PER. The importance of habitats in the project area are under-valued. The statement in the PER (page 68) that they are widespread regionally fails to recognise that this only refers to areas further east. To the west of the project area, most woodlands have been cleared for agriculture.	Cazaly recognise the regional importance of the area and environmental habitat values within the fringing Wheatbelt pastoral region, however partly disagrees with the matter raised. The estimated clearing of 414 ha at Mt Caudan Project area will substantially be returned with an estimated 333 ha to be rehabilitated (Page 125 PER Section 6.2.10). The significant portion of restored habitat reduces the long term impacts on species in the area. Within the same bioregion of the Parker Range PEC, the estimated total clearing is 0.7% of the total PEC and a smaller proportion of less than 0.2% post rehabilitation. The Great Western Woodlands comprises of 16 million hectares of remnant vegetation of which the Project represents an insignificant area (i.e. about 0.003%). To clarify the matter raised, there are substantial undisturbed woodlands not only to the east of Mt Caudan, but also to the north and south of the proposed mine area. Cazaly's EIA-PER document lists twenty terrestrial fauna species and it is acknowledged that the conservation status of these species is insecure in the Wheatbelt. However, the matter raised fails to recognise that the insecure status substantially relates to the fragmented Wheatbelt vegetation habitat which is situated about 5 km west of the Mt Caudan Project site. Cazaly's EIA-PER document has summarised the potential likelihood of occurrence and potential impact of the Project to terrestrial fauna, with a further assessment of the twenty species provided in the Fauna Survey Report (refer to the PER Appendix 7). Considering the regional context of alternate habitat, the proposed clearing of 414 ha of habitat will have a non-significant impact on terrestrial fauna and is highly unlikely to result in a change in conservation status of listed species referenced in the matter raised. It is noted that Cazaly cannot be held responsible for matters beyond its control, including previous uncontrolled clearing in the Wheatbelt during post European occupation.
11	**Action:** address potential impacts to species likely to occur in the survey area including the Bush Stone-curlew, Rainbow Bee-eater, Shy Groundwren and Carpet Python. The PER (page 68. Table 18) does not recognise that the databases searched to provide the species list for this table provide few data specific to the region of the study area. Accordingly the table is not comprehensive on species likely to occur and the likelihood of species to occur is underrated. For example some species listed as having a low likelihood of occurrence probably do occur and should be upgraded to high. These include Bush Stone-curlew, Rainbow Bee-eater, Shy Groundwren and Carpet Python. The Slender-billed Thornbill is outside its known distributional range and should be deleted from the list.	Cazaly's environmental consultants undertake extensive government agency database searches prior to undertaking ground surveys. This also includes searches through other literature available at the time of the background search. The prime reason for this approach is to gain an understanding of the species likely to occur in the area. Cazaly's fauna consultants have presented the information that was available at the time of these searches, which occurred before surveys in 2008 and 2009. The matter raised references information which was not available at the time of the background searches. Cazaly would encourage the information provided in the matter raised to be added to the relevant government agency database. Cazaly's EIA-PER document has assessed the potential impacts to species likely to occur in the area, with detail assessment provided in the Fauna Survey Report (refer to the PER Appendix 7). In regards to the matter raised on species of Bush Stone-curlew, Rainbow Bee-eater, Shy Groundwren and Carpet Python, Cazaly respond as follows: • Bush Stone-curlew: The results of the original database search (July 2008) listed this species as a Priority 4 with one bird heard at Hyden in 1972 (DEC, 2008). A subsequent search of the DEC Threatened and Priority Fauna Database search (October 2009) did not list this species (DEC, 2009). Three references of EPBC list, NatureMap list from Western Australian Museum (WAM) and list from Birds Australia (2010) for the area do not include the Bush Stone-Curlew as likely to occur in the area. The Parker Range Project is located at the eastern extent of the species distributional range. No other information was readily available that suggested the Bush Stone-curlew had persisted in the area or that the distributional range had extended eastwards to include the Parker Range area (reference

Issue No.	EPA Matter Raised	Proponent Response
		verbal conversation with R. Johnstone at WAM*)*. On this advice, Cazaly disagrees with the matter raised that the likelihood of occurrence for this species should be upgraded from Low to High, therefore no further assessment from the information presented in EIA-PER is deemed necessary. • Rainbow Bee-eater: This species is listed as a Migratory Terrestrial Species under the *EPBC Act 1999* and does not occur on the State DEC Threatened and Priority Fauna Database. It has been recorded on the Birds Australia list for the area but not on the WAM NatureMap list. It was recorded during the spring seasonal survey at Mt Caudan south and is likely to use the area within its migratory path. The Rainbow Bee-eater is scarce to common in the Parker Range area and there would not be large numbers in the Mt Caudan area (reference verbal conversation R. Johnstone at WAM). Notwithstanding this, Cazaly agrees to change the likelihood of its occurrence from "Medium" to "High" (page 68 of the PER Table 18). The impact assessment presented in the EIA-PER document for this species remains appropriate with this change to the proposal. • Shy Groundwren: This species is not listed under the *EPBC Act 1999*. While the species (*Hylacola cauta*) is listed by NatureMap and Birds Australia for the area, it is the western subspecies (*Hylacola cauta whitlocki*) that is classified as a Priority 4 species under the DEC Threatened and Priority Fauna database. Advice from R. Johnstone at WAM reports that this subspecies ('*whitlocki*') is no longer recognised. It is also not recognised by Christidis and Boles (Christidis et. al., 2008). WAM advice also reports that the Shy Groundwren has a large population throughout Western Australia. As such the likelihood of the subspecies *Hylacola cauta whitlocki* occurring in the Mt Caudan area is very low and the likelihood of *Hylacola cauta* occurring is deemed Medium. The likelihood of species *Hylacola cauta* occurring in the area is correctly presented in EIA-PER Table 18 on page 68. • Carpet Python: No other information is available to date to suggest the increased likelihood of the Carpet Python in the area. If the OEPA is in possession of such information, Cazaly would consider a review of the likelihood of the species in the area. The likelihood of occurrence in Cazaly's EIA-PER for the Carpet Python is to remain Low (page 68 of the PER Table 18). The matter raised that the Slender-billed Thornbill is outside its known distributional range is noted, however it is acknowledged that the *EPBC Act* Protected Matters Report specifically listed this species in the area at the time (July 2008 and November 2009). For consistency of historical search information; species *Acanthiza iredalei iredalei* (Slender-billed Thornbill) is to remain as possibly occurring in the area (page 68 of the PER Table 18).
12	**Action:** adequately address the statutory status of the White-browed Babbler, Crested Bellbird and Western Rosella and their relevance in the project area. The PER (Page 69) provides misleading statements about the Threatened status of the White-browed Babbler, Crested Bellbird and Western Rosella. The statutory status of each species is relevant throughout the region. The fact that these species occur in the project area makes them significant populations. The statement that "a reasonable representation of fauna was recorded" is unlikely to be true when the small sample areas are taken into context as well as the poor seasonal survey timing. A number of species which are likely to be common in the area based on known distributional patterns were not recorded.	Cazaly disagree with the matter raised. Cazaly's EIA-PER document addresses the statutory status and potential impacts on the White-browed Babbler, Crested Bellbird and Western Rosella. Cazaly acknowledge that the presence of these species in the Project area is significant and provide the following clarifications regarding their statutory status: • White-browed Babbler - Results of the DEC Threatened and Priority Fauna Database search lists the White-browed Babbler (western wheatbelt) as a Priority 4 species (DEC, 2008). While Cazaly recognises the threatened status of the western wheatbelt species, conservation status of the White-browed Babbler is not likely to be altered by the proposed development within the contiguous vegetation at Mt Caudan area. • Crested Bellbird - Results of the DEC Threatened and Priority Fauna Database search lists the Crested Bellbird (southern) as a Priority 4 species (DEC, 2008). Advice from R. Johnstone at WAM

Issue No.	EPA Matter Raised	Proponent Response
		indicates that the Crested Bellbird has a wide Australian distribution and that there are no subspecies recognised in Western Australia. While Cazaly recognises the threatened status of the southern species, conservation status of the Crested Bellbird is not likely to be altered by the proposed development within the contiguous vegetation at Mt Caudan area. • Western Rosella - The subspecies *Platycercus icterotis xanthogenys* was not listed in any of the results of the government database searches for the area (DEC, 2008 – 2009). However, it is listed as a Schedule 1 species under the *Wildlife Conservation Act 1950* and Vulnerable in the Goldfields, Wheatbelt and South Coast Regions. Western Rosella were sighted during one of the seasonal surveys and Cazaly's EIA-PER document addressed its conservation significance (refer page 70 of the PER Table 19). WAM reports that the Western Rosella is rare and patchily distributed in parts of the Parker Range area and that it becomes common in the woodlands to the east and south (reference verbal conversation R. Johnstone at WAM). Cazaly recognises the importance of woodlands habitat for this species. The proportion of woodlands habitat impacted (i.e. estimated 247.1 ha) by the proposal is a very low to that habitat available locally and regionally (i.e. 38,000 ha Eucalypt woodlands in PEC and the wider Great Western Woodlands). Refer Section 3.5 and Table 7 Issue No. 10 for further response to this matter. Cazaly's EIA-PER document impact assessment and predicted outcome is unaltered. The conservation status of species within the matter raised is unlikely to be altered from proposed development in the contiguous vegetation at Mt Caudan. Cazaly disagree with the matter raised that surveys completed are unlikely to provide a reasonable representation of fauna. Three seasonal surveys were conducted with twelve trapping grids in different vegetation communities. Each trapping grid measured over 1 ha with the potential capture area far greater in the surrounding area (species specific). Furthermore, in addition to the avifauna systematic sampling of 82 ha, and the nocturnal spotlighting, opportunistic recording was conducted in all areas at all times by field personnel. The matter raised fails to acknowledge that survey limitations are inherent in all projects. Cazaly's consultants have undertaken seasonal surveys in conjunction with requirements of EPA Guidance Statements. Additionally Cazaly cannot be reasonably expected to survey large areas of contiguous vegetation for fauna outside in the local Project area to either prove or disprove individual species range extent. The results of the fauna surveys provide a sufficient level of certainty to enable the Minister of Environment, other decision-making authorities and the public to make informed conclusions about the species present and the potential impacts of the Mt Caudan deposit proposal.
13	**Action:** address the impacts to Malleefowl in terms of loss of 421 ha of habitat. The statement that only 49 ha of Malleefowl habitat is likely to be lost (PER Page 97) is not likely to be true. This does not take into account the feeding range of Malleefowl or the habitats utilised by dispersing young which are known to disperse several kilometres per day. In actual fact the entire area of disturbance of 421 ha is likely to be Malleefowl habitat. The statement on preferred habitat needs to consider all habitats used by Malleefowl including breeding, feeding and dispersal habitat. The source for the conclusions that "they are particularly sparse both in the local and regional context" need to be stated together with which populations are being compared with the project area.	Cazaly partly disagrees with this matter raised. Cazaly's EIA-PER document lists an estimated 49 ha of preferred Malleefowl habitat as being identified within the Project impact area. Based on results from targeted surveys it is recognised by Cazaly that Malleefowl may utilise other areas within the Project impact area (e.g. breeding, shelter and foraging habitat). The extent in which other habitat within the Project impact area is utilised cannot be reliably ascertained. However Cazaly acknowledge that Malleefowl could potentially utilise the entire 414 ha footprint of disturbance located at Mt Caudan. It is recognised that the laterite ridge at the Mt Caudan mine is unlikely to provide suitable habitat for breeding and foraging. The unaccounted impact of 7 ha (from the submission 421 ha) is located in the Upper Haul Road Project area (near Moorine Rock) which is not potential habitat for Malleefowl. Cazaly have now revised this figure to 4.1 ha (Refer to Table 8, Issue 1). Furthermore, the results of the intensive biological survey by Newbey *et al.* (1995) suggests that there are very

Issue No.	EPA Matter Raised	Proponent Response
		few Malleefowl within the regional area. The results of the targeted Malleefowl survey in the Mt Caudan disturbance area suggest that Malleefowl are sparse locally. Cazaly acknowledge that potentially up to 414 ha of potential Malleefowl habitat will be disturbed at Mt Caudan Project area, however the management actions presented in the EIA-PER are deemed adequate. In addition, Cazaly provide further monitoring actions for Malleefowl in the Environmental Monitoring Strategy (Appendix 14).
14	**Action:** Justify why the PER reached the conclusion that there would be no impact to the Western Rosella. The Fauna Surveys (KLA 2010) recorded an occurrence of the Threatened Western Rosella within the mining area. Taking into consideration that no comprehensive survey was conducted for this species, what is the basis for the statement in the PER (page 97) that there will be no impact on populations of this species?	Only two Western Rosella were sighted during one of the seasonal surveys. The Western Rosella is rare and patchily distributed in parts of the Parker Range area and that it becomes common in the woodlands to the east and south (reference verbal advice R. Johnstone at WAM). While the Mt Caudan area may be important to this species, these other woodlands are of greater importance to its conservation status. Comprehensive bird surveys were conducted during all three seasonal surveys for all bird species including Western Rosella. KLA have undertaken a further targeted survey for Western Rosella in April 2011 (refer to Section 3.5 and Table 7 Issue No. 10 for further response to this matter). Given the reported low number of Western Rosellas in the area (reference verbal advice R. Johnstone at WAM and evidenced by surveys) it is unlikely that the proposed mining activity at Mt Caudan will have a major impact on the species. Therefore Cazaly's EIA-PER document conclusion is based on known distribution, the low number of birds using the area, the high mobility of the species and the knowledge of extensive surrounding woodlands habitat.
Fauna – Malleefowl Management		
15	**Action:** amend Malleefowl management measures so that monitoring of Malleefowl nests is undertaken on a more frequent basis and management takes into account that the entire project area is potential Malleefowl habitat. Monitoring Malleefowl nesting mounds biannually (PER page 99) is insufficient and not likely to indicate breeding success. It is noted that the Environmental Management Plan (page 70) proposes more frequent monitoring. Management of Malleefowl should reflect the fact that the whole of the project area is likely to be used by Malleefowl as feeding or dispersing habitat e.g. speed limits should be imposed on the whole project area.	Cazaly acknowledge that up to 414 ha of the impact at Mt Caudan is potential Malleefowl habitat (refer Table 8 Issue No. 13 (Office of the EPA Matters)). Cazaly's EIA-PER document lists management actions for Malleefowl which apply to the entire impact area and any implied restriction to the preferred habitat of 49 ha is incorrect. Cazaly have committed to Malleefowl surveys prior to disturbance for the entire Project impact area (EIA-PER Appendix 13 EMP sub-plan Malleefowl Management). Cazaly have provided further Malleefowl monitoring actions, frequency and triggers within the Environmental Monitoring Strategy Appendix 14, including: • Targeted surveys for Malleefowl (monthly frequency breeding periods of September through to December and pre-clearing surveys prior to clearing where greater than 1 ha is planned for disturbance). This will include surveys of known nesting mounds for breeding activity. • Inspection of Malleefowl sighting locations for activity (as sighted). • Monitoring of detected active known nesting mounds (weekly). • Inspection of established minimum 50 m buffer zones from active nesting mounds from operational activities (monthly frequency).
Fauna - Troglofauna		
16	**Action:** provide information on the actual impact of groundwater drawdown on troglofauna habitat within the actual project area. More information needs to be provided on the relevance to the current project area of the assertion that drawdown of the watertable in the Pilbara is unlikely to affect the humidity of troglofauna habitats. The source and relevance of the statements to the current project area of reduced infiltration of rainfall and	The actual impact of groundwater drawdown on troglofauna habitat within the Project Area (impact zone) is not relevant as the orebody will be progressively dewatered and mined. Numerical groundwater flow modelling of the aquifer has indicated that reduction (drawdown) in the water table will extend less than 1 km from the planned mine pit (refer to the PER Appendix 8 Figure 4 – Rockwater, 2010). Troglofauna habitat has been shown to occur locally in a range of different rock types and up to 3.3 km east and 46 km north-west of the Mt Caudan pit.

Issue No.	EPA Matter Raised	Proponent Response
	nutrients needs to be stated.	The reference to work at Balmoral South in the Pilbara relates to the risk of impacts to troglofauna habitat from groundwater drawdown during mining. Other than for cave systems, there is no information on the humidity requirements for troglofauna in subterranean environments. The assessment of impacts to humidity in troglofauna habitat for the Balmoral South project is relevant to the Parker Range proposal because: • It describes a principle that relates to a common issue with troglofauna impact assessment, and • Troglofauna at both sites inhabit banded iron formation within the mine pits. Given that humidity in subterranean systems is controlled by distance to the rooting zone of plants rather than distance to the water table (see Rockwater, 2010), the indirect impact of dewatering on troglofauna habitat adjacent to the Parker Range mine pit is considered to be negligible. The source of the Balmoral South reference is cited as Bennelongia (2008c) in Rockwater (2010) presented within Cazaly's EIA-PER document as Appendix 8.
Omissions and Errors of Fact		
17	**Action:** a number of technical errors in the fauna reports should be addressed including: • Appendix K. Identification of Variegated Fairy-wren is questionable. The study area is outside the known range of this species. Other Tables in the report do not include this species, but do include the similar Blue-breasted Fairy-wren. • The Redthroat is incorrectly listed as a honeyeater. • The Yellow-throated Honeyeater and Yellow-throated Miner are the same species and should not be duplicated.	Cazaly provide the following response to the matter raised: • The Mt Caudan area is not within the distributional range of the Variegated Fairy-wren, and this is to be amended in Cazaly's EIA-PER Appendix 7 Fauna Report provided Appendix K to "Blue-breasted Fairy-wren". • The Acanthizid Redthroat is not a honeyeater and this reference in Cazaly's EIA-PER Appendix 7 Fauna Report provided Appendix K is to be deleted. • Cazaly's EIA-PER Appendix 7 Fauna Report provided Appendix K the listings of the Yellow –throated Miner and Yellow-throated Honeyeater. All reference and discussion to the "Yellow-throated Honeyeater" in Appendix K Annotated List-Birds is to be deleted. References to the Yellow –throated Miner are correct and hence remain unchanged.

Figure 7: Vegetation Associations for the Upper Haul Road Project Area

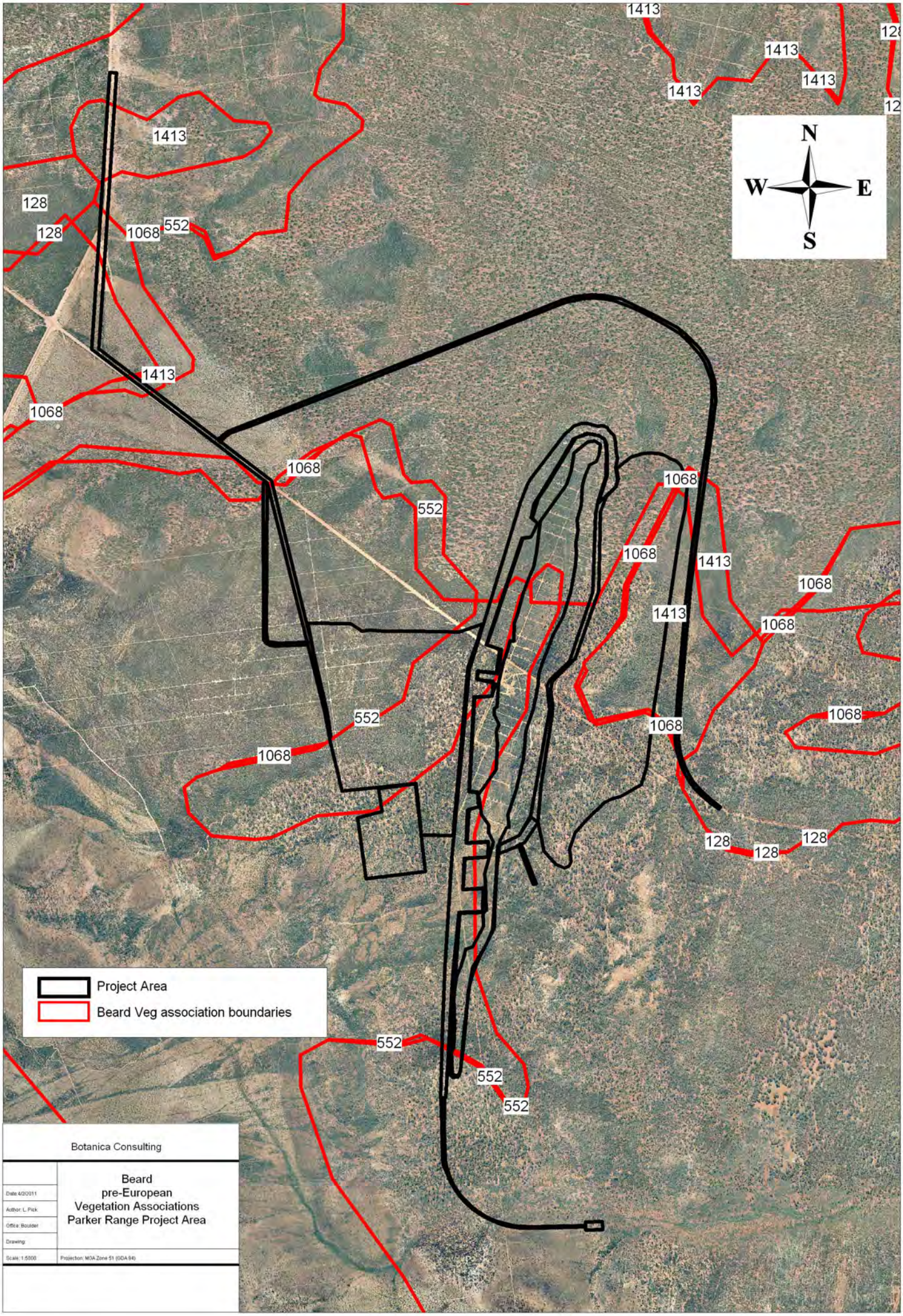


Figure 8: Vegetation Associations for the Mt Caudan Project Area

6.0 COMMITMENTS

Cazaly made a number of commitments in the EIA-PER document for the management and mitigation of potential impacts from the project proposal (Cazaly, 2010). Cazaly has considered the need for revised commitments to include new matters raised through the public submissions.

Cazaly's commitments have been restated, with proposed amendments as a result of new matters raised through public submissions (changes depicted in bold text) as Table 9.

Table 9: Summary of Cazaly's Commitments for the Parker Range Iron Ore Project

6.2.1 Vegetation 6.2.1-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Land Clearing and Rehabilitation for the management of vegetation assemblages during mine operations, closure and rehabilitation. **6.2.1-2 Cazaly will establish a buffer zone of 250 m around the final Mt Caudan Project area of disturbance in which the vegetation condition and population health may decline up to 50% of baseline or reference site health condition, before requiring a contingency action plan to be implemented.**
6.2.2 Flora 6.2.2-1 Cazaly will implement actions detailed in Project Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Surface Water Management, sub-plan Flora and Fauna Management, sub-plan Robust Coneflower Management, sub-plan Land Disturbance and Rehabilitation for the management of flora during mine operations, closure and rehabilitation. **6.2.2-2 Cazaly will undertake a rehabilitation research program (within 6 months of operations commencement) for species *Lepidosperma* sp. Parker Range (P1) which will focus on shallow soil analysis, transplantation trials and seed trials for the restoration of this species post mine decommissioning, closure and rehabilitation.**
6.2.3 Terrestrial Fauna 6.2.3-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Flora and Fauna Management, sub-plan Malleefowl Management for the management of terrestrial fauna during mine development, operations, closure and rehabilitation.
6.2.4 Subterranean Fauna 6.2.4-1 Cazaly will commit to further field survey (scrape and trapping) of troglofauna within local Project area and regionally within suitable habitat of the PEC to improve the understanding of the species distribution and abundance within 12 months of operations commencement.
6.2.5 Invertebrate Terrestrial Fauna 6.2.5-1 Cazaly will implement clearing controls **to avoid (where possible)** all known *Aganippe castellum* (Tree-stem Trapdoor Spider) for the management of this **Priority species** during mine development, operations, closure and rehabilitation.
6.2.6 Groundwater 6.2.6-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Surface and Groundwater, for the management of groundwater during mine development, operations, closure and rehabilitation. 6.2.6-2 Cazaly will implement a groundwater monitoring and reporting program with monitoring bores established within and adjacent to the Project impact area.
6.2.7 ARD and Metal Leaching 6.2.7-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Surface and Groundwater, for the management of ARD and metal leaching during mine development, operations, closure and rehabilitation. 6.2.7-2 Cazaly will monitor mine waste for PAF and if detected segregate in purpose designed PAF encapsulation cell within the waste landform.

6.2.8 Dust 6.2.8-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Air Quality, for the management of dust generated during mine development, operations, closure and rehabilitation. 6.2.8-2 Cazaly will undertake annual environmental health surveys of vegetation, flora and fauna in areas within predicted dust impact zone (including reference areas outside impact zone) and report to DEC and DMP. 6.2.8-3 Cazaly will undertake monthly dust monitoring for the workforce and sensitive dust receptors within the community. 6.2.8-4 Cazaly will provide an incident reporting and corrective action investigation process for dust emissions for the community use. 6.2.8-5 Cazaly will meet quarterly (year 1), then biannual (year 2+) with a Consultation Committee to provide performance data (such as dust) and seek improvement opportunities.
6.2.9 Noise and Vibration 6.2.9-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Noise and Vibration, for the management of noise and vibration during mine development, operations, closure and rehabilitation 6.2.9-2 Cazaly will undertake monthly noise monitoring for the workforce and sensitive noise receptors within the community. 6.2.9-3 Cazaly will provide an incident reporting and corrective action investigation process for noise emissions for the community use.
6.2.10 Rehabilitation and Closure 6.2.10-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Land Disturbance and Rehabilitation, for the management of mine rehabilitation and closure. 6.2.10-2 Cazaly will implement actions detailed in Parker Range Conceptual Mine Closure Plan (Appendix 14) for the management of rehabilitation and closure. 6.2.10-3 Cazaly will review and update the Parker Range Conceptual Mine Closure Plan (Appendix 14) on a three-yearly basis throughout the life of the Project **inclusive of refinement of rehabilitation completion criteria**. 6.2.10-4 Cazaly will monitor the rehabilitation program of the mine annually post-closure of the mine until EFA performance outcomes are achieved for any two consecutive years. 6.2.10-5 Cazaly will monitor the indigenous and feral fauna populations during mine closure and if found to materially increase in numbers, will install fauna exclusion fencing around the perimeter of Mt Caudan north and central open pit voids.
6.3.1 Landform and Soils 6.3.1-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Land Disturbance and Rehabilitation for the management of soils during mine development, operations, closure and rehabilitation.
6.3.2 Weed Species and Dieback 6.3.2-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001) sub-plan Weed and Dieback and sub-plan Land Disturbance and Rehabilitation for the management of weeds during mine development, operations, closure and rehabilitation.
6.3.3 Surface Water Management 6.3.3-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Surface and Groundwater, for the management of surface water during mine operations, closure and rehabilitation.
6.3.4 Erosion 6.3.4-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Surface and Groundwater, sub-plan Land Disturbance and Rehabilitation for the management of erosion during mine development, operations, closure and rehabilitation.
6.3.5 Waste Products 6.3.5-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Waste and Pollution, for the management of waste during mine development, operations, closure and rehabilitation.

6.3.6 Dangerous Goods and Hazardous Substances 6.3.6-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Hydrocarbon and Chemical, for the management of dangerous goods during mine development, operations, closure and rehabilitation.
6.3.7 Light 6.3.7-1 Cazaly will implement design and position lighting to limit spill outside the Project impact area.
6.3.8 Greenhouse Gas 6.3.8-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Greenhouse Gas and Energy, for the management of greenhouse gases during mine development, operations, closure and rehabilitation.
6.3.9 Fire 6.3.9-1 Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Fire, for the management of fire during mine development, operations, closure and rehabilitation.
7.1 Aboriginal Heritage 7.1-1 Cazaly will consult with Aboriginal people and complete heritage survey for proposed powerline route prior to development. Results will be made public and conveyed to the EPA and DIA. 7.1-2 In the event an Aboriginal heritage site is discovered, Cazaly will implement actions detailed in Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Cultural Heritage, for the management of Aboriginal heritage during mine development, operations, closure and rehabilitation. Additionally, a specific Cultural Heritage Management Plan will be designed and implemented, in the event cultural material is discovered in the Project impact area. **7-1-3 Cazaly will include Aboriginal heritage awareness and cultural material identification in site inductions for employees/contractors inclusive of reference to the Environmental Management Plan (M8521-G00-EN-PL-001), sub-plan Cultural Heritage with specific actions required in the event of discovery of any Aboriginal cultural material.**
8.3 Environmental Offsets 8.3-1 Cazaly will establish and fund the Parker Range Conservation Trust (to be set-up within 6 months of first ore from Parker Range operations) with a mandate to acquire asset areas for conservation, study and research within Parker Range PEC and fragmented native vegetation in the Yilgarn.

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Environmental Protection Authority (2000). Position Statement No. 2. *Environmental Protection of Native Vegetation in Western Australia.* Environmental Protection Authority, Perth, WA

Appendix 1: Advertisement Inviting Public Submissions

Cazaly Resources (November 2010)

MONDAY, NOVEMBER 29, 2010 • 29

Cazaly Resources Limited

Parker Range Iron Ore Project Mt Caudan Deposit

(29th November 2010 to 10th January 2011)

Cazaly Resources Limited is proposing to mine iron ore from the Parker Range Mt Caudan deposit by conventional open pit hard rock mining methods at a 4 million tonne per annum for an estimated life of mine of 7 to 10 years.

A Public Environmental Review (PER) has been prepared by the Company in accordance with Western Australian Government procedures and is released for public review. The PER describes the proposal, examines the likely environmental effects and the proposed environmental management procedures associated with the proposed development.

Hard copies of the PER may be purchased for $10 (including postage and packaging) or a CD version is available free of charge from:

Cazaly Resources Limited
Level 2, 38 Richardson Street, WEST PERTH WA 6005.
Telephone No. (08) 9322 6283

A project summary is available free of charge from the companys office.

Copies of the PER may also be downloaded from www.cazalyresources.com.au

Copies of the PER will be available for examination at:

- Environmental Protection Authority, Library/Reading Room
  Level 4, The Atrium, 168 St Georges Terrace, PERTH WA 6000
- Department of Environment and Conservation Merredin District Office
  33 Bates Street, MERREDIN WA 6415
- Southern Cross Community Resource Centre
  Canopus Street, SOUTHERN CROSS WA 6426
- Shire of Yilgarn Council Office
  23 Antares Street, SOUTHERN CROSS WA 6426
- State Library of Western Australia
  25 Frances Street, Perth Cultural Centre, PERTH WA 6000

Public submissions close on 10th January 2010.

The EPA prefers submissions to be made by email to submissions@epa.wa.gov.au.

Alternatively, submissions can be:

Posted to: Chairman, Environmental Protection Authority, Locked Bag 33,

- CLOISTERS SQUARE WA 6850, Attention: Ms Helen Dagnall; or
- Delivered to the Environmental Protection Authority, Level 4, The Atrium, 168 St Georges Terrace, Perth, Attention: Ms Helen Dagnall.

If you have any questions on how to make a submission, please ring the EPA assessment officer, Ms Helen Dagnall on 6467 5416.

Appendix 2: A Classification of Flora Quadrats of Vegetation of the Parker Range Region, Western Australia

Ted Griffin (December 2010)

A Classification of Flora Quadrats of Vegetation of the Parker Range Region

Western Australia

Prepared for
Botanica Consulting Pty Ltd and Cazaly Resources Ltd

by Ted Griffin

December 2010

Contents

Introduction 2
Limitations 2
Methods 3
Results 4
Testing difference between All species vs Perennials only classification 4
Just how much difference does it make using these different data sets? 6
How does this potentially affect the original BC classification? 8
Vegetation Types in PARK and G & L sites 9
How many vegetation types PARK and G & L? 10
Comparison of PARK with Newbey Data 20
Discussion 26
References 28
Appendices 29
Appendix 1 Species Reconciliation between PARK and G & L 29
Appendix 2 Species Reconciliation between PARK and NEW 29
Appendix 3 PATN analyses carried out 30
Appendix 4 Dendrogram showing classification group and vegetation type (PARK and G & L) 31
Appendix 5 Main species in PARK and G & L classification (perennials) at 10 and 20 group level (>60% of sites in group) 33
Appendix 6 Dendrogram showing classification group and vegetation type, PARK with NEW (perennials) 36
Appendix 7 Main species in PARK and NEW classification (perennials) at 10group level (>40% of sites in group) 39

Introduction

Botanica Consulting have prepared a botanical assessment of the flora and vegetation of the Parker Range and related areas. This is a requirement of the environmental assessment process which is evaluating the significance of a proposal to mine iron ore from this area by Cazaly Resources. Part of that assessment included numerical classification of the quadrat data.

This report presents the results of a series of analysis of quadrat data of plant species prepared by Botanica. In part this is a parallel analysis to provide clarifying and supporting evidence by which their assessment can be evaluated.

This analysis focus on two key parts of the Botanica report: the relationships with the Gibson and Lyons (1998) study and Newbey *et. al* (1991) study. It addresses aspects of species reconciliation and the use of annuals in the analysis. It also provides a higher level of analysis by which implied relationships between floristics and vegetation types can be more clearly assessed.

It attempts to demonstrate to what degree the numerical classification prepared by Botanica can be relied on.

Limitations

This report relies on the data prepared by Botanica.

All reconciliation of plant species names were done by Botanica.

This report is meant to complement the study prepared by Botanica and as such does not cover the range of environmental assessment which might be drawn from those analyses.

Methods

Two datasets referred to by Botanica as

- PATN analysis on the Botanica Consulting (BC) Parker Range Quadrats (PARK) and Gibson & Lyons (G & L) Quadrats, and
- Analysis for All Recorded Species: Project Park (PARK) & Southern Cross region (Newbey *et. al*) and Analysis for All Recorded Species: Project Park & Lake Johnston-Hyden region (Newbey *et. al*) (NEW).

were used. The reconciliation of some nomenclatural differences is shown in Appendices 1 and 2 respectively.

These were imported independently into a database and species names reconciled with the assistance of Botanica. These separate data were analysed using a number of modules in the DOS version of PATN (Belbin 1987). A description of the modules used is described in Appendix 3.

The classification produced by Botanica Consulting of the Park and G & L quadrats using all species is referred to as BC classification.

Results

Testing difference between All species vs Perennials only classification

Species not always conspicuous during a survey (annuals and geophytes) can influence the classification when the season and survey efforts differ within the dataset. Thus some of the differences in a classification may reflect what is obvious at the time of observation rather than "real". This analysis using the PARK with G & L data set in which Botanica used all species.

The hypothesis is that the difference in the season might have influenced the classification performed by Botanica. The effect of that is groups are formed which are influenced by these project related differences. In extreme cases the site group by project rather than the "real" plant communities.

Table 1 shows that the BC classification with all species at 10 group level there are consistently more species in the G & L sites than in the PARK sites. This table also shows that the number of annuals and geophytes are part but not all of these differences. It could be inferred that these differences might contribute to difference classifications of sites from these data sets and that removal might improve the classification.

Table 1 Average number of species per site by BC Classification group (all species) and Project

		ALL Species (#)				Annuals and Geophytes (#)			
gp10	#sites	All	G & L	PARK	diff	all	G & L	PARK	Diff
1	11	19.6		19.6		1.5		1.5	
2	11	14.2	15.9	6.5	9.4	1.3	1.6	0.0	1.6
3	3	13.3		13.3		1.0		1.0	
4	19	11.3	12.0	10.9	1.1	0.5	1.0	0.2	0.8
5	17	15.7	15.7			2.6	2.6		
6	1	13.0	13.0			4.0	4.0		
7	13	20.3	20.3			3.5	3.5		
8	14	20.2	21.4	13.0	8.4	3.5	4.1	0.0	4.1
9	5	19.8		19.8		0.4		0.4	
10	4	11.5		11.5		0.8		0.8	

Table 2 suggests that the differences still exist when the data set used omitted annuals and geophytes (current analysis, perennials).

Table 2 Average number of species per site by Classification group (perennial species) and Project (PARK and G & L)

		Species			
gp10	#sites	Av	G & L	PARK	Diff
1	7	14.3	16.3	12.8	3.6
2	4	11.5	14	10.7	3.3
3	16	17.4	17.4		
4	5	14.4	17.5	12.3	5.2
5	10	12.9	14.5	6.5	8.0
6	11	18.2		18.2	
7	5	19.4		19.4	
8	12	10.5	10.5		
9	28	13.3	14.2	11.7	2.5
10	5	8.8	12	8	4.0

This possible survey difference is clearer in the summary in Table 3 which shows that most of the groups at the 20 group level were made up of sites from only one project.

Table 3 Number of sites in the current classification group (perennials) (20 group level) by project (PARK and G & L)

		Sites		
gp10	gp20	All	G & L	PARK
1	1	4	3	1
1	2	3		3
2	3	4	1	3
3	4	5	5	
3	5	3	3	
3	6	6	6	
3	7	2	2	
4	8	5	2	3
5	9	7	7	
5	10	3	1	2
6	11	11		11
7	12	5		5
8	13	11	11	
8	14	1	1	
9	15	10	10	
9	16	6	6	
9	17	1	1	
9	18	9	1	8
9	19	2		2
10	20	5	1	4
# groups			16	10
# groups only in project			10	4

(Yellow highlighted cells in this and following tables distinguish differences between the data sets.)

Some of this is because the datasets span different plant communities as suggested by Table 4. A closer examination would be necessary to clarify this.

Table 4 Number of sites in vegetation types by project

	# sites		
Veg type	All	G & L	PARK
allo lat	12	12	
Allocas	14	9	5
Callit lat	2	2	
E. long	10	10	
E. salu	12	6	6
LAT	11		11
MALLE HEA	3		3
Mix Euc	16	7	9
OP MAL	3		3
Salmon	20	15	5
# groups		7	7
# groups only in project		3	3

A brief look at the species in the projects shows that a significant proportion of species are in only one project (Table 5). Only a little more than a third of the species were shared between projects. Again some of this is because of the difference in the communities samples.

Table 5 Total number of species by project

	Species		
Project	#	% of total	% in Project
PARK only	51	23	39
both	79	36	
G & L only	90	41	53
Total	220		

Just how much difference does it make using these different data sets?

Tables 6 and 7 show that the broad pattern of classification is retained irrespective whether all species or perennials only are used. If there was perfect accord, there would be 40 values in Table 7. Of the 47 present, 25 are perfect correspondence. The relationships of some have been modified (Table 6). This suggests that the annual and geophytes had a limited effect on the classification.

Table 6 Comparison between current classifications using perennials (columns) compared to that using all (rows) at 10 group level (number of sites) (PARK and G & L)

gp10	sites	1	2	3	4	5	6	7	8	9	10
1	14	7	4	2						1	
2	8			1	5					2	
3	6			6							
4	7			6						1	
5	22								12	10	
6	14									14	
7	5										5
8	11			1		10					
9	11						11				
10	5							5			

Table 7 Comparison between PARK and G & L classifications using perennials (columns) compared to that using all (rows) at 40 group level (number of sites)

			gp10	1	1	1	2	2	3	3	3	3	3	3	3	3	4	4	5	5	6	7	7	7	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	9	9	10
			gp20	1	1	2	3	3	4	4	4	5	6	6	7	7	8	8	9	10	11	12	12	12	13	13	13	13	14	15	15	15	15	15	16	16	17	18	18	18	19	19	20
			gp40	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
gp10	gp20	gp40	s	2	2	3	3	1	2	2	1	3	2	4	1	1	1	4	7	3	11	3	1	1	4	4	2	1	1	2	1	3	3	1	4	2	1	6	1	2	1	1	5
1	1	1	3	1					2																																	
1	1	2	2		2																																					
1	1	3	2			2																																				
1	1	4	1			1																																				
1	2	5	2	1																											1											
1	3	6	3				3																																			
1	3	7	1					1																																		
2	4	8	1																											1												
2	4	9	1																											1												
2	5	10	1														1																									
2	5	11	4															4																								
2	5	12	1												1																											
3	6	13	5										1	4																												
3	7	14	1													1																										
4	8	15	3									3																														
4	9	16	2							2																																
4	9	17	1								1																															
4	9	18	1																																						1	
5	10	19	4																						4																	
5	10	20	1																									1														
5	11	21	1																										1													
5	12	22	3																							1									2							
5	12	23	6																							3							3									
5	12	24	2																								2															
5	12	25	3																													3										
5	13	26	1																																		1					
5	13	27	1																															1								
6	14	28	2																																	2						
6	14	29	2																																2							
6	15	30	6																																			6				
6	15	31	1																																						1	
6	15	32	3																																				1	2		
7	16	33	5																																							5
8	17	34	6																6																							
8	17	35	2										1						1																							
8	18	36	3																	3																						
9	19	37	11																		11																					
10	20	38	3																			3																				
10	20	39	1																					1																		
10	20	40	1																				1																			

How does this potentially affect the original BC classification?

The original classification used all species. Table 8 is a comparison of that with the current using only perennials at the 10 group level. (Note that slight differences will be due to different species reconciliation.)

Table 8 Botanica BC classification (columns) vs PARK and G & L perennials (rows)

gp10	# sites	<>	1	2	3	4	5	6	7	8	9	10	G & L	PARK
	# sites		11	11	3	19	17	1	13	14	5	4		
1	7									4		3	3	4
2	4					2				1		1	1	3
3	16			1					12	3			16	
4	5				3				1	1			2	3
5	10			10									8	2
6	11		11											11
7	5										5			5
8	12	3					9						12	
9	28	2				13	8	1		4			18	10
10	5					4				1			1	4
	PARK		11	2	3	13				2	5	4		
	G & L			9		6	17	1	13	12				

There are differences but, as for the comparable table with current classification using all species (Table 9), there are similar groups although the relationships differ a little. It should be appreciated that the gross relationships (in this case the relationships between the groups at the 10 group level) can vary with different analyses for it is attempting to group a number of things which generally have almost nothing in common.

It is noted that in the BC classification 7 of the 10 groups contained sites from only one project while in the current with perennials only, 4 out of 10 groups were from only one project. This suggests that some apparent differences were lessened through the removal of the annuals and geophytes.

However, it is concluded that while the presence of annuals and geophytes contributes to the classification differences between the surveys, there are also differences in the perennial species too.

Table 9 BC classification (columns) vs PARK and G & L all species (rows)

gp10	s	<>	1	2	3	4	5	6	7	8	9	10
	# sites		11	11	3	19	17	1	13	14	5	4
1	14					2				8		4
2	8				3				2	3		
3	6								6			
4	7								5	2		
5	22	3				1	17	1				
6	14	2				12						
7	5					4				1		
8	11			11								
9	11		11									
10	5										5	

Why the current classification (all species) is different from the BC classification is not known but it may be due to the specific parameters used in PATN as well as the reconciliation.

It is concluded that were Botanica to have used only perennials, the basis for the interpretations that were made would be quite similar.

Vegetation Types in PARK and G & L sites

The Botanica report uses the physiognomically based vegetation type (Table 10) as an important reference.

Table 10 Description of vegetation type in PARK and G & L datasets
(G_L – code used in Gibson and Lyons study)

	G_L	Vegetation Type
Mix Euc	*1*	*Mixed Eucalyptus woodland*
Salmon	*3*	*Eucalyptus salmonophloia* Woodland
E. salu	*3*	*Eucalyptus salubris* Woodland
LAT/ Callit lat	*-/6*	Mallee woodland/*Allocasuarina* shrubland Laterite Ridge
Allocas	*4*	*Allocasuarina* Shrubland
MALLE HEA	-	Mallee Heath
OP MAL	-	Open Mallee Woodland
allo lat	5	*Allocasuarina* laterite
E. long	*2*	*Eucalyptus longicornis* woodland

Tables 11 and 12 show the relationship between the BC classification and the vegetation type, and the current classification and the vegetation type respectively. At this level of classification, there is a similar degree of accord, even though the patterns between the classifications appear different.

Table 11 Relationship of vegetation type to BC classification – 10 group level
(number of sites)

Gp	n	G & L	PARK	Mix Euc	OP MAL	allo lat	Callit lat	Allocas	LAT	MALLE HEA	E_ long	Salmon	E_ salu
1	11		11					3	8				
2	11	9	2	1		2		8					
3	3		3						3				
4	19	6	13	3								5	11
5	17	17									7	2	8
6	1	1										1	
7	13	13				9	2	2					
8	14	12	2	9		1						3	1
9	5		5	1				1		3			
10	4		4		3							1	
		6	7										
		3	4										

Table 12 Relationship of vegetation type to PARK and G & L classification (perennials) – 10 group level
(number of sites)

gp10	s	G & L	PARK	Mix Euc	OP MAL	allo lat	Callit lat	Allocas	LAT	MALLE HEA	E_ long	Salmon	E_ salu
1	7	3	4	4	3								
2	4	1	3	1								2	1
3	16	16		3		9	2	2					
4	5	2	3			2			3				
5	10	8	2	1		1		8					
6	11		11					3	8				
7	5		5	1				1		3			
8	12	12									10	2	
9	28	18	10	6								16	6
10	5	1	4										5
		8	8										
		2	2										

Most vegetation types are heterogeneous as represented by the number of classification groups present. The degree heterogeneity by this measure is quite similar for the two classifications. Thus in this respect the BC classification describes the variation in a similar way to the present using only perennial species.

Important to recognise is that these tables suggest that there are more plant communities than the 10 vegetation types used in Botanica's interpretations.

How many vegetation types PARK and G & L?

This is an important question but one difficult to answer. The dendrogram's structure (Appendix 4) including the fusion scores can assist but there is no hard and fast rules. A dendrogram's structure suggests a two dimensional relationship but it is multidimensional.

A classification can be the partitioning of the dataset using the level of fusion in a dendrogram or an arbitrary number of groups. In this case 10, 20 and 40 were used for the purpose of investigation.

These groups are used in Figure 1, an alternate view in which the matrix of similarity of all sites to all other is presented. This shows that most of the sites are very different from each other. It shows that the heterogeneity of groups increased as the number of groups decreased. This is exemplified in Figure 2 more clearly.

Figure 1 Association matrix of PARK and G & L data set perennial species. Order consistent with dendrogram. Thickness of lines distinguish 10, 20 and 40 group levels. The shading of the dissimilarity measures are <0.5, 0.5-0.55 and 0.55-0.6, dark to light respectively. Yellow are PARK sites.

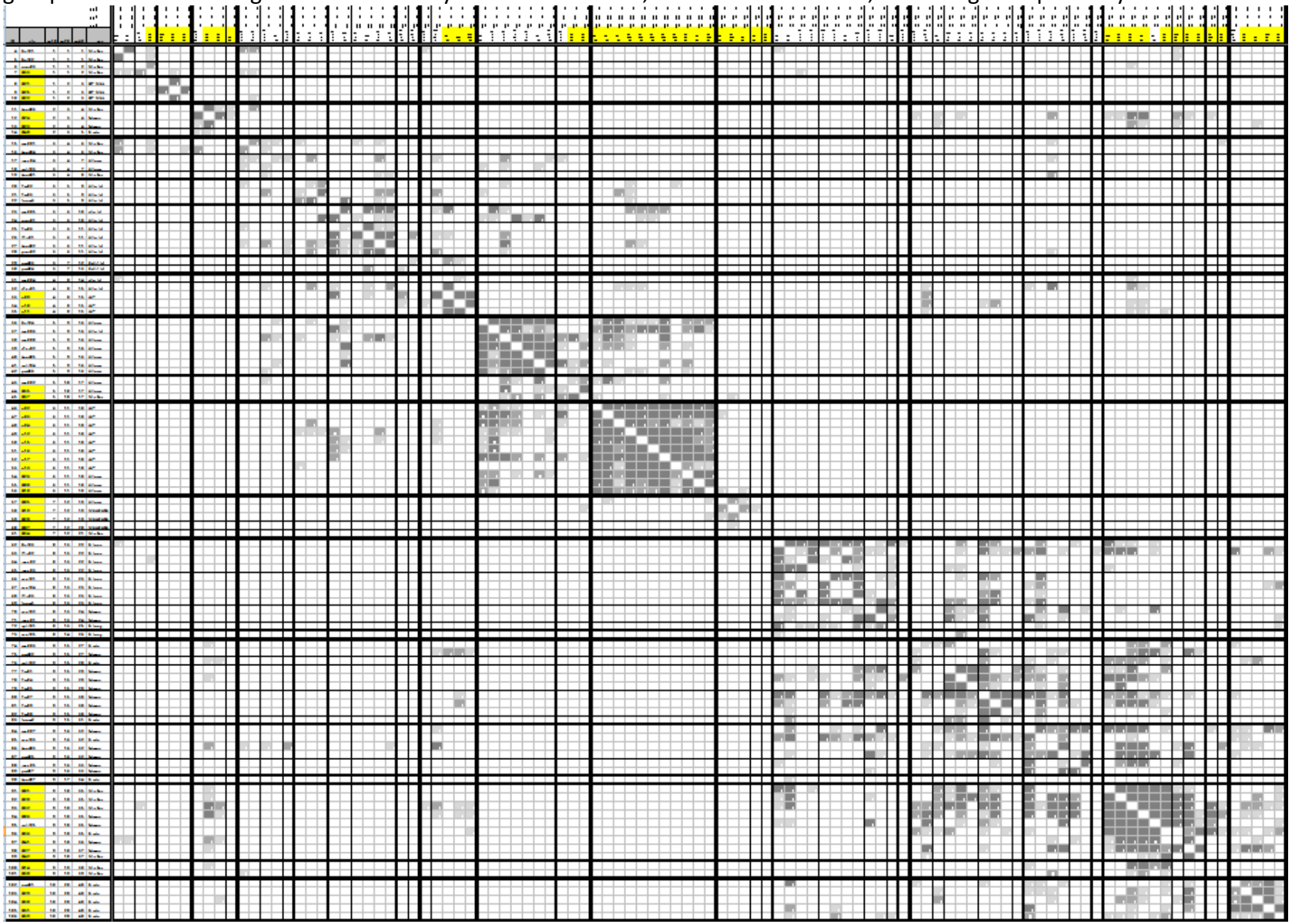
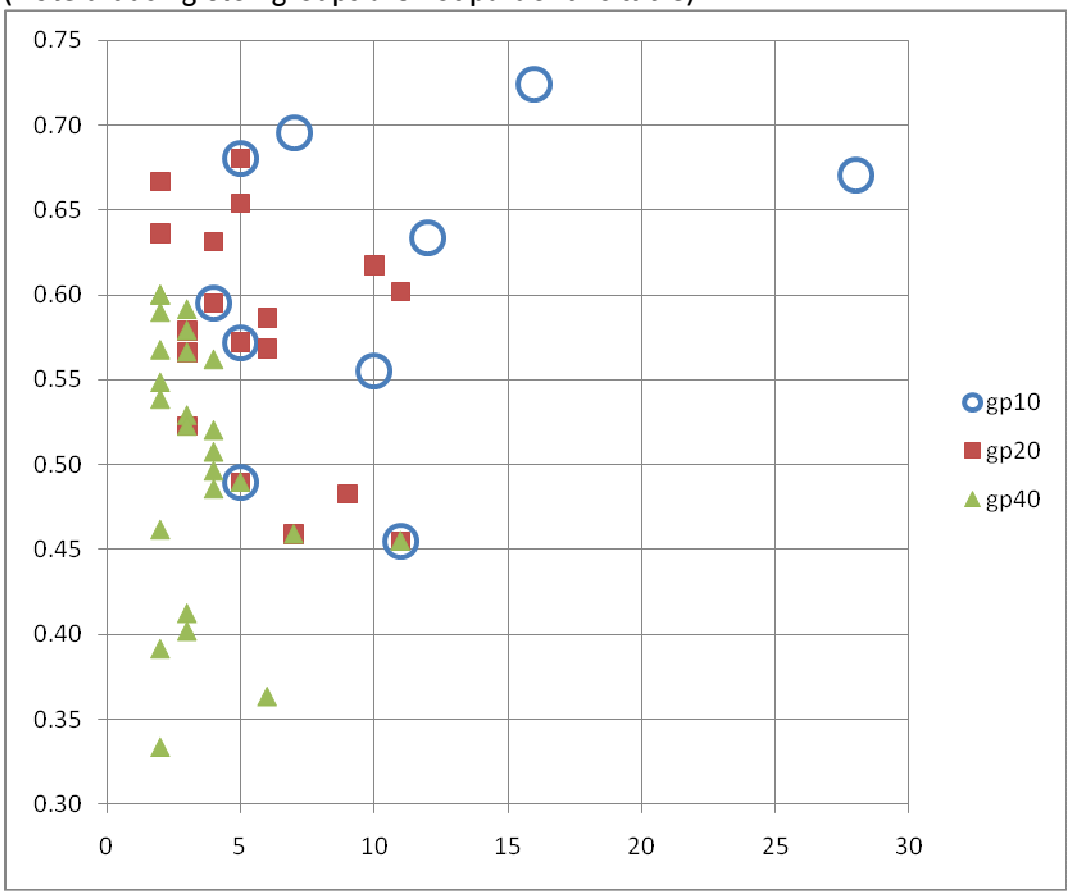


Figure 2 Average dissimilarity between sites in PARK and G & L classification group compared to classification level and number of sites in classification group.
(Note that singleton groups are not part of this table).



While there are no clear rules about how many floristic groups are present in this dataset, experience suggests that more than20 are likely. For the purpose of these analyses, 20 will be used in further analyses.

Returning to the relationship with vegetation types, Table 13 shows this at the 20 group level.

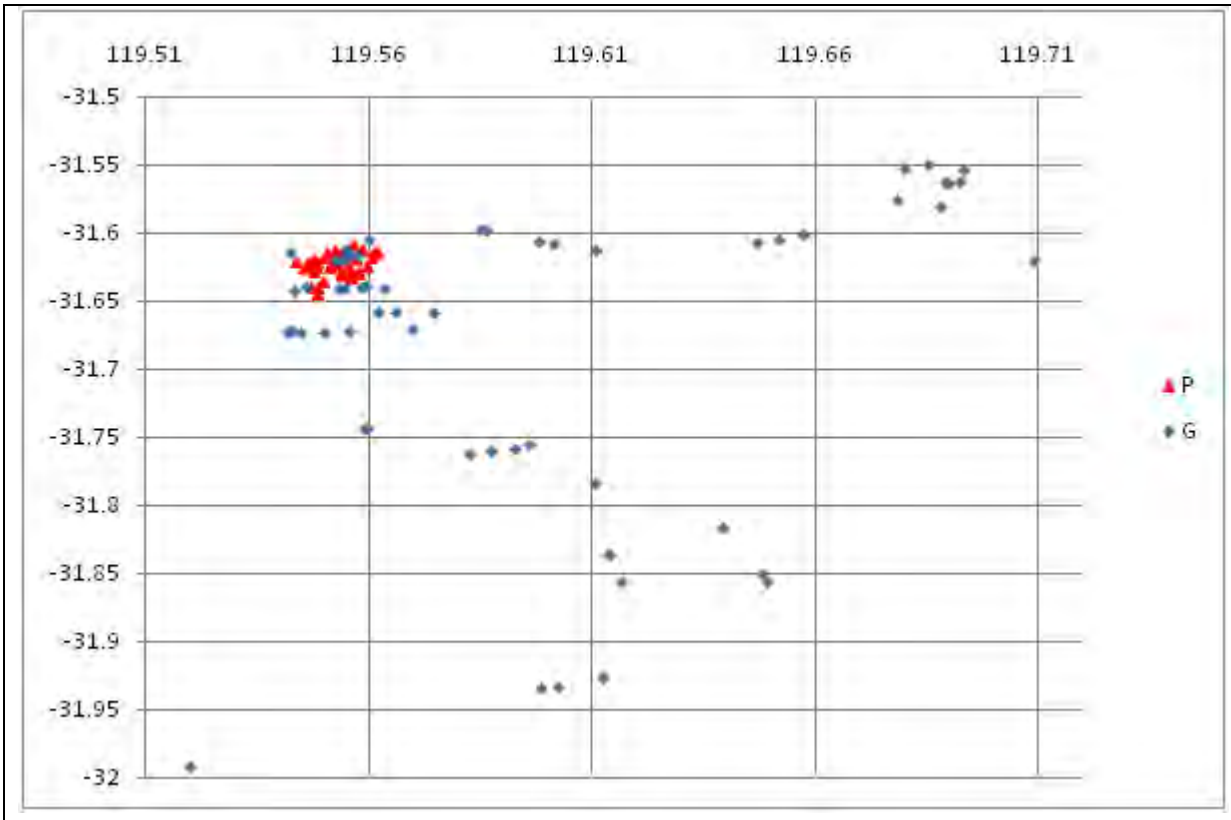
Table 13 Relationship of vegetation type to PARK and G & L classification (perennials) – 20 group level

gp10	gp20	#sites	G & L	PARK	Mix Euc	OP MAL	allo lat	Callit lat	Allocas	LAT	MALLE HEA	E_ long	Salmon	E_ salu	# Veg Types in 20 Groups	# Veg Types in 10 Groups
1	1	4	3	1	4										1	2
1	2	3		3		3									1	
2	3	4	1	3	1								2	1	3	3
3	4	5	5		3				2						2	4
3	5	3	3				3								1	
3	6	6	6				6								1	
3	7	2	2					2							1	
4	8	5	2	3			2			3					2	2
5	9	7	7				1		6						2	3
5	10	3	1	2	1				2						2	
6	11	11		11					3	8					2	
7	12	5		5	1				1		3				3	3
8	13	11	11									9	2		2	2
8	14	1	1									1			1	
9	15	10	10										7	3	2	3
9	16	6	6										5	1	2	
9	17	1	1											1	1	
9	18	9	1	8	4								4	1	3	
9	19	2		2	2										1	
10	20	5	1	4										5	1	1
			16	10												
			10	4												
			#gps		7	1	4	1	5	2	1	2	5	6		
			PARK		9	3			5	11	3		5	6		
			G & L		7		12	2	9			10	15	6		

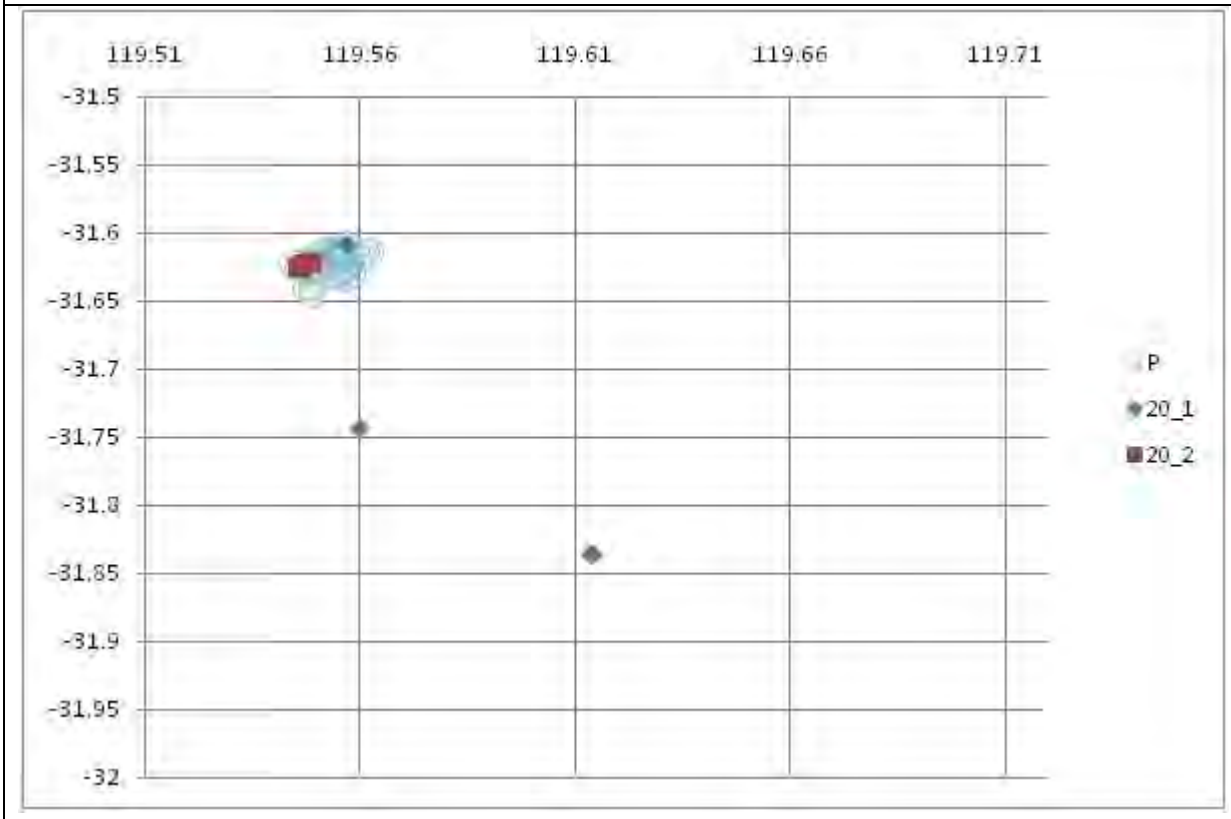
With 14 of the 20 groups occurring in only one survey, the apparent influence of survey on floristic types was significant. This may in part be due to the slightly different spectrum of vegetation types in the different surveys (see Table 13).

Thus, 7 of the 10 groups are in the PARK dataset. Two of these (6 and 7 largely laterite and mallee heath) were not in the G & L sites. Similarly 10 of the 20 are in PARK. Four (2, 11, 12 and 19) were not in the G & L sites. Figure 3 is a series of scatter plots showing the distribution of these groups.

Figure 3 Distribution of sites by PARK and G & L classification groups – 20 group level
(Only groups containing sites from PARK are shown)

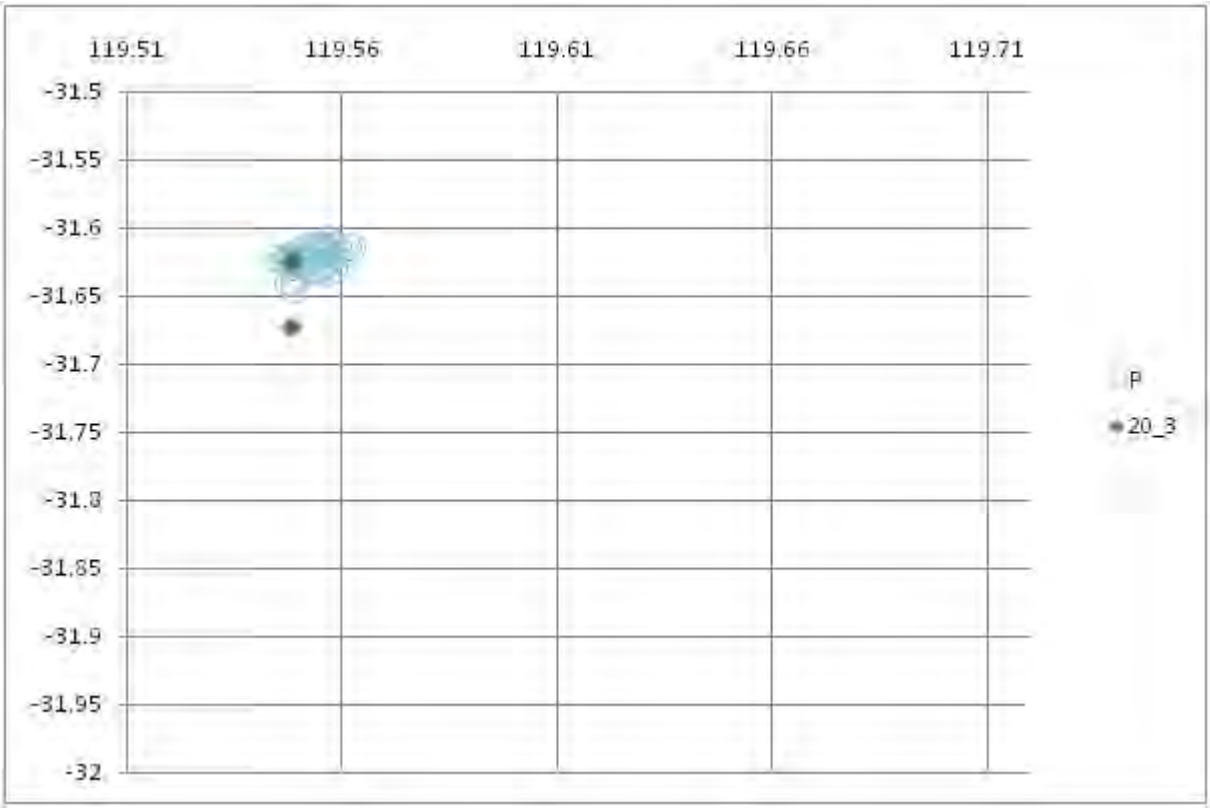


Distribution of PARK (red triangle) and G & L (blue diamond) sites

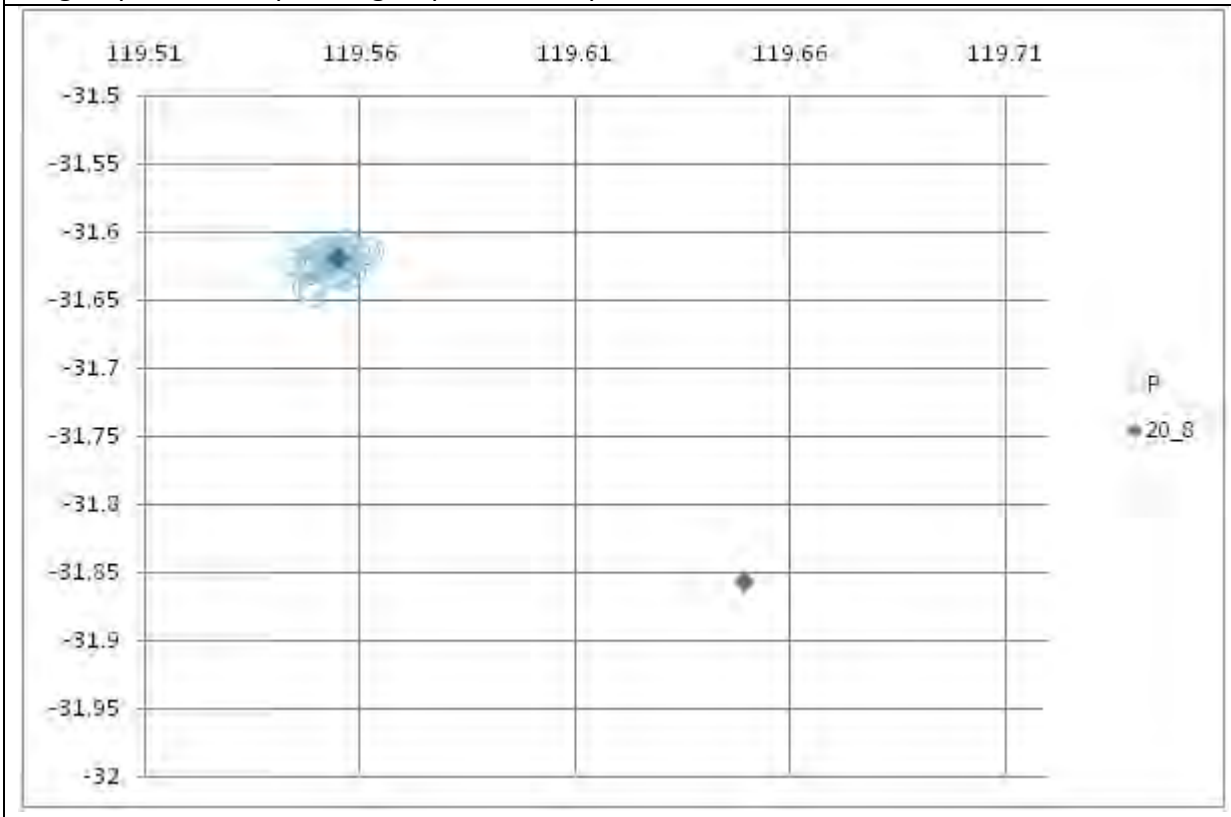


10 group level Group 1; 20 group level Groups 1 & 2; PARK sites

Figure 3 cont.

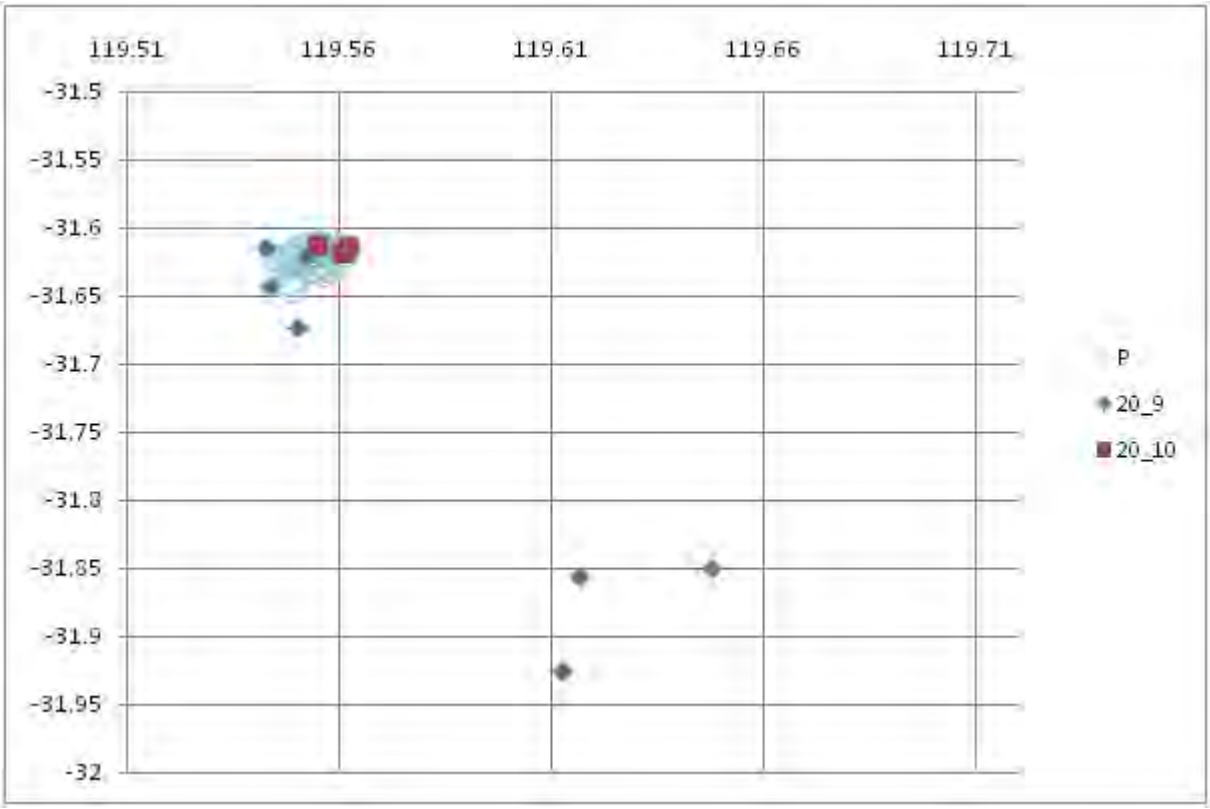


10 group level Group 2; 20 group level Group 3; PARK sites

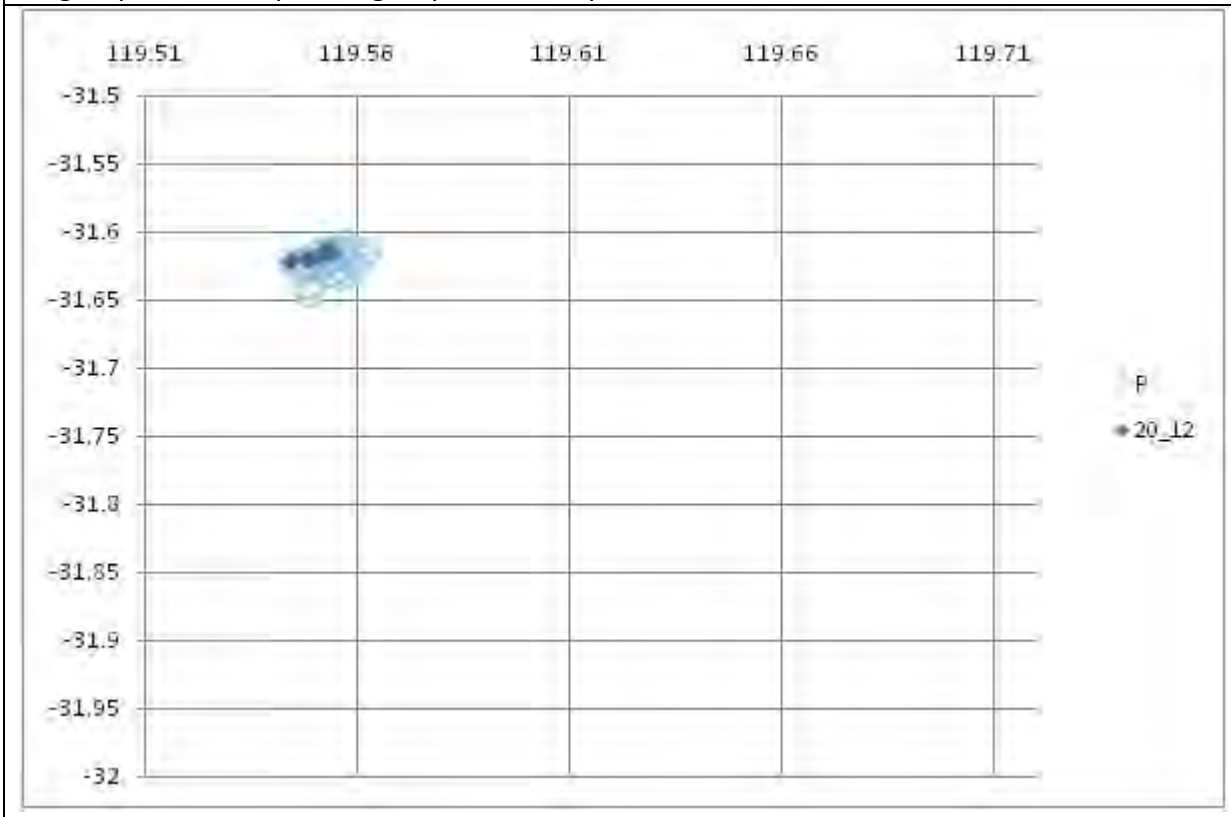


10 group level Group 4; 20 group level Group 8; PARK sites

Figure 3 cont.

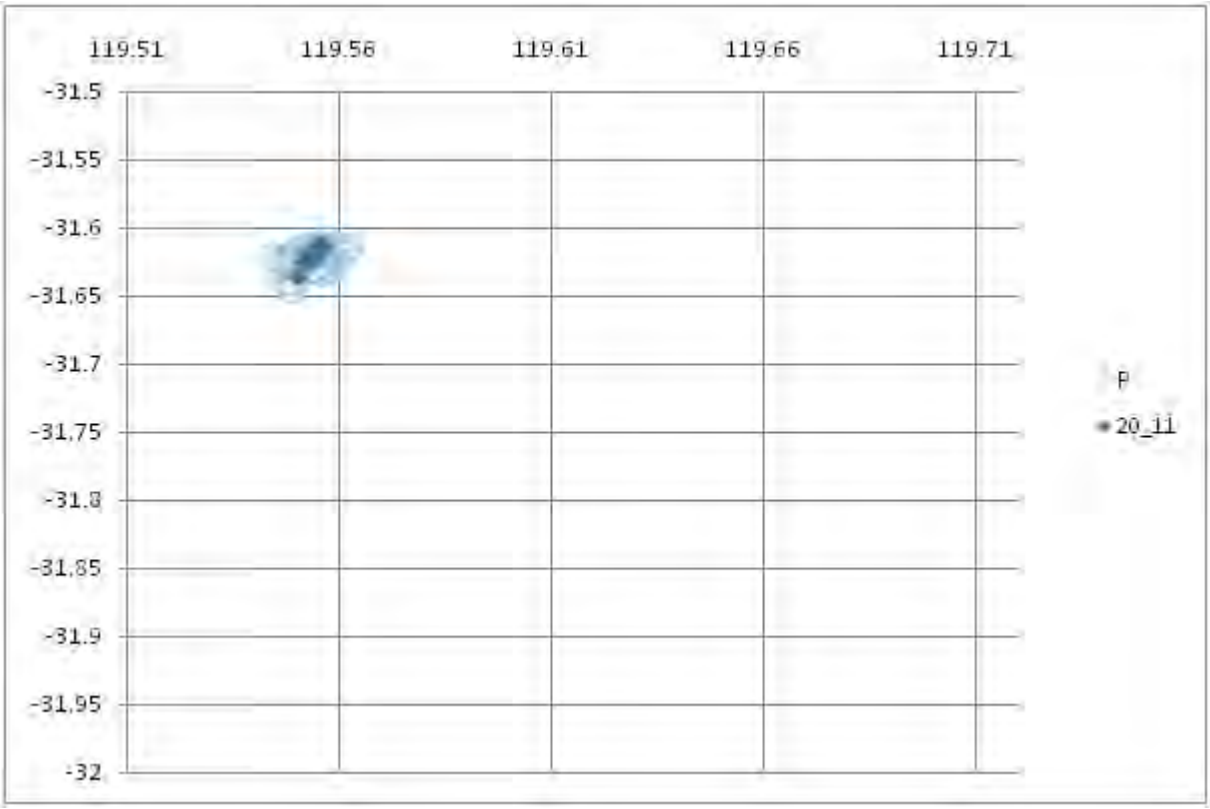


10 group level Group 5; 20 group level Groups 9 & 10; PARK sites

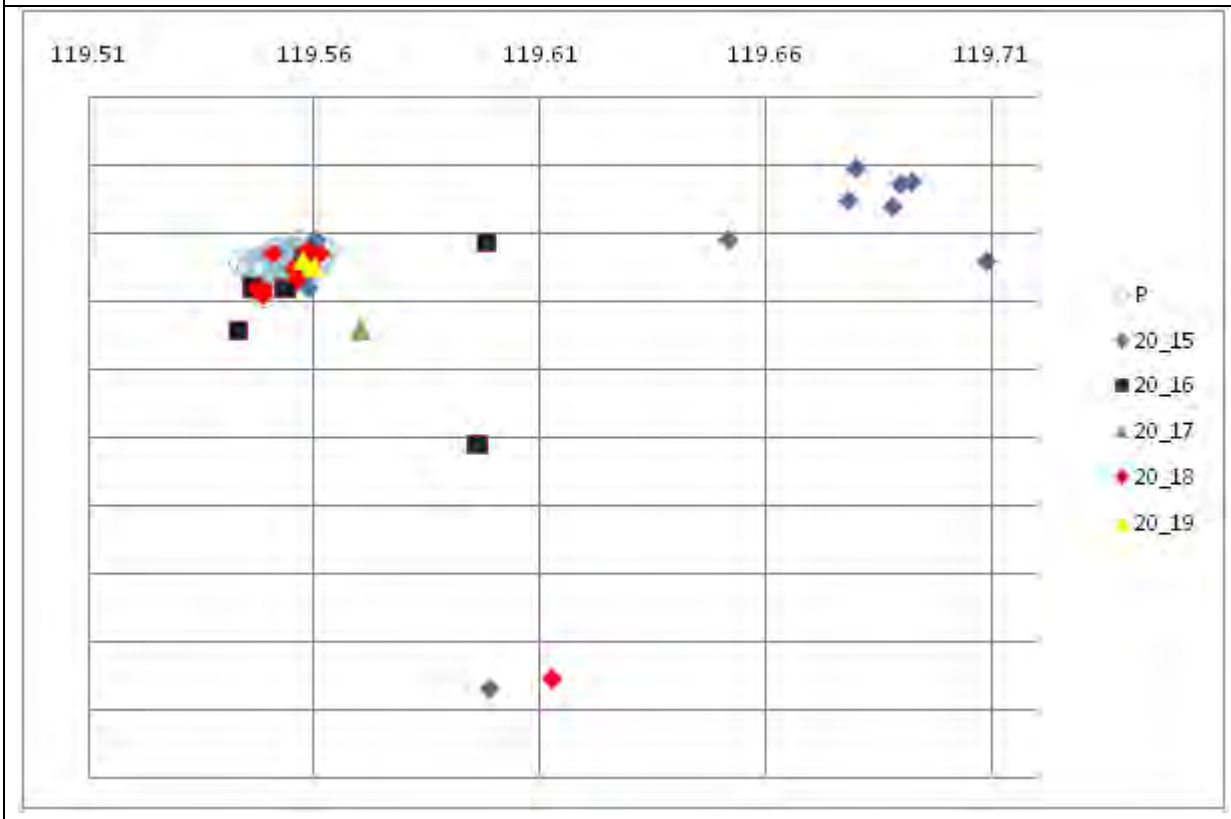


10 group level Group 6; 20 group level Group 12; PARK sites

Figure 3 cont.

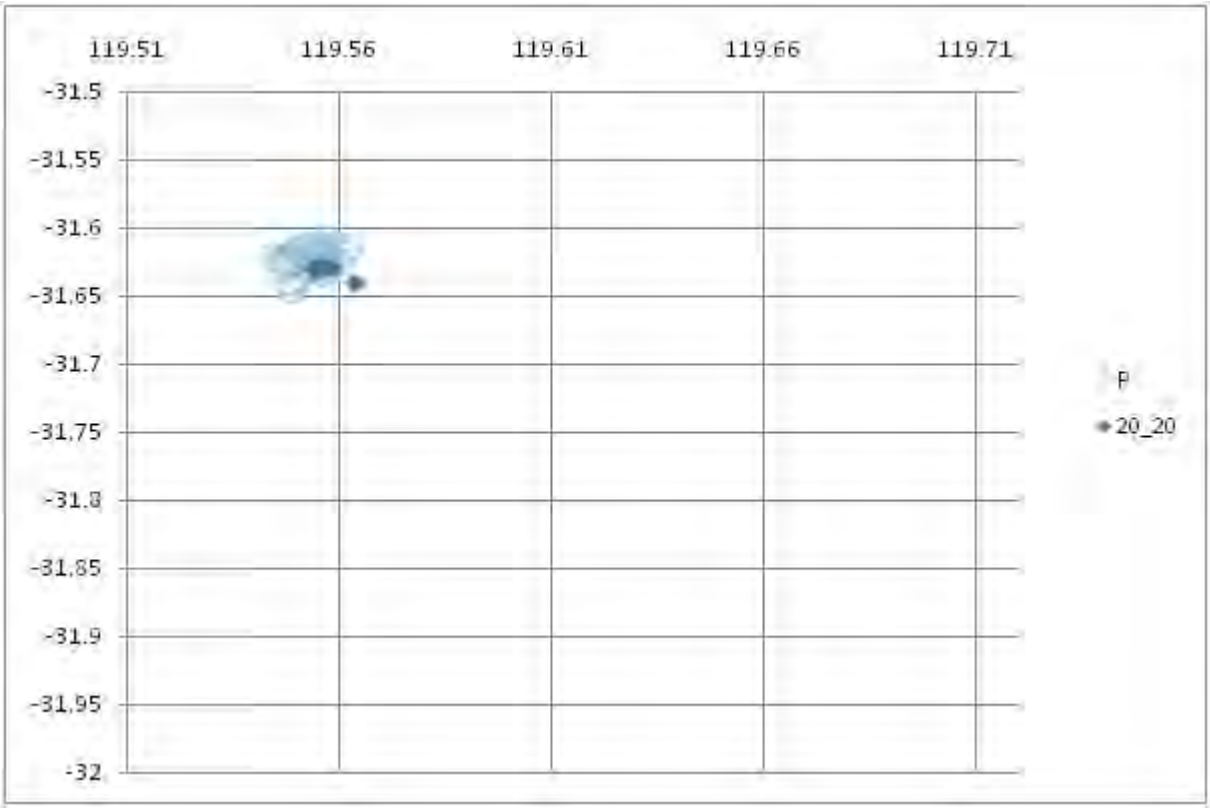


10 group level Group 7; 20 group level Group 11; PARK sites



10 group level Group 9; 20 group level Groups 15 - 19; PARK sites

Figure 3 cont.



10 group level Group 10; 20 group level Group 20; PARK sites

Group 1 (at 10 group level) was shared between project with one sub group (20_2) confined to PARK. Groups 2 and 4 were shared. Group 5 was shared with one subgroup (20_10) confined. Groups 6 and 7 were confined to PARK. Group 9 was shared with one subgroup (20_19) confined. Group 10 was shared.

This analyses suggests that there are at least 10 different floristic types in the PARK area with 4 not represented by the G & L sites. Appendix 5 is a tabulation of the species which were present in more than 60% of the sites in each group at the 10 and 20 group level. This provdes an indication of what are the main species present across these vegetation communities.

Table 14 shows the distribution of these species across the floristic groups. Where they are >60% in a group they are shaded. The thick lines divide the sites into 3 groups. This highlights strong patterns in the species distributions.

These species distributions tend to support an impression that each of the 20 groups are distinct floristic groups. (See Appendix 5 for the most commonly occuring species in these groups.) Note that this is about twice the number of vegetation units recognised in the combined data set. Ten of these floristic groups occur in the PARK sites. Five apparantly only in the PARK data set bear further examination. (Refer to Table L for how these relate to the vegetation types.)

- Group 20_2 appears to have a number of species only present in it. It is the only representation of the OP_MAL vegetation type.
- Group 20_11 also has a number of species apparantly restricted. It includes most of the laterite vegetation which is split with Group 20_8.

- Group 20_12 has no species apparantly restricted and is mainly mallee heath including all those occurrences.
- Group 20_18 has no species apparantly restricted and is mixed eucalypt and salmon gum vegetation units.
- Group 20_19 has no species apparantly restricted and is mixed eucalypts unit.

Table 14 Distribution of main species by 20 group PARK and G & L classification level

	1	1	2	3	3	3	3	4	5	5	6	7	8	8	9	9	9	9	9	10
NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sites →	4	3	4	5	3	6	2	5	7	3	11	5	11	1	10	6	1	9	2	5
G & L	3		1	5	3	6	2	2	7	1			11	1	10	6	1	1		1
Parker	1	3	3					3		2	11	5						8	2	4
Euryomyrtus sp. Parker Range				20													100			
Senna artemisioides								80						100						
Cheilanthes austrotenuifolia						100														
Comesperma volubile				20		50	100		29											
Callitris columellaris							100		14											
Eucalyptus corrugata					67										20					
Eucalyptus oleosa					67											17				
Dodonaea bursariifolia					67															
Grevillea huegelii	100	67	100	20								20			10			11		
Eucalyptus transcontinentalis	50	67		40									18			33	100			
Acacia camptoclada		100	50	20		17									10					
Westringia rigida		100																22		
Prostanthera althoferi subsp. Althoferi		67	25																	
Grevillea oncogyne		67		20						33										
Eucalyptus eremophila	25	67		40							9									
Melaleuca acuminata	25		75	60							9				20	17				
Daviesia argillacea	100		25	80							9		9			17		11		20
Melaleuca eleuterostachya	25	33	50	20	67			20			9									40
Lomandra effusa	50	33				17						20		100						
Eucalyptus loxophleba	25			20	100	17						20								
Allocasuarina acutivalvis				80	67	50		20	71	67						17			50	
Acacia acuminata				60	33	83		20	43								100		50	
Phebalium tuberculosum				40	33	67	50	60	14	33	45				20			11		80
Hakea pendens	25			20		83		60	14		18									
Eucalyptus capillosa subsp. polyclada				100	33	83	50	40	43		45	20				17			100	
Santalum acuminatum	25	33	75	100	33	33		40	29		18	20	27	100	30	17		33		
Alyxia buxifolia	25	33	50	20	33	83	100	100			45				70	50		56	100	
Trymalium myrtillus				20	33	17	50	80							20					
Phebalium filifolium	25	33		60	100	17					27	40				17			50	
Westringia cephalantha	100	67		80	100	33		20			82	20				17		22		40
Melaleuca hamata	75	67	25	80	67	33	100		14			80			10					20
Phebalium megaphyllum	25	67		60			50	40			18	40								
Beyeria brevifolia				20		17		20		33		20	9		20		100			
Chamelaucium sp. Victoria (J. Coleby-Williams 99)										100	18	60								
Thryptomene kochii			25	20					71		36	60								
Allocasuarina campestris					67	33		60	29		100	60								
Calothamnus gilesii					33	50		40	86		82									
Grevillea obliquistigma					100	67			86		9									
Hibbertia rostellata				40	67	100	50	20	100	33	73									
Allocasuarina corniculata				40	33				71	100	64	100								
Grevillea paradoxa				20	100				100	100	82									
Baeckea elderiana				40					86	67	64	20								
Melaleuca cordata				40		17		20	71	100	91	60								
Grevillea pterosperma											64	20								
Hakea subsulcata					33	17			14	33	91									
Stenanthemum stipulosum					33						82									
Acacia enervia		67	50								82	20								
Hibbertia pungens				20		17					91	40								
Drummondita hassellii											9	80								
Eucalyptus leptophylla		67								33	9	80								
Grevillea phillipsiana														100	30					

	1	1	2	3	3	3	3	4	5	5	6	7	8	8	9	9	9	9	9	10
NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sites →	4	3	4	5	3	6	2	5	7	3	11	5	11	1	10	6	1	9	2	5
G & L	3		1	5	3	6	2	2	7	1			11	1	10	6	1	1		1
Parker	1	3	3					3		2	11	5						8	2	4
Zygophyllum apiculatum														100	10					
Rhagodia drummondii														100	50			11		
Sclerolaena diacantha													45		60	33	100			
Templetonia sulcata	25												82		50	17				
Eremophila scoparia													55	100	40	50		33		
Eucalyptus longicornis		33						20					82		30	17				
Lycium australe													9	100	10					
Austrostipa trichophylla																	100			
Grevillea acuaria	25	33	50	20					14						10			100	100	60
Acacia hemiteles	25			40	33										20			67	100	
Melaleuca lateriflora	25		75												20					40
Eremophila decipiens			25		33								9	100	10			11		
Acacia erinacea	25			40		17		40					9		60	67		67	50	80
Olearia muelleri	100		50	20		17	50	40					27	100	70	50	100	78	50	20
Eucalyptus salubris			75	40				40					45		60	67	100	33		100
Melaleuca pauperiflora	50	33										20	64		30	100	100	78		100
Eucalyptus salmonophloia			75					20					18		40	83		67	50	
Eremophila oppositifolia			25				50	80							50	100		22	50	20
Scaevola spinescens			50	20				100							80	33		100		
Exocarpos aphyllus	50			20				40					18		80			78	50	
Acacia merrallii	50			20				20				20	73	100	40	17		44	50	60
Austrostipa elegantissima	25	33		20	33	67		40					73	100	90	33		11		20
Maireana marginata														100						
Maireana pentagona														100						
Acacia nyssophylla														100						
Eucalyptus myriadena														100						

Comparison of PARK with Newbey Data

The perennials from the PARK data combined with data from Newbey (NEW) was analysed using PATN. Arbitrary 10, 20 and 40 groups were classified from the 135 sites. The dendrogram is shown in Appendix 6. Table 15 shows that only 4 of the groups at the 10 group level had members from both projects. Two of these had just one member from one of the projects. There is even a suggestion of further project differences with 5 of the groups being only in the Borrabin/Southern cross (BS) or Lake Johnson/Hyden (LH) areas within the Newbey dataset.

At the 20 group level there were 4 and at the 40 group level there were just 5 (Table 16). This strongly suggests that there is a strong project influence on the classification.

Table 15 Summary of Classification of PARK with NEW data – 10 group level
(Number of sites by project and average dissimilarity within groups)

gp10	n	PARK	NEW	BS	LH	AvgOfdis	# Species in > 50% sites
1	11		11	3	8	0.89	1
2	17		17		17	0.87	2
3	14	4	10		10	0.78	2
4	10		10	8	2	0.82	2
5	3		3		3	0.80	3
6	20		20	16	4	0.69	10
7	5	3	2	2		0.64	8
8	18	17	1	1		0.65	8
9	20	1	19	12	7	0.78	7
10	17	17				0.62	11
						0.75	

The groups at the 10 group level are quite heterogeneous with average dissimilarity 0.75. (Totally dissimilarity is 1.00.) Five of these groups have less than 5 species which occur in more than half the sites in the group. The main species in these groups are shown in Appendix 7.

Even at the 40 group level this average is only 0.64 and only 4 groups with values less than 0.5. This suggests that the dataset is very diverse and probably has more than 40 distinct plant communities.

Looking closer at the association matrix, the PARK sites are apparently quite distinct from almost all NEW sites (Figure 4).

The most similar NEW site to each PARK site was determined. The average dissimilarity of these pairs was 0.67. Only 4 had a NEW site more similar than 0.6. These were all from group 40 # 30. This is in accord with the classification using all species by Botanica.

This apparent stark difference is probably related to the number of species which are only in one of these projects (Table 17). Less than a sixth of the species were in both projects. About 30% of the species in PARK were not in the NEW sites.

Table 16 Summary of Classification of PARK with NEW data – 40 group level
(Number of sites by project and average dissimilarity within groups)

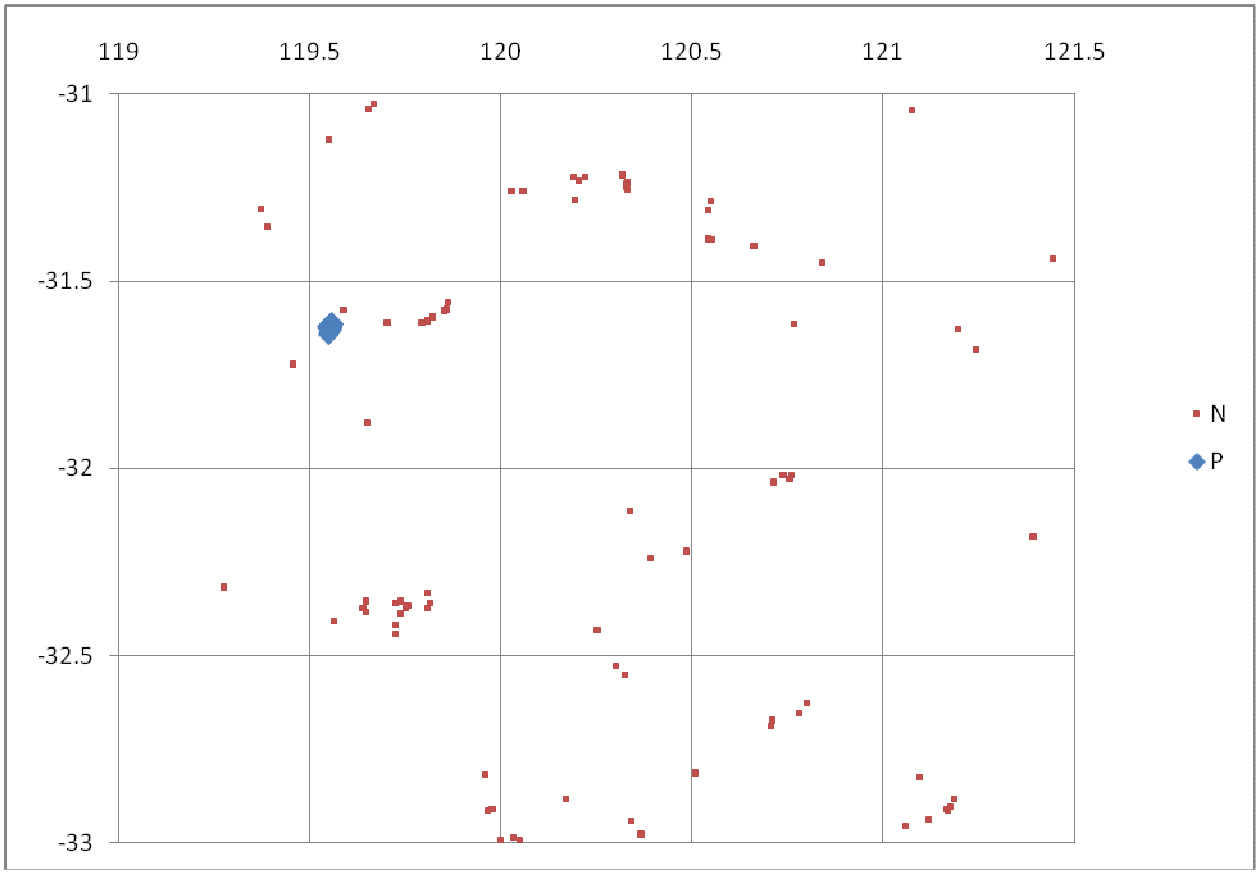
			Average	# sites		
gp10	gp20	gp40	Dissimilarity	All	PARK	NEW
1	1	1	0.77	2		2
1	2	2	0.76	2		2
1	3	3	0.72	3		3
1	4	6	0.79	2		2
2	5	7	0.71	2		2
2	5	8	0.76	2		2
2	7	11	0.72	4		4
2	8	12	0.67	2		2
2	8	14	0.68	4		4
3	10	16	0.63	3	2	1
3	10	17	0.60	4		4
3	10	18	0.66	3	1	2
3	10	19	0.74	3	1	2
4	11	20	0.72	3		3
4	11	21	0.71	2		2
4	12	22	0.69	5		5
5	13	24	0.64	2		2
6	14	25	0.62	11		11
6	14	27	0.63	8		8
7	15	28	0.58	2		2
7	15	29	0.38	3	3	
8	16	30	0.56	10	9	1
8	16	31	0.60	4	4	
8	16	32	0.46	4	4	
9	17	34	0.60	4		4
9	17	35	0.72	4		4
9	18	36	0.68	4		4
9	18	37	0.64	7	1	6
10	19	38	0.45	11	11	
10	20	39	0.66	4	4	
10	20	40	0.38	2	2	
			0.64			

Table 17 Total number of species by project (PARK and NEW)

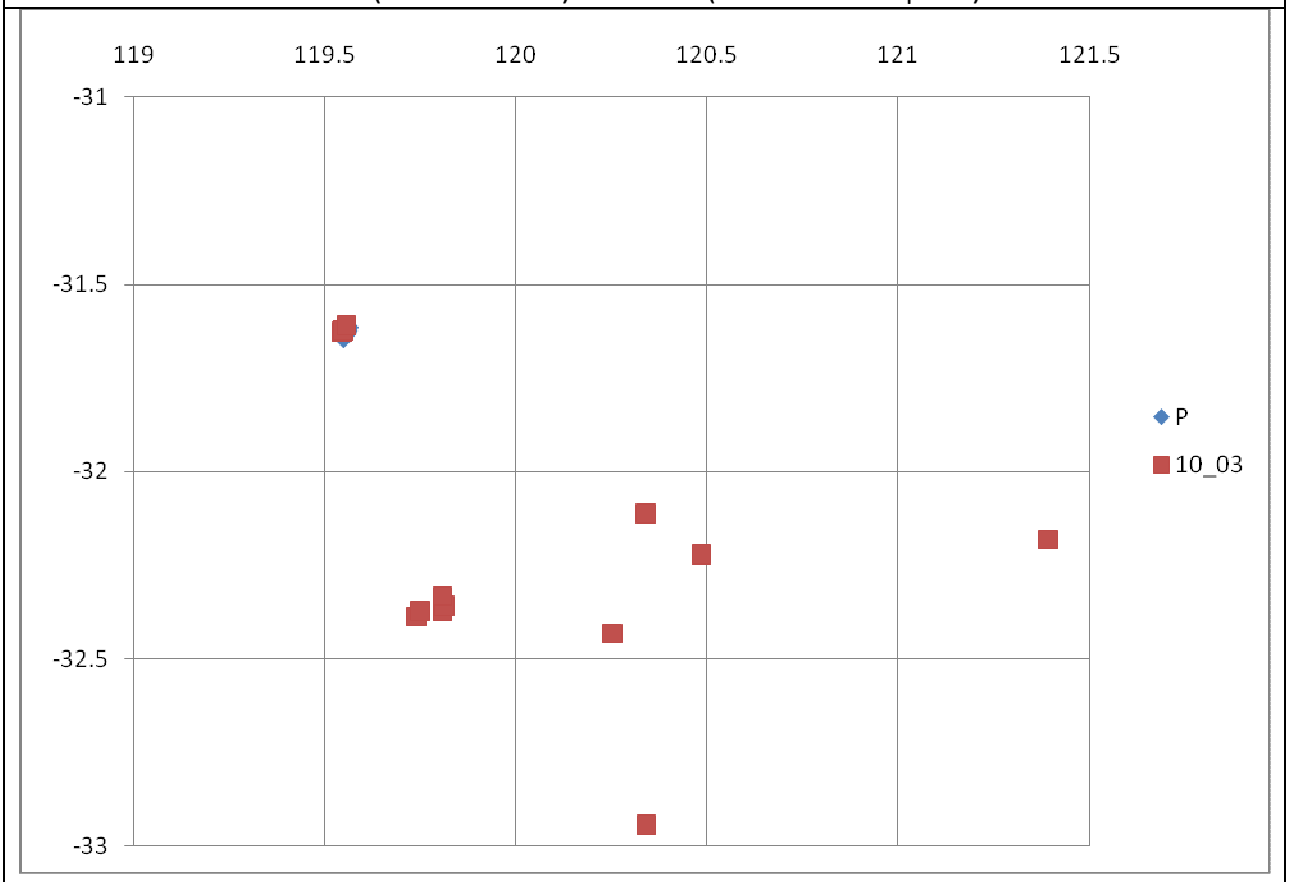
Project	# species	% of total	Total
PARK	37	5.7	29.4
both	89	13.7	
NEW	526	80.7	85.5
Total	652		

Figure 5 is the distribution of the Groups in which PARK sites were present. This shows little pattern of significance except that the concentration of sites from these groups is in the PARK area.

Figure 5 Distribution of sites by PARK and NEW classification groups – 10 group level
(Only groups containing sites from PARK are shown)

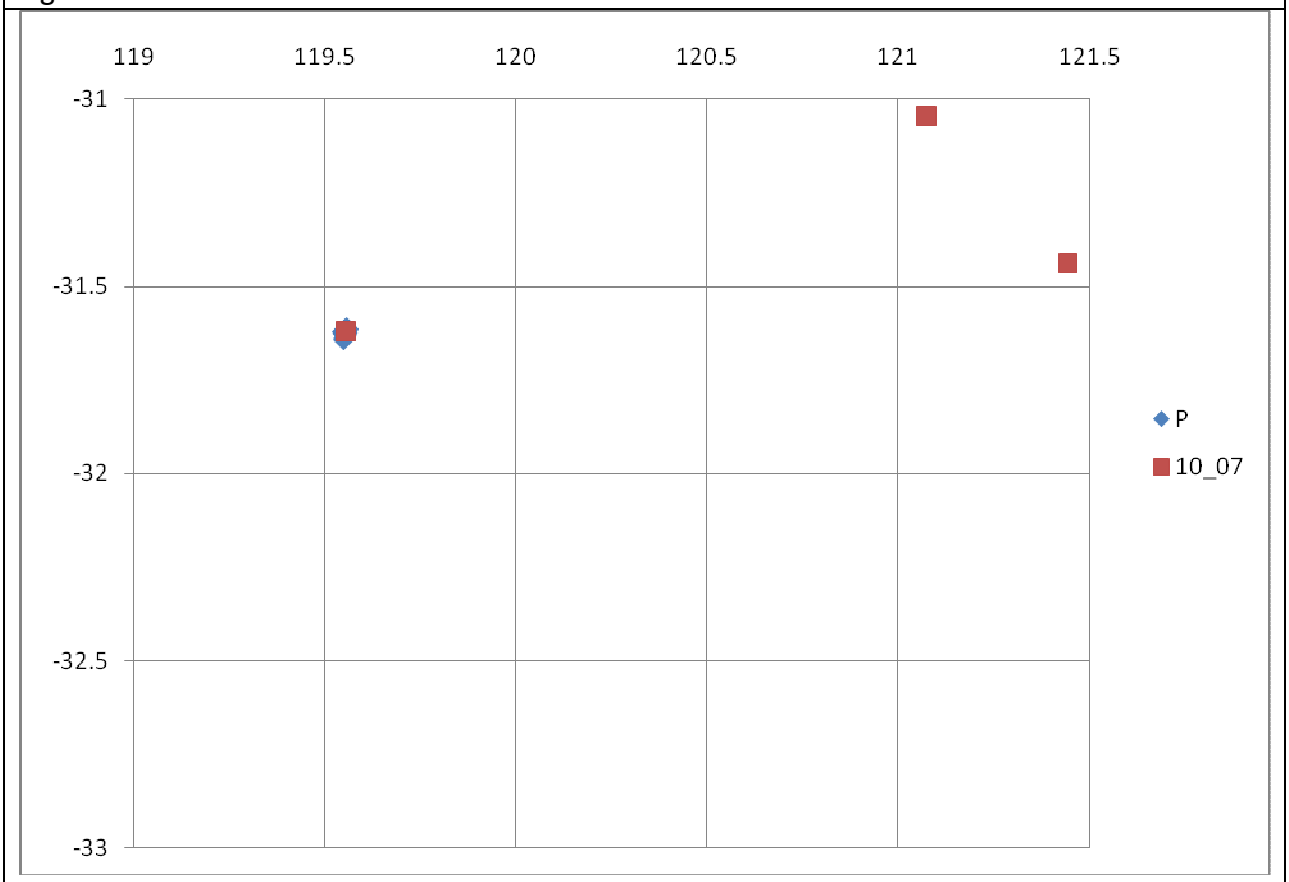


Distribution of sites: PARK (blue diamond) and NEW (small brown square)

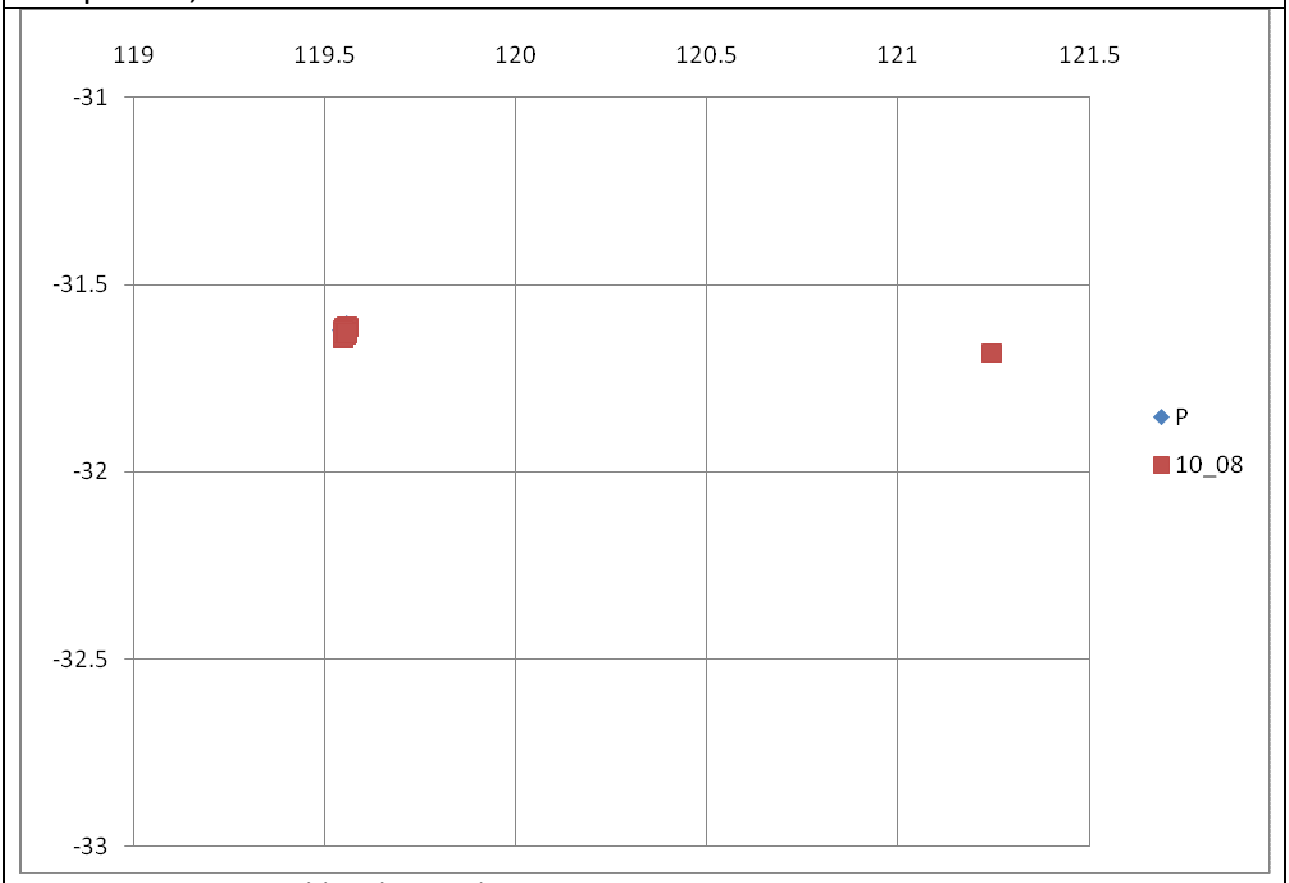


Group 3 sites; PARK – blue diamonds

Figure 5 cont.

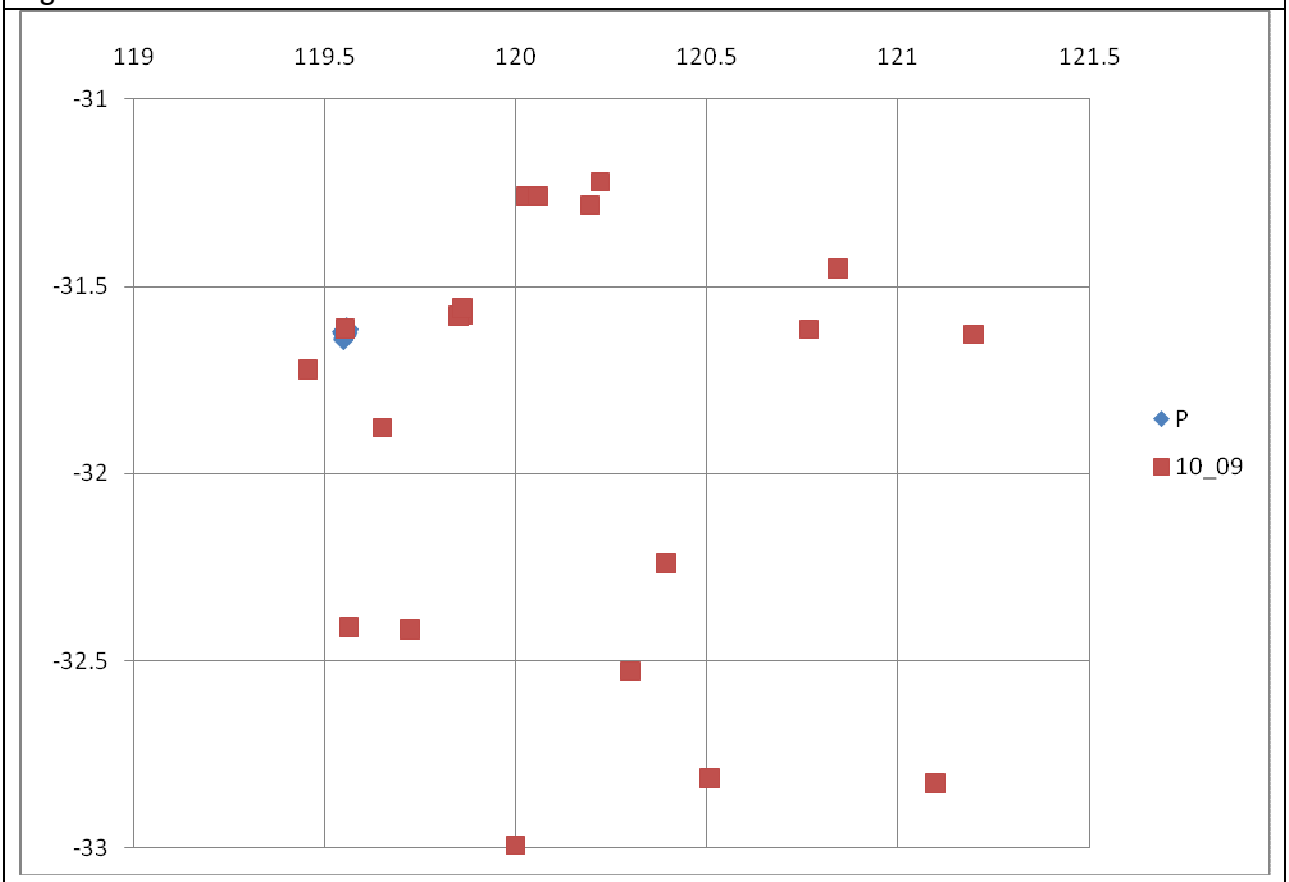


Group 7 sites; PARK – blue diamonds

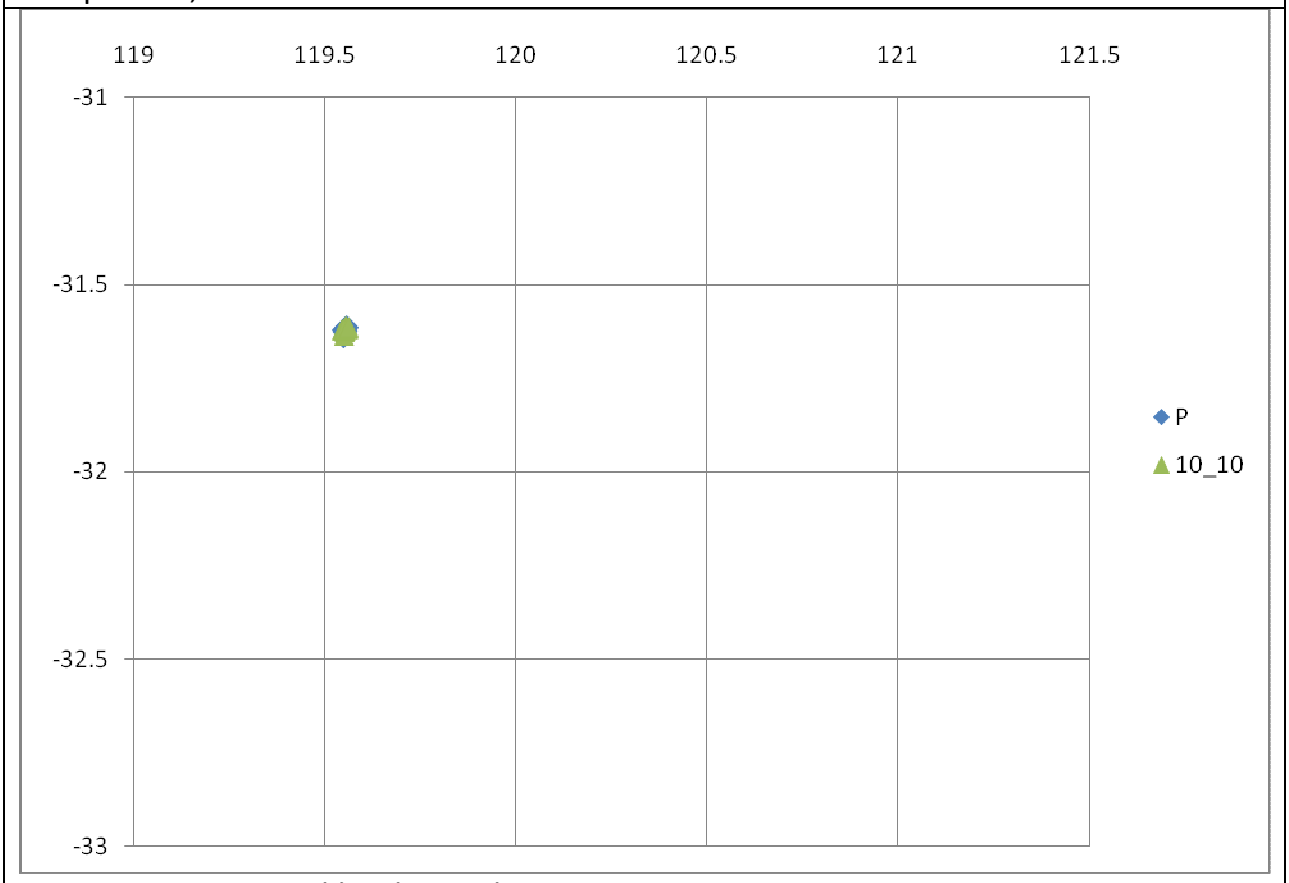


Group 8 sites; PARK – blue diamonds

Figure 5 cont.



Group 9 sites; PARK – blue diamonds



Group 10 sites; PARK – blue diamonds

Having a look at the groups that the PARK sites share with Newby, the main vegetation types of the PARK sites are (see Appendix 5):

Group 3 - open mallee

Group 7 - laterite vegetation

Group 8 – Salmon gum and Gimlet

Group 9 – mixed eucalyptus

Group 10 – laterite, casuarina and mallee

It was difficult to compare this classification to the vegetation types. However, one observation requires comment. The Salmon gum and gimlet vegetation from the PARK data was in Group 8 and from the Newbey sites in Group 6. This suggests that the species composition of these conspicuous vegetation types was quite different. Is this a survey influence or reality?

Discussion

Evidence was presented that the differences in the number of annual and perennial species recorded by the PARK survey compared to that of Gibson and Lyons might have influenced the classification. However, their removal had a limited effect on the membership of the classification groups. Parallel to this the removal of such species from the classification using the PARK with Newby data had limited effect on bringing the PARK sites closer to the Newby sites.

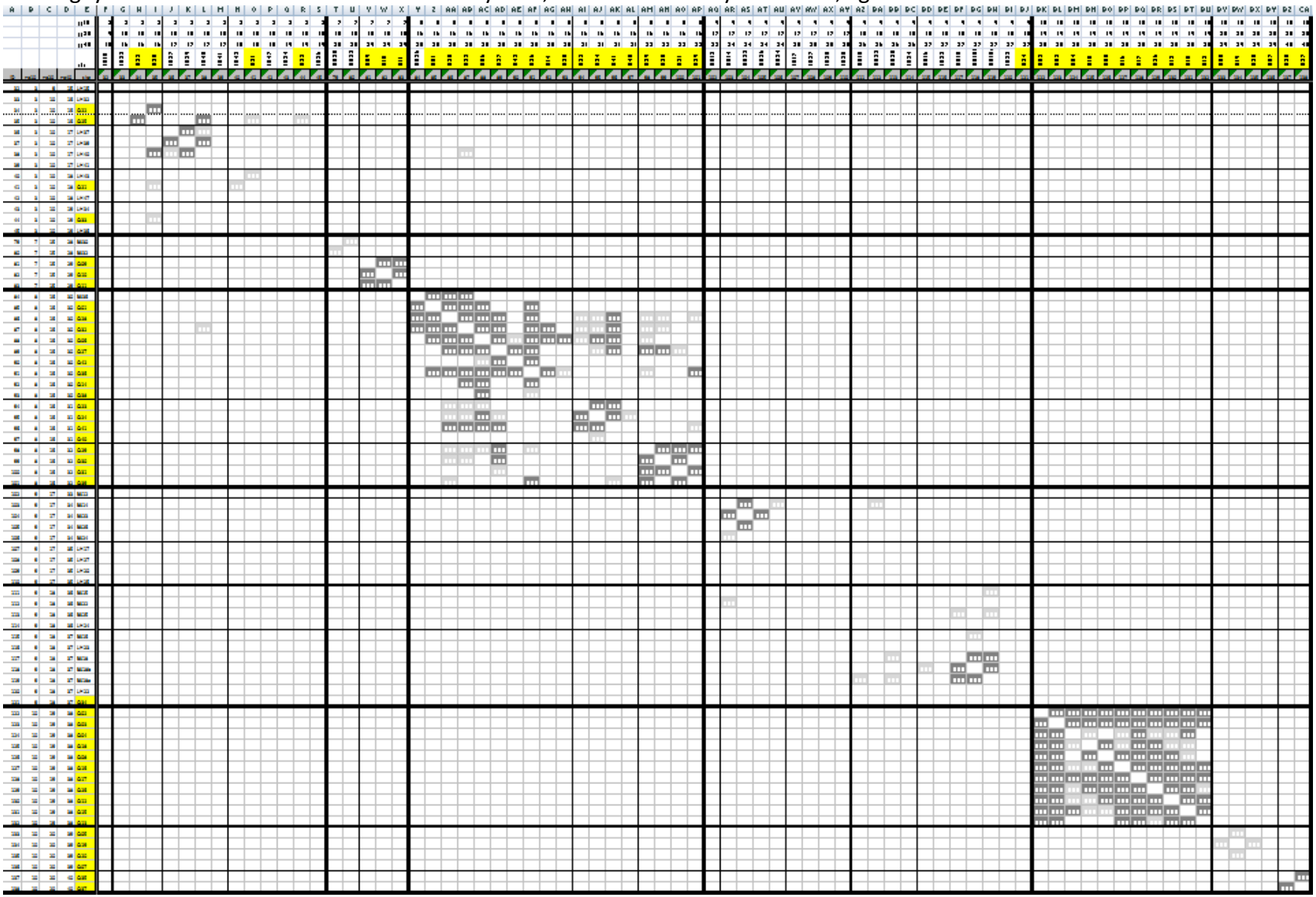
It is likely that the PATN numerical analysis on which Botanica made its interpretations of significance was not likely to be very different had it been done using perennials only.

This analysis also demonstrates that the PARK, Gibson and Lyons and Newbey data sets have floristic communities not widely shared. Just how distinct the communities in the PARK data set cannot be readily determined as there appears to be some survey/season differences as exemplified by Table 2.

Several floristic groups in the PARK appeared distinct from G & L sites. These are mostly related to the lateritic vegetation type.

The floristic comparison with the Newbey data does not appear to provide useful context for evaluation. There is a strong suggestion that the nomenclature of species may not be consistent with those currently applied.

Figure 4 PARK and NEW association Matrix limited to the Group 10 groups which have sites from the PARK dataset.
Shading: yellow – PARK sites. Darkest dissimilarity <0.5, mid – dissimilarity 0.5 – 0.55, light 0.55 – 0.6.



References

Belbin, L. (1987). PATN Reference Manual (313p), Users Guide (79p), Command Manual (47p), and Example Manual (108p). CSIRO Division of Wildlife and Ecology, Lynham, ACT.

Gibson, N. and Lyons, M., (1998), Flora and Vegetation of the Eastern Goldfields Ranges: Part 3 Parker Range, *Journal of the Royal Society of Western Australia,* **81:**119-129, 1998

Newbey, K.R, Keighery, G.J, Hall, N.J, McKenzie, N.L & Rolfe, J.K (1991), *Biological survey of the Eastern Goldfields: Part 11 Boorabin-Southern Cross study area.* Department of Environment and Conservation.

Newbey, K.R., How, R.A., Dell, J., Muir, B.G. & Hnatiuk, R.J., (1988),*Biological survey of the Eastern Goldfields: Part 4 Lake Johnston-Hyden study area.* .Department of Environment and Conservation.

Appendices

Appendix 1 Species Reconciliation between PARK and G & L

NAME	Reconciliated Name
Austrodanthonia sp.	omitted
Lepidosperma sp.	omitted
Acacia enervia subsp. enervia	Acacia enervia
Acacia neurophylla subsp. neurophylla	Acacia neurophylla
Senna artemisioides subsp. filifolia	Senna artemisioides
Micromyrtus sp. (NG & ML sn)	omitted
Melaleuca sp. (NG & ML 2335)	omitted
Micromyrtus racemosa var. racemosa	Micromyrtus racemosa
Goodenia sp.	omitted
Vittadinia sp.	omitted

Appendix 2 Species Reconciliation between PARK and NEW

NAME	Reconciliated Name
Mesomelaena stygia subsp. stygia	Mesomelaena stygia
Schoenus sp.	omitted
Caladenia amplexans	Cyanicula amplexans
Grevillea didymobotrya subsp. didymobotrya	Grevillea didymobotrya
Tecticornia halocnemoides subsp. halocnemoides	Tecticornia halocnemoides

Appendix 3 PATN analyses carried out

Several modules of the numerical classification package PATN (Belbin 1987) were used for the analyses. The default parameter settings were used in all analyses.

The PATN modules used were ASO (calculation of similarity matrix), FUSE (classification), DEND (representation of classification) and SSH (a form of ordination to display relationship of sites to the whole dataset). The results of the analyses were imported into a database so that site characteristics could be joined with the groups formed in the analysis.

The modules were run twice;
first with the sites as the classified objects (ie. the species as the attributes), and
then with the species as the classified objects (ie. the sites as the attributes).

In this way both site and species groups were generated. The whole data matrix can then be presented with the rows being ordered by the species groupings and the columns ordered by the site groupings. This provides a way of inspecting how well the data conform with the classifications. Most of the interpretation is made from the classification of sites. The species groups are used to support the interpretations more than to identify species that may be expected to occur in similar habitats.

The dendrogram represents the way the classified rows (sites or species) fuse. This can be used to construct groups of rows by “cutting” at a particular value or cutting to obtain a particular number of groups. For the purpose of this study, three “cuts” were made for each of the sites to form “10 group”, “20 group” and “40 group” classifications and for the species to form “20 group”, “40” and “80 group” classifications. While these are arbitrary, they provide an opportunity to make interpretations of the nature of the classification.

In addition to the classifications described above, an ordination of the site and species data was carried out using the SSH (semi-strong hybrid multi-dimensional scaling) module of the PATN package (Belbin 1987). This was performed to diagrammatically present some of the relationships between sites.

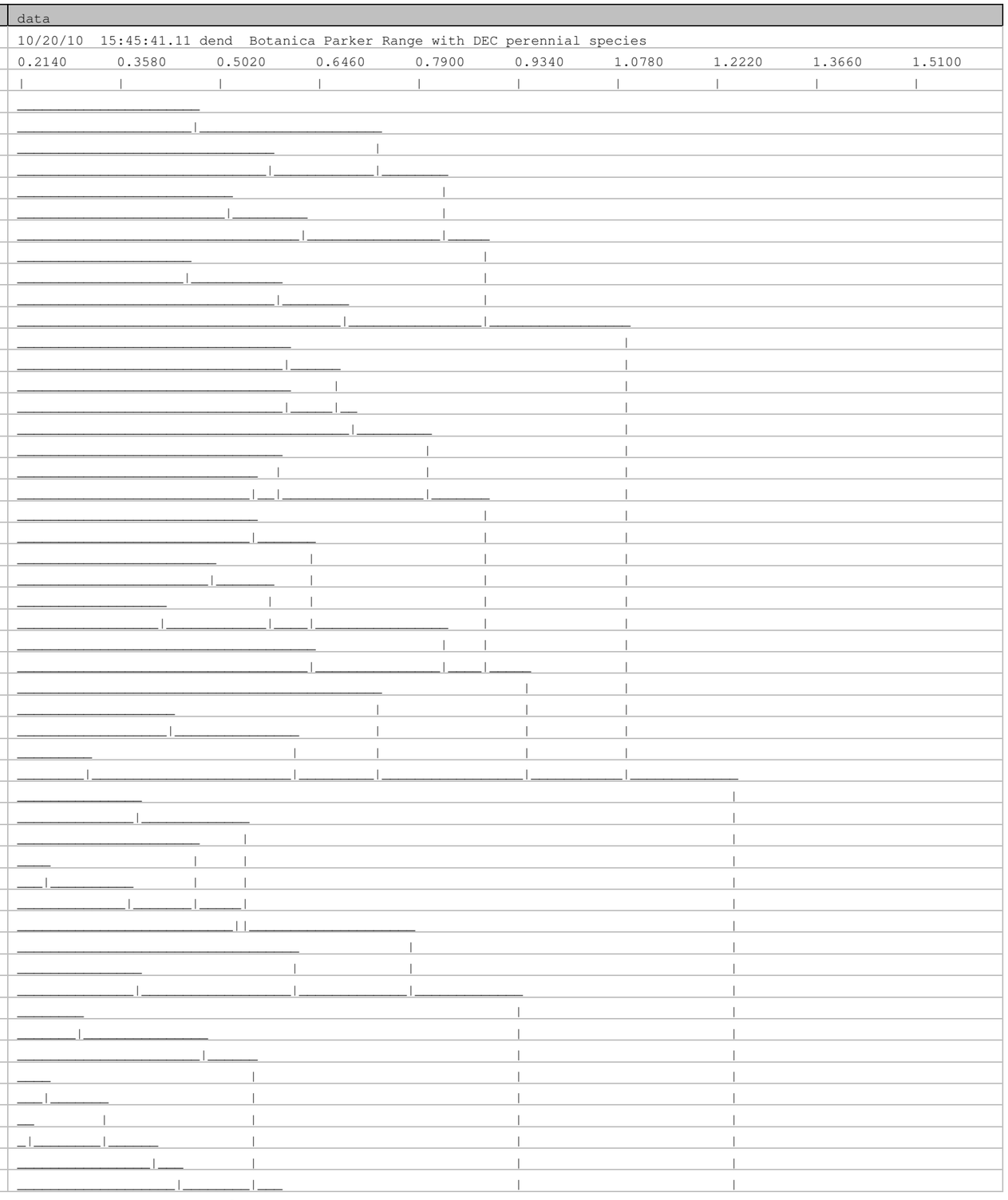
Commonly, there is too much variation in the datasets to allow useful interpretations to be made using this technique. Interpretation from the preliminary analysis suggested that in this case it is to some degree useful.

Nearest Neighbour analysis (NNB) was also use to assist in relating the PARK sites to those of the earlier datasets.

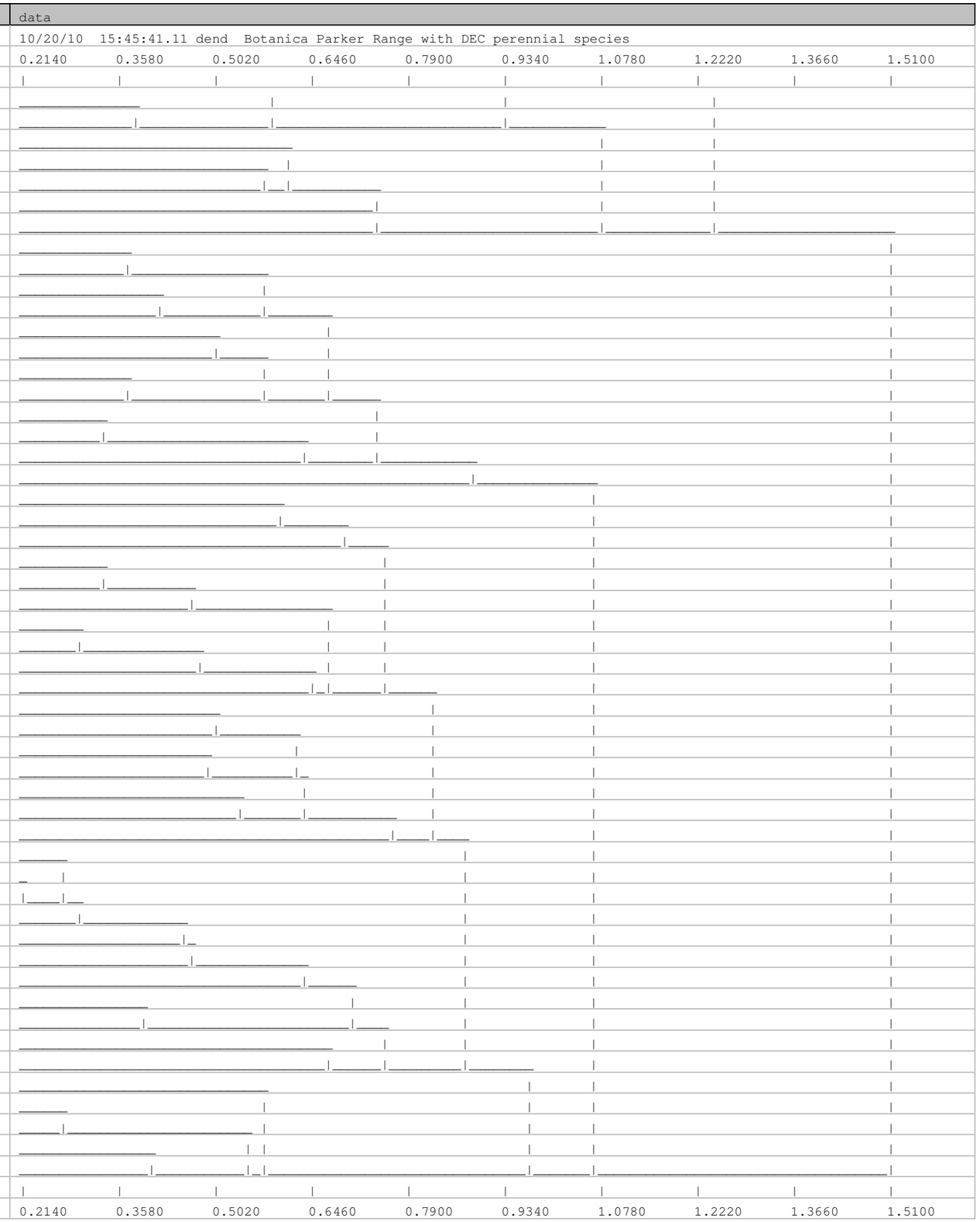
Appendix 4 Dendrogram showing classification group and vegetation type (PARK and G & L)

so – most similar G & L site. v – dissimilarity. so_40 classification group 40 group level

ID	Proj	Site	so	v	so_40	no_sp	gp10	gp20	gp40	veg	data
1											10/20/10 15:45:41.11 dend Botanica Parker Range with DEC perennial species
2											0.2140 0.3580 0.5020 0.6460 0.7900 0.9340 1.0780 1.2220 1.3660 1.5100
3											| | | | | | | | |
4	G & L	brit01				13	1	1	1	Mix Euc	
5	G & L	brit02				13	1	1	1	Mix Euc	
6	G & L	pros03				23	1	1	2	Mix Euc	
7	PARK	Q33	pros03	0.5676	2	14	1	1	2	MIX EUC	
8	PARK	Q21	kook04	0.6774	6	12	1	2	3	OP MAL	
9	PARK	Q25	brit02	0.6667	1	17	1	2	3	OP MAL	
10	PARK	Q22	kook04	0.6296	6	8	1	2	3	OP MAL	
11	G & L	kook06				14	2	3	4	Mix Euc	
12	PARK	Q24	kook06	0.4483	4	15	2	3	4	SALM WOO	
13	PARK	Q23	kook06	0.6	4	11	2	3	4	SALM WOO	
14	PARK	Q40	kook06	0.6	4	6	2	3	5	EUC SALU	
15	G & L	caud01				20	3	4	6	Mix Euc	
16	G & L	kook04				19	3	4	6	Mix Euc	
17	G & L	jane04				19	3	4	7	Allocas	
18	G & L	split03				21	3	4	7	Allocas	
19	G & L	kook01				24	3	4	8	Mix Euc	
20	G & L	har02				18	3	5	9	Allo lat	
21	G & L	har03				17	3	5	9	Allo lat	
22	G & L	toom3				18	3	5	9	Allo lat	
23	G & L	caud05				18	3	6	10	allo lat	
24	G & L	pros01				13	3	6	10	Allo lat	
25	G & L	har06				14	3	6	11	Allo lat	
26	G & L	thir01				17	3	6	11	Allo lat	
27	G & L	kook02				21	3	6	11	Allo lat	
28	G & L	pros02				17	3	6	11	Allo lat	
29	G & L	park03				12	3	7	12	Callit lat	
30	G & L	park04				10	3	7	13	Callit lat	
31	G & L	caud04				18	4	8	14	allo lat	
32	G & L	cher01				17	4	8	15	Allo lat	
33	PARK	Q09	cher01	0.4286	15	11	4	8	15	LAT	
34	PARK	Q10	park02	0.5625	27	15	4	8	15	LAT	
35	PARK	Q11	park02	0.6429	27	11	4	8	15	LAT	
36	G & L	brit04				18	5	9	16	Allocas	
37	G & L	caud06				14	5	9	16	Allo lat	
38	G & L	caud08				15	5	9	16	Allocas	
39	G & L	cher02				12	5	9	16	Allocas	
40	G & L	kook05				12	5	9	16	Allocas	
41	G & L	split04				13	5	9	16	Allocas	
42	G & L	park06				14	5	9	16	Allocas	
43	G & L	caud02				18	5	10	17	Allocas	
44	PARK	Q35	caud08	0.5455	16	7	5	10	17	ALLOCAS SHRUB	
45	PARK	Q37	cher02	0.5556	16	6	5	10	17	MIX EUC	
46	PARK	Q02	caud06	0.5882	16	20	6	11	18	LAT	
47	PARK	Q03	brit04	0.5263	16	20	6	11	18	LAT	
48	PARK	Q04	brit04	0.5429	16	17	6	11	18	LAT	
49	PARK	Q12	caud05	0.55	10	22	6	11	18	LAT	
50	PARK	Q15	caud06	0.5	16	18	6	11	18	LAT	
51	PARK	Q16	caud06	0.5172	16	15	6	11	18	LAT	
52	PARK	Q17	caud06	0.4	16	16	6	11	18	LAT	
53	PARK	Q13	har02	0.6316	9	20	6	11	18	LAT	
54	PARK	Q26	split04	0.5758	16	20	6	11	18	ALLOCAS SHR	



ID	Proj	Site	so	v	so_40	no_sp	gp10	gp20	gp40	veg	data
1											10/20/10 15:45:41.11 dend Botanica Parker Range with DEC perennial species
2											0.2140 0.3580 0.5020 0.6460 0.7900 0.9340 1.0780 1.2220 1.3660 1.5100
3											| | | | | | | | | |
55	PARK	Q08	caud06	0.44	16	11	6	11	18	ALLOCAS SHR	
56	PARK	Q18	brit04	0.5897	16	21	6	11	18	ALLOCAS SHR	
57	PARK	Q05	brit04	0.7	16	22	7	12	19	ALLOCAS SHR	
58	PARK	Q19	caud08	0.7419	16	16	7	12	19	MALLE HEA	
59	PARK	Q20	brit04	0.6923	16	21	7	12	19	MALLE HEA	
60	PARK	Q07	split03	0.7436	7	18	7	12	20	MALLE HEA	
61	PARK	Q34	jane04	0.7949	7	20	7	12	21	MIX EUC	
62	G & L	brit03				9	8	13	22	e. long	
63	G & L	thir02				13	8	13	22	E. long	
64	G & L	jane02				8	8	13	22	E. long	
65	G & L	jane03				9	8	13	22	E.long	
66	G & L	cent01				14	8	13	23	E. long	
67	G & L	cent04				10	8	13	23	E. long	
68	G & L	thir03				8	8	13	23	E. long	
69	G & L	toom1				11	8	13	23	E. long	
70	G & L	cent02				9	8	13	24	Salmon	
71	G & L	jane01				12	8	13	24	Salmon	
72	G & L	split01				7	8	13	25	E. long	
73	G & L	cent05				16	8	14	26	E. long	
74	G & L	caud03				18	9	15	27	E. salu	
75	G & L	park02				17	9	15	27	Salmon	
76	G & L	split02				17	9	15	28	E. salu	
77	G & L	har01				18	9	15	29	Salmon	
78	G & L	har04				18	9	15	29	Salmon	
79	G & L	har05				13	9	15	29	Salmon	
80	G & L	har07				20	9	15	30	Salmon	
81	G & L	har09				14	9	15	30	Salmon	
82	G & L	har08				18	9	15	30	Salmon	
83	G & L	toom2				14	9	15	31	E. salu	
84	G & L	caud07				10	9	16	32	Salmon	
85	G & L	cent03				14	9	16	32	E. salu	
86	G & L	kook03				17	9	16	32	Salmon	
87	G & L	park05				14	9	16	32	Salmon	
88	G & L	jane05				6	9	16	33	Salmon	
89	G & L	park07				7	9	16	33	Salmon	
90	G & L	kook07				9	9	17	34	E. salu	
91	PARK	Q01	split05	0.4167	35	12	9	18	35	MIX EUC	
92	PARK	Q28	split05	0.4167	35	12	9	18	35	MIX EUC	
93	PARK	Q32	caud07	0.3846	32	16	9	18	35	MIX EUC	
94	PARK	Q06	split05	0.3913	35	11	9	18	35	SALM WOO	
95	G & L	split05				12	9	18	35	Salmon	
96	PARK	Q36	split05	0.4545	35	10	9	18	35	EUC SALU	
97	PARK	Q41	split05	0.5238	35	9	9	18	36	SALM WOO	
98	PARK	Q27	park05	0.4815	32	13	9	18	37	SALM WOO	
99	PARK	Q42	park02	0.6296	27	10	9	18	37	MIX EUC	
##	PARK	Q14	split05	0.5833	35	12	9	19	38	MIX EUC	
##	PARK	Q38	kook03	0.5862	32	12	9	19	39	MIX EUC	
##	G & L	park01				12	10	20	40	E. salu	
##	PARK	Q29	park01	0.5652	40	11	10	20	40	EUC SALU	
##	PARK	Q30	park01	0.5652	40	11	10	20	40	EUC SALU	
##	PARK	Q31	park01	0.4444	40	6	10	20	40	EUC SALU	
##	PARK	Q39	caud07	0.5714	32	4	10	20	40	EUC SALU	
##											| | | | | | | | | |
##											0.2140 0.3580 0.5020 0.6460 0.7900 0.9340 1.0780 1.2220 1.3660 1.5100



Appendix 5 Main species in PARK and G & L classification (perennials) at 10 and 20 group level (>60% of sites in group)

10 Group level

gp10	sites	NAME	pc
1	7	Westringia cephalantha	86
1	7	Grevillea huegelii	86
1	7	Melaleuca hamata	71
2	4	Grevillea huegelii	100
2	4	Melaleuca lateriflora	75
2	4	Santalum acuminatum	75
2	4	Melaleuca acuminata	75
2	4	Eucalyptus salubris	75
2	4	Eucalyptus salmonophloia	75
3	16	Eucalyptus capillosa subsp. polyclada	75
3	16	Hibbertia rostellata	69
3	16	Melaleuca hamata	63
4	5	Alyxia buxifolia	100
4	5	Scaevola spinescens	100
4	5	Senna artemisioides	80
4	5	Trymalium myrtillus	80
4	5	Eremophila oppositifolia	80
5	10	Grevillea paradoxa	100
5	10	Allocasuarina corniculata	80
5	10	Hibbertia rostellata	80
5	10	Melaleuca cordata	80
5	10	Baeckea elderiana	80

20 Group level

gp10	gp20	sites	NAME	pc
1	1	4	Grevillea huegelii	100
1	1	4	Olearia muelleri	100
1	1	4	Westringia cephalantha	100
1	1	4	Daviesia argillacea	100
1	1	4	Melaleuca hamata	75
1	2	3	Westringia rigida	100
1	2	3	Acacia camptoclada	100
1	2	3	Westringia cephalantha	67
1	2	3	Prostanthera althoferi subsp. althoferi	67
1	2	3	Phebalium megaphyllum	67
1	2	3	Melaleuca hamata	67
1	2	3	Grevillea huegelii	67
1	2	3	Eucalyptus transcontinentalis	67
1	2	3	Eucalyptus leptophylla	67
1	2	3	Acacia enervia	67
1	2	3	Eucalyptus eremophila	67
1	2	3	Grevillea oncogyne	67
2	3	4	Grevillea huegelii	100
2	3	4	Melaleuca lateriflora	75
2	3	4	Eucalyptus salmonophloia	75
2	3	4	Santalum acuminatum	75
2	3	4	Melaleuca acuminata	75
2	3	4	Eucalyptus salubris	75
3	4	5	Eucalyptus capillosa subsp. polyclada	100
3	4	5	Santalum acuminatum	100
3	4	5	Daviesia argillacea	80
3	4	5	Melaleuca hamata	80
3	4	5	Westringia cephalantha	80
3	4	5	Allocasuarina acutivalvis	80
3	5	3	Grevillea paradoxa	100
3	5	3	Grevillea obliquistigma	100
3	5	3	Westringia cephalantha	100
3	5	3	Phebalium filifolium	100
3	5	3	Eucalyptus loxophleba	100
3	5	3	Eucalyptus oleosa	67
3	5	3	Allocasuarina acutivalvis	67
3	5	3	Eucalyptus corrugata	67
3	5	3	Melaleuca eleuterostachya	67
3	5	3	Melaleuca hamata	67
3	5	3	Dodonaea bursariifolia	67
3	5	3	Allocasuarina campestris	67
3	5	3	Hibbertia rostellata	67
3	6	6	Hibbertia rostellata	100
3	6	6	Cheilanthes austrotenuifolia	100
3	6	6	Acacia acuminata	83
3	6	6	Hakea pendens	83
3	6	6	Eucalyptus capillosa subsp. polyclada	83
3	6	6	Alyxia buxifolia	83
3	6	6	Grevillea obliquistigma	67
3	6	6	Phebalium tuberculosum	67
3	6	6	Austrostipa elegantissima	67
3	7	2	Alyxia buxifolia	100
3	7	2	Melaleuca hamata	100
3	7	2	Callitris columellaris	100
3	7	2	Comesperma volubile	100
4	8	5	Alyxia buxifolia	100
4	8	5	Scaevola spinescens	100
4	8	5	Eremophila oppositifolia	80
4	8	5	Senna artemisioides	80
4	8	5	Trymalium myrtillus	80
5	9	7	Hibbertia rostellata	100
5	9	7	Grevillea paradoxa	100
5	9	7	Baeckea elderiana	86
5	9	7	Grevillea obliquistigma	86
5	9	7	Calothamnus gilesii	86

10 Group level

gp10	sites	NAME	pc
5	10	Allocasuarina acutivalvis	70
6	11	Allocasuarina campestris	100
6	11	Hakea subsulcata	91
6	11	Hibbertia pungens	91
6	11	Melaleuca cordata	91
6	11	Calothamnus gilesii	82
6	11	Westringia cephalantha	82
6	11	Acacia enervia	82
6	11	Stenanthemum stipulosum	82
6	11	Grevillea paradoxa	82
6	11	Hibbertia rostellata	73
6	11	Allocasuarina corniculata	64
6	11	Grevillea pterosperma	64
6	11	Baeckea elderiana	64
7	5	Allocasuarina corniculata	100
7	5	Drummondita hassellii	80
7	5	Eucalyptus leptophylla	80
7	5	Melaleuca hamata	80
8	12	Eucalyptus longicornis	75
8	12	Templetonia sulcata	75
8	12	Austrostipa elegantissima	75
8	12	Acacia merrallii	75
9	28	Olearia muelleri	68
9	28	Scaevola spinescens	68
9	28	Alyxia buxifolia	61
9	28	Melaleuca pauperiflora	61
9	28	Acacia erinacea	61

20 Group level

gp10	gp20	sites	NAME	pc
5	9	7	Allocasuarina acutivalvis	71
5	9	7	Melaleuca cordata	71
5	9	7	Thryptomene kochii	71
5	9	7	Allocasuarina corniculata	71
5	10	3	Grevillea paradoxa	100
5	10	3	Allocasuarina corniculata	100
5	10	3	Melaleuca cordata	100
5	10	3	Chamelaucium sp. Victoria (J. Coleby-Williams 99)	100
5	10	3	Baeckea elderiana	67
5	10	3	Allocasuarina acutivalvis	67
6	11	11	Allocasuarina campestris	100
6	11	11	Melaleuca cordata	91
6	11	11	Hibbertia pungens	91
6	11	11	Hakea subsulcata	91
6	11	11	Calothamnus gilesii	82
6	11	11	Stenanthemum stipulosum	82
6	11	11	Grevillea paradoxa	82
6	11	11	Westringia cephalantha	82
6	11	11	Acacia enervia	82
6	11	11	Hibbertia rostellata	73
6	11	11	Baeckea elderiana	64
6	11	11	Allocasuarina corniculata	64
6	11	11	Grevillea pterosperma	64
7	12	5	Allocasuarina corniculata	100
7	12	5	Drummondita hassellii	80
7	12	5	Eucalyptus leptophylla	80
7	12	5	Melaleuca hamata	80
8	13	11	Templetonia sulcata	82
8	13	11	Eucalyptus longicornis	82
8	13	11	Acacia merrallii	73
8	13	11	Austrostipa elegantissima	73
8	13	11	Melaleuca pauperiflora	64
8	14	1	Lycium australe	100
8	14	1	Santalum acuminatum	100
8	14	1	Zygophyllum apiculatum	100
8	14	1	Olearia muelleri	100
8	14	1	Maireana pentagona	100
8	14	1	Maireana marginata	100
8	14	1	Rhagodia drummondii	100
8	14	1	Grevillea phillipsiana	100
8	14	1	Eucalyptus myriadena	100
8	14	1	Eremophila scoparia	100
8	14	1	Eremophila decipiens	100
8	14	1	Austrostipa elegantissima	100
8	14	1	Acacia nyssophylla	100
8	14	1	Acacia merrallii	100
8	14	1	Lomandra effusa	100
8	14	1	Senna artemisioides	100
9	15	10	Austrostipa elegantissima	90
9	15	10	Exocarpos aphyllus	80
9	15	10	Scaevola spinescens	80
9	15	10	Alyxia buxifolia	70
9	15	10	Olearia muelleri	70
9	16	6	Eremophila oppositifolia	100
9	16	6	Melaleuca pauperiflora	100
9	16	6	Eucalyptus salmonophloia	83
9	16	6	Acacia erinacea	67
9	16	6	Eucalyptus salubris	67
9	17	1	Beyeria brevifolia	100
9	17	1	Olearia muelleri	100
9	17	1	Melaleuca pauperiflora	100
9	17	1	Sclerolaena diacantha	100
9	17	1	Euryomyrtus sp. Parker Range	100
9	17	1	Austrostipa trichophylla	100
9	17	1	Acacia acuminata	100
9	17	1	Eucalyptus transcontinentalis	100
9	17	1	Eucalyptus salubris	100
9	18	9	Scaevola spinescens	100
9	18	9	Grevillea acuaria	100

10 Group level

gp10	sites	NAME	pc
10	5	Eucalyptus salubris	100
10	5	Melaleuca pauperiflora	100
10	5	Phebalium tuberculosum	80
10	5	Acacia erinacea	80

20 Group level

gp10	gp20	sites	NAME	pc
9	18	9	Melaleuca pauperiflora	78
9	18	9	Exocarpos aphyllus	78
9	18	9	Olearia muelleri	78
9	18	9	Eucalyptus salmonophloia	67
9	18	9	Acacia hemiteles	67
9	18	9	Acacia erinacea	67
9	19	2	Acacia hemiteles	100
9	19	2	Alyxia buxifolia	100
9	19	2	Eucalyptus capillosa subsp. polyclada	100
9	19	2	Grevillea acuaria	100
10	20	5	Eucalyptus salubris	100
10	20	5	Melaleuca pauperiflora	100
10	20	5	Phebalium tuberculosum	80
10	20	5	Acacia erinacea	80

Appendix 6 Dendrogram showing classification group and vegetation type, PARK with NEW (perennials)

site	Proj	gp10	gp20	gp40	veg	data
						11/05/10 05:37:11.80 dend Parker Range with Newbey perenials Nov 2010
						0.1490 0.2913 0.4337 0.5760 0.7183 0.8607 1.0030 1.1453 1.2877 1.4300
BS01	NEW	1	1	1	euc cap	
BS33	NEW	1	1	1	Hakea pen	
BS04a	NEW	1	2	2	Granite	
LH10	NEW	1	2	2	Granite	
LH02	NEW	1	3	3	Acacia shrub	
LH07	NEW	1	3	3	Acacia shrub	
LH08	NEW	1	3	3	Allocas shrub	
LH11	NEW	1	3	4	BIF	
LH03	NEW	1	3	5	Allocas shrub	
LH06	NEW	1	4	6	Acacia shrub	
LH49	NEW	1	4	6	Acacia shrub	
LH01	NEW	2	5	7	Breakaway	
LH18	NEW	2	5	7	open mallee	
LH16	NEW	2	5	8	open mallee	
LH30	NEW	2	5	8	mix euc	
LH05	NEW	2	6	9	mix Euc	
LH31	NEW	2	6	10	greenstone	
LH04	NEW	2	7	11	Open mallee	
LH09	NEW	2	7	11	Mela shrub	
LH42	NEW	2	7	11	open mallee	
LH44	NEW	2	7	11	open mallee	
LH19	NEW	2	8	12	open mallee	
LH46	NEW	2	8	12	open mallee	
LH45	NEW	2	8	13	open mallee	
LH21	NEW	2	8	14	open mallee	
LH26	NEW	2	8	14	Mela shrub	
LH48	NEW	2	8	14	open mallee	
LH35	NEW	2	8	14	mix euc	
LH15	NEW	3	9	15	mix Euc	
LH32	NEW	3	10	16	mix euc	
Q22	PARK	3	10	16	open mal2	
Q25	PARK	3	10	16	open mal3	
LH37	NEW	3	10	17	mix euc	
LH39	NEW	3	10	17	mix euc	
LH40	NEW	3	10	17	mix euc	
LH41	NEW	3	10	17	open mallee	
LH43	NEW	3	10	18	open mallee	
Q21	PARK	3	10	18	open mal1	
LH47	NEW	3	10	18	open mallee	
LH34	NEW	3	10	19	E. salm	
Q33	PARK	3	10	19	mix euc5	
LH36	NEW	3	10	19	mix euc	
BS03	NEW	4	11	20	Acacia sp. narrow1	
BS03a	NEW	4	11	20	Acacia sp. narrow2	
BS07	NEW	4	11	20	Euc Sali	
BS05	NEW	4	11	21	Callitris coll	
BS10	NEW	4	11	21	Dodon angus	
BS06	NEW	4	12	22	Cas obesa	
LH13	NEW	4	12	22	Atriplex shrub	
BS11	NEW	4	12	22	Tecticor1	
LH14	NEW	4	12	22	Tect shrub	
BS11a	NEW	4	12	22	Tecticor2	
LH12	NEW	5	13	23	Mixed Euc	

site	Proj	gp10	gp20	gp40	veg	data
						11/05/10 05:37:11.80 dend Parker Range with Newbey perenials Nov 2010
						0.1490 0.2913 0.4337 0.5760 0.7183 0.8607 1.0030 1.1453 1.2877 1.4300
LH50	NEW	5	13	24	Mela shrub	
LH51	NEW	5	13	24	Tect shrub	
BS13a	NEW	6	14	25	Euc hypo	
BS41	NEW	6	14	25	E. trans	
BS42	NEW	6	14	25	E. gracil mallee	
BS44	NEW	6	14	25	E. pil mallee	
BS39	NEW	6	14	25	E. salu1	
BS40	NEW	6	14	25	E.salu2	
BS43a	NEW	6	14	25	Euc loxo mallee1	
BS47	NEW	6	14	25	Salmon3	
BS46	NEW	6	14	25	Salmon2	
BS40a	NEW	6	14	25	E. salu3	
BS43b	NEW	6	14	25	Euc loxo mallee2	
BS29	NEW	6	14	26	Euc corrug	
BS31	NEW	6	14	27	Euc melan	
BS34	NEW	6	14	27	Euc longi	
BS35a	NEW	6	14	27	Salmon1	
BS38	NEW	6	14	27	Euc gracilis	
LH28	NEW	6	14	27	mix euc	
LH29	NEW	6	14	27	mix euc	
LH33	NEW	6	14	27	mix euc	
LH38	NEW	6	14	27	E. salub	
BS30	NEW	7	15	28	Euc lesouf	
BS32	NEW	7	15	28	Euc torq	
Q09	PARK	7	15	29	later4	
Q10	PARK	7	15	29	later5	
Q11	PARK	7	15	29	later6	
BS36	NEW	8	16	30	Euc camp	
Q01	PARK	8	16	30	mix euc1	
Q28	PARK	8	16	30	mix euc3	
Q32	PARK	8	16	30	mix euc4	
Q06	PARK	8	16	30	salmon1	
Q27	PARK	8	16	30	salmon4	
Q42	PARK	8	16	30	mix euc9	
Q36	PARK	8	16	30	E.salu4	
Q14	PARK	8	16	30	mix euc2	
Q38	PARK	8	16	30	mix euc8	
Q23	PARK	8	16	31	salmon2	
Q24	PARK	8	16	31	salmon3	
Q41	PARK	8	16	31	salmon5	
Q40	PARK	8	16	31	E. salu6	
Q29	PARK	8	16	32	e. salu1	
Q30	PARK	8	16	32	e.salu2	
Q31	PARK	8	16	32	e. salu3	
Q39	PARK	8	16	32	E. salu5	
BS12	NEW	9	17	33	Euc burra mallee	
BS14	NEW	9	17	34	Euc lepto mallee	
BS23	NEW	9	17	34	Callitris pres	
BS26	NEW	9	17	34	Mixed grev	
BS24	NEW	9	17	34	Grevillea excel	
LH17	NEW	9	17	35	open mallee	
LH27	NEW	9	17	35	Hakea shrub	
LH20	NEW	9	17	35	open mallee	
LH25	NEW	9	17	35	grev shrub	
BS15	NEW	9	18	36	Euc platy mallee	
BS22	NEW	9	18	36	Allocas cor	

Classification of Parker Range Quadrats Ted Griffin, December 2010

site	Proj	gp10	gp20	gp40	veg	data
						11/05/10 05:37:11.80 dend Parker Range with Newbey perenials Nov 2010
						0.1490 0.2913 0.4337 0.5760 0.7183 0.8607 1.0030 1.1453 1.2877 1.4300
BS25	NEW	9	18	36	Mela ham	
LH24	NEW	9	18	36	allocas shrub	
BS16	NEW	9	18	37	Euc scyp mallee	
LH23	NEW	9	18	37	acacia shrub	
BS18	NEW	9	18	37	Acacia beauv1	
BS18b	NEW	9	18	37	Acacia beauv3	
BS18a	NEW	9	18	37	Acacia beauv2	
LH22	NEW	9	18	37	acacia shrub	
Q34	PARK	9	18	37	mix euc6	
Q02	PARK	10	19	38	later1	
Q03	PARK	10	19	38	later2	
Q04	PARK	10	19	38	later3	
Q18	PARK	10	19	38	allcas3	
Q08	PARK	10	19	38	allcas2	
Q16	PARK	10	19	38	later10	
Q17	PARK	10	19	38	later11	
Q26	PARK	10	19	38	allcas4	
Q12	PARK	10	19	38	later7	
Q15	PARK	10	19	38	later9	
Q13	PARK	10	19	38	later8	
Q05	PARK	10	20	39	allcas1	
Q19	PARK	10	20	39	mallee2	
Q20	PARK	10	20	39	mallee3	
Q07	PARK	10	20	39	mallee1	
Q35	PARK	10	20	40	allcas5	
Q37	PARK	10	20	40	mix euc7	
						0.1490 0.2913 0.4337 0.5760 0.7183 0.8607 1.0030 1.1453 1.2877 1.4300

Appendix 7 Main species in PARK and NEW classification (perennials) at 10group level (>40% of sites in group)

gp10	sites	NAME	c	pc
1	11	Santalum acuminatum	7	64
1	11	Lepidosperma drummondii	5	45
2	17	Melaleuca uncinata	10	59
2	17	Melaleuca lateriflora	9	53
2	17	Cassytha melantha	7	41
2	17	Daviesia benthamii	7	41
2	17	Grevillea acuaria	7	41
2	17	Santalum acuminatum	7	41
3	14	Grevillea huegelii	10	71
3	14	Westringia rigida	8	57
3	14	Grevillea oncogyne	7	50
3	14	Acacia camptoclada	7	50
3	14	Templetonia sulcata	6	43
3	14	Santalum acuminatum	6	43
3	14	Olearia muelleri	6	43
3	14	Lomandra effusa	6	43
3	14	Melaleuca eleuterostachya	6	43
4	10	Disphyma crassifolium	6	60
4	10	Eragrostis dielsii	6	60
4	10	Frankenia cinerea	5	50
4	10	Tecticornia halocnemoides	5	50
5	3	Carpobrotus modestus	3	100
5	3	Disphyma crassifolium	2	67
5	3	Muehlenbeckia florulenta	2	67
6	20	Santalum acuminatum	17	85
6	20	Exocarpos aphyllus	17	85
6	20	Acacia nyssophylla	14	70
6	20	Eremophila decipiens	14	70
6	20	Eucalyptus gracilis	13	65
6	20	Austrostipa elegantissima	12	60
6	20	Olearia muelleri	12	60
6	20	Atriplex vesicaria	11	55
6	20	Austrostipa trichophylla	11	55
6	20	Melaleuca pauperiflora	11	55
6	20	Ptilotus holosericeus	10	50
6	20	Eriochiton sclerolaenoides	10	50
6	20	Eremophila scoparia	9	45
6	20	Eremophila ionantha	9	45
6	20	Pelargonium havlasae	9	45
6	20	Acacia merrallii	9	45
6	20	Sclerolaena diacantha	9	45
6	20	Eucalyptus salubris	9	45
7	5	Senna artemisioides	5	100
7	5	Scaevola spinescens	5	100
7	5	Alyxia buxifolia	4	80
7	5	Dodonaea lobulata	3	60
7	5	Exocarpos aphyllus	3	60
7	5	Olearia muelleri	3	60
7	5	Trymalium myrtillus	3	60
7	5	Eremophila oppositifolia	3	60
8	18	Grevillea acuaria	15	83

gp10	sites	NAME	c	pc
8	18	Templetonia sulcata	12	67
8	18	Acacia erinacea	11	61
8	18	Melaleuca pauperiflora	11	61
8	18	Olearia muelleri	11	61
8	18	Scaevola spinescens	10	56
8	18	Eucalyptus salubris	9	50
8	18	Alyxia buxifolia	9	50
8	18	Eucalyptus salmonophloia	8	44
8	18	Exocarpos aphyllus	8	44
9	20	Melaleuca cordata	15	75
9	20	Leptospermum roei	14	70
9	20	Allocasuarina corniculata	14	70
9	20	Callitris preissii	13	65
9	20	Lepidosperma drummondii	12	60
9	20	Phebalium filifolium	12	60
9	20	Santalum acuminatum	12	60
9	20	Thryptomene kochii	9	45
9	20	Amphipogon turbinatus	9	45
9	20	Micromyrtus obovata	9	45
9	20	Banksia elderiana	9	45
10	17	Melaleuca cordata	15	88
10	17	Allocasuarina campestris	14	82
10	17	Allocasuarina corniculata	13	76
10	17	Hibbertia pungens	12	71
10	17	Grevillea paradoxa	11	65
10	17	Hakea subsulcata	10	59
10	17	Westringia cephalantha	10	59
10	17	Acacia enervia	10	59
10	17	Stenanthemum stipulosum	9	53
10	17	Baeckea elderiana	9	53
10	17	Calothamnus gilesii	9	53
10	17	Hibbertia rostellata	8	47
10	17	Grevillea pterosperma	7	41
10	17	Eucalyptus capillosa subsp. polyclada	7	41
10	17	Eucalyptus burracoppinensis	7	41
10	17	Micromyrtus racemosa	7	41
10	17	Chamelaucium sp. Victoria (J. Coleby-Williams 99)	7	41

Appendix 3: Assessment of Independent PATN Analysis Results for the Parker Range Iron Ore Project – Mt Caudan Deposit

Botanica Consulting (April 2011)

Assessment of Independent PATN Analysis Results for Parker Range Iron Ore Project – Mt Caudan Deposit.

April 2011

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An internal quality review process has been implemented to each project task undertaken by BC. Each document and its contents is carefully reviewed by core members of the Consultancy team and signed off at Director Level prior to issue to the client. Draft documents are submitted to the client for comment and acceptance prior to final production.

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Table of Contents

1 Introduction 2
2 Data Analysis Methodology 3
3 Results of the Independent Assessment 3
3.1 BC study compared to Gibson & Lyon study 3
3.2 BC study compared to Newbey *et. al* study 4
3.3 BC analysis compared to Griffins analysis using only perennials 4
4 Summary 5
5 Conclusions 7
6 Amendments to Vegetation Impact Assessment 8
7 References 12

List of Tables

Table 1: Relationship of vegetation type to PARK and G & L classification (perennials) – 10 group level from Griffins analysis 6
Table 2: Relationship of vegetation type to Park and G & L classification (all species)- 10 group level from BCs analysis 7
Table 3: Impact assessment of proposed Mt Caudan Iron Ore Mine development on vegetation within the Parker Range PEC 10

1 Introduction

As requested by the Department of Environment and Conservation (DEC), Cazaly Resources commissioned Botanical Consultant Ted Griffin to conduct a PATN analysis of the plant quadrat data compiled by Botanica Consulting (BC). The main purpose of this analysis was to address the concerns raised by the DEC that the PATN analysis carried out by BC did not conform to the Recommended Interim Protocol for Flora Surveys of Banded Ironstone Formations (BIF) of the Yilgarn Craton, particularly relating to the following statement:

'*Quadrats are classified according to similarities in species composition of perennial taxa to facilitate comparisons with classifications from other ranges (Gibson et al. 1997; Gibson & Lyons 1998ab; Gibson & Lyons 2000, Gibson (2004ab). The quadrat and species classifications are undertaken using the Czekanowski coefficient and followed by "weighted pair-group mean average" fusion methods (UPGMA; Sneath & Sokal 1973, with a beta value of -0.1). Semi-strong hybrid (SSH) ordination of the quadrat data can then be undertaken to show spatial relationships between groups and to elucidate possible environmental correlates with the classification (Belbin 1991).* Other analysis pathways may also be suitable; however, it is important that the analysis pathways are fully documented and justified and the analysed dataset be available for further analysis and comparison'.

The independent analysis was also conducted in order to;

- Compare the relationships of BC's data with the Gibson and Lyons (1998) study and Newbey *et. al* study (1991);
- Compare results of BC's analysis to results of the revised analysis particularly to determine whether use of annual species within the analysis conducted by BC may impact the results
- Demonstrate to what degree the numerical classification prepared by BC can be relied upon.

The report by Ted Griffin is not intended to replace the study prepared by BC but rather provide a higher level of analysis by which implied relationships between floristic and vegetation types can be more clearly assessed in accordance with the BIF protocol.

2 Data Analysis Methodology

BC provided Ted Griffin with several excel datasheets in order to complete the review including;

- excel spreadsheet of the raw quadrat data from the Gibson & Lyons study (provided to BC by the DEC);
- excel spreadsheets of the quadrat data recorded by BC;
- excel spreadsheets of the Gibson & Lyon data and BC's data combined;
- excel spreadsheets of the Newbey *et. al* and BC's data combined; and
- GPS coordinates for all Gibson & Lyon quadrats, Newbey *et. al* sample locations and BC's quadrat locations (all GDA94).

Using the data provided by BC, Ted Griffin identified several species that required reconciliation. A list of those species requiring reconciliation and the proposed changes to the data were provided to BC. BC confirmed the reconciliations of these species. BC in conjunction with Ted Griffin also reviewed all species data (Gibson & Lyon, Newbey and BC) and identified all annual species. Once all annuals were identified and species had been reconciled, Ted Griffin conducted his own PATN analyses using the modified data.

3 Results of the Independent Assessment

3.1 BC study compared to Gibson & Lyon study

The main conclusions made in the independent analysis when comparing BC's study to Gibson & Lyons study are as follows;

- There were consistently more species recorded in the Gibson & Lyon sites than in the BC sites.
- A significant proportion of species are only recorded in one study area. Only a little more than a third of the species were shared between study areas.
- While the presence of annuals and geophytes contributes to the classification differences between the surveys, there are differences in the perennial species too.
- The quadrats were highly diverse and more than 20 distinct communities were likely to be present in the combined dataset (BC and Gibson & Lyon).
- Likely to be at least 10 different floristic types in the BC study area four of which are not represented by the Gibson and Lyon study sites.
- BC and Gibson & Lyons datasets have floristic communities not widely shared.
- Several floristic groups in the BC appeared distinct from Gibson and Lyons. These are related to the lateritic vegetation type.

- The degree of distinctiveness of vegetation communities cannot be reliably determined as there appears to be survey/seasonal differences between BC's and Gibson & Lyons studies.
- With only six of the 20 groups occurring in both surveys, the apparent influence of the survey on floristic types was significant. This may in part be due to the slightly different spectrum of vegetation types in the different surveys.

3.2 BC study compared to Newbey *et. al* study

The main conclusions made in the independent analysis when comparing BC's study to Newbey *et. al.* study are as follows;

- Removal of annual species from the classification using the BC with Newby data had limited effect on bringing the BC sites closer to the Newby sites.
- At a 40 group level only five groups had members from both study areas.
- About 30% of the species in BC sites were not identified in any Newbey sites.
- Results suggest that the dataset is very diverse and probably has more than 40 distinct plant communities.
- The floristic comparison with the Newbey data does not appear to provide useful context for evaluation. There is a strong suggestion that the nomenclature of species may not be consistent with those currently applied.

PATN analysis comparisons of BC's data and Newbey *et. al* data has been deemed irrelevant by the DEC and will not be used further for the evaluation of the the Mt Caudan Iron Ore Deposit.

3.3 BC analysis compared to Griffins analysis using only perennials

The main conclusions made in the independent analysis when comparing BC's analysis to the independent analysis conducted by Ted are as follows;

- It is likely that the PATN numerical analysis on which BC made its interpretations of significance was not likely to be very different had the analysis been done using perennials only.
- The degree of heterogeneity in vegetations groups is quite similar for the two classifications (BC's and Griffin's).
- The BC classification using both perennial and annual species and not including species reconciliations describes the variation in a similar way to the present using only perennial species.

- In BC's analysis of Gibson & Lyons data, seven of the ten groups contained sites from only one project. In Griffin's analysis with perennials only, four out of ten groups were from only one project. This suggests that some apparent differences were lessened through the removal of the annuals and geophytes (see Table 1 and 2).

4 Summary

Quadrat data was obtained by BC from seven structurally based distinct vegetation communities and by Gibson & Lyon from six vegetation communities. In total, between the two surveys ten distinct vegetation communities were identified in the Parker Range region. The results of the independent analysis however determined that based on both the Gibson & Lyon data and BC's data combined there were likely to be more than 20 floristic communities. It is also suggests that there may be more than ten floristic communities within the BC survey area rather than seven.

BC have conducted extensive surveys of the Parker Range project area and have only identified seven structurally based distinct vegetation communities within the project area where the quadrat based survey was completed. Aerial imagery which was used to assist in identifying vegetation groups in conjunction with field surveys has also not revealed additional vegetation communities not previously identified. The area in which the quadrat based survey was completed has been adequately surveyed.

Table 1 below which is taken from Ted Griffin's report (Table 12) outlines the different floristic communities identified from the PATN within each vegetation group identified by BC and Gibson & Lyon within the Parker Range region. This Table was generated using data from Griffins analysis on perennial species only. Table 1 illustrates that, with the exception of the open Mallee woodland, *Callitris glacuophylla* on decomposing laterite, Mallee heath and *Eucalyptus longicornis* woodland vegetation communities, all vegetation communities identified contain more than one floristic community. For example from Table 1 it is evident that the Mixed *Eucalyptus* woodland contains six different floristic communities (see columns). This is not unexpected given that as the name suggests the vegetation community comprises a mix of Eucalypts. The vegetation communities identified by BC were quite broad however to determine the full range of floristic communities surveying needs to be conducted on a finer scale. The *Eucalyptus salubris* and *Eucalyptus salmonophloia* woodlands also contained a variety of floristic communities, many of which were common between these two vegetation communities.

The laterite vegetation communities (not decomposing laterite) identified by BC and Gibson & Lyon contained a variety of floristic communities, of which a few were similar between the two study areas. There is also a degree of similarity between floristic communities of the laterite vegetation communities to that of surrounding vegetation including the *Allocasuarina* shrubland and Mixed *Eucalyptus* woodland. The *Callitris glacuophylla* on decomposing laterite vegetation community which will not be impacted by the development contains a floristic community similar to the *Allocasuarina* laterite vegetation.

Table 2 was also generated by Griffin (Table 11 of report) however using data from BC's analysis on all species. It shows that by using all species there are seven out of ten vegetation communities belonging only to either the BC or Gibson & Lyon survey whereas Table 1 using perennial data reveals that only four out of ten vegetation communities belong only in either the BC or Gibson & Lyon study.

The analysis provided in Table 1 and Table 2 both demonstrate the degree of overlap between vegetation communities and also the degree of heterogeneity within vegetation communities of the Parker Range.

Table 1: Relationship of vegetation type to PARK and G & L classification (perennials) – 10 group level from Griffins analysis

gp10	s	G & L	PARK	Mix Euc	OP MAL	allo lat	Callit lat	Allocas	LAT	MALLE HEA	E_ long	Salmon	E_ salu
1	7	3	4	4	3								
2	4	1	3	1								2	1
3	16	16		3		9	2	2					
4	5	2	3			2			3				
5	10	8	2	1		1		8					
6	11		11					3	8				
7	5		5	1				1		3			
8	12	12									10	2	
9	28	18	10	6								16	6
10	5	1	4										5
		8	8										
		2	2										

NB: Yellow cells denote those sites occurring within either BC's or Gibson & Lyons study area only.

Table 2: Relationship of vegetation type to Park and G & L classification (all species)- 10 group level from BCs analysis

Gp	s	G & L	PARK	Mix Euc	OP MAL	allo lat	Callit lat	Allocas	LAT	MALLE HEA	E_ long	Salmon	E_ salu
1	11		11					3	8				
2	11	9	2	1		2		8					
3	3		3						3				
4	19	6	13	3								5	11
5	17	17									7	2	8
6	1	1										1	
7	13	13				9	2	2					
8	14	12	2	9		1						3	1
9	5		5	1				1		3			
10	4		4		3							1	
		6	7										
		3	4										

NB: Yellow cells denote those sites occurring within either BC's or Gibson & Lyons study area only.

5 Conclusions

There are a variety of factors that may have contributed to the heterogeneity of the Parker Range landscape including a variety of disturbances and seasonal changes over time. The Parker range has been affected by European settlement since the 1890's when gold was first found in the Southern Cross area with farming following shortly after. Mining exploration activities on a larger scale have been conducted throughout the area since the early 1960s. The area has also been disturbed by fire, particularly within the South-West. These fires have occurred naturally and form the regions fire regime or in some cases they have been intentionally started by adjoining landholders or during prescribed burns the DEC.

The Parker Range region has experienced seasonal changes throughout the past 20 years between Gibson & Lyons study and BC's recent study which can alter the floristic composition of the vegetation communities. Over the past two years, during which BC's studies have been completed rainfall has been low.

Another possible explanation for the heterogeneity identified in the PATN across the Parker Range region as revealed in the independent review is due to sampling technique. A number of the quadrats established by both Gibson & Lyon and BC appear to be located along transition zones between two or more distinct vegetation communities. As a result quadrats that visually appear to belong to one distinct vegetation communities are being represented as dissimilar and potentially separate vegetation communities within the PATN analysis.

6 Amendments to Vegetation Impact Assessment

As mentioned previously the results of the independent analysis identified that there is potentially more than ten floristic communities within the BC study area and likely 20 or more floristic communities within the BC and Gibson & Lyon study area combined. Based on field studies conducted by BC and Gibson and Lyon on the structural variation in vegetation communities, nine vegetation communities were identified within the combined Parker Range study area.

The actual locations of these potentially different floristic communities identified in the PATN analysis is unknown and are therefore cannot be reliably be mapped. The PATN analysis has provided information on the similarities and dissimilarities floristic communities within the area but cannot be reliably used to map boundaries of vegetation communities. The results of the PATN show that vegetation within the area is heterogenic and that there are several overlapping floristic communities throughout the region.

Updated from the Flora report Table 3 below provides an impact assessment for each vegetation group identified by BC within the Parker Range PEC. These vegetation communities have been categorised into six structural groups.

Of the nine vegetation communities within the Tall *Eucalyptus* woodland group, seven will be impacted. The Tall *Eucalyptus* woodlands covers approximately 34,587 ha of the Parker Range PEC. It is estimated that there has previously been 2,134 ha of clearing within this vegetation group which accounts for 3.8% of the vegetation cleared in the PEC. The proposed development will impact an additional 0.4% of this vegetation group within the PEC.

Four out of the six Mallee woodland vegetation communities will also be impacted. This vegetation group covers approximately 4,952 ha of vegetation within the PEC. It is estimated that 85 ha of Mallee woodland vegetation has been cleared within the PEC which accounts for 0.15% of vegetation cleared within the PEC. The proposed development will have an impact on an additional 0.12% of this vegetation group within the PEC.

None of the three Salt Lake vegetation communities will be impacted. This vegetation group covers an estimated area of 2, 380 ha within the Parker Range PEC. Approximately 4 ha has been cleared in the past which accounts for 0.007%

The five disturbed vegetation communities will also not be impacted by the proposed Mine development. Disturbed vegetation covers an estimated area of 9,924 ha within the PEC. Approximately 152 ha has been cleared which accounts for 0.3% of the vegetation previously cleared within the Parker Range PEC.

All four shrubland/thicket vegetation communities identified within the Parker Range PEC will be impacted. This vegetation group covers an estimated area of 3,988 ha. Approximately 270 ha has previously been cleared which accounts for 0.48% of the vegetation cleared within the PEC. The proposed development will have an impact on an 0.14% of this vegetation group within the PEC.

Of the two Rocky outcrop vegetation communities only the Mallee woodland/*Allocasuarina* shrubland on Laterite ridge will be impacted. There will be no direct impacts on the *Isopogon robustus* on decomposing Laterite/Granite vegetation community. The Rocky outcrop vegetation group covers an estimated area of 139 ha within the PEC. There is no record of previous clearing within this vegetation group. The proposed development will impact on 8ha of this vegetation group which accounts for 0.014% of vegetation cleared within the PEC.

Table 3: Impact assessment of proposed Mt Caudan Iron Ore Mine development on vegetation within the Parker Range PEC.

Vegetation group	Vegetation community within the PEC*	total area (ha)	Total area in PEC cleared (ha)	% of vegetation community cleared	% of cleared vegetation in PEC	Total area to be impacted (ha)	% of each vegetation community to be impacted	% of entire PEC to be impacted	Impact of Mt Caudan Mine site development on vegetation within the PEC
Tall *Eucalyptus* woodlands	*Eucalyptus salmonophloia* woodland	5598	580	10.4	1	45	0.8	0.1	Low 1 Impact
	Eucalyptus longicornis woodland	584	85	14.6	0.2	8	1.4	0	Low 1 Impact
	Eucalyptus salubris woodland	4059	618	15.2	1.1	25	1.4	0	Low 1 Impact
	Mixed *Eucalyptus* woodland	22,147	832	3.9	1.5	149	0.7	0.3	Low 1 Impact
	E. salmonophloia/E. salubris woodland	909	11	1.2	0	28	3.1	0.1	Low 1 Impact
	Eucalyptus woodland over *Acacia steedmanii*	678							No Direct Impact
	Eucalyptus oleosa woodland over *Melaleuca*	5				0.1	2	0	Low 1 Impact
	Eucalyptus salicola woodland over *Melaleuca pauperiflora*	51							No Direct Impact
	Eucalyptus salubris woodland over *Melaleuca pauperiflora*	556	8	1.4	0	0.1	0	0	Low 1 Impact
	Eucalyptus transcontinentalis woodland	20				3	15	0	Low 1 Impact
Mallee woodlands	Mallee woodland over *Acacia sp. narrow phyllode* and *Melaleuca hamata*	31							No Direct Impact
	Open Mallee woodland	784				21	2.7	0	Low 1 Impact
	Mallee Heath	3887	85	2.2	0.2	45	1.2	0.1	Low 1 Impact
	Eucalyptus capillosa subsp. *polyclada* on Rise	216							No Direct Impact
	Eucalyptus capillosa subsp. *polyclada* woodland	4				0.4	10	0	Low 1 Impact
Salt Lake vegetation	*Eucalyptus longicornis* over Samphire Vegetation	905							No Direct Impact
	Samphire vegetation	1158							No Direct Impact
	Eucalyptus oleosa over Samphire Vegetation	317	4	1.3	0				No Direct Impact

Vegetation group	Vegetation community within the PEC*	total area (ha)	Total area in PEC cleared (ha)	% of vegetation community cleared	% of cleared vegetation in PEC	Total area to be impacted (ha)	% of each vegetation community to be impacted	% of entire PEC to be impacted	Impact of Mt Caudan Mine site development on vegetation within the PEC
Shrublands/Thickets	*Allocasuarina* shrubland	1260	130	10.3	0.2	77	6.1	0.1	Low 1 Impact
	Acacia sp. narrow phyllode and *Melaleuca eleuterostachya* shrubland	272	140	51.5	0.3	3	1.1	0	Low 1 Impact
	Allocasuarina thicket	2241				0.5	0	0	Low 1 Impact
	Acacia thicket	215				1	0.5	0	Low 1 Impact
Rocky outcrops	*Isopogon robustus* on decomposing Laterite/Granite	64							No Direct Impact
	Mallee woodland/*Allocasuarina* shrubland on Laterite ridge	75				8	10.7	0	Low 2 Impact
Disturbed Vegetation	Regenerating *E. salubris/E. salmonophloia* woodland	71							No Direct Impact
	Burnt *Eucalyptus* woodland	4384	152	3.5	0.3				No Direct Impact
	Burnt Mallee Woodland/*Allocasuarina* shrubland	1261							No Direct Impact
	Mixed Shrub rehabilitation in gravel pit	3							No Direct Impact
	Unknown vegetation (along cleared roads etc)	N/A	1560		2.8				N/A
	Cleared Native Vegetation	4205	**4205**	**N/A**	**7.5**	**414**	**N/A**	**0.7**	
	Total area in PEC (ha)	**55960**							

*Vegetation community identifications and area are subject to change following further surveys. Based on field and desktop assessment of vegetation.

7 References

DEC, (2007), *Banded Ironstone Formation ranges of the Midwest and Goldfields: Interim Status Report Biodiversity Values and Conservation Record.* Department of Environment and Conservation. September 2007.

Griffin, (2010), *A Classification of Flora Quadrats of Vegetation of the Parker Range Region Western Australia Prepared for Botanica Consulting Pty Ltd and Cazaly Resources Ltd.* Ted Griffin. December 2010

Appendix 4: Investigation and Assessment of *Chamelaucium* sp. Parker Range

Botanica Consulting (May 2011)

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Attention: Matt Timbrell

Monday 30th May 2011

RE: Priority search - *Chamelaucium* sp. Parker Range (P1)

Dear Matt

On the 28th March 2011, Cazaly Resources (CAZ) were notified by the Office of Environmental Protection Authority (EPA) that a species previously identified as *Chamelaucium halophilum* ms within a gravel pit at the Mt Caudan area by Gibson and Lyons (1998) could be a distinct entity *Chamelaucium* sp. Parker Range (B.H. Smith 1255). The taxon was determined by Matt Barrett on the 21st December 2010. On March 23rd 2011 this species was officially listed by the Department of Environment and Conservation (DEC) as a Priority 1 Flora species. Caz engaged Botanica Consulting (BC) to further investigate this matter and summarize finding in this letter.

On the 6th April 2011, BC collected samples of the *Chamelaucium halophilum* located within the gravel pit area and a location on the emu fence road to have the identification confirmed by Matt Barrett (Kings Park). Following a meeting with Kingsley Dixon, Russell Barrett, Matt Barrett (Kings Park Botanica Gardens), Jim Williams (BC) and Matt Timbrell (Caz) on the 7th April 2011 Matt Barrett positively identified and confirmed that the samples collected were *Chamelaucium* sp. Parker Range (P1).

BC was commissioned by Caz to carry out a search for the Priority Flora species, *Chamelaucium* sp. Parker Range (P1) within the Marvel Loch area in April 2011. The survey was carried out on the 14th and 15th April 2011. The potential habitat for this species was found to be Mallee heath and *Allocasuarina* shrubland vegetation communities. It is also commonly found in gravel pits and disturbed areas. Given that these disturbed areas received greater run off from roadside drains, plants were healthier than surrounding vegetation and more accurately identified.

Once a plant was identified, the location was marked with a handheld GPS (GDA94) and a sample was taken. The number of plants of each population were counted and recorded. For those populations that were highly dense, plant numbers were estimated. Separate populations were determined based on a 500m distance (as recommended by the DEC) between species identified.

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According to Matt Barrett, the optimal flowering period for this species is between spring and early summer (September-December). This species was not determined as *Chamelaucium* sp. Parker Range until late December and was not listed by the DEC as a Priority 1 Flora species until after this flowering period. As a result surveys of this species were not able to be completed during the optimal flowering period. Majority of the specimens provided to Matt Barrett for identification were sterile, however Matt Barrett was able to provide a positive identification. In the months preceding the April survey rainfall data (located 16km south-west of Mt Caudan) was very high with 148.8mm received from January to February. However over the optimal flowering period (September-December 2010) only 38.6mm was received in the area.

Population size was only determined for those populations located outside of the Parker Range Project Area and the number of plants within the Project Area is unknown. The populations of *Chamelaucium* sp. Parker Range identified within the Project Area were locations of the species previously identified as *Chamelaucium halophilum* during prior flora and vegetation surveys. This species was identified within the Mallee heath and *Allocasuarina* shrubland vegetation communities. Plants were not counted at the time of the flora and vegetation surveys as this species was not revised to *Chamelaucium* sp. Parker Range or listed as a Priority 1 Flora species until several months after flora and vegetation surveys were completed.

In total, BC identified nine populations of *Chamelaucium* sp. Parker Range. The GPS locations and estimated no. of plants for each of these populations are provided in Table 1. Four populations of this species were previously identified by BC during a Level 2 survey within the Parker Range Project Area (Appendix 1). The remaining five populations were identified by BC during the recent survey (Appendix 2).

To adequately assess the impact that the proposed development of the Parker Range Project will have on this species, targeted searches within the Parker Range region will need to be conducted. Currently much of the flora species in the area are sterile limiting positive identification of *Chamelaucium* sp. Parker Range (P1) within the region.

BC have been undertaking seasonal vegetation and flora surveys for Cazaly's Parker Range Project since 2007 and it is understood that the Project is advanced in the assessment process with the EPA. Due to the identification and classification of this species by the DEC as a Priority

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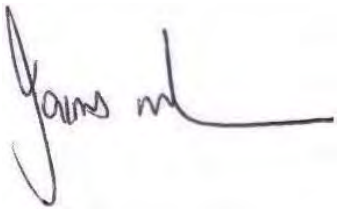
1 Flora species late in the assessment process it is highly unlikely the recommended surveying of this species could be completed in the assessment timeframe due to current seasonal rainfall conditions in the Parker Range region.

As mentioned previously this species commonly inhabits disturbance areas however it has also been identified within regions of dense vegetation in the Mt Caudan region including Mallee heath and *Allocasuarina* shrubland vegetation communities. These potential habitats occupy approximately 7,463ha of the Parker Range PEC which covers an area of 55,960ha. Given the large area of occupancy of this potential habitat it is almost certain that population numbers and species density of this species will increase with increasing survey intensity.

Should you require any further information, please don't hesitate to contact me via e-mail at jim@jimseeds.com.au.

Regards,



Jim Williams
Director
Botanica Consulting

Table 1: GPS locations of all *Chamelaucium* sp. Parker Range (P1) identified by BC.

Population	Species	Quadrat	zone	easting	northing	Estimated no. plants**
1*	*Chamelaucium* sp. Parker Range (P1)	4	50 J	742320	6499578	unknown
	Chamelaucium sp. Parker Range (P1)	5	50 J	742277	6499336	unknown
2*	*Chamelaucium* sp. Parker Range (P1)	18	50 J	742020	6498246	unknown
3*	*Chamelaucium* sp. Parker Range (P1)	19	50 J	741321	6498696	unknown
	Chamelaucium sp. Parker Range (P1)	20	50 J	741684	6498801	unknown
4*	*Chamelaucium* sp. Parker Range (P1)	N/A	50 J	742062	6498518	unknown
5	*Chamelaucium* sp. Parker Range (P1)	N/A	50 J	738500	6499031	34
	Chamelaucium sp. Parker Range (P1)	N/A	50 J	738418	6498883	14
6^	*Chamelaucium* sp. Parker Range (P1)	N/A	50 J	736425	6495095	50+
7^***	*Chamelaucium* sp. Parker Range (P1)	N/A	50 J	733227	6488639	50+
8^***	*Chamelaucium* sp. Parker Range (P1)	N/A	50 J	730417	6483347	5
9*	*Chamelaucium* sp. Parker Range (P1)	N/A	50 J	739710	6501151	200+

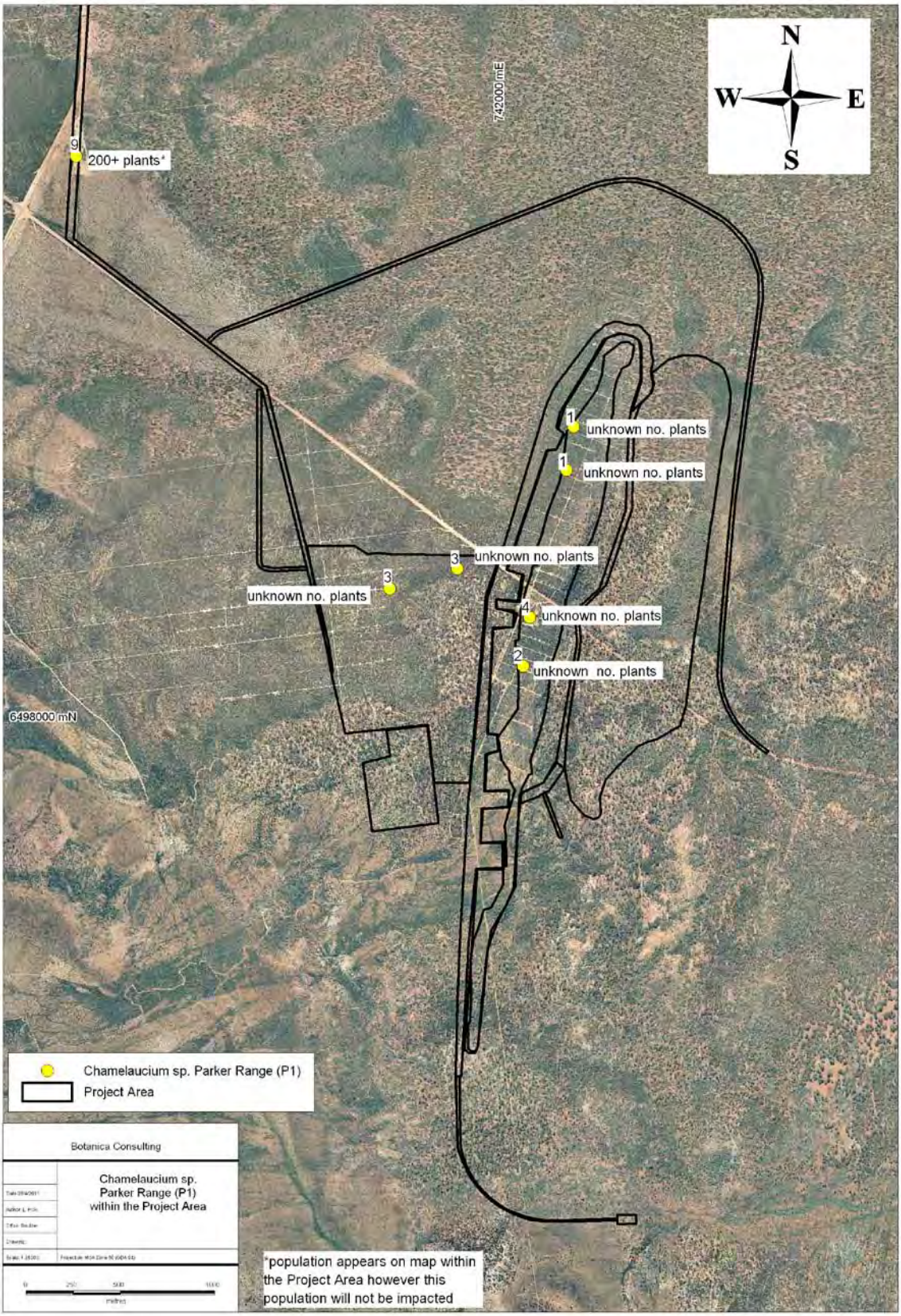
^not located within the Parker Range PEC boundary
*occurs within the proposed impact area.
**no. plants are estimated not an actual count.
***populations located between 10-20km of the Mt Caudan impact area.

Figure 1: *Chamelaucium* sp. Parker Range within the Gravel pit of the Parker Range Project Area.

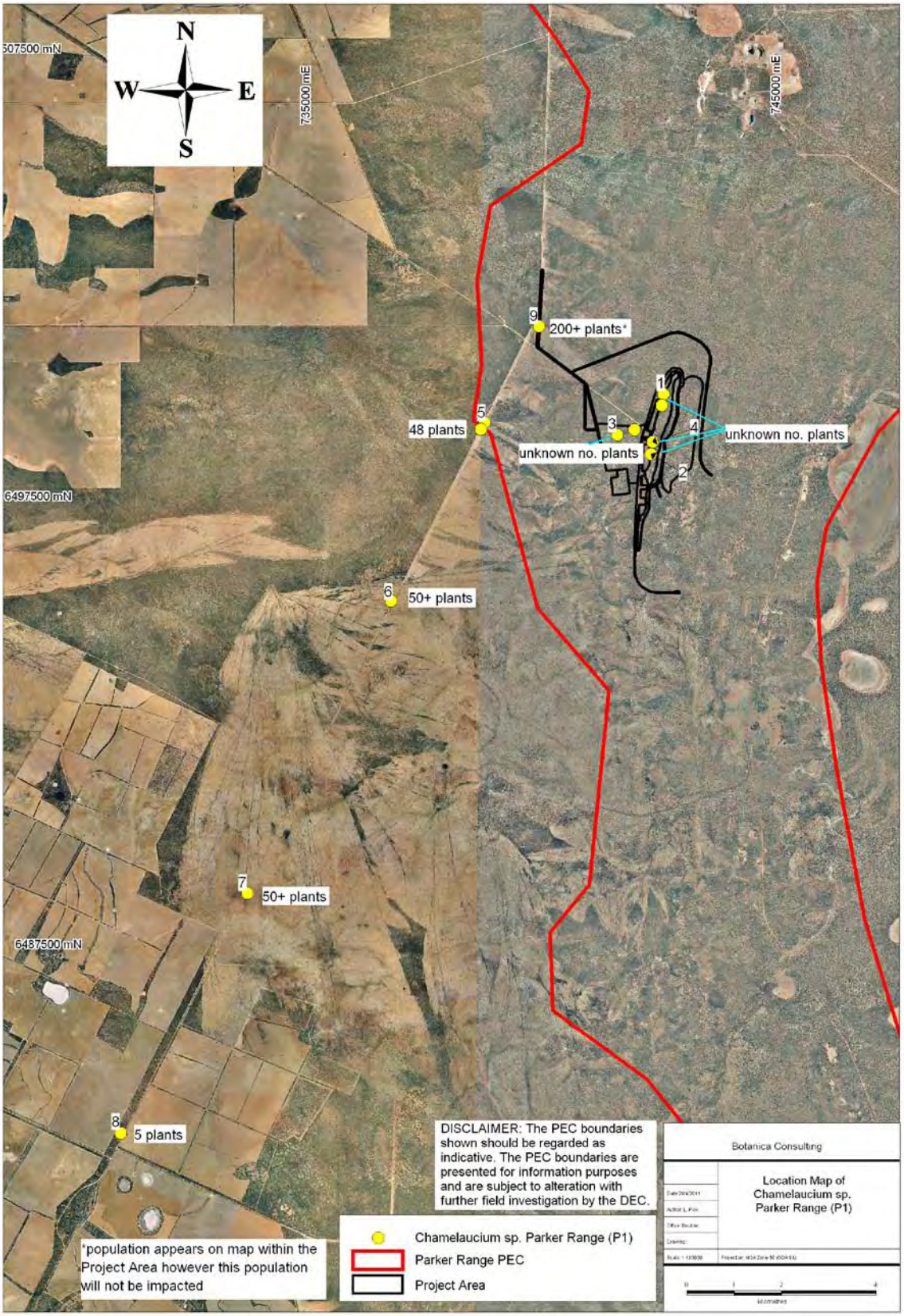
Figure 2: *Chamelaucium* sp. Parker Range (P1)

Figure 3: *Chamelaucium* sp. Parker Range (P1)

Appendix 1: Map of all *Chamelaucium* sp. Parker Range (P1) populations identified by BC within the proposed impact area.



Appendix 2: Regional Map of all *Chamelaucium* sp. Parker Range (P1) populations identified by BC



Appendix 5: Summary of the Main Elements for Parker Range Project

Cazaly Resources (January 2011)

Summary of the Main Elements for Parker Range Project

Element	Description
Life of Project	7 -10 years (current JORC resource and Export Port Capacity)
Mining Resource	30 Mt
Mining Method	Open pit
Mine Operation	Continuous
Depth of Pit	Up to 135 m
Depth to Water Table	60 m (365 mRL)
Total Area of Native Vegetation Disturbance	418 ha (approx)
List of Major Components: Pit Process plant Waste rock landform Tailings storage facility	 Open pit, 4.0 km (L) x 0.4 km (W) x 135 m (D) Mobile Crushing and Screening (year 1) replaced by Permanent Crushing and Screening with Wet-Plant/Beneficiation (year 2+) Contour profiled 2.0 km (L) x 0.5 km (W) x 45 m (H – maximum) Approximately 0.8 Mm^3 capacity 400 m (W) x 400 m (L) x 11 m (H) – 5 lifts
Ore Mining Rate	4 Mtpa (nominal), 4.6 Mtpa (max)
Total waste rock	55 Mt (approx)
Dewatering Rate (approximate)	14 L/s – mine pit
Water Supply: Source Maximum daily requirement Maximum annual requirement	 Pit Dewatering Bores Supply 1.1 ML/day (year 1) then 1.8 ML/day (year 2+) 321 ML/year (year 1) then 506 ML/year (year 2+)
Power Generation and Requirements	Initially diesel generation (during construction and initial operation), then 33 kV Grid power from Marvel Loch
Fuel Supply	Fuel Bunkers (nominally 3 x 110 kL).
Ore Haulage	57 km, 14 road trains
Operating Hours	24 hrs per day, 7 days per week
Operations Workforce	159 people (114 average on-site)
Construction Period Construction Workforce	Up to 12 months Up to 250 people (peak)
Construction commencement (anticipated)	July 2011

Appendix 6: Air Quality Impact Assessment

Ecotech Pty Ltd (February 2011)

ECOTECH

WORLD CLASS environmental MONITORING

Parker Range Project

AIR QUALITY IMPACT ASSESSMENT

- P9 (Final)
- 24 February 2011

Parker Range Project

AIR QUALITY IMPACT ASSESSMENT

- P9 (Final)
- 24 February 2011

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Limitations Statement

The sole purpose of this report and the associated services performed by Ecotech is to provide air quality modelling in connection with the Parker Range project. The services were provided in accordance with the scope of services set out in the contract between Ecotech and the Client. That scope of services, as described in this report, was developed with the Client.

Modelling and forecasting is not a precise science. Forecasts are only an indication of what might happen in the future and they may not be achieved. They rely upon complex sets of input data and assumptions. There is no guarantee that these assumptions will in fact be correct or accurate and there are numerous factors which can influence the actual air quality of the Project, many of which are beyond the control or reasonable foresight of the forecaster. Whilst the risk of inaccuracies cannot be eliminated, it can be reduced through a detailed process, including, but not limited to the adoption of reasonable assumptions, the use of accepted modelling standards and techniques, peer review and appropriate sensitivity testing. This process, in particular the key assumptions, applied by Ecotech for the purposes of this report were discussed and agreed with the client at various stages of the report.

Ecotech derived the input data used and identified in this report primarily from data provided by the Client or otherwise available in the public domain at the time. In preparing this report, Ecotech has relied upon and presumed that this data is accurate. Except as otherwise stated in the report, Ecotech has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Ecotech has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the sole purpose described above and by reference to applicable industry standards, guidelines, procedures and practices in existence at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and forecasts expressed in this report, to the extent permitted by law.

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Contents

Executive Summary **1**
Recommendations **2**
1. Introduction **4**
1.1. Background **4**
1.2. Structure of Report **6**
2. Assessment Methodology **7**
2.1. Overview **7**
2.2. Relevant Pollutants, Impacts and Assessment Criteria **7**
2.2.1. Relevant Pollutants 7
2.2.1.1. Impacts to Human Health and Amenity 7
2.2.2. Assessment Criteria 9
2.3. Dispersion Model **10**
2.4. Meteorological Data **10**
2.5. Sensitive Receptors **11**
2.5.1. Overview 11
2.5.2. Human Receptors 11
2.5.3. Sensitive Native Flora and Fauna Receptors 12
3. Existing Environment **14**
3.1. Overview **14**
3.2. Climate and Meteorology **14**
3.3. Temperature **14**
3.4. Rainfall **15**
3.5. Relative Humidity **16**
3.6. Evaporation **17**
3.7. Wind Direction and Speed **18**
3.8. Existing Air Quality **20**
4. Emission Estimation **22**
4.1. Emission Sources **22**
4.2. Emissions Calculations **22**
4.2.1. Blasting 23
4.2.2. Drilling 23
4.2.3. Ore/Waste Loading and Dumping 24
4.2.4. Bulldozing of Waste Material 24
4.2.5. Front End Loaders on Stockpiles 25
4.2.6. Ore Crushing and Stacking 25
4.2.7. Vehicles and Wheel Generated Dust 25
4.2.8. Wind Erosion 26
4.3. Parker Range Road Haulage **27**
4.4. Rainfall and Emission Reductions **27**
5. Results **29**
5.1. Overview **29**

5.2. Mine **29**
5.3. Haul Route **31**
5.4. Rail Head **34**
5.4.1. PM_{10} 35
5.4.2. TSP 35
5.4.3. $PM_{2.5}$ 36
5.4.4. Deposition 36
6. Summary and Recommendations **38**
6.1. Summary **38**
6.2. Recommendations **39**
7. References **40**
Appendix A AUSPLUME Configuration File **42**
Appendix B Approach to the Use of Modelled Meteorological Data **56**
Appendix C Source Emission Parameters **67**
Appendix D Contour Plots of Modelled Concentrations and Deposition Rates Along the Haul Road and at the Rail Head **74**
Appendix E Dust Deposition Results – Winter (July 2010) **79**
Appendix F PM_{10} 24Hrs Averages – Winter (July 2010) **80**
Appendix G Dust Deposition Results – Summer (January – February 2011) **81**
Appendix H PM_{10} 24 Hrs Averages – Summer (January – February 2011) **82**

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P4	23/07/2010	J Harper	M Gillen	26/07/2010	Final
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P9	- (electronic)	1	Client

Executive Summary

Rationale

This report provides an assessment of the impact to air quality and subsequent dust deposition rates as a result of the operation of the Parker Range Project, for the purposes of informing the Environmental Impact Assessment for the project.

Assessment Approach

The impact assessment approach conforms to Western Australia Department of Environment and Conservation guidance for such assessments. Emission characteristics from key components of the project have been quantified, including for the mine, the haulage route and the rail head. The calculated emissions assume the successful implementation of a range of dust mitigation measures, as defined though the site dust management plan.

The dispersion model AUSPLUME has been used as the primary assessment tool, using these emission characteristics. Impact assessment criteria have been identified, for the key pollutants TSP, PM_{10}, $PM_{2.5}$ and deposited dust. Sensitive receptors have been identified; at the mine, these are protected flora and fauna, along the haulage route these are wheat crops and at the rail head these are residential properties. For the protected flora and fauna and the wheat crops, modelled dust deposition rates have been compared to the deposited dust assessment criteria as identified through a literature review. For the residential properties, in addition to deposited dust being compared to nuisance criteria for dust, modelled airborne concentrations of TSP, PM_{10} and $PM_{2.5}$ have been compared to legislated criteria for the protection of amenity and human health.

Summary of Results and Significance

At the mine, an indentified malleefowl nest adjacent to the truck load out is predicted to exceed assessment criteria. However, it is advised this nest has been abandoned for some time, thus no malleefowl are expected to experience elevated dust deposition in this location. All other indentified receptor locations at the mine site meet the assessment criterion for deposition.

Along the truck haulage route, which is all sealed, incremental deposited dust levels are below the assessment criteria and have the potential to exceed 7 g/m^2 within 100 m of the road. The predicted deposition rate is shown to drop rapidly further from the road.

The modelled deposition rates were compared to deposition data recorded at the Windarling Iron Ore mine to the north of Southern Cross. This comparison indicates that the model predictions for deposition along the proposed haulage route are potentially over estimated.

Ground level concentrations of the pollutants $PM_{2.5}$, PM_{10}, TSP and deposited dust meet assessment criteria. Receptor 1, which is a residential property located approximately 450 m from the dust generating activities associated with the rail head, is shown to experience the highest concentrations from rail head operation. However, with adequate dust controls it is expected dust impacts will be acceptable at this location.

Recommendations

It is recommended that Cazaly commit to the following management actions (consistent with industry practices in Western Australia) to limit impacts from dust. It is understood that these are included within the Dust Management Plan that forms an Appendix to the Environmental Impact Statement (PER). Hence the emission estimates used in this assessment have assumed that these actions have been incorporated. The actions are that:

- Water trucks will be utilised in dust prone areas (e.g. local mine site roads, stockpiles and during open pit loading operations) to minimise dust generation
- Water sprays will be included in the crusher design to minimise the generation of dust
- Restriction of vehicle speeds will be required in high risk dust generation areas within the mine site
- Ore road haulage shall be undertaken on upgraded sealed roadways for gazetted corridors to limit any impact on the community
- Stabilisation of dust on topsoil stockpiles or other earthen stockpiles with salvaged vegetation or stabilising emulsion where required, will be undertaken
- Control of product stockpiles moisture content with water sprays (and surfactant additives as required)
- Road train haulage leaving the plant site will have a water spray system (and surfactant additives as required) to limit potential for dust generation during road transport (this should include passing through a wash station to clean wheels and undercarriage)
- Baseline and monthly routine monitoring (or as deemed required) of dust levels at mine site and along ore haulage route through the community
- Routine community meetings to present results of dust monitoring and effectiveness
- Staff training on dust management procedures and practices
- Minimising vegetation clearing that could create dust prone areas
- Use of blasting techniques that produce minimal dust in the mine
- Progressive rehabilitation of disturbed areas

- Visual monitoring of dust generated from pits and stockpiles
- Internal reporting of dust incidents, with external annual reporting to the Department of Environment and Conservation (DEC) and the Department of Mines and Petroleum (DMP) (with subsequent review and audit by DEC and DMP).

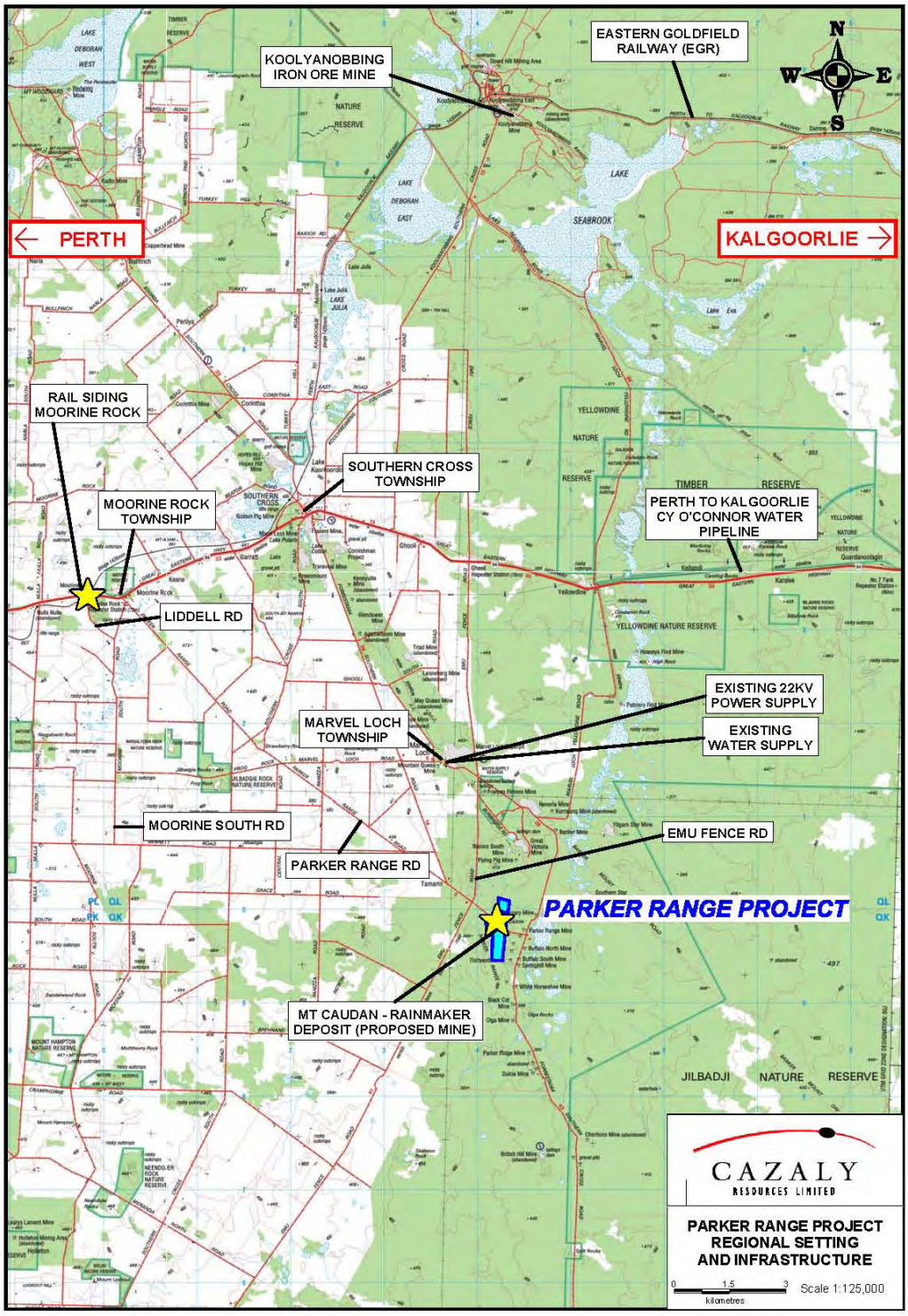
1. Introduction

1.1. Background

Cazaly Resources Limited propose to develop the Parker Range Iron Ore Project (the Project) which is located approximately 15 kilometres south of Marvel Loch in the Yilgarn province of Western Australia. The proposed deposit currently contains 28.4 million tonnes of direct shipping ore which Cazaly plan to extract using standard mining methodology (drill and blast, mine haulage and crushing). The processed ore will be trucked from the mine approximately 57 kilometres along a sealed road to the rail head at Moorine Rocks, where it will be stockpiled awaiting rail load out. **Figure 1-1** presents the project in a regional setting with the key infrastructure identified.

This report provides an air quality impact assessment, to inform the Environmental Impact Assessment (EIA) of the Project (understood to be at the Western Australia Public Environmental Review (PER) level of assessment). The assessment includes atmospheric dispersion modelling of emissions of particulates from the proposed mining, haulage operations and material handling at Moorine Rocks. As there are no residences within 10 kilometres of the proposed mine it is deemed that this component of the assessment should focus on dust deposition to determine the potential impact on flora and fauna. The mine to rail head haul route has also been modelled to show potential deposition impacts on adjacent wheat crops. The rail head assessment also covers total suspended particulates (TSP) and fine particulate (PM_{10} and $PM_{2.5}$) impacts to assist in determining if there is the potential for health or amenity issues.

- **Figure 1-1 Parker Range Project Regional Setting and Infrastructure**



1.2. Structure of Report

This report:

- Describes the Project, with a focus on the main air emission-generating activities (**Section 1**)
- Highlights air quality impact assessment criteria, study methodology and sensitive receptors relevant to the Project (**Section 2**)
- Quantifies the baseline environment, through local meteorological and any available background air quality data (**Section 3**)
- Describes emission estimation calculations and emission controls used in modelling (**Section 4**)
- Models the air quality impacts from the existing and proposed operations on sensitive receptors (**Section 5**)
- Provides an assessment of the current management plan's ability to meet air quality criteria, including recommendations to improve existing controls (**Section 6**)

2. Assessment Methodology

2.1. Overview

This assessment has been carried out with reference to the Air Quality Modelling Guidance Notes (DoE 2006). Assessments submitted to the DoE (now Department of Environment and Conservation (DEC)) for consideration under the Environmental Protection Act 1986 are required to comply with this guidance.

2.2. Relevant Pollutants, Impacts and Assessment Criteria

2.2.1. Relevant Pollutants

The likely impacts to air quality are judged to be from emissions of particulate matter. Other air pollutants have not been considered in this assessment owing to the relatively small concentrations (compared with particulate emissions) expected to result from normal site operations, and the low risk that national standards other than those for particulate matter will be exceeded. In addition to impacts to air quality, there will also be deposition of the particulate matter, in the form of dust.

The default assessment criteria used for airborne particulate matter and deposited dust are the *National Environment Protection (Ambient Air Quality) Measure* (NEPM) standards (NEPC 2003). Where no NEPM criteria exist, the Kwinana Environmental Protection Policy (EPA 1999) or the NSW EPA (2005) criteria have been applied. The study criteria used in this assessment are summarised in **Table 2-1**. In the case of criteria for impacts to vegetation, these have been taken from available literature.

2.2.1.1. Impacts to Human Health and Amenity

Total Suspended Particulates (TSP)

The term total suspended particulates (TSP) generally refers to particles approximately 50 microns or less in equivalent aerodynamic diameter. TSP is generally considered to be associated with aesthetic impacts (DEP 2001), as this range includes particles to be too large for inhalation. This is unsuitable for developing criteria based on observed health impacts (WHO 2000).

In Western Australia, the main criterion used to assess TSP impacts is from the 24 hour Kwinana Environmental Protection Policy (EPP). The NSW EPA also has a specified annual average criterion for TSP and this is also included in **Table 2-1**.

PM_{10}

PM_{10} refers to particulate with an aerodynamic diameter of 10 microns (µm) or smaller. Particulate of this size range are capable of entering the respiratory system (WHO 2000). The health effect of particulates in the PM_{10} range is mainly the exacerbation of respiratory problems, with the elderly, people with existing respiratory and/or cardiovascular problems and children the most susceptible (US EPA 2010).

In Western Australia, the main criterion used to assess PM_{10} impacts is the Ambient Air Quality NEPM, which is based as a 24 hour average. This standard is included in **Table 2-1**.

While the NEPM criteria for PM_{10} specifies that five days are allowed for exceedences, this is to allow for unpredictable high particulate events such as dust storms or bushfires. These special events are not captured in dispersion modelling, thus modelling results should take any exceedence of the 50 µg/m^3 target as a breach of criteria and treated as such.

$PM_{2.5}$

$PM_{2.5}$ refers to particulate with an aerodynamic diameter of 2.5 microns (µm) or smaller. Combustion sources, automobile diesel in particular, are the key source of $PM_{2.5}$ in many urban and regional areas (WHO 2005). Particles in this size range can penetrate far deeper into the lungs, and are retained for longer compared to larger particle size ranges (NEPC 2002). For mining sources, the total mass of $PM_{2.5}$ emitted is usually small, relative to the larger size fractions.

In Western Australia, the main criterion used to assess $PM_{2.5}$ impacts is the Ambient Air Quality NEPM (see **Table 2-1**). These standards are advisory only; their purpose is to collect data for future management strategies (NEPC 2002).

Deposited Dust

Deposition is the term used to describe the settling of suspended particulate on a surface. Excessive deposition of particulate matter on fabrics (such as laundry), house roofs and movement of dust into water tanks can potentially generate community concern. The deposition of larger particles can also cause aesthetic or chemical contamination of water bodies or vegetation, forest and farm crop damage and negatively impact on personal comfort, amenity and health (USEPA 2010).

In Western Australia there is no specified criteria for dust deposition, however an impact assessment criteria does exist in NSW (NSW EPA 2005) for nuisance dust (to humans). The criteria states that the maximum allowable increase from background contributions in deposited dust is 2 g/m^2/month with a total allowable maximum of 4 g/m^2/month and it is applicable to

amenities. In the absence of Western Australian specific criteria and deposition data for the project region, the NSW criteria for allowable increases have been used in this assessment.

For dust impacts to vegetation, the potential impact is less well understood. An assessment criterion of 7 g/m^2 has been applied for this assessment, as derived from Farmer (cited in Doley 2006). This is the level above which direct physical effects of mineral dusts on vegetation become apparent. This is compared to the chemical effects of reactive materials such as cement dust which may become evident at 2 g/m^2 or of particulate sulphates and nitrates that have indirect effects on ecosystems (Doley 2006). It is important to note that the assessment criterion of 7 g/m^2 represents a total dust loading and rainfall and winds strong enough to agitate leaves and branches may completely remove a dust coating (Doley & Rossato 2010) so a monthly averaging period for deposition to be 'reset' was selected based on maximum number of days without rain and winds speeds rated below '4' on the Beaufort scale in the modelled year.

2.2.2. Assessment Criteria

The assessment criteria discussed above and used in this assessment are presented in **Table 2-1**. These criteria are used in **Section 5** to assess the significance of impact for the sensitive receptors identified in **Section 2.5**.

Table 2-1 Assessment criteria

Pollutant	Criteria Type	Averaging Period	Assessment Criteria	Outcome of Criteria	Criteria Reference
Particulate matter (as $PM_{2.5}$)	Concentration in ambient air	24 hours	25 µg/m^3	Protects human health	NEPM
Particulate matter (as $PM_{2.5}$)	Concentration in ambient air	1 year	8 µg/m^3	Protects human health	NEPM
Particulate matter (as PM_{10})	Concentration in ambient air	24 hours	50 µg/m^3 No more than 5** days exceeding limit per year	Protects human health	NEPM
Total suspended particulates (TSP)	Concentration in ambient air	24 hours	Target: 90 µg/m^3 Limit: 150 µg/m^3	Protects amenity	Kwinana Environmental Protection Policy
Deposited dust	Deposition rate	Monthly	2 g/m^2/month (monthly maximum increase)	Protects amenity	NSW EPA
Deposited dust	Total deposition	Monthly	*7 g/m^2	Protects vegetation	Farmer (cited in Doley 2006)

* This is the total amount of deposition above which an impact is deemed to occur hence there is no averaging period defined in the literature. However, as detailed in this report, this period of time is judged to be the maximum period that dust will be able to accumulate on the surface of the vegetation, for the likely meteorology at this location.

**These 5 allowed exceedances are for background levels and not an allowance for industry.

2.3. Dispersion Model

The Australian State of Victoria Environment Protection Authority AUSPLUME (Version 6) computer dispersion model has been selected as the primary tool for this assessment, using a range of inputs detailed in the remainder of this Section. AUSPLUME has been used Ecotech and others for a range of similar assessments throughout Western Australia and elsewhere. AUSPLUME has been accepted by the WA Department of Environment and Conservation as being suitable for use for such assessments.

The model is designed to predict ground-level concentrations or dry deposition of pollutants emitted from one or more sources. These sources may be stacks, area sources, volume sources or any combination of these. AUSPLUME is essentially a statistical Gaussian plume model that requires a time series of both meteorological and source emission data. A file of the AUSPLUME setup used in this Study is presented in **Appendix A**.

The topography at proposed mine site is relatively gradual in undulations within 3 km of surroundings of Mt Caudan peak. However, Mt Caudan Peak rises abruptly to 48 m above natural ground level (on the east facing ridge) and graduates back into level landscape over about 500 m distance (North to south orientation). The Mt Caudan peak is proposed to be removed in pre-strip initial mining operations.

The proposed Parker Range truck haul road and Moorine Rock local area topography are both generally flat with little undulation (i.e. < 25 m) over low sloping transitions.

Given the lack of significant topographical features in the region (Mt Caudan peak will be removed for mining) AUSPLUME is considered adequate to predict dust level predictions from the mine.

2.4. Meteorological Data

A key input to the dispersion modelling is meteorological data. A time series meteorological data file is required for the AUSPLUME modelling, including hourly averaged values of:

- Wind speed and direction
- Ambient air temperature
- Pasquill-Gifford stability class
- Atmospheric mixing height.

It should be noted that whilst BoM data are used in quantifying local climate, cloud observation data was not available from Southern Cross, making the dataset insufficient to generate an AUSPLUME-ready meteorological file. A TAPM (ver4.0.3) model generated meteorological file was therefore used for the AUSPLUME dispersion modelling. One full year has been used (2009),

as this is the most recent full calendar year of data available at the time of this assessment. Given that dust is released relatively close to the ground, impacts are generally close to the source and therefore do not generally experience significant variations between years, hence the use of only one year of meteorological data is judged sufficient for this assessment.

Details of the approach used are discussed further in **Appendix B**, together with a verification of TAPM modelled meteorological data with actual recorded data at the Southern Cross BoM recording station.

2.5. Sensitive Receptors

2.5.1. Overview

Model results are presented in **Section 5** in tabular format for sensitive receptors surrounding the proposed operations and as contour plots. To enable the assessment of impact, predictions are made with reference to the assessment criteria presented in **Section 2.2**.

Receptors are selected for each of the three components of the Project: the mine, the haulage route and the rail head.

Ecotech has been advised there are no permanent residential properties close to the mine (>10 kilometres distant) (Cazaly 2010 as per e-mail comm.). Hence it is deemed that the assessment at this location should focus on dust deposition to determine the potential impact on flora and fauna, both directly and indirectly (to fauna habitat).

Likewise along the haul route, human (predominantly residential) receptors are sufficiently distant (> 1 kilometre), combined with the road being sealed (and therefore minimising resuspension of road dust), to negate the likelihood of any impact. The route does however pass through adjacent wheat farming district on a public road, which could present a cross contamination issue with material iron ore dust loss from the tops of road trains. Hence deposition of particulates emitted from the road trains has been assessed.

At the rail head the assessment additionally covers total suspended particulates (TSP) and airborne fine particulate (PM_{10} and $PM_{2.5}$) impacts to assist in determining if there is the potential for health or amenity issues, given there is a residential property close to this location.

2.5.2. Human Receptors

Table 2-2 presents the human receptor locations as provided to Ecotech (derived from noise monitoring locations).

As explained in **Section 2.5.1**, at the mine site and along the haul route, human receptors are sufficiently distant to not warrant an assessment of air quality and dust deposition impacts at these locations.

There are residential properties in close proximity to the rail terminal at Moorine Rocks. Hence air quality and dust deposition impacts have been assessed at this location.

- **Table 2-2 Human receptor locations as derived from the noise monitoring study**

Modelled Receptor Number	Lott Owner	Easting	Northing
1	G. Maddock	698176	6533022
2	Moorine Rock Primary School	702291	6533594
3	P & D Stevens	702347	6533650
4	J. Gill	702509	6533002
5	G & S Nicholson	702537	6532885
6	Unknown	702448	6532696
7	Unknown	702158	6532871

2.5.3. Sensitive Native Flora and Fauna Receptors

Malleefowl

Four inhabited malleefowl nest (mound) locations occur close to the mine site, the locations being defined from a vegetation survey, as provided to Ecotech. Surrounding these locations (**Table 2-3**), 50-metre radius exclusion zones (buffer zones) will be maintained.

- **Table 2-3 Locations of malleefowl nesting mounds within the surveyed area**

Modelled mine site reference number	Site description	Eastings (m)	Northings (m)
1*	Close to proposed access road	740816	6499448
2	Adjacent to Parker Range Road Diversion	743227	6499183
3*	Adjacent to Parker Range Road Diversion	743253	6498915
4	West of mining-plant infrastructure	740764	6498245

*. Source of information: Keith Linbeck & Associates, as provided to Ecotech by Cazaly Resources.

Robust Coneflower

The robust coneflower (scientific name *Isopogon robustus*) is located within the Project's mine tenement. Surrounding these locations (**Table 2-4**), 350-metre radius exclusion zones (buffer zones) will be maintained. Whilst the locations are not directly within the areas to be disturbed, they are all within 1 kilometre from mining activity and hence subject to elevated dust deposition rates.

Table 2-4 Locations of robust coneflower within the surveyed area

Modelled mine receptor reference number	Site Description	Eastings (m)	Northings (m)
5	West of Mt Caudan southern open pit	740850	6496660
6	West of Mt Caudan southern open pit	741320	6496760
7	South east of Mt Caudan southern open pit	742290	6496130
8	South east of the waste rock stockpile	742680	6466700
9	South east of the waste rock stockpile	742880	6496990
10	South east of the waste rock stockpile	742860	6497260

Source of information: Botanica Consulting as provided to Ecotech by Cazaly Resources. MGA 94 Zone 50 Coordinates

Crops

Cazaly has selected a truck route which avoids residences in the community. However the haul route passes through a wheat farming district on a public road. Hence the crops adjacent to this road are likely to experience elevated dust deposition rates as a result of emissions from the tops of the uncovered haul trucks. Any impacts would be solely in relation to the physical impact of this dust, as there is no known potential contamination issue due to the nature of iron ore dust as it is essentially non-reactive.

As the proposed road will be sealed (chip seal) and wheel/undercarriage washing undertaken, dust arising from re-suspended road dust and being transported from the mine via the wheels of vehicles is assumed to be negligible and hence is not assessed. Wind erosion from the back of road trains travelling at high speeds has been assessed to determine the potential deposition rate on crops adjacent to the truck route.

3. Existing Environment

3.1. Overview

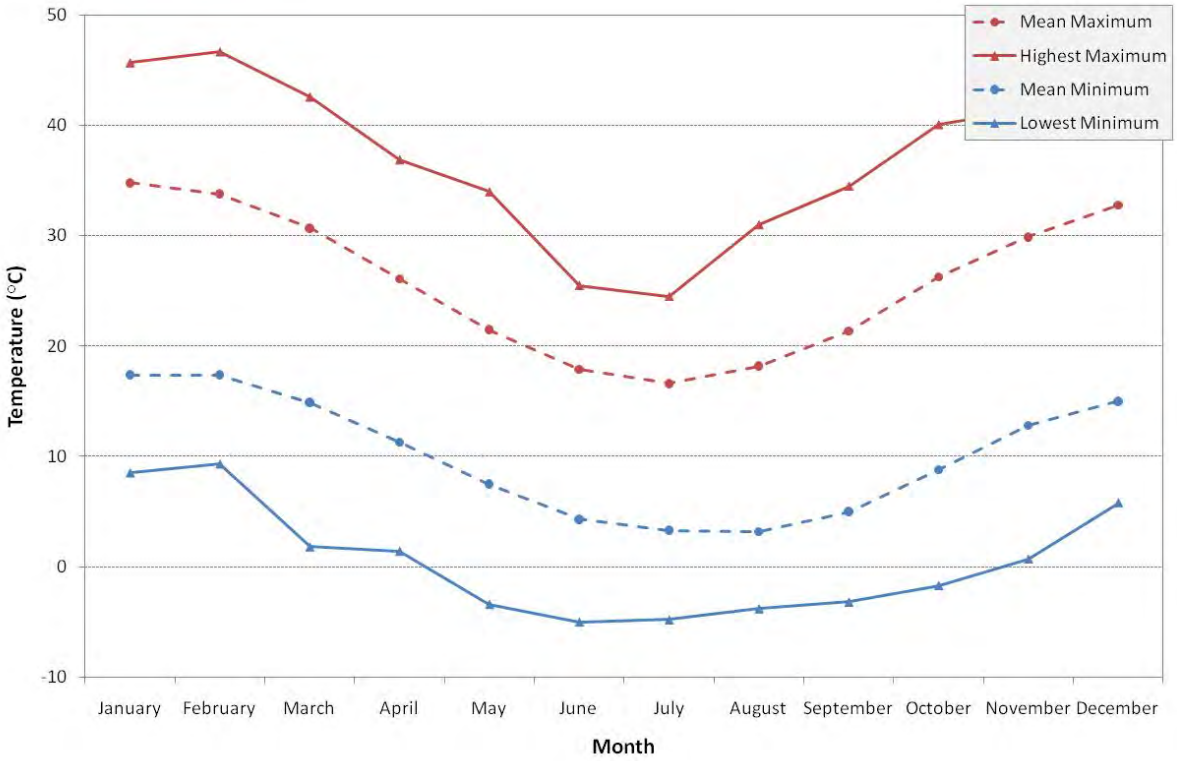
In this section, the character of the existing environment is quantified in the context of the key variables that influence air quality. Unless otherwise stated, data used is from the Bureau of Meteorology (BoM) Southern Cross Airfield station (site number 012320), which is the closest to the study area. The station is 46 km to the north-northwest of the mine and 28 km to the east-northeast of the rail head at Moorine Rocks. Ecotech considers this site sufficient to adequately characterise the climate in the study area.

3.2. Climate and Meteorology

The Wheatbelt region around Southern Cross is classified as having a dry climate, with hot summers and cool winters. The northwest monsoon season and the formation of low-pressure regions inland influence summer weather, whilst winter weather is dominated by south-westerly air movement which brings mild conditions and cold fronts. Rainfall in the region occurs primarily during the winter months, though on occasion decaying cyclones from the northwest during summer can bring high levels of rainfall. During summer, temperatures can range from above 40°C for several days at a time when hot, dry inland winds occur. While during winter, temperatures can drop below freezing on clear nights after a day of cold southerlies (BoM 2010).

3.3. Temperature

The long term mean maximum and minimum temperature profiles for the region are presented in **Figure 3-1** and include temperatures recorded at Southern Cross between 1996 and 2010 (to 8 July 2010). It can be seen that the average temperatures in Southern Cross range from 15°C to 35°C during summer, with maximums of up to 47°C recorded. During winter the average temperature can vary from 3°C through to 31°C, with minimum temperatures as low as -5°C.

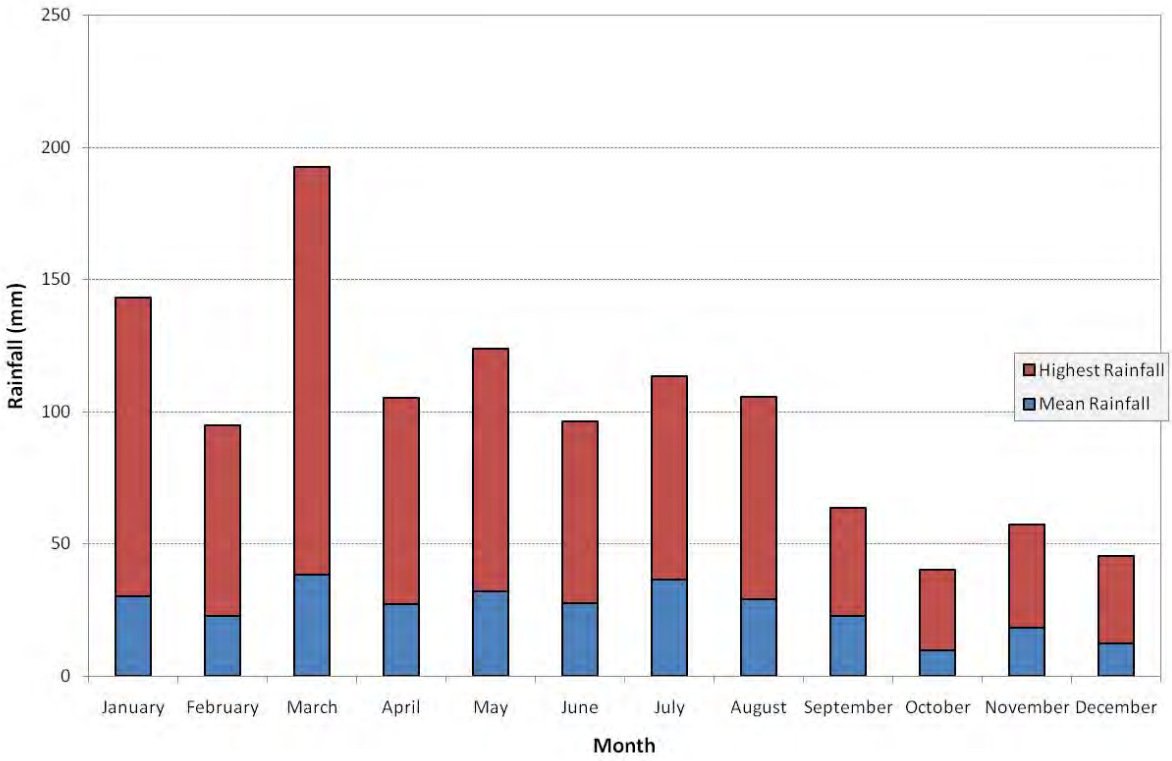


- **Figure 3-1 Monthly mean maximum and minimum temperature profiles for Southern Cross (BoM 2010)**

3.4. Rainfall

The long term mean monthly rainfall for Southern Cross is presented in **Figure 3-2** and includes rainfall data recorded from 1996 to 2010. It can be seen that the average rainfall over the year is relatively constant, with spring and early summer being the driest period of the year. January and March show high rainfall has been recorded during these months, possibly due to the influence of summer storm events. The total annual rainfall for Southern Cross is low, receiving an average 306 mm per annum.

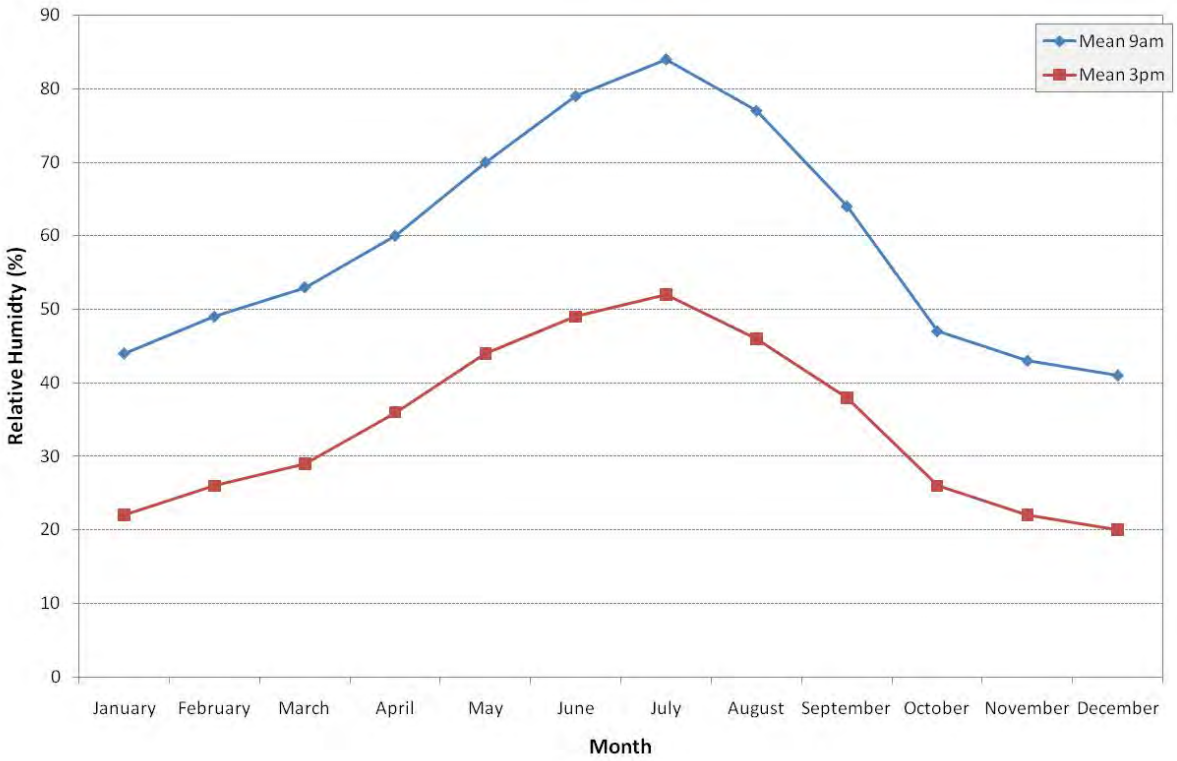
Rainfall events are used in modelling to 'switch off' emissions from surface sources such as wind erosion and wheel generated dust. This is detailed further in **Section 4**.



- **Figure 3-2 Mean monthly rainfall for Southern Cross (BoM 2010)**

3.5. Relative Humidity

The long term mean relative humidity of each month is presented in **Figure 3-3** and includes humidity recorded from 1996 to 2010. This figure shows that morning mean relative humidity is consistently higher than the evening mean. It also shows that mean monthly humidity varies between 38% and 84% in the winter months and decreases to between 20% and 49% in the summer months.



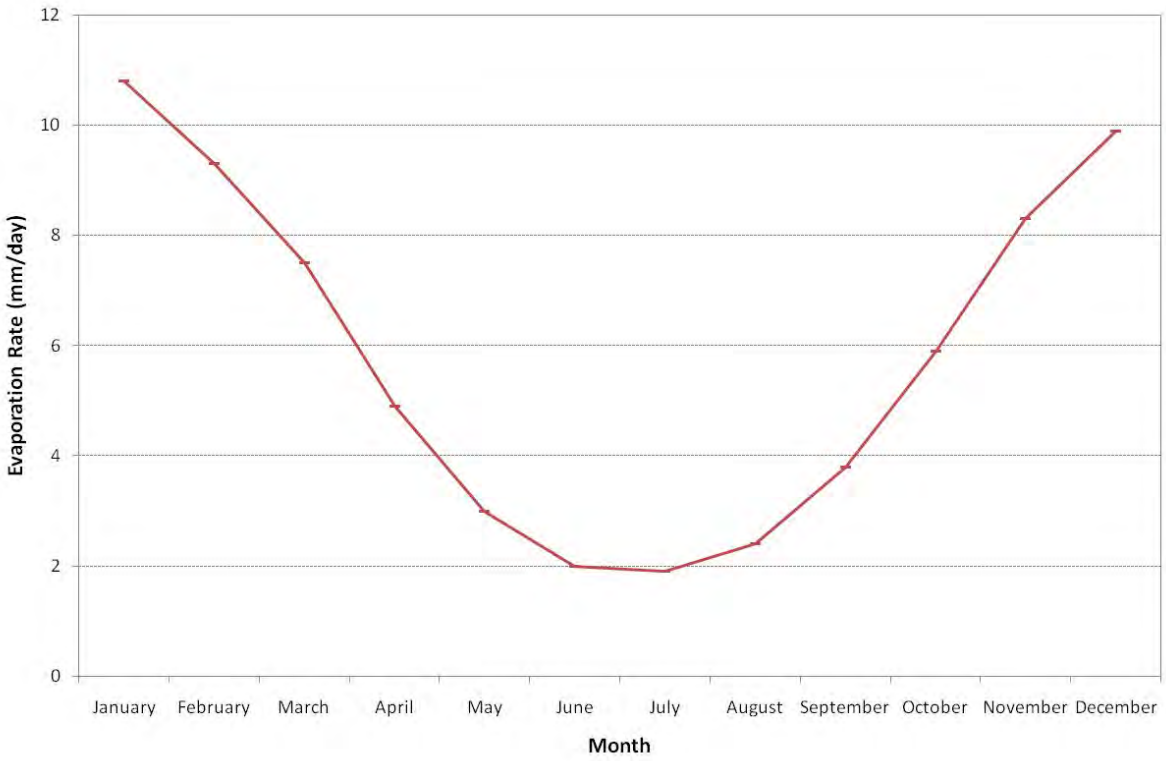
- **Figure 3-3 Mean relative humidity measured at Southern Cross (BoM 2010)**

3.6. Evaporation

The BoM does not record evaporation data at Southern Cross. These data were therefore obtained from Merredin which is the closest station that records this parameter. Merredin is located approximately 100 km west of Southern Cross and the data provides an indication of the relative evaporation rate of the area surrounding Southern Cross.

Evaporation trends are useful to determine how frequently water based dust controls need to be applied and monitored. Areas with high evaporation rates require more regular watering and/or consideration of alternate dust suppression solutions. Evaporation data is used in modelling to 'switch on' emissions after rainfall events.

The long term (1966 to 2010) evaporation rates from Merredin are presented in **Figure 3-4**. It can be seen that the evaporation rate is distinctly higher during the summer months and lower during the winter months.



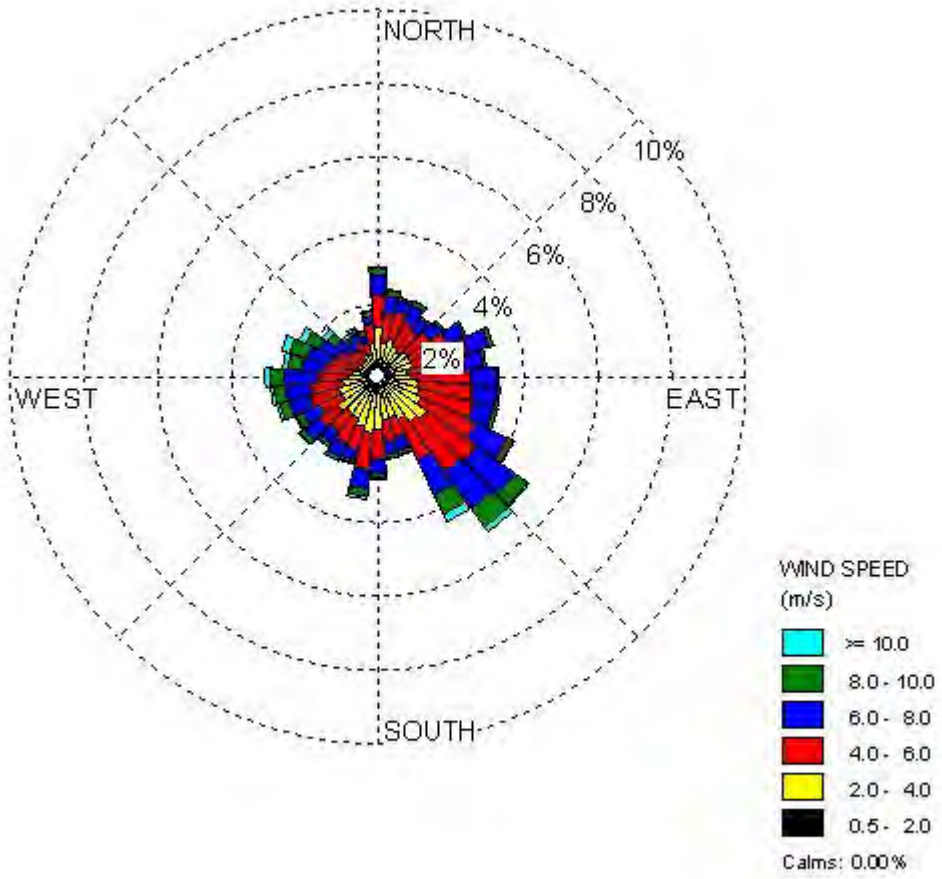
- **Figure 3-4 Mean daily evaporation at Merredin (BoM 2010)**

3.7. Wind Direction and Speed

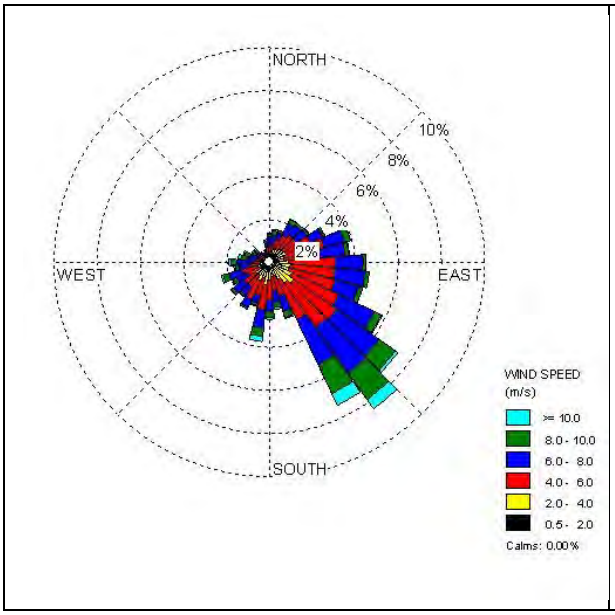
The annual wind rose for Southern Cross, representing the years 2005 to 2009, is presented in **Figure 3-5**. The dominant wind directions are east-southeast through to south-southeast and a smaller proportion is in a south-westerly direction.

Seasonal wind roses for Southern Cross 2005 to 2009 are presented from **Figure 3-6** to **Figure 3-9**. Wind direction during the summer period dominated by high south-easterly winds. In autumn, winds are slower and come from the northeast and southeast directions. Winter months experience high winds from the south-west to the north, and spring shows strong westerly winds are dominant as well as strong winds from the southeast.

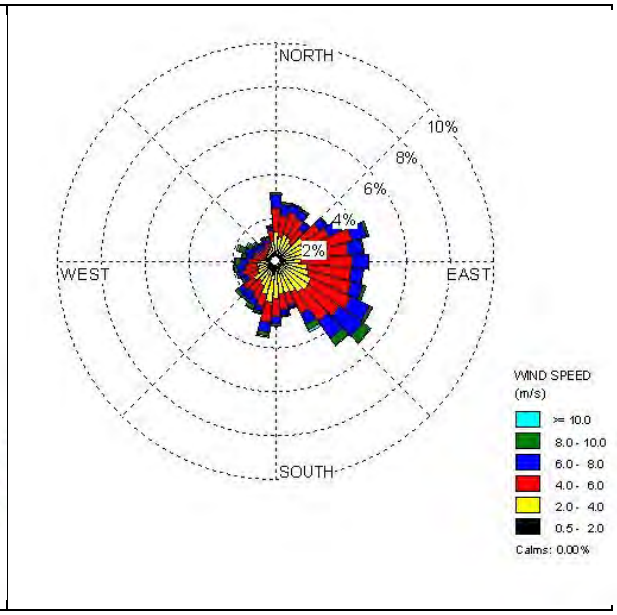
Due to local terrain and micro-meteorological effects, the actual wind conditions at any location within the study area may differ slightly to that shown in the Southern Cross wind roses. However, the broad patterns exhibited in the analysis of the data are likely to be similar to those exhibited within the Project area.



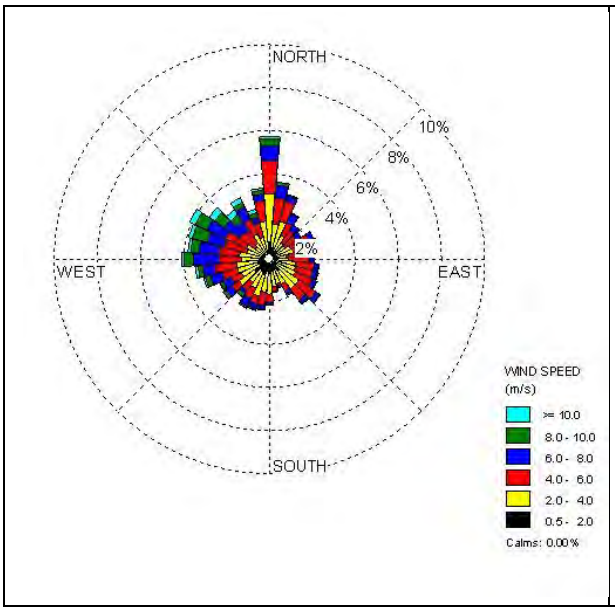
- **Figure 3-5 Annual wind rose for Southern Cross 2005 – 2009 (BoM 2010)**



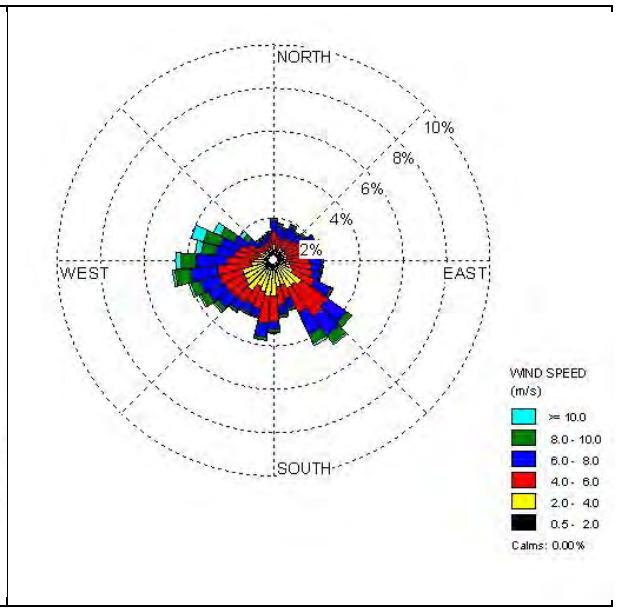
- **Figure 3-6 Summer wind rose**



- **Figure 3-7 Autumn wind rose**



- **Figure 3-8 Winter wind rose**



- **Figure 3-9 Spring wind rose**

3.8. Existing Air Quality

As the Parker Range operations are located within the Western Australia Wheatbelt region, it is expected that bushfires, agricultural operations and wind erosion from cleared paddocks will be the primary source of airborne particulate in the area. There is no available monitoring data for existing air quality in the vicinity of Parker Range. To include a reasonable level of background, annual averaged PM_{10} data from the DEC's 'Ambient Monitoring of Particulate Matter in

Kalgoorlie, 2006-2007' (DEC 2009) report was used. A nominal 22 µg/m^3 PM_{10} annual average has been used.

Ecotech has collected baseline data in the project area and the results are included in this report (**Appendix E** and **F**). The background study, performed after the modelling data was included in this report, showed that the maximum PM_{10} concentration recorded in the area was 9.8 µg/m^3. The baseline values were measured in winter months. A summer baseline survey (when the landscape is drier) would yield a likely higher baseline maximum PM_{10} concentration, hence for the modelling analysis the Kalgoorlie 22 µg/m^3 average yearly concentration represents a conservative assumption in modelling (in absence of a summer baseline survey data). In the event the summer baseline dust levels are measured to average above 22 µg/m^3 (noting peaks above 22 µg/m^3 would be permissible), the NEPM standard limits could be exceeded (refer **Table 2-1**).

To obtain a TSP value for modelling, the PM_{10} average was multiplied by 1.4 (31 µg/m^3).This value represents the ratio of TSP to PM_{10} from the Port Hedland airport monitoring station in recent times (SKM 2006). This value can be considered an indicative approximation in lieu of available data for the region. Background values are added as a blanket value to model results (**Section 5.4**).

Subsequent to modelling, Ecotech has collected baseline data in the project area and the results are included in this report (Appendix E, F, H and G). There were two monitoring periods, one during winter (Appendinx E, F) and one during summer (Appendix H, G). Based on the background studies undertaken on site during 2010 and 2011 the 22 µg/m³ baseline used in the model has proven to be conservative. The on-site PM_{10} levels range from 5.1 – 5.9 µg/m³ in winter and 21.9 – 22.9 µg/m³ in summer. Based on winter and summer month monitoring, the yearly average is likely to be between 13.5 and 14.4 µg/m³. This will have a direct impact on the predicted modelling concentrations, decreasing by 7 – 9 µg/m³.

It is noted that in the event of an annual baseline monitoring survey yielding on average PM_{10} background dust level above 22 µg/m³ (noting peaks above 22 µg/m³ would be permissible), the NEPM standard limits could be exceeded. Based on background monitoring by Ecotech, this result seems highly unlikely.

In addition, it is noted that the following monitoring measures are components of the Dust Management Plan that forms an Appendix to the Environmental Impact Statement:

- An Environmental Monitoring Station located on the site will measure deposited dust
- Routine dust monitoring along the truck haulage route will occur (and compared to a baseline level prior to operations commencement). This will provide the ability to monitor product loss and effectiveness of dust control

Cazaly commits to a routine dust monitoring program for the mine site and the community.

4. Emission Estimation

This Section details the emission identification and estimation techniques applied in this assessment. Information has either been provided by Cazaly Resources or otherwise estimated in order to derive the emissions from Parker Range operations. For clarity and brevity, **Appendix C** provides the source parameters and locations.

4.1. Emission Sources

Emission sources considered to be significant for inclusion in the model and in this assessment are:

- Drilling
- Blasting
- Ore/waste excavation and loading
- Ore/waste dumping onto stockpiles
- Bulldozing of bulk material
- Wheel generated dust from heavy vehicle movements
- Road train loading and unloading
- Wind erosion (ore/waste stockpiles, open areas)
- Ore crushing.

Emission rates were estimated using the National Pollutant Inventory (NPI) Emissions Estimation Technique Manual (EETM) for Mining Version 2.3 (NPI 2001).

Emission sources are 'switched on and off' using a random number function to simulate a variety of emission conditions over the modelled year. In certain cases, emissions from particular operations are linked, an example being loading haul trucks with waste/ore not occurring during scheduled blasting hours.

Mine throughput used in the modelling year represents the year with the largest expected waste and ore tonnage handled (11.6 Mtpa). This peak mining rate is only expected to occur for 2 years during the mine life.

4.2. Emissions Calculations

This section details the calculation method used for estimating the emissions from each mining activity utilising a dust deposition technique.

A coarse grid has been adopted for reporting emissions associated with mining and road haulage. Dust deposition predictions use an averaging technique for reporting which are not influenced by selection of a finer grid resolution.

4.2.1. Blasting

Dust emissions from blasting are difficult to model due to the short time interval and variability of the physical factors that define a blast event. Blasting activities are episodic in nature and the impacts are generally short-term, resulting from a distinct event at a specific location, in contrast with a number of diffuse sources spread across various locations within an open cut operation. The uncertainties associated with calculating dust impacts from blasting are therefore generally greater than those associated with other longer term activities of the mining operations as a whole.

Dust emissions from blasting have been estimated using the NPI blasting emissions equation from the NPI EETM for Mining v2.3 (NPI 2001), presented in **Equation 4-1**.

- **Equation 4-1**

$$\boxed{E = k \times 344 \times A^{0.8} / \left(M^{1.9} \times D^{1.8}\right)}, \text{ kg/blast}$$

Where: k = a constant (0.52 for PM_{10}, 344 for TSP)
A = the blast area (m^2)
M = moisture content (%)
D = depth of blast holes (m)

Specific blast information was not provided for this assessment. To calculate blasting emissions, the area per blast was assumed to be 4 500 m^2 based on mine plans provided to Ecotech. Moisture content was set to 2%, consistent with material testing data (TUNRA 2010). Blast holes were assumed to be 10 m deep. Blast events across the site were assumed to occur approximately once every two to three days, and were scheduled to occur either at 0900, 1200, or 1500 hours.

4.2.2. Drilling

Drilling emissions have been calculated using the default NPI drilling emission rates from the NPI EETM for Mining v2.3 (NPI 2001). For PM_{10} this is specified as 0.31 kg/hole and for TSP as 0.59 kg/hole.

Drilling information was not provided for this assessment. For this assessment drilling was scheduled to occur at all daylight hours[1] except during scheduled blast times. By assuming an

[1] For the purposes of this assessment 'daylight hours' refers to the period of time between 0600 and 1800 hours

approximate 300 holes per blast and using the number of blast events for a year, the total number of drill holes required for a year was calculated. The total emissions were then spread over all possible operating hours.

4.2.3. Ore/Waste Loading and Dumping

After blasting, waste and ore is loaded to haul trucks and taken and deposited at the waste dump, low grade stockpile or high grade stockpiles. Unloading emissions will also occur as road trains deposit ore at the rail head stockpiles. Emissions from this process occur as material is handled, typically after being dropped from height. The NPI EETM for Mining v2.3 (NPI 2001) provides emission rates for loading and dumping of overburden. These are presented in (**Table 4-1**).

- **Table 4-1 Loading and unloading emission rates**

Activity	Size fraction	Emission rate (kg/t)
Loading	PM_{10}	0.012
	TSP	0.025
Unloading	PM_{10}	0.0043
	TSP	0.012

An hourly tonnage load schedule was developed using the mine schedule and a random number function to determine if waste, low grade or high grade ore was loaded at the pit. Loading events were divided across three pits in proportion to the pit size; the largest pit was allocated 50% of loading events, the middle pit 33%, and the smallest pit 17%. Loading did not occur during scheduled blast hours. Unloading at a waste pile or ore stockpile occurred during the same hour as loading.

4.2.4. Bulldozing of Waste Material

After being dumped at the waste pile, waste material is then bulldozed to clear the way for further dumping. Emissions were calculated by the equation provided in the NPI EETM for Mining v2.3 (NPI 2001) for bulldozers operating on overburden. This equation is presented as **Equation 4-2**.

- **Equation 4-2**

$$\boxed{E = A \times \frac{s^B}{M^C}}, \text{ kg/h}$$

Where: s = silt content (%)
M = moisture content (%)
A = 0.34 for PM_{10}, 2.6 for TSP

B = 1.5 for PM_{10}, 1.2 for TSP
C = 1.4 for PM_{10}, 1.3 for TSP

The silt and moisture were set to NPI default values of 10% and 2% respectively. Two dozers were assumed to operate 8 hours a day (for a total of 5 840 hours in a year). These hours were divided in proportion to the amount of dumping events at each waste dump point (as per **Section 4.2.3**) and spread over a year using a random number function. Dozing has not been modelled on the ore stockpiles as it is expected that front end loaders will perform this function during loading events.

4.2.5. Front End Loaders on Stockpiles

For this assessment front end loaders have been modelled loading ore for the crusher, loading road trains at the mine and train carriages at the rail head. Emissions were calculated by the equation provided in the NPI EETM for Mining v2.3 (NPI 2001) for bulldozers operating on overburden. Front end loader emissions have been estimated using the emission factor for loading presented in **Table 4-1**.

Front end loader operating hours were calculated using the bucket capacity of the nominated loader model (Komatsu WA900) and an assumed dump rate of 30 loads an hour. At the mine two front end loaders operating at each source was modelled. At the rail head, three front end loaders were modelled operating on stockpiles and train loading. A random number function was used to distribute the operational hours over the modelled year.

4.2.6. Ore Crushing and Stacking

The emission estimation technique for crushing and stacking of ore, as described by the NPI EETM for Mining v2.3 (NPI 2001) are simple default emission factors. For crushing, the emission factor depends on of the moisture content of the material. There are two categories, one is ‘low moisture’ for materials with a moisture content less than or equal to 4%, the other is ‘high moisture’ for materials with a moisture content higher than 4% (NPI 2001). While the ore moisture is expected to be below 4% (thus considered ‘low’), the inclusion of water sprays in the crusher will raise the moisture content of processed ore to ‘high’.

For primary crushing of high moisture content ores, the PM_{10} default emission factor is given as 0.004 kg/t and the TSP default emission factor as 0.01 kg/t. The stacking emission rate are defined under ‘Loading stockpiles’ as 0.0017 kg/t for PM_{10} and 0.004 for TSP. Crushing and stacking emissions were linked to the operation of the front end loader on the ROM pad.

4.2.7. Vehicles and Wheel Generated Dust

For this assessment haul trucks (both empty and laden) have been modelled travelling along unsealed roads between the mine, waste pit, and ore stockpiles. The particulate matter emissions

from wheel generated dust have been estimated using the equation developed by the USEPA and provided in the NPI EETM for Mining v2.3 (NPI 2001). This is presented as **Equation 4-3**.

- **Equation 4-3**

$$EF_i = k_i \times \left(\frac{s}{12}\right)^A \times \left(\frac{W}{3}\right)^B \Big/ \left(\frac{M}{0.2}\right)^C, \text{ kg/VKT}$$

Where: k_i = 0.733 for PM_{10}, 2.82 for TSP
s = surface silt content (%)
W = vehicle gross mass (t)
M = surface moisture content (%)
A = empirical constant (0.8 for PM_{10} and TSP)
B = empirical constant (0.4 for PM_{10}, 0.5 for TSP)
C = empirical constant (0.3 for PM_{10}, 0.4 for TSP)

Silt content and surface moisture was taken as the NPI default values of 10% and 2% respectively. Vehicle weights (empty and laden) were as per specified vehicle operating capacities (Komatsu HD785-7 dump truck). Total Vehicle Kilometres Travelled (VKTs) for haul trucks were based on each truck driving along a haul road specific to the each of the pits three possible dump points (waste, low grade and high grad stockpiles). Haul truck operation was linked to loading times.

4.2.8. Wind Erosion

Wind erosion emissions occur from any exposed surface with sufficient dust loading. This typically includes stockpiles, cleared open areas and uncovered loads. Emissions from stockpiles and open areas in general were determined using the formula developed by Shao *et al* (Shao 1996), presented in **Equation 4-4**.

- **Equation 4-4**

$$PM_{10}(g/m^2/s) = k \times \left[WS^3 \times \left(1 - \frac{WS_0{}^2}{WS^2}\right)\right], \qquad \text{for } WS > WS_0$$

$$PM_{10}(g/m^2/s) = 0, \qquad \text{for } WS < WS_0$$

Where: WS = wind speed (m/s)
WS_0 = threshold for dust lift off (5 m/s)
k = a constant (5.2×10^{-7})

Wind speed data used was the TAPM generated data (see **Appendix B**). The area of the entire mine site was estimated based on maps provided by Cazaly Resources and divided into six areas to spread wind erosion emissions across the entire site. The rail head area was divided into two areas

around the stockpiles. To convert this calculation from PM_{10} to TSP the emission rate is multiplied by 2.86. This value has been established from validation studies of iron ore export facilities in Port Hedland by comparing measurements made on PM_{10} and TSP HiVol samplers on-site (Ecotech 2006).

4.3. Parker Range Road Haulage

Wind erosion emissions from laden road train trailers were calculated using product testing data (TUNRA 2010). The estimated volume of material exposed on the back of the truck and measured product density was used to calculate the mass of product exposed to wind erosion during transit between the mine and rail head. Wind tunnel testing provided a mass percentage loss for a sample exposed to 30 m/s (108 km/h) winds for an hour. This percentage value was used to determine the mass lost from the truck travelling over the same period of time at a similar speed (100 km/h). This mass lost was then scaled down for stretch of road within a 2km grid and converted to a hourly g/s emission rate using an activity rate of 6 trucks per hour.

Emissions from paved roads are covered by the NPI EETM for Aggregated Emissions from Paved and Unpaved Roads (NPI 1999). The emission equation for paved roads is presented in **Equation 4-5**.

- **Equation 4-5**

$$\boxed{EF = k \times \left(\frac{s}{2}\right)^{0.65} \times (W/3)^{1.5}}, \text{ kg/km}$$

Where: k = 0.0046 for PM_{10}, 0.024 for TSP
s = silt content of road, 0.4 for normal low traffic (<5000 vehicles/day) roads
W = vehicle weight (tonnes), 123.5 tonnes for road trains in this assessment

Emissions from the road were modelled along the same length of road at the same truck activity rate as wind erosion estimates.

4.4. Rainfall and Emission Reductions

Rainfall data from BoM recorded data was used in emission estimates to simulate the suppressive effect of precipitation on surface sources. Hourly rainfall data from the Southern Cross BoM dataset was compared to the evaporation rate from the Merredin BoM dataset (as Southern Cross did not have these data available). If rainfall over a 24 hour period exceeded the daily average evaporation rate then emissions from vehicles and wind erosion were 'switched off' until evaporation exceeded rainfall. (Merredin is located approximately 100 km to the west of Southern Cross, and hence is considered to be broadly representative of conditions at Southern Cross).

Control factors applied to emission estimates were derived from the NPI EETM for Mining v2.3 (NPI 2001) and include:

- Pit retention of emitted dust assumed to be 5% for PM_{10} and 50% for TSP, applicable only to drilling, blasting and loading sources.
- Dust suppression (water trucks) operational on hauling road for a 50% emission reduction in wheel generated dust emissions.
- Undercarriage and wheel cleaning of all road trains leaving site to prevent dust loading on sealed roads.
- No loading of train carriages while winds are blowing towards the nearest receptor (G. Maddock at 698176 mE, 6533022 mN).
- Water suppression (50% reduction to operational sources) on all rail head operations while winds are blowing towards the nearest receptor (G. Maddock at 698176 mE, 6533022 mN).
- Stockpile watering at rail head (50% reduction).

5. Results

5.1. Overview

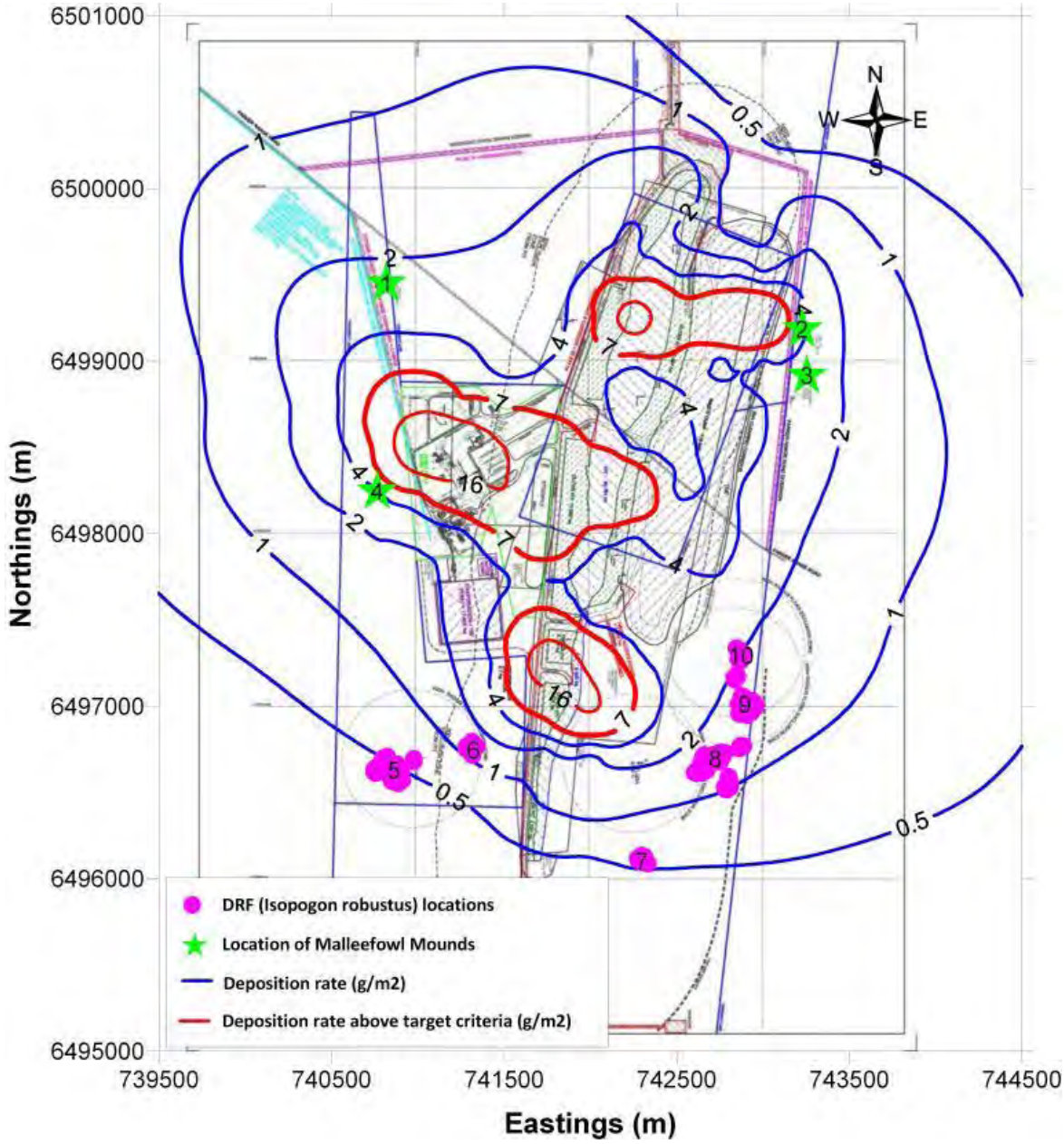
This Section presents the results of the dispersion modelling of emissions of the key pollutants identified, against the assessment criteria, for the three components of the assessment: the mine, the haulage route and the rail head. As explained in **Section 2.4**, the 2009 modelled meteorological data year has been used in this assessment.

5.2. Mine

A contour plot of dust deposition at the mine, for the modelled meteorological data year of 2009, is presented in **Figure 5-1**. It can be seen that whilst peaking at rates in excess of 16 g/m^2 for the averaging period considered (one month) the total deposited dust falls rapidly from the mine, such that at 2 km deposition rates are less than 1 g/m^2. The highest deposition rates are broadly coincident with the locations of the ROM pad and the fixed plant, with these sources in these areas having the highest long term emission rates.

Total monthly deposition at the sensitive receptors identified in **Section 2.5.3** is presented in **Table 5-1**. Receptor 2 and 4 in proximity of the road train load out is the most affected, with dust deposition rates peaking at 3.6 g/m^2 during the month of February (receptor 4) and 3.5 g/m^2 during the month of September (receptor 2). Deposition levels at all receptors are below the 7 g/m^2 deposition criterion, confirming the suitability of design buffer distances adopted by Cazaly.

While the deposition criterion for human amenity (maximum increase of 2 g/m^2/month) is exceeded at all but two receptor locations, this criterion is not considered applicable to flora and fauna, and has not been used to assess impacts from the mine.



- **Figure 5-1 Maximum monthly deposition (g/m^2). Source of basemap: HWE Mining, as provided to Ecotech by Cazaly Resources for use in this assessment. MGA 94 Zone 50 Coordinates**

- **Table 5-1 Monthly deposition (g/m^2) at identified flora/fauna receptor locations 1-10**

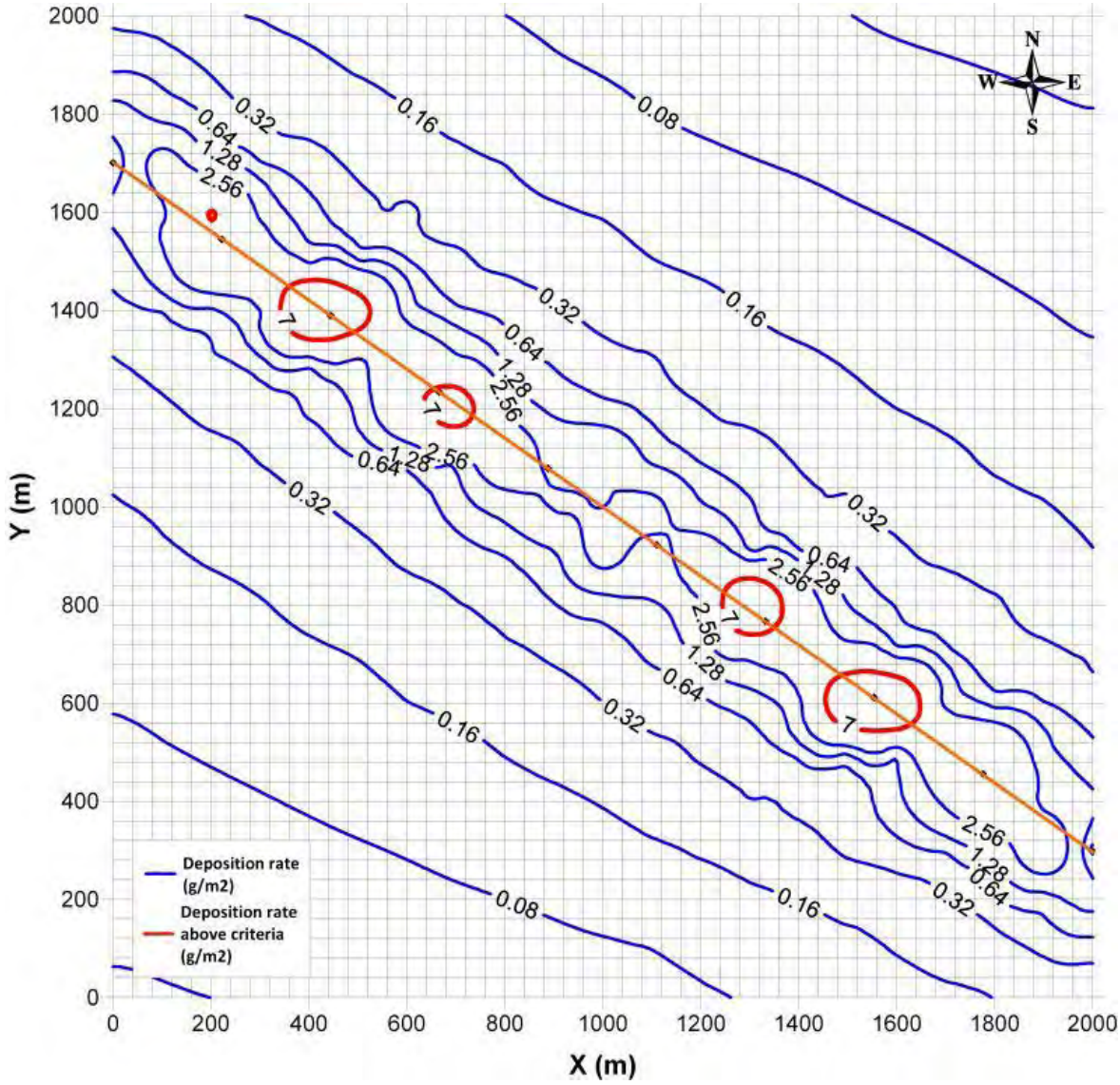
Month	1	2	3	4	5	6	7	8	9	10
Jan	2.4	0.8	0.7	2.4	0.3	0.8	0.1	0.2	0.2	0.3
Feb	1.7	1.0	0.9	3.6	0.5	1.3	0.1	0.4	0.3	0.4
Mar	1.2	0.7	0.6	2.3	0.3	0.7	0.1	0.1	0.1	0.2
Apr	0.7	0.1	0.1	3.4	0.5	1.1	0.1	0.0	0.0	0.0
May	0.2	0.8	0.5	3.6	0.4	0.9	0.4	0.5	0.5	0.6
Jun	0.1	2.3	2.0	1.1	0.3	0.7	0.6	1.0	1.0	1.3
Jul	0.3	1.0	0.9	1.2	0.2	0.4	0.2	0.5	0.5	0.6
Aug	0.4	1.5	1.2	0.7	0.1	0.2	0.3	0.9	0.8	0.9
Sep	0.1	3.5	2.8	0.3	0.1	0.2	0.5	1.5	1.6	2.0
Oct	1.4	2.6	2.2	1.7	0.3	0.7	0.1	0.5	0.5	0.8
Nov	0.6	2.5	2.1	1.6	0.3	0.6	0.5	0.9	1.0	1.4
Dec	2.4	0.7	0.6	2.1	0.3	0.8	0.3	0.4	0.3	0.4
Max	**2.4**	**3.5**	**2.8**	**3.6**	**0.5**	**1.3**	**0.6**	**1.5**	**1.6**	**2.0**

To determine if model predictions are sufficiently conservative, a benchmark comparison to publicly available dust deposition levels at the nearby Windarling Iron Ore mine was undertaken using data presented in the Mt Jackson J1 Deposit Environmental Impact Assessment (Cliffs 2009). Passive sampling is undertaken using deposition gauges under various meteorological conditions and has demonstrated deposition from pit operations is mostly limited to within a 100 – 150 metre range from the pits edge, making the 350 m exclusion zone around sensitive flora location an adequate distance for protection.

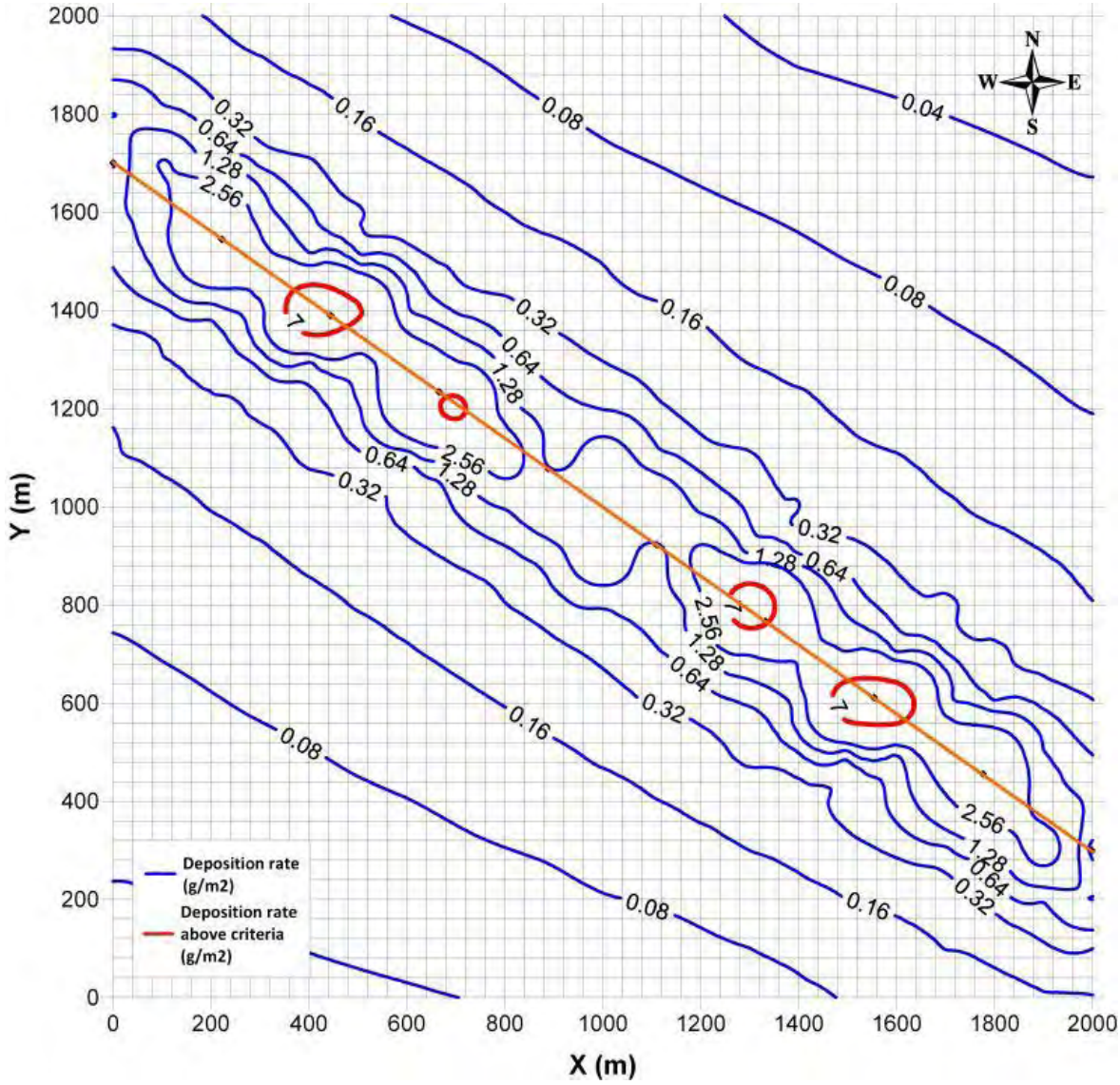
Maximum recorded deposition levels close to the pits edge at Windarling ranges from approximately 2.5 g/m^2 in summer to 0.5 g/m^2 during winter. As the Cazaly model results predict maximum deposition levels in exceedence of this range at the Parker Range pits the Cazaly modelling at Mt Caudan mine can be considered conservative.

5.3. Haul Route

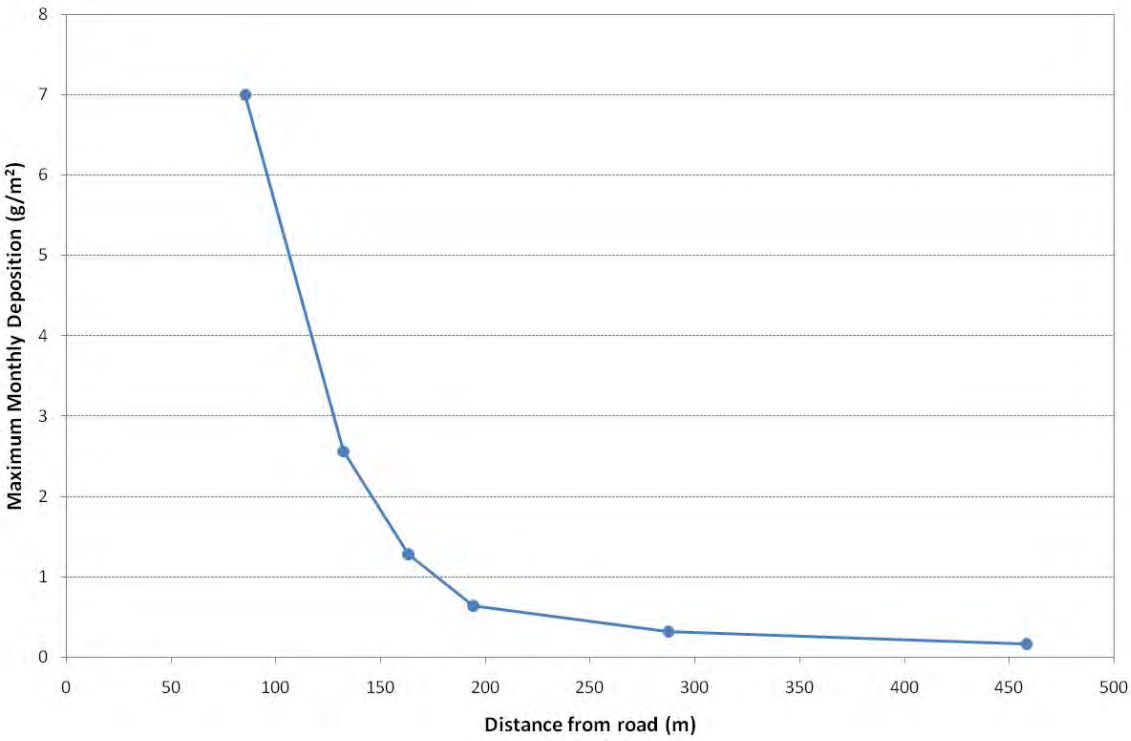
The model predictions for the haul route deposition are presented in **Figure 5-2** (no applied controls) and **Figure 5-3** (with gluon applied to truck loads). The model predicts there may be impacts above 7 g/m^2 within 100 m of the road regardless of if controls are applied to truck loads. A cross section taken from the bottom right region of high impact is presented in **Figure 5-4** and shows how quickly the predicted deposition rates drops over distance.



- **Figure 5-2 Maximum monthly deposition rate (g/m^2) resulting from dust emitted from road trains – no control**



- **Figure 5-3 Maximum monthly deposition rate (g/m^2) resulting from dust emitted from road trains – gluon applied to loads**



- **Figure 5-4 Maximum monthly deposition rate (g/m^2) resulting from dust emitted from road trains – distance from road**

A visual inspection of a haul road at the nearby Windarling mine has shown visible deposition on roadside vegetation exists up to approximately 10 metres from the road edge (Cliffs 2009). As the model is predicting deposition at levels considered to impact vegetation (7g/m^2) occurring at a distance of 100 metres from the road it is believed that the model predictions presented in this report are conservative and unlikely to occur under normal operating conditions.

5.4. Rail Head

This Section presents the results of the dispersion modelling, in a tabular format, at the sensitive receptors identified in **Table 2-2** as a result of the emission generating activities associated with the Project at the rail head. For brevity (and clarity) contour plots are not provided here, but are included within **Appendix D**. All results are for the 2009 modelled meteorological data year.

For the $PM_{2.5}$, PM_{10} and TSP 24 hour averages, the 99, 95, 90 and 70th percentiles have also been presented. Additionally, for these pollutants, the days exceeding the short term criteria are presented. This additional information is to aid the reader in interpreting the significance of the

maximum 24 hour average, as often the maximum is an extreme event, or could be due to a spurious model result.

A coarse grid has been adopted for reporting at Rail head area, which will result in a lower level estimate of PM_{10} concentrations.

5.4.1. PM_{10}

The only receptor experiencing significant concentrations is Receptor 1, where the predicted maximum 24 hour concentration and background are reaches, but does not exceed the NEPM target of 50 µg/m^3, as shown in **Table 5-2**. This prediction is considered conservative given the background applied to rail model predictions is high compared to monitoring data available since modelling was undertaken (**Section 3.8**).

For all the other receptors and averaging periods, the impact is significantly less, such as at Receptor 6, where 24 hour predicted concentrations and background represent 68% of the assessment criterion. This is no predicted exceedence of the PM_{10} assessment criterion.

- **Table 5-2 PM_{10} statistics (µg/m^3) at the sensitive receptor locations 1-7**

Statistic	1	2	3	4	5	6	7
Maximum 24 hour average	50	39	39	34	34	34	35
99th percentile	41	32	32	28	29	29	29
95th percentile	36	26	25	25	25	25	25
90th percentile	30	24	24	23	23	23	23
70th percentile	24	22	22	22	22	22	22
Average	24	23	23	22	22	22	23
Days >50	0	0	0	0	0	0	0

Results presented to two significant figures.

5.4.2. TSP

Maximum 24 hour predicted concentrations plus background as presented in **Table 5-3** represent 82% of the assessment criterion at Receptor 1. At all other locations, and for all averaging periods, the maximum impact is at Receptors 2 and 3, at which the impact represents 52% of the assessment criterion. There is no predicted exceedence of the TSP assessment criterion.

- **Table 5-3 TSP statistics (µg/m^3) at the sensitive receptor locations 1-7**

Statistic	1	2	3	4	5	6	7
Maximum 24 hour average	74	47	47	42	42	42	43
99th percentile	69	41	41	38	38	38	39
95th percentile	54	35	35	35	34	34	35
90th percentile	44	33	33	32	32	32	32
70th percentile	35	31	31	31	31	31	31
Average	35	32	32	32	32	31	32
Days >90	0	0	0	0	0	0	0

Results presented to two significant figures only.

5.4.3. $PM_{2.5}$

It can be seen from **Table 5-4** that incremental $PM_{2.5}$ concentrations are all significantly below the assessment criteria. The highest modelled concentration was at Receptor 1, where the predicted increment in ambient concentration represents 35% of the short term and 10% of the long term assessment criteria. It is noted there is no background value available for $PM_{2.5}$, however as the PM_{10} and TSP results do not indicate an exceedence of criteria with background values applied it is a reasonable assumption that $PM_{2.5}$ will also meet assessment criteria.

- **Table 5-4 $PM_{2.5}$ statistics (µg/m^3) at the sensitive receptor locations 1-7**

Statistic	1	2	3	4	5	6	7
Maximum 24 hour average	8.7	5.3	5.4	3.8	3.8	3.7	4.2
99th percentile	5.8	3.0	3.1	2.0	2.0	2.0	2.2
95th percentile	4.2	1.1	1.0	1.1	1.0	0.9	1.0
90th percentile	2.5	0.5	0.5	0.3	0.3	0.4	0.4
70th percentile	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.8	0.2	0.2	0.2	0.1	0.1	0.2
Days >25	0	0	0	0	0	0	0

Results presented to two significant figures.

5.4.4. Deposition

In contrast to the level of impact predicted for short term airborne concentrations of particulates, predicted incremental levels of deposited dust are relatively modest. The most affected location is Receptor 1, at which the maximum deposition rate is 0.41 g/m^2. This represents 21% of the allowed monthly maximum increase. There is no predicted exceedence of the deposition assessment criterion.

Table 5-5 Monthly deposition (g/m^2) at the sensitive receptor locations

Month	1	2	3	4	5	6	7
January	0.17	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00
February	0.26	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00
March	0.33	0.01	0.01	<0.00	<0.00	<0.00	<0.00
April	0.34	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00
May	0.41	<0.00	<0.00	0.01	0.01	0.01	0.01
June	0.23	0.01	0.01	0.01	0.01	0.01	0.02
July	0.17	0.01	0.01	0.01	0.01	0.02	0.02
August	0.07	0.03	0.03	0.03	0.03	0.03	0.03
September	0.05	0.05	0.04	0.04	0.04	0.03	0.04
October	0.20	0.01	0.01	0.01	0.01	0.01	0.01
November	0.28	0.01	0.01	0.01	0.01	0.01	0.02
December	0.27	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00
Max	**0.41**	**0.05**	**0.04**	**0.04**	**0.04**	**0.03**	**0.04**

Results presented to two significant figures only. The assessment criterion is 2 g/m^2/month as the monthly maximum increase

6. Summary and Recommendations

6.1. Summary

This report provides an assessment of the impact to air quality and subsequent dust deposition rates as a result of the operation of the Parker Range Project, for the purposes of informing the Environmental Impact Assessment for the project.

The impact assessment approach conforms to Western Australia Department of Environment and Conservation guidance for such assessments. Emission characteristics from key components of the project have been quantified, including for the mine, the haulage route and the rail head. The calculated emissions assumes the successful implementation of a range of dust mitigation measures, as defined though the site dust management plan, which is summarised in **Section 6.2** below.

The dispersion model AUSPLUME has been used as the primary assessment tool, using these emission characteristics. Impact assessment criteria have been identified, for the key pollutants TSP, PM_{10}, $PM_{2.5}$ and deposited dust. Sensitive receptors have been identified; at the mine, these are protected flora and fauna, along the haulage route these are wheat crops and at the rail head these are residential properties. For the protected flora and fauna and the wheat crops, modelled dust deposition rates have been compared to the deposited dust assessment criteria as identified through a literature review. For the residential properties, in addition to deposited dust being compared to nuisance criteria for dust, modelled airborne concentrations of TSP, PM_{10} and $PM_{2.5}$ have been compared to legislated criteria for the protection of amenity and human health.

Predicted dust deposition impacts from the mine are not expected to exceed criterion limits.

Along the truck haulage route, which is all sealed, incremental deposited dust levels are below the assessment criteria and have the potential to exceed 7 g/m^2 within 100 m of the road. The predicted deposition rate is shown to drop rapidly further from the road.

The modelled deposition rates were compared to deposition data recorded at the Windarling Iron Ore mine to the north of Southern Cross. This comparison indicates that the model predictions for deposition along the proposed haulage route are potentially over estimated.

Ground level concentrations of the pollutants $PM_{2.5}$, PM_{10}, TSP and deposited dust meet assessment criteria. Receptor 1, which is a residential property located approximately 450 m from the dust generating activities associated with the rail head, is shown to experience the highest concentrations from rail head operation. However, with adequate dust controls it is expected dust impacts will be acceptable at this location.

6.2. Recommendations

It is recommended that Cazaly commit to the following management actions (consistent with industry practices in Western Australia) to limit impacts from dust. It is understood that these are included within the Dust Management Plan that forms an Appendix to the Environmental Impact Statement (PER). Hence the emission estimates used in this assessment have assumed that these actions have been incorporated. The actions are that:

- Water trucks will be utilised in dust prone areas (e.g. local mine site roads, stockpiles and during open pit loading operations) to minimise dust generation
- Water sprays will be included in the crusher design to minimise the generation of dust
- Restriction of vehicle speeds will be required in high risk dust generation areas within the mine site
- Ore road haulage shall be undertaken on upgraded sealed roadways for gazetted corridors to limit any impact on the community
- Stabilisation of dust on topsoil stockpiles or other earthen stockpiles with salvaged vegetation or stabilising emulsion where required, will be undertaken
- Control of product stockpiles moisture content with water sprays (and surfactant additives as required)
- Road train haulage leaving the plant site will have a water spray system (and surfactant additives as required) to limit potential for dust generation during road transport (this should include passing through a wash station to clean wheels and undercarriage)
- Baseline and monthly routine monitoring (or as deemed required) of dust levels at mine site and along ore haulage route through the community
- Routine community meetings to present results of dust monitoring and effectiveness
- Staff training on dust management procedures and practices
- Minimising vegetation clearing that could create dust prone areas
- Use of blasting techniques that produce minimal dust in the mine
- Progressive rehabilitation of disturbed areas
- Visual monitoring of dust generated from pits and stockpiles
- Internal reporting of dust incidents, with external annual reporting to the Department of Environment and Conservation (DEC) and the Department of Mines and Petroleum (DMP) (with subsequent review and audit by DEC and DMP).

7. References

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Appendix A AUSPLUME Configuration File

```
1
_____________________________________________________________________

        WV03980 Parker Range Mine 2009 (0/07/2010) SMB Deposition Contour

_____________________________________________________________________
 Concentration or deposition                              Dry deposition only
 Emission load units                                      grams/second
 Deposition units                                         milligram/m2
 Units conversion factor                                  1.00E+03
 Plume depletion due to dry removal mechanisms included.
 Smooth stability class changes?                          No
 Other stability class adjustments ("urban modes")        None
 Ignore building wake effects?                            Yes
 Decay coefficient (unless overridden by met. file)       0.000
 Anemometer height                                        10 m
 Roughness height at the wind vane site                   0.100 m
 Use the convective PDF algorithm?                        No

                    DISPERSION CURVES
 Horizontal dispersion curves for sources <100m high  Pasquill-Gifford
 Vertical  dispersion  curves for sources <100m high  Pasquill-Gifford
 Horizontal dispersion curves for sources >100m high  Briggs Rural
 Vertical  dispersion  curves for sources >100m high  Briggs Rural
 Enhance horizontal plume spreads for buoyancy?       Yes
 Enhance  vertical  plume spreads for buoyancy?       Yes
 Adjust horizontal P-G formulae for roughness height? Yes
 Adjust  vertical  P-G formulae for roughness height? Yes
 Roughness height                                     0.400m
 Adjustment for wind directional shear                None

                     PLUME RISE OPTIONS
 Gradual plume rise?                                  Yes
 Stack-tip downwash included?                         Yes
 Building downwash algorithm:                        PRIME method.
 Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
 Partial penetration of elevated inversions?          No
 Disregard temp. gradients in the hourly met. file?   No

 and in the absence of boundary-layer potential temperature gradients
 given by the hourly met. file, a value from the following table
 (in K/m) is used:

    Wind Speed                 Stability Class
     Category       A      B      C      D      E      F
   ____________________________________________________________
        1         0.000  0.000  0.000  0.000  0.020  0.035
        2         0.000  0.000  0.000  0.000  0.020  0.035
        3         0.000  0.000  0.000  0.000  0.020  0.035
        4         0.000  0.000  0.000  0.000  0.020  0.035
        5         0.000  0.000  0.000  0.000  0.020  0.035
        6         0.000  0.000  0.000  0.000  0.020  0.035

 WIND SPEED CATEGORIES
 Boundaries between categories (in m/s) are:  1.54,  3.09,  5.14,  8.23, 10.80

 WIND PROFILE EXPONENTS: "Irwin Rural" values (unless overridden by met. file)
```

AVERAGING TIMES
24 hours

1

WV03980 Parker Range Mine 2009 (0/07/2010) SMB Depositon Contour

SOURCE CHARACTERISTICS

VOLUME SOURCE: DRILL1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742348	6499185	0m	1m	25m	0m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: DRILL2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742084	6498250	0m	1m	25m	0m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00

0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: DRILL3

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
741913	6497113	0m	1m	25m	0m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: BLAST1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742348	6499185	0m	5m	40m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: BLAST2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742084	6498250	0m	5m	40m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: BLAST3

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
741913	6497113	0m	5m	40m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: LOAD1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742348	6499185	0m	5m	25m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00

0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: LOAD2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742084	6498250	0m	5m	25m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: LOAD3

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
741913	6497113	0m	5m	25m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: ULDHG

```
  X(m)      Y(m)      Ground Elevation    Height    Hor. spread    Vert. spread
741440   6498424             0m             5m          40m             3m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.

                  Particle  Particle  Particle
                    Mass      Size    Density
                  fraction  (micron)  (g/cm3)
                 ___________________________
                    0.1100      1.0      1.00
                    0.0900      4.0      1.00
                    0.0800      7.0      1.00
                    0.0700      9.0      1.00
                    0.1300     12.0      1.00
                    0.1300     19.0      1.00
                    0.1300     26.0      1.00
                    0.1300     35.0      1.00
                    0.1300     45.0      1.00


                  VOLUME SOURCE: ULDLG

  X(m)      Y(m)      Ground Elevation    Height    Hor. spread    Vert. spread
741698   6498059             0m             5m          40m             3m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.

                  Particle  Particle  Particle
                    Mass      Size    Density
                  fraction  (micron)  (g/cm3)
                 ___________________________
                    0.1100      1.0      1.00
                    0.0900      4.0      1.00
                    0.0800      7.0      1.00
                    0.0700      9.0      1.00
                    0.1300     12.0      1.00
                    0.1300     19.0      1.00
                    0.1300     26.0      1.00
                    0.1300     35.0      1.00
                    0.1300     45.0      1.00


                  VOLUME SOURCE: ULDW1

  X(m)      Y(m)      Ground Elevation    Height    Hor. spread    Vert. spread
742878   6499280             0m             5m          40m             3m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.

                  Particle  Particle  Particle
```

Mass fraction	Size (micron)	Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: ULDW2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742699	6498642	0m	5m	40m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: ULDW3

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742491	6497925	0m	5m	40m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00

0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: DOZ1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742878	6499280	0m	2m	25m	1m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: DOZ2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742699	6498642	0m	2m	25m	1m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: DOZ3

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742491	6497925	0m	2m	25m	1m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: FELROM

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
741343	6498363	0m	5m	40m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: FELSTK

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
741098	6498551	0m	5m	15m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00

0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: CRUSH

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
741246	6498430	0m	10m	10m	3m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: STACK

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
741123	6498507	0m	15m	25m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: WE1

```
  X(m)      Y(m)      Ground Elevation    Height   Hor. spread   Vert. spread
742723   6499561             0m             2m        175m            1m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.

                  Particle  Particle  Particle
                    Mass      Size    Density
                  fraction  (micron)  (g/cm3)
                 ___________________________
                    0.1100      1.0      1.00
                    0.0900      4.0      1.00
                    0.0800      7.0      1.00
                    0.0700      9.0      1.00
                    0.1300     12.0      1.00
                    0.1300     19.0      1.00
                    0.1300     26.0      1.00
                    0.1300     35.0      1.00
                    0.1300     45.0      1.00


                  VOLUME SOURCE: WE2

  X(m)      Y(m)      Ground Elevation    Height   Hor. spread   Vert. spread
742559   6499016             0m             2m        175m            1m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.

                  Particle  Particle  Particle
                    Mass      Size    Density
                  fraction  (micron)  (g/cm3)
                 ___________________________
                    0.1100      1.0      1.00
                    0.0900      4.0      1.00
                    0.0800      7.0      1.00
                    0.0700      9.0      1.00
                    0.1300     12.0      1.00
                    0.1300     19.0      1.00
                    0.1300     26.0      1.00
                    0.1300     35.0      1.00
                    0.1300     45.0      1.00


                  VOLUME SOURCE: WE3

  X(m)      Y(m)      Ground Elevation    Height   Hor. spread   Vert. spread
742378   6498414             0m             2m        175m            1m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.

                  Particle  Particle  Particle
```

Mass fraction	Size (micron)	Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: WE4

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
742209	6497881	0m	2m	175m	1m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00
0.1300	35.0	1.00
0.1300	45.0	1.00

VOLUME SOURCE: WE5

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
741792	6496835	0m	2m	125m	1m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.1100	1.0	1.00
0.0900	4.0	1.00
0.0800	7.0	1.00
0.0700	9.0	1.00
0.1300	12.0	1.00
0.1300	19.0	1.00
0.1300	26.0	1.00

```
                    0.1300     35.0      1.00
                    0.1300     45.0      1.00


                  VOLUME SOURCE: WE6

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
 741394  6498475            0m             2m        225m            1m

             (Constant) emission rate = 1.00E+00 grams/second

        Hourly multiplicative factors will be used with
        this emission factor.

                  Particle  Particle  Particle
                    Mass      Size    Density
                  fraction  (micron)  (g/cm3)
                 ___________________________
                    0.1100      1.0      1.00
                    0.0900      4.0      1.00
                    0.0800      7.0      1.00
                    0.0700      9.0      1.00
                    0.1300     12.0      1.00
                    0.1300     19.0      1.00
                    0.1300     26.0      1.00
                    0.1300     35.0      1.00
                    0.1300     45.0      1.00

 ____________________________________________________________________________

1     ____________________________________________________________________

        WV03980 Parker Range Mine 2009 (0/07/2010) SMB Deposition Contour

                              RECEPTOR LOCATIONS

      ____________________________________________________________________

 The Cartesian receptor grid has the following x-values (or eastings):
 739500.m  739750.m  740000.m  740250.m  740500.m  740750.m  741000.m
 741250.m  741500.m  741750.m  742000.m  742250.m  742500.m  742750.m
 743000.m  743250.m  743500.m  743750.m  744000.m  744250.m  744500.m

 and these y-values (or northings):
6495000.m 6495250.m 6495500.m 6495750.m 6496000.m 6496250.m 6496500.m
6496750.m 6497000.m 6497250.m 6497500.m 6497750.m 6498000.m 6498250.m
6498500.m 6498750.m 6499000.m 6499250.m 6499500.m 6499750.m 6500000.m
6500250.m 6500500.m 6500750.m 6501000.m

 ____________________________________________________________________________

 METEOROLOGICAL DATA : TAPM Generated Southern Cross Met 2009 smb 07/07/201
0

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              HOURLY VARIABLE EMISSION FACTOR INFORMATION
              -------------------------------------------

 The input emission rates specfied above will be multiplied by hourly varying
```

```
factors entered via the input file:
D:\Ausplume\WV03980\Modelling\Mine\Deposition\Base\ParkerRangeMineEmissions_TS
For each stack source, hourly values within this file will be added to each
declared exit velocity (m/sec) and temperature (K).

Title of input hourly emission factor file is:
Parker Range TSP Emissions smb 07/07/2010

             HOURLY EMISSION FACTOR SOURCE TYPE ALLOCATION
             ---------------------------------------------

Prefix DRILL1 allocated: DRILL1
Prefix DRILL2 allocated: DRILL2
Prefix DRILL3 allocated: DRILL3
Prefix BLAST1 allocated: BLAST1
Prefix BLAST2 allocated: BLAST2
Prefix BLAST3 allocated: BLAST3
Prefix LOAD1  allocated: LOAD1
Prefix LOAD2  allocated: LOAD2
Prefix LOAD3  allocated: LOAD3
Prefix ULDHG  allocated: ULDHG
Prefix ULDLG  allocated: ULDLG
Prefix ULDW1  allocated: ULDW1
Prefix ULDW2  allocated: ULDW2
Prefix ULDW3  allocated: ULDW3
Prefix DOZ1   allocated: DOZ1
Prefix DOZ2   allocated: DOZ2
Prefix DOZ3   allocated: DOZ3
Prefix FELROM allocated: FELROM
Prefix FELSTK allocated: FELSTK
Prefix CRUSH  allocated: CRUSH
Prefix STACK  allocated: STACK
Prefix WE1    allocated: WE1
Prefix WE2    allocated: WE2
Prefix WE3    allocated: WE3
Prefix WE4    allocated: WE4
Prefix WE5    allocated: WE5
Prefix WE6    allocated: WE6
```

Appendix B Approach to the Use of Modelled Meteorological Data

The Australian Bureau of Meteorology (BoM) maintains a meteorological station at the Southern Cross Airfield. Data available from this site that is useful for modelling in AUSPLUME include temperature, wind speed and wind direction. It does not however have a record of cloud observations, which are required for calculating the hourly Pasquill-Gifford stability classes and mixing heights. This necessitated the use of generated meteorological data for this assessment.

The Air Pollution Model (TAPM) (ver4.0.3) has been used to generate the time series meteorological data required by AUSPLUME. TAPM is a prognostic, three-dimensional model designed by CSIRO that can be used to predict meteorological and air pollution parameters on an hourly basis (Physick & Blockley 2001). TAPM incorporates synoptic analysis data provided by CSIRO to generate local meteorological data for dispersion modelling. TAPM calculates the interaction between the synoptic winds in the provided data and the local environmental conditions defined in the model to generate representative meteorological events over the defined time period.

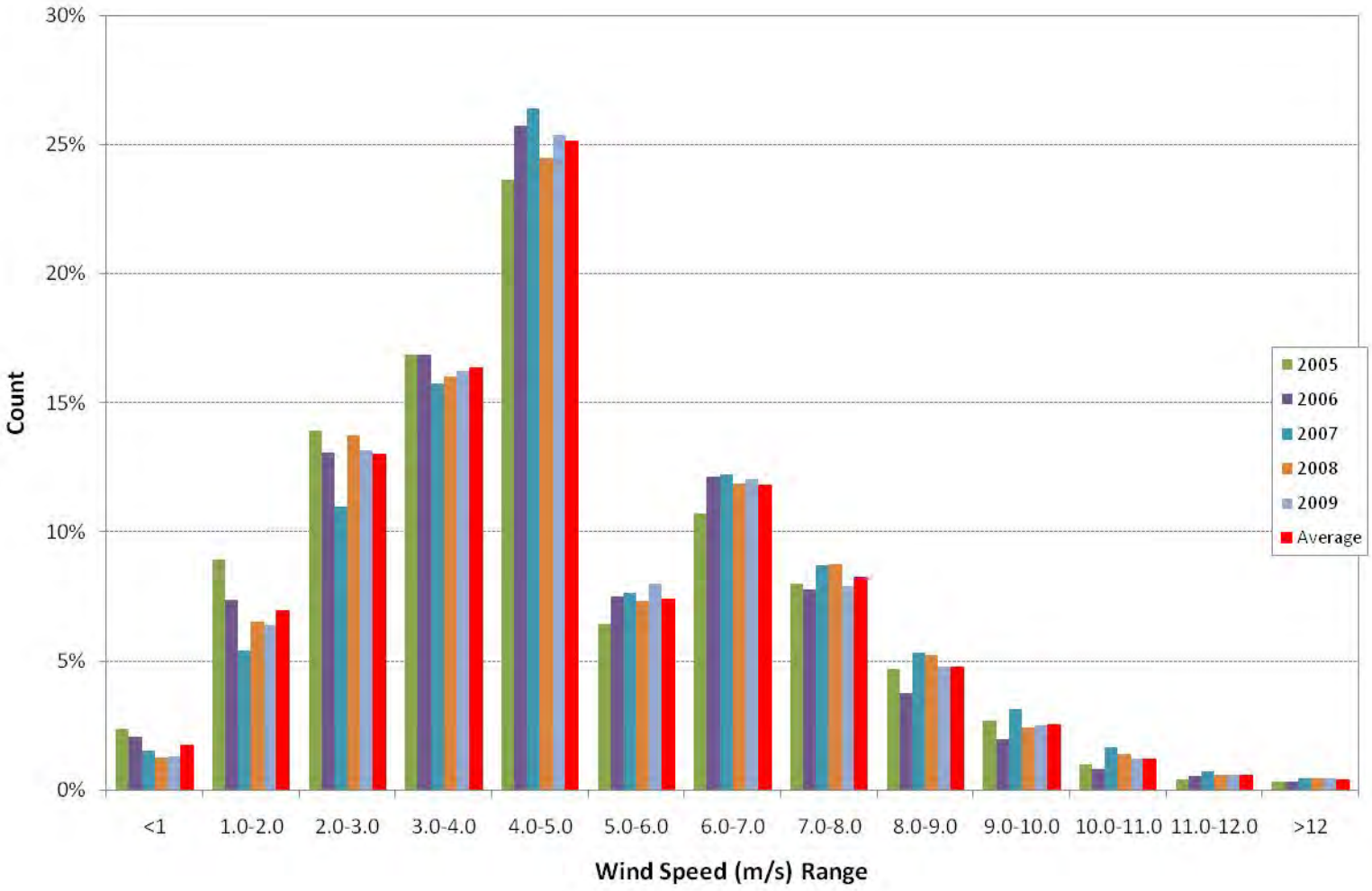
TAPM is able to solve approximations to fundamental fluid dynamics and scalar transport equations. It can predict meteorology and pollutant concentration for a range of pollutants. The model predicts flows that are of importance to local-scale air pollution such as sea breezes and terrain induced flows. TAPM solves momentum equations for horizontal wind components, the incompressible continuity equation for vertical velocity, and scalar equations for potential virtual temperature and specific humidity of water vapour. The turbulence terms in the equations are determined solving equations of turbulent kinetic energy and eddy dissipation rate. The vegetative canopy, soil scheme and urban schemes are also included at the surface and radiative fluxes at surface and upper levels (Hurley 2005).

The TAPM land/sea database was derived from the 9” Digital Elevation Model (DEM) data (Geoscience Australia 2002). This data provides an accurate representation of: the topographical elevation above sea level, the land use category and the vegetation and soil types of the region.

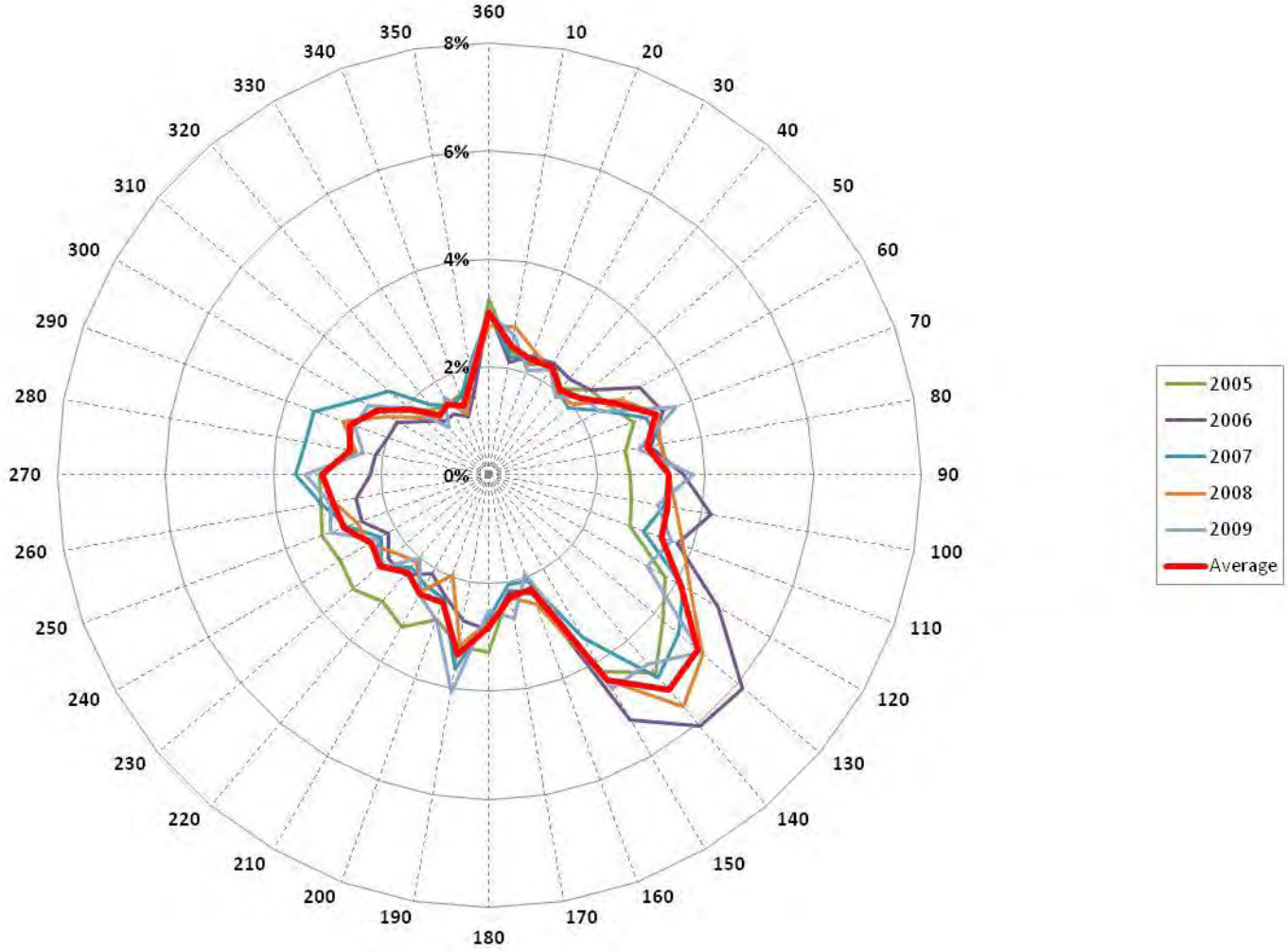
TAPM set-up is as follows:

- All grids were centred about 119°21.5’E and 31°14’S, which corresponds to 724410 E and 6541830 N in Map Grid Australia 94 (MGA94) Zone 50 coordinates.
- Four grid domains (30 km, 10 km, 3 km and 1 km) with 31 by 31 cells per domain.
- Standard 25 vertical levels from 10 metres to 8,000 metres in height.
- All output from model runs allowed two “wind up” days for the model to initialise.

The 2009 calendar year was chosen as it represents the most recent available calendar year. To determine if this year was representative of regional meteorology five years of BoM data (2005 to 2009) from Southern Cross Airfield were compared. The wind speeds and direction were categorised into speed and direction ranges and a normalised wind speed histogram (**Figure B-1**) and wind direction radar plot (**Figure B-2**) produced. There are minimal visual differences between the years, with 2009 showing a reasonable mean when compared to other years.



- **Figure B-1 Wind speed histogram (2005-2009) extracted from Southern Cross Airfield BoM data**

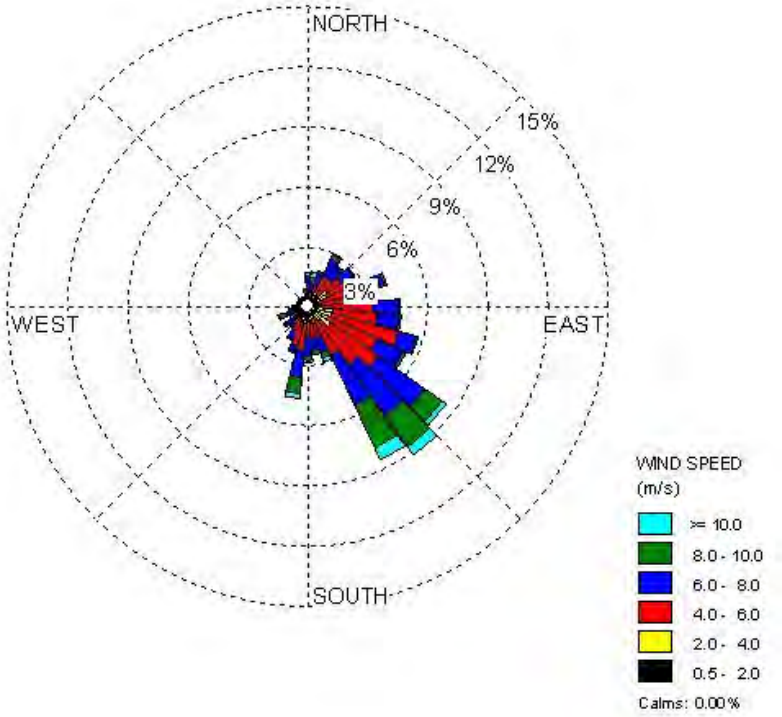


- **Figure B-2 Wind direction radar plot (2005-2009) extracted from Southern Cross Airfield BoM data**

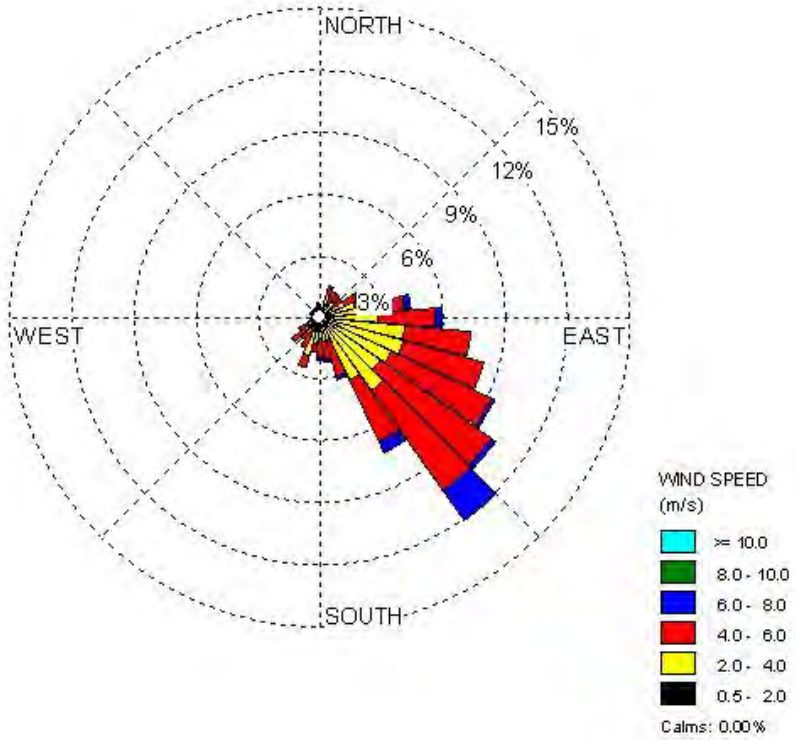
To confirm that the meteorological year modelled was representative the wind roses of the 2009 Southern Cross Airfield meteorology and the TAPM generated meteorology at the same location. The quarterly wind roses for the actual and generated meteorology are presented side by side in **Figure B-3** through **Figure B-10**.

For the summer and spring TAPM generated data shows a reasonable visual correlation of wind direction to BoM recorded data. Wind directions predicted by TAPM during autumn and winter show agree with the general direction recorded by the BoM station, however it lacks the spread; it is more focused in single directions than what has actually occurred.

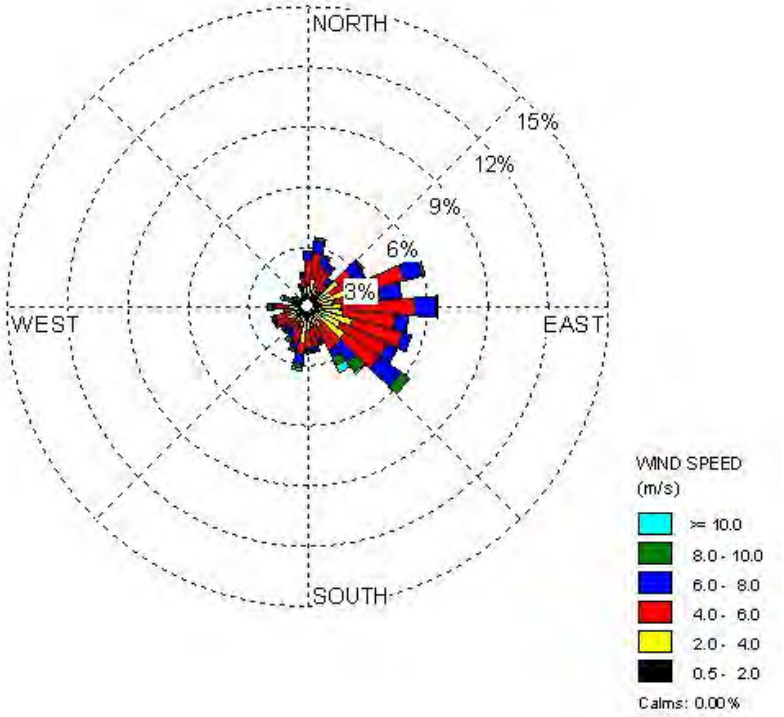
TAPM generated meteorology also displays consistently lower wind speeds when compared to BoM data, with no wind speeds above 10 m/s predicted. This does not compare favourably against BoM recorded data which indicates wind speeds 10 m/s or greater at all times of year. However, as low winds speeds can cause AUSPLUME to predict higher concentrations downwind, this may lead to conservative modelling results.



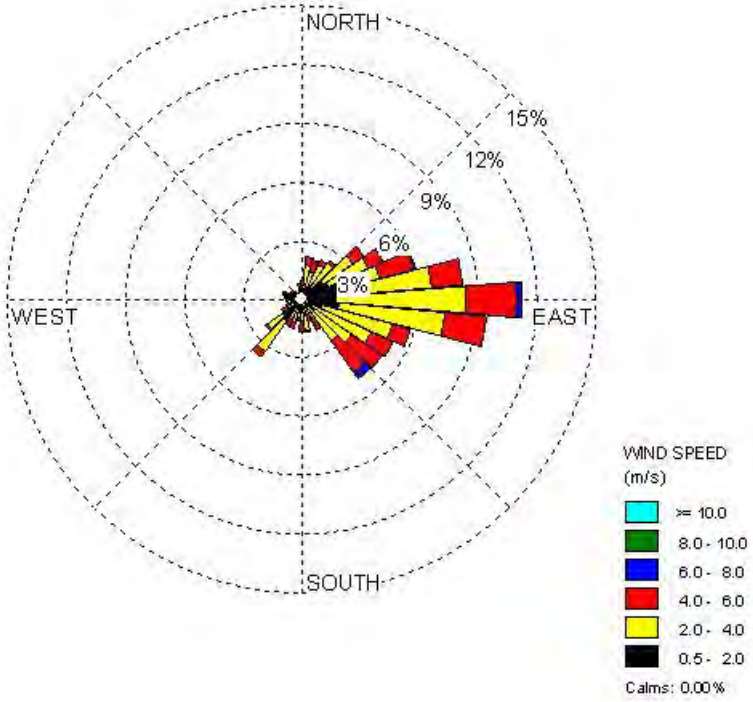
- **Figure B-3 Summer 2009 BoM wind rose**



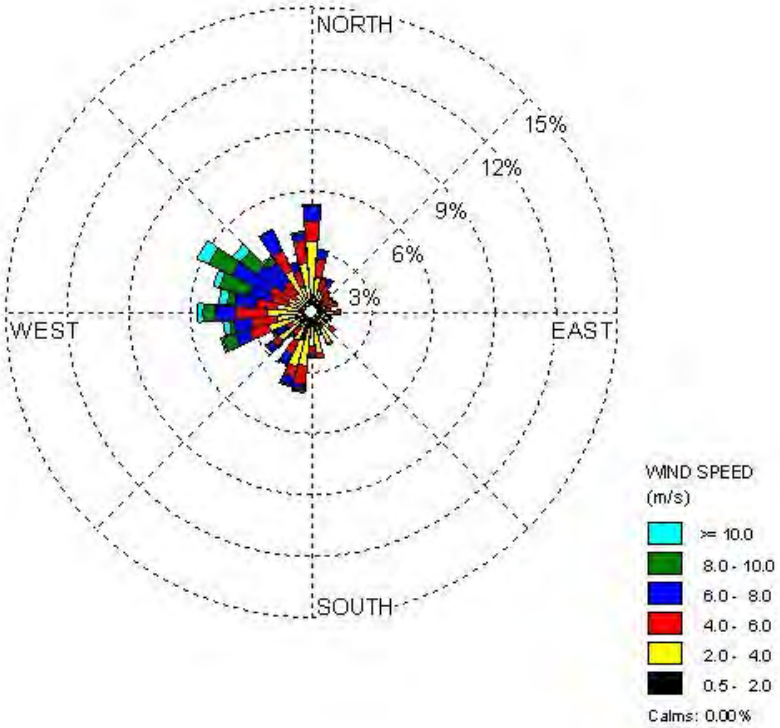
- **Figure B-4 Summer 2009 TAPM wind rose**



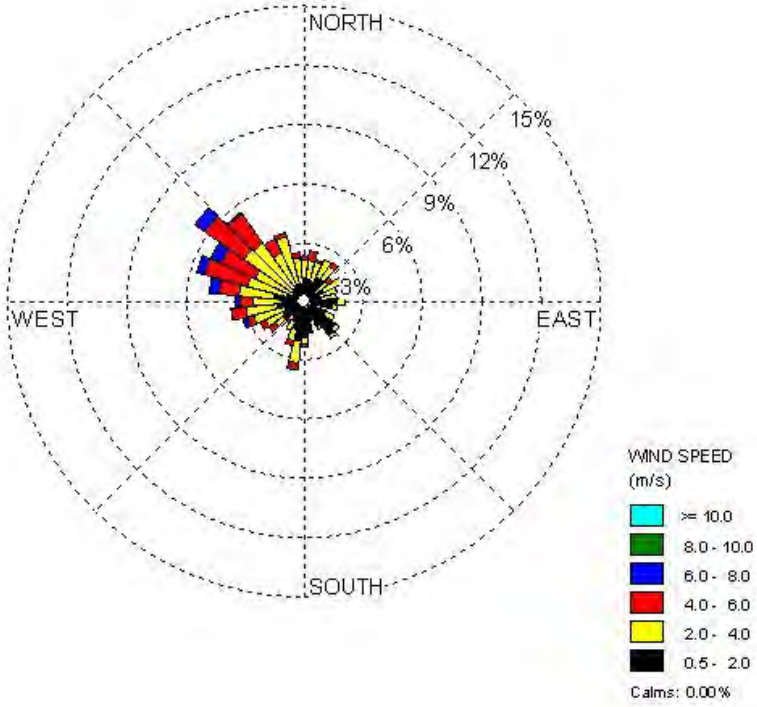
- **Figure B-5 Autumn 2009 BoM wind rose**



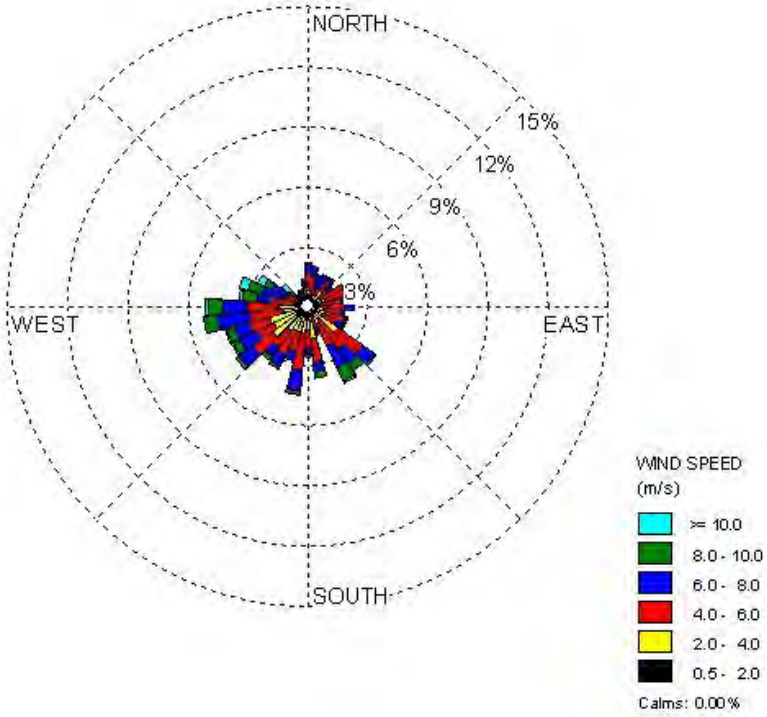
- **Figure B-6 Autumn 2009 TAPM wind rose**



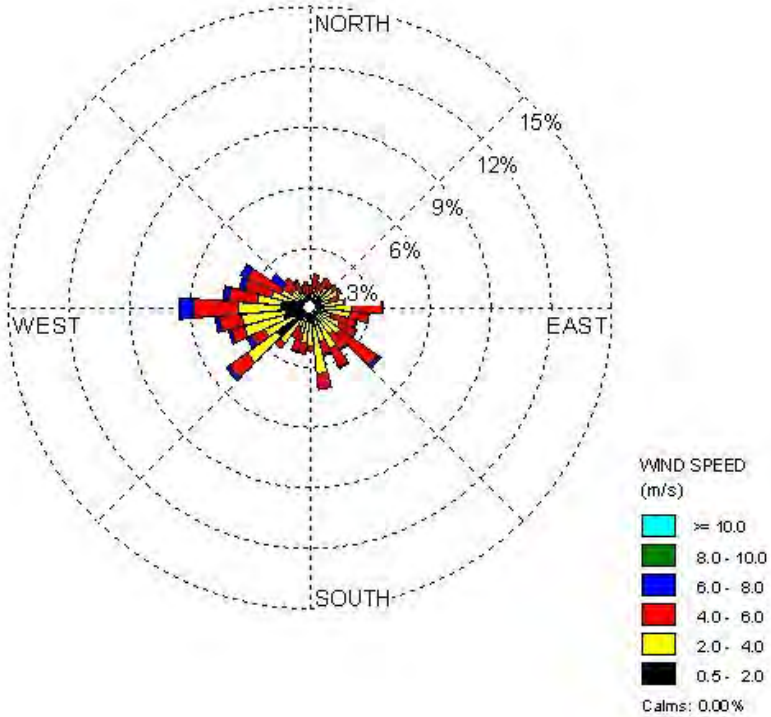
- **Figure B-7 Winter 2009 BoM wind rose**



- **Figure B-8 Winter 2009 TAPM wind rose**



- **Figure B-9 Spring 2009 BoM wind rose**



- **Figure B-10 Spring 2009 TAPM wind rose**

A further comparison of the statistics between the TAPM predicted meteorology and the BoM observations was undertaken by investigating the root mean square error (RMSE) and index of agreement (IOA) values.

RMSE is a commonly used statistical technique that determines the differences between predicted and observed values. It is commonly used in meteorology to determine how effective a model is in predicting the weather (Hurley et al 2005). The RMSE is represented as:

$$RSME = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)^2}$$

Where:
N = number of observations,
P_i are the predictions,
O_i are the observations

The lower the RMSE value the closer the model is to predicting the observed values.

The Index of Agreement (IOA) is a statistical methodology that determines the correlation of predicted and measured values. It differs from the alternative correlation coefficient (r) and coefficient of determination (r^2) in that it is a relative measure and is consistently related to the accuracy of the prediction. The IOA is represented as:

$$IOA = 1 - \frac{\sum_{i=1}^{N}(P_i - O_i)^2}{\sum_{i=1}^{N}(|P_i - O_{mean}| + |O_i - O_{mean}|)^2}$$

Where:
N = number of observations,
P_i are the predictions,
O_i are the observations

An IOA of 1 indicates perfect agreement while an IOA of 0 indicates no agreement.

From **Table B-** the average temperatures predicted by TAPM are close to BoM recordings, varying by 0.9°C. This is further confirmed by a low RMSE and a high IOA. The difference in the average wind speeds in **Table B-** shows TAPM is slightly under-predicting the wind speed, though the RMSE and IOA values indicate an acceptable level of agreement between the TAPM predicted wind speed and the BoM observations (Hurley et al 2005).

Table B-1 Summary of statistics of TAPM predictions

Parameter	Average		Standard Deviation		RMSE	IOA
	Predicted	Observed	Predicted	Observed		
Temperature	16.9	17.8	7.2	8.7	4.7	0.91
Wind Speed	3.2	4.8	1.5	2.3	3.0	0.76

References

Geoscience Australia (2002). *9 Second DEM – Digital Elevation Model of Australia version 2.1*. Data CD provided by Geoscience Australia, 2002.

Hurley, P. (2005). The Air Pollution Model (TAPM) Version 3. Part 1: Technical Description. CSIRO Atmospheric Research Technical Paper 71. CSIRO Atmospheric Research, Aspendale, Victoria.

Hurley, P., Physick, A., Luhar, A. and Edwards, M. (2005). *The Air Pollution Model (TAPM) Version 3. Part 2: Summary of some verification studies*. CSIRO Atmospheric Research Technical Paper No. 72.

Physick, W. and Blockley, A. (2001). *An Evaluation of Air Quality Models for the Pilbara Region.* http://portal.environment.wa.gov.au/pls/portal/docs/PAGE/DOE_ADMIN/PUBLICATION_REPOSITORY/PILBARAREPORT-MODELS.PDF.

Appendix C Source Emission Parameters

Table C-11 TSP emission statistics of mine sources

Source	Source ID	Max	99 Percentile	95 Percentile	90 Percentile	70 Percentile	Average
Drilling	DRILL1	1.12	1.12	1.12	1.12	1.12	0.47
	DRILL2	1.12	1.12	1.12	1.12	1.12	0.47
	DRILL3	1.12	1.12	1.12	1.12	1.12	0.47
Blasting	BLAST1	167.72	0.00	0.00	0.00	0.00	1.03
	BLAST2	167.72	0.00	0.00	0.00	0.00	1.03
	BLAST3	167.72	0.00	0.00	0.00	0.00	1.03
Loading	LOAD1	12.32	4.11	4.11	4.11	0.00	0.74
	LOAD2	12.32	4.11	4.11	4.11	0.00	0.51
	LOAD3	12.32	12.32	8.21	8.21	4.11	2.86
Unloading	ULDHG	4.70	3.13	3.13	1.57	1.57	0.78
	ULDLG	4.70	3.13	1.57	1.57	1.57	0.52
	ULDW1	1.57	1.57	0.00	0.00	0.00	0.05
	ULDW2	1.57	1.57	0.00	0.00	0.00	0.03
	ULDW3	1.57	1.57	1.57	1.57	0.00	0.18
Dozing	DOZ1	1.13	1.13	1.13	1.13	1.13	0.38
	DOZ2	1.13	1.13	1.13	1.13	0.00	0.25
	DOZ3	1.13	1.13	1.13	1.13	0.00	0.13
Front end loaders	FELROM	5.70	5.70	5.70	5.70	0.00	1.32
	FELSTK	5.70	5.70	5.70	5.70	0.00	1.32
Crushing	CRUSH	1.94	1.94	1.94	1.94	0.00	0.45
Stacking	STACK	0.82	0.82	0.82	0.82	0.00	0.19
Wind erosion	WE1	110.11	30.87	8.73	0.00	0.00	1.32
	WE2	110.11	30.87	8.73	0.00	0.00	1.32
	WE3	110.11	30.87	8.73	0.00	0.00	1.32
	WE4	110.11	30.87	8.73	0.00	0.00	1.32
	WE5	51.11	14.33	4.05	0.00	0.00	0.61
	WE6	115.17	32.29	9.13	0.00	0.00	1.38

Table C-12 TSP emission statistics of mine haulage sources

Source	Source ID	Max	99 Percentile	95 Percentile	90 Percentile	70 Percentile	Average
All haulage leaving pit 1	**VH1-1**	**0.82**	**0.31**	**0.28**	**0.28**	**0.00**	**0.04**
Pit 1 high grade ore haulage route	**VH1-2H**	**0.28**	**0.28**	**0.28**	**0.00**	**0.00**	**0.02**
	VH1-3H	**0.19**	**0.19**	**0.19**	**0.00**	**0.00**	**0.01**
	VH1-4H	**0.19**	**0.19**	**0.19**	**0.00**	**0.00**	**0.01**
Pit 1 low grade ore haulage route	**VH1-2L**	**0.31**	**0.31**	**0.00**	**0.00**	**0.00**	**0.01**
	VH1-3L	**0.20**	**0.20**	**0.00**	**0.00**	**0.00**	**0.01**
	VH1-4L	**0.20**	**0.20**	**0.00**	**0.00**	**0.00**	**0.01**
Pit 1 waste haulage route	**VH1-2W**	**0.23**	**0.23**	**0.00**	**0.00**	**0.00**	**0.01**
	VH1-3W	**0.23**	**0.23**	**0.00**	**0.00**	**0.00**	**0.01**
	VH1-4W	**0.23**	**0.23**	**0.00**	**0.00**	**0.00**	**0.01**
	VH1-5W	**0.23**	**0.23**	**0.00**	**0.00**	**0.00**	**0.01**
All haulage leaving pit 2	**VH2-1**	**0.69**	**0.28**	**0.23**	**0.00**	**0.00**	**0.02**
Pit 2 high grade ore haulage route	**VH2-2H**	**0.28**	**0.28**	**0.00**	**0.00**	**0.00**	**0.01**
	VH2-3H	**0.18**	**0.18**	**0.00**	**0.00**	**0.00**	**0.01**
	VH2-4H	**0.18**	**0.18**	**0.00**	**0.00**	**0.00**	**0.01**
Pit 2 low grade ore haulage route	**VH2-2L**	**0.18**	**0.18**	**0.00**	**0.00**	**0.00**	**0.01**
	VH2-3L	**0.24**	**0.24**	**0.00**	**0.00**	**0.00**	**0.01**
Pit 2 waste haulage route	**VH2-2W**	**0.23**	**0.23**	**0.00**	**0.00**	**0.00**	**0.00**
	VH2-3W	**0.23**	**0.23**	**0.00**	**0.00**	**0.00**	**0.00**
	VH2-4W	**0.23**	**0.23**	**0.00**	**0.00**	**0.00**	**0.00**
	VH2-5W	**0.23**	**0.23**	**0.00**	**0.00**	**0.00**	**0.00**
All haulage leaving pit 3	**VH3-1**	**0.75**	**0.52**	**0.52**	**0.47**	**0.24**	**0.14**
	VH3-2	**0.75**	**0.52**	**0.52**	**0.47**	**0.24**	**0.14**
Ore haulage leaving pit 3	**VH3-3O**	**0.52**	**0.52**	**0.52**	**0.28**	**0.24**	**0.12**
Pit 3 high grade ore haulage route	**VH3-4H**	**0.28**	**0.28**	**0.28**	**0.28**	**0.00**	**0.08**
	VH3-5H	**0.28**	**0.28**	**0.28**	**0.28**	**0.00**	**0.08**
	VH3-6H	**0.23**	**0.23**	**0.23**	**0.23**	**0.00**	**0.06**
	VH3-7H	**0.23**	**0.23**	**0.23**	**0.23**	**0.00**	**0.06**
	VH3-8H	**0.23**	**0.23**	**0.23**	**0.23**	**0.00**	**0.06**
	VH3-9H	**0.23**	**0.23**	**0.23**	**0.23**	**0.00**	**0.06**

Pit 3 low grade ore haulage route	**VH3-4L**	**0.24**	**0.24**	**0.24**	**0.24**	**0.00**	**0.04**
	VH3-5L	**0.24**	**0.24**	**0.24**	**0.24**	**0.00**	**0.04**
Pit 3 waste haulage route	**VH3-3W**	**0.23**	**0.23**	**0.23**	**0.00**	**0.00**	**0.02**
	VH3-4W	**0.23**	**0.23**	**0.23**	**0.00**	**0.00**	**0.02**
	VH3-5W	**0.21**	**0.21**	**0.21**	**0.00**	**0.00**	**0.02**
	VH3-6W	**0.21**	**0.21**	**0.21**	**0.00**	**0.00**	**0.02**
	VH3-7W	**0.21**	**0.21**	**0.21**	**0.00**	**0.00**	**0.02**

Table C-13 PM_{10} emission statistics of rail head sources

Source	Source ID	Max	99 Percentile	95 Percentile	90 Percentile	70 Percentile	Average
Unloading	**ULD1**	**2.07**	**2.07**	**2.07**	**2.07**	**0.00**	**0.24**
	ULD2	**2.07**	**2.07**	**2.07**	**2.07**	**0.00**	**0.24**
Front end loaders	**FELST1**	**2.85**	**2.85**	**2.85**	**2.85**	**0.00**	**0.60**
	FELST2	**2.85**	**2.85**	**2.85**	**2.85**	**0.00**	**0.60**
	FELTR1	**8.16**	**8.16**	**8.16**	**8.16**	**0.00**	**1.31**
Wind erosion	**WE1**	**8.33**	**2.34**	**0.66**	**0.00**	**0.00**	**0.10**
	WE2	**8.33**	**2.34**	**0.66**	**0.00**	**0.00**	**0.10**

Table C-14 TSP emission statistics of rail head sources

Source	Source ID	Max	99 Percentile	95 Percentile	90 Percentile	70 Percentile	Average
Unloading	**ULD1**	**5.82**	**5.82**	**5.82**	**5.82**	**0.00**	**0.67**
	ULD2	**5.82**	**5.82**	**5.82**	**5.82**	**0.00**	**0.67**
Front end loaders	**FELST1**	**6.06**	**6.06**	**6.06**	**6.06**	**0.00**	**1.27**
	FELST2	**6.06**	**6.06**	**6.06**	**6.06**	**0.00**	**1.27**
	FELTR1	**17.36**	**17.36**	**17.36**	**17.36**	**0.00**	**2.78**
Wind erosion	**WE1**	**23.84**	**6.68**	**1.89**	**0.00**	**0.00**	**0.29**
	WE2	**23.84**	**6.68**	**1.89**	**0.00**	**0.00**	**0.29**

Table C-15 Mine source locations and modelled dimensions

Source	Source ID	Easting (m)	Northing (m)	Horizontal spread	Height	Vertical spread
Drilling	DRILL1	742348	6499185	25.0	0.50	0.25
	DRILL2	742084	6498250	25.0	1.00	0.25
	DRILL3	741913	6497113	25.0	1.00	0.25
Blasting	BLAST1	742348	6499185	40.0	5.00	2.50
	BLAST2	742084	6498250	40.0	5.00	2.50
	BLAST3	741913	6497113	40.0	5.00	2.50
Loading	LOAD1	742348	6499185	25.0	5.00	2.50
	LOAD2	742084	6498250	25.0	5.00	2.50
	LOAD3	741913	6497113	25.0	5.00	2.50
Unloading	ULDHG	741440	6498424	40.0	5.00	2.50
	ULDLG	741698	6498059	40.0	5.00	2.50
	ULDW1	742878	6499280	40.0	5.00	2.50
	ULDW2	742699	6498642	40.0	5.00	2.50
	ULDW3	742491	6497925	40.0	5.00	2.50
Dozing	DOZ1	742878	6499280	25.0	2.00	1.00
	DOZ2	742699	6498642	25.0	2.00	1.00
	DOZ3	742491	6497925	25.0	2.00	1.00
Front end loaders	FELROM	741343	6498363	40.0	5.00	2.50
	FELSTK	741098	6498551	15.0	5.00	2.50
Crushing	CRUSH	741246	6498430	10.0	10.0	3.00
Stacking	STACK	741123	6498507	25.0	15.0	2.00
Wind erosion	WE1	742723	6499561	175	2.00	1.00
	WE2	742559	6499016	175	2.00	1.00
	WE3	742378	6498414	175	2.00	1.00
	WE4	742209	6497881	175	2.00	1.00
	WE5	741792	6496835	125	2.00	1.00
	WE6	741394	6498475	225	2.00	1.00

Table C-16 Mine vehicle source locations and modelled dimensions

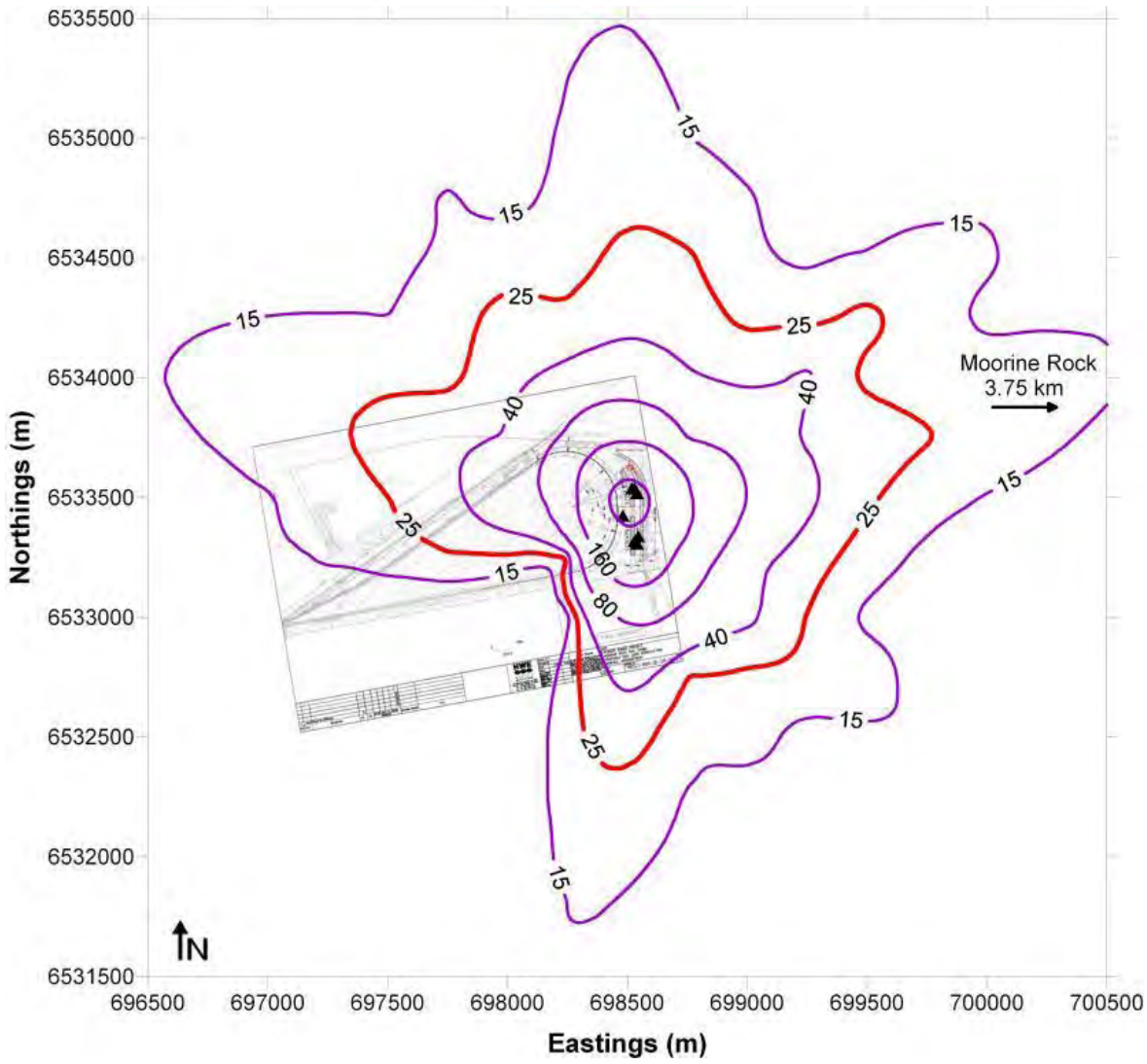
Source	Source ID	Easting (m)	Northing (m)	Horizontal spread	Height	Vertical spread
All haulage leaving pit 1	**VH1-1**	**741992**	**6498769**	**25**	**1**	**0.5**
Pit 1 high grade ore haulage route	**VH1-2H**	**741628**	**6498594**	**20**	**1**	**0.5**
	VH1-3H	**741665**	**6498473**	**20**	**1**	**0.5**
	VH1-4H	**741909**	**6498782**	**20**	**1**	**0.5**
Pit 1 low grade ore haulage route	**VH1-2L**	**741815**	**6498433**	**50**	**1**	**0.5**
	VH1-3L	**741789**	**6498186**	**50**	**1**	**0.5**
	VH1-4L	**741838**	**6498683**	**50**	**1**	**0.5**
Pit 1 waste haulage route	**VH1-2W**	**742385**	**6498574**	**50**	**20**	**0.5**
	VH1-3W	**742717**	**6498917**	**50**	**20**	**0.5**
	VH1-4W	**742578**	**6498756**	**50**	**20**	**0.5**
	VH1-5W	**742128**	**6498614**	**50**	**20**	**0.5**
All haulage leaving pit 2	**VH2-1**	**741985**	**6498393**	**25**	**1**	**0.5**
Pit 2 high grade ore haulage route	**VH2-2H**	**741759**	**6498659**	**20**	**1**	**0.5**
	VH2-3H	**741541**	**6498414**	**20**	**1**	**0.5**
	VH2-4H	**741914**	**6498404**	**20**	**1**	**0.5**
Pit 2 low grade ore haulage route	**VH2-2L**	**741771**	**6498077**	**50**	**1**	**0.5**
	VH2-3L	**741795**	**6498273**	**50**	**1**	**0.5**
Pit 2 waste haulage route	**VH2-2W**	**742288**	**6498558**	**50**	**20**	**0.5**
	VH2-3W	**742421**	**6498166**	**50**	**20**	**0.5**
	VH2-4W	**742340**	**6498350**	**50**	**20**	**0.5**
	VH2-5W	**742025**	**6498640**	**50**	**20**	**0.5**
All haulage leaving pit 3	**VH3-1**	**741867**	**6497170**	**20**	**1**	**0.5**
	VH3-2	**741716**	**6497435**	**20**	**1**	**0.5**
Ore haulage leaving pit 3	**VH3-3O**	**741761**	**6497933**	**20**	**1**	**0.5**
Pit 3 high grade ore haulage route	**VH3-4H**	**741815**	**6498433**	**20**	**1**	**0.5**
	VH3-5H	**741580**	**6498564**	**20**	**1**	**0.5**
	VH3-6H	**741721**	**6498502**	**20**	**1**	**0.5**
	VH3-7H	**741775**	**6498098**	**20**	**1**	**0.5**
	VH3-8H	**741728**	**6497598**	**20**	**1**	**0.5**
	VH3-9H	**741816**	**6497201**	**20**	**1**	**0.5**

Pit 3 low grade ore haulage route	**VH3-4L**	**741740**	**6497692**	**50**	**1**	**0.5**
	VH3-5L	**741734**	**6497217**	**50**	**1**	**0.5**
Pit 3 waste haulage route	**VH3-3W**	**742127**	**6497564**	**50**	**20**	**0.5**
	VH3-4W	**742385**	**6497881**	**50**	**20**	**0.5**
	VH3-5W	**742248**	**6497753**	**50**	**20**	**0.5**
	VH3-6W	**741921**	**6497513**	**50**	**20**	**0.5**
	VH3-7W	**741694**	**6497226**	**50**	**20**	**0.5**

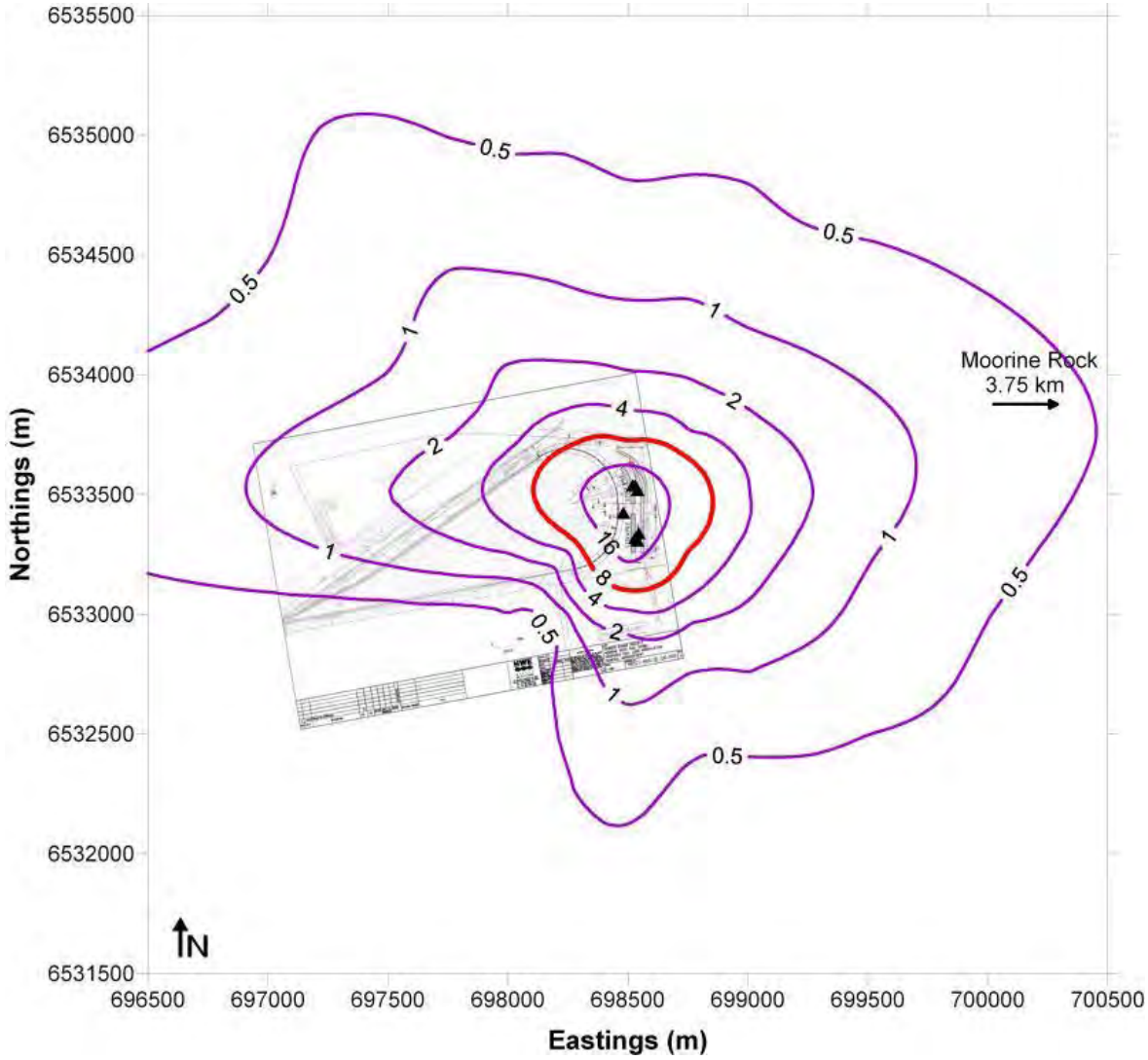
Table C-17 Rail head source locations and modelled dimensions

Source	Source ID	Easting (m)	Northing (m)	Horizontal spread	Height	Vertical spread
Unloading	**ULD1**	**698540**	**6533300**	**20**	**2**	**1**
	ULD2	**698530**	**6533530**	**20**	**2**	**1**
Front end loaders	**FELST1**	**698545**	**6533330**	**20**	**2**	**1**
	FELST2	**698540**	**6533510**	**20**	**2**	**1**
	FELTR1	**698480**	**6533415**	**20**	**2**	**1**
Wind erosion	**WE1**	**698530**	**6533310**	**50**	**2**	**1**
	WE2	**698520**	**6533530**	**50**	**2**	**1**

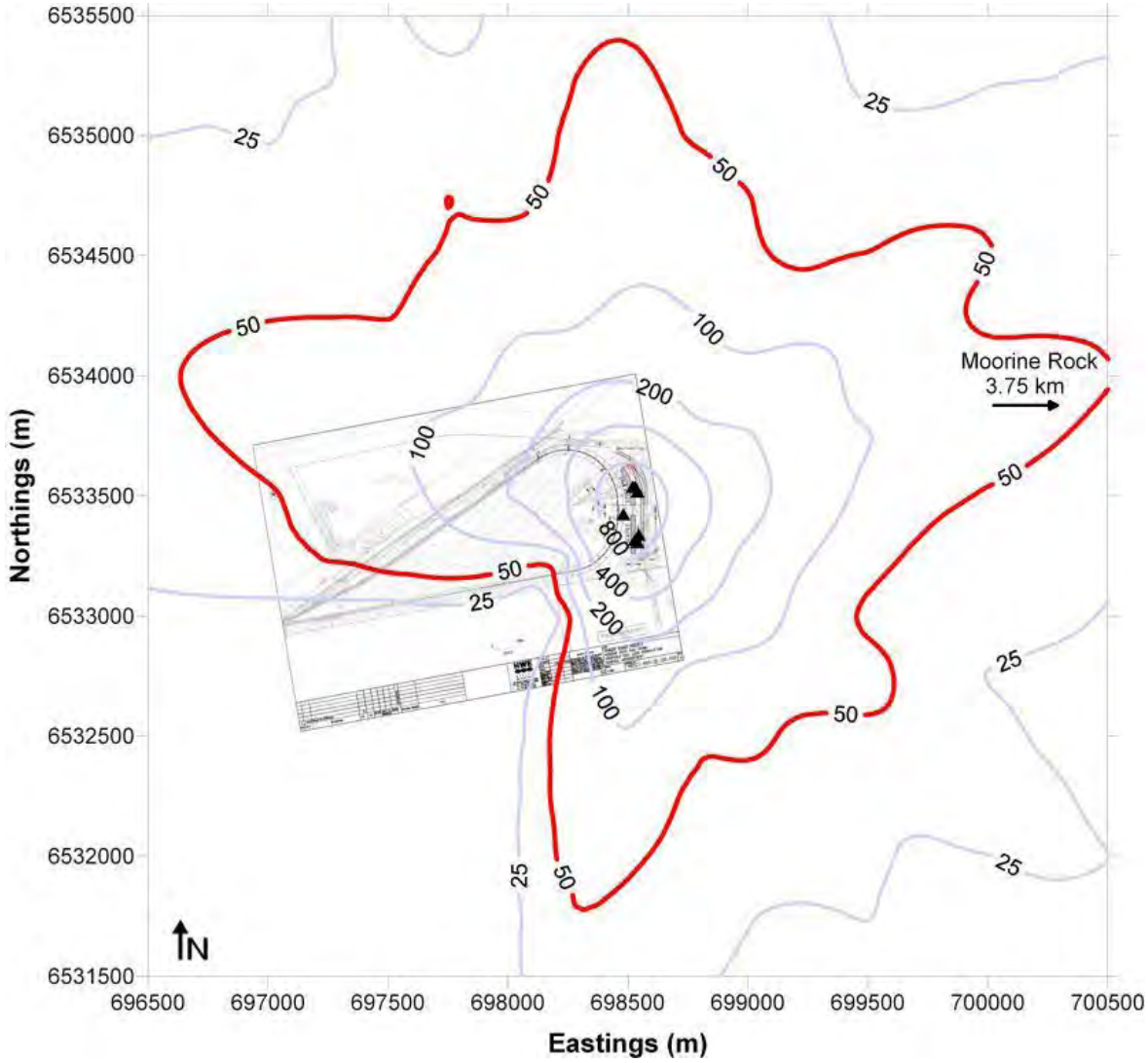
Appendix D Contour Plots of Modelled Concentrations and Deposition Rates Along the Haul Road and at the Rail Head



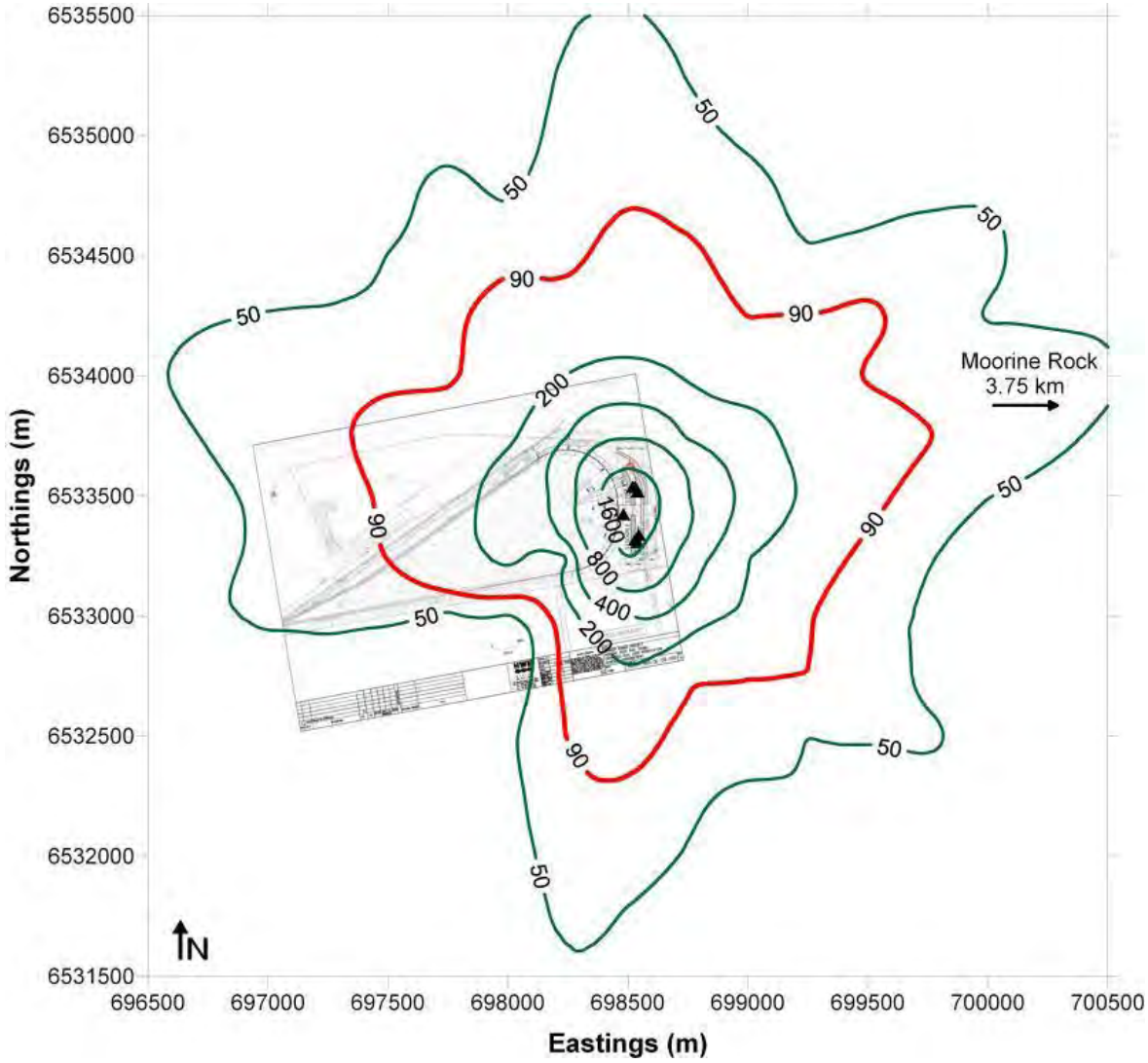
- **Figure D-1 Rail head $PM_{2.5}$ 24 hour averaged maximum predicted concentrations. MGA 94 Zone 50 Coordinates.**



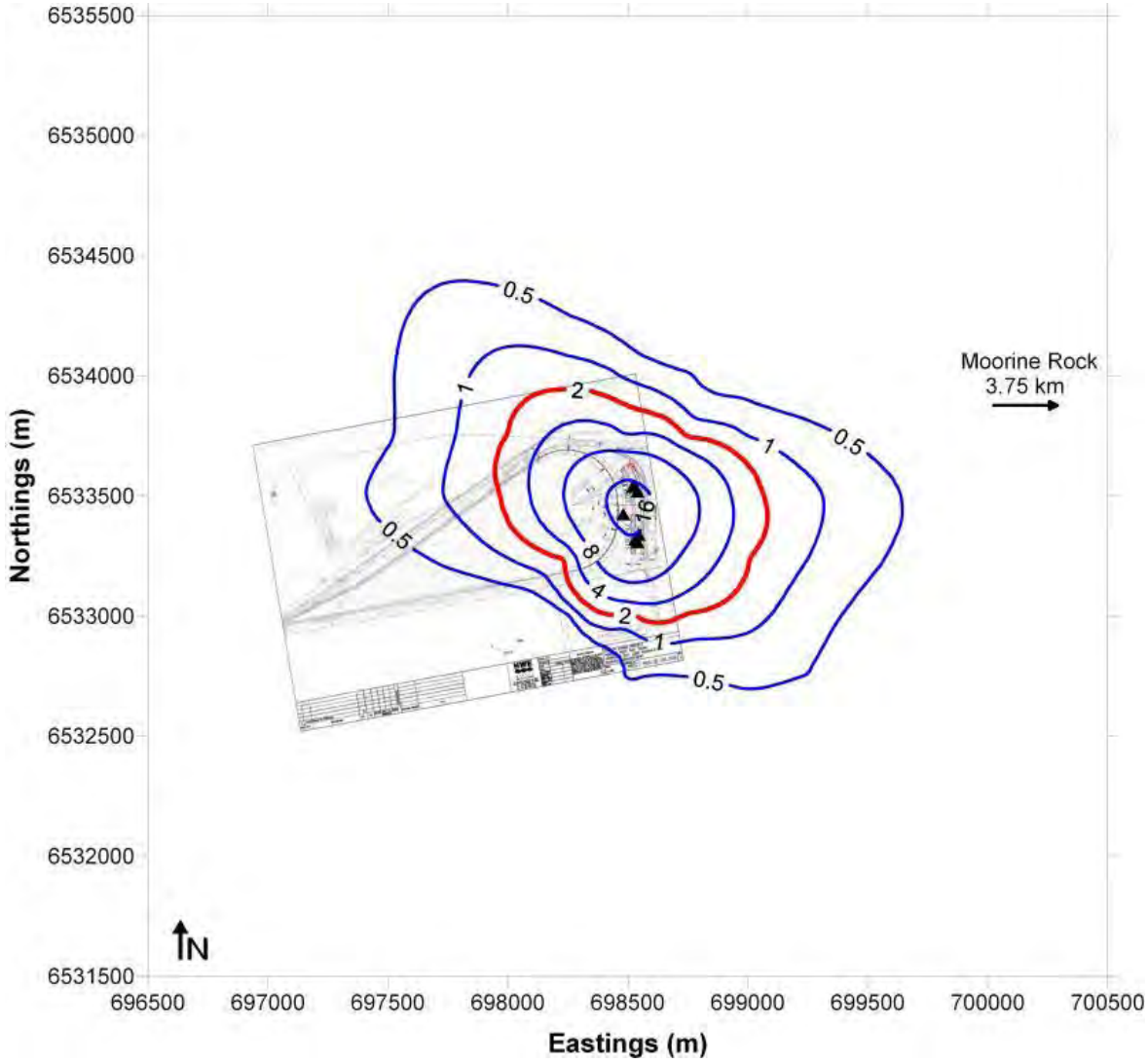
- **Figure D-2 Rail head $PM_{2.5}$ annual average predicted concentrations. MGA 94 Zone 50 Coordinates.**



- **Figure D-3 Rail head PM_{10} 24 hour averaged maximum predicted concentrations. MGA 94 Zone 50 Coordinates.**



- **Figure D-5 Rail head TSP 24 hour averaged maximum predicted concentrations MGA 94 Zone 50 Coordinates.**



- **Figure D-6 Rail head maximum monthly predicted dust deposition. MGA 94 Zone 50 Coordinates.**

Appendix E Dust Deposition Results – Winter (July 2010)

Project: Cazaly **Job Number:** PE051557

Method Name	**Analyte Name**	**Units**	**Reporting Limit**
Dust in Air (Deposited Matter)	Total Solids	MG	1
		Funnel area m2 (150 mm Dia)	0.017671459

Moorine Rock Dust Deposition Gauges					
No.	**Site Name**	**Gauge #**	**GPS Coordinates**	**Result**	**g/m2/month**
1	Liddell Road	DDG#1	Lat = 31°18'55.34"S Long = 119° 5'5.20"E	27	1.528
2	Maddock Residence	DDG#2	Lat = 31°19'13.54"S Long = 119° 4'56.97"E	29	1.641
3	Lot 59, Stephen/Nicholson	DDG#3	Lat = 31°19'55.48"S Long = 119° 7'20.97"E	21	1.188
4	K Stephen Residence	DDG#4	Lat = 31°19'17.84"S Long = 119° 7'23.98"E	46	2.603
5	G Nicholson Residence	DDG#5	Lat = 31°19'14.68"S Long = 119° 7'42.31"E	23	1.302
6	Nicholson - Parker Range Road Intersection	DDG#6	Lat = 31°19'53.11"S Long = 119° 8'21.37"E	65	3.678
7	Lot 272, Gobbetti	DDG#7	Lat = 31°27'1.69"S Long = 119°16'10.66"E	38	2.150
8	H - Blue Roof House	DDG#8	Lat = 31°28'10.36"S Long = 119°18'35.78"E	91	5.150
9	Lot 425	DDG#9	Lat = 31°31'58.82"S Long = 119°24'21.14"E	40	2.264
10	Lot 453, R Patroni	DDG#10	Lat = 31°34'43.92"S Long = 119°29'2.18"E	43	2.433
11	PRMS - Site Access	DDG#11	Lat = 31°37'45.68"S Long = 119°32'57.10"E	350	19.806
12	PRMS - Haul Road	DDG#12	Lat = 31°37'25.18"S Long = 119°33'2.80"E	17	0.962

Appendix F PM_{10} 24Hrs Averages – Winter (July 2010)

Date/Time	CBH Site PM_{10} µg/m³	School Site PM_{10} µg/m³	WS m/s	WD deg	Ambient Temp °C	Rack Temp °C
02/07/10						
03/07/10	6.0	5.3	1.1	197	9.6	31.1
04/07/10	6.2	4.8	1.3	189	9.5	31.1
05/07/10	3.0	3.4	1.2	150	10.5	31.3
06/07/10	4.6	5.6	0.6	134	10.4	31.3
07/07/10	3.9	4.8	0.5	24	10.5	31.0
08/07/10	6.4		1.3	344	13.9	30.7
09/07/10	4.4		3.3	289	9.6	30.7
10/07/10	5.9		2.0	295	9.8	31.1
11/07/10	4.0		1.9	324	11.8	31.0
12/07/10	7.4		3.3	290	10.4	30.7
13/07/10	8.9		1.2	263	9.8	31.2
14/07/10	7.0		0.2	236	10.6	31.3
15/07/10	5.5		0.3	32	10.9	31.1
16/07/10	6.7		0.3	302	13.3	30.8
17/07/10	5.8	5.0	1.3	178	11.1	31.2
18/07/10	7.5	6.0	1.1	193	10.0	31.4
19/07/10	6.8	5.8	1.1	179	11.5	31.2
20/07/10	4.5	4.6	1.4	140	12.6	31.2
21/07/10	4.9	5.3	0.6	121	11.5	31.2
22/07/10	4.5	4.9	0.3	84	11.4	31.1
23/07/10	4.9	5.4	0.6	138	11.9	31.1
24/07/10	4.3	4.4	0.4	49	11.3	31.1
25/07/10	4.0	4.2	0.7	27	12.5	30.9
26/07/10	9.8	5.9	0.7	303	13.4	30.8
27/07/10	8.9	5.7	1.2	289	13.8	30.7
28/07/10	7.0	4.8	2.1	287	13.2	30.6
29/07/10						
30/07/10						
31/07/10						
Average	**5.9**	**5.1**				
Peak	**9.8**	**6.0**				
Low	**3.0**	**3.4**				

Appendix G Dust Deposition Results – Summer (January – February 2011)

Project: Cazaly **Job Number:** PE055564

Method Name	**Analyte Name**	**Units**	**Reporting Limit**
Dust in Air (Deposited Matter)	Total Solids	MG	1
		Funnel area m2 (150 mm Dia)	0.017671459

Moorine Rock Dust Deposition Gauges					
No.	**Site Name**	**Gauge #**	**GPS Coordinates**	**Result**	**g/m2/month**
1	Liddell Road	DDG#1	Lat = 31°18'55.34"S Long = 119° 5'5.20"E	81	4.584
2	Maddock Residence	DDG#2	Lat = 31°19'13.54"S Long = 119° 4'56.97"E	85	4.810
3	Lot 59, Stephen/Nicholson	DDG#3	Lat = 31°19'55.48"S Long = 119° 7'20.97"E	24	1.358
4	K Stephen Residence	DDG#4	Lat = 31°19'17.84"S Long = 119° 7'23.98"E	46	2.603
5	G Nicholson Residence	DDG#5	Lat = 31°19'14.68"S Long = 119° 7'42.31"E	87	4.923
6	Nicholson - Parker Range Road Intersection	DDG#6	Lat = 31°19'53.11"S Long = 119° 8'21.37"E	N/A	N/A
7	Lot 272, Gobbetti	DDG#7	Lat = 31°27'1.69"S Long = 119°16'10.66"E	N/A	N/A
8	H - Blue Roof House	DDG#8	Lat = 31°28'10.36"S Long = 119°18'35.78"E	130	7.356
9	Lot 425	DDG#9	Lat = 31°31'58.82"S Long = 119°24'21.14"E	61	3.452
10	Lot 453, R Patroni	DDG#10	Lat = 31°34'43.92"S Long = 119°29'2.18"E	40	2.264
11	PRMS - Site Access	DDG#11	Lat = 31°37'45.68"S Long = 119°32'57.10"E	38	2.150
12	PRMS - Haul Road	DDG#12	Lat = 31°37'25.18"S Long = 119°33'2.80"E	45	2.546

Appendix H PM$_{10}$ 24 Hrs Averages – Summer (January – February 2011)

Date/Time	CBH Site PM$_{10}$ µg/m³	School Site PM$_{10}$ µg/m³	WS m/s	WD deg	Ambient Temp °C	Rack Temp °C
01/01/11		14.2				
02/01/11	9.3	15.8			31.3	28.6
03/01/11	13.9	20.0			32.7	28.7
04/01/11						
05/01/11						
06/01/11						
07/01/11	11.2		2.4	232	23.5	30.4
08/01/11	13.9	12.8	1.8	128	26.3	29.9
09/01/11	13.8		1.7	116	28.5	30.1
10/01/11	15.1		2.9	136	28.2	30.9
11/01/11	15.2		2.7	134	26.4	30.7
12/01/11	10.4	10.7	1.1	83	28.2	30.3
13/01/11	35.8		0.8	347	32.0	30.3
14/01/11	18.7		2.2	238	25.6	29.8
15/01/11	24.0		3.2	146	25.5	30.3
16/01/11	21.4		2.5	129	27.4	29.9
17/01/11	16.8		0.6	51	31.5	31.0
18/01/11	25.9	27.1	1.6	188	30.8	29.9
19/01/11	22.8	21.2	1.1	229	30.8	30.7
20/01/11	19.0	18.3	3.5	160	27.0	30.6
21/01/11	16.9	20.1	1.1	106	29.3	30.2
22/01/11	38.7	29.7	0.6	12	33.1	29.2
23/01/11	11.9	10.8	2.9	147	26.3	31.1
24/01/11	11.8	14.5	1.5	189	26.4	31.0
25/01/11	4.5	6.7	2.4	154	24.5	30.3
26/01/11	14.7		1.3	154	31.0	30.8
27/01/11	12.5		2.0	115	31.4	31.1
28/01/11	21.4	24.0	1.2	20	38.7	31.0
29/01/11						
30/01/11	108.4	94.5	0.6	315	33.7	30.6
31/01/11	21.7	22.0	2.3	185	29.1	29.7
01/02/11	8.3	10.0	2.6	133	26.5	30.4
02/02/11	25.0	29.9	2.1	139	29.2	30.2
03/02/11	14.4	14.9	1.8	122	29.0	30.9
04/02/11	66.1	31.7	3.5	162	28.6	31.6
05/02/11	57.4	20.9	5.9	140	22.1	31.9
06/02/11	13.4	12.8	1.9	121	22.2	30.1
Average	**22.9**	**21.9**				
Peak	**108.4**	**94.5**				
Low	**4.5**	**6.7**				

Appendix 7: Targeted Survey for Western Rosella at Mt Caudan Within the Parker Range Region

Keith Lindbeck and Associates (April 2011)

Keith Lindbeck and Associates
Environmental Management Consultants
ABN 36 150 274 469

CAZALY RESOURCES LTD

PARKER RANGE IRON ORE PROJECT

TARGETED SURVEY FOR WESTERN ROSELLA AT MT CAUDAN WITHIN THE PARKER RANGE REGION

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April 2011

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 BACKGROUND 1
1.2 PURPOSE 1

2.0 THE SPECIES 3

2.1 DESCRIPTION OF THE SPECIES 3
2.2 GENERAL ECOLOGY 3
2.3 DISTRIBUTION OF THE WESTERN ROSELLA 4
2.4 WESTERN ROSELLA CONSERVATION STATUS 4

3.0 PROJECT BACKGROUND 6

3.1 LOCATION 6
3.2 EXISTING ENVIRONMENT 6
3.2.1 Interim Biogeographic Regionalisation of Australia Region 6
3.2.2 Flora and Vegetation Mapping 6

4.0 METHODOLOGY 9

4.1 TARGETED WESTERN ROSELLA SURVEY 9
4.2 PERSONNEL AND REPORTING 10
4.3 LICENCE AND PERMITS 10
4.4 LIMITATIONS 10

5.0 RESULTS 12

6.0 CONCLUSIONS 17

7.0 REFERENCES 18

TABLES

Table 1 - Descriptions of areas surveyed 9
Table 2 - Areas surveyed, number of potential hollows recorded and potential number of hollows to be disturbed 14
Table 3 - Vegetation Communities in the Parker Range Priority Ecological Community and amount (ha and %) impacted in the Mt Caudan Project area. The amount of vegetation communities surveyed (ha) is included. 15

FIGURES

Figure 1 - Location of Parker Range Iron Ore Project 2
Figure 2 - Distribution of the Western Rosella in Western Australia showing the inland subspecies (*P. i. xanthogenys*) and the south-west subspecies (*P. i. icterotis*) (DEC 2009) 5
Figure 3 - Outline (---) of proposed mining infrastructure and vegetation communities in the Mt Caudan Project Area 8
Figure 4 - Locations of Western Rosella survey areas and potential breeding hollows in the Parker Range Project Area 11
Figure 5 - Vegetation Communities in the Parker Range Priority Ecological Community 16

APPENDIX A GPS locations and number of hollows at 100m intervals along survey routes 19

1.0 INTRODUCTION

1.1 BACKGROUND

Cazaly Resources Limited (Cazaly) proposes to develop an Iron Ore mining operation in the Parker Range area (Figure 1). Cazaly is seeking approval for the iron ore operation under Part IV of the *Environmental Protection Act 1986* (EP Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). On 21 September 2009, the Environmental Protection Authority (EPA) determined that the level of assessment for the proposal would be a Public Environmental Review (PER). The PER was released for public comment between 29 November 2010 to 10 January 2011, with Cazaly invited to respond to public submissions received by the Office of the EPA (OEPA). One response (Cazaly's response document submission number 8 issue 10) states that OEPA does not consider that Cazaly has adequately addressed the management of the potential impact of the mining proposal on the Threatened Western Rosella *Platycercus icterotis*. Targeted breeding habitat surveys were recommended to be undertaken to assist in avoidance of breeding hollows.

In response to this recommendation, Cazaly commissioned Keith Lindbeck and Associates (KLA) to undertake a targeted survey to determine the presence of potential breeding hollows for the Western Rosella in the proposed area of impact.

Comprehensive seasonal fauna surveys were conducted in the Parker Range Project Area in September 2008, May 2009 and October 2009 in accordance with EPA statements and guidelines (EPA 2002, 2004a) (KLA 2010). In addition, numerous Level 1 surveys and other targeted surveys have been conducted in the area (KLA 2010). During all surveys, including opportunistic observations, only two individual Western Rosella were sighted during the Autumn 2009 survey on a laterite ridge (31°36'57"S 119°33'19"E) (KLA 2010). No other Western Rosella were seen or heard during all other surveys.

1.2 PURPOSE

This document has been prepared to provide the results of the targeted Western Rosella search and breeding habitat survey, to satisfy the recommendation from the OEPA to determine the presence and extent of Western Rosella breeding habitat in the Mt Caudan Project area.

Figure 1 - Location of Parker Range Iron Ore Project

2.0 THE SPECIES

2.1 DESCRIPTION OF THE SPECIES

Western Rosella *Platycercus icterotis (*Temminck and Kuhl, 1820) are a medium size parrot belonging to the Psittacidae family. This rosella is predominantly red with yellow cheek patches and the back feathers are usually black with green margins (Plate 1). Females are generally duller than the males with the head and breast mostly green (Morcombe 2003, DEC 2009). Colour variation exists between the coastal (*Platycercus icterotis icterotis)* and inland sub-species (*Platycercus icterotis xanthogenys)* with the upper back feathers varying between black with green margins and black with red margins respectively. Western Rosellas are quiet and unobtrusive birds with a clear melodious 'pink pink' or 'ching ching' voice (Johnstone and Storr 1998, Morcombe 2003).

Plate 1 - Western Rosella (inland spp.) (*Platycercus icterotis xanthogenys*)

2.2 GENERAL ECOLOGY

The Western Rosella primarily inhabits eucalypt and casuarina woodlands and favours Salmon Gum, Wandoo and tall mallees (Johnstone and Storr 1998). This species nests in tree hollows, with favoured nesting trees including Salmon Gum (*Eucalyptus salmonophloia*), Gimlet (*E. salubris*), Wandoo (*E. wandoo*), Marri (*Corymbia calophylla*), Flooded Gum (*E. rudis*) and York Gum (*E. loxophleba*). Nesting hollows are small (2) and are often in a dry sprout leading from a green limb (Johnstone and Storr 1998). This rosella feeds on the ground and in trees on various fruits, seeds and marri flowers (Johnstone and Storr 1998).

Eggs are laid generally from August to November, the incubation period is approximately 23-25 days and only the female incubates and broods the young. The male remains nearby and feeds the female when she leaves the nest. The young fledge about five weeks after hatching (Johnstone and Storr 1998). Breeding Western Rosellas are easily disturbed but will return to hollows to brood and tend to chicks (R. Johnstone *pers comm.*).

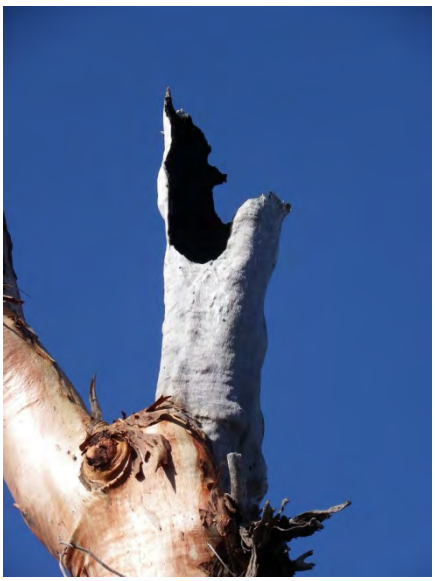

Plate 2 - Potential Hollow for Western Rosella

2.3 DISTRIBUTION OF THE WESTERN ROSELLA

The Inland subspecies of Western Rosella *Platycercus icterotis xanthogenys* occurs within the semi-arid southern interior of Western Australia (Figure 2). Described as being rare to moderately common, this species prefers wetter areas of the south west (Johnstone and Storr 1998). This species was once distributed throughout the wheatbelt, but numbers have declined significantly since the 1930's as a result of land clearing (Johnstone and Storr 1998).

2.4 WESTERN ROSELLA CONSERVATION STATUS

Historically, the Western Rosella was a declared pest of agriculture under the *Agriculture and Related Resources Protection Act 1976*. In 1988 it was removed as it was found to cause only minimal damage to fruit crops, and some populations of this parrot have declined or become locally extinct due to habitat loss (DEC 2009). The Western Rosella is now protected and is classified as a Schedule 1 species: Fauna that is rare or is likely to become extinct under the Western Australia *Wildlife Conservation Act* (WCA) *1950* and ranked Vulnerable by the Department of Environment and Conservation (DEC).

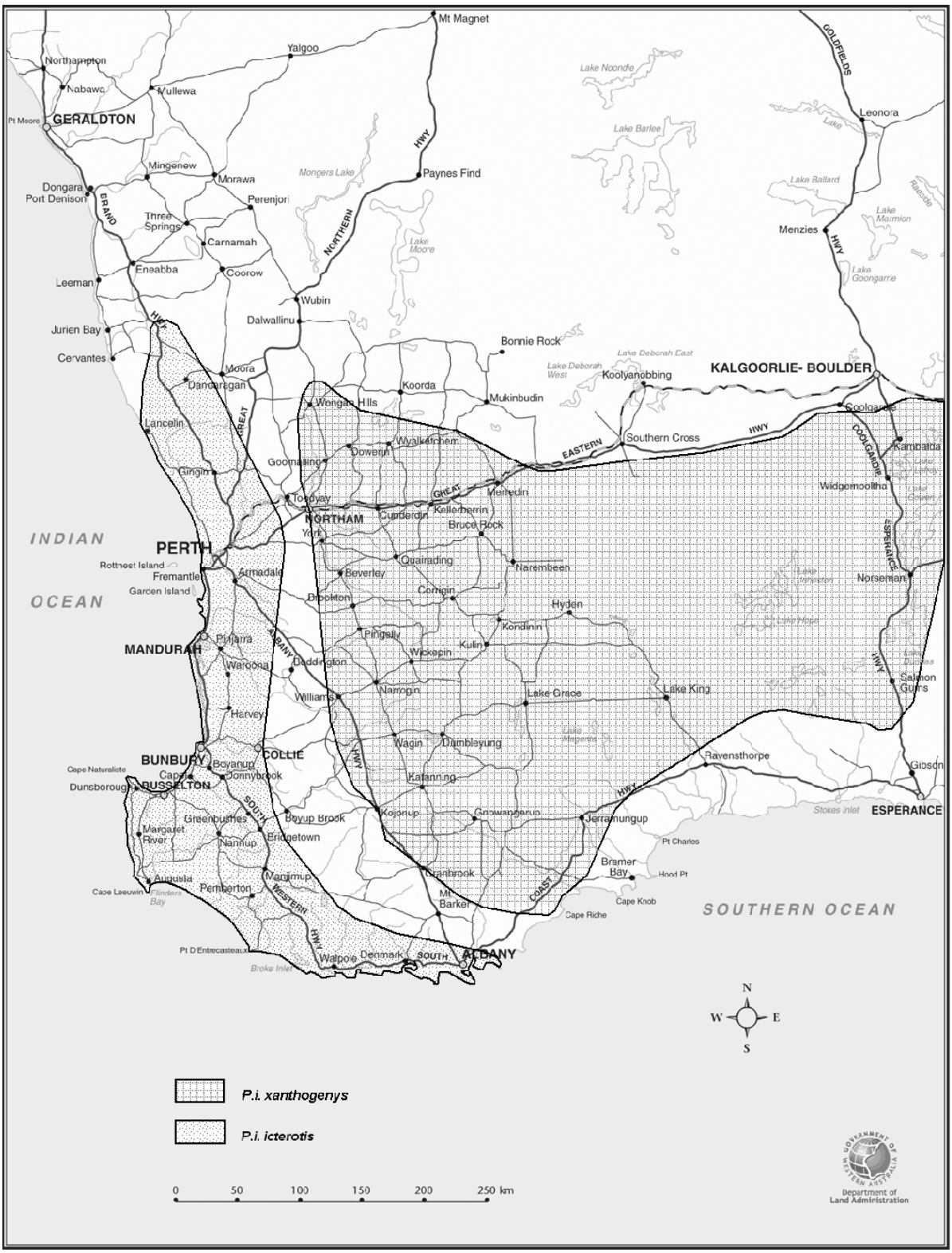

Figure 2 - Distribution of the Western Rosella in Western Australia showing the inland subspecies (*P. i. xanthogenys*) and the south-west subspecies (*P. i. icterotis*) (DEC 2009)

3.0 PROJECT BACKGROUND

3.1 LOCATION

The proposed Parker Range Iron Ore mine is situated approximately 15 kilometres southeast of Marvel Loch in the Shire of Yilgarn in Western Australia. Figure 1 shows the general location of the Parker Range Iron Ore project (Mt Caudan Deposit area) and Figure 3 shows the proposed mining infrastructure footprint of the Mt Caudan Project Area.

3.2 EXISTING ENVIRONMENT

All existing environmental parameters are presented in the Cazaly's PER document (Cazaly, 2010).

Of relevance in relation to the Western Rosella are the local vegetation communities which will be summarised below.

3.2.1 Interim Biogeographic Regionalisation of Australia Region

The Interim Biogeographic Regionalisation for Australia (IBRA) divides the Australian continent into 85 bioregions and 403 subregions (DEWHA 2009). The Parker Range Iron Ore Project tenements are located within the Coolgardie IBRA region and within the Coolgardie 2 (*COO2 – Southern Cross*) subregion (Cowan *et al.* 2001). The subregional area alone covers >7 million hectares.

The subregion is recognised as a centre of endemism for banded-ironstone hill flora, sandplain Acacia, Myrtaceae, Goldfield woodlands and one sandplain skink (*Ctenotus xenopleura*). High species and ecosystem diversity includes Banded ironstone ranges, ephemeral flora communities of Tertiary sandplain scrubs and of valley floor woodlands.

3.2.2 Flora and Vegetation Mapping

A number of vegetation and flora surveys of the project area have been undertaken by Botanica Consulting (2011) in accordance with EPA statements and guidelines (EPA 2002, 2004b) as presented in Cazaly's PER (Cazaly 2010).

Collectively, eighteen vegetation communities were identified within the Mt Caudan Project area within the Parker Range (Botanica Consulting 2011):

- *Eucalyptus salmonophloia* woodland,
- *Eucalyptus longicornis* Woodland,
- *Eucalyptus salubris* Woodland,
- Mixed *Eucalyptus* Woodland,
- *Eucalyptus salmonophloia/Eucalyptus salubris* Woodland,
- *Eucalyptus oleosa* Woodland over *Melaleuca,*
- *Eucalyptus salubris woodland over Melaleuca pauperiflora,*
- *Eucalyptus transcontinentalis* Woodland,

- Open Mallee Woodland,
- Mallee Heath,
- *Eucalyptus capillosa* subsp. *polyclada* Woodland,
- *Allocasuarina* Shrubland,
- *Acacia* sp. narrow phyllode and *Melaleuca eleuterostachya* shrubland,
- *Allocasuarina* Thicket,
- *Acacia* Thicket,
- Mallee Woodland / *Allocasuarina* Shrubland on Laterite Ridge,
- Burnt Mallee Woodland/*Allocasuarina* shrubland, and
- Mixed Shrub Rehabilitation within Gravel Pit.

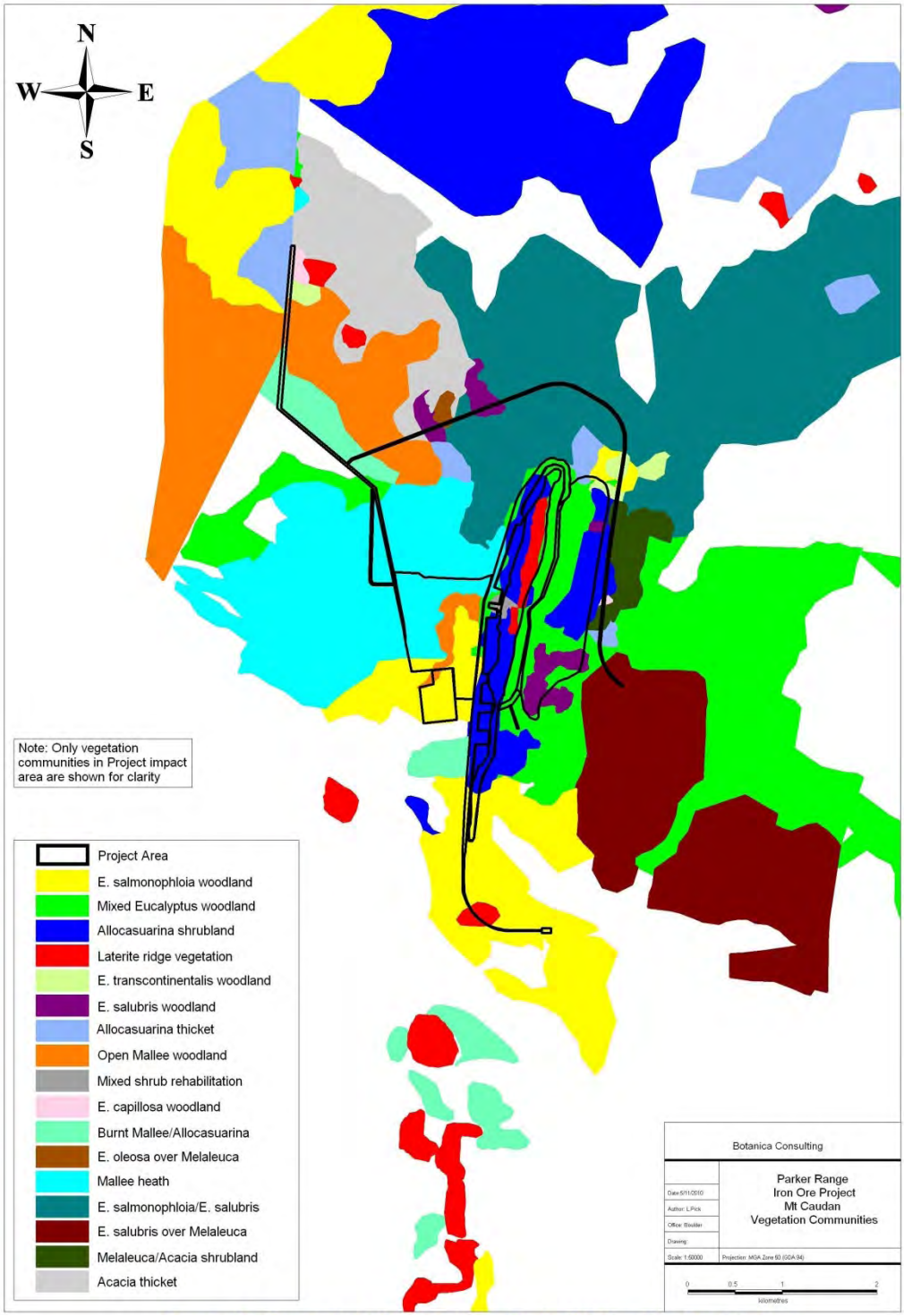

Figure 3 - Outline (---) of proposed mining infrastructure and vegetation communities in the Mt Caudan Project Area

4.0 METHODOLOGY

4.1 TARGETED WESTERN ROSELLA SURVEY

As detailed in Section 2.2, favoured nesting trees of the Western Rosella includes Salmon Gum, Gimlet, Wandoo, Marri, Flooded Gum and York Gum. Within the vegetation communities mapped within the Mt Caudan project area and wider Parker Range PEC region, vegetation communities comprising Salmon Gum and Gimlet are recorded with no records of any of the other favoured species.

Therefore, using the areas mapped by Botanica Consulting (2011), all vegetation communities that comprised Salmon Gum and Gimlet and combinations of both (Mixed *Eucalyptus* Woodland) were targeted for the survey. Particular focus was targeted for impact areas which would result from proposed project clearing. Given that many mature Salmon Gums and most mature Gimlets are likely to support potential breeding hollows for Western Rosella, the survey included areas within and outside of the footprint of disturbance to determine if the vegetation within the zone of impact was unique to the area or that preferred breeding habitat was also likely to be found outside of the proposed disturbance (Figure 4).

The targeted Western Rosella survey was conducted from 13 and 14 April 2011. All personnel were familiar with the field identification of Western Rosella including their call.

A line survey approach was adopted that ensured large swathes of vegetation were inspected. Areas to be inspected were numbered for convenience (Table 1) (Figure 4).

Table 1 - Descriptions of areas surveyed

Area inspected	Description	Vegetation community	Area surveyed
#1	Magazine access and magazine area	*E. salmonophloia* Woodland	86.0 ha
#2	Proposed Tailings Storage facility (TSF) area	*E. salmonophloia* Woodland	33.5 ha
#3	North of Parker Range Road and west of Banded Iron Formation (BIF)	*E. salmonophloia/E. salubris* Woodland	73.2 ha
#4	North of Parker Range Road and east of BIF	Mixed *Eucalyptus* Woodland	57.8 ha
#5	Bypass Road	Mixed *Eucalyptus* Woodland	37.6 ha
#6	South of Parker Range Road	*E. salubris* Woodland and Mixed *Eucalyptus* Woodland	101.3 ha

Four qualified personnel walked in parallel straight lines approximately 25m apart within the areas delineated to be surveyed. Personnel on the outside tracked the walked lines using GPS units to ensure that all targeted areas were inspected. All four surveyors stopped after every 100 m and the number of potential Western Rosella breeding hollows in the preceding 100 m was recorded in addition to any sightings or evidence of bird calls. Each 100 m interval was recorded on one GPS unit and tallies of the number of potential hollows were made against each GPS location. The numbers of potential hollows were grouped into three categories:

- 1 – 10 potential hollows (small circles),
- 11 – 20 potential hollows (medium circles), and
- >20 potential hollows (large circles).

While the number of potential hollows depicted by various sized circles are plotted in one line, the potential hollows were recorded in a swathe 100 m x 125 m wide along the route.

4.2 PERSONNEL AND REPORTING

The following personnel were involved in the surveys:

- Dr Vi Saffer *BSc (Biol.) Hons (Biol.) PhD (Biol.)*: Senior Zoologist, KLA,
- Ms Feigh Sugg *BSc Hons*, Project Environmental Scientist, KLA,
- Ms Erica MacIntyre *BSc Hons (in prep)*, Project Ecologist, KLA, and
- Mr Hamish Burnett, Field Assistant, TAFE Certificate II Conservation and Land Management, KLA

Mr Keith Lindbeck *BA, WDA, Dip Environ Studies;* Principal, KLA, reviewed the report.

4.3 LICENCE AND PERMITS

A license was not required for the targeted Western Rosella survey.

4.4 LIMITATIONS

While an attempt was made to survey all vegetation communities within the footprint of disturbance that potentially supported potential Western Rosella breeding hollows, logistical, time constraints and the presence of dense vegetation (in some areas) prevented complete survey of all vegetation.

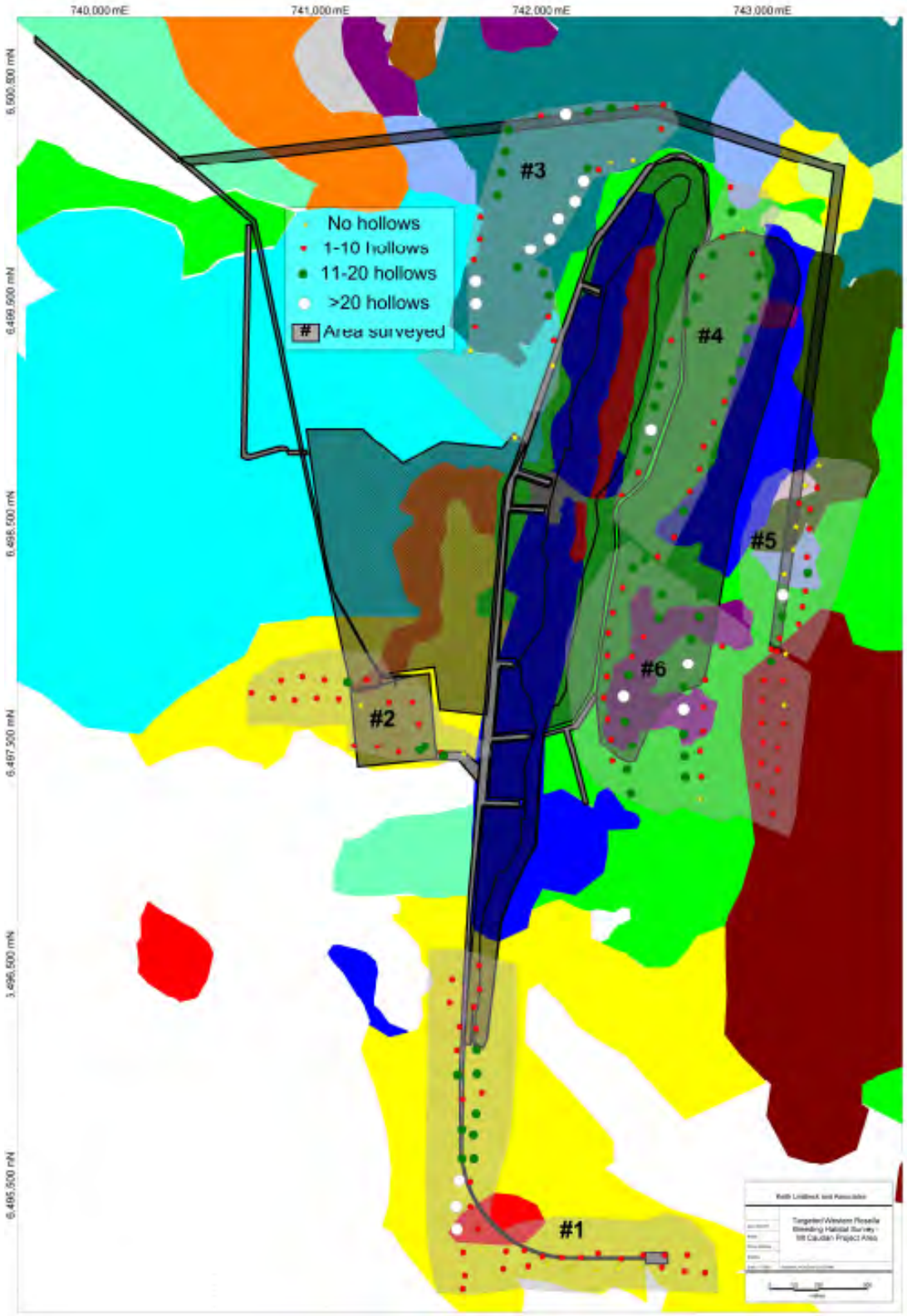

Figure 4 - Locations of Western Rosella survey areas and potential breeding hollows in the Parker Range Project Area

5.0 RESULTS

No Western Rosellas were seen or heard during the survey, hence the survey results are limited to discussion of habitat and presence of potential breeding hollows.

A total of 1,837 potential Western Rosella breeding hollows were recorded during the targeted survey (Figure 5).

Area #1 incorporated access to and the Magazine area and the southern extent of the proposed pit. Within the ~81 ha of Salmon Gum Woodland surveyed within and adjacent to the footprint of this disturbance a total of 341 potential hollows were recorded. Results indicated that while there are potential hollows throughout this area there are fewer hollows in the north-south and east-west portions of the area surveyed, with a concentration of more hollows in the central area. Notwithstanding this, within the ~81 ha of Salmon Gum Woodland surveyed, the access track accounts for 2.9 ha, the southern extent of the pit 4.6 ha and the area for the magazine approximately 0.5 ha totalling only 8 ha (<10% of the area surveyed). Therefore, potential Western Rosella breeding hollows are not limited to the area proposed for disturbance but are scattered throughout the Salmon Gum Woodland in this area.

Area #2 incorporated access to and the proposed TSF area, and a similar sized expanse to the west, totalling ~33 ha of Salmon Gum Woodland. While a maximum of 20 hollows and less were recorded at each of the GPS recording points, a total of 138 potential Western Rosella breeding hollows were recorded in the combined area. The results do indicate that a similar number of hollows were recorded in the area surveyed for the proposed TSF (n = 73, 14.5 ha) and outside of the footprint of disturbance (n = 65, ~19 ha).

Area #3, north of Parker Range Road and west of the BIF, comprises 73 ha of Salmon Gum / Gimlet Woodland. Up to 3.6 ha of the northern portion of the Bypass road passes through this woodland. Results indicated that within the ~73 ha surveyed, including 3.6 ha for the Bypass Road, a total of 427 potential Western Rosella breeding hollows were recorded. These results indicate that potential breeding hollows are scattered throughout this woodland and are not limited to the (3.6 ha) area proposed for disturbance for the Bypass Road.

Area #4 includes part of the western aspect of the proposed pit and a northern portion of the area proposed for the waste dump north of Parker Range Road and totals ~58 ha. The vegetation community in both areas has been identified as Mixed *Eucalyptus* Woodland and 332 potential Western Rosella breeding hollows were recorded along its entire length. Potential breeding hollows in Mixed *Eucalyptus* Woodland outside of the footprint of disturbance were surveyed in Areas #5 and #6.

The vegetation community in Area #5 (~38 ha) was identified primarily as Mixed *Eucalyptus* Woodland and the area included 3.4 ha of the southern-most portion of the Bypass Road. This survey did extend north into the *Allocasuarina* Thicket, *Acacia* sp. narrow phyllode and *Melaleuca eleuterostachya* shrubland and *E. capillosa* Woodland, but only to the extent to record potential hollows in the few

scattered Gimlets in the area. A total of 118 potential Western Rosella breeding hollows were recorded in this area. This result indicates that the potential hollows are not limited to the disturbance area but are scattered throughout the Mixed *Eucalyptus* Woodland.

Area #6, measuring ~101 ha, is located to the south of Parker Range Road and covers the southern portion of the waste dump. Of the 101 ha, approximately 21.4 ha is identified as Gimlet Woodland, 60 ha as Mixed *Eucalyptus* Woodland and 20 ha as Gimlet Woodland over *Melaleuca*. A total of 481 potential Western Rosella breeding hollows were recorded in this area. While only 1 – 10 potential hollows were recorded at most of the 100m recording locations in the Mixed *Eucalyptus* Woodland and Gimlet Woodland over *Melaleuca*, many more hollows (>20 hollows per recording location) were recorded in the Gimlet Woodland. However, Figure 5 clearly shows that similar numbers of potential hollows were recorded within and outside of the proposed footprint of disturbance.

Table 2 details the numbers of hectares surveyed in the six nominated areas, the number of hollows recorded within these areas, the areas proposed to be disturbed in these areas and the potential number of hollows that may be disturbed in these areas. While some figures are high, it is recognised that these figures are an artefact of the design of the survey areas.

Notwithstanding this, a summary of the results presented above indicate that there are many potential Western Rosella breeding hollows throughout the Salmon Gum, Gimlet and Mixed *Eucalyptus* Woodlands within the area proposed for disturbance. However, these areas are not unique inasmuch as similar vegetation complexes outside of the zone of impact also support similar numbers of potential hollows. Further, the total number of hectares proposed for disturbance represents only 3% of Salmon Gum / Gimlet Woodland within the Parker Range Priority Ecological Community (PEC) (Figure 5) and less than 1% of the remaining communities within the PEC that support potential Western Rosella breeding hollows (Table 3).

Table 2 - Areas surveyed, number of potential hollows recorded and potential number of hollows to be disturbed

Area	Area surveyed (ha)	Number of hollows	Area proposed to be cleared within survey area (ha)	Approximate number of hollows in cleared area	% of hollows proposed to be cleared
1	86.0	341	7.5	29.8	8.7%
2	33.5	138	14.4	59.4	43.1%
3	73.2	427	3.6	20.9	4.9%
4	57.8	332	43.8	251.8	75.8%
5	37.6	118	3.4	10.7	9.0%
6	101.3	481	65.0	308.6	64.2%
TOTAL	**389.3**	**1837**	**137.7**	**681.2**	**37.1%**

Table 3 - Vegetation Communities in the Parker Range Priority Ecological Community and amount (ha and %) impacted in the Mt Caudan Project area. The amount of vegetation communities surveyed (ha) is included.

Vegetation Community	**Parker Range PEC**	**Mt Caudan Project Area**		
	Total Area (ha)	**Total area to be impacted (ha)**	**Vegetation community impacted (%)**	**Area surveyed for potential Western Rosella Breeding Habitat (ha)**
Eucalyptus salmonophloia woodland	5,598	45	0.80	115
E. salubris woodland	4,059	25	0.62	22
Mixed *Eucalyptus* woodland	22,147	149	0.67	126
E. salmonophloia/E. salubris woodland	909	28	3.08	55
E. salubris woodland over *Melaleuca pauperiflora*	556	0.1	0.02	23

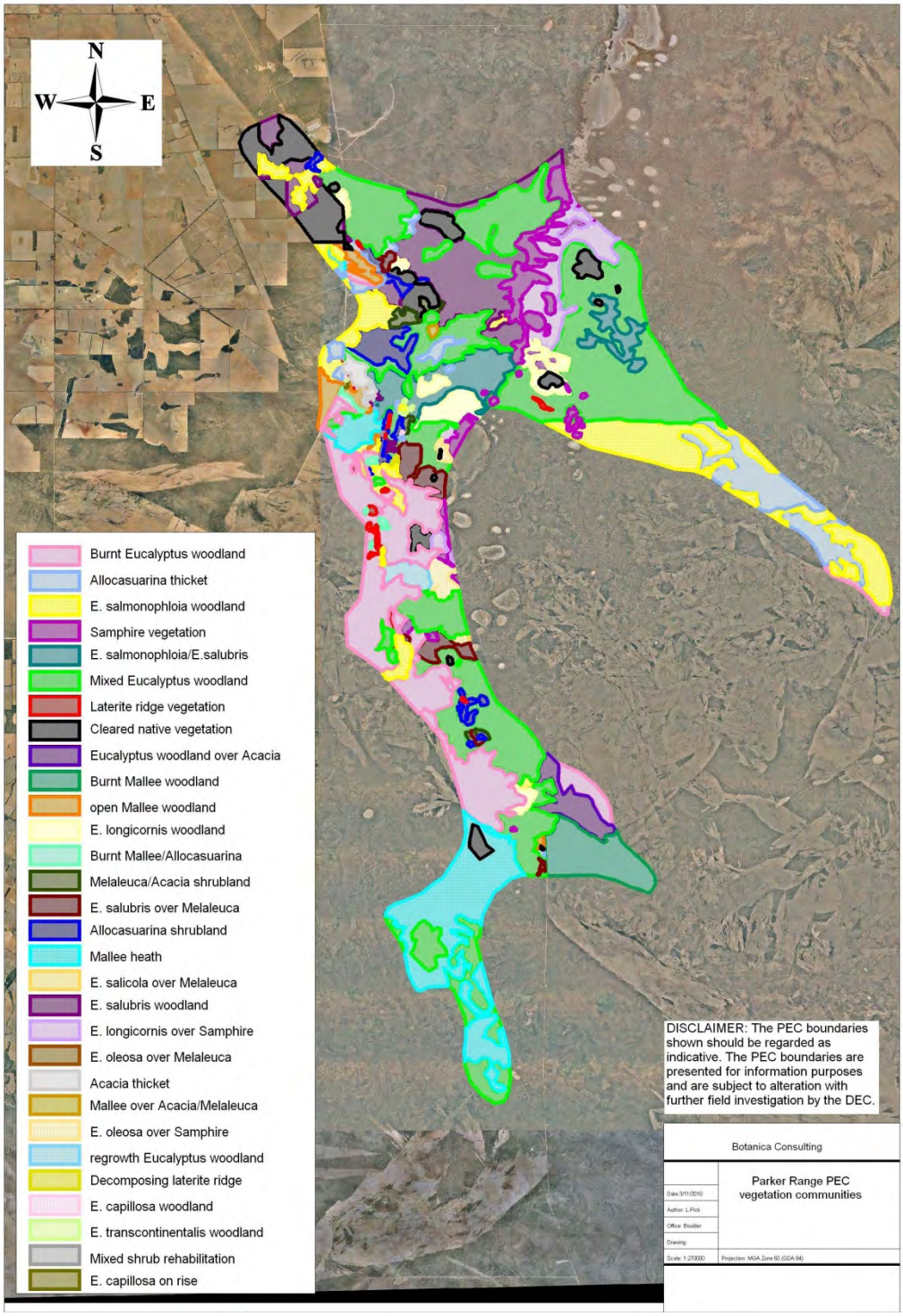

Figure 5 - Vegetation Communities in the Parker Range Priority Ecological Community

6.0 CONCLUSIONS

The Western Rosella is not listed as a threatened species under the Federal *Environmental Protection and Biodiversity Conservation* (EPBC) *Act 1999.* However, it is classified as a Schedule 1 species under the WCA 1950 and ranked vulnerable by the DEC. It is recognised that the Western Rosella "has undergone a significant change in distribution and status since 1970. It has declined or become extinct from more than 25 per cent of the shires where it was once found. This parrot has disappeared from the northern and eastern parts of the Wheatbelt because of the removal of its feeding and breeding habitat. There are no shires in Western Australia where the western rosella (*sic)* is thought to be increasing in number but it remains relatively common in the lower south. Breeding habitat and contiguous vegetation may be particularly important to the species." (OEPA comment 2011).

The Mt Caudan Project area is located immediately east of the agricultural line delineating the fragmented vegetation of the wheatbelt and within contiguous vegetation close to the western boundary of the Great Western Woodlands. The Great Western Woodlands covers approximately 16 million hectares of intact contiguous woodland that extends east to the Nullabor Plain (DEC 2010).

Since avifauna surveys have been undertaken in 2008 by KLA, only two Western Rosellas have been seen or heard in the Mt Caudan project area (Autumn 2009 survey). This is consistent with the understanding that the species is patchily distributed within the Parker Range area, and is more prevalent in the South West (reference phone conversation R. Johnstone at WAM). The results of this targeted survey support the conclusion that the Mt Caudan Project area is not a core breeding or nesting habitat area for the Western Rosella.

The identification of 1,837 potential breeding hollows within the targeted mixed eucalypt woodlands vegetation groups within and adjacent to the project area that support Salmon Gums and Gimlets is not unexpected. Of the 1,837 potential breeding hollows, an estimated 38% (n = 681) are located within the 137.7 ha surveyed that may be impacted by the proposed clearing (Table 2). The 137.7 ha surveyed represents 56% of the 247.1 ha identified potential habitat (i.e. Salmon Gum Woodland, Gimlet Woodland and Mixed Eucalypt woodlands) within the footprint of disturbance. Extrapolating these figures, an estimated 1,222 potential breeding hollows are located within the Mt Caudan impact area. A further 1,156 potential breeding hollows were recorded in 251 ha included in the targeted survey outside the Mt Caudan impact area. An extrapolation of these figures results in an estimated 175,012 potential breeding hollows within the PEC alone, excluding the Mt Caudan impact area.

Thus, Cazaly has established that potential breeding hollows for Western Rosella are not confined to the proposed footprint of disturbance within the Mt Caudan area but exist locally outside the impact area and more widely within the Parker Range PEC and Great Western Woodlands. Given that eucalypt woodlands represent 38,000 ha (i.e 68%) of the total 55,960 ha within the Parker Range PEC, it is considered unlikely that the removal of potential breeding hollows for the proposed mine at Mt Caudan will compromise the conservation status of the Western Rosella.

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APPENDIX A

GPS locations and number of hollows at 100m intervals along survey routes

Site #1 Magazine			Site #1 Magazine		
Latitude	**Longitude**	**Number of Hollows**	**Latitude**	**Longitude**	**Number of Hollows**
S31 38 31.7	E119 32 50.4	5	S31 39 11.5	E119 33 31.9	1
S31 38 35.3	E119 32 50.0	2	S31 39 11.6	E119 33 28.0	3
S31 38 38.8	E119 32 51.9	3	S31 39 11.6	E119 33 24.3	5
S31 38 42.2	E119 32 51.5	7	S31 39 12.3	E119 33 20.5	7
S31 38 45.8	E119 32 51.7	11	S31 39 11.5	E119 33 16.6	4
S31 38 49.5	E119 32 52.7	10	S31 39 12.2	E119 33 13.6	4
S31 38 53.9	E119 32 52.7	12	S31 39 12.3	E119 33 10.4	7
S31 38 58.1	E119 32 52.8	19	S31 39 12.2	E119 33 07.0	6
S31 39 01.5	E119 32 52.4	21	S31 39 11.4	E119 33 03.9	3
S31 39 05.3	E119 32 52.0	23	S31 39 11.6	E119 33 00.7	1
S31 39 08.6	E119 32 52.2	27	S31 39 11.4	E119 32 56.2	0
S31 39 11.9	E119 32 53.4	9	S31 39 08.4	E119 32 55.8	1
S31 39 15.2	E119 32 53.8	3	S31 39 05.3	E119 32 54.4	2
S31 39 17.1	E119 32 53.5	2	S31 39 01.7	E119 32 54.3	7
S31 39 14.1	E119 33 00.4	1	S31 38 58.1	E119 32 54.8	20
S31 39 13.7	E119 33 04.6	3	S31 38 54.6	E119 32 54.7	20
S31 39 13.2	E119 33 07.9	0	S31 38 51.6	E119 32 55.0	19
S31 39 13.8	E119 33 11.7	0	S31 38 48.6	E119 32 56.0	10
S31 39 13.5	E119 33 11.9	0	S31 38 45.5	E119 32 55.0	14
S31 39 14.0	E119 33 16.1	0	S31 38 42.1	E119 32 54.9	15
S31 39 13.6	E119 33 20.0	0	S31 38 39.0	E119 32 54.7	7
S31 39 13.4	E119 33 23.7	0	S31 38 35.9	E119 32 54.2	8
S31 39 13.3	E119 33 27.6	2	S31 38 33.0	E119 32 55.1	6
S31 39 13.8	E119 33 31.4	4	S31 38 29.6	E119 32 54.9	6
S31 39 14.0	E119 33 34.9	1	**TOTAL HOLLOWS:**		**341**

Site #2 TSF		
Latitude	**Longitude**	**Number of Hollows**
S31 37 58.8	E119 32 51.5	0
S31 37 58.8	E119 32 47.6	7
S31 37 58.4	E119 32 44.0	14
S31 37 58.7	E119 32 40.3	6
S31 37 58.0	E119 32 36.6	2
S31 37 57.9	E119 32 32.6	2
S31 37 52.0	E119 32 33.6	0
S31 37 51.1	E119 32 29.8	3
S31 37 51.1	E119 32 26.1	6
S31 37 51.4	E119 32 22.2	3
S31 37 51.2	E119 32 18.6	7
S31 37 50.5	E119 32 14.8	10
S31 37 48.6	E119 32 19.9	3
S31 37 48.0	E119 32 23.5	10
S31 37 48.4	E119 32 27.3	9
S31 37 48.7	E119 32 31.3	14
S31 37 48.2	E119 32 34.5	5
S31 37 51.5	E119 32 38.5	5
S31 37 51.3	E119 32 42.5	5
S31 37 54.5	E119 32 43.6	5
S31 37 57.7	E119 32 44.8	11
S31 37 59.2	E119 32 48.0	11
TOTAL HOLLOWS:		**138**

Site #3 North Parker Range Road West of BIF		
Latitude	**Longitude**	**Number of Hollows**
S31 36 59.5	E119 32 51.0	0
S31 36 55.9	E119 32 51.7	6
S31 36 52.5	E119 32 51.8	31
S31 36 49.3	E119 32 51.6	24
S31 36 46.1	E119 32 51.2	8
S31 36 42.9	E119 32 52.1	1
S31 36 39.7	E119 32 52.2	3
S31 36 36.6	E119 32 55.0	12
S31 36 33.3	E119 32 55.6	13
S31 36 30.0	E119 32 56.3	12
S31 36 26.9	E119 32 56.6	20
S31 36 24.6	E119 33 02.2	5
S31 36 24.3	E119 33 06.4	22
S31 36 23.8	E119 33 10.3	15
S31 36 23.3	E119 33 14.3	16
S31 36 23.1	E119 33 18.4	4
S31 36 22.6	E119 33 23.1	2
S31 36 26.1	E119 33 22.9	3
S31 36 30.7	E119 33 18.1	0
S31 36 31.2	E119 33 14.3	0
S31 36 32.3	E119 33 10.4	7
S31 36 32.5	E119 33 12.3	19
S31 36 34.2	E119 33 09.8	22
S31 36 37.2	E119 33 08.4	38
S31 36 39.7	E119 33 05.6	23
S31 36 42.7	E119 33 04.2	31
S31 36 44.4	E119 33 00.9	21
S31 36 47.1	E119 32 58.8	20
S31 36 47.9	E119 33 03.2	20
S31 36 51.0	E119 33 04.3	13
S31 36 54.1	E119 33 04.3	7
S31 36 57.8	E119 33 05.3	9
S31 37 01.4	E119 33 05.2	0
S31 37 11.9	E119 32 59.0	0
TOTAL HOLLOWS:		**427**

Site #4 North Parker Range Road East of BIF		
Latitude	**Longitude**	**Number of Hollows**
S31 37 20.0	E119 33 17.5	3
S31 37 16.6	E119 33 20.3	10
S31 37 13.3	E119 33 21.9	12
S31 37 10.4	E119 33 22.4	27
S31 37 07.0	E119 33 22.8	11
S31 37 03.9	E119 33 23.4	11
S31 37 00.9	E119 33 24.2	12
S31 36 57.4	E119 33 25.5	5
S31 36 54.4	E119 33 28.0	17
S31 36 50.9	E119 33 29.4	17
S31 36 47.8	E119 33 30.5	8
S31 36 44.7	E119 33 32.2	11
S31 36 41.8	E119 33 33.8	6
S31 36 38.1	E119 33 35.2	14
S31 36 34.6	E119 33 35.0	10
S31 36 40.7	E119 33 37.3	0
S31 36 44.3	E119 33 39.0	8
S31 36 47.5	E119 33 40.3	13
S31 36 50.5	E119 33 39.7	13
S31 36 53.7	E119 33 39.4	15
S31 36 56.9	E119 33 38.3	13
S31 37 00.2	E119 33 37.5	19
S31 37 03.1	E119 33 36.1	16
S31 37 06.0	E119 33 34.8	9
S31 37 09.1	E119 33 33.1	7
S31 37 12.6	E119 33 31.4	9
S31 37 15.9	E119 33 30.8	5
S31 37 19.1	E119 33 29.2	6
S31 37 22.2	E119 33 28.1	11
S31 37 26.0	E119 33 26.7	7
S31 37 28.9	E119 33 24.0	7
TOTAL HOLLOWS:		**332**

Site #5 Bypass Road		
Latitude	**Longitude**	**Number of Hollows**
S31 37 38.5	E119 33 48.4	10
S31 37 35.9	E119 33 49.0	2
S31 37 33.6	E119 33 49.4	4
S31 37 28.5	E119 33 49.6	10
S31 37 30.8	E119 33 49.8	12
S31 37 24.4	E119 33 49.8	8
S31 37 21.5	E119 33 49.9	3
S31 37 18.2	E119 33 51.0	5
S31 37 14.9	E119 33 51.3	0
S31 37 17.9	E119 33 48.9	0
S31 37 20.8	E119 33 48.0	6
S31 37 24.1	E119 33 47.6	0
S31 37 27.4	E119 33 47.2	0
S31 37 31.0	E119 33 45.7	0
S31 37 34.3	E119 33 45.6	30
S31 37 37.4	E119 33 45.5	15
S31 37 40.6	E119 33 45.3	10
S31 37 42.4	E119 33 44.8	3
TOTAL HOLLOWS:		**118**

Site #6 South of Parker Range Road			Site #6 South of Parker Range Road		
Latitude	**Longitude**	**Number of Hollows**	**Latitude**	**Longitude**	**Number of Hollows**
S31 37 47.0	E119 33 45.9	4	S31 37 48.2	E119 33 29.0	12
S31 37 50.3	E119 33 46.2	0	S31 37 44.7	E119 33 29.6	29
S31 37 53.2	E119 33 46.1	6	S31 37 41.0	E119 33 30.2	16
S31 37 56.7	E119 33 45.3	5	S31 37 37.7	E119 33 31.4	20
S31 38 00.1	E119 33 45.5	1	S31 37 34.7	E119 33 31.6	12
S31 38 03.1	E119 33 44.6	1	S31 37 34.6	E119 33 24.8	16
S31 38 06.5	E119 33 44.8	2	S31 37 38.0	E119 33 24.4	11
S31 38 02.5	E119 33 42.1	3	S31 37 40.8	E119 33 21.9	10
S31 37 59.2	E119 33 42.6	2	S31 37 43.7	E119 33 19.9	10
S31 37 55.9	E119 33 42.8	5	S31 37 46.6	E119 33 19.5	15
S31 37 53.1	E119 33 42.4	1	S31 37 49.7	E119 33 18.7	25
S31 37 49.9	E119 33 42.4	6	S31 37 53.5	E119 33 19.0	18
S31 37 47.0	E119 33 42.8	7	S31 37 57.0	E119 33 20.3	11
S31 37 44.1	E119 33 43.9	11	S31 38 00.6	E119 33 19.6	13
S31 37 42.2	E119 33 43.8	4	S31 38 04.0	E119 33 20.3	17
S31 37 41.9	E119 33 35.4	9	S31 37 59.3	E119 33 17.0	7
S31 37 47.1	E119 33 32.6	4	S31 37 56.0	E119 33 16.7	9
S31 37 51.0	E119 33 32.4	1	S31 37 53.1	E119 33 16.1	5
S31 37 54.5	E119 33 32.4	8	S31 37 50.0	E119 33 15.3	1
S31 37 57.7	E119 33 32.1	7	S31 37 46.9	E119 33 15.7	6
S31 38 01.3	E119 33 32.3	7	S31 37 43.7	E119 33 15.7	3
S31 38 04.5	E119 33 32.2	0	S31 37 40.4	E119 33 15.9	4
S31 38 01.4	E119 33 29.6	14	S31 37 37.5	E119 33 16.5	5
S31 37 58.5	E119 33 29.4	19	S31 37 33.8	E119 33 18.1	10
S31 37 55.0	E119 33 29.1	20	S31 37 30.6	E119 33 19.8	14
S31 37 51.4	E119 33 29.0	21	S31 37 29.2	E119 33 21.8	14
			TOTAL HOLLOWS:		**481**

Appendix 8: Conceptual Rehabilitation and Closure Plan (Draft)

Cazaly Resources (May 2011)

CAZALY RESOURCES LIMITED

PARKER RANGE IRON ORE PROJECT

MT CAUDAN DEPOSIT

CONCEPTUAL REHABILITATION AND CLOSURE PLAN

May 2011

Revision H

PARKER RANGE (MT CAUDAN) IRON ORE PROJECT
CONCEPTUAL REHABILITATION AND CLOSURE PLAN

TABLE OF CONTENTS

1.0	**INTRODUCTION**			**1**
	1.1	Background		1
	1.2	Location of Project		1
2.0	**OVERVIEW OF THE PROPOSAL**			**3**
	2.1	Mining Program		6
3.0	**CLOSURE PLAN OBJECTIVES**			**7**
4.0	**LEGAL OBLIGATIONS**			**8**
	4.1	Guidance Documents		8
5.0	**STAKEHOLDER INVOLVEMENT**			**9**
	5.1	Consultation Undertaken		9
	5.2	Future Consultation		10
6.0	**RISK ASSESSMENT**			**12**
	6.1	Existing Legacies		12
	6.2	Future Risks		12
7.0	**CONCEPTUAL CLOSURE CRITERIA**			**16**
8.0	**CONCEPTUAL CLOSURE ASSESSMENT**			**17**
	8.1	Open Pit		17
		8.1.1	Closure Objective	17
		8.1.2	Closure Criteria	17
		8.1.3	Options considered	17
		8.1.4	Work Required at Closure	18
	8.2	Waste Landform		19
		8.2.1	Closure Objective	19
		8.2.2	Closure Criteria	19
		8.2.3	Options considered	19
		8.2.4	Work required at closure	19
	8.3	Processing Plant (Dry and Wet Circuits)		25
		8.3.1	Closure Objective	25
		8.3.2	Closure Criteria	25
		8.3.3	Options considered	25
		8.3.4	Work required at closure	25
	8.4	Tailings Storage Facility (TSF)		25
		8.4.1	Closure Objective	25
		8.4.2	Closure Criteria	26
		8.4.3	Options considered	26
		8.4.4	Proposed capping	26
		8.4.5	Work required at closure	26
	8.5	ROM Stockpile		26
		8.5.1	Closure Objective	26
		8.5.2	Closure Criteria	26
		8.5.3	Options considered	26
		8.5.4	Work required at closure	26
	8.6	Power Supply		27
		8.6.1	Closure Objective	27
		8.6.2	Closure Criteria	27
		8.6.3	Options considered	27
		8.6.4	Work required at closure	27
	8.7	Workshop/Administration area		27
		8.7.1	Closure Objective	27
		8.7.2	Closure Criteria	27
		8.7.3	Options considered	27
		8.7.4	Work required at closure	28
	8.8	Explosives Magazine		28
		8.8.1	Closure Objective	28
		8.8.2	Closure Criteria	28
		8.8.3	Options considered	28
		8.8.4	Work required at closure	28
	8.9	Haul and Access Roads		29
		8.9.1	Closure Objective	29
		8.9.2	Closure Criteria	29
		8.9.3	Options considered	29

TABLE OF CONTENTS

		8.9.4 Work required at closure	29
	8.10	Water Supply Pipelines and Monitoring Bores	29
		8.10.1 Closure Objective	29
		8.10.2 Closure Criteria	29
		8.10.3 Options considered	29
		8.10.4 Work required at closure	29
9.0	**REHABILITATION**		**31**
	9.1	Footprint and Clearing	31
		9.1.1 Design Footprint	32
		9.1.2 Management Actions for Disturbance	32
	9.2	Progressive Rehabilitation and Topsoil Viability	32
	9.3	Seed Collection	33
	9.4	Performance Indicators for Rehabilitation	33
	9.5	Monitoring	33
	9.6	Records and Reporting	33
10.0	**GENERAL CLOSURE AND REHABILITATON STRATEGY**		**35**
	10.1	De-commissioning	35
	10.2	Remediation of Contaminated Sites	35
	10.3	Landform Establishment	35
	10.4	Surface Water Drainage & Groundwater	35
	10.5	Revegetation	35
	10.6	Aesthetics	36
	10.7	Safety	36
11.0	**PERFORMANCE INDICATORS AND CONTINGENCY MEASURES**		**37**
	11.1	Costs and Resources	37
	11.2	Monitoring, Reporting and Records	37
	11.3	Performance Indicators and Objectives	37
		11.3.1 Infrastructure Decommissioning Objective	37
		11.3.2 Rehabilitation Objective	37
		11.3.3 Decommissioning and Rehabilitation Performance	37
	11.4	Unplanned or Temporary Closure	38
		11.4.1 Unplanned Closure	38
		11.4.2 Temporary (Care and Maintenance) Closure	38
	11.5	Tenement Relinquishment	38
12.0	**PREDICTED OUTCOME**		**39**
13.0	**REFERENCES**		**42**

TABLES

Table 1: Summary of the Main Elements of the Project 3
Table 2: Forecast Mining Material Movement - Ore and Waste 6
Table 3: Consultation Register 9
Table 4: Future Consultation Register 11
Table 5: Potential Risks Associated with Closure and Rehabilitation of the Project 13
Table 6: Estimated Pit Void Dimensions and Volume per Option 3 Backfilling Mt Caudan South 18
Table 7: Proposed Disturbance for the Project 32

FIGURES

Figure 1: Project Location 2
Figure 2: Project Area and Site Layout 5
Figure 3: Section of Waste Landform and Stormwater Drainage Design 21
Figure 4: Plan of Waste Landform Stormwater Drainage Design 22
Figure 5: Section of Open Pit and Waste Landform Outside Zone of Instability 23
Figure 6: Detail Design of PAF Encapsulation Cell in Waste Landform 24
Figure 8: Landform Impact Assessment (Existing Environment) 40
Figure 9: Landform Impact Assessment (Post-closure) 40
Figure 10: Clearing Area Estimate Mt Caudan Impact Area 41

APPENDICES

Appendix 1: Risk Assessment Methodology And Risk Tables, Cazaly Resources
Appendix 2: Method Statement For Soil And Vegetation Restoration At Mt Caudan, Soil Water Consultants

1.0 INTRODUCTION

1.1 Background

The Parker Range Iron Ore Project (the Project) is 100% owned and managed by Cazaly Resources Limited (Cazaly) and comprises 900 ha of mining tenements within the Southern Cross greenstone belt, part of the Yilgarn iron ore province.

The Yilgarn iron ore province has a history of large-scale iron ore production, with the first iron ore exported from Western Australia coming from the Koolanooka deposit in the Yilgarn during the mid 1960s. Koolyanobbing Iron Ore (Cliffs Natural Resources Ltd) is the only current iron ore operation in the Yilgarn region.

Within the Parker Range, resource drilling has been concentrated at the Mt Caudan deposit which consists of 4.0 km of strike from the Banded Iron Formation (BIF) horizon that stretches over 16 km. The 4.0 km Mt Caudan deposit is the focus of the Project development.

1.2 Location of Project

The Project is located approximately 52 km south of Southern Cross and 15 km south-east of Marvel Loch (Figure 1).

The Perth – Kalgoorlie public access rail line is approximately 60 km to the north west of the Project area, with the preferred rail siding located at Moorine Rock (57 km via the Parker Range Road).

The public access rail line services the ports of Esperance and Kwinana. The port of Kwinana is preferred for the Project as it is 416 km by rail from Moorine Rock and is approximately 240 km closer to the Project than Esperance.

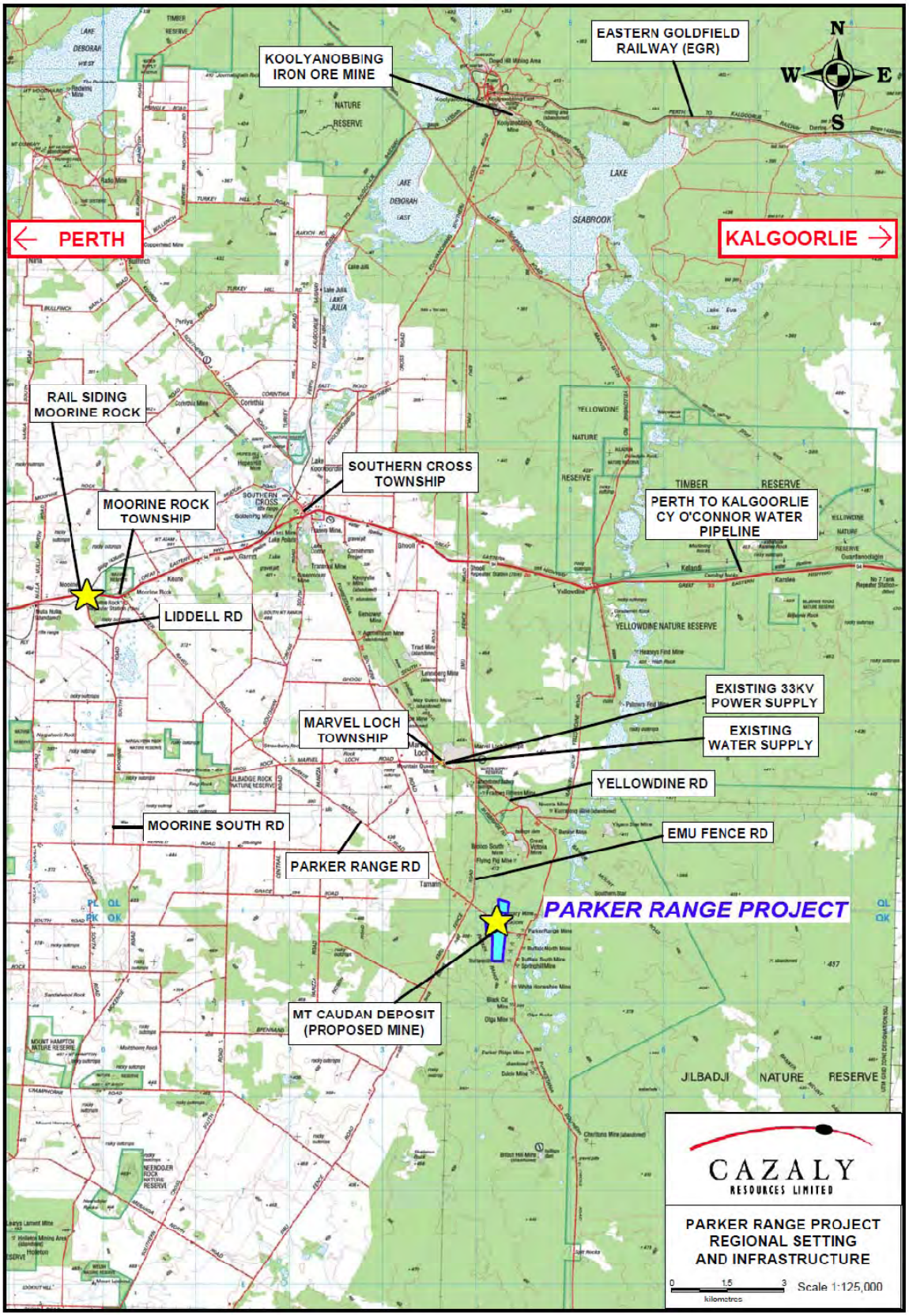

Figure 1: Project Location

2.0 OVERVIEW OF THE PROPOSAL

Cazaly propose to mine iron ore from the Parker Range deposit by conventional open pit hard rock mining methods at 4 Mtpa. The estimated life of the mine is 7 - 10 years based on current economically mineable JORC resources and available port allocation.

Approximately 55 Mt of waste rock is expected to be generated from the mining operation. The waste rock landform will be located east of the open pit away from the BIF ridge.

A Run-of-Mine (ROM) pad will be built from waste to a final height equal to the primary crushing process plant tipple station. The ROM pad will be accessed by way of vehicle ramps.

A low grade waste rock landform will be constructed in the region south of the ROM pad in a similar method utilising waste material to a base height matching the ROM pad.

For the first year of operation, ore will be treated by way of an on-site 4.0 Mtpa dry crushing, screening and stockpiling plant located to the west of the mine operation. From year 2+ of operation, the mobile dry plant will be replaced with a permanent wet-plant/beneficiation process which involves washing and screening of lower grade ore impurities to tailings.

The Tailings Storage Facility (TSF) facility is proposed to be positioned to the south west of the permanent process plant, which will be designed with a water recovery from tailings circuit. The tailings material will contain no adverse reagents, and will have similar chemical composition to the ROM feed material. The iron tailings will be nominally fine material of less than 150 microns and have similar chemical characteristics of the lower grade ore material, with elevated silica and alumina levels of approximately 1% each. Results of water analyses indicate the ground water is neutral (pH 6.96 – 7.37) with no elevation in acidity levels within tailings material expected.

Iron ore products will be loaded into on-highway road trains and transported to railway infrastructure approximately 57 km northwest to Moorine Rock rail siding. Products will be loaded from the stockyard at Moorine Rock rail siding into ore cars and transported along existing rail infrastructure to the Port of Kwinana (Kwinana Bulk Terminal), Western Australia. The Port is operated by Fremantle Ports. The Moorine Rock rail siding, rail haulage transport and Kwinana Port Operations are excluded from this project assessment.

Various buildings will be constructed at the Mt Caudan mine site, including a temporary construction office, mine/operations administration complex, mine/operations crib rooms with toilets, workshop/warehouse/laydown facility, fuel management facility (storage tanks and in/outloading pumps), vehicle park-up (including go-line and water stand-pipe) and heavy/light vehicle wash down bays.

Water for the mine site will be provided from pit dewatering bores. Bore water will be treated (in part) by a desalination plant which will provide fresh water for the site. The remaining bore water will be used for dust suppression during operations.

Power for the site will be provided initially from on-site diesel generators and then changed over to a new 33 kV power line supply connected to existing mains situated at Marvel Loch.

A summary of the main elements of the Project is shown in Table 1.

Table 1: Summary of the Main Elements of the Project

Element	Description
Life of Project	7 -10 years (current JORC resource and Export Port Capacity)
Mining Resource	30 Mt
Mining Method	Open pit
Mine Operation	Continuous
Depth of Pit	Up to 135 m
Depth to Water Table	60 m (365 mRL)
Total Area of Disturbance	421 ha (approx)
List of Major Components: Pit Process plant Waste rock landform Tailings storage facility	 Open pit, 4.0 km (L) x 0.4 km (W) x 135 m (D) Mobile Crushing and Screening (year 1) replaced by Permanent Crushing and Screening with Wet-Plant/Beneficiation (year 2+) Contour profiled 2.0 km (L) x 0.5 km (W) x 45 m (H – maximum) Approximately 0.8 Mm^3 capacity 400 m (W) x 400 m (L) x 11 m (H) – 5 lifts
Ore Mining Rate	4 Mtpa (nominal), 4.6 Mtpa (max)
Total waste rock	55 Mt (approx)
Dewatering Rate (approximate)	14 L/s – mine pit
Water Supply: Source Maximum daily requirement	 Pit Dewatering Bores Supply 1.1 ML/day (year 1) then 1.8 ML/day (year 2+)

Element	Description
Maximum annual requirement	321 ML/year (year 1) then 506 ML/year (year 2+)
Power Generation and Requirements	Initially diesel generation (during construction and initial operation), then 33 kV Grid power from Marvel Loch
Fuel Supply	Fuel Bunkers (nominally 3 x 110 kL).
Ore Haulage	57 km, 14 road trains
Operating Hours	24 hrs per day, 7 days per week
Operations Workforce	159 people (114 average on-site)
Construction Period Construction Workforce	Up to 12 months Up to 250 people (peak)
Construction commencement (anticipated)	July 2011

Figure 2 shows the project area and site layout and includes:

- Mt Caudan North and Central Deposit approximately L2.6 km x W0.4km x D0.135 km and Mt Caudan South Deposit approximately L1.4km x W0.2km x D0.05 km.
- Waste rock landform on the eastern side of the open pits approximately 45 m in height.
- Low grade and ROM landform on the western side of the open pits approximately 10 m in height.
- Road network including mining haul roads, light vehicle roads, bores, explosive magazine and pipeline service corridors for the mine.
- Tailings storage and evaporation pond facility including pipeline service corridor.
- Plant, Infrastructure and Administration facility.

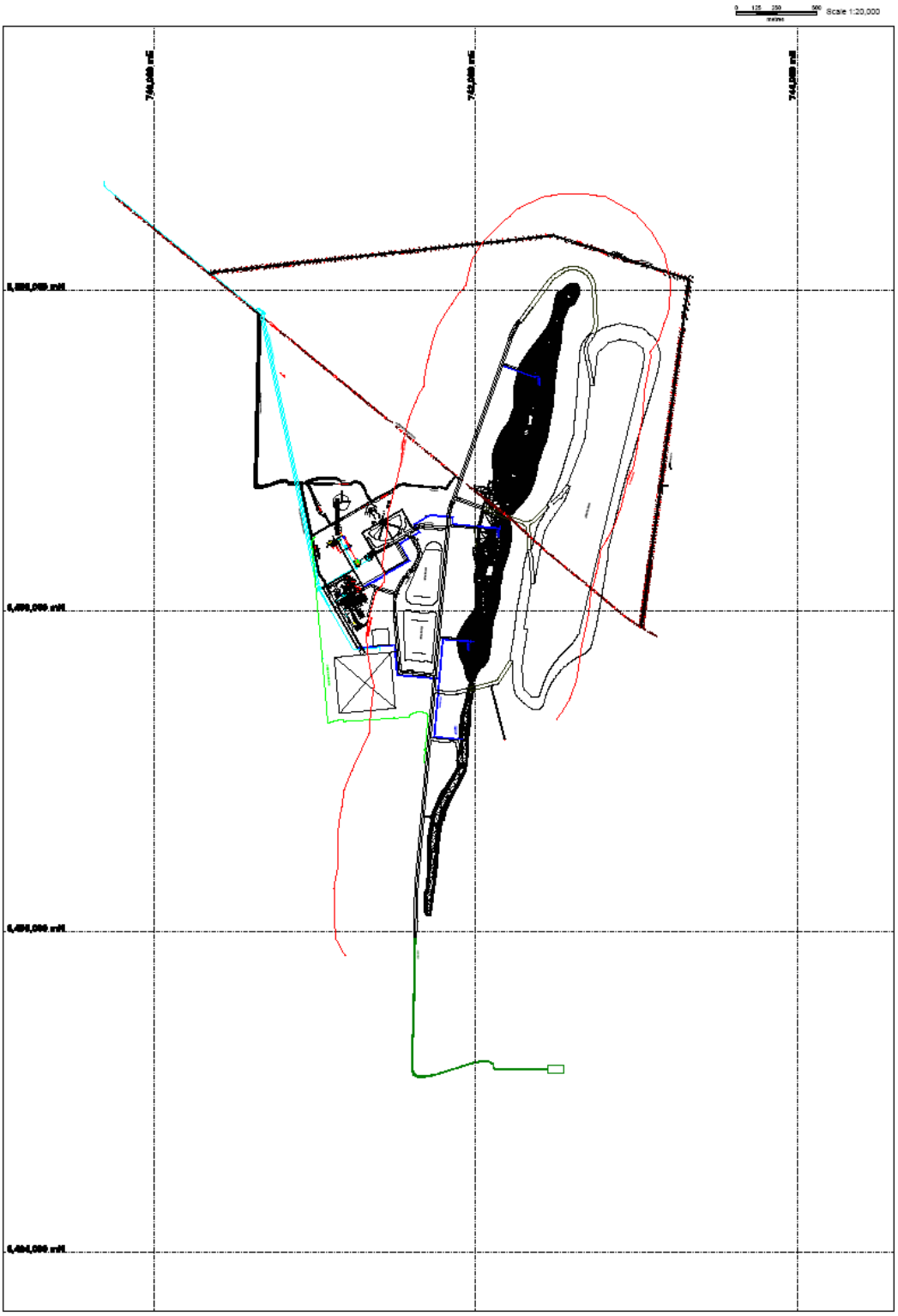

Figure 2: Project Area and Site Layout

2.1 Mining Program

Cazaly propose to mine iron ore from the Parker Range deposit by conventional open pit hard rock mining methods at 4 Mtpa. The estimated life of the mine is 7 - 10 years based on current economically mineable JORC resources and available port allocation.

The mineable ore is located to 135 m depth and occurs along a strike length of 4.0 km and to width 0.4 km within the BIF for the Mt Caudan deposit (refer to Figure 2).

An open pit will be developed to mine the ore body using a conventional drill and blast operation at 18 m bench intervals and 6 m bench widths (governed by local geotechnical conditions).

The estimated total material movements are presented in Table 2.

Table 2: Forecast Mining Material Movement - Ore and Waste

Description*	Units	Year 1-2		Year 3-7		Total LOM	
		Ore	Waste	Ore	Waste	Ore	Waste
Mining tonnage	Mt	5.42	11.45	24.19	43.86	29.6	55.3
Mining volume	Mbcm	1.79	5.35	8.5	21.48	9.9	26.8

*all material movement quoted in dry tonnes and insitu bcm.

3.0 CLOSURE PLAN OBJECTIVES

The objectives of this Conceptual Rehabilitation and Closure Plan (CRCP) as recommended in the Strategic Framework for Mine Closure by the Australia and New Zealand Minerals and Energy Council (2000) include:

- To enable all stakeholders to have their interests considered during the mine closure process;
- To ensure the process of closure occurs in an orderly, cost effective and timely manner;
- To ensure there is clear accountability, and adequate resources, for the implementation of the closure plan;
- To establish a set of indicators that will demonstrate the successful completion of the closure process.

This CRCP provides a framework for Cazaly to enable rehabilitation of the disturbed areas to ensure that soil erosion and subsequent sedimentation are minimal and to establish a self-sustaining vegetation complex similar to that found in the surrounding landforms.

The plan takes into consideration:

- Public health and safety.
- Regulatory requirements.
- Expectations of stakeholders.
- Geotechnical stability and the suitability of final landforms.
- Sustainability of revegetated areas and surrounding ecosystems.
- Post-closure land use objectives.

The plan outlines specific closure and rehabilitation works to be undertaken for each item of infrastructure to ensure self sustaining, safe, non-eroding, stable and non-polluting structures are achieved. Specific closure objectives relating to each aspect of the project are discussed in Section 8.0, Conceptual Closure Assessment.

Regulatory agencies and industry bodies have established guidelines (industry best practice) to assist mining companies to achieve acceptable standards of mine closure and rehabilitation.

Project Closure objectives will be achieved by:

- Establishing through survey and investigation a baseline of the environment prior to project disturbance.
- Allocating appropriate cost and resource provision requirements.
- Planning mining and associated activities to best fit with closure concepts.
- Consulting with stakeholders to determine post closure land use and completion criteria for the project areas.
- Undertaking environmental monitoring to ensure that rehabilitation techniques have been successful in achieving post closure land use criteria.

This CRCP is a conceptual document and will be reviewed and updated based on best practices and rehabilitation trial outcomes on a three-yearly basis throughout the life of the project. The document will be reviewed into a final closure plan at least two years prior to planned closure of the Parker Range Project. The Completion Criteria will be further developed and refined over the life of the project as data is collected and the closure plan is reviewed.

4.0 LEGAL OBLIGATIONS

Cazaly will comply with the provision in applicable Acts and their Regulations during closure which include the following but may not be restricted to the:

- *Aboriginal Heritage Act* 1972.
- *Conservation and Land Management Act* 1984.
- *Dangerous Goods Safety Act* 2004 *and Regulations.*
- *Environmental Protection Act* 1986 *(and Administrative Procedures* 1993*).*
- *Environmental Protection (Noise) Regulations* 1997.
- *Environmental Protection (Clearing of Native Vegetation) Regulations* 2004.
- *Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth).*
- *Heritage of Western Australia Act* 1990*.*
- *Land Administration Act* 1997.
- *Land Drainage Act* 1925.
- *Local Government Act* 1995.
- *Local Government (Miscellaneous Provisions) Act* 1960.
- *Mines Safety and Inspection Act* 1994*, Mines Safety and Inspection Regulations* 1995
- *Mining Act 1978 and Regulations* 1981.
- *Native Title Act* 1973 *(Commonwealth).*
- *Occupation Safety and Health Act* 1984.
- *Rights in Water and Irrigation Act* 1914.
- *Wildlife Conservation Act* 1950.
- *EPA Guidance Statement No 6: Rehabilitation of terrestrial ecosystems.*
- *ANZMEC/MCA (*2000*). Strategic Framework for Mine Closure.*
- *DITR (*2006*), Mine Rehabilitation.*
- *DITR (*2006*), Mine Closure and Completion.*
- *DME (*1997*), Safety Bund Walls Around Abandoned Open Pit Mines.*
- *WRC (*2003*), Hydrogeological Record Series Report No. 9: Mine Void Water Resource Issues in Western Australia.*
- *Mining Act* 1978 *and Regulations* 1981*.*
- *Mines Safety and Inspection Act* 1994 *and Regulations* 1995*.*
- *EPA Act* 1986*.*
- *Contaminated Sites Act* 2003*.*

4.1 Guidance Documents

The following documents are relevant to this conceptual rehabilitation and closure plan.

- Strategic Framework for Mine Closure (ANZMEC/MCA, 2000);
- Mine Closure Guidelines for Mineral Operations in Western Australia (CME, 2000);
- Enduring Values – The Australian Minerals Industry Framework for Sustainable Development (MCA, 2004);
- Relevant sections of the Best Practice Environmental Management in Mining Series (EA, 2006, 2007, 2008, 2009).

This CRCP has been developed to be consistent with the principles of these guidelines.

5.0 STAKEHOLDER INVOLVEMENT

This CRCP for the Project site has been developed to incorporate advice received from the various stakeholders obtained during the initial assessment of the project. Obtaining advice will be ongoing.

This report will be submitted to Department of Mines and Petroleum (DMP) as the lead agency in regulating closure rehabilitation for mine sites in Western Australia. DMP has the authority to direct final outcomes and for the relinquishment of the environmental performance bonds and release from rehabilitation obligations.

5.1 Consultation Undertaken

Table 3 lists the groups and organisations Cazaly have consulted with in relation to the Project, operations, mine closure and rehabilitation since 2009.

Table 3: Consultation Register

Meeting Date	Stakeholder (Attendees)	Parker Range Project Attendees	Meeting Purpose / Consultation Discussion
31 August 2009	CBH Group (M.Johnson, E.Kalajzic)	M.Timbrell	Discussions regarding shared synergies at CBH Grain Terminals with the Project at Southern Cross, Moorine Rock, and Bodallin).
2 September 2009	Shire of Yilgarn (P.Clarke, R.Bossenberg)	M.Timbrell, M.Walker(Lycopodium), J.Shaw (Lycopodium, A.Harvey(Lycopodium)	Discussion Project issues from mine development to truck routes and existing commerce / infrastructure in Shire.
2 September 2009	CBH Group (A.Walker)	M.Timbrell, M.Walker(Lycopodium), J.Shaw (Lycopodium, A.Harvey(Lycopdoium)	Site inspection of regional CBH Grain rail sidings and discussion technical issues.
11 September 2009	Main Roads of Western Australia (D. Morgan)	M. Walker (Lycopodium)	Government policy associated with RAV trucking, concessional loading schemes (West of Kalgoorlie) and Project freight task (use Shire roads).
3 to 9 November 2009	Traditional Land Owners (Gubrun People, Central West People, Ballardong People)	W.Glendenning(WHR)	Site visit and discussions regarding Project area. No areas/sites of significance identified by any group.
12 October 2009	Western Power (T. Linley)	J. Shaw(Lycopodium)	Discussions regarding Marvel Loch power system and capacity for supply to Project.
16 October 2008	Department of Environment and Conservation (S.Thomas, D.Coffey)	K.Lindbeck(KLA)	Discussion regarding fauna surveys and further work for Project.
20 November 2009	St Barbara Mines Ltd (K.Payne, R.Parray, D.Rose)	M.Timbrell, B.Osmetti(Lycopodium)	Discussion synergies between Marvel Loch and Airport between Marvel Loch Gold Operations and the Project.
13 November 2009	Shire of Yilgarn (Councillors)	M.Timbrell, N McMahon, C.Jones	Presentation of Project and discussion on key issues.
4 December 2009	Shire of Yilgarn (P.Clarke)	J. Shaw(Lycopodium)	Discussion on water and health requirements and building code requirements.
15 December 2009	Dept of Mines and Petroleum / Department of Environment and Conservation (A.Bartleet, D.Coffey)	M.Timbrell, K.Lindbeck(KLA)	Discussions regarding mining and environmental impact assessment for Project (including mine closure, water and flora/fauna)
19 January 2010	Department of Education (P.Newnham)	M.Timbrell	Discussion and finalise approach development approach for Marvel Loch School Site.
8 February 2010	Office of EPA (H.Dagnall, P.Tapsell)	M.Timbrell, K.Lindbeck(KLA)	Discussions regarding review of ESD submission for Project
20 February 2010	CBH Group (A.Walker, G.Smallman, E.Kalajzic)	M.Timbrell	Discussions regarding proposed rail terminal locations and grain siding proximity for the Project.
24 February 2010	Australian Railroad Group (I.McLeod,T.Stratton, M.Jones)	M.Timbrell, J.Goodall(BRS)	Discussions regarding rail freight requirements for Project.
24 February 2010	Department of Environmental Conservation & EMB (D.Coffey, S.Thomas, N.Caporn)	M.Timbrell, J.Williams(Botanica), K.Lindbeck(KLA)	Discussions regarding the vegetation, flora, fauna and water surveys at the Project.

Meeting Date	Stakeholder (Attendees)	Parker Range Project Attendees	Meeting Purpose / Consultation Discussion
26 March 2010	Office of EPA / Department of Environment and Conservation / Environmental Management Branch (H.Dagnall, P.Tapsell, N.Caporn, D.Coffey, S.Thomas)	M.Timbrell, J.Williams(Botanica), K.Lindbeck(KLA)	Discussion regarding ESD and alignment on key environmental criteria for impact assessment.
15 April 2010	Department of Indigenous Affairs (S.McGann, C.Rodregez)	M. Timbrell, W.Glendenning(WHR)	Consult findings Heritage Surveys and discuss Cultural Management Plan requirements.
16 April 2010	Various Yilgarn Rural Landholders	M. Timbrell	Consult on various truck route options to propose Moorine Rock Rail Terminal.
20 April 2010	Truck Route Stakeholders & Shire of Yilgarn Councillors	M. Timbrell, N. McMahon	Present findings of truck route options and seek feedback for recommended truck route.
5 May 2010	Various Yilgarn Rural Landholders	M. Timbrell, R. Haigh (Cardno)	Consult on various truck route options to propose Moorine Rock Rail Terminal.
2 June 2010	Department of Environment and Conservation (S.Thomas, D.Coffey, M.Smith), Office EPA (H.Dagnall)	M.Timbrell, J.Williams (Botanica)	Overview of studies and impact assessment discussion on flora.
3 June 2010	Shire of Yilgarn (E.Piper, W.Dallywater, R.Bossenberg, V.Murphy)	M. Timbrell, I Jaeche	Consult on various issues for truck route, Rail Terminal and Village Development.
11 June 2010	Conservation Council (G.Rundall), Greater Western Woodlands (P.Price), Wildflower Society (B. Moyle)	M.Timbrell, J.Williams (Botanica)	Site visit to Parker Range and field observation/discussion on Priority vegetation and flora in impact area.
15 June 2010	T.Wibisono (DOW)	M.McGowan (Rockwater)	Discuss water bores and water exploration.
7 July 2010	Office of EPA (H.Dagnall, J.Dell, P.Tapsell, C.Murray), DEC (S.Thomas, D.Coffey)	M.Timbrell, C.Jones J.Williams (Botanica) K.Lindbeck, V.Saffer (KLA)	Site visit to Parker Range and field inspection vegetation, flora and fauna
19 August 2010	DEC (S.Thomas, D.Coffey), DOW (J.Rose, Y.Brookes, R.Short), DMP (E. Bouwhuis)	M.Timbrell, J.Williams (Botanica), K.Lindbeck, V.Saffer (KLA), N.Everlegh (Rockwater)	Discussion on PER and consultation on key environmental factors and impacts. Mining discussion on closure and rehabilitation proposed.
9 September 2010	DEWHA (L.Butterfield, T.English)	M.Timbrell, N.McMahon, K. Lindbeck (KLA)	Discussion on PER and consultation on controlling actions.
24 September 2010	Malleefowl Preservation Society (S.Dennings, A.Dennings)	M.Timbrell V.Saffer (KLA)	Discussion on Malleefowl impacts and consultation for preservation initiatives.
16 December 2010	Department of Mines and Petroleum (E.Bouwhuis, D.Endacott)	M.Timbrell	Discussion regarding Mining Proposal, waste landform design and tenure for Project.

5.2 Future Consultation

Cazaly will aim to maintain a high level of communication throughout the Project and to obtain input from stakeholders in relation to all aspects of the development, emphasising environmental management options and seeking improvements in performance.

Cazaly will continue to identify stakeholders for closure consultation during the life of the project and will provide updates on closure developments on an ongoing basis. Once the options and schedule for closure have been narrowed down, a targeted consultation strategy will be developed which will provide information to stakeholders and address any concerns raised.

Table 4 lists the groups and organisations Cazaly will be consulting with in relation to the Project, operations, mine closure and rehabilitation in the future.

Table 4: Future Consultation Register

Government Stakeholders	Consultation to be Undertaken	Proposed Timing
Office of the Environmental Protection Authority	• Compliance to ministerial conditions *EPA Act* Part IV regarding rehabilitation and mine closure.	• Annual frequency during operations.
Department of the Environment, Water, Heritage and the Arts	• Compliance to ministerial conditions *EPBC Act* regarding rehabilitation and mine closure.	• Annual frequency during operations. • Annual report following closure.
Department of Environment and Conservation	• Review of methodology and quadrat selection for EFA reference sites to be used in rehabilitation. • Progressive EFA trials and rehabilitation results, discussion on mitigation measures (if required) to improve probability of success.	• Ongoing during operations.
Department of Mines and Petroleum	• Consultation (annually) on changes and best practices adopted for mine closure in Western Australia. Updated CMCP's to be provided as revised by Cazaly. • Submission and approval of 3 yearly Mine Closure and Rehabilitation Plan. • Progressive EFA trials and rehabilitation results, discussion on mitigation measures (if required) to improve probability of success. • Consultation (annually) on changes and best practices for mine closure in Western Australia.	• Annual frequency during operations. • Every 3 years (triennial) during operation. • Annual basis during operations and mine closure activities. • Annual basis during operations
Department of Water	• Consultation on aquifer drawdown and recharge modelling results, including water quality monitoring.	• Annual basis during operations and mine closure activities.
Main Roads of Western Australia	• Progressive notices on heavy vehicle operations and cessation of operations.	• 6 months prior to mine closure.
Shire of Yilgarn	• Consultation on shire road network and community safety of mine site.	• 1 year prior to mine closure.
Department of Indigenous Affairs	• No consultation envisaged, unless heritage site is discovered.	• Not applicable.
Non-Government Stakeholders	**Consultation to be Undertaken**	**Proposed Timing**
CBH Group	• Consultation on cessation of road haulage operations and wheat haulage interaction.	• 3 months prior to mine closure.
Conservation Council	• Consultation on draft CMCP and recommended inclusions to final measures adopted.	• Triennial with each review of Closure Plan
Greater Western Woodlands	• Consultation on draft CMCP and recommended inclusions to final measures adopted.	• Triennial with each review of Closure Plan
Wildflower Society	• Consultation on draft CMCP and recommended inclusions to final measures adopted.	• Triennial with each review of Closure Plan
Malleefowl Preservation Society	• Consultation on draft CMCP and recommended inclusions to final measures adopted.	• Triennial with each review of Closure Plan
St Barbara Mines Ltd	• Shared experiences with rehabilitation trial results and effective methods for the region. • Consultation on possible synergies associated with mine closure and residual infrastructure.	• Ongoing during operations. • 1 year prior to mine closure.
Water Corporation	• Consultation on water infrastructure and preservation for future use (associated with import of water from Perth-Kalgoorlie Pipeline).	• 6 months prior to mine closure.
Western Power	• Consultation on power supply infrastructure and preservation for future use.	• 6 months prior to mine closure.

Government Stakeholders	Consultation to be Undertaken	Proposed Timing
Truck Route Stakeholders	• Consultation on cessation of haulage operations.	• 6 months prior to mine closure.
Traditional Land Owners (Gubrun People, Central West People, Ballardong People)	• No consultation envisaged, unless heritage site is discovered.	• Not applicable.

6.0 RISK ASSESSMENT

6.1 Existing Legacies

Cazaly has undertaken an extensive drilling program at Parker Range and has an existing commitment to rehabilitate drilling activities as follows:

- Remove all plastic sample bags from site.
- Concrete plug drill holes below surface.
- Rip all drilling tracks, grid lines and pads to promote regrowth.
- Obstruct access to drilling track to enhance opportunity for regrowth.

A large majority of drilling tracks will be encompassed in the disturbed area; hence there are effectively no existing legacies at the project.

6.2 Future Risks

A risk assessment and register has been undertaken by Cazaly to identify potential risks associated with the project and their closure plan and works proposed to integrate these issues for closure (Table 5).

The environmental risk assessment was undertaken in accordance with Australian Standard HB 203:2006 Environmental Risk Management. The methodology and risk tables used are shown in Table 5.

Table 5: Potential Risks Associated with Closure and Rehabilitation of the Project

POTENTIAL INCIDENT / UNWANTED EVENT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CAUSE	CLOSURE CONTROL TO BE IMPLEMENTED
PIT							
Pit wall failure.	Slumping.	E	2	14	H	Erosion.	Pit has been designed by geotechnical engineers to ensure its stability. Construction of suitable abandonment bund.
ARD generation from exposed rock in pit walls.	Groundwater contamination.	E	4	25	L	If exposed rock in walls is PAF, exposed rock may react with water seepage from walls.	No PAF rock identified.
Poorly constructed bund.	Stability of bund and susceptibility to erosion.	E	3	19	M	Poor design and construction.	Construction will be designed and supervised by an engineer. Bund will be outside zone of instability and 2 m in height.
Access by public.	Public safety issue.	C	4	18	M	Ready access to pit.	Abandonment bund around final void will deter people from vicinity of the open pit. Signage and/or barrier if necessary.
Aesthetics.	Visual impact.	E	2	23	L	Creation of pit void.	Pit will not be visible from main road. Rehabilitation of surrounding areas.
Pit Void Lake attracting fauna.	Attraction of indigenous and predatory feral fauna to water source. Increase in grazing pressure with negative impact on flora and vegetation.	A	2	23	E	Creation of pit void lake from recovering water table.	Feral animal eradication and monitoring. Backfilling of south deposit pit at mine site. Abandonment bund to be installed (per DMP requirements) north and central open pits. Fencing of the north and central open pit voids (future - if required).
WASTE LANDFORM							
Slope failure.	Sedimentation. Safety.	E	3	19	M		Waste landform has a low overall elevation and long angle of relief that provide a degree of erosion protection.
Erosion of waste landform batters.	Sediment loading to surrounds.	E	3	19	M	Heavy rainfall. Lack of stormwater diversion. No drainage control on waste landform. Wind erosion.	Bunds will be constructed at the top edge of the waste landform and berms at 10 m vertical interval on the side slopes to divert stormwater. Effective waste landform construction. Drainage Management. Rehabilitation.
ARD generation.	Contamination of surrounding soils and water.	E	4	25	L	PAF material in waste rock.	No sulphides or PAF material identified.

POTENTIAL INCIDENT / UNWANTED EVENT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CAUSE	CLOSURE CONTROL TO BE IMPLEMENTED
Surface water.	Sedimentation. Contamination and interruption of water courses.	D	3	17	M	Poor waste landform design.	Placement of drainage control measures. Erosion resistant cover. Rehabilitation.
Excessive dust.	Air pollution – particulates. Contamination of vegetation and water.	D	4	20	L	Wind erosion.	Revegetation of the waste landform.
Aesthetics	Visual impact.	E	4	23	L	No consideration to surrounding landforms.	Waste landform has been designed with low slopes and will blend in with surrounding landscape.
PLANT AND INFRASTRUCTURE							
Remaining chemical or hydrocarbon material.	Soil contamination. Prevention of vegetation growth.	D	4	20	L	Spill during operations not cleaned up.	During rehabilitation works any hydrocarbon spills will be cleaned up. Hydrocarbon contaminated material will be removed from site.
Rubbish.	Source of contamination to surrounds. Encourage feral animals.	D	4	20	L	Disposal of rubbish inadequate. Failure of landfill to be covered adequately.	Removal of all rubbish from site during rehabilitation works. Covering of landfill.
Concrete.	Soil pollution. Prevention of vegetation growth.	D	4	20	L	Not removed from site.	Break up and bury or cover with waste rock.
Surface runoff.	Contaminated drainage.	D	4	20	L	Infrastructure altered natural drainage lines.	Revegetation.
TSF							
Seepage.	Groundwater contamination. Soil contamination.					Poor TSF management. Poor wall compaction. Wrong wall material selection.	Careful management of TSF during operation. TSF monitoring bores to be sampled post-closure (for up to five years).
Dust.	Contamination of vegetation and water.	D	4	20	L	Fine materials on surface. Surface materials dry out.	Revegetation. Store and release cover.
Structural instability.	Erosion.	E	3	19	M	Poor TSF management during operation.	Drainage control. Progressive rehabilitation.
Aesthetics.	Visual impact.	E	4	23	L	No consideration of location of final landforms relative to public access areas.	Rehabilitation. Effective landform and cover design.
Public and fauna safety.	Injury or death.	C	4	18	M	Ready access to TSF.	Rehabilitation. Restrict Access.
REHABILITATION							
Compaction of soils.	Prevent revegetation. Increased erosion.	D	3	17	M	Equipment and machinery used for rehabilitation work.	All areas of compacted soils will be deep ripped on the contour.
Rehabilitated areas with minimal vegetation growth.	Air Pollution (particulates). Lack of rehabilitation. Visual impact (aesthetics). Erosion of landform.	C	3	13	H	Insufficient rainfall. Heavy rainfall washing away seed and topsoil. Inappropriate species used. Poor quality topsoil used.	Use local plant species for re-seeding. EFA monitoring to assess rehabilitation.

POTENTIAL INCIDENT / UNWANTED EVENT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CAUSE	CLOSURE CONTROL TO BE IMPLEMENTED
Invasion by weeds.	Reduction on germination and growth of native species.	C	4	18	M	Lack of weed hygiene mechanisms on incoming equipment/machinery.	Machinery hygiene guidelines to minimise weed spread. Regular inspections and control of declared weed species.

7.0 CONCEPTUAL CLOSURE CRITERIA

Completion criteria for closure of the site are:

- All relevant legislative requirements and ministerial commitments have been met.
- Post-closure land use objectives and closure management requirements have been established and agreed upon with stakeholders and regulatory agencies through effective consultation.
- Consultation, accountability, costs and resource requirements for closure of the project have been determined and facilitated.
- Potential contaminated areas have been remediated to acceptable levels as agreed with stakeholders and regulatory agencies.
- All infrastructure not required by a post-closure land user has been removed and disposed of appropriately.
- Post operational landforms have been shaped so they are geotechnically stable and adequately consider erosion and drainage.
- As much as is practicable, final landforms are compatible with the surrounding landscape.
- Native plant species to be seeded on landforms.
- There are no unsafe site areas where the general public could gain inadvertent access.

Section 8.0 lists the closure assessment (guided by criteria) specific to each element of the mine.

8.0 CONCEPTUAL CLOSURE ASSESSMENT

The following section provides the conceptual design criteria and appropriate closure activities. At this stage it is not possible to anticipate exactly the actions required for closure due to the potential for changes in technology available to the mining and processing industries and closure standards over time.

Cazaly will remove above-ground infrastructure from the mine area including buildings, machinery, roads, hazardous materials and equipment. This infrastructure will be re-used, recycled or disposed of (as appropriate).

Buried mine infrastructure, and mine infrastructure that has a foreseeable future use (specifically powerline and communications towers external to mine lease), will remain insitu. The powerline will be an asset of Western Power (future State use) and the communication towers an asset of the Communications contractor (able to expand services to farming areas).

Any retained infrastructure will remain insitu upon contractual acceptance of ongoing asset liability (post-mine closure) as accepted by Western Power and the Communications contractor.

In regards to post closure access, a 10 m width road comprised from a haul road and internal mine access road will be retained to enable long-term access for rehabilitation works, monitoring and maintenance. Other sections of haul roads and internal mine access roads will be rehabilitated in accordance with assessment herein.

The following conceptual closure assessment details criteria specific to each of the main areas of the project. Completion criteria for closure will be further developed and detailed during the project lifetime.

8.1 Open Pit

8.1.1 Closure Objective

- Establish a safe and stable post-mining land surface.
- Minimise surface water collection.
- Minimise surface water ponding around pit.
- Ensure pit water does not become acidic.
- Ensure public safety - restrict access to pit to discourage third party access.

8.1.2 Closure Criteria

- Pit voids and walls meet stability and safety requirements.
- Safety bund design complies with the procedures detailed in “Safety Bund Walls around Abandoned Open Pit Mines” (DME, 1997).

8.1.3 Options considered

The following options have been considered for mine closure:

- Alternative 1 - No backfilling either Mt Caudan north, central and south open pit zones.
- Alternative 2 - Backfilling Mt Caudan north and central open pit with waste rock material from Mt Caudan south open pit zone.
- Alternative 3 - No backfilling of Mt Caudan north and central, but backfilling Mt Caudan south open pit zone.
- Alternative 4 – Backfill all open pit voids (No Mining as backfilling is not a viable economic alternative for the proposal to proceed).

Alternative 3 is preferred given Mt Caudan south open pit is all above water table (no pit void lake) and thin aspect (size 1.4 km long, width approximately 90 m) which is conjunctive to strip mining and backfilling with 1.2 Mbcm of waste rock. With the exception of no mining, alternative 3 represents the best alternative to minimise impact on the natural environment.

A final pit void will remain following mine closure (Mt Caudan north and central pits). A pit void lake will form and function as a groundwater sink, with equilibrium water level below that of the surrounding area due to natural evaporation. Groundwater levels will recover to be slightly lower than existed pre-dewatering commencement.

Each option is considered in more detail below:

Alternative 1 – No Backfilling

This option involves traditional mine closure techniques, in that the mine pit void is left from mining operations (noting below water table mining is planned in Mt Caudan open pit) and an abandonment bund wall is installed to prevent public, fauna and any unauthorised access to the highwall area and the pit void.

For this option a pit void lake would be established approximately 75 m below the natural surface level and would be a water depth of maximum 60 m.

Alternative 2 – Backfilling Mt Caudan (North and Central) Open Pits

This option involves the same highwall edge protection (per alternative 1), however incorporates the backfilling of approximately 1 million m^3 of waste material from adjacent Mt Caudan Southern deposit into the Mt Caudan (Northern and Central) pit voids. This option has the benefit reducing the volume of the pit void lake; however the estimated volume of the pit void lake will still exceed 30 million m^3.

A further sub-alternative involves the backfilling of Northern and Central pits with approximately 54 MT waste rock. However, the concurrent mining and backfilling of Mt Caudan (Northern and Central) pits is not feasible due to the scheduling and additional economic cost of backfilling 54 MT of waste, which is conservatively estimated to cost A$189 M (2010 cost base). This sub-alternative is not credible due to technical and economic constraints.

The partial backfilling of Northern and Central pits with waste from Southern pit alternative will offer some reduction in lake volume; however, it will be relatively minor in context and hence is not preferred.

Alternative 3 – Concurrent Mining and Backfilling Mt Caudan Southern Open Pit

This alternative involves the same highwall edge protection (per alternative 1), however incorporates the backfilling of the Mt Caudan Southern pit void concurrently with mining operations. As the Southern deposit is planned to be mined at the end of the mining program (as a stand-alone stage), with modest mineralisation, this deposit is most conducive to backfilling.

The thin aspect ratio of the Southern deposit, would allow effective pit establishment, temporary stockpiling and then concurrent backfilling/mining activities with a total material movement of approximately 2 million m^3 (0.7 million m^3 ore and 1.3 million m^3 waste). The economic cost for this alternative is conservatively estimated as A$7 M (2010 cost base).

The Southern pit void could be backfilled to the existing pre-mining landform topography supplemented by approximately 0.7m^3 of waste rock from Mt Caudan north and central pits which would be 1.4 km in length all above natural ground water table.

As this alternative will have a material effect upon the size of the pit void and remaining landform, this option is selected as the preferred closure method for pit void management.

Alternative 4 – Backfilling all Mt Caudan Open Pits

Backfilling all Mt Caudan open pits (No mining, as backfilling is not economically viable for the proposal to precede).

The backfilling of approximately 55 MT of waste rock is conservatively estimated to cost $193 M (2010 cost base) which would render the mine uneconomic. This alternative is hence not preferred.

8.1.4 Work Required at Closure

The location and design of the abandonment bund wall will be in accordance with procedures detailed in DME (1997).

Based on the current mine scheduling and closure planning, Cazaly propose Option 3 to be selected for the open pit closure. Based on current mine pit designs and schedules the pit void volumes at closure are summarised in Table 6.

Table 6: Estimated Pit Void Dimensions and Volume per Option 3 Backfilling Mt Caudan South

Pit Void	Dimensions (LxWxD)	Estimated Volume Below Water Table (M bcm)	Estimated Volume Above Water Table (M bcm)	Estimated Total Volume* (M bcm)
Mt Caudan North and Central	2600 m x 400 m x 135 m	3.03	18.34	21.38
Mt Caudan South	1400 m x 200 m x 0 m	0	0	0
Total Mine Post-Closure	N/A	3.03	19.54	22.57

*Volume estimates based on Runge Mining Report, December 2009.

A final pit void and lake will remain at Mt Caudan (North and Central) mine; with no lake and a similar pre-mining landform (with no pit void) present for Mt Caudan South mine.

During mine closure, indigenous and feral fauna populations will be monitored regarding possible attraction to the recovering pit void lake at Mt Caudan (North and Central) open pits. In the event the population numbers are surveyed to increase materially, then the following actions will be implemented:

- Installation of fauna exclusion fencing around the North and Central open pits; and
- Implementation of feral animal eradication and monitoring program.

A 10 m wide perimeter mine site road will remain around the mine pit void to enable access for ongoing monitoring post closure. As the Mt Caudan south pit will be backfilled, this pit area will be rehabilitated in accordance with EFA criteria within this document.

8.2 Waste Landform

8.2.1 Closure Objective

- Establish a safe, stable and non-polluting post-mining landform which as far as possible supports vegetation growth and is erosion resistant over the long-term.
- Minimise downstream impacts on vegetation due to interruption of drainage.
- Re-establish a self-generating ecosystem comprising local native vegetation which resembles the surrounding environment, as close as is practical.
- Establish a system free of weed species.
- Final landform conforms to design criteria, visually comparable with local area landforms and is resistant to erosive events.

8.2.2 Closure Criteria

- Waste landform has been shaped to design criteria, not to exceed 45 m (consistent with surrounding landforms in area).
- Nil to insignificant evidence of erosion.
- Vegetation cover is self-sustaining and comprises local native species.
- Nil to low establishment of weeds.
- No establishment of 'declared' weeds (as listed by the Department of Agriculture and Food).

8.2.3 Options considered

Cazaly is considering the use of concave slopes in an effort to have more stable outer batters on the waste landform. This will involve a greater area of disturbance and the practicality and effectiveness of this design will be assessed as the project progresses.

Waste formation design is currently based on final side wall profile of 15 degrees measured from the horizontal.

8.2.4 Work required at closure

The waste rock landform will be contour designed and shaped to form stable structures and not exceed the similar surrounding area landforms (designed limited height to 45 m). The waste rock landform will be constructed in four 10 m high lifts.

Construction of final overall batter slopes will be 15 degrees, local contour slopes of 18 degrees, separated by a 2% back sloping 10 m wide berm between the lifts to maximise retention of water.

On the crown and leading edge of the berm, a 1 m high bund will be included to prevent water flowing down batter slopes. The crown will be concave profile to promote water retention and infiltration rather than water shedding.

Peak storm or rainfall intensity events will be included in design (100-year ARI event) by the provision of overflow spillway regions (landform ramps) and on berms to prevent break-out and erosion of the crown and berms. Engineered rock pitching techniques with cross levee bunds will be employed to slow velocity of stormwater to pit void lake. Landform ramps will be sheeted and formed with non-erodible waste rock materials (detritals, basalts and lateritic gravels) yielding less than 5.0 t/ha/yr in 100 year ARI rainfall events.

Cross levee bunds on WRL berms will be positioned at approximately 100 m intervals to slow water flows. Such stormwater flows will be directed into the pit lake void, which will assist in dilution of the gradual salinity increase from evaporation (Figure 3 and Figure 4).

The waste rock landform meets current industry requirements and will be stable in the long term. The waste rock landform will not have an adverse effect on pit stability (Runge, 2010). The waste rock landform is positioned outside the zone of instability for the ultimate pit (Figure 5).

Whilst no sulphides or PAF material has been identified, should any be discovered during mining, the process will be followed for creating a “PAF encapsulation cell” within the waste rock landform. This is a contingency action only in the event PAF material is discovered.

The PAF encapsulation cell in the waste form will be minimum 3 m from the natural ground level to prevent water ingress under the landform after closure. Construction of the encapsulation cell will be from high acid neutralising capacity waste rock material (detrital and basalt), with floor and roof to be minimum 1 m thickness and walls of stable embankment design. The roof will extend 3 m past the walls of the encapsulation cell. A convex crown will be constructed from non-acid forming waste rock on the roof of the encapsulation cell to shed water away from the area (Figure 6).

Stockpiled vegetation will be spread on waste landform surfaces to provide erosion protections and fauna habitat. Stockpiled topsoil will be spread on waste landform surfaces to provide seed source and microbial inoculums.

With the exception of the PAF encapsulation cell, all waste form surfaces will be either deep ripped on contour to assist with water infiltration and provide seed bed or stockpiled vegetation will be spread on waste landform. A conceptual design for the waste landform is provided in Figure 3.

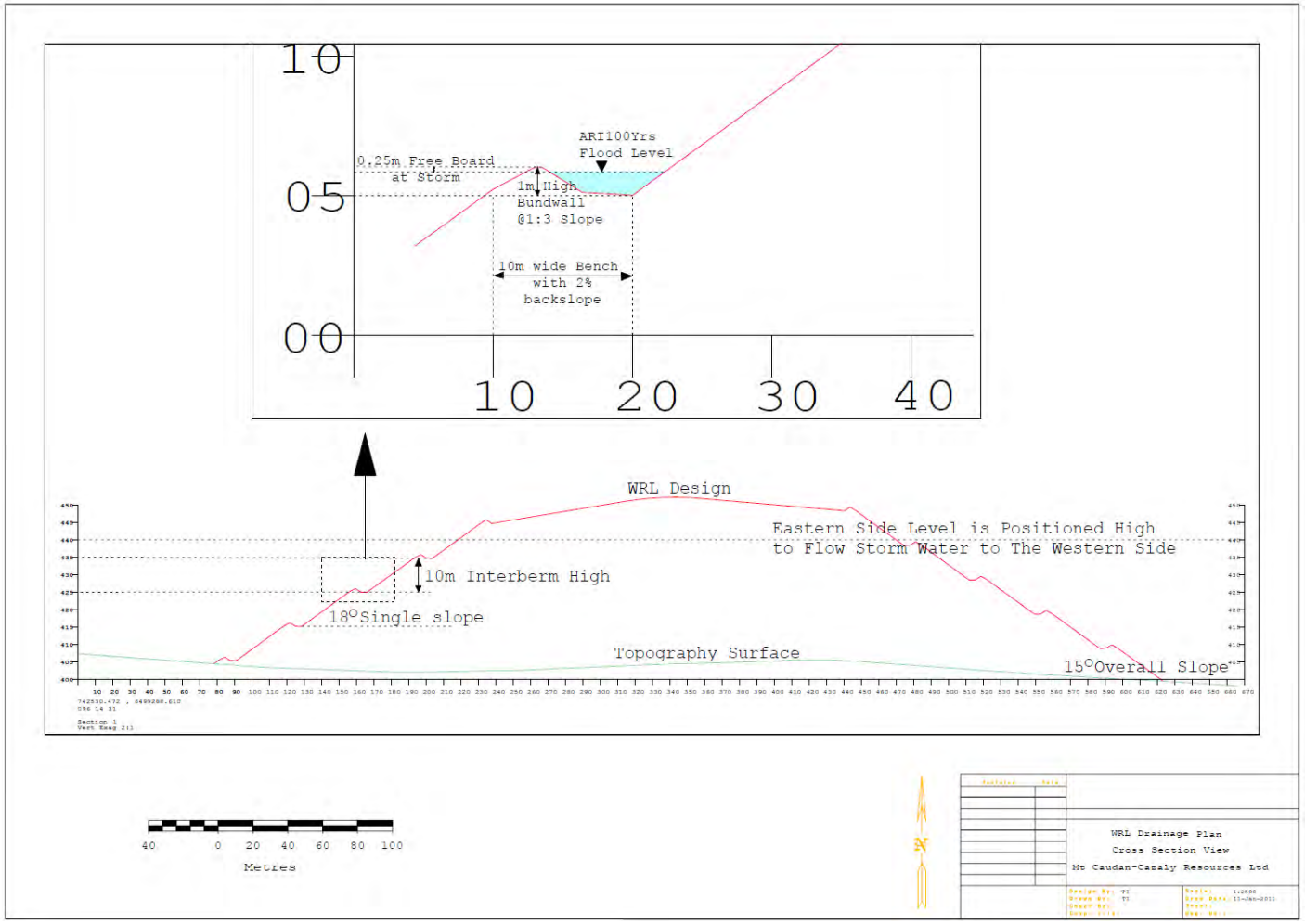

Figure 3: Section of Waste Landform and Stormwater Drainage Design

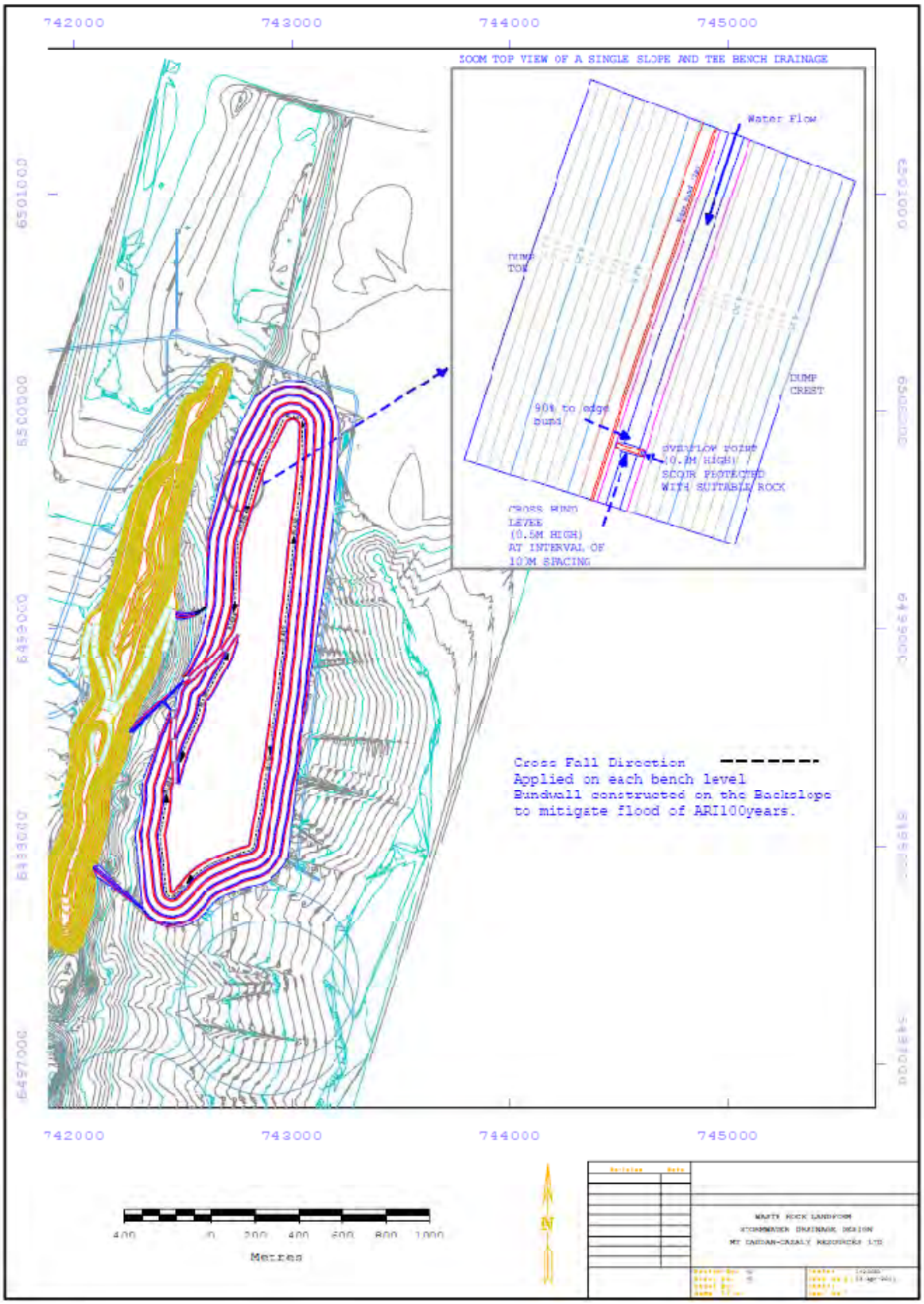

Figure 4: Plan of Waste Landform Stormwater Drainage Design

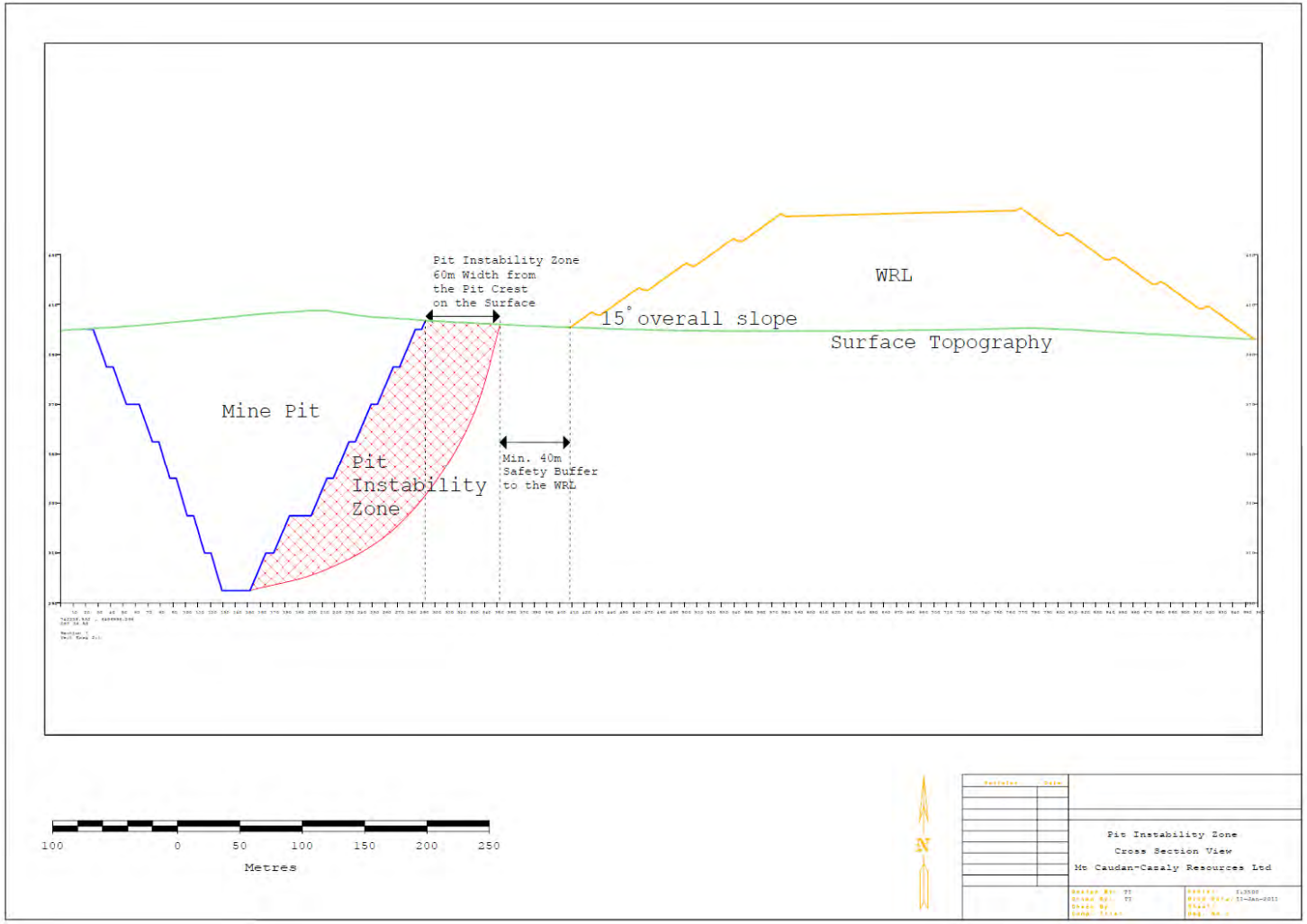

Figure 5: Section of Open Pit and Waste Landform Outside Zone of Instability

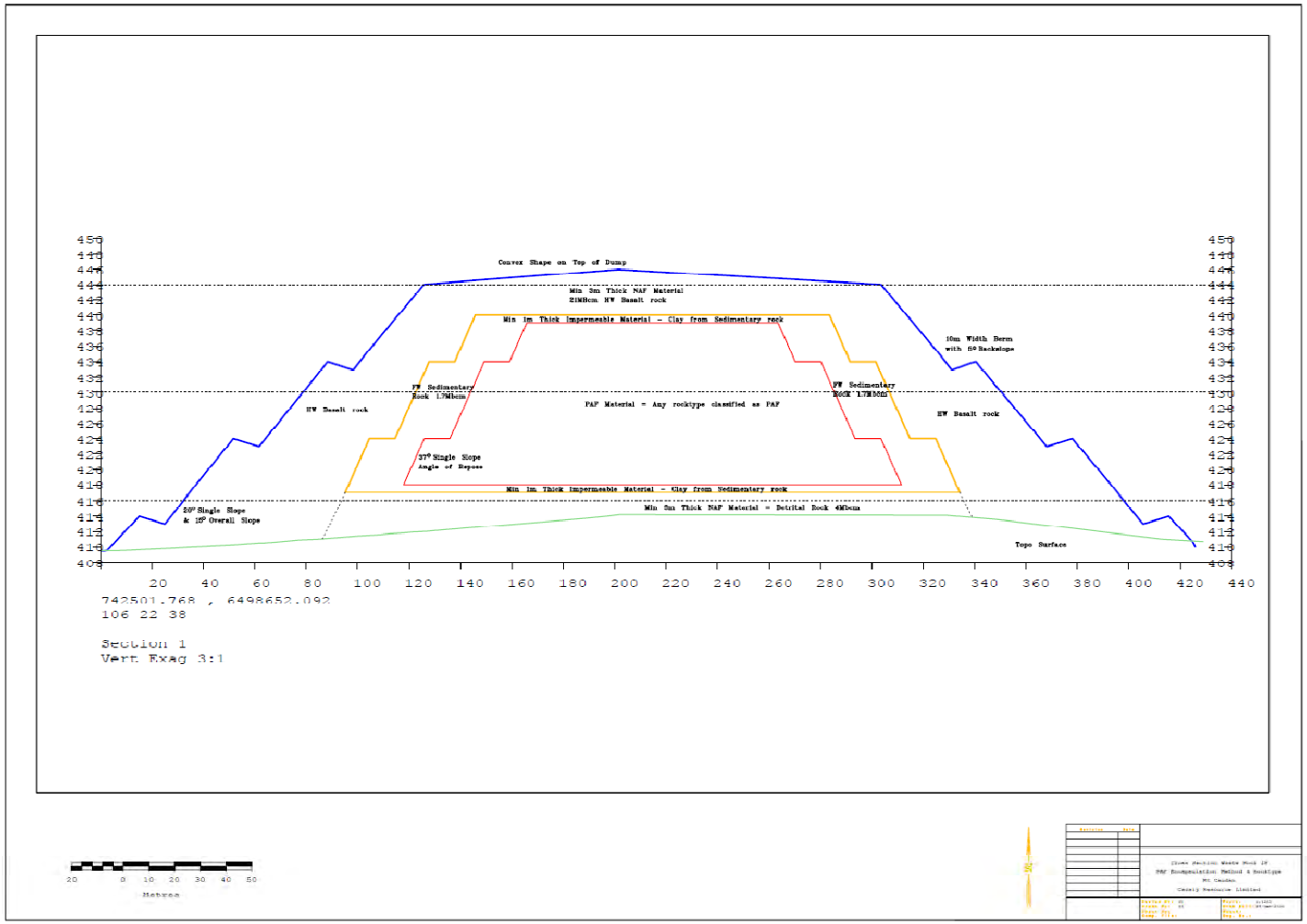

Figure 6: Detail Design of PAF Encapsulation Cell in Waste Landform

8.3 Processing Plant (Dry and Wet Circuits)

8.3.1 Closure Objective

- Remove all sources of potential contamination such as remaining chemicals, mineralised ore, spillage etc.
- Ensure that all Process plant areas are investigated to determine if any contamination is present and if so remediation strategies are developed and implemented.
- Ensure drainage from the plant is contained.
- Ensure that the level of potential contaminants is assessed and material is removed.

8.3.2 Closure Criteria

- Stabilise the surface of all disturbed areas and protect against accelerated erosion from wind and water.
- Vegetation cover is self-sustaining and comprised of local native species.

8.3.3 Options considered

- None required.

8.3.4 Work required at closure

- Dismantle and remove crushing plant, materials handling and beneficiation plant facilities from site.
- Excavate and remove and/or bury concrete bunding and/footings.
- Bury or remove to landfill remaining inert scrap materials which are not suitable for sale or recycling.
- Remove pumps, power generating sets, fuel storage and associated infrastructure. Remove any hydrocarbon contaminated soil.
- Flush out pipelines, cut into sections and remove.
- Pump out excess water in ponds (or let dry out). Push in the plastic liner in ponds and bury. Push down walls of storage area and reshape.
- Remove any residual hydrocarbon materials or contaminated materials.
- Contour to restore natural drainage.
- Re-spread topsoil to near pre-clearing levels (average 0.2 m).
- Deep rip surface to alleviate compaction, mix in the coarse rocks to provide a stable surface and encourage re-growth of native species.
- Seed with local provenance native species.
- Re-spread stockpiled vegetation.

8.4 Tailings Storage Facility (TSF)

8.4.1 Closure Objective

- Establish a safe, stable and non-polluting post-mining landform which supports vegetation growth and is erosion resistant over the long-term.
- To ensure sufficient cover of vegetation will be established to minimise erosion.
- Comply with the closure requirements outlined in DMP ‘Guidelines for the Safe Design and Operating Standards for Tailings Storages’ and the requirements of the DMP Geotechnical Engineer and Environment Branch.
- To ensure that the level of potential contaminants is assessed and its influence negated.

8.4.2 Closure Criteria

- Decommissioning and rehabilitation of the TSF will be in accordance with approved designs submitted to the DMP Geotechnical Engineer.
- On completion, the TSF will have outslopes revegetated and the top surface capped with caprock/waste material and topsoil.
- Stabilise the surface of all disturbed areas and protect against accelerated erosion from wind and water.
- Vegetation cover is self-sustaining and comprises local native species.

8.4.3 Options considered

- Progressive rehabilitation of the TSF walls will be undertaken.

8.4.4 Proposed capping

- The proposed capping of the of the TSF area will involve utilising basalt sized caprock waste material (to Geotechnical Engineer's requirements) and then further capped with topsoil to support revegetation and regrowth.

8.4.5 Work required at closure

- Allow sufficient time for consolidation and drying of tailings to achieve a geotechnically stable landform.
- Submit decommissioning plan to DMP Geotechnical Engineer for assessment and approval.
- Finalise waste rock and topsoil cover investigations.
- Remove and seal decant.
- Progressively revegetate outslopes and cap surface as required.
- Respread topsoil to near pre-clearing levels (average 0.2 m).
- Seed with local provenance native species.
- Weed and pest management options.
- Maintain/establish surface water diversion.

8.5 ROM Stockpile

8.5.1 Closure Objective

- Establish a safe, stable and non-polluting post-mining landform which supports vegetation growth and is erosion resistant over the long-term.

8.5.2 Closure Criteria

- Stabilise the surface of all disturbed areas and protect against accelerated erosion from wind and water.
- All crusher footings have been broken up and buried or covered.
- Revegetation cover is self-sustaining and comprised of local native species.

8.5.3 Options considered

- None required.

8.5.4 Work required at closure

- The ROM pad will be reshaped (if required).
- Where available, growth medium will be spread over the surface of the ROM and the surface will then be ripped, prepared and seeded with local native species.

8.6 Power Supply

8.6.1 Closure Objective

- To leave the site in a safe, stable, sustainable, non-polluting and tidy condition.

8.6.2 Closure Criteria

- All power supply infrastructure is removed and disposed of appropriately (with exception of Western Power owned assets which remain post-closure as part of the State power network).
- Landforms associated with these structures have been reshaped to consider aesthetics, erosion, stability and final land use.
- Revegetation cover (local native species) is appropriate and self-sustaining (refer to Section 9).

8.6.3 Options considered

- None required.

8.6.4 Work required at closure

- Power and communications systems shut off and the buildings and generating sets removed from site. A selected communications tower will remain at the site for the provision of regional communications owned by the local contractor.
- The Western Power overhead power line (at boundary L77/220) on Parker Range Road cables to be terminated and made safe. All other power lines and systems for the mine are to be removed.
- Remove scrap metal from site for sale or recycling.
- Bury remaining inert scrap materials which are not suitable for sale or recycling.
- Remove or bury any concrete.
- Remove any hydrocarbon contaminated soils for remediation.
- Contour to restore natural drainage.
- Deep rip surface to alleviate compaction, mix coarse rocks to provide a stable surface and encourage re-growth of native species.
- Seed with local provenance native species.

8.7 Workshop/Administration area

8.7.1 Closure Objective

- To leave the site in a safe, stable, sustainable, non-polluting and tidy condition.
- Workshop areas are investigated to determine if any contamination is present and if so remediation strategies are developed and implemented.

8.7.2 Closure Criteria

- All administration office, workshops and crib infrastructure is removed and disposed of appropriately.
- All infrastructure associated with dangerous goods storage and refuelling has been removed and disposed of appropriately.
- Storage areas are not classed as a ‘contaminated site’ as per the *Contaminated Sites Act* 2003.
- Landforms associated with these structures have been reshaped to consider aesthetics, erosion and stability.
- Revegetation cover is appropriate and self-sustaining.

8.7.3 Options considered

- None required.

8.7.4 Work required at closure

- Power, water and drainage systems to be shut off and the buildings removed from site.
- Remove scrap metal from site for sale or recycling.
- Bury remaining inert scrap materials which are not suitable for sale or recycling.
- Excavate and remove and/or bury concrete footings.
- Remove any hydrocarbon contaminated soils for remediation.
- Remove any residual hydrocarbon materials from the bulk storage tanks, transfer to a licensed facility for disposal.
- Remove empty bulk storage vessels from site.
- If any contamination is identified, develop an action plan for further sampling and appropriate remediation or removal.
- Sewage effluent treatment tanks will be pumped out and disposed of as required by the local Council. Effluent tanks will be removed or broken up and buried.
- Contour to restore natural drainage.
- Deep rip surface to alleviate compaction, mix coarse rocks to provide a stable surface and encourage re-growth of native species.
- Seed with local provenance native species.

8.8 Explosives Magazine

8.8.1 Closure Objective

- To leave the site in a safe, stable, sustainable, sustainable, non-polluting and tidy condition.

8.8.2 Closure Criteria

- All infrastructure is removed and disposed of appropriately.
- All infrastructure associated with dangerous goods storage (explosives) has been removed and disposed of appropriately.
- Storage areas are not classed as a ‘contaminated site’ as per the Contaminated Sites Act 2003.
- Landforms associated with these structures have been reshaped to consider aesthetics, erosion and stability.
- Revegetation cover is appropriate and self-sustaining (refer to section 9).

8.8.3 Options considered

- None required.

8.8.4 Work required at closure

- Remove all explosives and associated equipment.
- Dismantle the magazine and remove from site for sale or disposal (if transportable), or demolish (if permanent).
- Sample the storage site for the presence of any contamination.
- If any contamination is identified, develop an action plan for further sampling and appropriate remediation or removal.
- Deep rip surface to alleviate compaction, mix coarse rocks to provide a stable surface and encourage re-growth of native species.
- Seed with local provenance native species.

8.9 Haul and Access Roads

8.9.1 Closure Objective

- All infrastructure (e.g. signage) associated with the access and haulage roads will be removed (with the exception of single access road for ongoing closure monitoring).
- All disturbed areas are reshaped to blend into the landscape and rehabilitated.
- Third party access is prevented/restricted.

8.9.2 Closure Criteria

- All infrastructure will be removed and disposed of appropriately.
- Earthwork structures have been removed or modified as appropriate.
- All disturbed areas will be rehabilitated.
- Barriers installed across roads to restrict third party vehicle access.
- All public roads will be made safe for general users.

8.9.3 Options considered

- None required.

8.9.4 Work required at closure

- Bitumen seal and base course will be removed and buried or recycled (base course only). The mine site access road and a selected haul road are to be retained to enable safe access to the pit and site for closure monitoring.
- Culverts and other associated infrastructure will be removed.
- Haul roads and access tracks will be rehabilitated (with the exception of closure monitoring access road). Removal and rehabilitation of the Upper Haul Road will not be undertaken (unless otherwise required per infrastructure agreement).
- All stockpiled growth medium will be respread over the road surface.
- Contour to restore natural drainage.
- Deep rip surface to alleviate compaction, mix coarse rocks to provide a stable surface and encourage re-growth of native species.
- Seed with local provenance native species.

8.10 Water Supply Pipelines and Monitoring Bores

8.10.1 Closure Objective

- Removal of all infrastructure

8.10.2 Closure Criteria

- Leave the site in a safe, stable, sustainable, non-polluting and tidy condition, and to re-establish local native species.
- Vegetation cover is self-sustaining (refer to section 9).

8.10.3 Options considered

- None required.

8.10.4 Work required at closure

- Selected water supply and monitoring bores will be retained for post-decommissioning monitoring.
- Groundwater quality monitoring bores that are not required for ongoing monitoring will be shut down, bore casings cut off below ground surface and holes plugged.
- Water supply bores that are not required for ongoing monitoring will be shut down, bore casings cut off below ground surface and holes plugged.

- Above ground sections of buried pipelines will be cut off below ground surface and the pipelines will remain buried.
- Areas around the bores and pipeline routes, if they have been excessively disturbed, will be contoured, ripped and seeded with suitable species.
- Retained bores will be capped with a lockable steel cap.

9.0 REHABILITATION

Following the civil earthworks required for the removal of mine infrastructure, remediation of contaminated areas and the installation of safety bunding, the mine areas will be rehabilitated for the restoration of environmental values.

Rehabilitation works for the project will involve:

- Collection program within the Parker Range PEC of seed required for the rehabilitation program (18 months prior to closure), conducted in consultation with the DEC.
- Soil and vegetation assessment which will evaluate the depth of rooting systems of each plant species within each vegetation type, identify which species can exist in differing soils and vegetation types tolerances (including tolerances for soil salinity, soil acidity and rooting depth).
- Salinity and acidity testing of soils to determine whether soils are able to support plant growth prior to seeding. This would include sub-soil and construction materials for Project made landforms (e.g. WRL). Identify possible implementation of soil treatment programs (i.e. gypsum, fertilizer addition) to enhance plant growth.
- Deep ripping of hardstand areas for improved soil condition and drainage.
- Respreading of stored topsoil and retained vegetation to provide seed and an appropriate microclimate for seed growth.
- Spreading of local provenance native seed.

Rehabilitation will be undertaken in accordance with EPA Guidance Statement No 6: Rehabilitation of Terrestrial Ecosystems.

Management initiatives for rehabilitation will be guided by the following principles:

- Ensure that vegetation clearing is kept to the minimum.
- Wherever possible use areas cleared during previous mining operations.
- Minimise soil erosion particularly on the batters of the waste landform.
- Collect and correctly stockpile vegetative material and available topsoil for later use at selected sites.
- Progressively rehabilitate completed areas as soon as practicable.
- Only use local native plant species.
- Undertake decommissioning and closure of the site to industry leading practice principles and to statutory requirements.

Cazaly have undertaken a preliminary review of soils, native species and vegetation within the Project area. A methodology for topsoil and vegetation restoration has been prepared (Appendix 2) which outlines:

- Identified native seed species in the Project area.
- Tolerances (rooting depth, soil conditions, water tolerance, etc) for native species based on existing vegetation and regional knowledge.
- Rationale of seed mix selection for vegetation restoration, with specific focus on those recommended for WRL.

The methodology statement (Appendix 2) is proposed to be adopted for a trial rehabilitation program (within 2 years of operations commencement) to further refine restoration criteria within this document. To provide a meaningful indicator, the rehabilitation trial will be undertaken with sufficient bulk waste and topsoil material available.

9.1 Footprint and Clearing

Cazaly have completed a vegetation clearance estimate for the Project (Figure 10) which indicates approximately 421 ha of vegetation will be cleared (Table 7). Of the 421 ha of vegetation cleared, 379 ha are located in mining tenure M77/764, M77/741, M77/742, L77/220, L77/228 and L77/229 (excluding 17.4 ha for TSF).

Table 7: Proposed Disturbance for the Project

Element	Clearing required (ha)
Pit	58.8
Pit Edge Protection	58.4
Waste Rock Landform	119.8
Process Plant and Associated Infrastructure	89.5
Mine Haul/Magazine Roads, Borefield and Pipeline Corridors	42.0
Parker Range Bypass Road	10.3
Power Line	14.6
Site Access Road	2.5
TSF	17.4
Stormwater Diversion Levee	0.7
Upper Haul Road (near Moorine Rock)	6.8*
TOTAL	420.8

*Note: The clearing estimate of 6.8 ha consists of 2.7 ha of already cleared pastoral land and 4.1 ha of proposed clearing to native vegetation.

Based on an average 0.2 m topsoil cover observed throughout the disturbance area, 0.8 Mbcm of topsoil is estimated to be removed and stored for future use.

9.1.1 Design Footprint

The design footprint for the project is based on the preliminary mine site and infrastructure layouts. Prior to disturbance, Cazaly shall seek to reduce required clearing facility areas and infrastructure corridors inclusive of opportunities to progressively rehabilitate temporary cleared areas during both construction and maintenance/operations phases.

9.1.2 Management Actions for Disturbance

Disturbance management actions are provided in project EMP (M8521-G00-EN-PL-001) sub-plan Land Disturbance and Rehabilitation. Implementation of these actions will help ensure that the performance indicators in Section 9.4 are achieved. These actions in summary are:

- Topsoil management measures shall be adopted during clearing to store separately in height not exceeding 3 m (truck tipped). The stockpiles will be located and constructed to reduce the disturbance area for topsoil stockpiling, minimise erosion from rainfall, wind and introduction of saline dust suppression water to preserve soil integrity. Topsoil shall be stockpiled in non-vehicle road areas for example around the base of mine waste landform.
- Vegetation stockpiles will be immediately upslope of the topsoil stockpiles (or in separate stockpiles based on location) to minimise surface water run-on to the topsoil. This stockpiling arrangement will allow minimal handling and transport of both vegetation and topsoil, hence maintaining integrity and minimising soil losses. Provision for 850,000 m^3 of topsoil, subsoil and vegetation has been provided (Figure 7).
- Rehabilitating disturbed areas from construction not required for ongoing operations and maintenance.
- Cleaning down of machinery to reduce weed and disease introduction and spread.
- Induction of employees to communicate field survey identification and ensure disturbance is confined to areas only authorised areas in the field.
- Collect and correctly stockpile vegetative material and topsoil for later use at selected sites.
- Progressively rehabilitate completed areas as soon as practicable.
- Only use local native plant species shall be used for rehabilitation.

The clearance of vegetation and topsoil under the footprint of the waste rock stockpiles will be a gradual process, conducted as required in advance of the growing toe of the waste rock landform. This will minimise the length of time topsoil is stored.

9.2 Progressive Rehabilitation and Topsoil Viability

Cazaly will undertake progressive rehabilitation as soon as practicable (within 6 months) following an area becoming available. Ongoing vegetation trials shall be undertaken to refine the rehabilitation process to maximise the probability of success. Outcomes from rehabilitation trials will be incorporated in this document during three-yearly reviews.

Topsoil will be managed in such a way to help ensure viability, meaning it has the capacity to support native vegetation and a functioning and stable ecosystem. Where possible, topsoil from areas currently being cleared will be placed on rehabilitated sites (direct placement) rather than placing in stockpiles. This will improve the potential for successful rehabilitation.

9.3 Seed Collection

Prior to land clearing and periodically during mine operations, seed collection will be undertaken within the impact area (and adjacent areas if appropriate) to collect seed for rehabilitation.

Seed collections will have a particular focus on the following:

- Dominant species and opportunistic species occurring within and surrounding the disturbed areas will be targeted and seed collected at the optimum time by licensed seed collectors. Prior to the disturbance of any PEC priority species, seed (if available) will be collected and will be stored for use in the rehabilitation program. If required by the DEC, seed will also be supplied to the Threatened Flora Seed Bank and used for propagation and research.
- A preliminary soil-vegetation assessment and identification of target seed mix for restoration trials is provided within Appendix 2.

9.4 Performance Indicators for Rehabilitation

Rehabilitation in this context has been defined as “the return of disturbed land to a stable, productive and self-sustaining condition, after taking into account beneficial uses of the site and surrounding land.” The success of the rehabilitation works will be compared to performance indicators using Ecosystem Function Analysis (EFA).

EFA uses assessed indicators that focus on soil surface processes of landscape function and is able to supply information from the earliest times of rehabilitation up to the satisfaction of completion criteria, with a continuous record of ecological development. EFA will be carried out along established transects and compared to data from analogue (or reference) sites not affected by mining activities. Monitoring will be carried out on an annual basis and over time indicators will show if the rehabilitation is progressing to that of the analogue site.

Vegetation will be surveyed at each transect using 20 x 20 quadrats. Final EFA quadrat selection will be approved by DEC. Species density, composition and canopy cover will be assessed using this monitoring technique. Each tree or shrub seedling will be identified to species or genus level so that species composition and species density can be determined and compared to the analogue sites.

Photographs will be taken at each transect to depict the direction and representative vegetation at each site.

Performance indicators will be developed from a wide range of scientific disciplines and will provide a predictive understanding of ecosystem or landscape trajectory, and thus provide crucial information about trend and response to stress and disturbance. By using analogue sites for the Project it is possible to compare the characteristics of the existing natural environment. The development of site-specific performance indicators is considered more appropriate than a “one size fits all” approach, and is consistent with the approach of ANZMEC & AMI (2000) and DITR (2006) which recommend that performance indicators should be specific to the mine being closed to reflect the unique environmental circumstances of the site, and are achievable.

9.5 Monitoring

Cazaly will monitor the rehabilitation works annually to determine the success of the rehabilitation and any contingency actions that may be required. An outcomes based performance (from EFA) will be utilised to determine rehabilitation success. Methods and monitoring will be in accordance with those developed by D. Tongway (Tongway et. al. 2004). Performance indicators will be deemed to have been met if outcomes are met in two consecutive years.

9.6 Records and Reporting

Comprehensive records of the planning and implementation of all rehabilitation and closure works will be maintained for each rehabilitated area.

A detailed closure and rehabilitation plan will be developed and updated outlining the specific works and scheduling required for rehabilitation works as the project progresses.

Annual reporting will include status of rehabilitation undertaken and performance monitoring against set indicators.

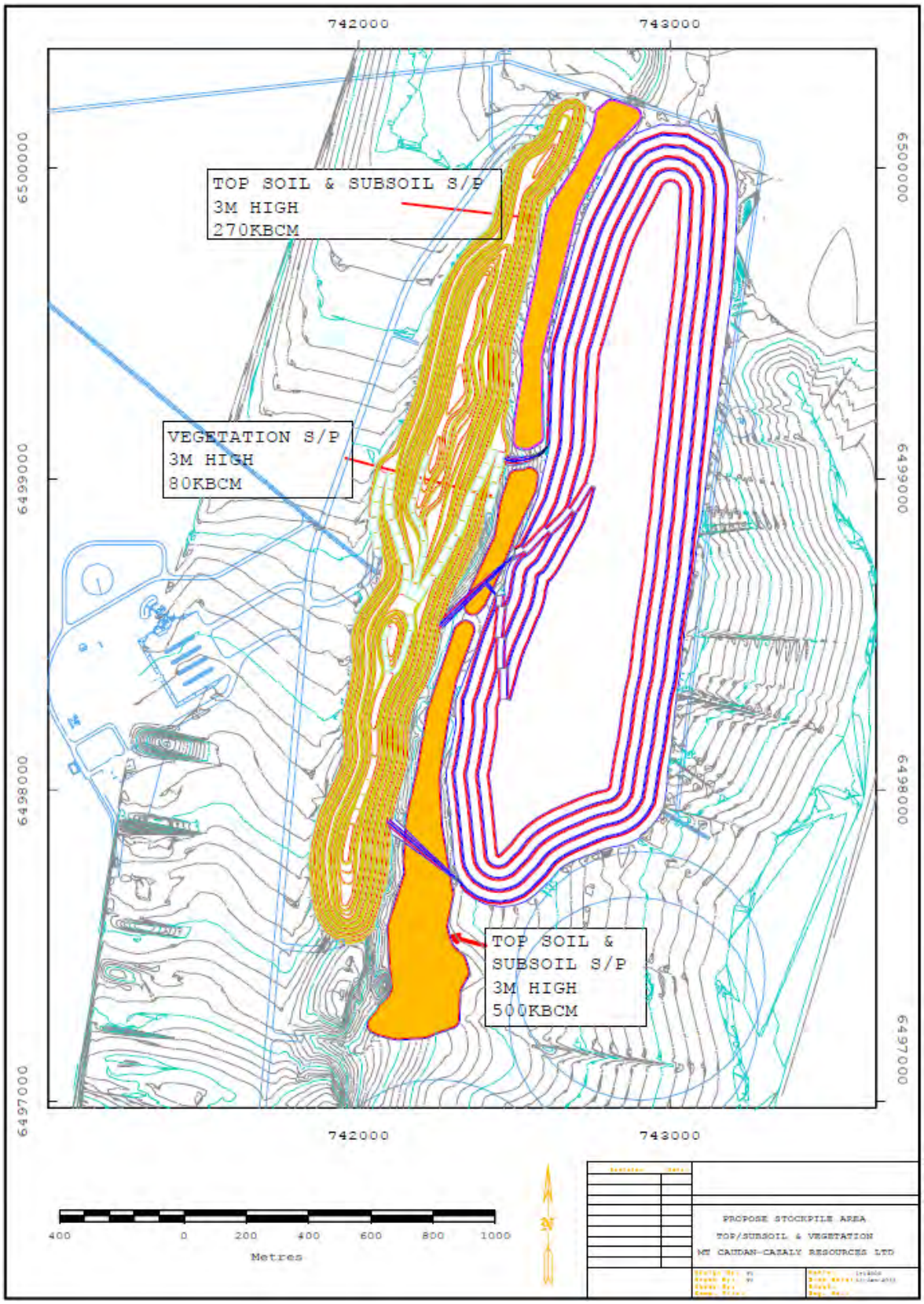

Figure 7: Location of Topsoil and Vegetation Stockpiles for the Project

10.0 GENERAL CLOSURE AND REHABILITATON STRATEGY

10.1 De-commissioning

Objectives:

- Appropriate removal and / or modification of all required infrastructure;
- Stable long term structural integrity is achieved;
- Public and environmental health and safety is protected;
- Successful rehabilitation occurs where necessary; and
- Consideration of post closure land uses is undertaken.

The project areas requiring decommissioning have been addressed in the previous section. A Supervisor will manage the site works which will include the mobilisation and demobilisation of closure equipment.

10.2 Remediation of Contaminated Sites

Objectives:

- Undertake a contaminated site assessment as per DEC guidelines, as part of the decommissioning and closure process;
- Remove contaminated infrastructure;
- Remediate all sites of contamination before closure or remove contaminated material to an approved landfill site.

Fuel storage areas, process plant areas and the washdown bay may have contaminated material. If present this material will be removed from site.

At decommissioning of the rehabilitation equipment, any contaminated materials (hydrocarbon) will be removed from site.

10.3 Landform Establishment

Objectives:

- Establish a safe, stable and non-polluting post-mining landform which supports vegetation growth and is erosion resistant over the long-term;
- All project infrastructure has been removed and rehabilitation of the site to final land use requirements has been completed.

The waste landform will be rehabilitated to establish a safe, stable and non-erosive structure (see section 8.2 for specific information relating to Waste Landform).

The ROM will be reshaped to form safe and a stable post-mining landform.

10.4 Surface Water Drainage & Groundwater

Objectives:

- Re-establish natural surface water flows and groundwater levels as per the pre-disturbance environment.

Diversion levees shall be deconstructed to re-establish natural water flows, with the exception of the pit abandonment levee. A pit void lake will allow recovery of the natural groundwater table after decommissioning of dewatering. The pit void lake will form and function as a groundwater sink, with equilibrium water level below that of the surrounding area due to natural evaporation. Groundwater levels will recover to slightly lower than existed pre-dewatering commencement.

10.5 Revegetation

Objectives:

- Return the mine site to a viable, self-sustaining ecosystem;

- Disturbed areas are assessed for weed outbreaks and where found these issues are remediated in a manner agreed with stakeholders and regulatory agencies; and
- All sites impacted by the project will be rehabilitated to the agreed land use.

Revegetation of the project at closure will be enhanced by the replacement of stored topsoil on the waste landform and disturbed areas (from areas cleared at the start of the mining phase).

The waste landform and all other areas will then be deep ripped to reduce compaction of the soil and to enhance the penetration of water. The areas will then be prepared and seeded with local native seed. Vegetation previously cleared from the project areas and stockpiled will be replaced over some rehabilitated areas to enhance organic matter in the soil and to provide small fauna habitat as well as develop discrete natural vegetation complexes.

10.6 Aesthetics

Objectives:

- Re-establish natural system that resembles the surrounding environment (as close as is practical).

All mining infrastructure will be removed at closure. This will enable the waste landform, TSF and other rehabilitated areas to blend in with the surrounding landscape.

10.7 Safety

Objectives:

- Public access to the mining areas is restricted and the various project sites rendered as safe as possible;
- To ensure that disturbed areas are left stable and free of infrastructure and waste;
- To restrict access to areas that cannot be made safe through land forming and rehabilitative techniques; and
- On cessation of mining all roads leading to any open pit and at the entrance to the site will be closed.

An abandonment bund will be constructed to minimise the potential risk to public safety of inadvertent access to abandoned open pits as per the DMP procedures detailed in “Safety Bund Walls around Abandoned Open Pit Mines” (DME, 1997).

11.0 PERFORMANCE INDICATORS AND CONTINGENCY MEASURES

11.1 Costs and Resources

ANZMEC (2000) states that clear accountability and adequate resources must be provided for the implementation of the closure plan. The ANZMEC objective for financial provision is to ensure that the cost of closure is adequately represented in company accounts and that the community is not left with liability.

Cost planning and contingency for the closure of the Project has been considered in the feasibility stage of the project and will continue to be refined and adjusted as the project progresses. Development of strategy and cost estimate for preferred closure options will be periodically reviewed and adjusted as required as closure needs, environmental risks or economic factors dictate.

11.2 Monitoring, Reporting and Records

Post closure monitoring programs will be progressively developed as the Closure planning process matures to help determine if closure objectives have been met. Monitoring programs will be developed in consultation with stakeholders, including regulatory agencies. Appropriate records will be kept for all required monitoring.

Areas where monitoring may be required (but are not limited to) include the following:

- Surface and groundwater
- Contaminated sites
- Flora
- Fauna
- Landform stability

Annual reporting will include status of rehabilitation undertaken and performance monitoring against set indicators.

11.3 Performance Indicators and Objectives

Performance indicators will be developed specifically for the Project based on the characteristics of the existing natural environment. The development of site-specific performance indicators is considered more appropriate than a 'one size fits all' approach, and is consistent with the approach of ANZMEC & AMI (2000) and DITR (2006) which recommend that performance indicators should be specific to the mine being closed to reflect the unique environmental circumstances of the site, and are achievable. These performance indicators will be developed as per section 9.4 and following rehabilitation trials.

11.3.1 Infrastructure Decommissioning Objective

- Decommissioning leaves the mine area in a safe and stable condition for future land use.

11.3.2 Rehabilitation Objective

- Rehabilitation achieves a post-mining vegetation condition that will, in the future, likely support a self sustaining native vegetation community that resembles the existing natural environment as best as is practicable.

11.3.3 Decommissioning and Rehabilitation Performance

Cazaly will monitor the rehabilitation works annually to determine the success of the rehabilitation and any contingency actions that may be required after closure. Performance indicators will be deemed to have been met if outcomes are met in two consecutive years.

In the event that the decommissioning and rehabilitation performance indicators have not been achieved, appropriate contingency actions or strategies will be implemented to achieve the performance indicators. Such actions may include:

- Review and further remediation of potentially contaminated areas.
- Earthworks to rectify major erosion damage on rehabilitated landforms.
- Re-seeding.
- Planting of seedlings.

- Irrigation of rehabilitation areas, such as using water sprays or water carts.
- Importing alternative growth media.

Cazaly will implement the above contingency actions in the event that it is identified that the decommissioning and rehabilitation performance indicators are not being achieved.

11.4 Unplanned or Temporary Closure

This CRCP has been developed for the scenario of planned closure. It is a requirement of the Strategic Framework for Mine Closure (ANZMEC/MCA, 2000) that the scenarios of Unplanned or Temporary (Care & Maintenance) Closure are also considered.

11.4.1 Unplanned Closure

In the event of sudden or unplanned closure of the project a plan will be immediately developed to take into account immediate requirements to minimise environmental impact and ensure that safety and health risk is minimised. Further requirements for walkway from the project will then be developed, based on the current version of the Rehabilitation and Closure plan for the project and on an accelerated basis.

11.4.2 Temporary (Care and Maintenance) Closure

A temporary closure is normally planned and is carried out on the assumption that the project will re-commence operations at some point. A suspensions plan with immediate and interim actions will be put in place to ensure short term and ongoing requirements to minimise environmental impact and ensure that safety and health risk is minimised whilst the project is under care and maintenance. The suspension plan will take into account the potential for further operations at the site. Closure strategies may later be developed if it is determined in the future that operations are not to re-commence.

11.5 Tenement Relinquishment

Following closure (or prior to final closure), Cazaly may take the following action:

- Complete the rehabilitation work and apply to seek the release (return) of the mining bonds;
- Sell the leases to another party with that party taking on all rehabilitation responsibilities. Cazaly will not then be responsible for the rehabilitation programs.

Cazaly is committed to completing the rehabilitation work or assigning it to a new owner.

12.0 PREDICTED OUTCOME

Implementation of the Rehabilitation and Closure Plan will result in the Project being satisfactorily decommissioned and rehabilitated with native vegetation to a condition suitable for continued conservation or pastoral use. Decommissioning and rehabilitation can therefore be managed to meet both EPA's and DMP's objectives as specified.

This conceptual closure rehabilitation strategy has been based on the known and current rehabilitation requirements imposed by statutory authorities and leading practice undertaken by the mining industry.

This CRCP is a conceptual document and will be reviewed and updated to a final Closure plan throughout the life of the project. Cazaly will review and update the Plan on a three-yearly basis throughout the life of the mine inclusive of refinement of rehabilitation completion criteria.

A conceptual assessment of the existing pre-mining and post-mining states are shown in Figure 8 and Figure 9. Figure 8 shows the conceptual pre-closure or pre-mining state of the Project area. Figure 9 shows the predicted post-closure or post-mining state of the Project area.

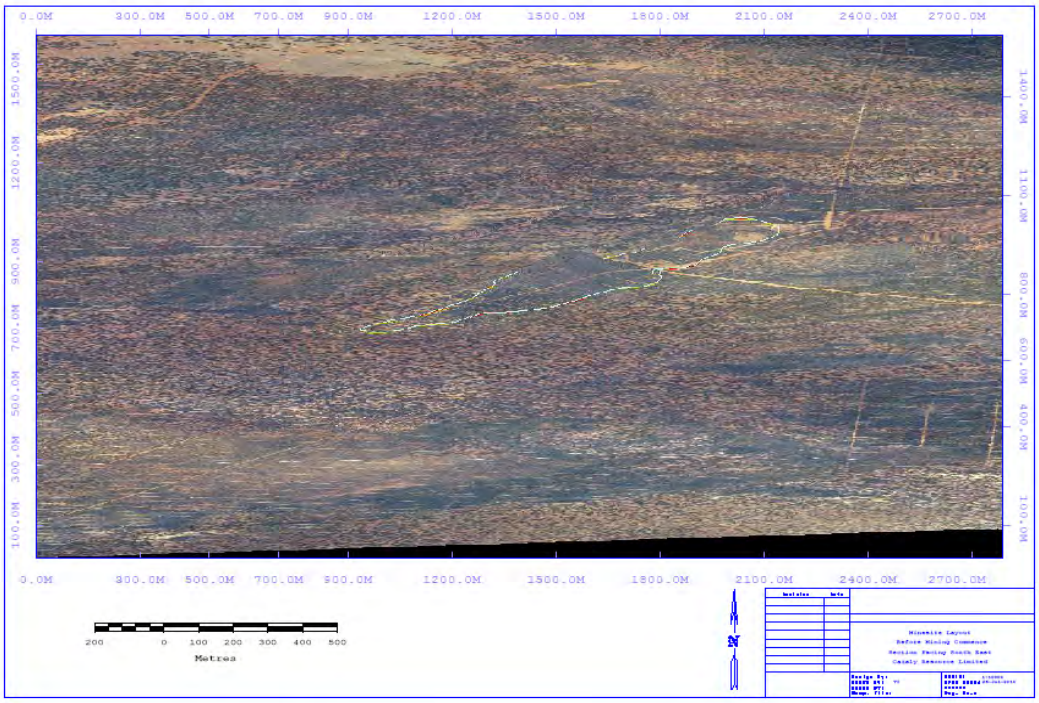

Figure 8: Landform Impact Assessment (Existing Environment)

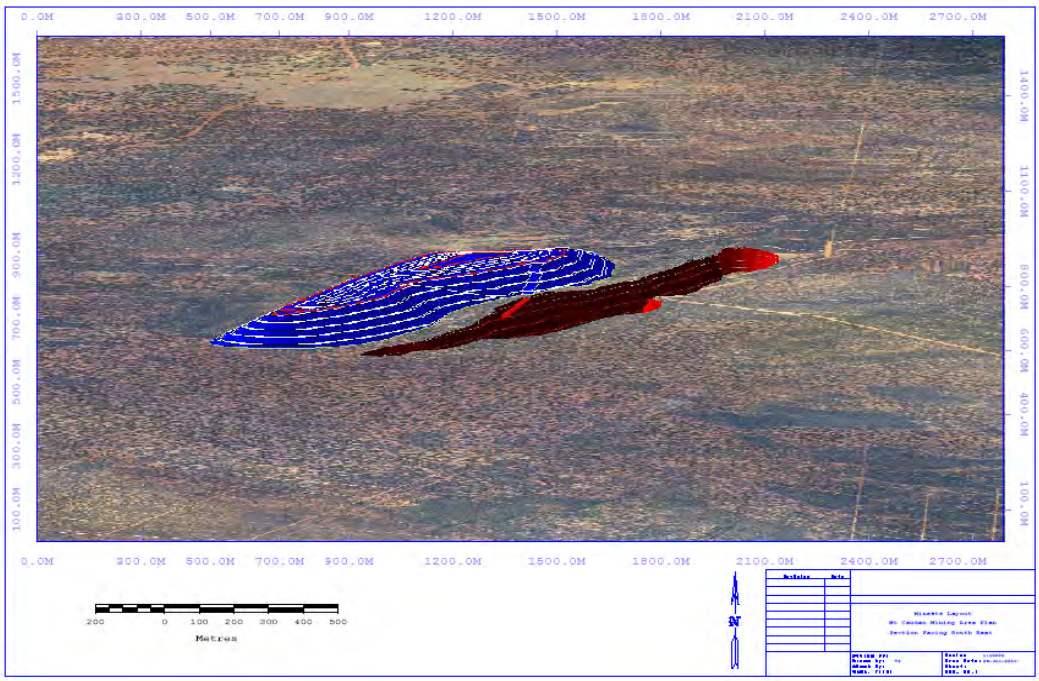

Figure 9: Landform Impact Assessment (Post-closure)

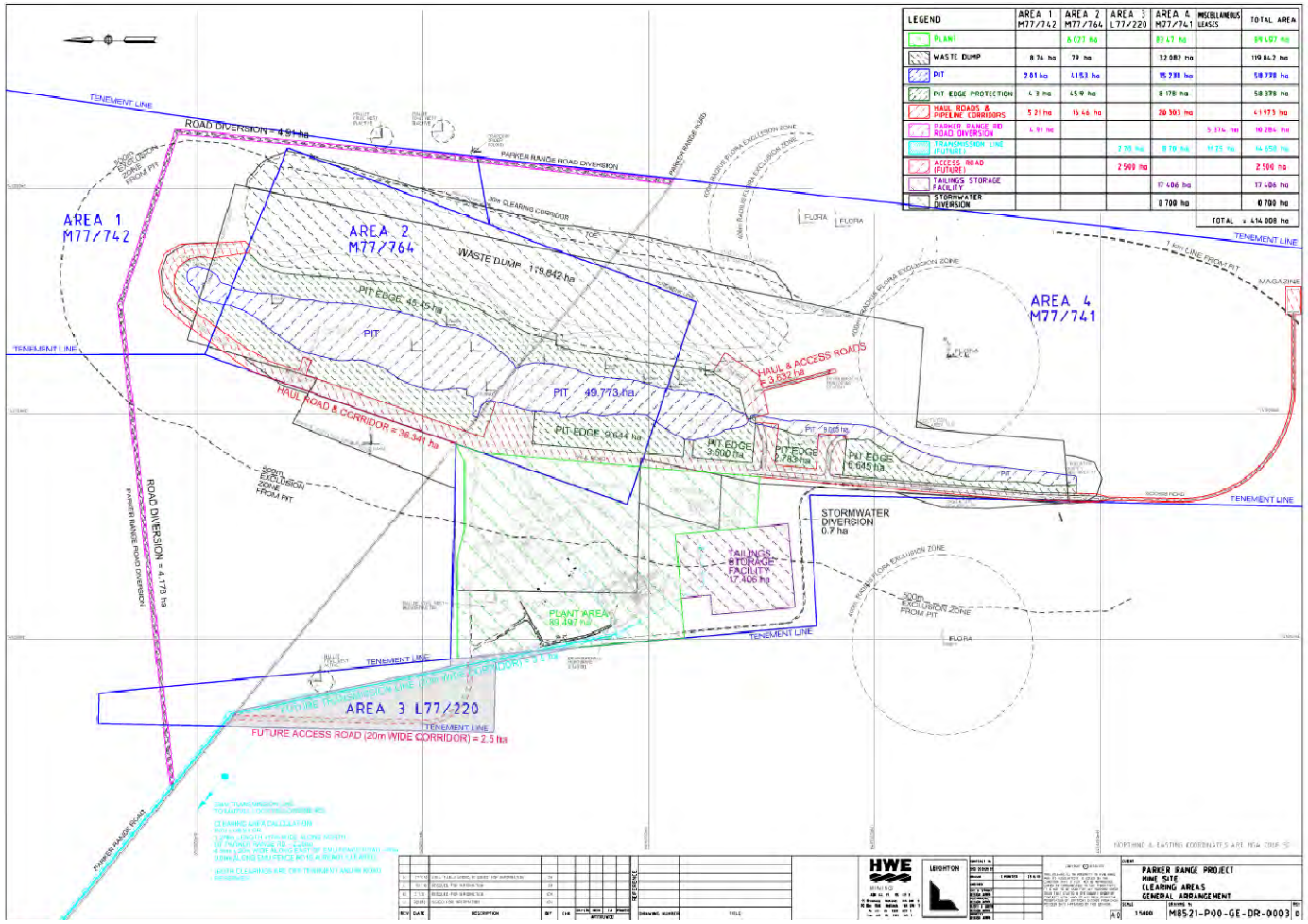

Figure 10: Clearing Area Estimate Mt Caudan Impact Area

13.0 REFERENCES

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Appendix 1: Risk Assessment Methodology And Risk Tables

Cazaly Resources Limited (April 2011)

RISK ASSESSMENT METHODOLOGY AND RISK TABLES

The methodology used in this risk assessment rated both likelihood and consequence on a scale of 1 to 5. These numbers were assessed in the matrix shown in Table 1 - Qualitative Risk Analysis Matrix to provide an indicator to the degree of risk associated with the issue and relative priority of the issue. Historical data from similar operations based on experience was used to assess the likelihood of an environmental risk occurring (Table 2). The consequence of an environmental issue was assessed by determining the severity of the effect, the area/population to be affected, the permanence of effects and the capacity of the area to recover. The resulting consequence descriptions are presented in Table 3. Table 4 and Table 5 show the prioritisation matrix used in the risk assessment and the definitions of the risk levels respectively.

Table 1: Qualitative Risk Analysis Matrix

Likelihood	Consequence				
	1	2	3	4	5
A	E	E	E	H	H
B	E	E	H	H	M
C	E	E	H	M	L
D	E	H	M	L	L
E	H	H	M	L	L

E = Extreme risk, H = High risk, M = Moderate risk, L = Low risk

Table 2: Qualitative Measures of Likelihood

Level	Descriptor	Description
A	Almost Certain	Environmental issue that is expected to occur in most circumstances.
B	Likely	Environmental issue that has been a common problem in the past and will probably occur in most circumstances.
C	Possible	Environmental issue may have arisen in the past and could occur.
D	Unlikely	Environmental issue may have occurred in the past and it could occur but not expected.
E	Rare	Environmental issue that would occur only in exceptional circumstances.

Table 3: Qualitative Measures of Consequence

Level	Descriptor	Description (And Example)
1	Catastrophic	Death, toxic release off-site with detrimental effect, huge financial loss. Major hydrocarbon spill to a land are with extensive surface and water pollution.
2	Major	Extensive injuries, loss of production capability, off-site release contained with outside assistance and little detrimental impact, major financial loss Removal of Priority flora without permission.
3	Moderate	Medical treatment required, onsite release contained with outside assistance, high financial loss. Groundwater pollution with limited biological damage and no contamination of a potentially usable groundwater resource.
4	Minor	First aid treatment, on-site release immediately contained, medium financial loss. Minor hydrocarbon spills from vehicles and equipment.
5	Insignificant	No injuries, low financial loss, negligible environmental impact. Erosion control structures not constructed along pipeline access road.

Table 4: Prioritisation of Risks

Likelihood	Consequence				
	1	2	3	4	5
A	1	3	8	11	16
B	2	5	10	15	21
C	4	9	13	18	22
D	6	12	17	20	24
E	7	14	19	23	25

Table 5: Risk Definitions (AS HB203:2006)

Extreme	Immediate action required.
High	Senior management attention required.
Moderate	Management responsibility must be specified.
Low	Manage by routine procedures.

Appendix 2: Method Statement for Soil and Vegetation Restoration at Mt Caudan

Soil Water Consultants (May 2011)

Electronic copy of Appendix provided on CD

S O I L W A T E R C O N S U L T A N T S

METHOD STATEMENT FOR SOIL AND VEGETATION RESTORATION AT MT CAUDAN DEPOSIT.

Prepared for:	**CAZALY RESOURCES LIMITED**
Date of Issue:	2 May 2011
Project No.:	PN0196-1-2-CAZ-001

soilwater

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Project No.:	PN0196-1-2-CAZ-001
Client:	CAZALY RESOURCES LIMITED

Revision History

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			Originator	Reviewer	Approved
B1	21/04/11	First draft issued to client	KB	ASP	ASP
C	02/05/11	Final report issued to client	KB	ASP	ASP

Revision Code*

A - Report issued for internal SWC review	1 - First Revision
B - Draft report issued for client for review	2 - Second Revision
C - Final report issued to	3 - Third Revision

LIMITATIONS

The sole purpose of this report and the associated services performed by Soil Water Consultants (SWC) was to undertake a literature review of soil and vegetation associations for species occurring within the Mt Caudan region. This work was conducted in accordance with the Scope of Work presented to Cazaly Resources Limited ('the Client').

SWC performed the services in a manner consistent with the normal level of care and expertise exercised by members of the earth sciences profession. Subject to the Scope of Work, the literature was confined solely to the species occurring within the Mt Caudan region. No extrapolation of the results and recommendations reported in this study should be made to areas external to this project area. In preparing this study, SWC has relied on published soil reports from various soil researchers and information provided by the Client. All information is presumed accurate and SWC has not attempted to verify the accuracy or completeness of such information. While normal assessments of data reliability have been made, SWC assumes no responsibility or liability for errors in this information. All conclusions and recommendations are the professional opinions of SWC personnel.

SWC is not engaged in reporting for the purpose of advertising, sales, promoting or endorsement of any client interests. No warranties, expressed or implied, are made with respect to the data reported or to the findings, observations and conclusions expressed in this report. All data, findings, observations and conclusions are based solely upon site conditions at the time of the investigation and information provided by the Client.

This report has been prepared on behalf of and for the exclusive use of the Client, its representatives and advisors. SWC accepts no liability or responsibility for the use of this report by any third party

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1. INTRODUCTION 1

1.1 STUDY OBJECTIVES 1
1.2 SCOPE OF WORK 1

2. STUDY METHODOLOGY 2

2.1 LITERATURE REVIEW 2
2.2 SITE VISIT 4

3. STUDY RESULTS 7

3.1 EXISTING VEGETATION WITHIN THE MT CAUDAN REGION 7
3.2 EXISTING SOILS WITHIN THE MT CAUDAN REGION 9
3.3 PROPOSED REVEGETATION SEED MIX FOR POST-MINE LANDFORMS 17
3.4 LITERATURE REVIEW 19
3.5 REVISION OF THE PROPOSED REVEGETATION SEED MIX FOR THE POST-MINE LANDFORMS 20

4. CONCLUSIONS & RECOMMENDATIONS 23

5. REFERENCES 24

List of Figures

Figure 1: Regional locations of the Parker Range Iron Ore Project. 5
Figure 2: Site layout for the Mt Caudan Iron Ore deposit. 6
Figure 3: Vegetation distribution across the Mt Caudan deposit (Botanica Consulting, 2010). 15
Figure 4: Soil distribution across the Mt Caudan deposit (KLA, 2010). 16

List of Tables

Table 1: Key soil and plant parameters reviewed in the literature. 3
Table 2: Vegetation associations occurring within the Mt Caudan operations area (Botanica Consulting, 2010). 8
Table 3: Dominant species occurring in each strata within each vegetation association mapped within the Mt Caudan deposit (Botanica Consulting, 2010). 10
Table 4: Selected chemical properties of the major soils within the Mt Caudan deposit (KLA, 2010). 17
Table 5: Proposed composition of the revegetation seed mix. 17
Table 6: Species considered most suitable for inclusion in the revegetation seed mix for the Mt Caudan deposit post-mine landforms. 21
Table 7: Species considered suitable for inclusion in the revegetation seed mix for the Mt Caudan deposit post-mine landforms. 21
Table 8: Species considered unsuitable for inclusion in the revegetation seed mix for the Mt Caudan deposit post-mine landforms. 22
Table 9: Species considered unsuitable for inclusion in the revegetation seed mix due to their location outside of the Mt Caudan area. 22

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List of Plates

Plate 1: Yellow earthy sands occurring primarily on the western side of the deposit. 9
Plate 2: Extensive dunal sandplains on the western side of the ironstone ridge supporting primarily Mallee heath (MallH) and Open mallee woodland (OMallW) vegetation. 12
Plate 3: Calcareous sands on the eastern side of the ironstone ridge supporting the various Eucalypt vegetation associations (i.e. Esalm, Esalu and MixEW; Botanica Consulting, 2010)....12
Plate 4: Extensive low-lying plain on the eastern side of the ironstone ridge with predominately calcareous sands supporting the various Eucalypt vegetation associations (i.e. Esalm, Esalu and MixEW; Botanica Consulting, 2010). 13
Plate 5: Skeletal gravelly soils covering the ironstone ridge. 13
Plate 6: Thick surficial gravelly sands along the mid- to upper-slopes of the ironstone ridge.....14

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1. INTRODUCTION

Cazaly Resources Limited (Cazaly) are proposing to develop the Mt Caudan Deposit as part of the Parker Range Iron Ore Project (PRIOP; the 'Project'), located approximately 50 km southeast of Southern Cross and 18 km south of Marvel Loch, within the Shire of Yilgarn (Figure 1). Mining of this deposit will be undertaken using open-pit techniques, with the excavated waste rock stored in an adjacent purpose-built above ground Waste Rock Landform (WRL; Figure 2). The operations will also involve of a run-of-mine (ROM) pad, tailings storage facility (TSF) and associated office/workshop, road and plant infrastructure, covering a total disturbance area of 414 ha at Mt Caudan.

To assist in the preparation of the Rehabilitation and Closure Plan for this operation, Cazaly engaged Soil Water Consultants (SWC) to undertake a literature review and site visit to establish the soil and vegetation associations for the plant species likely to be used in the rehabilitation of the post-mine landforms, predominately focused on the WRL and TSF. The primary objective of this work was to identify the soil and site conditions necessary for the successful growth and establishment for each species so that the reconstructed soil profiles can be designed and implemented to ensure sustainable rehabilitation of these landforms. This information can also be used to develop appropriate management strategies for the soil materials and to routinely undertake a volumes balance to ensure that there is sufficient suitable soil and waste materials available for rehabilitation during operations.

The critical aspect to successfully rehabilitating any post-mine landform is to ensure that a suitable habitat (i.e. soil and profile conditions) are re-established that meet the physical, chemical, hydraulic requirements of the revegetation species (i.e. to ensure that the needs of the revegetation are met). Although this is the case very little is typically known of the actual requirements or tolerances of the dominant species to be revegetated in an area, and therefore it is difficult to specifically design a waste dump profile that meets the needs of the revegetation. At the Mt Caudan Deposit, there exists an opportunity to characterise the growth and functioning of the existing native vegetation so that this information can be incorporated into the Rehabilitation and Closure Plan for the site, facilitating successful rehabilitation and closure.

The outcomes from this study will provide necessary guidance for parameters of rehabilitation trials contemplated at the Project Site.

1.1 STUDY OBJECTIVES

The specific objectives of this soil and vegetation association investigation were to:

- Identify the growth requirements, plant parameters and tolerances of the revegetation species planned to be used during rehabilitation of the WRL and TSF.
- Using this information, design an optimal reconstructed soil profile that meets the needs of the proposed revegetation species.
- If required, optimise the proposed revegetation seed mix composition based on the actual soil and waste materials and their volumes available for rehabilitation.

1.2 SCOPE OF WORK

The Scope of Work completed by SWC for this project included:

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- Review of all available literature, including published journal articles and governmental reports and databases, and unpublished consultants reports, to identify key soil and morphological parameters influencing the growth, establishment and functioning of the proposed revegetation species.
- Review the proposed revegetation seed mix to be utilised during rehabilitation of the MCIOD (as provided by Botanica Consulting).
- Undertake a site visit to view the local vegetation communities and to establish their geomorphologic and pedogenic relationships;
- Preparation of this report.

2. STUDY METHODOLOGY

2.1 LITERATURE REVIEW

The key literature reviewed for this investigation included (but not limited to):

Published journal articles in:

- Austral Ecology (CSIRO Publishing).
- Australian Journal of Biological Sciences (CSIRO Publishing).
- Australian Journal of Botany (CSIRO Publishing).
- Australian Systematic Botany (CSIRO Publishing).
- Functional Plant Biology (CSIRO Publishing).
- Soil Research (CSIRO Publishing).
- Soil Science Society of America Journal (Soil Science Society of America Publishing).
- Geoderma (Elsevier Publishing).
- Catena (Elsevier Publishing).
- Journal of the Royal Society of Western Australia.
- Annals of Botany (Oxford University Press).
- Restoration Ecology.

Governmental reports and databases:

- Identification and Assessment of Nationally Threatened Woodlands. Description of Ecological Communities: Arid Eucalypt Woodlands (Elith and Bidwell, 2004).
- Department of Environment and Conservation (DEC) Database searches, including FloraBase and WorldWide Wattle.
- FloraBank (Greening Australia).
- Department of Agriculture Reports, Bulletins and Factsheets (Department of Agriculture WA).

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Consultants Reports:

- Botanica Consulting (2010). *Flora and Vegetation of the Parker Range Region, Western Australia*. Unpublished report to Cazaly Resources Limited.
- Keith Lindbeck and Associates (KLA; 2010). Parker Range Iron Ore Project: Landforms and Soils Survey Report. Unpublished report to Cazaly Resources Limited.
- Western Botanical (2009). Flora and Vegetation of the Western Jackson Range (Mt Jackson Range), Western Australia. Unpublished report to Cliffs Natural Resources (published within PER report July 2009).

The aim of the literature review was to identify and quantify the key soil and plant morphological parameters that are likely to influence the establishment and sustainable growth of the native vegetation proposed for the revegetation of the post-mine landforms. The key parameters searched for are provided in Table 1.

Table 1: Key soil and plant parameters reviewed in the literature.

Parameter	Reason for inclusion in review
Plant morphological properties	
Above-ground properties	
Plant height	The height of the plant provides an indication of the likely 'draw' on the system. Larger plants generally have higher water use requirements (i.e. transpiration rates) than smaller plants.
Above ground biomass	To support a large above ground biomass, plants typically require a deep root system to support their high transpiration rates.
Leaf shape	The shape of the leaf strongly influences the volume of water lost during transpiration (hence the volume of water that needs to be accessed) due to the exposed surface area of the leaf.
Leaf area index (LAI)	Similar to the above ground biomass, plants with a high LAI often have higher transpiration and water uptake rates than plants with a smaller LAI.
Stomatal control	Stomatal control influences the volume of water lost during transpiration. Plants that can control stomatal opening and closing often have lower water use requirements than plant that have no control.
Transpiration rate	Plants with a higher transpiration rate must access a deeper or greater volume of the soil profile to extract sufficient plant available water to meet their water use requirements.
Below-ground properties	
Rooting depth	The rooting depth of plants strongly influences the transpiration rate, as it controls the volume of plant available soil moisture accessed.
Below ground biomass	Similar to rooting depth, whereby a large below ground biomass is required to support a large above ground biomass or transpiration rate.

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Root morphology	The distribution of the roots influences the tolerance of the species to water deficit conditions.
Root density	Rooting density influences the uptake of plant available moisture. Plants with a lower root density have a lower water uptake and therefore must access a deeper portion of the soil profile.
Soil properties	
Physical properties	
Soil type/texture	Soil type/texture influences the water holding capacity and plant available water content of the soils.
Gravel content	Influences the overall water holding capacity as gravel represents an inert soil fraction with no water holding capacity.
Bulk density	Influences the total porosity of the soil and therefore it water holding capacity.
Soil strength	Influences the ability of roots to explore the soil profile.
Hydraulic properties	
Hydraulic conductivity	Influences the residence time of water in the soil, and therefore its availability to plants.
Soil water retention	Determines how moisture is stored in the soil and its availability to vegetation.
Chemical properties	
Major nutrients (N, P, K, S)	Specific species require high major and/or minor nutrients for germination and continued growth, whilst others can tolerate (i.e. have adapted to) low nutrient levels.
Minor nutrients (DTPA Cu, Zn, Mn, Fe + B)	
pH & electrical conductivity (EC)	Plant species typically have a narrow pH and EC range in which they will grow. pH and EC also influences the availability and mobility of nutrients.
Metals & metalloids	Germination and establishment of plants is often influenced by the soil metal and metalloid content. Some species can tolerate high metal contents, whilst other experience toxicity.
Exchangeable cations	Reflects the functioning of the pedogenic environment.

2.2 Site Visit

A site visit to the Mt Caudan Deposit was undertaken on the 29th March to visually assess the structure and composition of the vegetation, and its spatial distribution. Prior to this visit the soil, flora and vegetation reports prepared by KLA (2010) and BC (2010), respectively, were reviewed to provide a preliminary understanding of the soil and vegetation associations at this site. Key aspects visually assessed in the field included the species richness, plant density and foliage coverage within each identified vegetation community (BC, 2010), and the variability of these parameters within each community type.

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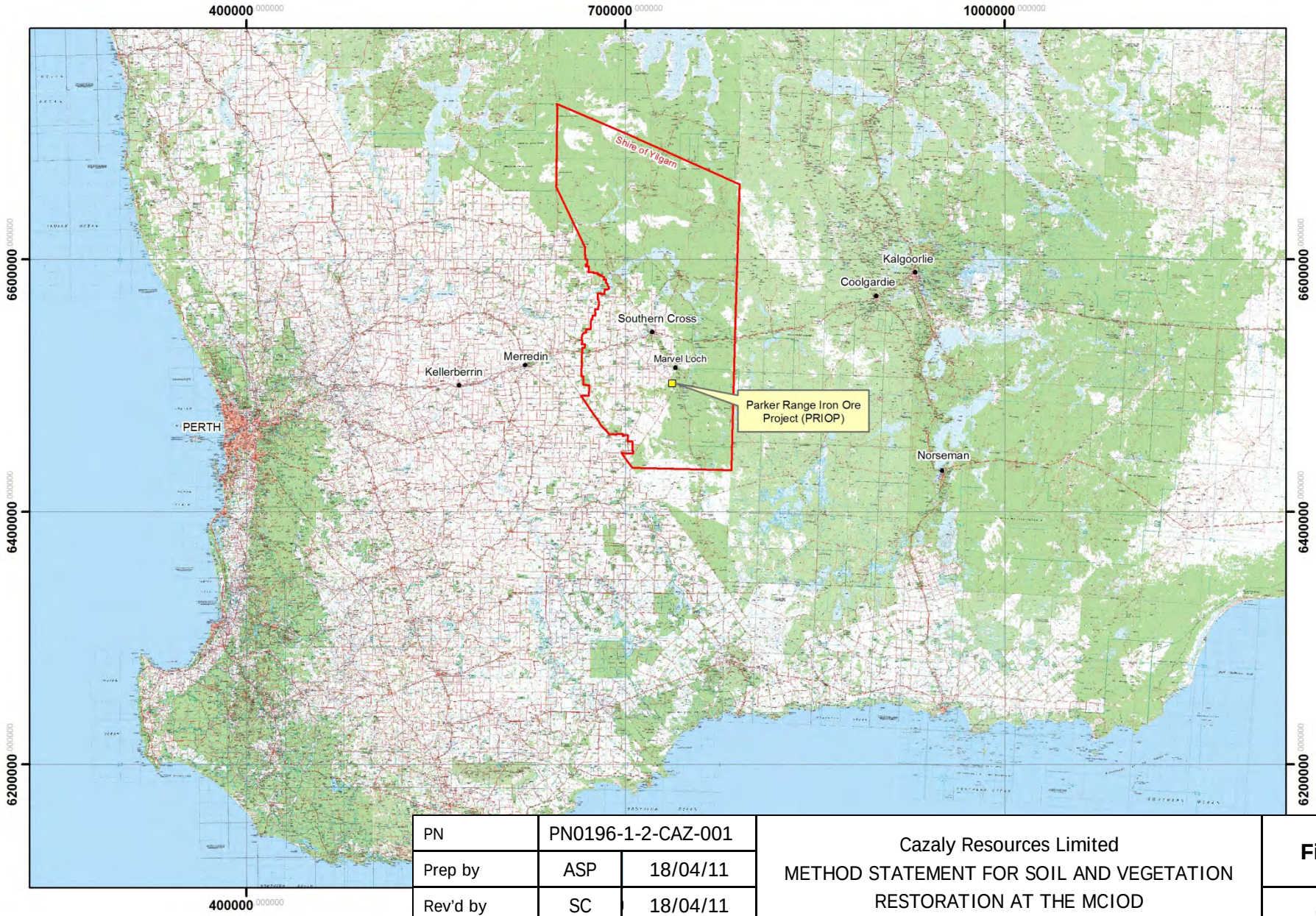

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Rev'd by	SC	18/04/11
Revision No.	0	

Cazaly Resources Limited
METHOD STATEMENT FOR SOIL AND VEGETATION RESTORATION AT THE MCIOD
REGIONAL LOCATION

Figure 1

soilwater

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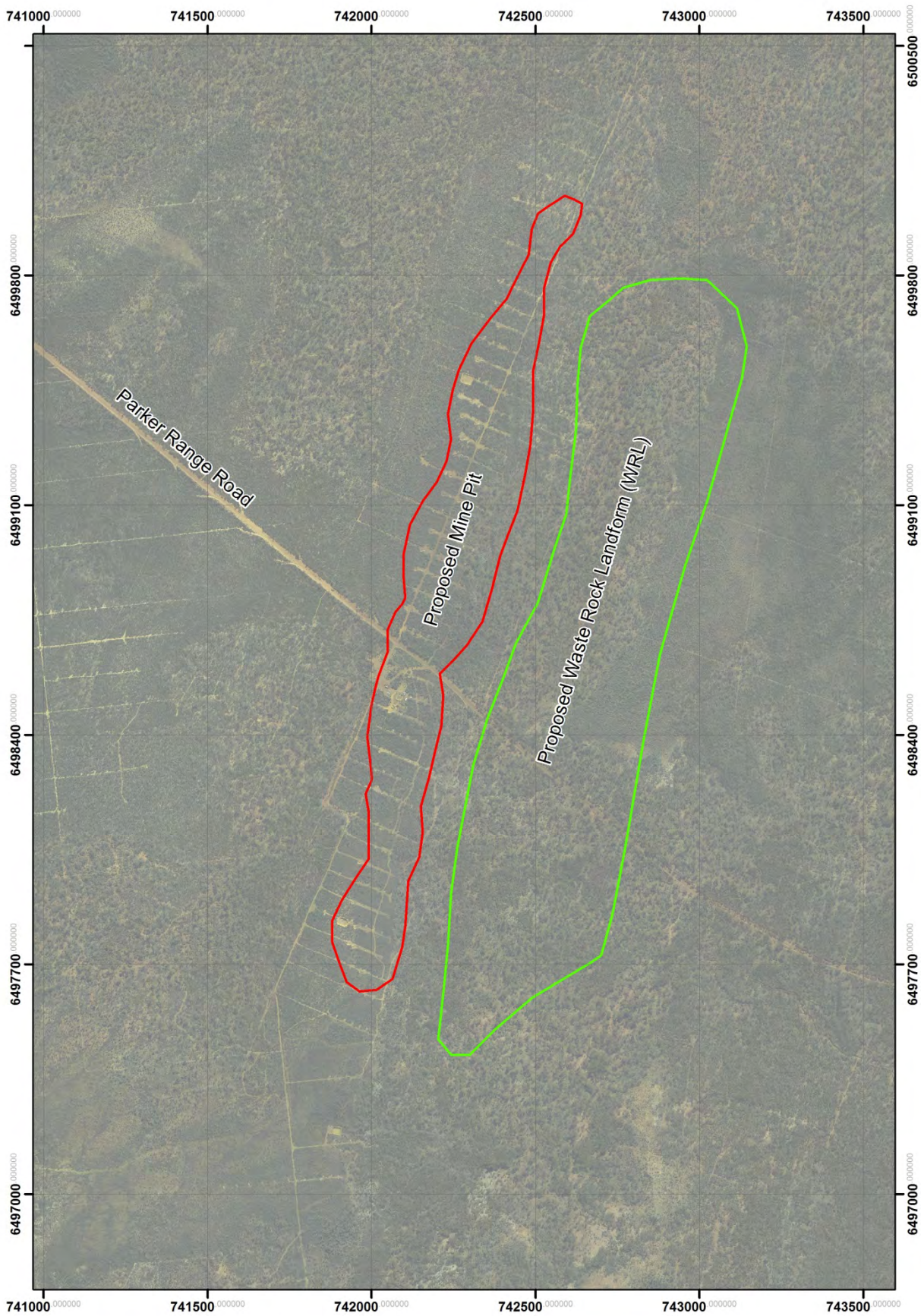

PN	PN0196-1-2-CAZ-001		Cazaly Resources Limited METHOD STATEMENT FOR SOIL AND VEGETATION RESTORATION AT THE MCIOD **REGIONAL LOCATION**	**Figure 2**
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3. STUDY RESULTS

3.1 EXISTING VEGETATION WITHIN THE MT CAUDAN REGION

The vegetation within the Mt Caudan region forms part of the Parker Range Vegetation Complex, which has been classified as a Priority 3 Ecological Community (PEC; DEC, 2010). This complex straddles the Coolgardie 2 (COO2 – Southern Cross) and Avon Wheatbelt (AW1 – Ancient Drainage) Subregions of the Interim Biogeographic Regions for Australia (IBRA, 2010). The Coolgardie – Southern Cross subregion is characterised by mixed eucalypt open woodlands over saltbush/bluebush understorey, with *Casuarina* thickets dominating the sandplain country (Beard, 1990). There is a high degree of endemism associated with the low greenstone hill and prominent banded iron formations (BIF). In contrast, the Avon Wheatbelt subregion is characterised by proteaceous scrubheaths on residual lateritic uplands and derived sandplain, with mixed eucalypt, *Allocasuarina huegeliana*, *Acacia acuminata* (Jam Wattle) and *Eucalyptus loxophleba* (York Gum) woodlands on Quaternary alluvials and eluvials (Beard, 1990).

Gibson and Lyons (1998) conducted a regional flora and vegetation survey over the Parker Range Greenstone Belt, covering the Parker Range PEC region and Mt Caudan deposit. During this survey the following six dominant vegetation communities were identified:

- Community Type 1: *Eucalyptus sheathiana* with E. transcontinentalis and/or *E. eremophila* over *Daviesia argillacea* and *Grevillea huegelii*. Occurs predominately on sandy soils at the base of ridges and low rises.
- Community Type 2: *Eucalyptus longicornis* with co-dominants *E. corrugata* and *E. salubris*. Occurs predominately on the broad flats.
- Community Type 3: *Eucalyptus salubris* and *E. salmonophloia* over *Eremophila oppositifolia*, *Acacia concolorans*, *Dodonaea stenozyga* and *Scaevola spinescens*. Occurs predominately on the broads flats within the greenstone belt.
- Community Type 4: *Allocasuarina acutivalvis* and *A. corniculata* shrubland, with minor *E. capillosa* subsp. *polyclada*. Occurs predominately on low sandy slopes and flats associated with lateritic and greenstone ridges.
- Community Type 5: *Allocasuarina campestric* and *A. acutivalvis*, with *Eucalyptus capillosa* subsp. *polyclada* and/or *E. loxophleba*. *Hakea pendens*, *Phebalium tuberculosum* and *Westringia cephalantha* are common understorey elements. Occurs predominately along lateritic breakaways and massive gossanous caps of the Mt Caudan area.
- Community Type 6: Low trees of *Callitris glaucophylla* and *Isopogon robusta*. Minor spatial distribution being confined to small area of decomposing granite and laterite.

The composition and distribution of these vegetation communities was strongly related to both soil and geomorphic position, with community types 1 – 3 occurring predominately within the deep finer textured low-lying plains, whilst communities 4 – 6 were more associated with the shallower gravelly soils of the ironstone and greenstone ridges and breakaways (Gibson and Lyons, 1998). Analysis of the soil physical and chemical properties within each community type revealed a strong gradient between soil nutrients and particle size distribution, and ultimately plant available water (PAW) content, between the community types. The soils within the low-lying plains had significantly greater silt and clay contents, compared to the upland soils, resulting in a greater retention of nutrients in the surficial profiles and a greater water holding capacity. Slight variations in these properties produced the observed floristic differences between community types 1 – 3, with the soils within the Type 1

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community having a higher sand content, with an associated decrease in all nutrients (due to the low nutrient retention capacity of the sand), lower pH and lower water holding (the plant species occurring in this community type therefore more closely resemble those occurring along the upland ridges). The soils in both community types 2 and 3 had appreciable silt and clay contents, with the soils in community type 3 having the highest clay content. The clayey soils within community types 2 and 3 have considerable nutrient retention properties, and thus these soils were the most chemical fertile. Their low permeability results in considerable evaporative concentration of soluble salts, and subsequently these soils typically have the highest salinity and pH values in the region. Species within community types 2 and 3 are therefore adapted to high nutrient levels and plant availability moisture contents.

In contrast, the soils within the upland community types are generally characterised by high gravel contents and a dominant sand-sized fraction. These soils are therefore well drained, with low water holding capacities, more acidic (due to their greater weathering) and have low nutrient contents due to their nutrient retention capacity. These physical and chemical properties are further exacerbated by the shallow nature of the soils. Species within community types 4 – 6 are therefore well adapted to low to very low nutrient levels and plant available water contents.

As part of the environmental approvals for the Project, a detailed flora and vegetation survey of the Parker Range PEC area was undertaken by Botanica Consulting (2010). This survey identified 25 vegetation associations within the PEC region, with 12 associations occurring in the Mt Caudan area. The associations occurring within this area, and the equivalent Gibson and Lyons Community Type are listed in Table 2, whilst their distribution is shown in Figure 3.

The distribution of the vegetation associations identified by Botanica Consulting (2010) closely follows the soil – vegetation associations identified by Gibson and Lyons (1998). On the flat plain areas, surrounding the ironstone ridge, the vegetation is dominated by mixed *Eucalyptus* woodland (MixEW), *Eucalyptus salmonophloia* woodland (EsalmW), *Eucalyptus salubris* woodland (EsaluW) and *Eucalyptus transcontinentalis* woodland (EtW); all of which corresponding to the low-lying plain community types (i.e. Types 1 – 3) of Gibson and Lyons (1998). On the deep dunal sandplain soils on the western side of the ridge (See Section 3.2), Mallee heath (MallH) and Open mallee woodland (OmallW) associations occur, corresponding the Gibson and Lyons (1998) community type 4. The ironstone ridge is dominated by Allocasuarina shrubland (AlloS), Allocasuarina thicket (AlloT) and Mallee woodland/Allocasuarina shrubland on laterite ridge (MallWAlloSLatR), equivalent to community type 5 of Gibson and Lyons (1998).

Table 2: Vegetation associations occurring within the Mt Caudan operations area (Botanica Consulting, 2010).

Vegetation Code	Vegetation Community	Equivalent Gibson & Lyons (1998) community type
MallH	Mallee heath	Type 4
OMallW	Open mallee woodland	Type 4
EsalmW	*Eucalyptus salmonophloia* woodland	Type 3
EsaluW	*Eucalyptus salubris* woodland	Type 3
AsMeS	*Acacia sp*. narrow phyllode and *Melaleuca eleuterostachya*	-

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AlloS	*Allocasuarina* shrubland	Type 4
MallWAlloSLatR	Mallee woodland/*Allocasuarina* shrubland on Lateritic ridge	Type 5
AlloT	Allocasuarina thicket	Type 4
BMallWAlloS	Burnt Mallee woodland/*Allocasuarina* shrubland	-
MixSRehab	Mixed shrub rehabilitation within gravel pit	-
MixEW	Mixed *Eucalyptus* woodland	Type 1
EtW	*Eucalyptus transcontinentalis* woodland	Type 1

A list of the dominant species in each strata of each vegetation association within the Mt Caudan area is provided in Table 3, whilst the reader is referred to the Botanica Consulting (2010) report for a full list of species in each community.

3.2 Existing Soils within the Mt Caudan Region

The soils within the Mt Caudan deposit have been mapped at a local scale by KLA (2010), as part of the environmental approvals for the Project. A map showing the distribution of the major soil types is provided in Figure 4. The ironstone ridge represents the boundary between the two dominant soil types: yellow earthy sand (Plate 1) on the western side associated with the extensive dunal sandplain that supports the Mallee Heath (MallH) and Open mallee woodland (OMallW) vegetation (Plate 2), and the calcareous sands to loamy sands on the eastern side (Plate 3), reflecting the low-lying plain that supports primarily the Eucalypt woodlands (Esalm; Esalu;MixEW; Plate 4).

Plate 1: Yellow earthy sands occurring primarily on the western side of the deposit.

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Table 3: Dominant species occurring in each strata within each vegetation association mapped within the Mt Caudan deposit (Botanica Consulting, 2010).

Survey area	Vegetation code	Vegetation Community	Dominant upper storey	Dominant mid-storey	Dominant under storey	Gibson & Lyon (1998) vegetation community type
Mt Caudan	MallH	Mallee health	*Eucalyptus leptophylla*	*Hakea erecta*	*Banksia shanklandiorum (P4)*	Type 4
			Eucalyptus platycorys	*Persoonia coriacea*	*Beaufortia interstans*	
Mt Caudan	OmallW	Open mallee woodland	*Eucalyptus eremophila subsp. Eremophila*	*Melaleuca eleuterostachya*	*Olearia muelleri*	Type 4
			Eucalyptus transcontinentalis	*Melaleuca laxiflora*	*Westringia cephalantha var. caterva*	
Mt Caudan	EsalmW	*Eucalyptus salmonophloia* woodland	*Eucalyptus salmonophloia*	*Alyxia buxifolia*	*Acacia erinacea*	Type 3
			Eucalyptus salubris	*Grevillea acuaria*	*Olearia muelleri*	
Mt Caudan	EsaluW	Eucalyptus *salubris* woodland	*Eucalyptus salubris*	*Melaleuca pauperiflora*	*Scaevola spinescens*	Type 3
					Olearia muelleri	
Mt Caudan	AlloS	*Allocasuarina* shrubland	*Allocasuarina acutivalvis*	*Acacia enervia subsp. enervia*	*Hibbertia pungens*	Type 4
			Allocasuarina campestris	*Melaleuca cordata*	*Hibbertia rostellata*	
Mt Caudan	MallWAlloSLatR	Mallee woodland/*Allocasuarina* shrubland on Laterite ridge	*Eucalyptus salubris*	*Allocasuarina acutivalvis*	*Olearia muelleri*	Type 5
			Eucalyptus capillosa subsp.polyclada	*Eremophila oppositifolia subsp. Angustifolia*	*Hibbertia rostellata*	
Mt Caudan	MixShRehab	Mixed Shrub rehabilitation within gravel pit	*Grevillea pterosperma*	*Cyanostegia angustifolia*	*Verticordia roei*	-
			Acacia neurophylla subsp.neurophylla	*Goodenia pinifolia*	*Persoonia striata*	
Mt Caudan	MixEW	Mixed *Eucalyptus* woodland	*Eucalyptus salubris*	*Melaleuca hamata*	*Grevillea acuaria*	Type 1
			Eucalyptus salmonophloia	*Santalum acuminatum*	*Olearia muelleri*	
Mt Caudan	AsMeS	*Acacia* sp. narrow phyllode and *Melaleuca eleuterostachya* shrubland	*Acacia sp. narrow phyllode*	*Melaleuca hamata*	*Hibbertia eatoniae*	-
			Melaleuca eleuterostachya	*Melaleuca cordata*		
Mt	AlloT	*Allocasuarina* thicket	*Allocasuarina acutivalvis*	*Baeckea elderiana*	*Hibbertia pungens*	Type 4

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Caudan			*Allocasuarina campestris*	*Melaleuca cordata*	*Hibbertia rostellata*	
Mt Caudan	EtW	*Eucalyptus transcontinentalis* woodland	*Eucalyptus transcontinentalis*	*Melaleuca pauperiflora subsp.pauperiflora*	*Acacia hemiteles*	Type 1
				Eremophila scoparia	*Scaevola spinescens*	
Mt Caudan	BMallWAlloS	Burnt Mallee Woodland/*Allocasuarina* shrubland	*Eucalyptus eremophila*	*Allocasuarina campestris*	*Phebalium filifolium*	-
			Eucalyptus horistes	*Allocasuarina corniculata*	*Melaleuca hamata*	

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Plate 2: Extensive dunal sandplains on the western side of the ironstone ridge supporting primarily Mallee heath (MallH) and Open mallee woodland (OMallW) vegetation.

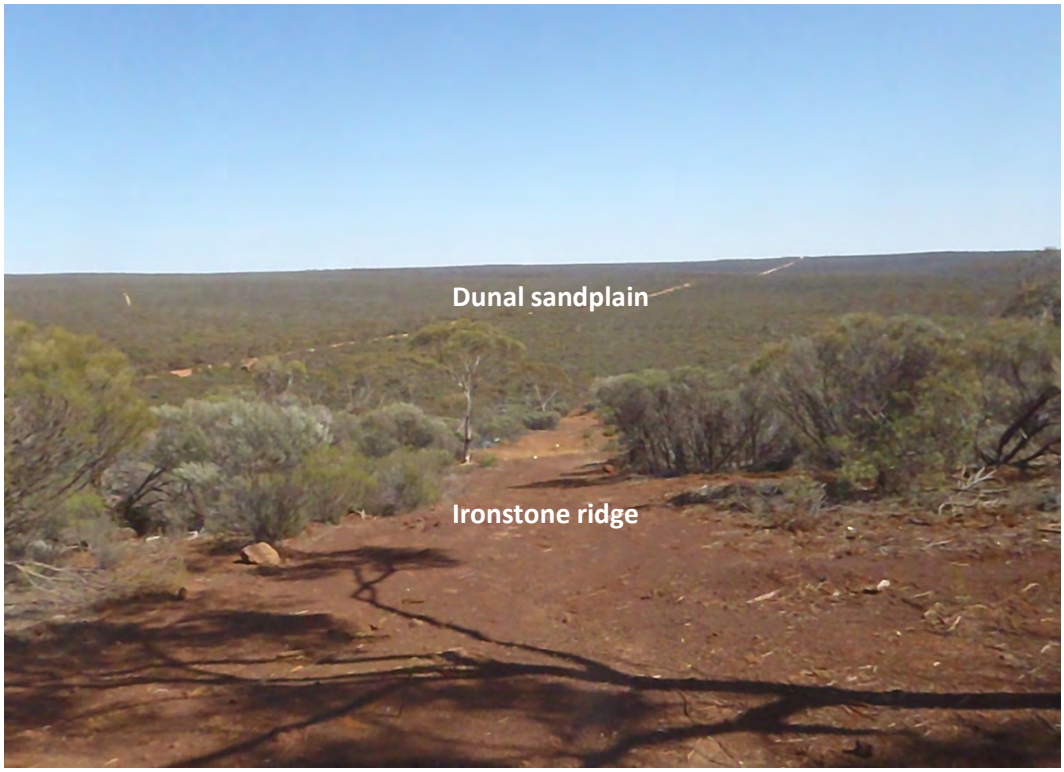

Plate 3: Calcareous sands on the eastern side of the ironstone ridge supporting the various Eucalypt vegetation associations (i.e. Esalm, Esalu and MixEW; Botanica Consulting, 2010).

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Plate 4: Extensive low-lying plain on the eastern side of the ironstone ridge with predominately calcareous sands supporting the various Eucalypt vegetation associations (i.e. Esalm, Esalu and MixEW; Botanica Consulting, 2010).

The soils along the ironstone ridge are characterised as skeletal, gravelly sands overlying the often calcareous massive ironstone (Plate 5). Along the mid- to lower-slopes of the ridge the thickness of the surficial gravels increases forming a relatively thick (up to 50 cm thick) surface cover (Plate 6).

Plate 5: Skeletal gravelly soils covering the ironstone ridge.

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Plate 6: Thick surficial gravelly sands along the mid- to upper-slopes of the ironstone ridge.

The skeletal gravelly soils support primarily the Allocasuarina shrubland (AlloS) and the Mallee woodland/Allocasuarina Shrubland on laterite ridge (MallWAlloSLatR) (Botanica Consulting, 2010). Given the shallow nature of the surface soils, with the deeper the roots of the vegetation likely to be restricted to only structural surfaces within the underlying ironstone, this vegetation is expected to be well adapted to water deficit conditions, with morphological adaptations such as thin (low surface area) leaves and stomatal control, limiting the loss of water through transpiration.

The dominant chemical properties of each of the major soil types within the Mt Caudan deposit are provided in Table 4 (KLA, 2010). The results show that the finer textured calcareous soils, characteristic of the flat plain on the eastern side of the deposit, are generally more alkaline and saline than the other two predominately sandy soils. The higher clay content of these soils results in them having a lower permeability, and hence the salts are not leached to the same extent as the other soils, resulting in their more alkaline pH and higher EC. The Gravelly ironstone surface soils have the lowest pH (slightly to strongly acidic) and EC, in response to their high permeability and low buffering capacity due to the dominance of inert gravels and quartz.

The properties of the soils and the corresponding vegetation associations (Table 4) are similar to those reported by Gibson and Lyons (1998), and suggest that the vegetation within the Mt Caudan area (and wider Parker Range region) have a relatively narrow tolerance for the soil and site conditions. Along the ironstone ridges, the sandy and gravelly nature of the surface soils results in them having very low nutrients (due to low nutrient retention capacity) and plant available moisture. The dominance of the Allocasuarina shrubland (AlloS) and Mallee woodland/Allocasuarina shrubland on laterite ridge (MallWAlloSLatR) implies that the species within these communities are well adapted to both nutrient deficit and low water holding capacity soils. In contrast, the dominance of the Eucalyptus woodland communities (i.e. Esalm, Esalu, MixEW, EtW) on the finer-texted calcareous soils on the the plains, suggests that these species require greater nutrients and substantially more plant available water to survive. The mallee heath vegetation (i.e. MallH, OMallW) is likely to represent an immediate between these two end-members, likely being reasonably tolerant of low nutrients and water availability.

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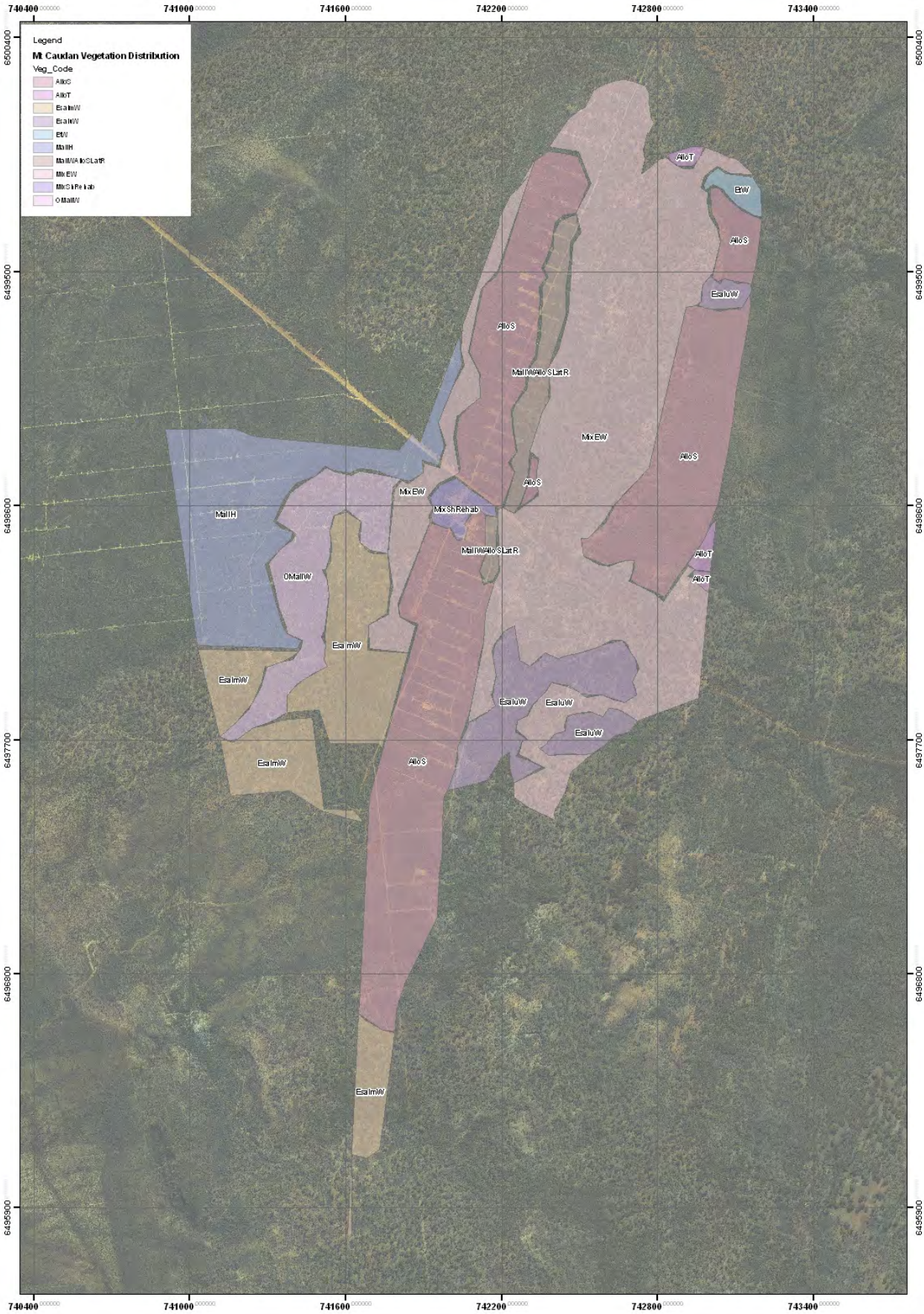

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Table 4: Selected chemical properties of the major soils within the Mt Caudan deposit (KLA, 2010).

Soil type	Depth (cm)	Vegetation association	pH	EC (mS/m)	TDS (mg/kg)	Total N (mg/kg)	Total P (mg/kg)
Calcareous sand – sandy loam	0 – 15	Esalm	6.8	8.1	51	430	42
	15 – 40	Esalu	8.3	27	170	320	28
	40 – 80	MixEW	8.8	63	410	180	25
	80 – 100	EtW	8.5	120	770	260	27
Yellow earthy sand	0 – 12	MallH	7.4	2.1	14	170	24
	12 – 25	OMallW	7.2	2.3	15	160	16
	25 – 60		8.3	15	96	230	28
Gravelly ironstone sand	0 – 20	AlloS	6.3	2.5	16	230	13
	20 - 40	MallWAlloSLatR	5.3	3.8	24	210	6.3

3.3 Proposed Revegetation Seed Mix for Post-Mine Landforms

Based on the flora and vegetation survey results for the PEC region, Botanica Consulting prepared a preliminary revegetation seed mix for the various post-mine landforms at the Mt Caudan deposit. The species included in this seed mix are listed in Table 5. A total of 65 species have been identified for use in revegetation. These species cover all vegetation associations within the PEC, and represent species that produce sufficient quantities of seed for collection (i.e. so that seed collection does not have an adverse impact on their reproduction and overall survival) and that the seed is readily available.

The majority of the species included on the preliminary seed mix list come from the Myrtaceae and Fabaceae families, with several species from the Asteraceae, Casuarinaceae and Sapindaceae families. Single species were also included from the Gyrostemonaceae, Haloragaceae, Rutaceae, Scrophulariaceae and Zygophyllaceae families to increase the diversity of the seed mix.

The selected species cover all stratum levels observed in the native vegetation in the region, from upper-stratum *Eucalyptus*, *Allocasuarina*, *Acacia* and *Melaleuca* species, to mid-stratum *Calothamnus*, *Eremophila* and *Olearia* species, to lower-stratum *Dodonaea* and *Microcybe* species, including annual grasses such as *Austrostipa* species.

Table 5: Proposed composition of the revegetation seed mix.

Family	Genus	Species
Asteraceae	*Angianthus*	*tomentosus*
Asteraceae	*Olearia*	*dampieri* subsp. *eremicola*
Asteraceae	*Olearia*	*muelleri*
Asteraceae	*Waitzia*	*acuminata* var. *acuminata*
Casuarinaceae	*Allocasuarina*	*acutivalvis* subsp. *acutivalvis*
Casuarinaceae	*Allocasuarina*	*campestris*
Casuarinaceae	*Allocasuarina*	*corniculata*
Casuarinaceae	*Allocasuarina*	*helmsii*
Chenopodiaceae	*Maireana*	*georgei*

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Chenopodiaceae	*Maireana*	*oppositifolia*
Fabaceae	*Acacia*	*assimilis* subsp. *assimilis*
Fabaceae	*Acacia*	*colletioides*
Fabaceae	*Acacia*	*eremophila*
Fabaceae	*Acacia*	*erinacea*
Fabaceae	*Acacia*	*hemiteles*
Fabaceae	*Acacia*	*heteroneura* var. *jutsonii*
Fabaceae	*Acacia*	*merrallii*
Fabaceae	*Acacia*	*steedmanii* subsp. *steedmanii*
Fabaceae	*Acacia*	*uncinella*
Fabaceae	*Acacia*	*yorkrakinensis* subsp. *acrita*
Fabaceae	*Senna*	*artemisioides* subsp. *filifolia*
Fabaceae	*Senna*	*cardiosperma*
Gyrostemonaceae	*Codonocarpus*	*cotinifolius*
Haloragaceae	*Glischrocaryon*	*roei*
Myrtaceae	*Eucalyptus*	*longicornis*
Myrtaceae	*Eucalyptus*	*salubris*
Myrtaceae	*Eucalyptus*	*transcontinentalis*
Myrtaceae	*Melaleuca*	*calyptroides*
Myrtaceae	*Melaleuca*	*hamata*
Myrtaceae	*Melaleuca*	*lateriflora*
Myrtaceae	*Calothamnus*	*gilesii*
Myrtaceae	*Calothamnus*	*quadrifidus*
Myrtaceae	*Eucalyptus*	*burracoppinensis*
Myrtaceae	*Eucalyptus*	*capillosa* subsp. *capillosa*
Myrtaceae	*Eucalyptus*	*celastroides* subsp. *celastroides*
Myrtaceae	*Eucalyptus*	*cylindriflora*
Myrtaceae	*Eucalyptus*	*eremophila* subsp. *eremophila*
Myrtaceae	*Eucalyptus*	*gracilis*
Myrtaceae	*Eucalyptus*	*horistes*
Myrtaceae	*Eucalyptus*	*leptopoda*
Myrtaceae	*Eucalyptus*	*longicornis*
Myrtaceae	*Eucalyptus*	*loxophleba* subsp. *lissophloia*
Myrtaceae	*Eucalyptus*	*oleosa*
Myrtaceae	*Eucalyptus*	*pileata*
Myrtaceae	*Eucalyptus*	*rigidula*
Myrtaceae	*Eucalyptus*	*salubris*
Myrtaceae	*Eucalyptus*	*sheathiana*
Myrtaceae	*Eucalyptus*	*transcontinentalis*
Myrtaceae	*Eucalyptus*	*urna*
Myrtaceae	*Eucalyptus*	*vittata*
Myrtaceae	*Melaleuca*	*acuminata subsp. acuminata*
Myrtaceae	*Melaleuca*	*calyptroides*
Myrtaceae	*Melaleuca*	*cordata*
Myrtaceae	*Melaleuca*	*eleuterostachya*

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Myrtaceae	*Melaleuca*	*hamata*
Myrtaceae	*Melaleuca*	*lateriflora* subsp. *lateriflora*
Myrtaceae	*Melaleuca*	*pauperiflora*
Myrtaceae	*Melaleuca*	*sheathiana*
Rutaceae	*Microcybe*	*multiflora* subsp. *baccharoides*
Sapindaceae	*Dodonaea*	*stenozyga*
Sapindaceae	*Dodonaea*	*inaequifolia*
Sapindaceae	*Dodonaea*	*lobulata*
Sapindaceae	*Dodonaea*	*stenozyga*
Scrophulariaceae	*Eremophila*	*scoparia*
Zygophyllaceae	*Zygophyllum*	*glaucum*

3.4 LITERATURE REVIEW

The literature review described in Section 2.1 was undertaken for all species listed in Table 5 to establish their growth requirements and tolerances for various soil and site conditions, and therefore to determine their suitability as potential revegetation species for the post-mine landforms. The key parameters listed in Table 1 were researched.

Very little species specific information could be sourced during this investigation for any of the proposed revegetation species. Only generic morphological parameters, such as plant height, leave shape and form, could be obtained, with no information available for the key parameters affecting their function and sustainable growth, such as rooting depth, transpiration rate (water use), stomatal control or soil chemical/nutritional requirements and tolerances. Given this lack of information, only generic soil – vegetation relationships could only be established from their general descriptions. For example, the species *Eucalyptus salubris* (Gimlet) is a mallee or tree, 4 – 15 m high, preferring clay loam or loam soils on undulating plains. Its preference for finer textured soil within flat plain areas (where water accumulation and vertical infiltration of rainfall is dominant) suggests that it has a high water use (transpiration) requirement, and its height would imply a deep to very deep root system. In contrast, the *Allocasaurina campestris* is a 1 – 3 m high shrub, preferring lateritic and sandy soils. The leaves of this species are minute, needle-like with their stomata vertically aligned in deep furrows that alternate with the stem ridges. These morphological characteristics result in a low transpiring surface area, and therefore they have much a reduced water use requirement; hence they are only required to access a relatively small volume of the soil profile to obtain sufficient moisture to satisfy their low transpiration rates (they are therefore expected to have a relatively shallow root system).

The general descriptions obtained for each of the proposed revegetation species are congruent with their spatial distribution within the Parker Range region, as identified by Gibson and Lyons (1998) and highlighted in this report (Sections 3.1 and 3.2). Species preferring loamy to clayey deep soils, with a resulting high water holding capacity, are generally restricted to the flat plain regions in the Mt Caudan area and are belong to the Eucalypt dominated vegetation associations (MixEW, Esalm, Esalu, EtW). Due to the accumulation or convergence of surface water in these areas, and the high water holding capacity of the soils, there is significant plant available moisture stored within the profiles, which is periodically replenished, to meet their higher water use requirements. In addition, the finer texture of these soils results in a greater nutrient retention, and subsequently the species occurring in these regions are more adapted to higher nutrient levels.

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Species that show a preference for deep sands and sandplain soils belong primarily to the heath vegetation communities (MallH, OMallW). These species are more tolerant of both water and nutrient deficit conditions, as the sandy soils have very low water holding and nutrient retention capacities. In order to overcome the low plant available water content of the sands, these species typically have deep root systems that enable them to access a large volume of the soil profile, and obtain sufficient moisture to meet their transpiration requirements. It is also likely that these species has developed morphological adaptations to reduce water loss through transpiration, such as good stomatal control (i.e. they can close their stomata during maximum evaporative periods) and reduced leave surface area; hence keeping the required rooting depth to a minimum.

Species that can tolerate shallow gravelly or lateritic soils over granite or ironstone are typically grouped within the *Allocasuarina* dominated communities (AlloS, MallWAlloSLatR). These species are the most tolerant to both water and nutrient deficit conditions, and have defined morphological adaptations that minimise water loss through transpiration (i.e. thin, low surface area needle-like leaves, and protected and/or controlled stomata) and symbiotic and/or mycorrhizal root systems that maximise nutrient uptake from nutrient poor soils.

3.5 Revision of the Proposed Revegetation Seed Mix for the Post-Mine Landforms

Although no species specific information regarding the growth requirements or tolerances of the various species in the proposed revegetation seed mix is available from the literature, the general soil – vegetation associations highlighted in Section 3.4 can be used to refine the seed mix to ensure that only suitable species are used to revegetate the post-mine landforms. It is important to recognise the fundamental properties of WRL and cover systems/embankment walls of TSF. These landforms exist primarily in a water deficit condition[1], which is further exacerbated through the use of gravelly soils or the incorporation of appreciable waste rock to help stabilise the outer surface, and the typical occurrence of only a thin oxide profile (growth medium) over waste rock. Given their above ground location, post-mine landforms are typically disconnected from the groundwater system and do not receive surface water runoff from upstream catchment areas. Based on these conditions they closely resemble *in situ* ironstone ridges that have a relatively thin soil mantle over massive or fractured ironstone or bedrock.

At the Mt Caudan deposit, it is proposed that the reconstructed waste dump will consist of a relatively shallow (< 0.5 m thick) surface gravelly sand overlying the fractured and predominately lateritic waste rock material. Similar to that occurring on the native ironstone ridge, this reconstructed profile will be well drained, have low nutrient levels either through rapid leaching of available nutrients or strong retention onto the iron oxides (thus unavailable to the vegetation) and have very low stored plant available water. From the soil and vegetation associations highlighted in this report, species occurring in the *Allocasuarina* vegetation communities are likely to be best suited to the WRL environment, with the Mallee heath vegetation also being suitable. Species within the Eucalypt dominated, low-lying plain vegetation communities (MixEW, Esalm, Esalu, EtW) are unlikely to well suited to the WRL, unless used only along the berms and within water catchment areas on the top of the waste dump.

Given the above scenario and the likely suitability of the various vegetation communities to the post-mine landform environment, the preliminary revegetation seed mix was revised into the following three groupings:

[1] This generally only applies to TSF containing hypersaline tailings. In this situations the interaction between the surface soils and the tailings material is generally prevented through the use of a capillary break or the adverse physical and chemical properties of the tailings material itself; hence the revegetation is solely reliant on the relatively thin growth medium on the outer surface of the TSF.

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- ***Most suitable species*** for use in the revegetation seed mix for the post-mine landforms.
- ***Suitable*** for use in the revegetation seed mix for the post-mine landforms.
- ***Unsuitable*** for use in the revegetation seed mix for the post-mine landforms – these species can however be strategically seeded into areas of water convergence and accumulation (i.e. berms and localised depressions) as moisture levels will be continually replenished and thus there will likely be sufficient moisture to support their transpiration requirements.

Tables 6 – 8 list the species in each of the above groupings, with 12 species identified as most suitable, 21 species identified as suitable and 9 species identified as unsuitable for most areas on the post-mine landforms. In addition, the original revegetation seed mix contained 17 species not present in any of the vegetation communities within the Mt Caudan area, and these were restricted to communities in the wider PEC region. The natural habitat of these species is uncertain, and it is therefore considered that unless they occur within an environment similar to the Mt Caudan ironstone ridge or adjacent dunal sandplains, then they should be removed from the revegetation seed mix as their likelihood of success is questionable. These species are provided in Table 9.

Table 6: Species considered most suitable for inclusion in the revegetation seed mix for the Mt Caudan deposit post-mine landforms.

Family	Genus	Species
Casuarinaceae	*Allocasuarina*	*campestris*
Casuarinaceae	*Allocasuarina*	*helmsii*
Fabaceae	*Acacia*	*heteroneura* var. *jutsonii*
Fabaceae	*Acacia*	*uncinella*
Fabaceae	*Acacia*	*yorkrakinensis* subsp. *acrita*
Myrtaceae	*Calothamnus*	*gilesii*
Myrtaceae	*Eucalyptus*	*burracoppinensis*
Myrtaceae	*Eucalyptus*	*capillosa* subsp. *capillosa*
Myrtaceae	*Eucalyptus*	*loxophleba* subsp. *lissophloia*
Sapindaceae	*Dodonaea*	*inaequifolia*
Sapindaceae	*Dodonaea*	*lobulata*
Zygophyllaceae	*Zygophyllum*	*glaucum*

Table 7: Species considered suitable for inclusion in the revegetation seed mix for the Mt Caudan deposit post-mine landforms.

Family	Genus	Species
Asteraceae	*Olearia*	*dampieri* subsp. *eremicola*
Asteraceae	*Olearia*	*muelleri*
Asteraceae	*Waitzia*	*acuminata* var. *acuminata*
Casuarinaceae	*Allocasuarina*	*acutivalvis* subsp. *acutivalvis*
Casuarinaceae	*Allocasuarina*	*corniculata*
Fabaceae	*Acacia*	*colletioides*
Fabaceae	*Acacia*	*hemiteles*

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Fabaceae	*Acacia*	*merrallii*
Fabaceae	*Senna*	*artemisioides* subsp. *filifolia*
Myrtaceae	*Eucalyptus*	*eremophila* subsp. *eremophila*
Myrtaceae	*Eucalyptus*	*horistes*
Myrtaceae	*Eucalyptus*	*salubris*
Myrtaceae	*Eucalyptus*	*transcontinentalis*
Myrtaceae	*Melaleuca*	*acuminata subsp. acuminata*
Myrtaceae	*Melaleuca*	*calyptroides*
Myrtaceae	*Melaleuca*	*cordata*
Myrtaceae	*Melaleuca*	*eleuterostachya*
Myrtaceae	*Melaleuca*	*hamata*
Myrtaceae	*Melaleuca*	*lateriflora*
Myrtaceae	*Melaleuca*	*pauperiflora*
Sapindaceae	*Dodonaea*	*stenozyga*

Table 8: Species considered unsuitable for inclusion in the revegetation seed mix for the Mt Caudan deposit post-mine landforms.

Family	Genus	Species
Fabaceae	*Acacia*	*eremophila*
Fabaceae	*Acacia*	*erinacea*
Fabaceae	*Senna*	*cardiosperma*
Myrtaceae	*Eucalyptus*	*cylindriflora*
Myrtaceae	*Eucalyptus*	*sheathiana*
Myrtaceae	*Eucalyptus*	*urna*
Myrtaceae	*Melaleuca*	*lateriflora* subsp. *lateriflora*
Rutaceae	*Microcybe*	*multiflora* subsp. *baccharoides*
Scrophulariaceae	*Eremophila*	*scoparia*

Table 9: Species considered unsuitable for inclusion in the revegetation seed mix due to their location outside of the Mt Caudan area.

Family	Genus	Species
Asteraceae	*Angianthus*	*tomentosus*
Chenopodiaceae	*Maireana*	*georgei*
Chenopodiaceae	*Maireana*	*oppositifolia*
Fabaceae	*Acacia*	*assimilis* subsp. *assimilis*
Fabaceae	*Acacia*	*steedmanii* subsp. *steedmanii*
Gyrostemonaceae	*Codonocarpus*	*cotinifolius*
Haloragaceae	*Glischrocaryon*	*roei*
Myrtaceae	*Calothamnus*	*quadrifidus*
Myrtaceae	*Eucalyptus*	*celastroides* subsp. *celastroides*

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Myrtaceae	*Eucalyptus*	*gracilis*
Myrtaceae	*Eucalyptus*	*leptopoda*
Myrtaceae	*Eucalyptus*	*longicornis*
Myrtaceae	*Eucalyptus*	*oleosa*
Myrtaceae	*Eucalyptus*	*pileata*
Myrtaceae	*Eucalyptus*	*rigidula*
Myrtaceae	*Eucalyptus*	*vittata*
Myrtaceae	*Melaleuca*	*sheathiana*

4. CONCLUSIONS & RECOMMENDATIONS

A literature review and site visit of the soil and vegetation associations at the Mt Caudan Deposit was undertaken to assist in the successful rehabilitation of the post-mine landforms following mining. The primary objective of this study was to enable a more strategic approach to rehabilitation, so that only revegetation species that are most likely to successfully establish and sustainably grow on these landforms are utilised. Fulfilment of this objective will reduce the overall costs of rehabilitation (as seed collection and application costs will be lower), reduce the impact on the existing environment (as seed is collected from a narrower range of native species), and improve the success of rehabilitation (as the seeding/revegetation strategy is targeted towards ensuring that the growth requirements of the revegetation species are satisfied).

The results from this study will be used throughout the mining and rehabilitation process to provide guidance on the handling and utilisation of the soil resources, in the planning and construction of the proposed post-mine landforms, and in the development and establishment of appropriate field trials to confirm that sustainable rehabilitation of this site will occur. Although very little species-specific information exists in the available literature with respect to the growth requirements and tolerances of the native vegetation within the Mt Caudan region, the generic soil and vegetation associations established in this report have been used to refine the revegetation seed mix to include only those species that are most suitable to the pedogenic and geomorphic conditions likely to existing in the reconstructed post-mine landforms (i.e. shallow gravel dominated soil profile that experiences water deficit conditions throughout most of the year). A total of 33 species, covering 10 Genera and 6 Families, were considered appropriate for use in the rehabilitation of the WRL and TSF at this site. Large, high transpiring (i.e. high water use) *Eucalyptus*, *Acacia* and *Melaleuca* species, which typically occur within the flat plain areas dominated by finer textured soils, were excluded from this seed mix, as it was considered that their growth requirements would not be fully met within the post-mine landform environment.

In response to the findings from this investigation, the following recommendations are suggested:

- Although the revegetation seed mix has been refined based on the soil – vegetation associations identified in this report, it would be beneficial to clearly establish the specific growth requirements and plant tolerances for the dominant species to be used in the revegetation of the post-mine landforms. This work would involve excavating trenches adjacent to a representative number of suitable revegetation species (i.e. species identified in this study), and assessing the soil and plant parameters listed in Table 1. The results from this additional work will clearly establish the suitability of the selected species for the soil profiles to be reconstructed on the post-mine landforms and their continued use in the revegetation seed mix.

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- Rehabilitation trials using the revised seed mix identified in this investigation should be undertaken as part of the progressive rehabilitation of the site. The key factors to consider are whether a sufficient number of species (i.e. species richness) and plants (plant density) establish during the trials. Monitoring of these trials will identify which species germinate and continue to growth, and which ones do not. For species with a low success rate, further investigation should be undertaken to determine whether the poor establishment and/or growth rates are due to pedogenic factors or are a function of the species themselves (i.e. inherently low germination rates). The primary objective of these trials is to ensure that a sufficient number and diversity of revegetation plants/species establish over the post-mine landforms so that the rehabilitation goals or completion criteria are successfully met, so that closure of these landforms can be achieved.

- Given that the species considered suitable for use in the revegetation seed mix for the post-mine landforms all occur within the *Allocasuarina* shrubland (AlloS), Mallee woodland/*Allocasaurina* shrubland on the lateritic ridge (MallWAlloSLatR), Mallee shrubland (MallS) and open Mallee woodland (OMallW) the characteristics of these vegetation associations, and in particular the variability in these characteristics, should be established to assist in developing suitable completion criteria for the post-mine landforms. This work would involve assessing the parameters of species richness, plant density and foliage cover in all existing vegetation gradrats (established during the flora and vegetation survey) in each of these vegetation associations. The information captured during this assessment should be used to quantitatively assess the performance of both the rehabilitation trials and the overall growth of the revegetation across the post-mine landforms, to determine whether acceptable establishment and growth of the revegetation species has occurred.

5. REFERENCES

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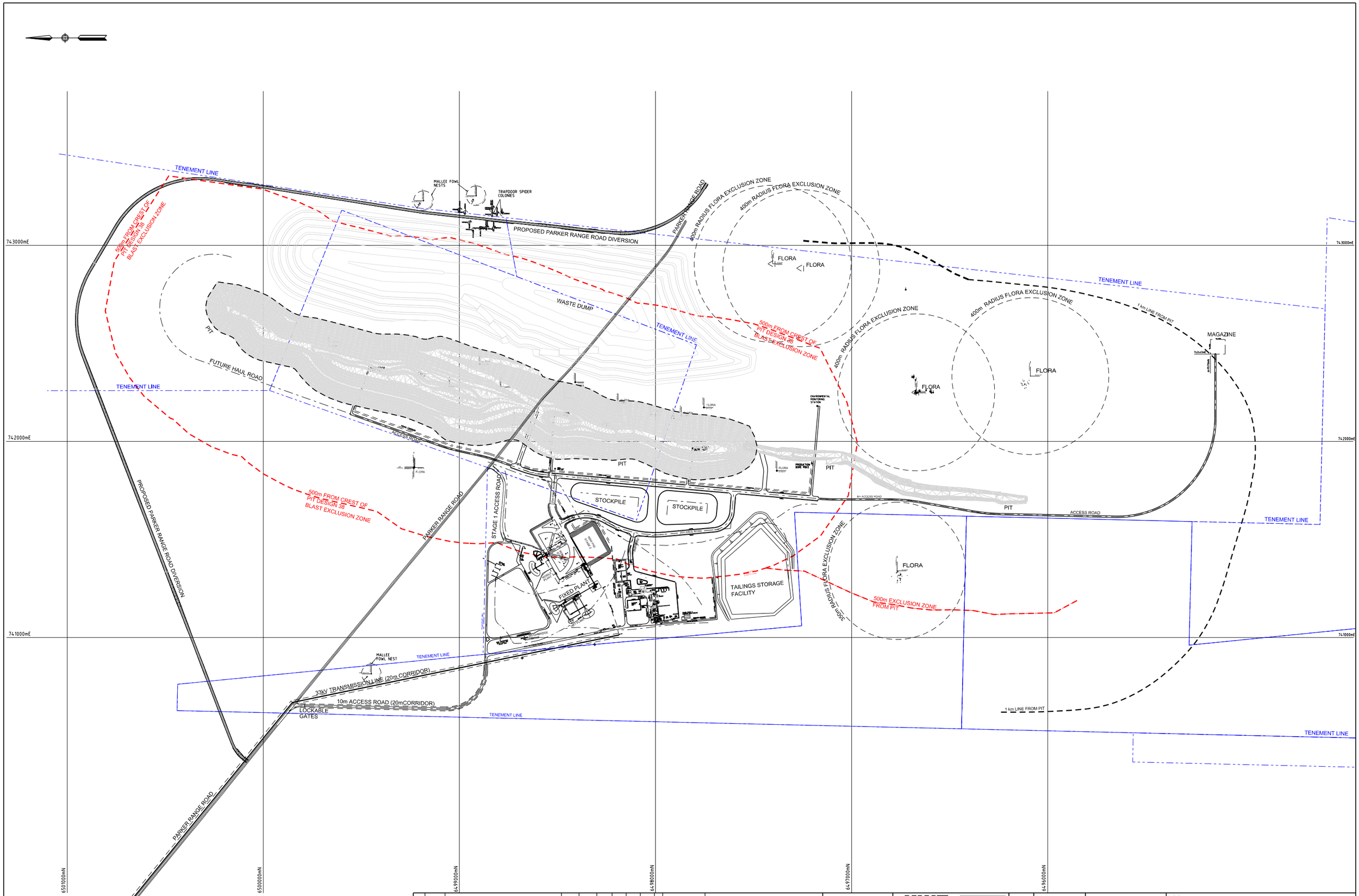
Appendix 9: Proposed Mine and Infrastructure for the Project (Detailed)

Cazaly Resources (January 2011)



REV	DATE	DESCRIPTION	BY	CHK	CIV/STR	MECH	E/I	PROCESS
E	30-11-10	TAILINGS STORAGE FACILITY MODIFIED	CH					
D	7.9.10	REISSUED FOR INFORMATION	CH					
C	6.8.10	REISSUED FOR INFORMATION	CH					
B	16.6.10	REISSUED FOR INFORMATION	CH					
A	8.6.10	ISSUED FOR INFORMATION	CH					

APPROVED

REFERENCE

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A1

CLIENT

PARKER RANGE PROJECT
MINE SITE
PROPOSED PLANT LAYOUT
GENERAL ARRANGEMENT

SCALE 1:6000

DRAWING No M8521-P00-GE-DR-0001

REV E

Appendix 10: Impact of the Cazaly Resources Parker Range (Mt Caudan) Iron Ore Project, Recalculated by DEC

Extract from Submission No. 8 (DEC, January 2011)

Submission 8 – DEC's Table 1: Impact of the Cazaly Resources Parker Range (Mt Caudan) Iron Ore Project on Priority Flora, Recalculated by DEC and Updated by Cazaly

As the information the PER was not clearly presented, these impact calculations could be over or under-estimated. The proponent needs to provide clarification so that the impacts on species of conservation significance can be confirmed. Proponent Response: Cazaly have updated (**in bold**) clarification requested in the submission.

Species	Cons. Code	Number of Plants Impacted	Total Number of Plants in Project Area	% Impact at Project Level	Impacts suggested in PER	Approximate Other Populations in 10 km of Project Area	Impact at Local Level (within 10 km)	Regional Context (Approximate Number of Populations Known for Species)
Acacia concolorans	P2	120	120 **168 from six populations**	100% **71.4%**	1.3%	671 plants outside project area **Minimum eleven populations outside Project Area. 9,369 plants (incl. Burbridge)**	15% **1.3%**	Six populations (two east of Hyden, four in Parker Range region). **Minimum 17 populations in Parker Range region (incl. Burbridge) and two east of Hyden**
Baeckea grandibracteata subsp. Parker Range (K.Newbey 9270)	P1	22	158 **158 from five populations**	13.9%	13.9%	1 (not verified)	13.9%	Eight populations in Parker Range region from Marvel Loch to Skeleton Rocks.
Banksia shanklandiorum	P4	7,293 (extrapolated)	7,293 **17,812 from one population (extrapolated)**	100%[1] **40.9%**	1%	1 population 10,519 (extrapolated) **None (range extension)**	40% **40.9%**	Wide distribution over 260 km range for more than 18 populations, ca. six locations including Cadoux, Manmanning, SE Merredin, Carrabin, South Yilgarn, Parker Range.
Cyptandra crispula	P3	3	46 **46 from two populations**	6.5%	6.5%	None (range extension)	6.5%	Five populations including Parker Range, Boorabbin, Dundas, Victoria Rock and South Karonie.
Hakea pendens	P2	600 **630** **Three populations**	630 **1,129 from seven populations**	95% **55.8%**	12.6%	1,681 outside project area and 3,293 at St Barbara **552 outside Project Area and 3,293 at St Barbara** **Minimum twenty populations**	12% **16.4%**	Twenty-eight populations at four locations with a distribution over 160 km from Southern Cross to Maggie Hays. Greatest concentration in Parker Range region.
Isopogon robustus	DRF	0	1,020	0	0	None	0	Two populations restricted to the one location.
Lepidosperma sp. Mt Caudan (N Gibson & M Lyons 2081)	P1	3,629 plants (extrapolated) **Two populations**	9,308 (+300) **10,355 from four populations**	38% (42%) **35%** **Impact two populations of four known populations**	4.7%	73,144 (extrapolated) **66,797** **Eight populations (based on extrapolated no. and actual counts)**	4.7% **4.8%**	Parker Range Endemic. All five populations within 10 km of project area. **Parker Range Endemic. All total of 12 populations within Parker Range region totalling 77,152 plants.**

Species	Cons. Code	Number of Plants Impacted	Total Number of Plants in Project Area	% Impact at Project Level	Impacts suggested in PER	Approximate Other Populations in 10 km of Project Area	Impact at Local Level (within 10 km)	Regional Context (Approximate Number of Populations Known for Species)
Lepidosperma sp. Parker Range (N Gibson & M Lyons 2094)	P1	219	219	100% **Impact to one population out of five within 10 km of the project area. All populations genetically similar**	1.6%	1? (197)[2] **Four populations 197 plants**	52 – 100%? **52%** **Same distinct species as other four populations within 10 km and Mt Palmer - Finnerty Range**	Eight populations, four locations including Parker Range, Mt Finnerty. Windy Hill and Bremer Range.
***Chamelaucium* sp. Parker Range[3]**	**P1**	**Unknown** **Four populations 27 positively identified**	**Unknown** **Minimum four populations**	**Cannot be determined**	**Not Assessed in PER** **New Priority 1 Taxa (Listed March 2011)**	**298** **Three populations**	**Cannot be determined**	**Nine populations in total within 20 km of Project area. Further two populations of 55 plants outside the 10 km of Project Area.**

[1] Information provided on *B. Shanklandiorum* in the PER is confusing and conflicting. The PER suggests an impact to 7,293 individuals within the project area (100% of the population), however, in reviewing Figure 30 it is clear that the entire population will not be impacted and that there are records of this species outside the project footprint.
[2] Information provided on *Lepidosperma* sp. Parker Range in the PER does not clearly state if there is one or two populations of the taxon within the project area or where the other surveyed populations of the taxon occur within the Parker Range region. The Barrett report identifies one population at the Parker Range and two populations to the east were included in the DNA analysis.
[3] Cazaly added this species to DEC Table 1 based on notification received 28 March 2011 by Office of EPA and taxonomical confirmation by M. Barrett (BGKPA on 7 April 2011). Species listed as new Priority 1 on 23 March 2011.

Appendix 11: Vegetation Group and Community Consolidation Summary for Parker Range Project as requested by the EPA

Extract from Matters Raised by Office of the EPA (EPA, January 2011)

Office of the EPA Matters Raised – EPA's Table 1: Vegetation Group and Community Consolidation Summary as requested by EPA and Updated by Cazaly

Region	Vegetation Group	Gibson & Lyon Vegetation Community Type (1-6)	Vegetation Community	Mine Area	Parker Range Bypass Road	Powerline Corridor	Upper Truck Haul Road Near Moorine Rock	Project Area (i.e. Disturbance Footprint)
Parker Range PEC	Tall *Eucalyptus* woodlands	3	*Eucalyptus salmonophloia* woodland	*	*	*		*
		2	*Eucalyptus longicornis* woodland			*		*
		3	*Eucalyptus salubris* woodland	*	*	*		*
		3	Mixed *Eucalyptus* woodland	*		*		*
		3	*E. salmonophloia/E. salubris* woodland		*			*
		N/A	*Eucalyptus* woodland over *Acacia steedmanii*					
		N/A	*Eucalyptus oleosa* woodland over *Melaleuca*		*			*
		N/A	*Eucalyptus salicola* woodland over *Melaleuca pauperiflora*					
		1	*Eucalyptus transcontinentalis* woodland	*	*			*
	Mallee woodlands	N/A	*Eucalyptus salubris* woodland over *Melaleuca pauperiflora*		*			*
		N/A	Mallee woodland over *Acacia sp. narrow phyllode* and *Melaleuca hamata*					
		4	Open Mallee woodland	*	*	*		*
		4	Mallee Heath	*		*		*
		N/A	Burnt Mallee woodland					
		5	*Eucalyptus capillosa* subsp. *polyclada* on Rise					
		5	*Eucalyptus capillosa* subsp. *polyclada* woodland		*	*		*
	Salt Lake vegetation	2	*Eucalyptus longicornis* over Samphire Vegetation					
		N/A	Samphire vegetation					
		N/A	*Eucalyptus oleosa* over Samphire Vegetation					
	Shrublands/Thickets	4	*Allocasuarina* shrubland	*	*			*
		N/A	*Acacia* sp. narrow phyllode and *Melaleuca eleuterostachya* shrubland	*	*			*
		4	*Allocasuarina* thicket	*	*	*		*
		N/A	*Acacia* thicket		*			*
	Rocky outcrops	6	*Isopogon robustus* on decomposing Laterite/Granite					

Region	Vegetation Group	Gibson & Lyon Vegetation Community Type (1-6)	Vegetation Community	Mine Area	Parker Range Bypass Road	Powerline Corridor	Upper Truck Haul Road Near Moorine Rock	Project Area (i.e. Disturbance Footprint)
		5	Mallee woodland/*Allocasuarina* shrubland on Laterite ridge	*		*		*
	Disturbed vegetation	N/A	Cleared Native Vegetation					
		N/A	Regenerating *E. salubris/E. salmonophloia* woodland					
		N/A	Burnt *Eucalyptus* woodland					
		N/A	Burnt Mallee Woodland/*Allocasuarina* shrubland	*	*	*		*
		N/A	Mixed Shrub rehabilitation in gravel pit	*				*
Moorine Rock	***Acacia & Melaleuca* woodlands/thickets**		*Acacia* woodland over granite				*	*
			Acacia coolgardiensis woodland				*	*
			Allocasuarina thicket				*	*
			Melaleuca thicket				*	*
	Tall *Eucalyptus* woodlands		*Eucalyptus salubris* woodland				*	*
	Mallee woodlands		*Eucalyptus capillosa/Eucalyptus salubris* Mallee woodland				*	*
			Eucalyptus loxophleba subsp. *lissophloia* over *Melaleuca lateriflora*				*	*
			Eucalyptus transcontinentalis Mallee woodland				*	*
			Total no. vegetation communities	**12**	**13**	**10**	**8**	**26**
			Total no. vegetation communities within the PEC	**30**				
			Total no. vegetation communities impacted within the PEC	**18**				
			Total no. vegetation communities impacted (i.e. within project area)	**26**				

Appendix 12: Supporting Information to Cazaly's Responses (Referenced within Tables 4 and 5)

Cazaly Resources (January 2011 to April 2011)

Table A: Revised Extent of Vegetation Associations by Subregion for the Project Area

IBRA Subregion	Vegetation Association	Local System	Pre-European Extent (ha)	Current Extent (ha)	% Original Extent Remaining	Area In Reserves (ha)	% In DEC Managed Lands	Area Proposed To Be Impacted (ha)	% Impact On Remaining Vegetation	Current Extent After Impact (ha)	% Original Extent Remaining After Impact	Total Area (ha) Impacted In Subregion
Project Area - Mt Caudan and Bypass Road												
COO2	552	Parker Range	1,873	1,873	100	0	0	4	0.2	1,869	99.8	**188.3**
	1068	Parker Range	35,759	31,333	87.6	2,920	9.3	182.7	0.6	31,150	99.4	
	1413	Parker Range	3,478	2,500	71.9	0	0	1.6	0.1	2,498	99.9	
AW1	552	Parker Range	1,873	1,873	100	0	0	95	5.1	1,778	94.9	**211.7**
	1068	Parker Range	35,759	31,333	87.6	2,920	9.3	77.3	0.2	31,256	99.8	
	1413	Parker Range	8,496	3,972	46.7	0	0	39.4	1.0	3,933	99.0	
Project Area – Powerline Corridor												
COO2	8	Parker Range	1,483	1,482	100	0	0	1	0.1	1,481	99.9	**10.4**
	128	Parker Range	932	891	95.5	0	0	1	0.1	890	95.5	
	552	Parker Range	1,873	1,873	100	0	0	1	0.1	1,872	99.9	
	1068	Parker Range	35,759	31,333	87.6	2,920	9.3	5	0.0	31,328	87.6	
	1413	Parker Range	3,478	2,500	71.9	0	0	2.4	0.1	2,498	99.9	
AW1	1413	Parker Range	8,496	3,972	46.7	0	0	3.6	0.1	3,968	99.9	**3.6**
Project Area – Upper Haul Road (near Moorine Rock)												
AW1	8	Moorine Rocks	319,539	29,661	9.28	1,917	6.46	0.3	0.0	29,661	9.3	**4.1**
	1413	Moorine Rocks	319,735	94,903	29.7	6,138	6.5	3.8	0.0	94,899	29.7	
Project Area - Cumulative Impacts of Mt Caudan, Bypass Road and Powerline Corridor												
COO2	8	Parker Range	1,483	1,482	100	0	0	1	0.1	1,481	99.9	**198.7**
	128	Parker Range	932	891	95.5	0	0	1	0.1	890	95.5	

IBRA Subregion	Vegetation Association	Local System	Pre-European Extent (ha)	Current Extent (ha)	% Original Extent Remaining	Area In Reserves (ha)	% In DEC Managed Lands	Area Proposed To Be Impacted (ha)	% Impact On Remaining Vegetation	Current Extent After Impact (ha)	% Original Extent Remaining After Impact	Total Area (ha) Impacted In Subregion
	552	Parker Range	1,873	1,873	100	0	0	5	0.3	1,868	99.7	
	1068	Parker Range	35,759	31,333	87.6	2,920	9.3	187.7	0.6	31,145	99.4	
	1413	Parker Range	3,478	2,500	71.9	0	0	4	0.2	2,496	99.8	
AW1	552	Parker Range	1,873	1,873	100	0	0	95	5.1	1,778	94.9	**215.3**
	1068	Parker Range	35,759	31,333	87.6	2,920	9.3	77.3	0.2	31,256	99.8	
	1413	Parker Range	8496	3,972	46.7	0	0	43	1.1	3,929	98.9	

Table B: Vegetation Communities identified within the Parker Range PEC that occur within the Jilbadji Nature Reserve and Mt Caudan Project Area

Region	Vegetation Group	Vegetation Community (Within the Parker Range PEC)	Jilbadji Nature Reserve	Mine Area	Parker Range Bypass Road	Powerline Corridor
Parker Range PEC	Tall *Eucalyptus* woodlands	*Eucalyptus salmonophloia* woodland	*	*	*	*
		Eucalyptus longicornis woodland	*			*
		Eucalyptus salubris woodland		*	*	*
		Mixed *Eucalyptus* woodland	*	*		*
		E. salmonophloia/E. salubris woodland			*	
		Eucalyptus woodland over *Acacia steedmanii*	*			
		Eucalyptus oleosa woodland over *Melaleuca*			*	
		Eucalyptus salicola woodland over *Melaleuca pauperiflora*				
		Eucalyptus salubris woodland over *Melaleuca pauperiflora*	*		*	
		Eucalyptus transcontinentalis woodland		*	*	
	Mallee woodlands	Mallee woodland over *Acacia sp. narrow phyllode* and *Melaleuca hamata*				
		Open Mallee woodland	*	*	*	*
		Mallee Heath		*		*
		Burnt Mallee woodland	*			
		Eucalyptus capillosa subsp. *polyclada* on Rise				
		Eucalyptus capillosa subsp. *polyclada* woodland			*	*
	Salt Lake vegetation	*Eucalyptus longicornis* over Samphire Vegetation				
		Samphire vegetation				
		Eucalyptus oleosa over Samphire Vegetation				
	Shrublands/Thickets	*Allocasuarina* shrubland		*	*	
		Acacia sp. narrow phyllode and *Melaleuca eleuterostachya* shrubland		*	*	
		Allocasuarina thicket	*	*	*	*
		Acacia thicket			*	
	Rocky outcrops	*Isopogon robustus* on decomposing Laterite/Granite				
		Mallee woodland/*Allocasuarina* shrubland on Laterite ridge		*		*

Region	Vegetation Group	Vegetation Community (Within the Parker Range PEC)	Jilbadji Nature Reserve	Mine Area	Parker Range Bypass Road	Powerline Corridor
	Disturbed vegetation	Cleared Native Vegetation				
		Regenerating *E. salubris/E. salmonophloia* woodland				
		Burnt *Eucalyptus* woodland	*			
		Burnt Mallee Woodland/*Allocasuarina* shrubland		*	*	*
		Mixed Shrub rehabilitation in gravel pit		*		
		No. vegetation communities	**8**	**12**	**13**	**10**
		No. vegetation communities in the Mt Caudan project areas within the Jilbadji Nature Reserve	**6**			

Yellow cells denote those vegetation communities identified within any of the Mt Caudan project areas and the Jilbadji Nature Reserve

Table C: Flora Species Endemic to the Parker Range Region

(Species endemic to the Parker Range region identified during the Gibson & Lyon survey (1998), within the impact area and represented within local conservation reserves)

Endemic Species to the Parker Range Region	Current Name / Classification (WAHERB, 2011)	Identified in Gibson & Lyon Report (1998)	Identified by Botanica Consulting in Impact Area	Represented in Jilbadji Nature Reserve
Chamelaucium halophilum subsp. *nov*	*Chamelaucium* sp. Parker Range (B.H. Smith 1255)	*	*[1]	
Drummondita wilsonii	*Drummondita wilsonii* P1	*		
Isopogon robusta ms	*Isopogon robustus* DRF	*		
Hakea pendens	*Hakea pendens* P2	*	*	*
Euryomyrtus ciliata ms	*Euryomyrtus* sp. Parker Range (N. Gibson & M. Lyons 2269) P1	*		
Lepidosperma sp. Mt Caudan (N. Gibson & M. Lyons 2081)	*Lepidosperma* sp. Mt Caudan (N. Gibson & M. Lyons 2081)		*	

[1]Cazaly added this species to impact area based on notification received 28 March 2011 by Office of EPA and taxonomical confirmation by M. Barrett (BGKPA on 7 April 2011). Species listed as new Priority 1 on 21 March 2011.

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18th April 2011

Matthew Timbrell
Cazaly Resources Limited
Level 2, 38 Richardson Street,
West Perth WA 6005

Ref - Ecotech's response to the EPA observations and comments to the Parker Range Project PER

Dust modelling of truck haulage was undertaken as part of the Parker Range environmental studies based on dust deposition. Model predictions indicate that dust impacts could reach levels exceeding the NSW EPA criteria for dust deposition (maximum 4 g/m^2/month) at a distance of approximately 120 m from the road edge (according to Figure 5-4 of the Air Quality Impact Assessment).

In regards to the matter raised by the EPA, at a short distance of 20 m the AUSPLUME model reliability is limited. However, for a Liddell Road truck route the model predictions make it reasonable to judge it likely that NSW EPA criteria will be exceeded with modelling predicting deposition levels materially greater than 4 g/m^2/month at distances further than 20 m. Criteria set by the NSW EPA is determined based on deposition levels greater than 4 g/m^2/month that will adversely affect the amenity of human receptors via prolonged exposure.

Truck transport of ore along Liddell Road route would likely result in unacceptable levels of dust deposition and loss of amenity at the Lot 638 residence.

Regards

Razvan Vlad
National Technical Support Supervisor

2006 Governor of Victoria Export Awards Winner
NATA

Figure E: Clarification Letter Liddell Road Truck Route Noise Impact Assessment (HSA, April 2011)

Rochdale Holdings Pty Ltd A.B.N. 85 009 049 067 trading as:

HERRING STORER ACOUSTICS

Suite 34, 11 Preston Street, Como, W.A. 6152
P.O. Box 219, Como, W.A. 6952
Telephone: (08) 9367 6200
Facsimile: (08) 9474 2579
Email: hsa@hsacoustics.com.au

EMAIL TRANSMITTAL

REF: 13071-2-10070

TO: Cazaly Resources

ATTENTION: Matt Timbrell

ADDRESS: matt@cazalyresources.com.au

FROM: Paul Daly

DATE: 20th April 2011

SUBJECT: EPA COMMENTS – PARKER RANGE PROJECT

Matt,

Further to our discussions and the email of 11th April 2011, herewith is Herring Storer Acoustics response to EPA comments in regards to the Parker Range Project.

It is understood that the proposed truck route along Liddell Road requires comment as to the impact of noise from truck haulage.

From information provided and monitoring conducted at the residence (Maddock property) the following preliminary assessment provides potential noise levels associated with this route.

- Existing noise levels at the Maddock residence is an $L_{Aeq(day)}$ of 43 dB(A) and an $L_{Aeq(night)}$ of 38 dB(A).
- Based on a Sound Power Level of 98 dB(A) from a large truck, noise levels received at the property would be 64 dB(A). Given the frontage of the residence, a conservative estimate of time the truck noise is present has been set at 2 minutes.
- In a 24hr period there will be 137 truck movements.
- Assuming 94% for day time period 06:00 to 22:00 the number of truck movements during the day and night periods would be 128 and 9 respectively.
- Based on the above information, calculations have been made to provide a resultant $L_{Aeq(day)}$ time noise level of 58 dB(A) and a $L_{Aeq(night)}$ of 49 dB(A)

Utilising the Liddell Road route would increase noise levels at the Maddock's residence by 15 dB(A) during the day and 11 dB(A) at night.

Due to the close proximity (20 m) of the residence to Liddell Road, maximum noise levels from individual truck events are likely to be in the order of +75 dB(A). The undertaking in the PER ref (Cazaly PER Revision E November 2010 page 122 Section 6.2.9 Noise and Vibration) states singular noise events from truck passes are unlikely to affect health and wellbeing significantly, if below 65 – 70 dB(A).

Criteria noise levels set by the WAPC and used as a basis of this assessment are an $L_{Aeq(day)}$ of 60 dB(A) and an $L_{Aeq(night)}$ of 55 dB(A).

Whilst compliance is achieved at this residence with the criteria stipulated, it is felt there would be a significant increase in noise levels and impact on the amenity of the residence. Therefore, if this route was used for the proposed Parker Range Project, noise control options should be investigated.

Yours faithfully,
for **HERRING STORER ACOUSTICS**

Paul Daly

Figure F: Clarification Letters Regarding Heritage Submissions (W Glendenning, January 2011)

WARRANUP PTY LTD
Anthropology & Archaeology Research
Po Box 4039 Victoria Park WA 6979
T:92596115 F:62305379 M:0457784861
Email: warranup@iinet.net.au
ABN:65913997211

31 January 2011

RECEIVED
BY

Matt Timbrell
Senior Project Manager
Parker Range Project
Cazaly Resources Limited
Level 2, 38 Richardson Street,
WEST PERTH WA 6005

Dear Matt

Re: Cultural Use of the Area by the Traditional Owners and Potentiality of Archaeological Deposit within Rockshelters and Overhangs

Thank you for providing a summary of matters raised by the DIA regarding the Parker Range Project PER and Aboriginal heritage reports. Herein I address the issues of cultural area use and likelihood archaeological deposits within rockshelters and overhangs.

Firstly with regard to use of the area by the Traditional Owners, although all of the people consulted for the survey have extensive knowledge of the area, there is little current use of the area by any of the individuals apart from the occasional passing through when travelling an alternative route to Kalgoorlie or Perth.

Generally however, the Traditional Owners prefer to travel along bitumen roads where there is access to fuel, food and other refreshments and there is less possibility of being stranded if a vehicle breaks down or has a flat tyre. The Forrestania Road is quite remote and there is no fuel, water or other facilities between Marvel Loch and Hyden or Norseman

Sometimes the Traditional Owners will travel around the Wheatbelt and Goldfields at certain times of the year to collect bush tucker such as quangdong fruit or witchety

grubs. I suggest that Cazaly consider the possibility that the Traditional Owners may want to gain access to areas around Parker Range, although obviously away from mining activities, to collect bushtucker. Cazaly may consider developing a protocol for these activities.

Secondly, with regard to the rockshelters I noted from our field notes that several rockshelters and overhangs were inspected on the Parker Range. Only one of the rockshelters has the potential for sub-surface material due to the sandy floor. Other rockshelters had a rocky floor and no possibility of a sub-surface component. Debris from ceiling falls also hampered observation of the surfaces of some of the rockshelters.

Cazaly could consider undertaking an excavation of the identified rockshelter's sandy floor (if the rockshelter is to be disturbed during mining or other activities), prior to any disturbance commencing.

If the floor excavation is necessary, Cazaly would be advised to appoint a Traditional Owner to assist with the excavation, which would also provide Cazaly an opportunity to engage with the Traditional Owners. The excavation would be undertaken in a timely manner.

If you wish to discuss this further please do not hesitate to contact the undersigned.

Yours sincerely

Wayne Glendenning
Anthropologist
Warranup pty Ltd

Warranup Pty Ltd
Anthropology & Archaeology Research
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T: 9259 6115 F: 6230 5379 M: 0457 784 861
Email: warranup@iinet.net.au
ABN: 65 913 997 211

18 April 2011

Matt Timbrell
Senior Project Manager
Parker Range Project
Cazaly Resources Limited
Level 2, 38 Richardson Street,
WEST PERTH WA 6005

Dear Matt

Re: Cultural Use of the Parker Range Project Area by the Traditional Owners - additional information

Thank you for providing a summary of the response by the DIA and EPA regarding the Parker Range Project PER relating to Aboriginal heritage as discussed in the ethnographic report of June 2010.

I refer to my letter dated 31 January 2011 in which I explained why the Traditional Owners rarely visit the Parker Range area due to the use of Great Eastern Highway as the current primary transportation route.

In that letter I also stated that at certain times of the year the Traditional Owners may undertake a daytrip around the Wheatbelt and Goldfields to collect bush tucker such as quangdong fruit or witchety grubs.

In addition to the information I provided in that letter, I would like to add that in former times the traditional owners from the Kalamaya Gubrun and Central West People (now known as the Walgu People) lived in Southern Cross and the Parker Range area was very accessible being only an hours drive from their homes. As the representatives of both groups now live in Kalgoorlie and Coolgardie the drive to Parker Range is now a prohibitive 3.5 to 4 hour drive, particularly for older people and there are more accessible places for bushtucker and medicinal plants close to where they now reside.

The same is the case for the Ballardong Traditional Owners of the Parker Range project area. The people attending the ethnographic survey (Yarran family who have familial ties with both the Kalamaya Gubrun and the Walgu) and their relatives once lived in the Wheatbelt towns of Quairading and Merredin, which are both relatively close to Parker Range, but now live within the Perth metropolitan area.

As I stated in my previous letter none of the Traditional Owners of the Parker Range area regularly visit the area now and if they do so it is as a detour whilst travelling along Great Eastern Highway when travelling to Kalgoorlie or Perth

If you wish to discuss this matter further please do not hesitate to contact me on 047784861.

Yours sincerely

Wayne Glendenning
Principal Anthropologist
Warranup Pty Ltd

Appendix 13: Environmental Management Plan (M8521-G00-EN-PL-001)

HWE Mining (January 2011)

Document No:	M8521-G00-EN-PL-001
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Distribution

This plan has been issued to the following personnel:

1	HWE Project Manager
2	Client Representative
3	HWE QA Representative
4	Intranet

Document Control

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Revision interval:	Annually
Date of next revision:	30/7/2011
Prepared by:	HSEC Manager

Approval

This document has been approved by:

HWE Project Manager	
Signature	
Date	MARILYN WOOD 27/7/10
Client Representative	MATTHEW TIMBRELL
Signature	
Date	30/7/2011

Table of Contents

1.0 PURPOSE AND SCOPE....4
1.1 PURPOSE....4
1.2 SCOPE....4
2.0 MANAGEMENT SYSTEM....7
2.1 RELATIONSHIPS....7
2.2 DOCUMENTATION AND DOCUMENT CONTROL....7
2.3 RECORDS....7
3.0 IMPLEMENTATION AND OPERATION....8
3.1 RESPONSIBILITIES....8
3.2 COMMUNICATION....8
4.0 PLANNING....9
4.1 RISK ASSESSMENT....9
4.2 LEGAL REQUIREMENTS....9
4.2.1 LEGISLATION....9
4.2.2 LICENCES / PERMITS/GUIDELINES/STANDARDS....9
4.3 ENVIRONMENTAL ASPECTS AND IMPACTS....9
4.4 ENVIRONMENTAL OBJECTIVES AND TARGETS....9
4.5 ENVIRONMENTAL MANAGEMENT SUB-PLANS....9
5.0 PROCESSES....10
5.1 ENVIRONMENTAL TRAINING....10
5.1.1 SITE INDUCTION....10
5.2 SUPPLIER AND CONTRACTORS....10
6.0 INSPECTIONS, MONITORING AND REVIEW....11
6.1 MONITORING & REPORTING....11
6.2 CALIBRATION....11
6.3 MONITORING EQUIPMENT....11
6.4 MONTHLY REPORTING AND EVALUATION OF ENVIRONMENTAL PERFORMANCE....11
6.5 AUDITS....11
6.6 ENVIRONMENTAL INSPECTIONS....11
6.6.1 DAILY INSPECTION....11
6.6.2 SCHEDULED ENVIRONMENTAL INSPECTIONS....12
6.6.3 ACTION REGISTER AND NON-CONFORMANCE....12
6.6.4 ENVIRONMENTAL MANAGEMENT PLAN REVIEW....12
7.0 INCIDENTS, COMPLAINTS AND EMERGENCY RESPONSE....13
7.1 ENVIRONMENTAL INCIDENT REPORTS AND COMPLAINTS REGISTER....13
7.1.1 ENVIRONMENTAL INCIDENTS....13
7.2 EMERGENCY RESPONSE....13
7.3 CHANGE MANAGEMENT....13
APPENDIX 1 – LEIGHTON CONTRACTORS ENVIRONMENT POLICY....14
APPENDIX 2 – ENVIRONMENTAL RESPONSIBILITIES....15
APPENDIX 3 –SUMMARY ENVIRONMENTAL RISK ASSESSMENT....17
APPENDIX 4 - ENVIRONMENTAL MANAGEMENT SUB PLANS AND PROCEDURES....29
APPENDIX 5 – CORRESPONDENCE BETWEEN ISO14001 AND PROJECT EMP....64
APPENDIX 6 – DOCUMENTATION ROAD MAP....65
APPENDIX 7 – CONTACT LIST....67
APPENDIX 8 – ENVIRONMENTAL MONITORING & REPORTING PROGRAMS....68

1.0 Purpose and Scope

1.1 Purpose

HWE Mining is committed to a proactive and responsible approach to managing the impact on the environment and communities in which we operate.

HWE Mining is a subsidiary of Leighton Contractors Pty Ltd and work under their policies. This commitment is stated in the Leighton Contractor's Environment policy (refer Appendix 1).

HWE Mining bases its business approach on five core values. One of these values is "Respect for community and environment". These values reinforce our culture, guide our behaviours and help to articulate the way we approach all aspects of our business.

HWE Mining has in place an ISO 14001 certified environmental management system (EMS) to assist with meeting this commitment.

This Environmental Management Plan (EMP) defines HWE Mining's approach to environmental management of the project and integrates client, regulatory and HWE Mining's EMS requirements.

1.2 Scope

The Parker Range Iron Ore Project is 100% owned and managed by Cazaly Resources Limited ('Cazaly') and comprises 900 ha of mining tenements within the Southern Cross greenstone belt, part of the Yilgarn iron ore province.

The Project is located approximately 52 kilometres south of Southern Cross and 15 kilometres south-east of Marvel Loch (Figure 8).

The Perth – Kalgoorlie public access rail line is approximately 60 km to the north west of the project area, with the preferred rail siding located at Moorine Rock (57 km via the Parker Range Road).

The ports of Esperance and Kwinana are serviced by the public access rail line, with the port of Kwinana preferred for the development as it is 416 km by rail from Moorine Rock (approximately 240 km closer than Esperance).

Within the Parker Range, resource drilling has been concentrated at the northern Mt Caudan deposit which consists of 4.0 kilometre of strike from the Banded Iron Formation (BIF) horizon that stretches over 16 km. The 4.0 kilometre Mt Caudan deposit is the focus of the Parker Range project development.

For the first year of operation, ore will be treated by way of an on-site 4 Mtpa dry crushing, screening and stockpiling plant located to the west of the mine operation. From year 2+ of operation, the dry plant will be retrofitted with a wet-plant/beneficiation process which involves washing and screening of lower grade ore impurities to tailings.

Iron ore products will be loaded into on-highway road trains and transported to railway infrastructure approximately 57 km northwest to Moorine Rock rail siding. Products will be loaded from the stockyard at Moorine Rock rail siding into ore cars and transported along existing rail infrastructure to the Port of Kwinana (Kwinana Bulk Terminal), Western Australia. The Port is operated by Fremantle Ports. The Moorine Rock rail siding, rail haulage transport and Kwinana Port Operations are excluded from the scope of this plan.

Various buildings will be constructed at the Mt Caudan mine site, including a temporary construction office, mine/operations administration complex, mine/operations crib rooms with toilets,

workshop/warehouse/laydown facility, fuel management facility (storage tanks and in/outloading pumps), vehicle park-up (including go-line and water stand-pipe) and heavy/light vehicle wash down bays.

Water for the mine site will be provided from pit dewatering bores. Water will be treated by a desalination plant which will provide fresh water for the site.

Power for the site will be provided initially from on-site generators and then changed over to a new 33kV powerline supply connected to existing mains situated at Marvel Loch.

In summary this Environmental Management Plan is applicable to the following areas/activities of the Parker Range Project:

- Open Pit Mining Operations
- Ore Processing and train loading infrastructure
- Borefield water supply
- Offices and associated support facilities
- Maintenance activities associated with the above areas
- Moorine Rock Rail Terminal

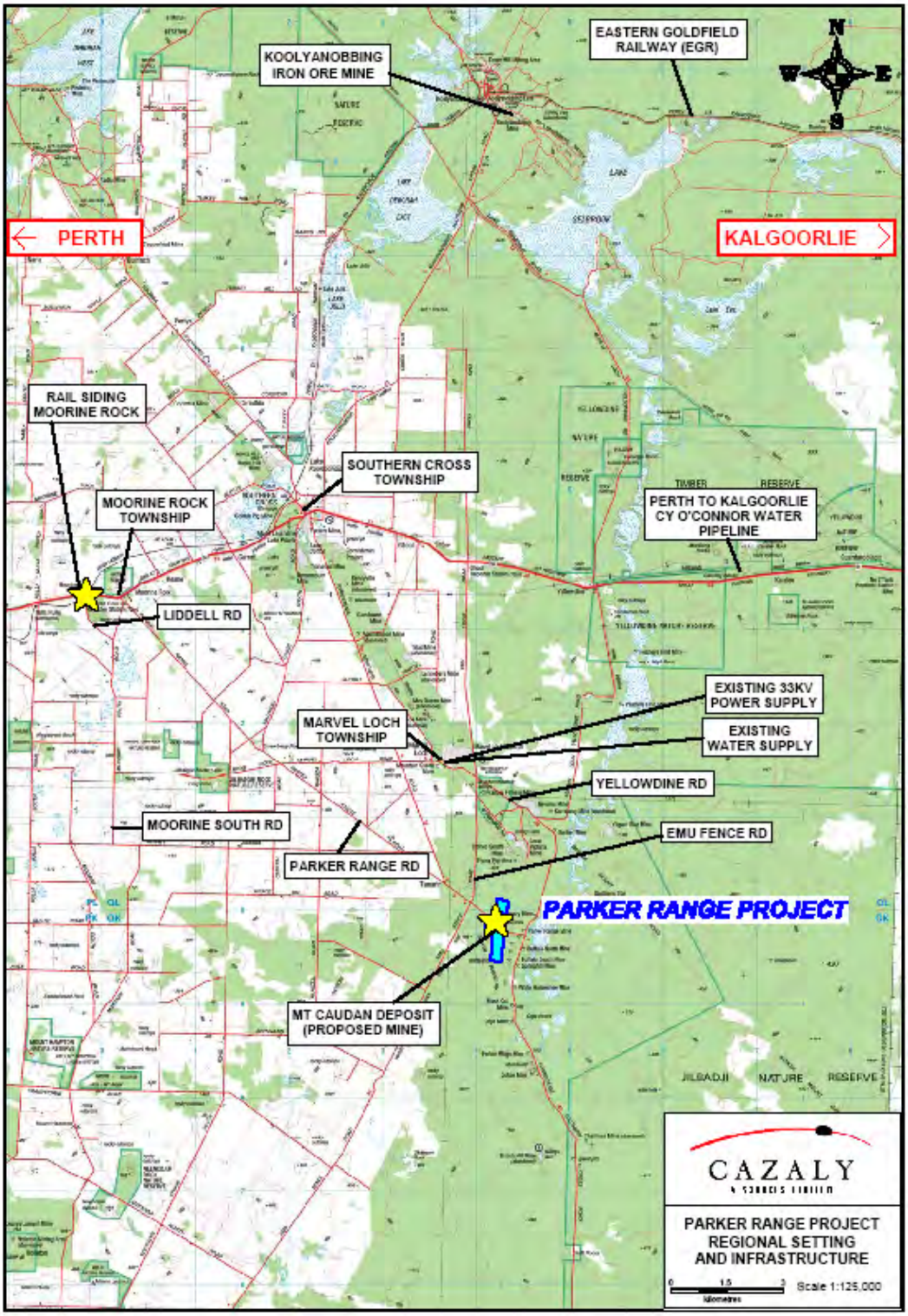


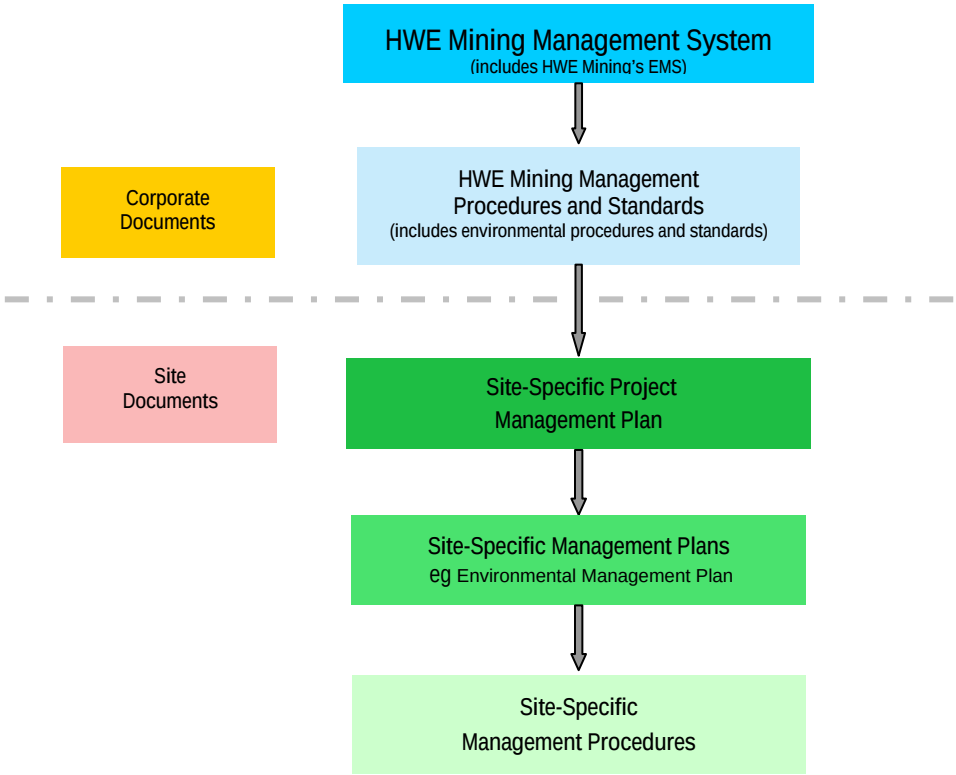
Figure 1: Location of Parker Range Project and Mt Caudan deposit

2.0 Management System

The EMS is part of a comprehensive management system that governs how HWE Mining conducts its business.

2.1 Relationships

This site specific Environmental Management Plan (EMP) relates directly to HWE Mining's EMS (PL-MG-011) and related procedures. This EMP also forms part of the site-specific management system. Figure 1 details this relationship.



2.2 Documentation and Document Control

Documentation pertaining to the EMS including plans, processes, procedures and forms is available through the HWE Mining intranet.

The control of EMS related documentation is detailed in procedure PC-QA-008 Document Control.

2.3 Records

Environmental Records are maintained on-site in accordance with administration procedures (PC-AD-001 through to PC-AD-009).

3.0 Implementation and Operation

3.1 Responsibilities

Generic environmental responsibilities for all employees and sub contractors are summarised in Appendix 2. Specific responsibilities are, where applicable incorporated into job descriptions.

3.2 Communication

The HWE Mining Project Manager will liaise with the client regarding any environmental issues.

No external correspondence regarding environmental incidents or issues will be issued without the prior authorisation of the HWE Mining Project Manager.

Contact details of relevant personnel are included in Appendix **7**.

4.0 Planning

Planning for environmental management starts with a risk assessment process to define key risk exposures. The planning process involves an understanding of relevant environmental aspects, impacts and legal requirements along with the development of objectives, targets and sub-plans.

4.1 Risk Assessment

Environmental risk has been assessed for this project using the Risk Assessment process as outlined in procedure PC-HS-3001 or other methodologies consistent with the Australian Standard for Risk Management AS/NZS ISO 31000:2009. The risk assessment document is available on site for reference purposes. A copy of the significant environmental risks and controls are included in Appendix 3.

4.2 Legal Requirements

4.2.1 Legislation

A summary of environmental legislation relevant to HWE Mining's business is detailed in the HSE Legal and Other Registers (FM-LR-001-02 and FM-LR-001-15) on the HWE Mining intranet. Copies of legislation are available via the intranet on Envirolaw. Changes to legislation are communicated via the monthly update which is available electronically.

4.2.2 Licences / Permits/Guidelines/Standards

Conditions associated with licences/permits/guidelines and standards are included in relevant environmental management sub plans. Current copies of applicable licences / permits are maintained on site files.

4.3 Environmental Aspects and Impacts

The significant aspects and impacts are confirmed by the risk assessment (Appendix 3), and control measures detailed in the environmental management sub plans attached as Appendix 4.

4.4 Environmental Objectives and Targets

The project environmental objectives and targets are developed and reported in accordance with procedure PC-QA-014 *Development of SHEQ Objectives and Targets* and take into consideration the projects significant environmental risks. Objectives and targets identified for the project are documented on FM-QA-047 SHEQ Objectives and Targets and filed on site. Site specific objectives and targets will be set in accordance with the HWE Mining SHEQ Strategic Plan.

Objectives and targets will be reviewed quarterly by the Project Management Team as a minimum to determine how they have been implemented. A full revision of the sites Objectives and Targets will be undertaken annually.

4.5 Environmental Management Sub-Plans

Project specific environmental management sub-plans are developed to assist in the management of project specific aspects and impacts. The environmental management sub plans for this project are attached as Appendix 4.

5.0 Processes

5.1 Environmental Training

5.1.1 Site Induction

HWE Mining employees and subcontractors are required to attend a site induction addressing environmental issues prior to commencing duties. Environmental issues covered include:

- Leighton Contractor's Environment Policy
- Our values including "Respect for Environment and Community"
- HWE Mining's Environmental Management System
- Project Environmental Management Plan
- Legal responsibilities and requirements
- Project hazards and significant risks
- Procedures for reporting incidents

All personnel (employees and contractors) are required to acknowledge their attendance at the site induction and acceptance of their environmental responsibilities by completing a written questionnaire and signing a register of attendance.

5.1.2 Site Training and Awareness Sessions

In addition to the project specific induction, further environmental training may be required for specific tasks carried out by the workforce. (E.g. Snake handlers Training, Spill Response Training.) A training matrix will be maintained by the HSEC department which shows what training has been completed by each employee.

Environmental information is also communicated via toolbox sessions. Environmental toolbox posters are found on the intranet under Toolbox Information. There is also FM-EN-043 Toolbox Register.

5.1.3 Training Records

Training records are to be maintained and filed in accordance with PC-TR-6000 HWE Mining Learning and Skills Development Policies and Procedures Manual.

5.2 Supplier and Contractors

Wherever practicable, the environmental impact of goods and services will be considered at the time of procurement and less hazardous alternatives to hazardous substances will be considered.

The ability of suppliers and subcontractors to meet the requirements of the HWE Mining EMS will be considered in selection process. All suppliers and Contractors will be required to comply with HWE Mining's environmental, quality and safety management systems.

HWE Mining will undertake surveillance of the suppliers and contractors to ensure compliance with system requirements, as per FM-EN-044 Annual HWE Environmental Sub-Contractors Audit Schedule and FM-EN-045 Environmental Sub-Contractors Due Diligence Audit. HWE Mining staff will liaise with suppliers and sub-contractors on a regular basis to ensure environmental protection controls, as defined in the EMP, are being implemented.

Contractors are required to consider environmental aspects during the preparation of a task specific job safety analyses for all work carried out.

6.0 Inspections, Monitoring and Review

Control over the project EMP will be exercised through a number of monitoring, inspection and assurance mechanisms. Importantly, a corrective action register will be maintained for the project through which control improvements are logged and actioned in Cintellate.

6.1 Monitoring & Reporting

The environmental monitoring and reporting programs for the project are detailed in Appendix 8.

6.2 Calibration

Should any calibration of equipment be required, this will be performed in accordance with procedure PC-QA-007 Calibration. A calibration register will be maintained onsite that identifies environmental equipment that requires calibration (FM-QA-022 Equipment Master List and Calibration Record).

6.3 Monitoring Equipment

Prior to using environmental monitoring equipment, relevant personnel will be instructed on the correct handling and use of the equipment to ensure measurements are accurate and prevent damage to equipment.

6.4 Monthly Reporting and Evaluation of Environmental Performance

The monthly Environmental Indicators report (in Cintellate) allows the project site to regularly evaluate and report their environmental performance. The site HWE Environmental Representative will ensure they review data produced from the monthly environmental report, investigate trends and implement actions put in place to improve environmental performance. The monthly environmental report will be entered into Cintellate by the 7th working day of the month. This should be undertaken as per PC-EN-005 Cintellate Environmental Monthly Reporting Procedure and FM-EN-040 Environmental Monthly Cintellate Report Instructions.

The corporate environment report to Leighton Contractors is as per FM-EN-016 Monthly environmental Business Report.

Evaluation of Environmental Legal and other requirements will be evaluated as per PC-EN-047.

6.5 Audits

Environmental audits may be performed during the course of the project in accordance with procedure PC-QA-004 Audits. Refer to FM-QA-019 Project Audit Schedule for further information regarding the frequency of environmental audits. Refer to FM-EN-044 Sub-Contractor Audit Schedule for further information regarding the frequency of subcontractor environmental audits.

6.6 Environmental Inspections

6.6.1 Daily Inspection

Employees and area supervisors will perform informal environmental inspection checks of both HWE Mining and subcontractor work areas daily.

6.6.2 Scheduled Environmental Inspections

Planned inspections include environmental inspections and should be undertaken as per PC-EN-027.

The generic environmental elements of the operation to be inspected and frequency of inspection are defined as per the table below and are detailed in the Project Activity Schedule.

Element	Reference	Frequency of Inspection
Bulk Combustible Liquid Storage	IS-SF-004	Monthly
Landfill, Bioremediation, Tyres	IS-SF-012	Monthly
Revegetation	IS-SF-018	Monthly
Vehicle Wash down Facilities	IS-SF-026	Monthly
Topsoil Stockpiles	IS-SF-021	Monthly
Workshop	IS-SF-025	Monthly
Hydrocarbon Spill Kits	IS-SF-027	Monthly

6.6.3 Action Register and Non-conformance

The action register within Cintellate will be used to ensure effective tracking and closure of all action items. Action items may be generated from audits, inspections, non-conformances, incident findings and hazard near miss reports. The HWE Mining Project Manager will be responsible for the management of the action register. Any item that has been entered into the action register will remain an action item until it has been addressed to the satisfaction of the HWE Mining Project Manager. . A weekly Action Close-out meeting will be help to determine the status of any open actions and to determine how and when they will be closed out.

6.6.4 Environmental Management Plan Review

The EMP will be reviewed annually and whenever there is a significant change to the scope of the works. Changes made will be in accordance with PC-EN-007 Site Specific Environmental Management Plan. Annual reviews will use PC-QA-007 Environmental Management Plan template to ensure all corporate/process changes will be incorporated into the site specific documentation.

The corporate environmental management team annually review the environment management system as per PC-EN-029 Annual Environmental Review and FM-EN-018 Annual Environmental Review.

7.0 Incidents, Complaints and Emergency Response

7.1 Environmental Incident Reports and Complaints Register

7.1.1 Environmental Incidents

All environmental incidents will be documented and reported to the Project Manager (HWE Mining) as soon as practicable. The Project Manager (HWE Mining) will be responsible for assessing the impact of the incident and reporting the incident to HWE Mining Senior Management and the client. The client will be responsible for notifying regulatory authorities as required.

The HWE Mining Incident Management Report Form (FM-HS-3040-1) and reporting process will be used for environmental incident reporting (refer to procedure PC-EN-006 Environmental Incident Reporting). All environmental incidents will be entered into Cintellate.

All employees are also required to use Hazard Near Miss Cards (FM-HS-3148-01) to report environmental-related hazards and near-miss events.

7.1.2 Environmental Complaints

The process for handling complaints is detailed in PC-EN-037 Environmental Complaint Procedure using Cintellate.

7.2 Emergency Response

The Project Emergency Response Plan will include responses to environmental emergencies.

The ERP will be tested through quarterly mock emergencies and this will include at least one mock emergency with potential environmental impact every year.

The Emergency Response Plan details emergency response personnel, responsibilities, contact details, and details of emergency services.

MSDS files will be located in the Site Office and at locations where hazardous substances are stored such that they can be utilised in the event of an emergency situation if required.

Emergency Response procedures from the Emergency Response Plan will be included in inductions and posted in obvious locations.

7.3 Change Management

HWE Mining recognises that significant hazards can be created due to changes in the following aspects of the project:

- Work environment and operational changes;
- Equipment changes; and
- Personnel changes.

The Change Management Procedure (PC-HS-3004) will be adhered to.

Appendix 1 – Leighton Contractors Environment Policy

Leighton Contractors Group Environmental Policy

'CREATING A SUSTAINABLE FUTURE'

Leighton Contractors is committed to environmental sustainability. We strive to balance our economic and operational requirements with social responsibilities whilst minimising the impact of our business activities on the environment and surrounding communities.

To assist us in achieving our environmental objectives we will undertake the following:

- Promote a culture of innovation, engagement and participation;
- Promote the efficient use of energy and water, reduction of waste, recycling of materials and prevention of pollution;
- Improve our energy efficiency and management of our greenhouse emissions;
- Maintain an Environmental Management Systems in accordance with AS/NZS ISO 14001;
- Meet or exceed relevant environmental legislation and other criteria to which we subscribe;
- Regularly review our environmental performance and identify and implement opportunities for improvement;
- Influence our suppliers and subcontractors with our approach towards responsible environmental practices;
- Promote practices, systems, values and behaviours that contribute to environmental sustainability;
- Demonstrate leadership in environmental management both internally and within the industries we operate.

This policy will provide the framework for setting environmental objectives and targets within our business.

P J McMorrow
Managing Director
Leighton Contractors Pty Ltd

Appendix 2 – Environmental Responsibilities

Position	Key Responsibilities
Employees and Subcontractors	Actively participate and comply with all environmental requirements as outlined in HWE Mining general and project specific inductions, site-specific environmental procedures and environmental management plan. Have a basic understanding of the HWE Mining Safety, Health, Environment and Community Policy Assist the Project Environmental Representative by proactively identifying and reporting environmental issues on site.
Supervisors	Read Environmental Management Plan (EMP) and execute plans within the designated areas of responsibility. Understand relevant regulatory requirements and licence / permit conditions listed in the EMP and communicate these conditions to employees and subcontractors. Ensure all activities carried out by employees and subcontractors comply with the project specific EMP. Report back to superintendent and project manager with respect to compliance issues. Allocate time and resources to assist the Project Environmental Representative in completing objectives, targets, improvement items and closing NCR's. Assist the Project Environmental Representative by proactively identifying and rectifying environmental issues on site. Assist the Project Environmental Representative in encouraging an environmentally responsible workplace culture through maintaining an adequate level of housekeeping, the identification of hazards and reporting of issues
Project Environmental Representative	Read Environmental Management Plan and execute plans as required and have read PC-EN-001 Environmental Representative Pack. Understand relevant regulatory requirements and licence / permit conditions listed in the EMP and communicate these conditions to employees and subcontractors. Provide advice and assistance to the Project Manager for implementation of the Company ISO 14001 certified EMS and specifically the project EMP Ensure site-specific Hazard Identification Risk Assessment and Control (HIRAC) study remains relevant and that environmental aspects are reviewed regularly, particularly upon a change in scope of the operation. Ensuring the EMP remains appropriate through regular review and establishment of site-specific procedures where necessary. Complete monthly environmental reporting and performance reviews and forward to the HWE Mining Group Environmental Coordinator / Project Manager. Assist the completion of objectives and targets, reporting status to project manager monthly. Identify areas for environmental improvement and communicate these to project manager for assessment. Conduct/allocate Planned Inspections and ensure these are completed as per the Activity Schedule. Ensure continued awareness of environmental issues on site through appropriate forums such as toolbox sessions. Maintain environmental action register and provide updates to the project manager on status of action items monthly. Conduct investigations on environmental incidents and document on All Incident Reporting Form. Assist the project manager in ensuring emergency environmental response procedures are in place and all staff including subcontractors have adequate training in these procedures. Assist with corporate and certification surveillance audits as required Communicate with other site environmental representatives and group environmental coordinators Informally communicate with HWE Mining Corporate, Client and government agencies with respect to environmental outcomes required. Maintain environmental records in accordance with site filing system.
Project Manager	Ensure the project risk assessment is complete and up to date. Ensure that all staff and subcontractors undertake tasks in a manner consistent with the Company ISO14001 certified EMS and specifically the project specific EMP. Ensure compliance with all legal obligations. Set and assist with implementation of project specific objectives and targets ensuring they are completed within the timeframe allocated. Delegate responsibilities, in writing, to a nominated person (Project Environmental Representative) who is suitably qualified to assume the responsibility of implementing the EMP. Ensure all staff and subcontractors undergo general and site-specific inductions that incorporate project specific environmental information. Formally communicate with HWE Mining corporate, client and government agencies, including notification of environmental incidents where required. Ensure emergency environmental response procedures are in place and all staff including subcontractors have adequate

	training in these procedures. Monitor non-conformances until corrective actions have been implemented. Allocate resources to all items on action register.

Appendix 3 –Summary Environmental Risk Assessment

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
LAND DISTURBANCE										
Clearing of vegetation in areas not covered by approvals.	Breach of *Environmental Protection Act* and Regulations. Breach of *Mining Act.* Habitat destruction.	E	3	19	M	Internal "Permit to Clear" procedure ensures that government approvals are obtained prior to any clearing and that the area to be cleared does not contain any significant flora.	E	4	23	L
Uncontrolled removal of vegetation.	Clearing of significant vegetation or habitat. Habitat destruction. Fauna loss. Vegetation loss. Over clearing.	E	3	19	M	The area to be cleared will be clearly marked prior to the commencement of clearing activities. All clearing activities will be supervised by Environmental staff. Area of disturbance will be minimised where possible and protection of all vegetation outside the clearing profile.	E	4	23	L
Clearing of habitat for fauna species of conservation significance.	Reduction in available fauna habitat. Fauna loss.	E	2	14	H	Significant habitat areas (i.e. Malleefowl mounds) will be flagged and avoided. Prior to ground disturbance a Targeted Malleefowl Survey will identify any active mounds.	E	3	19	M
Lack of awareness of requirement to stockpile available topsoil and/or cleared vegetation.	Loss of topsoil. Insufficient topsoil available for rehabilitation.	D	4	20	L	All personnel, prior to clearing, will be advised to stockpile topsoil and cleared vegetation. Follow site procedure for topsoil management.	E	4	23	L
Removal of topsoil when too dry.	Production of dust.	C	4	18	M	Avoid topsoil stripping in very dry and windy conditions.	E	4	23	L
Inappropriate stripping and storage of topsoil.	Damage to soil structure and viability of topsoil during stripping or storage.	D	4	20	L	Topsoil stockpiles will be located adjacent to and within the footprint of disturbance. The stockpiles will be constructed to a height of approximately 3 metres (truck tipped). Vegetation stockpiles will be immediately upslope of the topsoil stockpiles to minimise surface water run-on to the topsoil Follow site procedure for topsoil management.	E	4	23	L
Machinery infected with pathogens or weed seeds used to strip topsoil and clear native vegetation.	Weed or pathogens spread in topsoil.	D	3	17	M	Clean down of machinery to reduce weed and disease introduction and spread. Follow weed management procedure (i.e. wash or blow down machinery)	E	4	23	L

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
Increased soil erosion and change in soil structure due to clearing activities.	Soil erosion and reduced infiltration rates.	C	5	22	L	Visual site inspections to identify high erosion potential and implement erosion control measures.	E	5	25	L
Changes to surface water patterns.	Impact on flora communities in the area.	D	3	17	M	Drainage of the project area is in a north-south direction and there are no drainage lines, water courses or permanent surface water bodies within the project area.	D	4	20	L
SIGNIFICANT VEGETATION AND FLORA										
Accumulation of dust on plant surfaces.	May result in a decline in plant health and possibly the population.	C	3	13	H	Weekly visual inspections will be completed at the known *Isopogon robustus* (DRF) populations to determine if dust is impacting the populations. Follow procedures in the DRF management Plan.	E	4	23	L
Removal of significant vegetation communities/ Declared Rare flora (DRF)/Priority flora without approval.	Increased conservation significance of the species. Reduced population numbers.	E	2	14	H	All staff and contractors will be informed (during the site induction) the location and significance of all DRF and Priority flora species and instructed to avoid these areas. DRF and Priority flora will be access restricted and sign-posted.	E	3	19	M
FAUNA										
Loss of fauna species of conservation significance and other indigenous fauna species.	Loss of fauna habitat for fauna.	C	3	13	H	Undertake surveys to identify Malleefowl mounds habitat and avoid clearing these areas. Implementation of Malleefowl Management Plan.	E	4	23	L
Entrapment of fauna in project infrastructure (i.e. ponds, dams)	Loss of fauna.	D	4	20	L	Fauna egress matting will be provided in all ponds and dams to assist fauna to escape in the event of fauna entry. Daily inspections of all ponds and dams will be undertaken.				

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
OPEN PIT										
During a significant rainfall event, surface runoff above open pit could wash into void (if not adequately diverted).	Erosion of open pit walls. Surface water runoff into open pit.	D	4	20	L	Diversion of drainage around the open area of the pit with the diverted surface water maintaining flow within the catchment. Routine inspections of pit walls, especially after significant rainfall.	E	5	25	L
If exposed rock in walls is PAF, exposed rock may react with water seepage from walls.	Groundwater contamination. ARD generation from exposed rock open pit walls.	E	3	19	M	No PAF material expected in the walls of the open pit – minimal risk of ARD. If encountered, follow procedures in the ARD Environmental Procedure.	E	4	23	L
Noise and vibration associated with operational activities.	Noise and vibrations.	C	4	18	M	All mining operations will comply with the noise regulations under the *Environmental Protection (Noise) Regulations 1997*.	E	5	25	L
Pit wall subsidence and erosion.	Safety hazard. Land destruction.	E	2	14	H	Geotechnical test work used for designing pit walls. Safety bund walls built at an appropriate distance from pit walls.	E	3	19	M
WASTE ROCK DUMP										
ARD generation of waste rock.	Groundwater contamination. Land contamination.	E	3	19	M	No PAF material expected in the walls of the open pit – minimal risk of ARD. If encountered, follow procedures in the ARD Environmental Procedure.	E	4	23	L
Dust produced during dumping and loading of waste rock.	Dust generation from material handling (dumping/loading). Air Pollution (particulates).	B	5	21	M	Water cart will be used on waste rock dump as required.	E	5	25	L
Inadequate drainage on and around the waste dump	Surface water runoff into surrounding vegetation Sediment deposition. Water ponding. Vegetation damage.	D	4	20	L	Appropriate Mine Planning and ongoing monitoring for drainage.	E	5	25	L

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
PROCESSING PLANT										
Dust generation during ore handling and crushing.	Vegetation loss/damage. Public health concerns.	C	4	18	M	Dust suppression will be used when required.	E	5	25	L
Light generation from processing plant	Interruption of nocturnal species	D	5	24	L	Directional lighting will be used to minimise light spill outside of the project area.	E	5	25	L
Noise generation from crushing and processing operations	Increase in noise levels adjacent to the operation.	C	5	22	L	No private residents live close to processing plant. Cazaly will comply with *Environmental Protection (Noise) Regulations 1997, Mines Safety and Inspection Act 1994 and Mines Safety* and *Inspection Regulations 1995.*	E	5	25	L
Gas emissions	Air pollution.	B	5	21	M	All gas emissions will be monitored and reported in the NPI and NGERS. Gas emissions from this project are not likely to have a significant impact on the environment.	C	3	22	L
Inappropriate storage and handling of dangerous goods and hydrocarbons.	Vegetation loss/damage and land/ water contamination if there is a spill	C	4	18	M	Store all hydrocarbons and chemical reagents in appropriately bunded areas according to Australian Standards. Spill clean-up kits will be placed around the plant site for use in the event of a spill.	E	5	25	L
Surface water runoff via discharge of stormwater from site	Water contamination.	C	4	18	M	A conceptual detention basin design to trap hydrocarbons and solids for the project has been designed.	E	5	25	L
WORKSHOP FACILITIES/LAYDOWN AREAS										
Spillage of hydrocarbons during bulk transport to site.	Contamination of soil, groundwater and surface water. Loss of resources.	D	3	17	M	Ensure that transport company has adequate spillage controls and inspection schedule. Emergency Response Plan will address the actions required to deal with a road accident.	E	5	25	L

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
Hydrocarbon and chemical spill and/or leak.	Contaminated soil, groundwater & surface water.	C	4	18	M	Concrete bunds are located around bulk hydrocarbon storage tanks. Hardstand areas will surround refuelling stations. All hydrocarbons spilled in workshop areas will be cleaned up with the spill kits provided. Spillages will be cleaned up and disposed of as per appropriate MSDS and any other relevant environmental and safety guidelines. Use absorbent materials under machinery which is likely to leak oil. Ensure all chemicals and hydrocarbons are stored in accordance with DEC and DMP requirements.	E	5	25	L
Inappropriate disposal of hydrocarbon material.	Contamination of groundwater by hydrocarbons.	C	4	18	M	Bins and drums will be provided to dispose of hydrocarbon materials. In the event of a spill, the procedures outlined in the EMP will be followed. All blasting materials will be disposed of by blasting personnel.	E	5	25	L
Combustion emissions from vehicles and equipment.	Combustion products from exhaust pipes. Air emissions.	B	5	21	M	Regular servicing of vehicles and equipment.	E	5	25	L
EXPLORATION										
Drillholes not temporarily capped after drilling	Fauna trapped.	D	4	20	L	All drillholes are capped immediately after drilling.	E	4	23	L
MINE DEWATERING AND PIPELINES										
Water leak caused by a pipeline fracture or leaking valves.	Soil erosion. Land contamination. Vegetation loss/damage. Failure of pipelines	D	3	17	M	Trenched pipeline. Contingency plan for early detection and control of pipeline failure that includes pressure sensors and daily inspection of pipelines.	E	5	25	L
Ground water draw down from dewatering	Vegetation loss/damage, decreased water table	D	2	12	H	Regular inspection of monitoring bores surrounding dewatering sites.	E	4	23	L

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
TSF										
Seepage.	Increase in groundwater table. Soil and groundwater contamination.	E	2	14	H	Network of monitoring bores around TSF to measure groundwater levels, quantity and quality.	E	4	23	L
Embankment failure of the TSF.	Soil and ground water contamination	E	2	7	H	The TSF will be designed by a geotechnical engineer and its operation will be in accordance with their operation guidelines.	E	3	19	M
Appropriate freeboard not maintained.	Overflow of TSF. Land contamination.	E	2	14	H	TSF will be designed to manage the expected throughputs and any rainfall events. Routine inspections of TSF.	E	3	19	M
Spillage of tailings during transfer to TSF.	Soil contamination. Groundwater and surface water contamination.	D	3	17	M	Daily inspections of pipeline to detect failures. Pipelines contained within v-trench.	E	4	23	L
Tailings facilities becoming fauna traps.	Fauna death or injury.	D	3	17	M	Daily inspection of TSF by employees.	E	5	25	L
Structural damage to TSF wall.	Soil contamination. Groundwater and surface water contamination.	E	2	14	H	The TSF will be designed by a geotechnical engineer and its operation will be in accordance with their operation guidelines.	E	5	25	L
ORE STOCKPILING AND LOADING										
ARD generation of ore whilst in stockpile	Groundwater contamination. Land contamination.	D	3	17	M	No PAF material expected– minimal risk of ARD. If encountered, follow procedures in the ARD Environmental Procedure.	E	4	23	L
Dust produced during handling of dry materials.	Dust generation from material handling (dumping/loading) Air Pollution (particulates).	C	5	22	L	Water cart used as required for dust suppression.	E	5	25	L

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
ORE HAULAGE										
Dust produced by road traffic on unsealed roads.	Dust generation on ore haulage route (public unsealed road). Air Pollution (particulates). Public nuisance/traffic hazard.	C	5	22	L	Use of water trucks along haulage route when required.	D	5	24	L
Dust produced from uncovered loads.	Air Pollution (particulates).	D	2	20	L	Covering loads.	E	5	25	L
Increased road train traffic on publicly maintained road.	Damage to road surface (public road). Public nuisance/ complaints	B	5	21	M	Agreement in place with Shire with respect to road maintenance.	C	5	22	L
Road kill.	Fauna deaths on roads.	C	4	18	M	Staff educated to be alert for wildlife (especially at night) and speed restrictions.	D	4	24	L
DUST SUPRESSION										
Saline water spray may wet surrounding vegetation, especially if windy.	Saline water used for dust suppression affecting surrounding vegetation. Land contamination. Vegetation Damage.	D	4	20	L	Minimise spray drift into vegetation alongside roads by use of dribble bars.	D	4	24	L
Ponding of surface water and sediment may kill trees.	Disruption of surface water drainage along roadsides. Vegetation loss/damage.	D	4	20	L	Drainage for roads designed with culverts at appropriate locations.	E	5	25	L
Use of saline water in dust control.	Topsoil damage/loss due to contamination by saline water.	E	4	23	L	Ensure all water used for dust suppression in close proximity to topsoil stockpiles is not saline.	E	5	25	L

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
WASTE MANAGEMENT										
Disposal and frequency of waste collection.	Odours, vermin and litter generated from putrescible wastes. Increase in feral animals and vermin. Unpleasant odour. Windblown litter.	D	4	20	L	Putrescible wastes contained with the licensed putrescible landfill at site.	E	5	25	L
Bins and storage areas not available or inaccessible. Procedures not known and understood.	Loss of resources. Land Contamination. Contaminants from some wastes entering soil, groundwater or surface water. Recyclable materials or hazardous goods disposed of in general waste. Recyclable materials or hazardous goods disposed of in general waste.	E	4	23	L	Batteries are stored temporarily in a bunded area and sent offsite for recycling. Tyres are returned to suppliers by contractors. Recycling scrap metal and other re-usable wastes. Recycling bins (for plastic, glass and paper) are clearly available to all personnel.	E	5	25	L
Inappropriate storage, handling and disposal of wastes.	Spillage of hydrocarbon wastes. Contamination of soil, groundwater and surface water.	E	4	23	L	Waste oil tanks utilised and bunded facilities provided for waste hydrocarbons in the processing plant and workshops. Removed off-site for recycling by Wren Oil.	E	5	25	L
Waste disposal in inappropriate area.	Disposal of contaminated soil (eg. hydrocarbon contamination). Leaching of pollutants into soil, groundwater and surface water.	E	4	23	L	Disposal in designated area of waste dump or off-site, or bio-remediate.	E	5	25	L
REHABILITATION AND CLOSURE										
Insufficient rainfall or heavy rainfall washing away seed and topsoil. Inappropriate species used.	Rehabilitated areas with minimal vegetation growth. .Air Pollution (particulates). Lack of rehabilitation. Visual impact (aesthetics). Erosion of landform.	D	3	17	M	Use local plant species which are suitable for revegetation. Ensure topsoil is handled and stored appropriately. Direct placement of topsoil wherever possible.	D	5	24	L

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
Insufficient revegetation of slopes to help stabilise batter. Surface water runoff. Lack of stormwater diversion systems. Wind erosion. General surface instability.	Erosion of battered faces on waste rock dumps. Build up of sediment in stormwater drains and surface water systems. Invasion by weeds. Reduction on germination and growth of required native species.	D	3	17	M	Retention of stormwater on top of waste dump. Berms at discrete heights on waste dump. Deep ripping to encourage rainfall infiltration. Annual removal and control of important weed species. Follow machinery hygiene guidelines to minimise weed spread.	E	5	25	L
Generation of acid rock drainage from TSF.	ARD. Soil contamination. Groundwater and surface water contamination.	E	2	14	H	Resigned store and cover release will be constructed at completion of mining operations.	E	4	23	L
ABORIGINAL HERTAGE										
Disturbance to a Aboriginal Heritage Site	Damage to unknown Aboriginal Heritage sites.	E	3	19	M	No aboriginal heritage sites (Archaeological or Ethnographic) have been identified	E	4	23	L
GENERAL										
Lightning strike. Sparks from grinding equipment. Uncontrolled fire on-site.	Bushfire. Vegetation damage. Infrastructure damage.	E	3	19	M	A site emergency response plan will be completed inclusive of response for fire, spills and personnel injury. Personnel will be informed of burning restrictions, fire prevention, and trained in the use of fire fighting equipment and procedures. The local Shire's restrictions on activities during severe fire hazard days will be observed. Flammable material will be cleared from the working area as soon as practical per good housekeeping practices. Development and implementation of Fire Management Plan.	E	4	23	L
Lack of baseline data. Unaware of requirements. Procedures not followed.	Licence non-compliance. Environmental monitoring data not collected or poor quality data collected.	D	2	12	H	All monitoring requirements are well documented and carried out on a routine basis.	E	4	23	L

ASPECT	ENVIRONMENTAL IMPACT	LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK	CURRENT CONTROL	RESIDUAL RISK			
							LIKELIHOOD	CONSEQUENCE	PRIORITY	RISK
Changes in natural topography due to roads, drains, infrastructure, and sediment build-up due to increased erosion of surrounding areas.	Flooding of surrounding areas causing change in ecology. Vegetation loss/damage.	C	4	18	M	Progressive rehabilitation.	D	4	24	L
Complaints regarding noise.	Excessive noise generation associated with the construction and operation of support infrastructure. Public nuisance/ complaints.	E	4	23	L	Compliance with *Environmental Protection (Noise) Regulations 1997* as applicable.	E	5	25	L

The environmental risk assessment was undertaken in accordance with Australian Standard HB 203:2006 Environmental Risk Management (Standards Australia/Standards New Zealand, 2006).

The methodology used in this risk assessment was rating likelihood on a scale A to E and consequence on a scale of 1 to 5. Historical data from other mining operations was used to assess the likelihood of an environmental risk occurring. The consequence of an environmental issue was assessed by determining the severity of the effect, the area/population to be affected, the permanence of effects and the capacity of the area to recover.

These numbers were assessed in the matrix shown to provide an indicator of the degree of risk associated with the issue and relative priority of the issue. Tables show the prioritisation matrix used in the risk assessment and the definitions of the risk levels respectively.

Qualitative Measures of Likelihood

LEVEL	DESCRIPTOR	DESCRIPTION
A	Almost Certain	Environmental issue that is expected to occur in most circumstances.
B	Likely	Environmental issue that has been a common problem in the past and will probably occur in most circumstances.
C	Possible	Environmental issue may have arisen in the past and could occur.
D	Unlikely	Environmental issue may have occurred in the past and it could occur but not expected.
E	Rare	Environmental issue that would occur only in exceptional circumstances.

Qualitative Measures of Consequence

LEVEL	DESCRIPTOR	DESCRIPTION (*and example)*
1	Catastrophic	Death, toxic release off-site with detrimental effect, huge financial loss. *Major hydrocarbon spill to a land area with extensive surface and water pollution.*
2	Major	Extensive injuries, loss of production capability, off-site release contained with outside assistance and little detrimental impact, major financial loss *Removal of Priority flora without permission.*
3	Moderate	Medical treatment required, onsite release contained with outside assistance, high financial loss. *Groundwater pollution with limited biological damage and no contamination of a potentially usable groundwater resource.*
4	Minor	First aid treatment, on-site release immediately contained, medium financial loss. *Minor hydrocarbon spills from vehicles and equipment.*
5	Insignificant	No injuries, low financial loss, negligible environmental impact. *Erosion control structures not constructed along pipeline access road.*

Prioritisation of Risks

	CONSEQUENCE				
LIKELIHOOD	**1**	**2**	**3**	**4**	**5**
A	1	3	8	11	16
B	2	5	10	15	21
C	4	9	13	18	22
D	6	12	17	20	24
E	7	14	19	23	25

Qualitative Risk Analysis Matrix

	CONSEQUENCES				
LIKELIHOOD	**1**	**2**	**3**	**4**	**5**
A	H	H	H	S	S
B	H	H	S	S	M
C	H	H	S	M	L
D	H	S	M	L	L
E	S	S	M	L	L

H = High risk, S = Significant risk, M = Moderate risk, L = Low risk

Risk Definitions (AS HB 203:2006)

High	Immediate action required.
Significant	Senior management attention required.
Moderate	Management responsibility must be specified.
Low	Manage by routine procedures.

Appendix 4 - Environmental Management Sub Plans and Procedures

Air Quality Management Sub-plan

Background

Air quality can be reduced via dust emissions (as a result of vehicle movements and disturbed land) and emissions of exhaust gases. Emissions of greenhouse gases are covered in the Greenhouse Gas and Energy Management Subplan.

Management Requirements

HWE Mining EMS	• Water trucks will be used for dust suppression on haul roads and exposed areas and the timing, method and frequency of watering may be modified in response to excessive nuisance dust • Speed limits will be set with due consideration to minimising creation of dust. • Vehicles will be restricted to designated roads and tracks. • The use of sprinklers, water canons, enclosed storage areas and other dust minimising devices/ structures will be used where appropriate. • Crushing and screening facilities will be operated and maintained with suitable dust extraction systems, screens and/or sprays where practicable to minimise dust. • Haul roads will be maintained by graders and dozers • Stockpiles will be kept to minimal heights to minimise wind erosion and watered down where necessary. • Client approval must be obtained prior to any land disturbance; the area must then be surveyed and pegged prior to any disturbance. • The total cleared area at any one time will be kept to a minimum and exposed areas will be revegetated as soon as practicable • No burning of any material except for approved emergency response training. • Plant, vehicles and equipment will be regularly maintained in accordance with HWE Mining's preventative maintenance system • Effective maintenance and optimisation of haul routes • All mine drills will be equipped with dust suppression capabilities. • All complaints and incidents will be responded to immediately and reporting / notification to all parties within 48 hours

Project Specific	*Dust Management Plan*
	• Cazaly has an obligation to prepare and implement a Dust Management Plan. This requires Cazaly to:
	  • Undertake baseline and ongoing monitoring
	  • Detail management measures to minimise dust
	  • Demonstrate best practices and detail methods for all dust sources
	  • Monitor size and composition of particulates
	  • Monitor effects of dust and saline water on fringing vegetation
	  • Provide for continuous improvement in dust management
	General
	• Topsoil clearing or handling is to be avoided under windy conditions (>30km/h)
	• Ensure overspray of bore water from water trucks does not occur onto adjacent vegetation. Water carts will use a dribble bar to prevent any saline water impacts to surrounding vegetation.
	• Water sprays will be included in the crusher design to minimise the generation of dust.
	• Restriction of vehicle speeds will be required in high risk dust generation areas within the mine site.
	• Road train haulage will be undertaken on upgraded sealed roadways for gazetted

	corridors and private haul roads to limit any impact on the community. • Stabilisation of dust on topsoil stockpiles or other earthen stockpiles with salvaged vegetation or surfactant (where required), will be undertaken. • Control of product stockpiles moisture content with water sprays (and surfactant additives as required). • Road train haulage leaving the plant site will have a water spray system (and surfactant additives as required) to limit potential for dust lift-off during road transport. • Routine inspection of the truck route and periodic clean-up of any dust generating material from iron ore haulage along the route. • Routine community meetings to present results of dust monitoring and effectiveness. • Minimising vegetation clearing that could create dust-prone areas. • Use of blasting techniques that produce minimal dust in the mine. • Progressive rehabilitation of disturbed areas. • Visual monitoring of dust generated from pits and stockpiles. • Internal reporting of dust incidents, with external annual reporting to DEC and DMP (with subsequent review and audit by DEC and DMP). *Air Quality and Dust Deposition Monitoring* • Annual vegetation, flora and fauna surveys compared to baseline. • Baseline and regular monitoring (or as deemed required) of dust levels at mine site and along ore haulage route through the community. • Monitoring stations to measure dust deposition, wind speed, temperature and humidity will be installed a 2 locations at the Mt Caudan mine site (one station is located nearby to Isopogon robustus, (DRF) southern population). • Community incident reporting procedure will be put in place for observed emissions associated with dust from mining or truck haulage operations. *Buffer Zones* • A buffer zone of minimum 350 metres will be maintained between impact area of disturbance and Isopogon Robustus (DRF). • A buffer zone will be maintained for conservation significant fauna locations (ie. Active Malleefowl mounds minimum 50 metres, Western Browed Babbler nests tree trunks minimum 20 metres). Known preferred habitat of Tree-stem Trapdoor spiders will be avoided, where possible. *Training and Communication Requirements* • Include information on importance of and techniques for dust minimisation in project induction.

Legal	• Ensure that in any place in a mine where crushing, grinding, screening, conveying or other processing operation takes place, there are appliances present to control, suppress or dilute the emission of atmospheric contaminants. Ensure that any water used at a mine for the purpose of suppressing dust is not polluted by any noxious substance. Mines Safety and Inspection Regulations 1995, r 9.10, 9.18]
	• Unreasonable Emissions - Do not cause or allow an emission of noise, odour or electromagnetic radiation which unreasonably interferes with the health, welfare, convenience, comfort or amenity of any person. (Environmental Protection Act 1986, s 49)
	• Do not burn, or allow to be burnt:
	  • any material listed in Schedule 2 so as to cause or allow visible smoke to be discharged into the environment
	  • any material so as to cause or allow dark smoke to be discharged into the environment for more than 4 minutes in any hour (does not apply to the normal operation of road vehicles, trains or aircraft). (Environmental Protection (Unauthorised Discharges) Regulations 2004, r 4, sched 2)

Other	National Environment Protection (Ambient Air Quality) Measure (NEPC 2003) Environmental Protection Authority Guidance Statement No 18: Prevention of Air Quality

	Impacts from Land Development Sites (EPA 2000)
Procedures and References	
HWE Corporate	PC-EN-010 Air Quality Monitoring PC-EN-022 Environmental management controls for air quality
Site Specific	
Client	

Noise and Vibration Management Sub-plan

Background

Noise and vibration from construction and mining activities is generated by mobile plant on site, transport of product/material and blasting.

This subplan describes the measures to be taken to control noise and vibration levels on the project in accordance with legislative, safety, health and environmental requirements.

The wearing of hearing protection in designated areas and around designated machinery will be enforced with appropriate disciplinary measures being applied. Noise management additionally ensures that local communities and workers are not significantly impacted. Noise will be managed on projects according to the standard Occupational Noise Management, AS 1209.

Management Requirements

HWE Mining EMS	• Noise levels maintained within safe working limits at workplaces. • Plant, vehicles and equipment will be regularly maintained in accordance with HWE Mining's preventative maintenance system. • Screens, enclosures and other noise mitigating devices will be used where there is a risk of unacceptable noise levels to the community and employees (including camps) • Mufflers will be installed on all plant and light vehicles.
Project Specific	• A truck haulage route will be selected which separates truck operations from sensitive noise receptors. • Equipment will be only operated in compliance with noise regulations. Haulage trucks will be performance tested prior to acceptance by for operations. (This will involve individual noise testing of trucks on site prior to use along the haul route.) • New truck purchases are to be quietest units available, with stipulated noise levels emissions outlined to the supplier. • Internal reporting of noise incidents, with external annual reporting to DMP (with subsequent review and audit by DMP). • Post noise monitoring 3 months after the start of trucks transporting ore along the haul route to confirm predicted noise levels. • Monthly noise monitoring of noise levels at mine site and period locations along ore haulage route through the community at sensitive noise receptor locations. • Community incident reporting procedure for observed noise emissions from mining or truck haulage operations.
Legal	• Do not cause or allow an emission of noise, odour or electromagnetic radiation which unreasonably interferes with the health, welfare, convenience, comfort or amenity of any person. [Environmental Protection Act 1986, s 49] • Ensure the assigned noise levels are complied with (Environmental Protection (Noise) Regulations 1997, r 8) • Do not own or use any equipment, including a vehicle, capable of emitting noise that does not comply with a noise emission standard. When required under the Act, ensure equipment being sold is fitted with the required device to prevent or minimise noise emissions, or the prescribed plate, label, or marking stating the prescribed information. Ensure that noise control devices to be sold and fitted on equipment to prevent illegal noise emissions, achieve this purpose. [Environmental Protection Act 1986, s 84(1), 85(1), 86(2)(3)] • Do not install any equipment that is known, or could reasonably have been known, to cause unreasonable noise (Environmental Protection Act 1986, s 80) • Do not use equipment in such a way as to emit unreasonable noise as identified by any three or more persons on the premises directly affected by the noise, an authorised person or a police officer. [Environmental Protection Act 1986, s 79(1)(2); Environmental Protection (Noise) Regulations 1997, r 5, 7–15, 17]
Other	

Procedures and References		
HWE Corporate	PC-EN-012	Vibration Monitoring
	PC-EN-013	Noise Monitoring
	PC-EN-023	Environmental management controls for noise and vibration
Site Specific		
Client		

Waste and Pollution Management Sub-plan

Background

All work sites generate waste. The hierarchy of disposal should be followed: Avoid generation of waste, Reduce amount generated, Reuse waste where possible and Recycle prior to Disposal of waste.

Inappropriate disposal of wastes may cause soil contamination and in serious cases, may affect groundwater or surface water reserves. There is the potential for contamination of soil and water through inappropriate management of a number of facilities including but not limited to: wash down facilities, refuelling area, service truck operations and contaminated soil management. Additional information with regards to hydrocarbon waste is provided in the hydrocarbon and chemical waste management subplan. General waste (putrescible and inert) also needs to be managed appropriately to ensure windblown waste is minimised and disposal is limited to designated areas.

Personnel will be made aware of the minimum requirements of housekeeping and waste disposal through the induction process.

Waste Generated

The activities at Parker Range Project will generate waste materials such as scrap metals, tyres, plastics, wood, paper, domestic waste and liquid waste (waste oil). These wastes require management as they have the potential to contaminate soil, water and the atmosphere. Hydrocarbon waste materials pose the greatest risk in terms of contamination to groundwater, surface water and the soil at Parker Range. These materials include waste oil, used grease, oily rags, used oil filters and hydraulic hoses. There is also the potential for pollution through the accidental spillage of hydrocarbon products and other chemicals.

Waste Facilities (Waste Storage and Wastewater)

Waste Storage areas and wastewater systems are required to service the needs of the project. The impacts associated with storing waste include the potential for wind blown waste, the breeding of vermin and attracting wildlife. In order to prevent windblown waste regular pick up services will be undertaken to remove waste from site to Landfill.

The main impact associated with operation of the wastewater treatment systems is overflow as a result of inadequate maintenance. In such cases, these pollution events can lead to hygiene issues.

Management Requirements

HWE Mining EMS	• A waste stream analysis (using FM-EN-005) will be undertaken and is attached on the next page. • All wastes will be collected and stored at a designated waste disposal / transfer area. • Monthly planned inspections and site specific inspections will include waste disposal and transfer areas. • Soil contaminated by hydrocarbons will be taken to the hydrocarbon contaminated soil bin and then taken offsite for disposal at an appropriate landfill. • All work sites will be regularly monitored for litter accumulation. • Scrap steel will be separated for recycling. Scrap metal will be collected and removed by contractors for recycling. • Used batteries will be collected in bunded used battery storage areas and removed by contractors for recycling • Oily rags will be separated and taken off-site with hydrocarbon contaminated material • Oil filters will be separated from the waste stream, stored in designated bins (in the workshop) and taken away by a licensed contractor for recycling • Chemicals including waste grease and oil must be stored on spill containment pallets or in a bunded area with lids or under cover to prevent spillage. • All waste will be detailed in the monthly report. These details will include: general, scrap, batteries, tyres, waste oil, and hydrocarbon-contaminated waste. • Records/receipts for waste management will be retained. Records should stipulate waste type, mass/volume, calculations, any assumptions made and how the waste is managed (re-used, recycled, disposal location). This includes but is not limited to controlled wastes. • There will be no burning of waste unless approved by client or for emergency response training. • Sufficient bins, recycling and general waste collection areas, will be established to

	facilitate the management of waste. • Facilities must be designed and maintained to prevent release of waste to the environment. • The following materials will be recycled as a minimum: scrap metal, wood pallets and waste oil. • Recycling bins will be available and recycling will be carried out to the maximum practicable extent.
Project Specific	• Waste materials will be held in receptacles to prevent loss to the environment. • All waste materials, rubbish or litter, including formwork, structural steel, will be removed from the construction area to disposal points nominated by the Employer's Representative. • Waste materials will only be deposited in approved locations. • Any noxious, toxic or otherwise hazardous materials or containers of such materials will be disposed of by methods and in locations approved by the Employer's Representative. • Contractors will comply with the requirements of the Environmental Protection (Controlled Waste) Regulations 2004. • Receipts for the disposal of hazardous materials will be provided to the Employer's Representative.

Legal	• Management of Waste - Do not, intentionally or otherwise, allow waste to be placed such that it could reasonably be expected to gain access to any part of the environment and cause pollution. (Environmental Protection Act 1986, section 50)
	• Controlled Waste - General Ensure that:
	  • a DEC licensed carrier is engaged to transport controlled waste to an approved location
	  • packaged controlled waste is in a container that is fit for transportation before being given to the carrier
	  • accurate information regarding the type and amount of controlled waste, and its containment is provided to the carrier prior to transport
	  • prior to the controlled waste being transported from the premises, a receipt, detailing the date, valid controlled waste tracking number, and type and quantity of controlled waste removed, is obtained from the carrier's driver, and retained for at least 3 years. [Environmental Protection (Controlled Waste) Regulations 2004, r 2, 3, 25, 35, 38, sched 1, 2;]
	• Controlled Waste - Notice The Department of Environment may request a notice containing the following information on the controlled waste held by a waste holder:
	  • the type of controlled waste
	  • the quantity of controlled waste
	  • the location on the premises of the controlled waste. This notice must be provided within 14 days of receiving the request. [Environmental Protection (Controlled Waste) Regulations 2004, r 2, 3, 26, sched 1, 2;].
	• Asbestos Disposal Do not dispose of material containing asbestos otherwise than at an approved disposal site. If transporting material containing asbestos, or taking it for disposal, ensure that the asbestos is:
	  • separated from other material for disposal where practicable
	  • wrapped or contained so that asbestos fibres are prevented from entering the atmosphere during transportation
	  • labelled or marked with the words "CAUTION ASBESTOS" in letters at least 50 mm high. (Environmental Protection (Controlled Waste) Regulations 2004, r 43-46; Health (Asbestos) Regulations 1992, r 11 & 12)
	• Storage - Do not store more than:
	  • 500 used tyres at a tyre fitting business
	  • 100 used tyres at any other place.

	• Do not store used tyres on licensed premises other than in accordance with the specific licence conditions. [Environmental Protection Regulations 1987, r 12(b), 15] • Littering - Do not litter or break any glass, metal or earthenware on any land (unless on private land with consent) or into any waters. [Litter Act 1979, s 23 & 24]. • Notification of Waste Discharges - If a waste discharge that has or may cause pollution, material environmental harm or serious environmental harm occurs as the result of an emergency, accident or malfunction, or otherwise than in accordance with a works approval, licence or Environment Protection Notice as soon as practicable, notify the CEO of the Department of Environment orally or electronically, and follow up with written notification [Environmental Protection Act 1986, s 72(1); Environmental Protection Regulations 1987, r 5K, 5L].
Other	
Procedures and References	
HWE Corporate	PC-EN-016 Environmental management controls for waste and pollution FM-EN-005 Waste stream flow chart FM-EN-026 Chain of custody – waste transfer
Site Specific	
Client	

Waste Stream Flow Chart

WASTES GENERATED

If waste is generated click the check box (X)

PROJECT SITE		WORKSHOP		ADMINISTRATION	
Food Containers	☒	Tyres	☒	Paper	☒
Aluminium Cans	☒	44 Gallon Drums	☒	Stationery	☒
Scrap Steel	☒	Batteries	☒	Toner Cartridges	☒
Foodscraps	☒	Oil Filters	☒	Cardboard	☒
Timber	☒	Grease Cartridges	☒	Food Scraps	☒
Cardboard	☒	Electrical Cables	☒	Aluminium Cans	☒
Concrete	☒	Waste Oil	☒		
Packaging	☒	Mechanical Parts	☒		
Pallets	☒	Used Absorbent	☒		
Spray cans	☒	Coolant	☒		
Paint tins	☒	Oils/Grease	☒		
Stationery	☒	Scrap Steel	☒		
PVC Pipe	☒	Contaminated Soil	☒		
Steel Pipe	☒	Air Filters	☒		
Scrap Plastics	☒	Air Conditioning Gas	☒		
Conveyor Belt	☒				
Contaminated Soil	☒				
Wooden Reels	☒				
Plastic Reels	☒				
Used Absorbent	☒				
Electrical Cables	☒				
Hard Plastics	☒				
Drums	☒				

⇩ Reuse	⇩ Recycle	⇩ Dispose Off Site	⇩ Dispose On Site
Pallets	Aluminium Cans	Food Containers	Concrete
Mechanical Parts	Scrap Steel	Foodscraps	
Air Filters	Cardboard	Timber	
	Spray cans	Packaging	
	Paint tins	Stationery	
	Steel Pipe	PVC Pipe	
	Electrical Cables	Scrap Plastics	
	Drums	Conveyor Belt	
	44 Gallon Drums	Contaminated Soil	
	Batteries	Wooden Reels	
	Oil Filters	Plastic Reels	
	Grease Cartridges	Used Absorbent	
	Coolant	Hard Plastics	
	Oils/Grease	Tyres	
	Toner Cartridges	Air Conditioning Gas	

Note: All wastes taken off site require receipts to evidence change of custody

FINAL DESTINATION OF WASTES GENERATED AT PARKER RANGE			
WASTE TYPE		SERVICE PROVIDER	TREATMENT DETAILS
Absorbent Material	➡	Wren Oil	Placed in red hydrocarbon bins. Collected by Wren Oil
Aerosol cans	➡	SIMS Metal	Placed in steel bins to be removed from site by SIMS Metal.
Air conditioning gas	➡	BOC Gases	Goes to Perth for proper disposal
Air filters	➡	LOTEX	Undamaged: sent to LOTEX for cleaning and returned to site. Damaged: disposed of offsite.
Aluminium cans	➡	SIMS Metal	Placed in steel bins to be removed from site by SIMS Metal.
Batteries (wet cell) – lead acid	➡	Westrac CAT	Exchanged new for old through Westrac CAT. Placed on pallets and sent to Perth.
Batteries (dry cell) – NiCd (i.e. powertools)	➡	SIMS Metal	Placed in steel bins to be removed from site by SIMS Metal.
Cardboard	➡	Cleanaway	Placed in specified area onsite and taken to camp to recycling depot.
Conveyor belts	➡	Belting Contractor (TBA)	Disposed of by belt splicing contractor off site to depot.
Coolant	➡	Wren Oil	Combined with waste oil and collected by Wren Oil. Gets refined and reused.
Contaminated soil	➡	Cleanaway	Soil is placed in the hydrocarbon contaminated soil skip bin then removed from site by Cleanaway for treatment.
Contaminated slurry (from sumps)	➡	Cleanaway	Soil is placed in the hydrocarbon contaminated soil skip bin then removed from site by Cleanaway for treatment.
Crib containers	➡	Cleanaway	Disposed of as general waste. .
Drums (plastic 20L)	➡	Cleanaway	Disposed of as general waste. .
Dust masks	➡	n/a	Will be disposed of as per site specific procedure should fibrous materials be discovered onsite.
Fibrous material	➡	n/a	Will be disposed of as per site specific procedure should fibrous materials be discovered onsite.
Filters – steel crushed	➡	Wren Oil	Placed in blue filter bin then Wren takes off site. Oil is recovered for reefing and re-use, steel is sent to steel recycler (by Wren Oil) for recycling.
Florescent tubes	➡	Photographic Waste Management	Collected in special cardboard boxes by HWE. Full boxes are sent to PWM for recycling of individual components.
General rubbish	➡	Cleanaway	Placed in skip bins and collected by Cleanaway for disposal at landfill.
Glass	➡	n/a	Placed in specified bins located at the camp and removed from site by ESS.
Grease (hydrocarbon)	➡	Wren Oil	Placed into red hydrocarbon bins (as a spill clean up – includes use grease cartridges).
Medical waste (sharps etc)	➡	n/a	None generated by HWE onsite.
Oil (hydrocarbon)	➡	Wren Oil	Taken to waste oil tanks which are emptied by Wren Oil, taken to Perth and refined for re-use.
Oily water	➡	Wren Oil	Taken to waste oil tanks which are emptied by Wren Oil, taken to Perth and refined for re-use
Paint tins	➡	Cleanaway	Placed in steel bins to be removed from site by Cleanaway for recycling
Pallets	➡	Cleanaway	Reused onsite if possible OR - Removed from site for disposal by Cleanaway.
Paper	➡	TBA	Placed in specified bins onsite and taken to camp to the recycling depot.
Plastics (hard hats, drink bottles, safety glasses etc)	➡	Cleanaway	Placed in rubbish bins for disposal offsite.
Poly pipe	➡	Poly Pipe Contractor (TBA)	Stockpiled and then removed from site by poly pipe contractor.
Printer cartridges	➡	Planet Ark	Put in Planet Ark bin then taken to Post Office to be sent to Planet Ark.
Rags	➡	Wren Oil	Oily: placed in red hydrocarbon bins and collected by Wren Oil who dispose of them at a class 3 landfill in Perth. Non-oily: Disposed of in general waste bins and then removed from site for disposal.
Scrap steel	➡	Cleanaway	Placed in steel bins to be removed from site by Cleanaway for recycling
Steel drums	➡	Cleanaway	Placed in steel bins to be removed from site by Cleanaway for recycling.
Timber	➡	Cleanaway	Removed from site by Cleanaway as per general waste.
Tyres (all sizes)	➡	Cleanaway	Stored on site & returned to Perth for recycling/disposal (if unable to be repaired) If not taken by Cleanaway as controlled waste.

Fire Management Sub-plan

Background

The Parker Range Project is set in an area where mineral exploration and mining, pastoral activities and reservation of land for conservation purposes are the major land uses. The presence of project operations could potentially change the naturally occurring fire frequency of the area. The operation may also present an opportunity to help control any fires that occur in land reserved for conservation.

Management Requirements

Project Specific	*Fire Prevention* • Hot work permits will be issued for any all hot work activities. • Site Safety Inspections will include an assessment of potential fire risks. • Signage with no camping or fires warnings to be erected and marinated throughout the mine tenements. • The local Shire's restrictions on activities during severe fire hazard days will be observed. • Personnel will be informed of burning restrictions and fire prevention strategies. *Fire Management Planning* • The project with establish fire breaks to provide access to areas with significant biodiversity values, where this need is not met by existing access or haul roads. • An MOU to be developed with the DEC as to an agreed position as to the nature of assistance the Parker Range project may provide for bush fire management which includes a definition of the geographical area over which such a commitment will apply. • Discussion with FESA is to take place to formalise the level of assistance that the project may be able to give for bushfire management and if required a MOU be developed. • In conjunction with the DEC, the project will conduct a wildfire threat analysis to assist with identifying those areas within the project tenements that may require special protection from fire. *Fire Detection* • The project will report to the DEC (Wheatbelt Region – Narrogin office 9881 9222 or Northam office 9622 8940), any fires in or near conservation reserves or that are otherwise likely to threaten the biodiversity values. All emergency situations will be managed in accordance with the Project Emergency Response plan. *Emergency Response and Infrastructure* • All site vehicles will carry a fire extinguisher for use incase of vehicle or small fires. • The project will have a dedicated emergency vehicle with fire fighting capability. *Materials Storage/Handling/Disposal* • Personnel to be provided with personal ashtrays (butt bins) and to be instructed on the importance of using them. Adequate cigarette butt receptacles to be provided around designated smoking areas. No butts are to be discarded on the ground. • Storage and disposal of refuse will be undertaken in a manner to minimise fire risk. • Fuel storage and re-fuelling will be managed in accordance with Australian Standards (AS 1940:2004) *Training & Communication Requirements* • Information on the potential impacts of fires on biodiversity will be included in the environmental induction delivered to all site personnel. • The project will provide adequate training for the emergency response team in fighting bushfires.
Legal	Bush Fires Act 1954 DOCEP Technical & Safety Regulations 2001 Environmental Protection Act 1986. Fire and Emergency Services Authority of Western Australia Act 1998 Fire Brigades Act 1942 Occupational Safety, Health and Welfare Act 1996

	Australian Standards AS 1940-2004 The Storage and Handling of Flammable and Combustible Liquids *Licences* Dangerous Goods Licence – Storage of Explosives. Dangerous Goods Licence –for storage of fuel.
Other	
Procedures and References	
HWE Corporate	PC-EN-006 Environmental Incident Reporting PC-HS-3057 Hazardous Materials Management PC-HS-3007 Emergency Plans
Site Specific	
Client	

Surface and Groundwater Management Sub-plan

Background

Groundwater is water located beneath the ground surface. The level of the water table and quality of groundwater are generally established by the sinking of bores. A bore field will be developed for this project. Water bores and wells will be used for onsite water supply for the suppression of dust and wash downs of plant and equipment.

Managing water quality for the project site ensures that receiving waters surrounding the site do not suffer sustained or significant deterioration and minimises disruption to landholders, property and third party users. Water quality management is closely linked to environmental issues such as erosion and sediment control, hazardous substances management quality of the surrounding environment.

Management Requirements

HWE Mining EMS	• Intercept pit and oil / water separator will be installed and maintained in the washdown facility. • Sumps will be regularly inspected and cleaned out in accordance with a maintenance schedule. • Cleared and grubbed material will be stockpiled away from drainage lines to be later re-spread on disturbed areas. • The total cleared area at any one time will be kept to a minimum. • Water data will be maintained and included in monthly environmental Cintellate report. • Water-related infrastructure will be part of workplace inspection programs and maintenance performed where necessary to maintain a leak-free condition. • Opportunities for water recycling will be evaluated and will be undertaken where practicable. • Copies of all water licences, permits and operating strategies will be held on site • Extraction/discharge points will be fitted with a flow meter • Calibration certificates for meters will be retained on site. • Water quality monitoring will be undertaken as directed by the client • All potentially contaminated stormwater is treated prior to discharge to the environment (sediment and hydrocarbons as applicable). • Sediment basins will be constructed where discharges from the premises are likely to occur. These basins should allow sufficient retention time to reduce suspended solids prior to discharge. • Sediment basins must be regularly inspected and maintained.
Project Specific	*Stormwater Management* • Minimum impact of natural hydrological regime and maintenance of a sustainable water balance will be implemented onsite. • Areas of major erosion hazard will be identified and avoided where practicable. If unavoidable, specific management measures will be implemented to reduce the erosion risk. • Stormwater diversion structures will be constructed to control erosion and sedimentation downstream through the use of sedimentation ponds, riprap pads and maintenance excavation work to keep channels free flowing. • Diversion channels will be constructed to convey a 100-year ARI event for 72 hours duration. Maintain at least 0.3 m freeboard. Have a flow velocity of less than 1.4 m/s and where possible mimic the hydraulic characteristics of the original streamline. • Infrastructure that has the potential for interfering with creeks and natural flow systems will incorporate hydraulic structures such as drains, culverts and floodways into the design. These structures will be design to mimic the hydraulic characteristics of the original streamline. • Temporary stabilisation measures will be used in high erosion risk zones, such as creek beds and embankments, and culvert inlets. Where appropriate rock protection will be installed.

	• Sediment control devices such as detention basis and sediment traps will be incorporated as appropriate to the specific location and routinely inspected and maintained to ensure functionality. • Pipelines corridors will be constructed in a vee-drain or bund such that any undetected spill to unsealed ground is contained. • Mine services area-Stormwater drainage containment will be based on the 1 in 100 year ARI 72- hour storm event. • Rehabilitation will occur as soon as practicable and within 6 months of decommissioning of a work area or location. *Groundwater Management* • Water related infrastructure will be inspected as part of routine operational procedures. • Extraction points on bores will be fitted with flow meters which will be routinely calibrated. • Monitoring bores within and adjacent to the impact area at Mt Caudan will be established and measurement of the drawdown of the water table and water quality will be carried out on a monthly basis. Results of groundwater monitoring will be reported to DOW in accordance with regulatory requirements. Monitoring locations will include Water Reserve #13208. • Annual reporting of groundwater monitoring results to DOW. • Monthly visual recording of vegetation condition in proximity to production bores to monitor health of local area. *ARD and Metal Leaching* • Mine waste will be monitored for PAF and if detected it will be segregated as per designed PAF encapsulation cell within the waste landform.
Legal	• Do not construct enlarge, deepen or alter a well without a licence from the Water and Rivers Commission [Irrigation Act, 1914]Western Australian Legislation • Do not discharge any industrial effluent, waste or matter (whether treated or otherwise from a Mine into any waters [Water Conservation Act, 1976] • Do not take water from any watercourse, wetland or underground water source except in accordance with a licence granted by the DEC.(Rights in Water and Irrigation, 1914) • Waterways Conservation Regulations 1981
Other	
Procedures and References	
HWE Corporate	PC-EN-009 Water quality monitoring PC-EN-018 Environmental management controls for surface water and drainage FM-EN-011 Water quality monitoring field sheet PC-EN-048 Potable Water Microbiological Sampling FM-EN-046 Water Results Tracking List
Site Specific	
Client	

Hydrocarbon and Chemical Management Sub-plan

Background

Some hazardous materials will be required to execute the project activities. These materials have the potential to cause environmental damage, atmospheric, soil or water contamination and could potentially pose risks to human health.

The most effective way of managing hydrocarbons and chemicals is to eliminate and substitute them with less hazardous alternatives where practicable. In particular the work shop will store the majority of chemicals and there will also be bulk storage facilities (oil and fuel).

Bulk fuel and waste oil will be stored in above ground tanks located in impermeable, bunded enclosures in accordance with legislation, licence conditions and AS1940.

It is a legislative requirement that hazardous materials are controlled. Personnel will be informed of their responsibility with respect to hazardous materials during the induction process. Hazardous Materials will be managed as per PC-HS-3057.

Management Requirements

HWE Mining EMS	*Storage*
	• Chemicals will be stored in a chemicals cabinet which conforms to the requirements of Australian Standards.
	• Hydrocarbons will be stored in accordance with AS1940 and secondarily contained.
	• All storage tanks and associated piping must be above ground and be secondarily contained unless otherwise approved by client and supported by a risk assessment.
	• Diesel Generators and water pumps will be situated in bunded areas or will be self-bunded to prevent loss of fuels and oils.
	• Self-bunded (enclosed) facilities (i.e. where rain can not enter the bund) must have a bund capacity equal to or greater than the hydrocarbon storage capacity. Where the bund is not enclosed, the capacity must be 110% of the hydrocarbon storage capacity
	Refuelling
	• Fuelling of all vehicles and equipment will be carried out with an operator or driver in attendance at all times.
	• Where mobile refuelling is conducted:
	  • Dry-break hoses should be used;
	  • Refuelling will not occur within 30m of a watercourse; and
	  • Mobile refuelling trucks must carry spill kits.
	Waste
	• Soil contaminated by hydrocarbons will be collected and treated either at an onsite approved bioremediation facility or offsite by an approved waste contractor.
	• Oil filters will be separated from waste stream, stored in a designated bin and taken away by a licensed Contractor for recycling
	• Oily rags will be separated and taken off-site with hydrocarbon contaminated material
	• Hydrocarbons recovered must be collected and securely stored for recycling, destruction or disposal at an approved site. Treatment facilities must be designed to cope with the peak wastewater flows.
	• A landfarm (bioremediation facility) can only be established with the approval of the Client.
	Spill Response
	• Spill response equipment, including absorbent booms, socks, pillows and matting, should be readily available and used in work environments. Equipment should be clearly marked and housed in a manner that facilitates quick response to spills. The number of spill kits will be commensurate with the number of areas where hydrocarbons are regularly dispensed.
	• All spills or discharges will be cleaned up immediately and contaminated materials disposed in accordance with legal requirements, and the HWE Mining All Incident Report form or Hazard Near Miss Report complete.

	• Where safe to do so, dry clean up will be used in preference to other spill response measures.
	Washpad
	• Intercept pit and oil / water separator will be included in the washdown facility.
	• Sumps will be regularly inspected and cleaned out in accordance with a maintenance schedule.
	• Washdown pads will be cleaned out as required and silt dumped in an approved area.
	• Equipment washdown must occur in designated washdown areas only.
	• Water use should be minimised, and the use of solvent–based degreasers is not permitted.
	• For treatment of hydrocarbon contaminated waters referred to in clause (m) above, output water quality must not exceed either:
	  • 30 mg/L oil/grease content.
	  • 5 mg/L Total Petroleum Hydrocarbons (TPH)
	General
	• Chemwatch is to be used to register volumes and types of chemicals on sites
	• Chemicals will be managed as per the Hazardous Materials Management Procedure
	• Plant, vehicles and equipment will be regularly maintained in accordance with HWE Mining's preventive maintenance system
	• Where required, Dangerous Goods Licences must be obtained and copies be available on site.
	Contaminated Sites
	• Any contaminated sites must be investigated and contaminated soil treated or disposed of appropriately.
	• In the event that hydrocarbon or other contaminated areas are discovered, the client will be notified immediately. Where practicable the impacted area will be made safe (i.e. physical hazards associated with an excavation will be controlled) and the areas cordoned off for further inspection and assessment.
	Ammonium Nitrate (AN)
	• Loading and unloading of ammonium nitrate (AN) (eg. from the AN transport truck into storage or from storage into the ANFO truck) must occur in a contained area that facilitates easy recovery of spills. Where possible, this area should be undercover.
	• The catchment of this area must be minimised and ensure that uncontaminated runoff is directed away from the facility. Runoff from within the facility must drain to a lined containment pond to allow collection of contaminated water.
	• Any AN spillage must be recovered and returned to the appropriate storage area. Small quantities of AN may be disposed at an existing landfarm with the approval of the facility manager.
	• Emulsion tanks must be mounted on hardstand compacted earth or concrete pads. Concrete pads must be placed under transfer points for easy clean up of spillage.

Project Specific	• Processes will be put in place to ensure that suppliers meet the statutory requirements for transport of dangerous goods and will meet the same standards for storage and use. In particular, fuel and oil storage and waste oil management has and will be designed to practicably minimise risks of soil contamination from these products. • All explosives and toxic materials will be stored in fenced and locked site storage and used in accordance with the Mines Safety and Inspection Act 1994, the Mines Safety and Inspection Regulations 1995 and the Dangerous Goods Safety Act 2004. Authorised and trained personnel for the safe handling of explosives will have controlled entry. • Spill response equipment will be stored in all workshops and on maintenance/service vehicles. If an inadvertent spillage of hydrocarbon occurs, the spill will be contained as much as possible by the use of the spill response equipment. In the event of a large spill, earthmoving equipment will construct earthen bunds to contain the spill. Contaminated soils will be remediated onsite if possible or otherwise disposed of in appropriately licensed landfills. Bioremediation of contaminated soils would be undertaken in

	accordance with the Contaminated Sites Management Series - Bioremediation of Hydrocarbon-Contaminated Soils in Western Australia (DEC 2004c). • All waste hydrocarbon and hydrocarbon contaminated materials will be collected and stored in bulk containers, bins or drums and removed from site by a licensed operator for recycling, treatment or disposal at an approved landfill.

Legal	• Ensure that sites classified as contaminated:
	  • That were contaminated by you are remediated
	  • That are owned by you are remediated [Contaminated Sites Act 2003]
	• Comply with any prescribed emission standards and take all reasonable and practicable measures to prevent emissions from the premises.(Environmental Protection Act, 1986)
	• Ensure that any spill or leak of dangerous goods (other than those of Class 2) from an above ground container or plant, is contained within a drain, sump, tank or system at the site with the capacity to recover the spilled or leaked dangerous goods.
	
	Western Australian Legislation
	Mines Safety and Inspection Act 1994
	Mines Safety and Inspection Regulations 1995
	Contaminated Sites Act 2003
	Contaminated Sites Regulations 2006
	Occupational Safety and Health Act 1984
	Occupational Safety and Health Regulations 1996
	Australian Standards
	AS 1940-2004 The Storage and Handling of Flammable and Combustible Liquids
	Licences
	Dangerous Goods Licence – Storage of Explosives.
	Dangerous Goods Licence –for storage of fuel.

Other	
Procedures and References	
HWE Corporate	PC-EN-006 Environmental Incident Reporting PC-EN-025 Environmental management controls for Contaminated Soils and Remediation FM-EN-020 Spill Response Poster PC-EN-015 Contaminated Site Assessment and Soil Testing PC-EN-039 Bioremediation Management Procedure FM-EN-037 Bioremediation logbook FM-EN-038 Bioremediation maintenance record FM-EN-019 Soil assessment log PC-HS-3057 Hazardous Materials Management
Site Specific	
Client	

Flora and Fauna Management Sub-plan

Background

All Australian native animals are protected under Law. Protected flora species are listed at Federal, State and Territory level and include protected ecosystems and bioregion areas where associations of plant species are under threat by development during clearing.

Troglofauna are known to occur at the Parker Range project. Malleefowl are also present in the area, in addition to Priority species flora which are considered to be of high conservation significance. Separate sub plans follow this plan is relation to these rare, endangered or priority species.

The following actions will assist in minimising our impact on native fauna/flora:

- Only clear areas necessary for the work.
- Identify all trees that can be left in place.
- Felled trees will be used in the rehabilitation program to provide ground habitat.
- Dead, standing or fallen timber forms part of fauna habitat and its disturbance must be minimised.

Management Requirements

HWE Mining EMS	• Prior to ground disturbance client approval must be received and the extent of clearing will be agreed, surveyed and pegged prior to removal. Significant vegetation, Priority flora and fauna habitat will be identified and avoided (where practicable). • Where Priority flora clearing is unavoidable, plant seed will be collected by the client prior to clearing commencement (for future rehabilitation purposes). • Where significant risk is identified or a rare or endangered species is present a procedure will be established that outlines the safe relocation of fauna (such as snake relocation). • Do not feed any wild animals; this includes feral or native animals. • Ensure waste foods are correctly disposed of in appropriate bins/facilities. • Do not harass or tease any animals or birds. • Do not kill or injure any animals unless there is a real and direct threat to you, other staff /personnel or their families. In this instance an incident report is required. • To protect the habitat of local species, do not pick wildflowers or damage any vegetation without prior approval. • Dangerous animals (eg: snakes) are only to be handled by approved, trained personnel. • Kangaroos or wallabies, which have been injured or killed by vehicles, need to be checked for the presence of joeys. Injured animals will be treated or euthanized by registered veterinarian. • Dead animals need to be removed from the road as they will draw scavengers (eg: wedge-tail eagles) with potential for further accidents. When removing carcasses, you need to ensure it is safe to do so, as other passing vehicles present a significant risk. • All fauna deaths will be reported as an incident. • Firearms, traps and pets are prohibited on this project. • Fauna egress system is required for any steep walled lined facilities where there is a risk of animals entering the facility and not being able to get out. Fencing off the area should also be considered. The system should be made of fairly rigid material and care needs to be taken to ensure the mat does not cause wear and tear on the liner. For example; a length of conveyor matting which extends from the top of the lined pond to the deepest point. Attached to the conveyor matting a strip of cyclone fencing which is firmly secured to the matting. Items not to be used as fauna egress matting are orange air safety mesh, shade cloth, rope mesh because they are too flimsy and could entangle an animal. • Environmental personnel will provide flora, fauna and fauna habitat information to construction and operations staff at toolbox meetings.
Project Specific	*Buffer Zones*

	• A buffer zone of minimum 350 metres will be maintained between impact area of disturbance and any DRF. • A buffer zone of minimum 25 metres will be maintained for conservation significant threatened fauna locations.
Legal	• All fauna is wholly protected throughout the whole of the State at all times (other than fauna incidental to authorised native vegetation clearing operations unless the fauna has been declared as likely to become extinct, rare or otherwise in need of special protection). (Wildlife Conservation Act, 1950) • Do not, on Crown land, wilfully take any protected flora (declared for the purposes of the Act) unless authorised by, and carried out in accordance with the terms and conditions of, a licence. Do not, under any circumstances, take any rare flora (declared for the purposes of this section of the Act) from any land without first obtaining written consent from the Minister. (Wildlife Conservation Act, 1950) *Western Australian Legislation* Conservation and Land Management Act 1984 Conservation and Land Management Regulations 2002 Environmental Protection (Clearing of Native Vegetation) Regulations 2004 Wildlife Conservation Act 1950 *Commonwealth Legislation* Environment Protection and Biodiversity Conservation Act 1999 Environment Protection and Biodiversity Conservation Regulations 2000
Other	
Procedures and References	
HWE Corporate	PC-EN-019 Environmental management controls for flora and fauna PC-EN-021 Environmental management controls for land disturbance PC-EN-049 Fauna Care Procedure
Site Specific	
Client	

Malleefowl Management Sub-plan

Background

The Malleefowl is protected under Federal and State legislation: it is classified as Vulnerable: "Taxa facing a high risk of extinction in the wild in the medium-term future" under the Federal *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999* and is listed as Schedule 1: "Rare and likely to become extinct" under the *Western Australian Wildlife Conservation Act 1950*. The DEWHA administers the EPBC Act 1999 and the Department of Environment and Conservation (DEC) administers the Wildlife Conservation Act 1950.

The Malleefowl is also listed as Vulnerable on the 2007 IUCN Red List of Threatened Species.

Major threats to the Malleefowl include clearing and burning of native Vegetation, the introduction and spread of predatory species, grazing, starvation and road deaths. This plan has been developed to minimise and monitor for any impacts from the Parker Range Project on local Malleefowl.

The following actions will be implemented:

- Identify existing populations and potential Malleefowl habitat outside project infrastructure areas
- Minimise clearing and disturbance of identified Malleefowl habitat
- Obtain information for management of Malleefowl habitat and of Malleefowl that may come into and/or use the area
- Coordinate and implement management actions as prescribed in this plan

Management Requirements

Project Specific	*Secure Existing Populations* • Malleefowl habitat within the project will be identified and protected. • Signage will be erected around buffer zones of active Malleefowl mounds, levee bunds installed across access tracks and permission will be required to enter these areas. • The project induction will include information of Malleefowl and their habitat, as well as the importance of reporting of evidence of Malleefowl or actual sightings. *Reduce Fire Threat* • See Fire Management Sub-plan • Appropriate fire access tracks to be maintained to ensure access and protection of Malleefowl habitat. *Reduce Predation* • Feral Predator presence will be monitored and recorded. • Where appropriate, strategies will be determined and implemented in consultation with DEC and DAF *Minimise Risk of Road Deaths* • Speed limit and warning signs to be erected to create awareness of Malleefowl. • Vehicles to remain on designated tracks. • Incident report to be completed for any deaths or sightings of Malleefowl. *Monitor trends in Malleefowl abundance and distribution to assess threats* • A regular monitoring program will be put in place to monitor local populations and this information will be appropriately recorded. • Known Malleefowl mounds will be monitored annually for signs of activity. • Active mounds will be monitored biannually for signs of breeding success. • Malleefowl/Predator events will be monitored and reported. *Malleefowl habitat requirements* • Critical habitat features in local areas to be identified and this data to be analysed in association with breeding events and presence. • These identified areas are to be protected. *Contribute to genetic knowledge of Malleefowl* • Following any roadkill event, dead birds to be sent offsite to contribute samples of material for genetic analysis.

	Management Plan Review • Malleefowl sub plan to be reviewed annually. *Clearing* • Targeted Malleefowl survey immediately prior to disturbance in event of migration into the impact area (post current surveys). • In the event further Malleefowl nesting mounds are discovered in the impact area during a pre-clearing survey DEC will be consulted. Following consultation a possible mitigation measure may involve removal of the eggs, incubation and return of the chicks to the Parker Range area. • Clear marking of mounds near clearing lines prior to clearing commencing so disturbance to this species habitat is avoided. *Buffer Zones* • A buffer zone of minimum 50 metres will be maintained for active Malleefowl mound locations. Buffer zones will be established via earth levee and signage.
Legal	• All fauna is wholly protected throughout the whole of the State at all times (other than fauna incidental to authorised native vegetation clearing operations unless the fauna has been declared as likely to become extinct, rare or otherwise in need of special protection). (Wildlife Conservation Act, 1950) *Western Australian Legislation* Conservation and Land Management Act 1984 Conservation and Land Management Regulations 2002 Environmental Protection (Clearing of Native Vegetation) Regulations 2004 Wildlife Conservation Act 1950 *Commonwealth Legislation* Environment Protection and Biodiversity Conservation Act 1999 Environment Protection and Biodiversity Conservation Regulations 2000
Other	
Procedures and References	
HWE Corporate	PC-EN-019 Environmental management controls for flora and fauna PC-EN-021 Environmental management controls for land disturbance PC-EN-049 Fauna Care Procedure
Site Specific	
Client	

Robust Coneflower Management Sub-plan

Background

Robust Coneflower (*Isopogon robustus* DRF) is protected under Federal and State legislation: it is classified as "Critically Endangered" under the Federal *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999* and is listed as "Declared Rare Flora" under the *Western Australian Wildlife Conservation Act 1950*. The DEWHA administers the EPBC Act 1999 and the Department of Environment and Conservation (DEC) administers the Wildlife Conservation Act 1950.

Robust Coneflower is also listed as "Critically Endangered" under IUCN criteria.

The objective of this plan is to avoid, minimise, and mitigate impacts to Robust Coneflower in the project area.

The following actions will be implemented to achieve the above objective:

- Document the location, distribution and condition of the population
- Identify potential threats to the population
- Develop strategies to minimise adverse impacts on the population
- Develop a monitoring program for the population

Management Requirements

Project Specific	*Avoidance* • The preferred strategy for managing impacts on Robust Conseflower is avoidance. The project will not take any Robust Coneflower individuals. *Demarcation* • GPS Coordinates of each plant within the population has been previously recorded. Prior to the commencement of construction activities. Earth levee bunds and signage on access tracks will be utilised to protect the species. These steps will address several potential impacts from feral animals, fire risk and accidental clearing. *Onsite Awareness* • The project induction will include information on the importance of avoiding impact to this species and the requirements of this sub plan. *Access Management* • Permission will have to be granted to access to areas populated with Robust Coneflower. *Dust Management* • Dust Suppression/Management activities will be carried out as per Air Quality subplan. *Fire Management* • See Fire Management subplan. *Weed Management* • See Weed Management subplan. *Seed Collection* • In consultation with DEC, and only under an approved permit to take, plant propagules are to be collected by a licensed and trained seed collector and submitted to the DEC Threatened Flora Seed Centre. *Monitoring Requirements* • In consultation with DEC on methodology and timing, undertake annual monitoring of the known populations and reference areas during Spring. *Clearing Requirements* • Priority flora clearing procedures (involving consultation and approval with DEC) will be implemented to ensure unauthorised clearing is avoided. • Clearing procedures will include clearly marking priority flora in proximity to vegetation clearing. • Supervision of any authorised priority flora clearing activities will be undertaken by Environmental personnel. *Buffer Zones*

	• A buffer zone of minimum 350 metres will be maintained between impact area of disturbance and Robust Coneflower.
Legal	• Do not, on Crown land, wilfully take any protected flora (declared for the purposes of the Act) unless authorised by, and carried out in accordance with the terms and conditions of, a licence. Do not, under any circumstances, take any rare flora (declared for the purposes of this section of the Act) from any land without first obtaining written consent from the Minister. (Wildlife Conservation Act, 1950) *Western Australian Legislation* Conservation and Land Management Act 1984 Conservation and Land Management Regulations 2002 Environmental Protection (Clearing of Native Vegetation) Regulations 2004 Wildlife Conservation Act 1950 *Commonwealth Legislation* Environment Protection and Biodiversity Conservation Act 1999 Environment Protection and Biodiversity Conservation Regulations 2000
Other	
Procedures and References	
HWE Corporate	PC-EN-019 Environmental management controls for flora and fauna PC-EN-021 Environmental management controls for land disturbance
Site Specific	
Client	

Weed and Dieback Management Sub-plan

Background

The project area is located within relatively undisturbed vegetation, although cleared agricultural land occurs in the area and the haul road to the Moorine Rock rail depot will pass through farmland. The project will endeavour to prevent the introduction of new weed species and/or the spread of existing weed species from the agricultural land into adjacent native vegetation.

The intent of this management plan is to:

- Ensure that project activities do not lead to the introduction and/or spread of new and existing weed species.
- Prevent the introduction of weeds located on agricultural land into remnant vegetation.
- Identify, through regular monitoring, new weed establishment or dieback occurrence.
- Control weed infestations or potential outbreaks.

And to limit:

- Disturbance to and reduction of Priority flora and plant communities of conservation significance, including the Parker Range Complex PEC, by weeds or dieback.
- Impacts on significant fauna habitat.
- Soil erosion precipitated by native vegetation death.

Management Requirements

HWE Mining EMS	*Weed Hygiene*
	• Inspections of site to identify weed infestations will be conducted:
	  • As part of pre-clearing checks,
	  • During clearing works after rainfall events as these are likely to facilitate germination of weeds; and
	  • At the end of the project, to verify effectiveness of weed hygiene controls.
	• Locations of weed infestations will be recorded by GPS and mapped.
	• Vehicular access will be restricted to designated tracks
	• Prior to arriving on site all plant must washed down and provide a weed certificate.
	• A register is to be kept of all vehicles and machinery entering the site to ensure all machinery has been cleaned down.
	• A contingency for managing equipment that contains or potentially contains weed propagules will be established.
	Weed & Dieback Identification
	• In addition to the inspections above under weed hygiene, inspections will also be conducted during construction and operations to identify weed establishment or spread or the presence of dieback.
	• Project personnel will be trained in the identification of declared weeds that could potentially occur on the project.
	• Project personnel will be instructed to report any suspected weed occurrence to their Supervisor/Environmental Representative.
	• In the event that a weed species infestation is identified, targeted measures will be developed and implemented in consultation with the Department of Agriculture and DEC
	Weed Control
	• For identified weed species, suitable control methods are to be identified and approved.
	• Regular inspections will be implemented for areas susceptible to weed infestation.
	• Control measures will be implemented for emergent weed populations prior to seed set.
	• Appropriate project personnel will liaise with the Department of Agriculture and/or DEC regarding weed control activities.
	• Appropriate records of weed control treatments will be kept.

	• Topsoil will be replaced in the area it was removed from. *Training & Communication Requirements* • The site induction will contain appropriate information in relation to weed hygiene, identification and control. • Signage will be used where necessary to communicate weed-status of areas and hygiene requirements. • Posters and other educational material relating to weed identification and control will be displayed in the workplace.
Project Specific	*Clearing* • Clearing activities associated with areas of known weed occurrence will be segregated from other topsoil stockpiles to prevent spread of known weed.
Legal	
Other	
Procedures and References	
HWE Corporate	PC-EN-019 Environmental management controls for flora and fauna PC-EN-021 Environmental management controls for land disturbance FM-EN-035 Weed Inspection Certificate
Site Specific	
Client	

Land Disturbance and Rehabilitation Management Sub-plan

Background

Unauthorised land disturbance has the potential to impact on sensitive and rare flora, habitats and sites of heritage significance. Prior to any land disturbance, a land Disturbance Permit must be submitted to the client for approval.

Ground disturbance includes but is not limited to:

- - Construction of buildings
- - New pits or expansion of existing pits
- - Any clearing of vegetation
- - Creation or upgrade of roads
- - Exploration drilling

Management Requirements

HWE Mining EMS	• Prior to ground disturbance client approval must be received and the extent of clearing will be agreed, surveyed and pegged prior to removal. • A Clearing Permit will be obtained prior to any clearing taking place. • Stockpiles will be watered down where necessary. • Cleared and grubbed material will be stockpiled away from drainage lines to be later re-spread on disturbed areas. • Topsoil and sub-soil must be stockpiled separately. • Top-soil heaps must be stabilised to prevent erosion, signposted and shown on mine plan maps • Topsoil must not be mixed with sub-soil. • Topsoil must not be located in areas prone to saline water spills. • Significant tree communities or individuals to be retained in site works, will be clearly identified through appropriate tagging • All on-site drainage will be constructed to ensure that run-off from all unsealed areas will be directed to sediment control structures prior to entering the local drainage system.
Project Specific	• Significant vegetation and flora groups or fauna habitat will be identified by way of tagging prior to disturbance. A targeted search will be undertaken in known areas of significance prior to disturbance, and these areas will be avoided (where practicable). • Topsoil management measures will be adopted during clearing to store separately in height not exceeding 3m (truck tipped). The stockpiles will be located and constructed to a height of approximately 3m to reduce the disturbance area for topsoil stockpiling, minimise erosion from rainfall, wind and introduction of saline dust suppression water to preserve soil integrity. Topsoil will be stockpiled in non-vehicle road areas for example around the base of mine waste landform. • Topsoil condition will be monitored on stockpiles and adjacent to saline watering areas for future use and conditioning in rehabilitation. • Clearing activities associated with areas of known weed occurrence will be segregated from other topsoil stockpiles to prevent spread of known weed. • Vegetation stockpiles will be immediately upslope of the topsoil stockpiles to minimise surface water run-on to the topsoil. This stockpiling arrangement will allow minimal handling and transport of both vegetation and topsoil, hence maintaining integrity and minimising soil losses. • Disturbed areas will be progressively rehabilitated as they become available (within 6 months). This includes areas that have been disturbed during construction that will not be used for ongoing operations or maintenance. • Induction of employees to communicate field survey identification and ensure disturbance is confined to areas only authorised areas in the field. • Only local native plant species will be used for rehabilitation. • The clearance of vegetation and topsoil under the footprint of the waste rock stockpiles

	will be a gradual process, conducted as required in advance of the growing toe of the waste rock landform. This will minimise the length of time topsoil is stored. *Erosion* • During the operational phase, high erosion potential areas will be identified by Environmental personnel. • High erosion potential areas will be treated with by way of water cart sprays and/or commercially available stabilisation surfactant. • Disturbed sites will be rehabilitated within 6 months of becoming available from operations to minimise erosion exposure risk.
Legal	• Do not cause or allow land clearing unless it is: in accordance with a Clearing Permit (other than land subject of an Agreement to Reserve, Conservation Covenant or Soil Conservation Notice under the Soil and Land Conservation Act 1945). *Western Australian Legislation* Conservation and Land Management Act 1984 Conservation and Land Management Regulations 2002 Environmental Protection (Clearing of Native Vegetation) Regulations 2004
Other	
Procedures and References	
HWE Corporate	PC-EN-020 Environmental management controls for cultural heritage PC-EN-021 Environmental management controls for land disturbance PC-EN-024 Environmental management controls for rehabilitation
Site Specific	
Client	

Greenhouse and Energy Management Sub-plan

Background

As per the Kyoto Protocol, there are six groups of gases listed as greenhouse gases. These are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydroflurocarbons (HFCs), perfluoro carbons (PFCs) and sulphur hexafluoride (FS6).

Activities such as burning fossil fuels and land clearing have been directly linked to the increased concentration of greenhouse gases in the atmosphere. The increased concentration results in the enhanced greenhouse effect, by trapping more heat in the atmosphere and thus elevating temperatures on the Earth's surface.

HWE Mining aims to minimise greenhouse gas emissions by;

Implementing the requirements of the Greenhouse Challenge Plus program, Energy Efficiency Opportunities Act and the National Greenhouse and Energy Reporting Systems Act (includes annual reporting and development of abatement strategies).

Complying with all requirements of the Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995, including the National Refrigeration and Air-conditioning licensing scheme.

Energy Efficiency Opportunities (EEO) is a mandatory, national energy efficiency assessment and public reporting program for corporations that use more than 0.5 petajoules (PJ) of energy each year (approximately equivalent to 139GWh or 13ML diesel). The EEO program is designed to ensure energy efficiencies are integrated into all aspects of the business.

- Greenhouse Challenge Plus is a national program that aims to support and encourage industry management of greenhouse gas emissions. It is mandatory for companies intending to claim more than $3 million under the Fuel Excise Rebate Scheme.

Management Requirements

HWE Mining EMS	Greenhouse gas and energy reporting • Greenhouse gas and energy data (including but not limited to diesel, explosives, electricity consumption and total production) will be recorded on a monthly basis and reported via the Cintellate program. • Appropriate monitoring systems (eg flow meters, calibration records) will be established for recording and reporting of GHG emissions. . Greenhouse gas abatement and energy efficiency strategies • HWE will implement LCPL "Climate 4 Change 2010-2011" program where applicable. • Energy assessments will be undertaken Refrigeration and Air-conditioning Gases. • Any person who handles refrigerant gases where there is a risk of emission (either ozone depleting substances or synthetic greenhouse gases) requires a Refrigerant Handling Licence. • All refrigerant equipment must be maintained and inspected for leaks on a quarterly basis as a minimum. • All refrigerant gas recovered will be recorded on FM-EN-34 Refrigerant Recovered Register • All refrigerant gas purchased will be recorded on FM-EN-44 HWE Refrigerant Purchasing Record. • All refrigerant gas must be recovered and sent off site to BOC Gases for disposal. Preventative Maintenance • Plant, vehicles and equipment will be regularly maintained in accordance with HWE Mining's preventative maintenance system. Land Clearing • The total cleared area at any one time will be kept to a minimum and exposed areas will be revegetated as soon as practicable. Staff Training and Awareness • Information to raise energy management awareness will be provided to site personnel during site-specific inductions and through toolbox presentations and site noticeboard

	bulletins. • All personnel will be made aware of project specific GHG reduction or energy efficiency programmes and their associated targets.
Project Specific	• Practices and training of personnel to minimise carbon footprint of the project will be implemented including preventative maintenance of vehicles and machinery, maintenance of air-conditioning systems and refrigerant disposal off-site and, controls to minimise land clearing. • All employees will be educated on energy efficient practices that can be used in their daily activities and the site induction will include a section on this issue. • In accordance with the National Greenhouse and Energy Reporting Act 2007, greenhouse gases and energy consumption above the thresholds specified under the Act, will be reported. • As part of the National Pollutant Inventory (NPI), quantities of air and ground emissions will be estimated or measured and reported under the programme. This will include emissions from various activities on-site including blasting, crushing, screening, combustion, vehicle movements and wind erosion (dust). These will be reported once the project is in production and when reporting thresholds are met. • Future greenhouse gas emission targets will be set in accordance with measured and reported performance.
Legal	• If the total energy used by a corporate group of businesses is more than 0.5 petajoules in a financial year (from the 2005/2006 financial year onwards) ensure that the controlling corporation of the group applies to be registered with the Department of Resources, Energy and Tourism (DRET) by 31 March in the following financial year. (Energy Efficiency Opportunities Act, 2007). • If a corporation exceeds a greenhouse gas or energy threshold for a financial year ending on or after 30 June 2009 (the trigger year) ensure that the corporation is registered on the National Greenhouse and Energy Register. (National Greenhouse and Energy Reporting Act, 2007). • Each financial year (including the trigger year) submit a report, prepared in the required manner and form, to the Greenhouse and Energy Data Officer within 4 months of the end of the financial year, relating to the: ▪ greenhouse gas emissions ▪ energy production, and ▪ energy consumption (National Greenhouse and Energy Reporting Act, 2007) *Western Australian Legislation* Environmental Protection Regulations 1987 *Commonwealth Legislation* Energy Efficiency Opportunities Act 2006 Energy Efficiency Opportunities Regulations 2006 Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995 ▪ National Greenhouse and Energy Reporting System
Other	
Procedures and References	
HWE Corporate	PC-EN-038 Refrigeration and Air-conditioning: Greenhouse Gas Emission Controls PL-QA-020 Greenhouse Emissions and Energy Management Plan PC-EN-050 Tracking Managing and Reporting Abatement Actions FM-EN-050 Abatement Action Report PC-MA-1710 Mobile Plant Inspections PC-MA-1685 Mobile Plant Servicing

	PC-MA-1700	Defect Reporting
	MI-1900	Air-conditioning service-diagnosis and repair instruction
Site Specific		
Client		

Cultural Heritage Management Sub-plan

Background

Management of Aboriginal and Torres Strait Islander cultural heritage (CH) is a statutory requirement. Cultural heritage is defined as areas, objects and places displaying archaeological or historic significance. This may include but is not limited to scar trees, rock paintings, scatters and campsites.

There is a possibility of locating Cultural Heritage sites/features on the project area. Should a site be identified, personnel are not to disturb the site and are to inform their immediate supervisor without delay.

Management Requirements

HWE Mining EMS	• Management of sites including signage, fencing and flagging will be as directed by the client.
	• If any finds of suspected Aboriginal or European Heritage are made, the following steps will be taken:
	  • Cease work and take care to minimise further disturbance
	  • Notify the supervisor immediately, who should then report the find to the onsite environmental officer and project manager.
	  • The project manager will notify client representative and submit an incident report.
	  • Protect and manage the site, restrict access, do not disturb materials or site, erect barriers and proceed as directed by the client representative.

Project Specific	• Aboriginal heritage awareness information to be provided in site induction programs to aid in identification and preservation of any possible heritage sites. • Periodic awareness training will be offered with traditional owner groups. • Reporting of any new sites identified in compliance with section 15 of the Aboriginal Heritage Act 1972. • A specific CH Management Plan will be developed in event any CH material is discovered.

Legal	• Do not:
	  ▪ excavate, destroy, damage, conceal or in any way alter any Aboriginal site
	  ▪ in any way alter, damage, remove, destroy, conceal, deal with in a manner not sanctioned by relevant custom, or assume the possession, custody or control of, any object on or under an Aboriginal site
	  ▪ destroy, damage, alter, move or interfere with any notice, boundary mark, fence or other structure erected in a declared protected area. (Aboriginal Heritage Act 1972)
	Report the finding of any potential Aboriginal heritage place or thing (eg. Aboriginal burial grounds, symbols or objects of sacred, ritual or ceremonial significance, cave or rock paintings or engravings, stone structures or arranged stones, or carved trees) to the Registrar of Aboriginal Sites or to a police officer. (Aboriginal Heritage Act 1972)
	Western Australian Legislation
	Aboriginal Heritage Act 1972
	Aboriginal Heritage Regulations 1974
	Commonwealth Legislation
	Aboriginal and Torres Strait Islander Heritage Protection Act 1984

Other	

Procedures and References

HWE Corporate	PC-EN-020 Environmental Management Controls for Cultural Heritage
Site Specific	
Client	

Concrete Batching Management Sub-plan

Background

Concrete batching activities must be managed effectively to ensure that no unacceptable environmental impact occurs, with particular regard to control of dust, materials and waste.

Management Requirements

HWE Mining EMS	• The chemical properties and hazards associated with mineral waste must be documented and understood. • Concrete batching work must be undertaken in compliance with the Environmental Protection (Concrete Batching and Cement Product Manufacturing) Regulations 1998
Project Specific	
Legal	*Western Australian Legislation* Environmental Protection (Concrete Batching & Cement Product Manufacturing) Regulations 1998
Other	

Procedures and References

HWE Corporate	
Site Specific	
Client	

Abrasive Blasting Management Sub-plan

Background

Abrasive blasting activities must be managed effectively to ensure that no unacceptable environmental impact occurs, with particular regard to control of dust and waste generated.

Management Requirements

HWE Mining EMS	• Abrasive blasting work must be undertaken in compliance with AS 1627.4 Metal Finishing – Preparation and pre-treatments of surfaces, Part 4 – Abrasive Blasting and the Environmental Protection (Abrasive Blasting) Regulations 1998.
Project Specific	
Legal	*Western Australian Legislation* Environmental Protection Regulations (Abrasive Blasting) Occupational Safety and Health Regulations 1996 (3.102-3.107) Mines Safety and Inspection Regulations 1995 (9.9)
Other	

Procedures and References

HWE Corporate	
Site Specific	
Client	

Borrow Pit Management Sub-plan

Background

A borrow pit is an area from which construction materials (gravel, rock, sand or fill material) are removed for the purposes of road, rail or other infrastructure construction. Borrow pits must be planned, managed and rehabilitated so as to minimise their long-term environmental impact.

Management Requirements

HWE Mining EMS	• Considerations being given to sighting borrow pits according to the presence of pre–existing pits or previously disturbed areas. • Sites with evidence of weed infestations being avoided, or appropriate weed treatment implemented prior to disturbance. • Borrow pits placed so as to avoid significant flora species, threatened ecological communities or habitats. • Sites incorporating Aboriginal and/or European heritage areas being avoided. • Ensuring borrow pits are located no closer than 50 metres from any water course. • Ensuring that ponding is minimised during use of the borrow pit and cannot occur following rehabilitation.
Project Specific	
Legal	
Other	

Procedures and References

HWE Corporate	
Site Specific	
Client	

Spray Painting Management Sub-plan

Background

All spray painting activities must be managed effectively to ensure that no unacceptable environmental impact occurs, with particular regard to spray drift.

Management Requirements

HWE Mining EMS	• When spray painting occurs on site, Contractors engaged must hold a current DEC Registration for Spray Painting which covers work outside the contractors own premises. • Controls will be undertaken and documented in accordance with Environmental Protection (Metal Coating) Regulations 2001: Note: "Metal Coating" is defined as a method used to coat metal products including spray painting, powder coating and enamelling. • Spray painting booths must be designed in accordance with AS 4114.1 Spray Painting Booths.
Project Specific	
Legal	*Western Australian Legislation* Environmental Protection (Metal Coating) Regulations 2001
Other	

Procedures and References

HWE Corporate	
Site Specific	
Client	

Appendix 5 – Correspondence between ISO14001 and Project EMP

ISO 14001: 2004		Parker Range EMP
4.1	General Requirements	
4.2	Environmental Policy	EMP Section 1.1 EMP Appendix 1.0 SHEC Policy
4.3	Planning	
4.3.1	Environmental Aspects	EMP Section 4.1 EMP Appendix 3.0
4.3.2	Legal and other requirements	EMP Section 4.2 EMP Management Sub Plans
4.3.3	Objectives, targets and programmes	EMP Section 4.4
4.4	Implementation & Operation	
4.4.1	Resources, roles, responsibility and authority	EMP Section 3.1 EMP Appendix 2.0
4.4.2	Competence, training and awareness	EMP Section 5.1
4.4.3	Communication	EMP Section 3.2
4.4.4	Documentation	EMP Section 2.0
4.4.5	Control of documents	EMP Section 2.2 EMP Section 2.3
4.4.6	Operational Control	EMP Management Sub Plans
4.4.7	Emergency preparedness and response	EMP Section 7.2
4.5	Checking	
4.5.1	Monitoring and Measurement	EMP Section 6.0
4.5.2	Evaluation of compliance	EMP Section 6.4
4.5.3	Nonconformity, corrective & preventative action	EMP Section 6.7
4.5.4	Control of records	EMP Section 2.3
4.5.5	Internal audit	EMP Section 6.5
4.6	Management Review	EMP Section 6.8

Appendix 6 – Documentation Road Map

Aspect	Environmental Procedure	Associated Procedures	Forms
Environmental Risk Assessment	PC-HS-3001 Risk Management Safety, Health & Environmental		FM-HS-3001-5 Risk Register Template
Environmental Objectives and Targets	PC-QA-012 Development of Quality and HSEC Objectives and Targets		FM-QA-047 Objectives and Targets
Environmental Reporting	PC-EN-005 Environmental Reporting		FM-EN-040 Environmental Monthly Report Instructions
Environmental Incident Reporting	PC-EN-006 Environmental Incident Reporting	PC-HS-3007 Emergency Plans PC-HS-3040 Incident Management	FM-EN-023 Environmental Incident Guide FM-HS-3040-01 All Incident Report Form
Environmental Management Plan	PC-EN-007 Project Specific Environmental Management Plan	PC-QA-008 Document Control	PL-QA-007 Environmental Management Plan Template
Environmental Monitoring	PC-EN-009 Water Quality Monitoring PC-EN-010 Air Quality Monitoring PC-EN-012 Vibration Monitoring PC-EN-013 Noise Monitoring PC-EN-014 Acid Sulphate Soil Assessment PC-EN-015 Contaminated Site Assessment and Soil Testing	PC-EN-018 Environmental Management Controls for Surface Water and Drainage. PC-EN-022 Environmental Management Controls for Air Quality PC-EN-023 Environmental management controls for noise & vib. PC-EN-025 Environmental Management Controls for Contaminated Soils and Remediation PC-EN-026 Environmental Management Controls for ASS PC-QA-007 Calibration	FM-EN-007 Dust Deposition Monitoring Record Sheet FM-EN-008 Record Sheet- High Volume Sampler FM-EN-011 Surface Water Quality Monitoring Form FM-EN-019 Soil Assessment Log FM-QA-022 Equipment Master List and Calibration Record FM-QA-023 Calibration Record – Method Card

Aspect	Environmental Procedure	Associated Procedures	Forms
Development of Environmental Management Sub-plans	PC-EN-016 Environmental management controls for waste and pollution PC-EN-017 Environmental management controls for dangerous goods & hazardous substances PC-EN-018 Environmental management controls for surface water & drainage PC-EN-019 Environmental management controls for flora & fauna PC-EN-020 Environmental management controls for cultural heritage PC-EN-021 Environmental management controls for land disturbance PC-EN-022 Environmental management controls for air quality PC-EN-023 Environmental management controls for noise and vibration PC-EN-024 Environmental management controls for rehabilitation PC-EN-025 Environmental management controls for contaminated soils PC-EN-026 Environmental management controls for acid sulphate soils	PC-EN-009 Surface Water Quality Monitoring PC-EN-010 Air Quality Monitoring PC-EN-012 Vibration Monitoring PC-EN-013 Noise Monitoring PC-EN-014 Acid Sulphate Soil Assessment PC-EN-015 Contaminated Soil Assessment and Soil Testing PC-EN-027 Environmental Inspections PC-HS-008 Emergency Response Plan	FM-EN-005 Waste Stream Flow Chart FM-EN-020 Spill Response FM-EN-026 Chain of Custody – Waste Transfer FM-HS-3040-01 HWE Mining All Incident Report Form
Environmental Inspections	PC-EN-027 Environmental Inspections	PC-HS-3142 Safety Activities Schedule	IS-SF-01 to IS-SF-027 Surface Planned Inspections IS-UG-01 to IS-UG-051 Underground Planned Inspections
Management Auditing	PC-QA-004 Management System Audits	PC-QA-002 Non-conformances	FM-EN-017 Environmental Management Audit FM-QA-019 Audit Schedule
EMS Review	PC-EN-029 Annual Environmental Review		FM-EN-018 Annual Environmental Review Agenda

Appendix 7 – Contact List

	POSITION	NAME	CONTACT DETAILS
HWE Mining Corporate	General Manager MIDA	Ian Meares	(08) 9389 4815
	National HSEC Manager	Mark Edebone	(08) 9389 4777
	Environment Manager	Teresa Eldridge	(08) 9389 4707
	Environmental Coordinator	Tim Pavlos	(08) 9389 4756
HWE Mining Site	Project Manager	Marilyn Wood	(08) 9286 0722
	HSEC Manager	Meagan Smart	(08) 9201 3760
Client	Contract Representative	Matt Timbrell	(08) 9322 6283
	Environmental Representative	TBA	

Appendix 8 – Environmental Monitoring & Reporting Programs

Monitoring Type	Frequency
Water Monitoring (Health)	
Routine Microbiological Drinking Water Analysis	Fortnightly
Chemical Drinking Water Analysis	Every two months
Turkeys Nest Treated Waste Water	Monthly
WWTP Treated Waste Water	Quarterly
Dust Monitoring	
Annual vegetation, flora and fauna surveys compared to baseline.	Annual
Baseline and regular monitoring (or as deemed required) of dust levels at mine site and along ore haulage route through the community.	Monthly
Monitoring stations to measure dust deposition, wind speed, temperature and humidity will be installed a 2 locations at the Mt Caudan mine site (one station is located nearby to Isopogon robustus, (DRF) southern population).	All times, data accessed monthly
Land Disturbance and Rehabilitation	
Significant vegetation and flora groups or fauna habitat will be identified by way of tagging prior to disturbance. A targeted search will be undertaken in known areas of significance prior to disturbance, and these areas will be avoided (where practicable).	Prior to clearing
Topsoil condition will be monitored in areas subject to saline water spraying for dust suppression to assess suitability for rehabilitation.	Annually
Malleefowl	
A regular monitoring program will be put in place to monitor local populations and this information will be appropriately recorded.	As required
Known Malleefowl mounds will be monitored annually for signs of activity. Active mounds will be monitored more regularly for signs of breeding success.	Annually
Targeted Malleefowl survey immediately prior to disturbance in event of migration into the impact area (post current surveys).	Prior to clearing
Isopogon Robustus	
Undertaking annual monitoring of the population during Spring in the month of September. Monitoring of reference areas will also be done topotentially capture sources of health decline unrelated to mining activity.	Annually - Spring
Weed and Dieback Management	
Regular inspections will be implemented for areas susceptible to weed infestation.	As required
Surface and Groundwater Management	
Monitoring bores within and adjacent to the impact area at Mt Caudan will be established and measurement of the drawdown of the water table and water quality will be carried out on a monthly basis. (Annual reporting of groundwater monitoring results to DOW.)	Monthly

Monthly visual recording of vegetation condition in proximity to production bores to monitor health of local area.	Monthly
Noise & Vibration	
Post noise monitoring 3 months after the start of trucks transporting ore along the haul route to confirm predicted noise levels.	Three months from truck haulage commencing.
Monthly noise monitoring of noise levels at mine site and period locations along ore haulage route through the community at sensitive noise receptor locations.	Monthly
Greenhouse and Energy Management	
Greenhouse gas and energy data (including but not limited to diesel, explosives, electricity consumption and total production) will be recorded on a monthly basis and reported via the Cintellate program.	Monthly

Appendix 14: Environmental Monitoring Strategy

Cazaly Resources Limited (February 2011)

CAZALY RESOURCES LIMITED

PARKER RANGE IRON ORE PROJECT

MT CAUDAN DEPOSIT

ENVIRONMENTAL MONITORING STRATEGY

February 2011

Issued DMA Comment, Revision B

DOCUMENT HISTORY

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PARKER RANGE (MT CAUDAN) IRON ORE PROJECT
ENVIRONMENTAL MONITORING STRATEGY
TABLE OF CONTENTS

1.0 DEFINITIONS AND ABBREVIATIONS 1
1.1 Definitions 1
1.2 Abbreviations 1

2.0 INTRODUCTION 3
2.1 Overview 3
2.2 Purpose of the Document 3
2.3 Scope 3
2.4 Background 3

3.0 LEGISLATIVE APPROVAL AND POLICY FRAMEWORK 4
3.1 *Environmental Protection Act 1986* (WA) 5
3.2 *Environmental Protection of Biodiversity and Conservation Act 1999* (Commonwealth) 5
3.3 *Mining Act 1978* (WA) 5
3.4 *Environmental Protection Act 1986 – Part V* (WA) 5
3.5 *Rights in Water Irrigation Act 1914* (WA) 5
3.6 *Wildlife Conservation Act 1950* 5
3.7 *Dangerous Goods and Safety Act 2004* 6
3.8 *Contaminated Sites Act 2003* 6
3.9 *National Greenhouse Emissions Reporting Act 2004* 6
3.10 National Pollutant Inventory 6
3.11 Other Requirements and Considerations 6
3.11.1 Department of Environment and Conservation Priority List 6
3.11.2 EPA Position Statement 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection 6
3.11.3 International Council on Mining and Metals Sustainable Development Principle 7

4.0 ENVIRONMENTAL MONITORING STRATEGY 7

TABLES

Table 1: Relevant Legislation 4
Table 2: Summary of Environmental Monitoring Strategies for the Project 8

1.0 DEFINITIONS AND ABBREVIATIONS

1.1 Definitions

Project	The Parker Range Iron Ore development outlined in this proposal.
Project Area	The local area surrounding the Project impact area.
Project Region	The region in context of the Yilgarn region in Western Australia including the PEC.
Impact Area	The proposed area of clearing for the Project.
Mt Caudan Deposit	The area of iron mineralisation comprised of three areas – northern, central and southern.

1.2 Abbreviations

AMD	Acid mine drainage
ANC	Acid neutralizing capacity
ARD	Acid Rock Drainage
ARI	Assessment on Referral Information
AS	Australian Standard
ASL	Above Sea Level
AW1	Avon Wheatbelt
bcm	Bulk cubic metres
BIF	Banded Iron Formation
Cazaly	Cazaly Resources Limited
dB(A)	Decibel (A-weighting)
DAFWA	Department of Agriculture and Food (Western Australia)
DEC	Department of Environment and Conservation
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth), was formally Department of the Environment, Water, Heritage and the Arts (DEWHA)
DFS	Definitive Feasibility Study
DIA	Department of Indigenous Affairs
DMP	Department of Mines and Petroleum
DoW	Department of Water
DRF	Declared Rare Flora
EAT	Emmerson Aggregate Test
EC	Electrical Conductivity
EFA	Ecosystem Function Analysis
EIA	Environmental Impact Assessment
EIA-PER	Environmental Impact Assessment Public Environmental Review
EMS	Environmental Monitoring Strategy
EP	Environmental Protection
EPA	Environmental Protection Authority
EPBC	Environmental Protection and Biodiversity Conservation
ESA	Environmentally Sensitive Area
Fe	Iron
FESA	Fire and Emergency Services Authority
GPS	Global Positioning System
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
ICMM	International Council on Mining and Metals
JORC	Australasian Joint Ore Reserves Committee
K	Potassium
kg	Kilograms
lcm	Loose cubic metres
L/s	Litres per second
m^3	Cubic metre
mAHD	Mine Australian Height Datum
mE	Metres - Easting
mg	Miligrams
MGA	Map Grid Australia
ML	Megalitres
Mn	Manganese
mN	Metres - Northing
MRWA	Main Roads of Western Australia
NGER	National Greenhouse Emissions Reporting
NPI	National Pollutant Inventory
NSW	New South Wales
OEPA	Office of the Environmental Protection Authority
PAF	Potential Acid Forming

PEC	Priority Ecological Community
PER	Public Environmental Review
PRCT	Parker Range Conservation Trust
RC	Reverse Circulation
RL	Relative Level
ROM	Run-of-Mine
S	Sulphur
SO_4	Sulphate
SRE	Short Range Endemic invertebrates
SWL	Standing Water Level
TDS	Total Dissolved Salts
TSF	Tailings Storage Facility
TSP	Total Suspended Particulates
WA	Western Australia
WC	Wildlife Conservation
WET	Waste Extraction Test
WRL	Waste Rock Landform

2.0 INTRODUCTION

2.1 Overview

The Environmental Monitoring Strategy (EMS) contained within this document provides an overview of all environmental monitoring that will occur over the life cycle of the Parker Range Iron Ore Project (Project) by Cazaly Resources Limited (Cazaly). The actual monitoring methods may change over the life of the Project as more appropriate technologies and methodologies become available. This EMS forms part of the Project's Environmental Management System that ensures the effective management of all environmental and social impacts from the Project.

The Project's Environmental Management System will operate on an adaptive management or continual improvement philosophy. The principle behind adaptive management is a structured, iterative process of optimal decision making when faced with new information, with the aim of reducing potential adverse situations over time by monitoring the outcomes of the management strategy or by adopting procedures.

2.2 Purpose of the Document

The purpose of this document is to collate the key details of environmental monitoring programs, methods and action triggers associated with changes in key environmental values for the Project. Trigger values have been set for monitoring methods to prompt investigation by the Project, when trigger values are exceeded and/or external notification / reporting is required. Triggers values have been selected cognisant on activities related to the Project, and other factors beyond control of the Project (e.g. drying arid climate). In the event that investigation identifies that the Project is the cause, management will be altered to address the impact.

2.3 Scope

This EMS is applicable to all activities associated with the Project from construction through closure.

2.4 Background

Cazaly's philosophy in the development of the Project has been to avoid impacts to threatened species or conservation significant environmental values (e.g. Declared Rare Flora) in the first instance, and to minimise impacts where avoidance is not possible. In cases where a potentially significant impact to an important environmental value could not be avoided (e.g. Priority Flora situated beneath the Waste Rock Landform (WRL) offsets have been proposed.

To ensure that the proposed management strategies, and procedures are resulting in the expected outcomes, the Project has proposed a series of monitoring actions, documented in the Environmental Impact Assessment Public Environmental Review (EIA-PER) and supporting documentation.

This document brings together all monitoring commitments made in the EIA-PER and the supporting documentation and monitoring obligations associated with legislation and other approvals. It is envisaged that this document will be periodically updated (bi-annually) to ensure that monitoring regimes are appropriate.

3.0 LEGISLATIVE APPROVAL AND POLICY FRAMEWORK

There are several Acts, regulations and other requirements that should be considered during the life of the Project. Cazaly will comply with the provisions in applicable Acts and their Regulations which include but may not be restricted to those listed in Table 1.

Table 1: Relevant Legislation

Reference	Scope	Administering Body
Western Australia - Legislation		
Aboriginal Heritage Act 1972	Protects Aboriginal Heritage	Department of Indigenous Affairs, Western Australia
Agriculture and Related Resources Protection Act 1976.	Provides for the management, control, prevention, introduction and spread, prohibition and regulation of certain plants and animals keeping for the protection of agriculture and related resources.	Department of Agriculture and Food.
Bush Fires Act 1954	Make better provision for diminishing the dangers resulting from bush fires, for the prevention, control and extinguishment of bush fires	Department of Environment and Conservation (DEC)
Conservation and Land Management Act 1984	Manages state conservation and land management matters.	DEC
Contaminated Sites Act 2003	Requires the reporting of known or suspected contaminated sites.	DEC
Environmental Protection (Noise) Regulations 1997	Sets standards for noise emissions, monitoring and controls.	DEC
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Provides protection of native vegetation.	Department of Mines and Petroleum (DMP)
Environmental Protection Act 1986 (EP Act) (and Administrative Procedures 1993)	Part IV defines the process of referral and assessment of proposals subject to formal assessment under the *EP Act*. Works Approvals and licences are issued under Part V of the *EP Act.*	Environmental Protection Authority (EPA) and DEC
Health Act 1911	Regulation of activities and provision of services relating to public health.	Department of Health
Heritage Act of Western Australia 1990	Protects European Heritage in Western Australia.	Heritage Council of Western Australia
Land Administration Act 1997	Governs administration of State land in WA.	Department of Regional Development and Lands
Local Government Act 1995	Provides for a system of local government in WA.	Department of Local Government
Local Government (Miscellaneous Provisions) Act 1960	Provides standards for construction activities.	Department of Local Government
Main Roads Act 1930	Provides for construction, maintenance, supervision, management and control of access to highways, main roads and secondary roads.	Main Roads Western Australia
Occupation Safety and Health Act 1984	Promotes and secures safety and health of persons in the workplace.	Department of Commerce (Worksafe)
Rights in Water and Irrigation Act 1914	Manages the use of water resources in Western Australia.	Department of Water (DoW)
Soil and Land Conservation Act 1945	Provides for development of soil conservation districts and communities, enables covenants on agricultural land to protect native vegetation.	Department of Agriculture and Food
Wildlife Conservation Act 1950	Principal legislation regarding the protection of flora and fauna species.	DEC
Dangerous Goods Safety Act 2004	Covers safe storage, handling and transport of dangerous goods and for related purposes.	DMP
Mining Act 1978 and Regulations 1981	Manages mineral exploration and mining operations.	DMP
Mines Safety and Inspection Act 1994 and Regulations 1995	Protects employees in the mining industry.	DMP
Commonwealth Legislation		
Environment Protection and Biodiversity Conservation Act 1999	Protects the environment, particularly matters of National environmental significance.	DEWHA
Native Title Act 1973	To provide for the recognition and protection of native title.	DEWHA, National Native Title Tribunal

Reference	Scope	Administering Body
National Greenhouse and Energy Reporting Act 2007 (DEWHA)	Provides framework for Australian corporations to report greenhouse gas emissions, reductions, removals and offset, and energy consumption and production.	Department of Climate Change and Energy Efficiency

The most significant documents related to EMS and legal obligations are summarised herein.

3.1 *Environmental Protection Act 1986* (WA)

The *Environmental Protection Act 1986* (*EP Act*) administered by the Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. The Project is subject to Part IV and V requirements under the *EP Act* which consider and manage environmental impacts such as clearing extent (Part IV) and pollution control (Part V), among other things.

3.2 *Environmental Protection of Biodiversity and Conservation Act 1999* (Commonwealth)

The *EPBC Act* is the Federal Government's central piece of environment legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined in the *EPBC Act* as matters of national environmental significance. The *EPBC Act* enables the Federal Government to join with the states and territories in providing a truly national scheme of environment and heritage protection and biodiversity conservation. The *EPBC Act* focuses Federal Government interests on the protection of matters of national environmental significance, with the states and territories having responsibility for matters of state and local significance.

Project specific matters of national environmental significance have been identified as listed threatened species, namely *Isopogon robustus* (Robust Coneflower), *and Leipoa ocellata* (Malleefowl) (EPBC 2010/5435).

3.3 *Mining Act 1978* (WA)

The *Mining Act 1978* is the key piece of legislation for all mineral exploration and mining activities in WA. The *Act* covers all aspects relating to obtaining prospecting licences, exploration and mining leases, obtaining access to land for mineral activities, bonds and expenditure.

Conforming to Tenement Conditions, Mining Proposal and Program of Work requirements under this *Act* will be crucial for all phases of the Project.

3.4 *Environmental Protection Act 1986 – Part V* (WA)

Under the provisions of Part V of the *EP Act 1986*, certain premises with significant potential to cause pollution of air, land or water are known as 'prescribed premises' and must hold a Works Approval (licence to construct) prior to commencing any work or construction. In addition, prior to operating these premises a Licence must be obtained for operation of the premises.

Prescribed premises for the Project requiring a Works Approval and Operating Licence at the Project include:

- Processing or beneficiation of metallic or non-metallic ore - greater than 50,000 tpa.
- Electrical power generation - greater than 20 MW gas or greater than 10 MW diesel.
- Sewage facility – where sewage is treated (excluding septic tanks) – greater than 100 m^3/day.
- Tailings Storage Facility (if required).
- Putrescible landfill - greater than 20 tpa.

3.5 *Rights in Water Irrigation Act 1914* (WA)

The *Rights in Water Irrigation Act 1914* provides for the planning, regulation, management, protection and allocation of water resources in Western Australia. The objectives of the legislation include providing for the management, sustainable use and development of water resources to meet the needs of current and future users, and for the protection of their ecosystems and the environment in which water resources are situated.

The *Act* provides for the permanent transfer of a licence or water entitlement (i.e., part of a licence), and also temporary transfer (called agreements with licensees).

3.6 *Wildlife Conservation Act 1950*

The *Wildlife Conservation Act 1950 (WC Act)* is a key piece of legislation in the protection and conservation of all native flora, vegetation and fauna within WA. Under the *Act*, the Minister may declare any flora and fauna to be specifically listed as threatened, rare or extinct. These lists of specially protected species are regularly updated and published in the Government Gazette.

3.7 *Dangerous Goods and Safety Act 2004*

The *Dangerous Goods and Safety Act 2004* relates to the safe storage, handling and transport of dangerous goods and related purposes. The *Act* indicates those activities and substances which require licensing prior to use, storage or transport. The aim of the *Act* is to reduce or minimise risk from dangerous goods.

Several substances used in the processing of iron ore, and in the general running and upkeep of the Project will require management under this *Act* and its associated regulations. For example:

- Explosives used for drill and blast in the mine.
- Hydrocarbons (e.g. diesel fuel).

3.8 *Contaminated Sites Act 2003*

The *Contaminated Sites Act 2003* provides for the identification, recording, management and remediation of contaminated sites. A site is considered 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'.

Various facilities and activities associated with different stages of the life of the Project have the potential to generate a contaminated site under this *Act*. The Project will appropriately manage its obligations under the *Act*, particularly, in regard to:

- Bulk hydrocarbon storage.
- Waste rock dumps and low-grade ore stockpiles.
- The tailings storage facility.

3.9 *National Greenhouse Emissions Reporting Act 2004*

The *National Greenhouse Emissions Reporting Act 2004* (*NGER Act*) is the National Emissions Data reporting framework that establishes for Australian corporations to report greenhouse gas emissions, reductions, removals and offsets, and energy consumption and production, from 1 July 2008.

The NGER Reporting Guidelines document outlines the steps corporations need to take when determining their registration and reporting obligations. The reporting guidelines also outline the principles of the *NGER Act,* for corporations needing to report.

3.10 National Pollutant Inventory

The National Pollutant Inventory (NPI) provides the community, industry and government with information regarding substance emissions in Australia. The NPI is tracking pollution across Australia, and ensuring that the community has access to information about the emission and transfer of toxic substances which may affect them locally.

The desired environmental outcomes of the NPI program are to:

- Maintain and improve air and water quality.
- Minimise environmental impacts associated with hazardous waste
- Improve the sustainable use of resources.

3.11 Other Requirements and Considerations

3.11.1 Department of Environment and Conservation Priority List

Species or communities are recognised under the Department of Environment and Conservation (DEC) Priority scheme. If a species does not meet the criteria for listing as Threatened Fauna or Declared Rare Flora under the *WC Act* (due to lack of information) and is poorly known and/or conservation dependent, it may be classified as a Priority Species at the discretion of the DEC. Priority species are not provided any extra protection to other native species in Western Australia. The listing of a species or a community as a Priority indicates that activities that may impact them are in need of special consideration. A similar program exists for Priority Ecological Communities (PEC).

3.11.2 EPA Position Statement 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection

The Environmental Protection Authority (EPA) regards biological diversity as a key environmental factor and has an objective to ensure that biodiversity is protected. Position Statement 3 discusses the principles which the EPA will use when assessing proposals which may impact on biodiversity values.

3.11.3 International Council on Mining and Metals Sustainable Development Principle

The International Council on Mining and Metals (ICMM) is an industry group that addresses key priorities and emerging issues within the sector. The ICMM has implemented ten principles to measure their performance relating to sustainable development in the mining of minerals. Of importance is Principle 7 – Contribute to conservation of biodiversity and integrated approaches to land use planning:

- Respect legally designated protected areas.
- Disseminate scientific data on and promote practices and experiences in biodiversity assessment and management.
- Support the development and implementation of scientifically sound, inclusive and transparent procedures for integrated approaches to land use planning, biodiversity, conservation and mining.

4.0 ENVIRONMENTAL MONITORING STRATEGY

Cazaly have undertaken commitments to implement the Project in an environmentally and socially responsible manner in accordance with relevant *Acts* and legislation.

The following key source documents provide framework for detail monitoring strategies within this EMS:

- Parker Range Iron Ore Project – Mt Caudan Deposit EIA-PER.
- Parker Range Environmental Management Plan (M8521-G00-EN-PL-001).

Following consultation with Project stakeholders and undertakings from key source documents, the summary of environmental monitoring commitments is provided in Table 2. Monitoring requirements are summarised in the following environmental and social factors:

- Air Quality.
- Noise and Vibration.
- Waste and Pollution.
- Fire.
- Surface and Groundwater.
- Landform and Soil.
- Vegetation and Flora.
- Fauna.
- Weed and Dieback.
- Greenhouse and Energy.

Table 2: Summary of Environmental Monitoring Strategies for the Project

Parameter	Monitoring Requirement	Purpose	Monitoring Method	Monitoring Frequency	Trigger	Regulating Authority	Reporting Frequency
Air Quality Monitoring							
Dust	*Isopogon robustus* (DRF) - Monitor emissions at sensitive dust receptor at Mt Caudan Mine.	To ensure the health of DRF is not adversely affected by dust.	Single portable Dust Deposition Gauge (DDG) located at each known population location orientated closest to Project clearing activities.	Monthly	Greater than 7 g/m^2/month.	EPA / DEC	Annually
			Single DDG located at Environmental Monitoring Stations (EMS) per drawing M8521-P00-GE-DR-001.	Monthly	Greater than 7 g/m^2/month.	EPA / DEC	Annually
Dust	Malleefowl nesting mounds - Monitor emissions at sensitive dust receptor at Mt Caudan Mine.	To ensure the breeding population of threatened species is not adversely affected by dust.	Single portable DDG located at each known "active" nesting mound location within 250 m of the Project clearing activities.	Monthly	Greater than 15 g/m^2/month.	EPA / DEC	Annually
Dust	Native Vegetation - Monitor emissions at sensitive dust receptor at Mt Caudan Mine.	To limit indirect impacts on native vegetation health.	Single portable DDG located at approximately 1 km perimeter spacing interval at about 250 m distance from the Project clearing activities.	Monthly	Alert at greater than 7 g/m^2/month.	EPA / DEC	Annually
			Single DDG located at permanent Environmental Monitoring Stations (EMS) per drawing M8521-P00-GE-DR-001.	Monthly	Alert at greater than 7 g/m^2/month.	EPA / DEC	Annually
Dust	Operations Personnel – Monitor emissions for health at Mt Caudan Mine.	To ensure the health of operations personnel is not adversely affected by dust.	Personnel dust particulate monitors worn by workforce at operation.	Weekly	Greater than 1,000 mg/m^3.	EPA / DEC / DMP	Annually
			Semi-mobile TEOM dust sampling units located at workforce population areas.	Weekly	$PM_{2.5}$ >25 µg/m³. PM_{10} > 50 µg/m³. TSP > 150 µg/m³.	EPA / DEC / DMP	Annually
Dust	Community – Monitoring emissions for sensitive dust receptors on Haul Route.	To ensure the health of community and wheat crops are not adversely affected by dust.	Single portable DDG located at approximately 15 km intervals (Lot 61 to mine) and 3 km intervals (Lot 59 and 61) along the truck route at a distance of about 125 m on each side from road centreline.	Monthly	Alert at greater than 7 g/m2/month.	EPA / DEC	Annually
			Semi-mobile TEOM dust sampling unit located alternating between residences (Lot 59, 61, 638), Moorine Rock School and CBH rail siding.	Monthly	$PM_{2.5}$ >25 µg/m³. PM_{10} > 50 µg/m³. TSP > 150 µg/m³.	EPA / DEC	Annually

Parameter	Monitoring Requirement	Purpose	Monitoring Method	Monitoring Frequency	Trigger	Regulating Authority	Reporting Frequency
Noise and Vibration Monitoring							
Noise	Operations Personnel – Monitor levels for occupational hearing loss at Mt Caudan Mine.	To ensure the hearing of operations personnel is not adversely affected by dust.	Single portable Sound Pressure Recorder (SPR) for key activity locations encompassing mining, crushing, workshops, village and ore haulage (Lot 59, 61, 638) over a survey period of 24 hours.	Monthly	Greater than 85 dB(A) – occupational work areas.	DMP / EPA / DEC	Annually
					Greater than 65 dB(A) – Lot 59, 61, 638 residences.	DMP / EPA / DEC	Annually
Vibration	Public – Monitoring of blasting induced vibration at Mt Caudan Site	To ensure the public road users are not adversely affected by blast induced vibration.	Single portable ground mounted accelerometer (GMA) located at 2 km intervals along the Parker Range bypass road at Mt Caudan.	Half Yearly	Greater than 2 mm/s.	EPA / DEC / DMP	Annually
Waste and Pollution Monitoring							
Waste	Collection and Storage - Monitor waste generated at Mt Caudan site.	To ensure waste is contained and disposed in an environmentally sensitive manner.	Audits of waste collection and storage sites.	Monthly	Identified non-compliance.	N/A	Annually
Fire Monitoring							
Fire	Initiation Sources – Monitor fire initiation sources at Mt Caudan site.	To ensure fire prevention and mitigation measures are in place for containment.	Audits of hot work permit processes (safety). Audits of vehicle movements from assigned roadways and tracks.	Monthly	Identified non-compliance.	N/A	Annually
Surface and Groundwater Monitoring							
Groundwater	Bores – Monitor groundwater level drawdown at Mt Caudan mine.	To assess water depression changes over life of mine.	Level measurement within 3 monitoring bores located within 100 m of operational bores (or 100 m of pit edge, if in-pit bores).	Monthly	25% deviation from Groundwater Modelling drawdown.	DOW / EPA	Annually
Groundwater	Bores – Monitor groundwater quality at Mt Caudan mine.	To assess water quality changes over life of mine.	Water sample (chemical assay) from 3 monitoring bores located within 100 m of operational bores (or 100 m of pit edge, if in-pit bores).	Quarterly	10% deviation from Baseline Chemical Assay.	DOW / EPA	Annually
			Water sample (Ec and pH) 3 monitoring bores located within 100 m of operational bores (or 100 m of pit edge, if in-pit bores).	Monthly	25% deviation from Baseline Ec or pH.	DOW / EPA	Annually

Parameter	Monitoring Requirement	Purpose	Monitoring Method	Monitoring Frequency	Trigger	Regulating Authority	Reporting Frequency
Groundwater	Bores – Monitor groundwater recovery at Mt Caudan mine.	To assess water table recovery at cessation of mine dewatering.	Level measurement within 3 monitoring bores located within 100 m of operational bores (or 100 m of pit edge, if in-pit bores).	Quarterly (until recovered to 75% of modelled level)	25% deviation from Groundwater Modelling recovery rate.	DOW / EPA	Annually
Groundwater	TSF – Monitor groundwater quality at Mt Caudan site.	To assess water quality changes over life of mine.	Water sample (chemical assay) from monitoring points in TSF wall design.	Quarterly	10% deviation from Tailings Chemical Assay.	DOW / EPA	Annually
			Water sample (Ec and pH) from monitoring points in TSF wall design.	Monthly	25% deviation from Tailings Ec or pH.	DOW / EPA	Annually
			Water sample (chemical assay, Ec and pH) from 3 monitoring bores located within 100 m of TSF.	Quarterly	10% deviation from Baseline Chemical Assay or 25% deviation from Baseline Ec or pH.	DOW / EPA	Annually
			Water level (dip measurement) from 3 monitoring bores located within 100 m of TSF.	Weekly	Data only.	DOW / DEC	Annually
Groundwater	Usage – Monitor water extraction and usage at Mt Caudan site.	To ensure compliance with extraction license.	Totaliser reading on flow meters (installed on water pipelines from bores and process water storage facility). Current calibration certificates to be sighted.	Monthly	Water license extraction limit exceeded.	DOW / EPA	Annually
Surface Water	Pipelines – Monitor bore water supply, tailings and tails water return pipelines at Mt Caudan site.	To limit uncontrolled spills to unsealed ground.	Differential reading on supply and discharge flow meters (installed on bore water supply, tailings and tails water return pipelines). Current calibration certificates to be sighted.	Every 60 seconds (when plant operating)	Reconciliation difference (>5%) by Plant Control System.	DMP / EPA	Annually
			Inspections of bore water supply, tailings and tails water return pipelines.	Daily	Detection of loss of containment (>5 m3).	DMP / EPA	Annually
Surface Water	Detention basin – Monitor stormwater drains at Mt Caudan site.	To ensure / limit emissions from stormwater run-off.	Monitor surface water quality at site detention basis (if level present) – chemical assay.	After rainfall > 20 mm in 24 h period	Detection of deleterious elements (eg. hydrocarbons).	DMP / EPA	Annually
			Inspect stormwater system for blockages or failures.	After rainfall > 20 mm in 24 h period	Identified non-compliance.	N/A	N/A

Parameter	Monitoring Requirement	Purpose	Monitoring Method	Monitoring Frequency	Trigger	Regulating Authority	Reporting Frequency
Surface Water	WRL – Monitor stormwater run-off at Mt Caudan site.	To prevent adverse affect to environment from WRL run-off.	Monitor surface water quality in drain collection points.	After rainfall > 20 mm in 24 h period	15% change in neutral pH. Detection of deleterious elements above waste baseline assay.	DMP / EPA	Annually
Surface Water	Pit Void Lake – Monitor water quality at Mt Caudan mine.	To assess water quality of the PVL post mine closure.	Water sample (chemical assay, Ec and pH) from 2 locations (near surface and at depth) in PVL.	Biannually (3 years), then annually until bond return	Statistically significant deleterious change in pH and/or metal content (other than salinity).	DMP / EPA	Annually
Water	Health – Monitor drinking water quality at Mt Caudan and Village sites.	To ensure drinking water quality is fit for human consumption.	Water sample from RO-Plant / Scheme water storage tank – Microbiological testing.	Monthly	Test result is out of specification.	DoH	In accordance with DoH document "Systems compliance and Routine Reporting Requirements for Minesites and Exploration Camps"
			Water sample from RO-Plant / Scheme water storage tank – Dissolved oxygen, hardness, pH and TDS.	Biannually	Test result is out of specification.	DoH	In accordance with DoH document "Systems compliance and Routine Reporting Requirements for Minesites and Exploration Camps"
Landform and Soil Monitoring							
Landform	TSF – Monitor embankment stability at Mt Caudan site.	To ensure TSF stability and integrity.	Survey points located at about 100 m intervals on top of TSF embankment.	Biannually	Greater than 5mm deviation between results.	DMP	Annually
			Survey points located at 250 m intervals on perimeter of embankment.	Biannually	Greater than 5mm deviation between results.	DMP	Annually
Landform	WRL – Monitor berm and batter stability at Mt Caudan site.	To ensure landform stability.	Survey points located within 1 km intervals on the final WRL profile areas.	Monthly	Greater than 50mm deviation between results.	DMP / EPA	Annually
			Inspection of berm and batter integrity – qualitative.	Monthly	N/A.	DMP / EPA	Annually

Parameter	Monitoring Requirement	Purpose	Monitoring Method	Monitoring Frequency	Trigger	Regulating Authority	Reporting Frequency
Soil	Soil Storage – Monitor soil volumes and storage at Mt Caudan site.	To ensure proper storage and sufficient quantity will be available for rehabilitation.	Survey of soil stockpiles to determine volume.	Annually	Negative reconciliation (actual vs required).	DMP / EPA	Annually
			Visual assessment by inspection.	Biannually	N/A.	DMP / EPA	Annually
Soil	Erosion – Monitor during clearing at Mt Caudan site.	To prevent sedimentation and ensure stability.	Visual inspection during clearing activities.	Monthly and following rain > 20 mm in 24 h period	Observed erosion by visual or photographic assessment.	DMP / EPA	Annually
Soil	Erosion – Monitor during rehabilitation at Mt Caudan site.	To prevent sedimentation and ensure stability.	Visual inspect during rehabilitation.	Quarterly (yr 1), Biannually (yr 2 - 3), Annually (until bonds returned)	Observed erosion by visual or photographic assessment.	DMP / EPA	Annually
Vegetation and Flora Monitoring							
Vegetation	Buffer zone – Monitor health condition of vegetation at Mt Caudan site.	To limit the indirect impacts to vegetation from operations.	Within the 250 m buffer zone of final disturbance footprint – At 500 m intervals (north-south coordinates) a transect heading (east-west) to monitor 20x20 m quadrats at 50 m intervals. Actual species count and health rating 1 (dead) to 5 (excellent) will be assigned (includes survey of reference sites). Soil sample (from quadrats above) tested for salinity, iron oxide and pH. Photographic record taken from each corner of each quadrat (above).	Quarterly during construction, then Annually	50% decline in cover or health compared to reference site quadrats.	DEC / EPA / DMP	Annually
Vegetation	Clearing Footprint – Monitor clearing quantity of vegetation at Project.	To ensure clearing boundaries and extent are not exceeded as approved.	Reconciliation from GIS and aerial imagery.	Annually	Actual clearing beyond GIS planned extent.	DEC / DMP	Annually
			Visual inspection of clearing boundaries and demarcation (per Clearing Permit (CP) process).	Fortnightly during construction, then Annually	Identified non-compliance (outside CP boundaries).	DEC / DMP	Annually

Parameter	Monitoring Requirement	Purpose	Monitoring Method	Monitoring Frequency	Trigger	Regulating Authority	Reporting Frequency
Vegetation	Saline water – Monitor vegetation condition at Mt Caudan site roads.	To limit the impact of saline water run-off on vegetation adjacent to Project roads.	Photographic record of vegetation at 2 locations to extent 5x5 m from cleared in-plant roads adjacent to contiguous vegetation. Visual health rating 1 (dead) to 5 (excellent) will be assigned to vegetation at each location.	Quarterly during construction, then Annually	Alert at 25% decline in vegetation health rating compared to previous rating.	DEC / DMP	Annually
Flora	*Isopogon robustus* (DRF) – Monitor health of populations at Project area.	To ensure no adverse impacts upon DRF from the Project.	Flora survey 20x20 m quadrats (2 within each DRF population) - species count and health rating 1 (dead) to 5 (excellent) will be assigned.	Annually	Alert at 10% decline in DRF health rating or any recorded plant loss.	DEC / EPA	Annually [2 yearly review of plan effectiveness]
			Photographic record taken from each corner of each quadrat (above).	Annually	Alert at 10% decline in DRF health rating or any recorded plant loss.	DEC / EPA	Annually [2 yearly review of plan effectiveness]
			Inspection of minimum 350 m buffer zone of DRF from clearing activities with GIS.	Quarterly during construction, then Annually	Identified non-compliance.	DEC / EPA	Annually [2 yearly review of plan effectiveness]
Vegetation	Rehabilitation – Monitor vegetation in restored area at Mt Caudan site.	To identify the attainment of successful rehabilitation outcomes.	Soil sampling - condition tests. Quadrat surveys (20x20 m) at established areas per EFA. Includes reference sites.	Annually	Non-attainment of rehabilitation outcomes measured per EFA.	DEC / EPA / DMP	Annually
Fauna Monitoring							
Fauna	TSF – Monitor for trapped fauna at Mt Caudan site.	To ensure TSF is not adversely affecting native fauna.	Visual inspection of TSF for presence of fauna.	Daily	Loss of native fauna of conservation significance.	DEC	Annually
Fauna	Process Water – Monitor for trapped fauna at Mt Caudan site.	To ensure process water storage is not adversely affecting native fauna.	Visual inspection of process water storage facility for presence of fauna.	Daily	Loss of native fauna of conservation significance.	DEC	Annually
Fauna	Malleefowl – Monitor for breeding activity at Mt Caudan area.	To ensure Malleefowl populations are not adversely affected by the Project.	Inspection of Malleefowl sighting locations.	As sighted	Active breeding nest mound located.	DEC / EPA	Annually
			Inspection of minimum 50 m buffer zone from active nesting mounds from operational activities with GIS locations.	Monthly	Identified non-compliance.	DEC / EPA	Annually
			Targeted surveys for Malleefowl including known nesting mounds (breeding and pre-clearing where >1 ha).	Monthly (Sept-Dec) and Pre-clearing	Active breeding nest mound located.	DEC / EPA	Annually

Parameter	Monitoring Requirement	Purpose	Monitoring Method	Monitoring Frequency	Trigger	Regulating Authority	Reporting Frequency
			Monitoring of detected active nesting mounds.	Weekly	Conservation significant incident.	DEC / EPA	Annually
Fauna	White-browed Babbler – Monitor for nesting activity at Mt Caudan area.	To ensure White-browed Babbler populations are not adversely affected by the Project.	Inspection of White-browed Babbler sighting locations.	As sighted	Detection of nest within 20 m of operational area.	DEC / EPA	Annually
			Inspection of minimum 20 m buffer zone from tree trunks with established White-browed Babbler nests from operational activities with GIS.	Monthly	Detection of nest within 20 m of operational area.	DEC / EPA	Annually
Weed and Dieback Monitoring							
Weeds	Invasive flora – Monitoring of weed present at Mt Caudan area.	To prevent the introduction of weeds and limit spread of existing weeds.	Vegetation reference monitoring sites to include collection of weed data (if present).	Annually	Identification of a weed species not previously recorded.	DEC / DMP	Annually
			Visual inspection of known weed locations and high risk areas (e.g. truck parking bays, workforce collection points).	Six weeks after rainfall > 20 mm.	A 25% increase of weed species by count or cover at a vegetation reference site.	DEC / DMP	Annually
			Spot audits of equipment, machinery and vehicle weed and seed clearance certificates.	Random	Identified non-compliance.	N/A	Annually
Greenhouse and Energy Monitoring							
GHG	Compliance – Monitor GHG emissions per NGERS.	To ensure compliance with NGERS reporting.	Calculation and estimation (in part) based on actual operations inputs for previous period.	Annually	N/A.	DSEWPaC	Annually
GHG	GHG Production – Monitor GHG emissions from operations.	To evaluate effectiveness of GHG production to targets.	Reconciliation between calculation/ estimation based on operations inputs and targets.	Annually	Alert at higher than annual target levels.	EPA / DCC	Annually