

# **MEDCALF PROJECT**

# **REHABILITATION PLAN**



Version 1.1

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# **Document Information**

Prepared for	Audalia Resources Limited
Project Name	Medcalf Project
Tenements	M63/656 & L63/75
Job Reference	Rehabilitation Plan
Version	1.1
Date	24 <sup>th</sup> January 2022

# **Document Control**

Version	Date	Author	Authorised by	Signature
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1.1	24/02/2022	Michelle Luinstra	Geoffrey Han	Hol.

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# **SUMMARY**

Summary of the Proposal	
Proposal title	Medcalf Project
Proponent name	Audalia Resources Limited
Purpose of the Rehabilitation Plan	To outline rehabilitation measures to be taken that are specific to re-establishing the Bremer Range Priority Ecological Community (PEC) and supporting growth of threatened and priority flora species within the Medcalf Project following mine closure.
Key Environmental Factor and Objectives	To protect flora and vegetation so that biological diversity and ecological integrity are maintained by remediating the disturbed land in the Medcalf Project to as closely resembling the surrounding community as possible.
Key components of the Rehabilitation Plan	The Rehabilitation Plan for the Medcalf Project will outline the community and species-specific actions to be taken during rehabilitation. This document will be used as a guide in conjunction with the Medcalf Project Mine Closure Plan (Preston Consulting, 2020) to ensure the long-term success of rehabilitation on the Medcalf Project site. Rehabilitation strategies and Measurement tools are outlined in Table <b>3-1</b> and Table <b>3-2</b> .

# **1 SCOPE & INTRODUCTION**

This Rehabilitation Plan has been prepared by Botanica Consulting Pty Ltd for Audalia Resources Limited to support environmental impact assessment under the *Environmental Protection Act 1986* (EP

Act). To respond to submissions on the Public Environmental Review (PER), a Rehabilitation Plan was required to be developed that describes:

- Specific actions to be taken to reintroduce significant flora species;
- Specific actions to be taken to reintroduce Priority Ecological Community (PEC) vegetation assemblage; and
- How historic disturbances within the *Marianthus aquilonaris* critical habitat boundary would be rehabilitated and what habitat quality would be expected to be achieved (over how many years).

This Rehabilitation Plan has been prepared in reference to *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA, 2020).

# **1.1 Medcalf Project Proposal**

Audalia Resources Limited propose to develop the Medcalf Project and associated haul road, which is located in the Bremer Range, Lake Johnston region of Western Australia, approximately 470 km east south-east of Perth.

The Project will include the development of three or four open mine pits, beneficiation plant, tailings storage facility (TSF), private haul road, road train transfer area and associated infrastructure such as laydown areas, borrow and gravel pits, groundwater bores, workshops and accommodation camp. The Project will clear no more than 300 ha within the 898 ha Mine Development Envelope, and no more than 350 ha within the 1,633 ha Haul Road Development Envelope (Figure 1-1).

The Proposal was referred under s 38 of the EP Act on 20 December 2017. The EPA determined the Proposal required a PER level of assessment on 13 March 2018. The EPA approved an Environmental Scoping Document (ESD) on 1 April 2019 identifying the preliminary key environmental factors, impacts to be assessed and work required to prepare the Environmental Review Document (ERD). The ERD was released for public review on 2 March 2021 until 4<sup>th</sup> May 2021. In addition to the EPA referral, the Project was referred under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 23 November 2017. It was determined that the proposal was not a controlled action on 9 January 2018.



Figure 1-1: Mine Development Envelope and Indicative Disturbance Footprint

# **1.2 Disturbance Footprint**

Details on the proposed indicative disturbance footprint of each development envelope are provided in Table 1-1.

Development Envelope	Feature	Area (ha)
Mine and associated infrastructure Development Envelope	Mine Pits	42
	Tailings Storage Facility	65
	Evaporation Pond	75
	Supporting Infrastructure	118
Total-Mine Disturb	300	
Haul road and associated infrastructure Development Envelope Haul road (including transfer yard, borrow pits and spoon drains)		350
Total-Haul Road Distu	350	
Total: Medca	650	

Table 1-1: Medcalf Project Indicative Disturbance Footprint

# **1.3 Key Environmental Factors**

The key environmental factor relevant to this Rehabilitation Plan is Flora and Vegetation. Table **1-2** describes the activities, values and actual or potential impacts on flora and vegetation.

Key Environmental Factor	Activities	Values	Impacts
Flora and Vegetation	Clearing of native vegetation Mining activities	<ul> <li>Threatened flora: <i>Marianthus aquilonaris</i> (listed under the BC Act)</li> <li>Ten Priority flora have been identified during flora/ vegetation surveys, seven of which are located within the Project Development Envelopes (as indicated by *):</li> <li>1. Acacia hystrix subsp. continua (P1);</li> <li>2. Acacia mutabilis subsp. stipulifera (P3)*;</li> <li>3. Bossiaea flexuosa (P3);</li> <li>4. Brachyloma stenolobum (P1);</li> <li>5. Eucalyptus pterocarpa (P3)*;</li> <li>6. Eucalyptus rhomboidea (P4)*;</li> <li>7. Hakea pendens (P3)*;</li> <li>8. Microcybe sp. Windy Hill (G.F. Craig 6583) (P3)*;</li> <li>9. Stenanthemum bremerense (P4)*; and</li> <li>10. Teucrium diabolicum (P3)*.</li> <li>Bremer Range vegetation complexes Priority 1 Ecological Community.</li> </ul>	Direct Impacts: Clearing of up to 300 Ha of native vegetation within a Development Envelope of 898 Ha (Mine Development Envelope); Clearing of up to 350 Ha of native vegetation within a Development Envelope of 1633 Ha (Haul Road Development Envelope) Indirect Impacts: - Potential increased spread or introduction of weeds; - Habitat fragmentation, - Increased fire risk; - Dust deposition; - Hydrocarbon or saline water spills; and - Changes to hydrological regime.

Table 1-2: Key Environmental factors and associated impacts at the Medcalf Project

Further information on Threatened and Priority flora and potential impacts can be found in the following documents:

- Botanica (2020d) *Flora and Vegetation Impact Assessment Medcalf Project*. Prepared for Audalia Resources Limited. June 2020.
- Preston Consulting (2021) *Medcalf Project: Draft Environmental Review Document*. Prepared for Audalia Resources Limited. March 2021.

# 2 FLORA & VEGETATION

Flora and vegetation surveys conducted within the Medcalf Project development envelopes and greater Bremer Range area are summarized in Table **2-1**.

### Table 2-1: Flora/Vegetation Surveys

Assessment
The Biological Survey of the Eastern Goldfields of Western Australia: Part 4 lake Johnston-Hyden study area
(How <i>et al</i> , 1988)
Biological Survey and Environmental Assessment of the Emily Ann Project Area (Curtin University, 1998)
Flora and vegetation of the Eastern Goldfields Ranges: Part 2. Bremer Range (Gibson & Lyons, 1998)
Vegetation survey and rare flora search of Maggie Hays Nickel Mine and adjacent areas (Armstrong and
Associates, 2002)
Vegetation survey and rare flora search of Maggie Hays and Emily Ann Nickel Mines and adjacent areas
(Armstrong and Associates, 2005)
Impact of proposed haul road from Maggie Hays to Emily Ann Plant (Armstrong and Associates, 2011)
Level 1 Flora and Vegetation survey of the Vesuvius Prospect Medcalf Project (Paul Armstrong and Associates,
2012)
Medcalf Exploration Project Targeted Flora search (Botanica Consulting, 2013)
Level 2 Flora & Vegetation Survey for Medcalf Vanadium Mining Project, Spring 2013 to Autumn 2015 (Botanica
Consulting, 2015)
Detailed Flora & Vegetation Survey Medcalf Vanadium Mining Project & Proposed Haul Road (Botanica
Consulting, 2020)

# 2.1 Vegetation Communities

The detailed flora and vegetation survey conducted by Botanica Consulting (Botanica, 2020a) covered a total area of 18,770 ha, encompassing the development envelopes and indicative disturbance footprint. Fourteen floristic communities were identified during the flora/vegetation survey, eight of which occur within the indicative disturbance footprint and development envelopes. The total area of each vegetation type within the indicative disturbance footprint and development envelopes is listed in Appendix 1 below. Maps showing the indicative disturbance footprint and development envelopes in relation to floristic communities identified in the flora and vegetation survey conducted by Botanica Consulting are also provided in Appendix 1.

# 2.2 Priority Ecological Communities

The Medcalf Project is located within the Bremer Range vegetation complexes Priority 1 Ecological Community (Bremer Range PEC). The Bremer Range PEC (including the 500m buffer zone) encompasses an area of 88,150ha and is centred on Mt Day, Round Top Hill and Honman Ridge. The Bremer Range has potentially been listed as a PEC based on studies conducted by How et. al. (1988) and Gibson & Lyons (1998) which identified specialised vegetation mosaics associated within the Banded Ironstone Formation of Bremer Range. A description of the Bremer Range vegetation complexes PEC provided by DBCA is provided below:

"Eucalyptus rhomboidea ms and E. eremophila woodland on the side slopes of low ridges; E. flocktoniae woodland (with E. salubris, E. salmonophloia, E. dundasii and E. tenuis) on broad flat ridges and side slopes; E. flocktoniae and/or E. longicornis woodland on saline soils on ridges and flats adjacent to large salt lake systems; E. longicornis and/or E. salmonophloia or, E. georgei subsp. georgei or, E. dundasii woodland, on low areas; E. livida woodland on lateritic tops or Allocasuarina thickets on greenstone ridges of lateritic breakaways; Acacia duriuscula, Allocasuarina globosa, E. georgei subsp. georgei and E. oleosa thickets on greenstone ridges with skeletal soils."

As specified in the flora/vegetation report prepared by Botanica Consulting (2020a), the lateritic hillslopes of the Medcalf deposit and lateritic hillslopes within the greater Bremer Range studied by

Gibson & Lyons (Community 5) were grouped together, indicating the lateritic hillslopes of the Medcalf area have a similar species composition of lateritic hillslopes within the greater Bremer Range PEC. The Eucalypt woodland and Mallee woodland vegetation types within the Bremer Range region were also representative of the Bremer Range PEC. The haul road development envelope/ indicative disturbance footprint is not located within a PEC and none of the vegetation communities of the haul road development envelope are representative of vegetation within the Bremer Range PEC.

# 2.3 Significant Flora

As defined in the Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016), flora and vegetation may be considered significant for a range of reasons, including, but not limited to the following criteria:

- Identified as threatened or priority species;
- Locally endemic or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- New species or anomalous features that indicate a potential new species;
- Representative of the range of a species (particularly, at the extremes of range recently discovered range extensions, or isolated outliers of the main range);
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids; and
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Flora and vegetation surveys of the local area identified one Threatened Flora and ten Priority Flora within the local area. No other significant flora were identified. Each category of significant flora identified (Threatened and Priority Flora) are summarized in Appendix 2.

### 2.3.1 Threatened Flora

One Threatened Flora taxon pursuant to the BC Act was identified within the local area; *Marianthus aquilonaris*. This taxon is not listed as Threatened under the EPBC Act. All current sub-populations of this taxon are located outside of the mine and haul road development envelopes/ indicative disturbance footprint. A map showing Threatened Flora records in relation to the development envelopes/ indicative disturbance disturbance footprint is provided in Appendix 3.

Further details on the ecology of this taxon, including assessments on the critical, optimal and suboptimal habitat for this taxon are provided in *Updated Summary on ecology of Marianthus aquilonaris* (Botanica Consulting, 2020b).

### 2.3.2 Priority Flora

Ten Priority Flora taxa as listed by DBCA were identified within the local area:

- 1. Acacia hystrix subsp. continua (P1);
- 2. Acacia mutabilis subsp. stipulifera (P3);
- 3. Bossiaea flexuosa (P3);
- 4. Brachyloma stenolobum (P1);
- 5. Eucalyptus pterocarpa (P3);
- 6. Eucalyptus rhomboidea (P4);
- 7. Hakea pendens (P3);
- 8. Microcybe sp. Windy Hill (G.F. Craig 6583) (P3);
- 9. Stenanthemum bremerense (P4); and
- 10. Teucrium diabolicum (P3).

Seven of the ten Priority Flora recorded within the local area occur within the development envelopes. A map showing Priority Flora records in relation to the development envelopes/ indicative disturbance footprint is provided in Appendix 4. One of the Priority Flora taxa identified; *Eucalyptus rhomboidea* (P4) is currently being nominated by DBCA for Threatened status under the BC Act. A second Priority Flora taxon; *Stenanthemum bremerense* (P4) is being considered by DBCA for nomination to Threatened status under the BC Act.

# 2.4 Habitat

A map of the critical habitat boundaries for significant flora can be found in Appendix 5.

# **3 REHABILITATION PLAN**

As specified in the Medcalf Project Interim Mine Closure Plan (Preston Consulting, 2020a) eight Mining Domains occur within the proposed Medcalf Project:

- Domain 1: Open Pits;
- Domain 2: Processing Facility and Workshops;
- Domain 3: Evaporation Ponds;
- Domain 4: TSF;
- Domain 5: Infrastructure;
- Domain 6: Stockpiles;
- Domain 7: Water Infrastructure; and
- Domain 8: Access Road and Tracks.

The specific rehabilitation works to be applied within each domain are specified in Section 9.2 (Closure Work Program) of the Interim Mine Closure Plan (Preston Consulting, 2020a).

# 3.1 Restoring Vegetation & Priority Ecological Communities

The detailed flora and vegetation survey conducted by Botanica Consulting (Botanica, 2020a) covered a total area of 18,770 ha, encompassing the development envelopes and indicative disturbance footprint. Fourteen floristic communities were identified during the flora/vegetation survey, eight of which occur within the indicative disturbance footprint and development envelopes. The Bremer Range PEC (including the 500m buffer zone) encompasses an area of 88,150 ha and is centred on Mt Day, Round Top Hill and Honman Ridge. The rehabilitation strategy for restoring the vegetation communities within the Bremer Range PEC is outlined in Table **3-1**.

Environmental Value	Current Extent	Direct Impacts	Rehabilitation Strategy	Measurement Tools
Clay Loam Plain Floristi Communities: CLP-EW1; CLP-MWS1; and CLP-MWS2	Total surveyed area of eight Floristic Communities representative of the Bremer Range PEC:15,247 ha	Direct Impact: up to 650 ha cleared Total area in Development Envelope: 2,528 ha Direct Impact: up to 650 ha cleared	For disturbed areas within the Clay Loam Plain Floristic Communities: -Cover with locally sourced clay topsoil; -Rip to 500 mm; -Application of locally sourced tree mulch applied to a minimum depth of 100 mm <sup>1</sup> ; -Application of tree logs recovered during clearing to provide fauna habitat diversity/ fauna refuge; and -Ensure that landforms are constructed to minimize surface water flow/erosion (i.e. backsloping berms, bunds and contouring of surface). - Re-seeding with appropriate species for as specified in Table <b>3-7</b> . Establish Analogue transects within each of the three Clay Loam Plain Floristic Communities to compare to performance on rehabilitated land within the same Floristic Community. Using analogue transect data, targets for species richness, plant density etc. can be determined <sup>2</sup> .	Landform Construction Audit, Decommissioning Audit, Landscape/Vegetation Monitoring

### Table 3-1: Rehabilitation Strategy for Floristic Communities within the Medcalf Project Development Envelope and Bremer Range PEC

<sup>&</sup>lt;sup>1</sup> Locally sourced from topsoil and tree mulch stockpiled during clearing.

<sup>&</sup>lt;sup>2</sup> Biodiversity criteria proposed will be consistent with existing literature on suitable targets for successful revegetation For example, *Guidance for the Assessment of Environmental Factors No. 6 Rehabilitation of Terrestrial Ecosystems* (EPA, 2006) which indicates that 60-80% of species richness of analogue communities may represent suitable completion criteria for rehabilitated areas.

Environmental Value	Current Extent	Direct Impacts	Rehabilitation Strategy	Measurement Tools
Hillslope Floristic Communities: HS-EW1; HS-MWS1; HS-MWS3; and HS-OS1	representative of the Bremer Range PEC:15,247 ha	Total area in Development Envelope: 2,528 ha	For disturbed areas within the Hillslope Floristic Communities: -Cover with topsoil. For the Hillslope Community, topsoil should resemble "Alkaline red shallow loamy duplex" soil group as assessed in Western Horticultural Consulting (Appendix 7) report for the Medcalf Project area; -Rip to 1.0m to incorporate rock and topsoil. This will aid stability of the slope and landform; -Application of locally sourced tree mulch applied to a minimum depth of 100mm; -Application of tree logs recovered during clearing to provide fauna habitat diversity/ fauna refuge; and -Ensure that landforms water drainage is acceptable (i.e. backsloping berms, bunds and contouring of surface) -Rehabilitated land to be constructed as close to the natural contour as possible; and - Re-seeding with appropriate species for as specified in Table <b>3-7</b> . Establish Analogue transects within each of the five Hillslope Floristic Communities to compare to performance on rehabilitated land within the same Floristic Community. Using analogue transect data, targets for species richness, plant density etc. can be determined <sup>2</sup> .	

Environmental Value	Current Extent	Direct Impacts	Rehabilitation Strategy	Measurement Tools
Bremer Range PEC	Bremer Range PEC (including the 500m buffer zone): 88,150 ha	Direct impact: 285 ha cleared. (Emily Ann/Maggie Hays mine disturbance: 202 ha within Bremer Range PEC)	As stated in Botanica Consulting's (2020) survey, the Medcalf deposit and lateritic hillslopes within the greater Bremer Range studied by Gibson & Lyons (Community 5) were grouped together in the floristic composition statistical analysis, indicating the lateritic hillslopes of the Medcalf area (Hillslope Floristic Communities listed above) have a similar species composition of lateritic hillslopes within the greater Bremer Range PEC. In addition to the rehabilitation strategies listed above, in order to reflect this rangeland habitat, rehabilitated land should be constructed to a slope angle no greater than 12 degrees. To quantify the ecological values on rehabilitated land within the Bremer Range PEC, analogue transects should be established on undisturbed lateritic hillslope. From the analogue transects, species composition targets that reflect the Bremer Range PEC can be set. Using analogue transect data, targets for species richness, plant density etc. can be determined. Species richness of Significant Flora will also be considered for targets on rehabilitated land <sup>1</sup> . Re-seeding will include Significant flora species outlined in Table <b>3-2</b> .	Landform Construction Audit, Landscape/Vegetation Monitoring

# 3.2 Reintroduction of Significant Flora

One Threatened flora species and seven Priority flora species occur within the development envelope of the Medcalf Project. Five Priority flora are located within the disturbance area. A translocation program for nominated Threatened species *Eucalyptus rhomboidea* will require application and approval of a translocation program from the DBCA before any seed collection or re-seeding can occur. Seed collected for all species will occur within a 50km radius of the Medcalf Project site. Re-seeding of all species will occur in late autumn prior to seasonal rains. Re-seeding locations for Priority species should be completed under the direction of an experienced botanist to maximise likelihood of successful re-seeding. The Rehabilitation Strategy for species within disturbance areas is outlined in Table **3-2**. Priority 3 species *Eucalyptus pterocarpa* was not included in the Rehabilitation Strategy as no individuals are within the disturbance area and the species is not representative of vegetation within the PEC.

Significant Flora	Current Local Extent	Direct Impacts	Rehabilitation Strategy	Measurement Tools
Acacia mutabilis subsp. Stipulifera (Priority 3)	20 populations and 348,452 individuals in local region.	10,001 individuals within disturbance footprint and 11,215 individuals within in development envelope.	Seed will be collected from individuals and applied to rehabilitated land reflecting the Clay Loam Plain habitat preferred by Acacia mutabilis subsp. stipulifera (WAHERB, 2021). Re- seeding is recommended to occur at a rate of 250 grams of seed per ha. Acacia mutabilis subsp. stipulifera is also noted to prefer low woodland habitat with Eucalyptus salmonophloia over mixed shrubs (Botanica Consulting, 2020d). Species representative of <i>E.</i> salmonophloia low woodland will be considered in the seed list for rehabilitated landforms.	Mark area where Priority species seeds have been applied and commence annual monitoring of re- growth, including individual counts, photographs and recording of vegetation health.
Eucalyptus rhomboidea (Priority 4)	Six sub-populations and 15,606 individuals in local region.	768 individuals within disturbance footprint and 1,198 individuals within development envelope.	Seed will be collected from individuals and applied rehabilitated land reflecting Hillslope habitat. According to the Critical Habitat Assessment conducted by Botanica Consulting (2020c), preferred habitat for <i>E. rhomboidea</i> includes creeklines and low to mid gravelly rises and lateritic slopes. Re- seeding is recommended to occur at a rate of 300 grams of seed per ha. <i>E.</i> <i>rhomboidea</i> often occurs in areas alongside <i>Eucalyptus eremophila</i> , <i>E.</i> <i>salubris</i> , <i>E. flocktoniae</i> , <i>E.</i> <i>salmonophloia</i> , <i>E. cylindrocarpa</i> will be considered in the seed list for rehabilitated landforms.	
Hakea pendens (Priority 3)	Six known population and 6,783 individuals in local region.	876 individuals within disturbance footprint and 1,246 individuals within development envelope.	Seed will be collected from individuals and applied to rehabilitated land where likelihood of success is highest (as determined by appropriately experienced botanist). Re-seeding is recommended to occur at a rate of 100 grams of seed per ha. <i>Hakea pendens</i> was noted to grow with <i>Eucalvotus</i>	

### Table 3-2: Rehabilitation Strategy for Significant Flora within the Medcalf Project

Significant Flora	Current Local Extent	Direct Impacts	Rehabilitation Strategy	Measurement Tools
			salmonophloia, Eucalyptus livida Goodia medicaginea and Melaleuca pauperiflora (Botanica Consulting, 2020d). These species will be considered in the seed list and also with regards to re-seeding location for Hakea pendens.	Mark area where Priority species seeds have been applied and commence annual monitoring of re- growth, including individual counts, photographs and recording of vegetation
<i>Microcybe</i> sp. Windy Hill (G.F. Craig 6583) (Priority 3)	15 populations and 26,962 individuals in local region.	No individuals within the disturbance 20 individuals within development envelope.	Though no individuals will be directly affected within the disturbance footprint, seed collection of <i>Microcybe</i> sp. Windy Hill should still be considered as the species is representative of the PEC. Re-seeding is recommended to occur at a rate of 200 grams of seed per ha. It is recommended that re-seeding occur on rehabilitated land reflecting the Clay Loam Plain habitat. According to the Flora Impact Assessment report (Botanica Consulting 2020d), <i>Microcybe</i> sp. Windy Hill were identified in clay, loam/sandy, and loam soils on plains and low slopes.	health.
Stenanthemum bremerense (Priority 4)	25 populations and 40,126 individuals within local region.	2,049 individuals within disturbance footprint and 3,455 individuals within development envelope.	Seed will be collected from individuals and applied to rehabilitated land with a gravel-lateritic surface, as is preferable for <i>S. bremerense</i> (WAHERB, 2021). According to the Critical Habitat Assessment report by Botanica Consulting (2020c) <i>S. bremerense</i> often occurs in areas where <i>Allocasuarina</i> and <i>Melaleuca</i> are dominant. These species will be included in the rehabilitated land seed list. It has also been noted that <i>S. bremerense</i> often occurs with <i>Hakea</i> <i>pendens</i> , and proximity of re-seeding locations should be taken into consideration. Re-seeding is recommended to occur at a rate of 250 grams of seed per ha.	Mark area where Priority species seeds have been

Significant Flora	Current Local Extent	Direct Impacts	Rehabilitation Strategy	Measurement Tools
<i>Teucrium diabolicum</i> (Priority 3)	12 populations and 16,153 individuals within local region.	1,150 individuals within disturbance footprint and 1,450 individuals within development envelope.	Seed will be collected from individuals and applied rehabilitated land reflecting Clay-Loam Plain habitat. <i>Teucrium</i> <i>diabolicum</i> was predominately identified growing in self-mulching/ heavy clay soils in low-lying plains (Botanica Consulting, 2020d). Appropriate location for re-seeding will be determined by a botanist. Re-seeding is recommended to occur at a rate of 100 grams of seed per ha.	applied and commence annual monitoring of re- growth, including individual counts, photographs and recording of vegetation health.

# 3.3 Rehabilitation of *Marianthus aquilonaris* Critical Habitat

One of the eight floristic communities identified by Botanica Consulting (2020a) as representative of the Bremer Range PEC provides habitat for *Marianthus aquilonaris:* Regrowth mid open mallee woodland of *Eucalyptus livida* over mid open shrubland of *Hakea pendens* and open low shrubland of *Goodia medicaginea* on hillslope (HS-MWS1). Proposed direct impacts to *Marianthus aquilonaris* habitat are summarised in Table **3-3**.

	Mine and associated infrastructure		associated ructure	Haul road ar infrast	Total Project				
Marianthus aquilonaris Habitat		Indicative Disturbance	Development	Indicative Disturbance	Development	Indicative Disturbance Footprint		Development Envelope	
	(na)	Footprint (ha)	(ha)	Footprint (ha)	otprint (ha)	Total Area (ha)	Total Area (%)	Total Area (ha)	Total Area (%)
Area of Occupancy	4.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Critical Habitat	64.50	1.51	2.48	0.00	0.00	1.51	2.34	2.48	3.84
Optimal Habitat	16.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub-optimal Habitat	52.57	1.51	2.48	0.00	0.00	1.51	2.87	2.48	4.72

Table 3-3: Direct Impacts to Marianthus aquilonaris habitat (Botanica Consulting, 2020b)

Potential indirect impacts for the Medcalf Project on *Marianthus aquilonaris* habitat could result in a reduction in habitat health due to:

- Excessive dust;
- Changes to microclimate;
- Changes to hydrological regimes;
- Hydrocarbon or saline water spills;
- Unauthorised access;
- Establishment or spread of weed species/populations;
- Increased fire risk; and
- Disturbance and indirect impacts to pollinator habitat

Habitat for *Marianthus aquilonaris* is positively associated where limonite bedrock is present at very shallow depth (Botanica Consulting, 2019). This habitat is difficult to recreate as a part of land rehabilitation, however re-seeding of *M. aquilonaris* on rehabilitated land should still be considered to re-create the unique ecology of the Bremer Range PEC.

The area to be seeded will be dependent on the area of rehabilitation best matched to the critical habitat description and will be subject to anapproved translocation program by DBCA. Scoping of the rehabilitated land where re-seeding is to occur should be done by an experienced botanist to maximize the likelihood of successful re-seeding. Information regarding the survivorship of M. aquilonaris seed and seedlings prepared in trials by the DBCA (2019) is show in Table **3-4**.

# Table 3-4: Number of seeds received by each mother plant and survivorship of seedlings (DBCA, 2019)

Mother	1	2	3	4	5	6	7	8	9	10
Number of seeds received	45	110	100	64	30	90	48	90	105	102
Number of seedlings successfully	16	12	17	19	7	23	12	24	21	29
grown										
Percent survivorship	35%	11%	17%	30%	23%	25%	25%	27%	20%	28%

According to the DBCA report (DBCA, 2019), the seeds were:

"...Cleaned then counted, listed in [Table 3-4] is the number of seeds received for each mother plant. For germination, 45 seed from each mother had the seed coat nicked with a scalpel blade. Seeds were then soaked in a 10% solution of PPM (Plant Preservative Material supplier) for 15 min before being placed onto agar containing 100 mg/L Gibberellic Acid (GA3). Gibberellic Acid (filter sterilised) was added to autoclaved water agar that had cooled to a temperature of 60°C. Plates were incubated at 15°C with light/dark cycles of 12 hours."

The low survivorship of seedlings in the DBCA trials suggest that a large quantity of seed be collected to ensure the success of a minority of germinants (range of percent survivorship being 11-28%). Seedlings are not recommended to be planted at the Medcalf Project as seedlings require intensive care and growth in a greenhouse facility and also have the potential to introduce soil-born pathogens such as *Phytophthora* (Die-back) into the Bremer Range PEC.

Should *M. aquilonaris* be established, monitoring of vegetation health (including photographs) should be assessed monthly to document growth and health of germinants. An exclusion zone should be established to prevent unintentional disturbance around any area where seeding of *M. aquilonaris* has occurred. The Significant Flora Management Plan (Botanica Consulting, 2021) also proposes monthly monitoring and photographic inspections of *M. aquilonaris* sub-populations surrounding the Medcalf Project site. These monitoring activities could be combined.

# 3.4 Rehabilitation of *Eucalyptus rhomboidea* and *Stenanthemum bremerense* Critical Habitat

*Eucalyptus rhomboidea* (P4) has been nominated by DBCA to be listed as a Threatened Species under the *Biodiversity Conservation Act 2016* (BC Act). *Stenanthemum bremerense* (P4) has been nominated to be listed as Endangered (EN) under World Conservation Union (IUCN 2001) criteria B1ab(iii,v)+B2ab(iii,v) due to its extent of occurrence being less than 5,000km<sup>2</sup> and area of occupancy being less than 500km<sup>2</sup>, with a continuing decline observed, estimated, inferred or projected in area, extent and/or quality of habitat and number of mature individuals (Botanica Consulting, 2020c).

A summary of the extent of proposed critical habitat, optimal habitat and sub-optimal habitat (including the occupied and unoccupied area within each habitat) for each species (as detailed in the "Critical Habitat Assessment of *Eucalyptus rhomboidea* and *Stenanthemum bremerense*" (Botanica Consulting, 2020c) is provided in Table 3-5. Critical habitat includes area of occupancy, optimal habitat and critical habitat.

Habitat	Extent (ha)	Occupied area (ha)	Unoccupied area (ha)			
Eucalyptus rhomboidea						
Critical Habitat	42,775	12*	42,763			
Optimal Habitat	2481	12*	2,469			
Sub-Optimal Habitat	40,294	0	40,294			
	Stenanthemun	n bremerense				
Critical Habitat	221,008	56*	220,952			
Optimal Habitat	23,554	56*	23,498			
Sub-Optimal Habitat	197,454	0	197,454			

### Table 3-5: Extent of Critical, Optimal and Sub-Optimal Habitat (Botanica Consulting, 2020c)

\*Excludes fire impacted populations

In Botanica Consulting's "Flora and Vegetation Impact Assessment for the Medcalf Project" (Botanica Consulting, 2020d) direct and indirect impacts our quantified for both *Eucalyptus rhomboidea* and

Stenanthemum bremerense with consideration to both the Maggie Hayes/Emily Ann Mine and the proposed disturbances resulting from the Medcalf Project (Table **3-6**).

		Diemerense				
	No. Plants pro	posed to be dir				
Taxon	Emily Ann/ Maggie Hayes Disturbance Footprint	Medcalf Project Indicative Disturbance Footprint	Cumulative Total	No. plants in local region	% Cumulative Impact	
Eucalyptus rhomboidea		768	768	15,606	4.9	
Stenanthemum bremerense	300	2,049	2,349	40,126	5.9	

# Table 3-6: Direct Cumulative Impacts to Eucalyptus rhomboidea and Stenanthemum bremerense

In order to rehabilitate suitable critical habitat, consideration must be given to the soil and surface preferred by each species. Soil assessment completed by Western Horticultural Consulting (2019) identified five main soil types favourable for the growth of *Eucalyptus rhomboidea* and *Stenanthemum bremerense* (and including *Marianthus aquilonaris*):

- 1. Alkaline red shallow loamy duplex
- 2. Loamy gravel
- 3. Shallow gravel over indurated mottled zone
- 4. Stony soils
- 5. Shallow gravel

As referred to in Table **3-1**, specific top soil will be applied during rehabilitation depending on the floristic community being replicated. *E. rhomboidea* occurs on a variety of soils and landforms ranging from mid to low lateritic rises-greenstone hillslopes and creeklines and *S. bremerense* occurs on a variety of soils on the top or sides of laterite outcrops and breakaways and in other sites with lateritic gravel or pebbles (Botanica Consulting, 2020c).

Following earthworks and topsoil placement, a botanist should select the most favourable locations within the rehabilitated communities for re-seeding of *E. rhomboidea* and *S. bremerense*. The recommended rate of re-seeding is 300 grams of seed per ha collected from within 50km of the Medcalf Project site.

### 3.5 Seed List

The contents of the seed lists are based on taxa documented during flora and vegetation of the Medcalf Project Area (Botanica Consulting, 2020e). Seed mixes proposed differ depending on whether the landscape has been rehabilitated to reflect Clay Loam Plain or Hillslope habitats (Table **3-7**). For all rehabilitation, seeding should be scheduled prior to seasonal rains. Ideally in the Norseman region this would occur in late autumn as most rainfall occurs in the winter months. Hand seeding will be undertaken at an application rate of 5-10kg/ha.

# Table 3-7: Proposed seed list based on Level 2 Flora Survey of Medcalf Project area (Botanica<br/>Consulting, 2020e)3

Taxon	Clay-Loam Plain	Hillslope
Acacia erinacea	*	
Acacia yorkrakinensis		*
Allocasuarina campestris	*	*
Anthocercis anisantha subsp. anisantha	*	
Austrostipa acrociliata	*	
Comesperma volubile		*
Daviesia aphylla	*	
Dodonaea bursariifolia		*
Dodonaea inaequifolia	*	
Dodonaea stenozyga	*	*
Eremophila caerulea		*
Eremophila psilocalyx		*
Eucalyptus cylindrocarpa	*	
Eucalyptus eremophila	*	
Eucalyptus livida		*
Eucalyptus salmonophloia	*	
Eucalyptus salubris	*	
Exocarpos sparteus	*	
Goodenia pinifolia	*	
Goodia medicaginea		*
Grevillea huegelii	*	*
Grevillea oncogyne	*	
Halgania integerrima		*
Melaleuca calyptroides	*	
Melaleuca eleuterostachya	*	
Melaleuca hamata		*
Melaleuca lateriflora	*	
Melaleuca pauperiflora subsp. pauperiflora	*	
Olearia muelleri	*	
Philotheca gardneri	*	
Rhagodia preissii subsp. preissii	*	*
Santalum acuminatum	*	
Scaevola spinescens		*
Sclerolaena uniflora		*
Senna artemisioides subsp. filifolia		*
Westringia cephalantha		*

<sup>&</sup>lt;sup>3</sup> Significant flora species to be included subject to DBCA approval, availability and germination trial results.

# **4 REHABILITATION MONITORING**

# 4.1 Landscape/Vegetation Monitoring

Landscape/Vegetation monitoring using EFA is proposed to be conducted to assess rehabilitation success of landforms of the Medcalf Project (as specified in the Medcalf Project Mine Closure Plan). Monitoring will be conducted in accordance with methods developed by Tongway and Hindley (2003) to measure landscape stability and ecosystem function.

EFA has two major components; the measurement of landscape zones such as "bare patches" and "vegetation patches" which are recorded along the transect and the assessment of the soil surface condition for the major landscape zones identified along the slope. Vegetation patches play an important role in regulating the flow of landscape resources down the slope (rainfall, litter, soil etc). Bare patches usually are the source of the resources deposited at vegetation patches after a period of time.

The second component of EFA assesses the soil surface condition and is conducted for the major landscape zones identified in the initial assessment of the slope. Three replicates of the soil assessments are obtained for each landscape zone, randomly selected along each transect. The Landscape/Vegetation Monitoring programme will be used to:

- Measure Landscape Function at each transect;
- Monitor the established analogue site(s);
- Record plant taxa present including introduced taxa;
- Measure the plant density for each species;
- Measure percentage vegetation cover and vegetation health;
- Statistically analyse the data and provide tabulated summaries of the findings;
- Identify rehabilitation which complies with the site Completion Criteria; and
- Identify any areas where vegetation establishment is not progressing and where remedial treatment may be necessary.

EFA monitoring data will be used to determine whether the rehabilitated landforms are showing a similar trend to the analogue sites (as applicable) and will continue until completion criteria specified in the Mine Closure Plan are met, with the criteria being refined as monitoring continues. Assessments will continue until completion criteria are met.

# 4.2 Fauna Monitoring

Quantitative assessment of fauna presence and composition is a challenging task, particularly on recently rehabilitated landforms. One proposed method of applying a "Rehabilitation and Degradation Index" for fauna on rehabilitated landforms involves quantifying reptile presence (by the use pit traps). Reptiles are assessed as bio-indicator species and their presence is compared to analogue sites (Thompson, Thompson & Withers, 2008). However, this methodology requires a significant amount of resources and invasive activities (ie. digging pit traps) which poses a potential risk of causing erosion to recently rehabilitated landforms and would likely inflict stress and/or mortality on the reptiles captured. It is further acknowledged within the report by Thompson *et al.* (2008) that colonisation of species occupying specific habitat niches (including many Short Range Endemic invertebrate species) will not likely be detected on disturbed landforms until at least 8-10 years following rehabilitation completion. During early stages of landform rehabilitation at the Medcalf Project, assessment of fauna would include assessment of landscape function/ habitat complexity of rehabilitated landforms and analogue sites during EFA monitoring and opportunistic records of any fauna presence observed on the landforms and analogue sites during EFA monitoring, including direct observations of both vertebrate and invertebrate fauna (for

example ants which are often noted during rehabilitation monitoring as an early colonising species) and secondary evidence of fauna presence including scats, tracks and nesting sites (i.e. ant nests, spiderwebs etc.). Preliminary completion criteria for early stages of fauna monitoring would be 'evidence of native fauna present on rehabilitated landforms'.

As rehabilitation and mine closure progress, potential for conducting more extensive fauna monitoring (for example, fauna trapping and applying the 'Rehabilitation and Degradation Index' as described above) should be considered, allowing for further refinement of completion criteria targets which will be detailed in subsequent Mine Closure Plan revisions.

# 5 LEARNINGS FROM OTHER MINES

### Lake Johnston Operations

The Emily Ann and Maggie Hays Nickel Mine are collectively referred to as the Lake Johnston Mining Operations (Lake Johnston Project) which is located within the Bremer Range PEC, approximately 40km north east of the proposed Medcalf Project. The Emily Ann and Maggie Hays Nickel Mine have been under Care and Maintenance since 2007 and 2014 respectively, however prior to development numerous flora and fauna studies were completed in the Lake Johnston Project area.

Paul Armstrong and Associates (2005) identified a total of 292 plant species from 50 families from within the Lake Johnston Project, including twenty-three conservation significant flora (Table **5-1**).

Taxon	Conservation Status	Identified in 2005 Survey	Identified in 2012 Survey
Allocasuarina globosa	Threatened	✓	$\checkmark$
Eucalyptus cerasiformis	Priority 4	✓	~
Hakea pendens	Priority 3	✓	
Eucalyptus exigua	Priority 3	✓	✓
Acacia hystrix subsp. continua	Priority 1	~	
Eucalyptus georgei subsp. georgei	Priority 4	✓	$\checkmark$
Microcybe pauciflora subsp. grandis	Priority 1	$\checkmark$	
Orianthera exilis <sup>1</sup>	Priority 2	$\checkmark$	$\checkmark$
Cryptandra polyclada subsp. polyclada	Priority 3	$\checkmark$	
Eremophila microphylla <sup>2</sup>	No longer listed as Priority	✓	
Stenanthemum sp. aff. poicilum	Priority 3	✓	
Stylidium validum	Priority 1	✓	✓
Seringia undulata <sup>3</sup>	Priority 1	✓	
Stylidium sejunctum	Priority 3	✓	$\checkmark$
Thysanotus brachyantherus	Priority 2		$\checkmark$
Lepidosperma amantiferrum	Priority 1		✓
Lepidosperma ferriculmen	Priority 1		✓
Acacia glaucissima	Priority 3		✓
Acacia gibsonii <sup>4</sup>	Priority 1		✓
Mirbelia ferricola <sup>5</sup>	Priority 3		✓
Stenanthemum bremerense	Priority 3		✓
Eucalyptus frenchiana	Priority 3		~

# Table 5-1: Significant Flora Identified at Lake Johnston Project in 2005 and 2012 surveys (Norilsk Nickel Australia, 2014)

<i>Microcybe</i> sp. Windy Hill (G.F. Craig 6583)	Priority 3		~
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<sup>1</sup> Previously known as Logania exilis (P2) <sup>2</sup> Previously known as *Diocirea microphylla* (P3)

<sup>5</sup> Previously known as *Mirbelia* sp. Helena & Aurora (B.J. Lepschi 2003)

According to the Mine Closure Plan (Norilsk Nickel Australia, 2014):

"The tenement holder is required to develop and implement a comprehensive Native Vegetation Rehabilitation Program to the satisfaction of the Environmental Officer, Department of Industry and Resources, the Department of Environment and the Department of Conservation and Land Management. This Program is required to be submitted to the relevant regulatory agencies within 12 months of the imposition of this condition. "

It cannot be determined whether this program has been developed.

### **Ravensthorpe Gold Mine**

The Ravensthorpe Gold Mine (Ravensthorpe Project) is located approximately 140km south west of the proposed Medcalf Project and 14km south east of the town of Ravensthorpe.

The Ravensthorpe Project is located within the following Priority Ecological Communities (PECs):

- Very open Mallee over Melaleuca sophisma dense heath (PEC1); and
- Proteaceae dominated Kwongkan shrublands of the Southeast Coastal Floristic Province of WA (PEC3) (ACH Minerals, 2019)<sup>4</sup>.

According to the 2019 Draft Mine Closure Plan (ACH Minerals, 2019) database searches identified five Threatened Flora species in the Ravensthorpe Project locality. No Threatened flora were found in the Ravensthorpe Project Disturbance footprint or Development envelope.

Of the 19 Priority species recorded in the locality of the Ravensthorpe Project, eight were recorded during flora surveys:

- Calothamnus roseus (P1)
- Lepidosperma sp. Maydon (S. Kern, R. Jasper, H. Hughes LCH 17844) (P1)
- Melaleuca sophisma (P1)
- Hydrocotyle tuberculata (P2)
- Pultenaea craigiana (P3)
- Marianthus mollis (P4)
- Stachystemon vinosus (P4)
- Thysanotus parviflorus (P4)

The Completion Criteria with regards to Revegetation at the Ravensthorpe Project are listed as:

Foliar cover is on a positive trajectory;

<sup>4</sup> Also listed as a Threatened Ecological Community under the EPBC Act

<sup>&</sup>lt;sup>3</sup> Previously known as Keraudrenia cacaobrunnea subsp. undulata <sup>4</sup> Previously known as Acacia sp. Lake Johnston (N. Gibson & M. Lyons 1959)

- Flowering, fruiting and seed production is evident in a range of species;
- Vegetation composition is reflective of undisturbed native vegetation in the immediate area; and
- Weeds do not inhibit establishment/out compete native with vegetation in rehabilitation areas.

Though the Mine Closure Plan (ACH Minerals, 2019) does not state any rehabilitation measures specific to restoring habitat for Threatened and Priority species or the PECs at large, research conducted by Outback Ecology in 2004 and 2011 found that:

"Plant available nutrients, native seed and soil-borne organisms were particularly concentrated within the top 15 cm of topsoil; therefore, the optimal stripping depth of topsoils to be used in rehabilitation should be no deeper than 15 cm."

# 6 STAKEHOLDER CONSULTATION

Audalia has a Consultation Strategy which identifies key external stakeholders and determines how they will be impacted by the Proposal and what influence they have over its implementation. The aim of the consultation is to develop productive relationships that ensure the Proposal is underwritten by sustainable agreements and necessary statutory approvals. The Consultation Strategy has also been developed to progress the approvals necessary for the construction and operation of the Proposal, which will require consultation with the following stakeholders:

- Local Government (including Shire);
- State Government (including DBCA and DWER);
- Ngadju People with a connection to the land; and
- Corporate and community stakeholders.

The Medcalf Project ERD was released for public comment for eight weeks, and Audalia is currently preparing the responses to the public and Government submissions. DWER submissions regarding rehabilitation of the Medcalf Project are addressed in Table **6-1**.

There were also several public comments made in response to the Medcalf Project ERD. Comments made in relation to rehabilitation of the Medcalf Project are addressed in

Table 6-2.

Requirement	DWER Comments	Botanica Advice	Section of Rehabilitation Plan
Impacts to Significant Vegetation	"The wider-scale impacts associated with development within large natural areas are significant, but difficult to quantify. In the case of this proposal, the haul road and mine site may potentially disrupt ecosystem processes, genetic transfer, recruitment and germination cues which may not be immediately evident. Overall, the significant values and viability of the site would erode over time. Section 12 Holistic Impact Assessment (page 382) does not adequately address these issues."	Though it is difficult to know all of the impacts arising from development within such a diverse community, the aim of rehabilitating land back to stable and self-sustaining is a goal that has been achieved through learnings at other mine sites and is reflected by rehabilitation methodology in the Mine Closure Plan (Preston Consulting, 2020a). Regarding ecosystem processes, genetic transfer, etc. one of the methods proposed in this Rehabilitation Plan is the consideration that different surface rehabilitation methods be applied based on the type of Floristic Community trying to be re-created (Table <b>3-1</b> ). Further, carefully selecting suitable sections of rehabilitated land for the reintroduction of specific species has been considered as part of the rehabilitation strategy. Carefully selecting re- seeding sites will also maximise the likelihood of success of particularly Priority and Threatened species which generally have an ideal habitat niche (Table <b>3-2</b> ). Rehabilitating the landscape to reflect a specific community and also recruiting an experienced botanist to select where valuable seed is distributed gives the ecosystem the best chance of long term re-establishment.	Section 3.1 Restoring Vegetation & Priority Ecological Communities Section 3.2 Reintroduction of Significant Flora Section 3.4: Seed List

### Table 6-1: DWER aspects to be addressed for Medcalf Project Draft Environmental Review (Preston Consulting, 2021)

Requirement	DWER Comments	Botanica Advice	Section of Rehabilitation Plan
Rehabilitation	"The ERD states that all disturbance will be rehabilitated at the completion of mining, which is expected to take approximately 13 years (p. 132). The ERD does not provide evidence of successful rehabilitation of equivalent ecosystems (Table 76, p. 377). The likelihood of success is unknown due to a lack of detailed information."	The Medcalf Project is not the first project to be developed within a Priority Ecological Community (or the Bremer Range PEC). The Emily Ann and Maggies Hays Nickel Mine are located within the Bremer Range PEC. The Ravensthorpe Gold Project Mine Closure Plan (ACH Minerals, 2019) was developed within the "Very open Mallee over <i>Melaleuca sophisma</i> dense heath" and "Proteaceae dominated Kwongkan shrublands of the Southeast Coastal Floristic Province of WA" both of which are PEC's. Though both projects have not progressed far with regards to rehabilitation, details from their respective Mine Closure Plans and standard best practices will be applied to the Medcalf Project.	Section 4.0: Learnings from other Mines
Rehabilitation	"There should be closure outcomes and completion criteria for significant flora species given significant flora are important environmental values of the development envelope and will be impacted directly and/or indirectly by the proposal. The closure outcome for revegetation in the MCP is generic to "re-establish vegetation that provides a self- generating ecosystem comprising local native vegetation which resembles the surrounding environment as closely as practical" (Table 32 Appendix 4). It does not reference the significant vegetation identified within the development envelope that will be impacted e.g. Bremer Range Vegetation. It is not clear if there will be attempts for rehabilitation to replace the values that have been impacted or how the analogue sites will be chosen."	The development of completion criteria will be updated throughout operations as the Medcalf Project is still in its early stages (for instance, germination trials for <i>Eucalyptus rhomboidea,</i> <i>Stenanthemum bremerense</i> are ongoing). For the specific completion criteria to be developed, the Rehabilitation Plan proposes to establish Analogue transects within each of the Clay Loam Plain and Hillslope floristic communities to compare to performance on rehabilitated land within the same floristic community. Using analogue transect data, targets for species richness, plant density etc. can be determined.	Section 3.2: Reintroduction of Significant Flora

Requirement	DWER Comments	Botanica Advice	Section of Rehabilitation Plan
Great Western Woodland- Rehabilitation	Discuss the likelihood that terrestrial fauna will use rehabilitated areas as fauna habitat and how the use of rehabilitated areas by fauna will determined and monitored. A discussion addressing how the rehabilitation will be undertaken to provide fauna habitat and reconnect habitat connectivity should be provided.	As specified in the EPA (2006) rehabilitation guidance, it is generally assumed that fauna will generally disperse to new habitats more readily than plants if favourable habitat conditions return, provided that there are effective means of dispersal via linkages to nearby intact habitats. The rehabilitation has been planned to reconnect habitats and re-establish a diversity of floristic communities (from the existing clay-loam plain and hillslope habitats) with biodiversity of rehabilitated lands to be monitored against Analogue transects within each of the Clay Loam Plain and Hillslope floristic communities. Logs recovered during clearing will be replaced on rehabilitated sites and rocky incorporated into the hillslope rehabilitation to provide habitat diversity and fauna refuge. Records of fauna utilising rehabilitated sites will be maintained during landscape/ vegetation monitoring including either direct observation or secondary evidence (i.e. ant nests, webs, scats).	Section 3.1: Restoring Vegetation & Priority Ecological Communities

Topic Regarding Rehabilitation	Comments	Botanica Advice	Section of Current Submission
Topsoil Depth	"The MCP for the Tailing Storage Facility (TSF) and Evaporation Ponds, assumes that a topsoil layer of 0.1 m (or 0.15 m) on top of a "rock armour" layer will be sufficient for the growth and maintenance of the rehabilitated plant communities. This is almost certainly inadequate and will not result in a replication of the pre-existing communities. At least 1-2 m of sub-surface soil will likely be required for adequate rehabilitation."	The issue with applying topsoil to such depths is the lack of a) availability of such quantities of topsoil and b) the erosional effects of rainfall on top soil applied at such depth. Deeper topsoil application encourages gullying and formation of erosion features, and ultimately the loss of topsoil. To ensure stability of the landform, deep ripping and incorporation of rock with the top layer of topsoil is recommended. The standard industry practise is to apply no more than 0.3m of topsoil over top of a ripped, bunded and backsloped landform to minimise potential for run off in a rainfall event.	Section 3.1: Restoring Vegetation & Priority Ecological Communities Section 4.0: Learnings from other Mines
Significant Flora	"Not only are the germination and likely rehabilitation success not considered for most of these priority species, critically, some of these species are key components of the vegetation communities to be impacted. This is especially the case for <i>H. pendens</i> , which occurs most abundantly in the areas to be mined (Fig. 24, ERD) and will have approximately 60% of its occurrence in the local area eliminated (page xx, ERD). These priority species need to be given special attention in the rehabilitation plan and completion criteria."	In the case of <i>Hakea pendens</i> , Botanica Consulting collected seed in 2019 and found that the species readily germinates (Appendix 6). As <i>Hakea pendens</i> is a Priority 3 species and is well documented between Lake Johnston and Southern Cross, the likelihood of the success of re-seeding is high.	Appendix 6 Section 3.2: Reintroduction of Significant Flora

### Table 6-2: Public comments regarding the Medcalf Project Draft Environmental Review and Rehabilitation

Topic Regarding Rehabilitation	Comments	Botanica Advice	Section of Current Submission
Significant Flora	"We consider that the mitigation reasoning given in Table 76 (ERD) for these species is inadequate, for reasons stated above in the Mine Closure Plan and Rehabilitation section. <i>H. pendens</i> has been demonstrated to have high germinability (page 108, ERD), however, it is not a key feature in the rehabilitation plan, despite the fact the bulk of its populations occur in the proposed mine pit areas. Nothing in particular is considered for the other two. species and, as stated above, the rehabilitation plan has critical failings. In addition, the haul road may never be rehabilitated so the impact on species occurring there should be offset as a precaution (i.e. it should be assumed that there remains a residual impact). In summary, if impacts to these species leave a residual impact, then those impacts must be offset, but this is not proposed."	The current Rehabilitation Plan proposes re- seeding <i>Hakea pendens</i> at a rate of 100 grams of seed per ha (Table <b>3-2</b> ). Offsets are proposed in Preston Consulting's (2020b) Offset Strategy for Audalia Resources Limited.	Section 3.2: Reintroduction of Significant Flora 7.0 References
Vegetation Communities	"The vegetation communities have been mapped, and these prior species compositions and densities should be used as the benchmark for rehabilitation of specific areas."	As specified in this Rehabilitation Plan, Analogue transects are proposed to be established within each of the Clay Loam Plain and Hillslope floristic communities to compare to performance on rehabilitated land within the target floristic community. Using analogue transect data, targets for species richness, plant density etc. can be determined.	Section 3.2: Reintroduction of Significant Flora
Vegetation Communities	"As part of the MCP, it is stated that to monitor vegetation rehabilitation success "The location and number of monitoring sites will be determined by a suitably qualified professional prior to the completion of operations at the Project." (page 167, Appendix 4). As stated above, because the rehabilitation does not attempt to replicate all prior vegetation communities, such a strategy will, at best, result in communities similar to those surrounding communities that remain after mining, but will not replicate those that were present before mining took place. We strongly advocate amending this monitoring regime to also include comparison to prior vegetation communities."	As specified in this Rehabilitation Plan, Analogue transects are proposed to be established within each of the Clay Loam Plain and Hillslope floristic communities to compare to performance on rehabilitated land within the same floristic community. Using analogue transect data, targets for species richness, plant density etc. can be determined.	Section 3.1: Restoring Vegetation & Priority Ecological Communities

Topic Regarding Rehabilitation	Comments	Botanica Advice	Section of Current Submission
Vegetation Communities	"Rehabilitation targets and monitoring for the rehabilitation are either vague or set a low bar (Table 32, Appendix 4). A completion criterion is established: "Revegetated areas are well established and represent a self-sustaining vegetation community (based on at least two seasons of seed production) and are similar to the surrounding environment in terms of floral compositions at analogue sites (>50% species richness, >50% stems cover/density) and <10% weed cover.". This criterion has two issues: 1) the species richness percentage is inadequately low; 2) as stated above, the prior communities are not referenced, only the surrounding environment is used as a reference. This would result in some vegetation communities, such as the <i>H. pendens</i> -dominated community being extirpated from the landscape permanently. Given the relatively low species richness in many of the communities (especially for perennial species), a target of 100% species occurrence is achievable. As stated above, the rehabilitation should attempt to replicate all prior vegetation communities that remain after mining."	As specified in this Rehabilitation Plan, Analogue transects are proposed to be established within each of the Clay Loam Plain and Hillslope floristic communities to compare to performance on rehabilitated land within the same floristic community. Using analogue transect data, targets for species richness, plant density etc. can be determined. Biodiversity criteria proposed will be consistent with existing literature on suitable targets for successful revegetation For example, <i>Guidance for the Assessment of Environmental Factors No. 6 Rehabilitation of Terrestrial Ecosystems</i> (EPA, 2006) which indicates that 60-80% of species richness of analogue communities may represent suitable completion criteria for rehabilitated areas.	Section 3.1: Restoring Vegetation & Priority Ecological Communities Section 3.2: Reintroduction of Significant Flora

# 7 CONCLUDING STATEMENT

The Rehabilitation Plan provides a guideline for the rehabilitation of the Bremer Range PEC vegetation communities and the re-introduction of Significant Flora within the Medcalf Disturbance Footprint.

The likelihood of success of rehabilitation at the Medcalf Project site will be dependent on implementation consistent with the Rehabilitation Plan, Mine Closure Plan and Significant Flora Management Plan. Further trials should be conducted to provide further information on Priority species germination, establishment and longevity after planting. The establishment of analogue transects is also essential to provide adequate baseline data.

# 8 REFERENCES

ACH Minerals (2019). Ravensthorpe Gold Project Draft Mine Closure Plan. Version 1a. July 2019.

Botanica Consulting (2020a). Detailed Flora & Vegetation Survey Medcalf Vanadium Mining Project & Proposed Haul Road. Prepared for Audalia Resources Limited. February 2020.

Botanica Consulting (2020b). *Updated Summary on ecology of Marianthus aquilonaris*. Prepared for Audalia Resources Limited. November 2020.

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		Total	Mine and associated infrastructure		Haul road and associated infrastructure		Total Project			
Floristic Community	Vegetation Code	Mapped	Indicative	Development	Indicative	Development	Indicative Disturbance		Development Envelope	
		(ha)	Footprint (ha)	Envelope (ha)	Footprint (ha)	Envelope (ha)	Total Area (ha)	Total Area (%)	Total Area (ha)	Total Area (%)
Low samphire shrubland of <i>Tecticornia indica</i> subsp. <i>bidens</i> over low open forbland of <i>Disphyma crassifolium</i> on playa	CD-CSSSF1	67			0.2	2	0.2	0.03	2	0.1
Low open woodland of <i>Eucalyptus salmonophloia</i> over mixed shrubs on clay- loam plain	CLP-EW1	10,022	79	271	200	965	279	43.2	1237	48.9
Mid mallee shrubland of <i>Eucalyptus</i> spp. over mid shrubland of <i>Melaleuca</i> pauperiflora and mixed low shrubland on clay-loam plain	CLP-MWS1	1,975	124	341	20	123	144	22.4	464	18.3
Mid mallee woodland of <i>Eucalyptus</i> spp. over mixed low shrubland/ heathland on clay-loam plain	CLP-MWS2	2,561			54	234	54	8.3	234	9.3
Heathland of <i>Thryptomene</i> spp. over sparse tussock grassland of <i>Neurachne</i> alopecuroidea on granite outcrop	G-H1	265			14	17	14	2.2	17	0.7
Regrowth of low open forest of Eucalyptus sp. (Sterile) on hillslope	HS-EW1	15	1	5			1	0.2	5	0.2
Regrowth mid open mallee woodland of <i>Eucalyptus livida</i> over mid open shrubland of <i>Hakea pendens</i> and open low shrubland of <i>Goodia medicaginea</i> on hillslope	HS-MWS1	150	30	63			30	4.6	63	2.5
Regrowth low open mallee shrubland of <i>Eucalyptus</i> spp. over low shrubland of <i>Acacia</i> spp. and open tussock grassland of <i>Schoenus breviculmis</i> on hillslope	HS-MWS2	16								
Mid open mallee woodland of <i>Eucalyptus livida</i> over heathland of <i>Allocasuarina/</i> <i>Hakea/ Melaleuca</i> and open low sedge of <i>Lepidosperma sanguinolentum</i> on hillslope	HS-MWS3	96								
Regrowth mixed low shrubland on hillslope	HS-OS1	412	36	167			36	5.5	167	6.6
Low woodland of <i>Eucalyptus salicola</i> over low open shrubland of <i>Phebalium filifolium</i> and low open sedgeland of <i>Gahnia ancistrocarpa</i> on sand-loam plain	SLP-EW1	1,520	0.2	1	17	127	17	2.7	128	5.1
Mid sparse mallee shrubland of <i>Eucalyptus eremophila</i> over heathland of <i>Melaleuca</i> spp. on sand-loam plain	SLP-MWS1	1,436			34	135	34	5.3	135	5.3
Regrowth mid sparse mallee shrubland of <i>Eucalyptus</i> spp. over low open shrubland of <i>Acacia / Grevillea</i> spp. and open hummock grassland of <i>Triodia scariosa</i> on sand-loam plain	SLP-MWS2	67	2	36			2	0.3	36	1.4
Regrowth low open woodland of <i>Codonocarpus cotinifolius</i> over mid shrubland of <i>Acacia/ Melaleuca</i> spp. and open tussock grassland of <i>Schoenus breviculmis</i> on sand-loam plain	SLP-OS1	27								
TOTAL (Vegetation)		18,630	272	884	340	1,604	612	95	2,488	98
Cleared Vegetation	CV	59	8	14	26	26	33	5.1	39	1.6
Bare Playa	Playa	142				0.2			0.2	0.0
TOTAL (Cleared Vegetation/ Playa)		201	8	14	26	26	33	5	39	2
TOTAL PROJECT		18,830	280	898	365	1630	645	100	2,528	100

# Appendix 1: Floristic Communities within the development envelopes and indicative disturbance footprint (Botanica Consulting, 2020)



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# Appendix 2: Threatened and Priority Flora Identified in the Medcalf Project Areas

### **Threatened Flora**

Taxon	Location and population description	Associated Habitat/ Vegetation	Identified within Development Envelope	Distribution (WAHERB, 2019)	
Marianthus aquilonaris (T)	Currently known from one population, including five subpopulations (population 1a-1e) all of which occur within the Bremer Range.	Found in the Bremer Range, growing in orange to grey-brown sandy loam, rocky red-orange clay loam, laterite and quartzite, on rock outcrops and slopes (WAHERB, 2020). Grows in gravelly, shallow loamy soils with an indurated, mottled zone layer that occurs within 30 cm of the soil surface ('Shallow gravel over indurated mottled zone' soil). These soils are almost always located on a low ridge that typically have outcrops of limonite (Western Horticultural Consulting, 2019). Identified within Regrowth mid open mallee woodland of <i>Eucalyptus</i> <i>livida</i> over mid open shrubland of <i>Hakea</i> <i>pendens</i> and open low shrubland of <i>Goodia</i> <i>medicaginea</i> on hillslope (HS-MWS1).	No		



Taxon	Location and population description	Associated Habitat/ Vegetation	Identified within Development Envelope	Distrib ution (WAHERB, 2019)	
<i>Acacia hystrix</i> subsp. <i>continua</i> (P1)	A total of four locations of this taxon recorded at one DBCA recorded location from one population (122 individuals including Botanica and DBCA records) located approximately 3km west of the Coolgardie-Esperance Highway. No other records on the DBCA database of this taxon within a 50km radius of the Medcalf Project.	Grows in clay-loam soils of Eucalypt woodlands (WAHERB, 2020). Identified within Low open woodland of <i>Eucalyptus</i> <i>salmonophloia</i> over mixed shrubs on clay-loam plain (CLP-EW1).	No	Acacia hystrix subsp. continua	
Acacia mutabilis subsp. stipulifera (P3)	A total of seventy- three locations of this taxon have been recorded from multiple populations (348,332 individuals) extending from Bremer Range to approximately 50km east of Bremer Range. 34 records of this taxon are listed on the DBCA database (120 individuals) extending 250km south-west of the Medcalf Project including records within the Lake Magenta Nature Reserve, Breakaway Ridge Nature Reserve and Lakeland Nature Reserve.	<ul> <li>Grows in loam or clay, usually in slightly saline soils (WAHERB, 2020).</li> <li>Identified within: <ol> <li>Low open woodland of <i>Eucalyptus salmonophloia</i> over mixed shrubs on clayloam plain (CLP-EW1).</li> <li>Mid mallee shrubland of <i>Eucalyptus</i> spp. over mid shrubland of <i>Melaleuca pauperiflora</i> and mixed low shrubland on clay-loam plain (CLP-MWS1).</li> <li>Mid mallee woodland of <i>Eucalyptus</i> spp. over mixed low shrubland of <i>Eucalyptus</i> spp. over mixed low shrubland on clay-loam plain (CLP-MWS1).</li> <li>Mid mallee woodland of <i>Eucalyptus</i> spp. over mixed low shrubland/ heathland on clay-loam plain (CLP-MWS2).</li> <li>Mid sparse mallee shrubland of <i>Eucalyptus</i> eremophila over heathland of <i>Melaleuca</i> spp. on sandloam plain (SLP-MWS1).</li> </ol> </li> <li>Regrowth mid sparse mallee shrubland of <i>Acacia / Grevillea</i> spp. and open hummock grassland of <i>Triodia scariosa</i> on sandloam plain (SLP-MWS2).</li> </ul>	Yes	Acacia mutabilis subsp. stipulifera	



Taxon	Location and population description	Associated Habitat/ Vegetation	Identified within Development Envelope	Distrib ution (WAHERB, 2019)	
Bossiaea flexuosa (P3)	One location of this taxon (100 individuals) recorded at Bremer Range. 26 records of this taxon are listed on the DBCA database (117 individuals) extending 220km to the south/ east and south-west of the Medcalf Project including records within the Frank Hann National Park and Dundas Nature Reserve.	Grows in deep sandy soil (WAHERB, 2020). Identified within Mid sparse mallee shrubland of <i>Eucalyptus</i> <i>eremophila</i> over heathland of <i>Melaleuca</i> spp. on sand-loam plain (SLP-MWS1).	No	Bossiaea flexuosa	
Brachyloma stenolobum (P1)	Two locations of this taxon were recorded from one population (500 individuals) located approximately 25km east of Bremer Range. This record represents a range extension for this taxon, having previously only been recorded on the DBCA database (60 individuals) within the Forrestania region (south of the Jilbadji Nature Reserve), approximately 100km west of the Medcalf Project.	Grows in yellow sandplain as a component of heath. Associated species include <i>Allocasuarina spinosissima,</i> <i>Acacia heteroneura, Melaleuca cordata</i> and <i>M. calyptroides</i> (Hislop & Cranfield, 2014). Identified within Mid mallee woodland of <i>Eucalyptus</i> spp. over mixed low shrubland/ heathland on clay-loam plain (CLP-MWS2).	No	Brachyloma stenolobum	



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Taxon	Location and population description	Associated Habitat/ Vegetation	Identified within Development Envelope	Distrib ution (WAHERB, 2019)	
Eucalyptus pterocarpa (P3)	One location of this taxon recorded from one population (100 individuals) located approximately 20km east of Bremer Range. No records on the DBCA database of this taxon within a 50km radius of the Medcalf Project.	Grows in red-brown sandy loam, yellow-brown silty loam soils of creek edges and rocky slopes (WAHERB, 2020). Identified within Low open woodland of <i>Eucalyptus</i> <i>salmonophloia</i> over mixed shrubs on clay-loam plain (CLP-EW1).	Yes	Eucalyptus pterocarpa	



Taxon	Location and population description	Associated Habitat/ Vegetation	Identified within Development Envelope	Distrib ution (WAHERB, 2019)	
Eucalyptus rhomboidea (P4)	A total of 268 locations of this taxon have been recorded from six sub-populations (15,606 individuals including Botanica and DBCA records). This taxon is endemic to the Bremer Range area. This taxon is currently being nominated for Threatened Status under the BC Act.	<ul> <li>Grows in gravelly sand, and is found on slight rises (WAHERB, 2020).</li> <li>Grows on a range of soil groups at a range of positions in the landscape. This species was found growing on 'Alkaline red shallow loamy duplex' soils that occur on the lower, mid and upper slopes. It was found growing on 'Loamy gravel' soils on the lateritic plateau at the top of the landscape and on the mid slopes. It was also found growing on 'Shallow gravel' soils, below a breakaway (Western Horticultural Consulting, 2019).</li> <li>Found in a variety of habitats including within creeklines and low to mid gravelly rises and lateritic slopes (Botanica pers. comms).</li> <li>Identified within: <ol> <li>Low open woodland of <i>Eucalyptus salmonophloia</i> over mixed shrubs on clayloam plain (CLP-EW1).</li> <li>Mid mallee shrubland of <i>Eucalyptus</i> spp. over mid shrubland of <i>Melaleuca pauperiflora</i> and mixed low shrubland of <i>Eucalyptus</i> livida over mid open shrubland of <i>Hakea pendens</i> and open low shrubland of <i>Hakea pendens</i> and open low shrubland of <i>Allocasuarina/ Hakea/ Melaleuca</i> and open low sedge of <i>Lepidosperma sanguinolentum</i> on hillslope (HS-MWS3).</li> </ol></li></ul>	Yes	Eucalyptus rhomboidea	

# Image

Taxon	Location and population description	Associated Habitat/ Vegetation	Identified within Development Envelope	Distrib ution (WAHERB, 2019)	
Hakea pendens (P3)	A total of 592 locations of this taxon were recorded from one population (2435 individuals) at Bremer Range. 64 records of this taxon listed on the DBCA database (4348 individuals) extending 200km north-west of the Medcalf Project including records within the Parker Range region and Jilbadji Nature Reserve.	<ul> <li>Grows in stony loam and is found on ironstone ridges (WAHERB, 2020).</li> <li>Identified within:</li> <li>1. Low open woodland of <i>Eucalyptus salmonophloia</i> over mixed shrubs on clayloam plain (CLP-EW1).</li> <li>2. Mid mallee shrubland of <i>Eucalyptus</i> spp. over mid shrubland of <i>Melaleuca pauperiflora</i> and mixed low shrubland on clay-loam plain (CLP-MWS1).</li> <li>3. Regrowth mid open mallee woodland of <i>Eucalyptus livida</i> over mid open shrubland of <i>Hakea pendens</i> and open low shrubland of <i>Goodia medicaginea</i> on hillslope (HS-MWS1).</li> <li>4. Regrowth mixed low shrubland on hillslope (HS-OS1).</li> </ul>	Yes	Hakea pendens	
<i>Microcybe</i> sp. Windy Hill (G.F. Craig 6583) (P3)	A total of four locations of this taxon were recorded from two populations (682 individuals) within the Bremer Range. 25 records of this taxon listed on the DBCA database (26,280 individuals) extending 60km north-west the Medcalf Project.	No description available (WAHERB, 2020). Found in clay-loam/ sandy- loam soils on plains and low slopes (Botanica pers. comms). Identified within: 1. Mid mallee shrubland of <i>Eucalyptus</i> spp. over mid shrubland of <i>Melaleuca</i> <i>pauperiflora</i> and mixed low shrubland on clay-loam plain (CLP-MWS1). 2. Regrowth mixed low shrubland on hillslope (HS- OS1).	Yes	Microcybe sp. Windy Hill (G.F. Craig 6583)	



Taxon	Location and population description	Associated Habitat/ Vegetation	Identified within Development Envelope	Distrib ution (WAHERB, 2019)	
Stenanthemum bremerense (P4)	A total of 1315 locations of this taxon were recorded from multiple populations (35,823 individuals) within the Bremer Range. 34 records of this taxon are listed on the DBCA database (4303 individuals) extending 100km north/ north-west of the Medcalf Project. This taxon is currently being considered for nomination for Threatened Status under the BC Act.	<ul> <li>Grows in orange-brown sandy loam, orange-red gravelly loam, skeletal red loam, laterite and ironstone. It is found on the top or sides of outcrops and breakaways (WAHERB, 2020).</li> <li>Grows in loamy gravel soils and is found on the lateritic plateau at the top of the landscape and on areas of gravelly rises on the mid to lower slopes (Western Horticultural Consulting, 2019).</li> <li>Found in a variety of habitats including sandy/ gravelly plains to low rise and lateritic slopes/ ridges (Botanica pers. comms).</li> <li>Identified within: <ol> <li>Low open woodland of <i>Eucalyptus salmonophloia</i> over mixed shrubs on clay- loam plain (CLP-EW1).</li> <li>Mid mallee shrubland of <i>Eucalyptus</i> spp. over mid shrubland on clay-loam plain (CLP-MWS1).</li> <li>Regrowth mid open mallee woodland of <i>Eucalyptus</i> <i>livida</i> over mid open shrubland of <i>Hakea</i> <i>pendens</i> and open low shrubland of <i>Goodia</i> <i>medicaginea</i> on hillslope (HS-MWS1).</li> </ol> </li> <li>Mid open mallee woodland of <i>Eucalyptus livida</i> over heathland of <i>Allocasuarina/</i> <i>Hakea/ Melaleuca</i> and open low sedge of <i>Lepidosperma</i> <i>sanguinolentum</i> on hillslope (HS-MWS3).</li> <li>Regrowth mixed low shrubland on hillslope (HS-OS1).</li> </ul>	Yes	Stenanthemum bremerense	



Taxon	Location and population description	Associated Habitat/ Vegetation	Identified within Development Envelope	Distrib ution (WAHERB, 2019)	
<i>Teucrium</i> sp. dwarf (R. Davis 8813) (P3)	A total of 39 locations of this taxon were recorded from multiple populations (12,700 individuals) within the Bremer Range. 15 records of this taxon are listed on the DBCA database (3453 individuals) extending 190km north/ north- west of the Medcalf Project. This taxon was previously listed as a Priority 1 taxon, however in 2018 was reduced to Priority 3.	<ul> <li>Found on hills and road verges (WAHERB, 2020).</li> <li>Grows in self-mulching/ heavy clay soils in low-lying plains (Botanica pers. comms).</li> <li>Identified within: <ol> <li>Low open woodland of <i>Eucalyptus salmonophloia</i> over mixed shrubs on clayloam plain (CLP-EW1).</li> <li>Mid mallee shrubland of <i>Eucalyptus</i> spp. over mid shrubland of <i>Melaleuca pauperiflora</i> and mixed low shrubland on clay-loam plain (CLP-MWS1).</li> <li>Mid open mallee woodland of <i>Eucalyptus livida</i> over heathland of <i>Allocasuarina/Hakea/Melaleuca</i> and open low sedge of <i>Lepidosperma sanguinolentum</i> on hillslope (HS-MWS3).</li> </ol> </li> <li>Regrowth mixed low shrubland of <i>Codonocarpus cotinifolius</i> over mid shrubland of <i>Acacia/Melaleuca</i> spp. and open tussock grassland of <i>Schoenus breviculmis</i> on sand-loam plain (SLP-OS1).</li> </ul>	Yes	Teucrium sp. dwarf (R. Davis 8813)	





Appendix 3: Threatened Flora in relation to the Indicative Disturbance Footprint/ Development Envelopes



Appendix 4: Priority Flora in relation to the Indicative Disturbance Footprint/ Development Envelopes

### Appendix 5: Maps of Habitat Boundaries for Threatened and Priority Flora within the Medcalf Project area

Location Map of Marianthus aquilonaris populations and habitat in relation to the development envelopes/ indicative disturbance footprint







Location Map of Eucalyptus rhomboidea populations and habitat in relation to the development envelopes/ indicative disturbance footprint



Location Map of Stenanthemum bremerense populations and habitat in relation to the development envelopes/ indicative disturbance footprint

Version 2

# Appendix 7: Soils of the Audalia Medcalf Area (Western Horticultural Consulting, 2019)