



HASTINGS
Technology Metals Limited

APPENDIX 1-4

**Memo: Field Validation of
Vegetation Types occurring
within the Proposed
Disturbance Footprint**

MEMORANDUM

TO Lara Jefferson (Hastings Technology Metals Ltd)

FROM Jeff Cargill (Eco Logical Australia)

DATE 13th October 2019

SUBJECT **Field validation of vegetation types occurring in proposed impact areas located within the Yangibana Project development envelope.**

1. Introduction

Eco Logical Australia (ELA) was engaged by Hastings Technology Metals Ltd (Hastings) to undertake field validation of vegetation types occurring in proposed impact areas located within the Yangibana Project development envelope as well as future areas for proposed development that may host fractured rock aquifers. All proposed areas selected by Hastings for field validation were previously surveyed and mapped by Ecoscape (2015).

Specifically, the objectives of this survey were to:

- Validate vegetation types occurring within proposed areas, utilising methods consistent with a Reconnaissance Flora and Vegetation Survey in accordance with the Environmental Protection Authority (EPA) *Technical Guide: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016); and
- Undertake a desktop assessment to improve the accuracy of potential GDE mapping that may have been missed by Ecoscape (2015)

Hastings engaged ELA to undertake the field survey in response to a request for additional information from the Department of the Environment and Energy regarding vegetation types associated with fractured rock aquifers.

2. Methodology

Prior to the field survey, ELA reviewed documentation and mapping provided by Ecoscape (2015). This information provided the basis for field validation, with the type and extent of vegetation occurring within each proposed impact area being the primary focus.

Twenty vegetation types were delineated and mapped by Ecoscape (2015) across the Yangibana Project development envelope; for reference, codes and descriptions have been provided below.

AaEpDr: *Acacia aptaneura* low open woodland over *Eremophila phyllopora* subsp. *obliqua*, *Acacia tetragonophylla* and *Dodonaea petiolaris* mid open shrubland over *Dysphania rhadinostachya*, *Bulbostylis barbata* and *Gomphrena cunninghamii* low open forbland/ sedgeland.

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- AaSaEs: *Acacia aptaneura* low open woodland over *Senna artemisioides* subsp. *oligophylla* low sparse shrubland over *Eragrostis setifolia* and *Eragrostis tenellula* low tussock grassland.
- AcAc: *Acacia curryana*, *Senna artemisioides* subsp. *helmsii* and *Eremophila exilifolia* mid sparse shrubland over *Aristida contorta* and *Eriachne pulchella* subsp. *dominii* low grassland.
- AcAsCc: *Acacia citrinoviridis* and *Eucalyptus victrix* low open woodland over *Acacia sclerosperma* subsp. *sclerosperma* and *A. cuthbertsonii* subsp. *cuthbertsonii* tall sparse shrubland over **Cenchrus ciliaris* and **C. setiger* mid tussock grassland.
- AcEt: *Acacia cyperophylla* var. *cyperophylla* low open woodland over *Eragrostis tenellula*, *Eragrostis cumingii* and *Eriachne aristidea* low tussock grassland.
- ApAsEp: *Acacia pruinocarpa* low open woodland over *Acacia sibirica*, *A. tetragonophylla* and *Eremophila phyllopoda* subsp. *obliqua* mid sparse shrubland over *Eriachne pulchella* subsp. *dominii* low sparse tussock grassland.
- ApSgAc: *Acacia pruinocarpa* and *Grevillea berryana* low open woodland over *Senna glutinosa* subsp. x *luerssenii* and *Eremophila phyllopoda* subsp. *obliqua* mid sparse shrubland over *Aristida contorta* and *Eriachne pulchella* subsp. *dominii* low grassland.
- ArPc: *Acacia ramulosa* var. *linophylla*, *A. aptaneura* and *A. pruinocarpa* low woodland over *Paspalidium clementii* and *Dysphania rhadinostachya* low grassland/forbland.
- AsFh: *Acacia synchronicia* and *Eremophila cuneifolia* mid sparse shrubland over *Frankenia hispidula* and *Aristida contorta* low open shrubland/ grassland.
- AtGc: *Acacia tetragonophylla*, *Dodonaea petiolaris* and *Eremophila latrobei* subsp. *latrobei* mid open shrubland over *Gomphrena cunninghamii*, *Aristida contorta* and *Cymbopogon ambiguus* low open forbland/grassland.
- AxEcAc: *Acacia xiphophylla*, *A. synchronicia* and *A. macraneura* low open woodland over *Eremophila cuneifolia*, *Senna artemisioides* subsp. *oligophylla*, *S. glutinosa* subsp. x *luerssenii* mid open shrubland over *Aristida contorta* and *Enneapogon caeruleus* low sparse tussock grassland.
- EcBp: *Eremophila cuneifolia* and *Scaevola spinescens* mid sparse shrubland over *Brachyachne prostrata* and *Sclerolaena ericantha* low sparse grassland/chenopod shrubland.
- EcMgCc: *Eucalyptus camaldulensis* mid woodland over *Melaleuca glomerata* and *Acacia coriacea* subsp. *pendens* tall shrubland over **Cenchrus ciliaris* mid tussock grassland
- EeAc: *Eremophila exilifolia*, *Acacia tetragonophylla* and *A. kempeana* mid open shrubland over *Aristida contorta* and *Eriachne pulchella* subsp. *dominii* low sparse tussock grassland.
- EfAc: *Eremophila flaccida*, *Acacia tetragonophylla* and *E. phyllopoda* mid sparse shrubland over *Aristida contorta*, *Calandrinia* sp. The Pink Hills (F. Obbens FO19/06), *Eriachne pulchella* subsp. *dominii* low grassland/forbland.
- EpAc: *Eremophila phyllopoda* subsp. *obliqua*, *Acacia tetragonophylla* and *Senna artemisioides* subsp. *helmsii* mid open shrubland over *Aristida contorta*, *Eriachne pulchella* subsp. *dominii* and *Portulaca oleracea* low grassland/forbland.
- EvCc: *Eucalyptus victrix* and *Acacia citrinoviridis* mid open forest over **Cenchrus ciliaris* and **C. setiger* mid tussock grassland.

EvReMg: *Eucalyptus victrix* low open woodland over *Rhagodia eremaea* and **Vachellia farnesiana* mid sparse shrubland over *Mimulus gracilis*, *Panicum laevinode* and *Ammannia multiflora* low forbland/grassland.

Fs: *Frankenia setosa*, *Sclerolaena medicaginoidea* and *Maireana georgei* low open shrubland.

Mp: *Maireana ?polypterygia*, *Lawrenzia densiflora* and *Eremophea spinosa* low open chenopod shrubland/forbland.

Field validation was undertaken on the 30th September and 1st October 2019 by Dr Jeff Cargill (Senior Botanist) and Daniel Marsh (Botanist).

The following tasks were undertaken as part of the field validation exercise:

- Qualitative vegetation assessment to broadly characterise vegetation types occurring within proposed impact areas;
- Validation or otherwise of vegetation types previously mapped by Ecoscape (2015) within proposed impact areas; and
- Photos and relevant notes pertaining to proposed impact areas.

Disturbance areas under assessment as part of the Project (Figure 1) were surveyed to verify Ecoscape's mapped vegetation types include:

- Frasers pit and waste rock landform;
- Bald Hill pit and waste rock landform;
- Yangibana North pit and waste rock landform;
- Yangibana West pit and waste rock landform;
- Tailings Storage Facilities (TSF);
- TSF spillway; and
- Process plant and ROM pad.

Disturbance areas that may form components of future approvals assessments (Figure 2) and may host fractured rock aquifers (not yet identified or determined if they are present) that were surveyed by ELA to verify Ecoscape's mapped vegetation types included:

- Auer pits and waste rock landform
- Yangibana pit and waste rock landform

ELA in conjunction with Hastings have further assessed the extent of the GDE's both within and outside of the development envelope. An aerial photograph overlaid with the Ecoscape (2015) mapped GDE's and the disturbance footprint (including drawdown areas), development envelope and beyond was further validated by:

1. Zooming into each area and extending GDE mapping in areas not previously mapped; and
2. Confirmation and validation of these locations by ELA senior botanist, Dr Jeff Cargill.

3. Results

3.1 Disturbance areas under assessment

TSF

Validation of vegetation types was undertaken within one polygon associated with the TSF, with results shown in Table 1.

Table 1. Vegetation types occurring in the TSF area

Type	Area	Ecotope (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecotope (2015) vegetation mapping units(s)
TSF	n/a	EpAc, AcEt and AxEcAc	<p>Western section: <i>Acacia tetragonophylla</i>, <i>Eremophila cuneifolia</i>, <i>Acacia synchronicia</i>, <i>Hakea</i> sp., <i>Senna artemisioides</i> subsp. <i>oligophylla</i>, <i>Senna artemisioides</i> subsp. <i>helmsii</i>, <i>Eremophila phyllopoda</i> and <i>Aristida contorta</i>.</p> <p>Central section: <i>Acacia cyperophylla</i>, <i>Eremophila fraseri</i>, <i>Acacia</i> sp. *<i>Bidens bipinnata</i> and *<i>Cenchrus ciliaris</i> (No <i>Eucalyptus victrix</i> present).</p> <p>Eastern section: <i>Acacia xiphophylla</i>, <i>Acacia synchronicia</i>, <i>Senna artemisioides</i> subsp. <i>oligophylla</i>, <i>Senna artemisioides</i> subsp. <i>helmsii</i>, <i>Eremophila cuneifolia</i> and <i>Aristida contorta</i>.</p>	EpAc, AcEt and AxEcAc

Spillway

Validation of vegetation types was undertaken within one polygon associated with the spillway, with results shown in **Error! Reference source not found..**

Table 1. Vegetation types occurring in the Spillway area

Type	Area	Ecotope (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecotope (2015) vegetation mapping units(s)
Spillway	n/a	AcAc	<i>Acacia curryana</i> (P1), <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila exilifolia</i> , <i>Cymbopogon ambiguus</i> , <i>Eriachne pulchella</i> and <i>Aristida contorta</i> .	AcAc

Frasers pit and waste rock landform areas

Validation of vegetation types was undertaken across 2 polygons within the Frasers area (1 pit and 1 WRL area), with results shown in Table .

Table 3. Vegetation types occurring in the Frasers pit and waste rock landform (WRL) areas

Type	Area	Ecoscape (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecoscape (2015) vegetation mapping units(s)
Pit	n/a	AtGc and EpAc	Small outcrop in south-eastern section: <i>Acacia tetragonophylla</i> , <i>Dodonaea petiolaris</i> , <i>Eremophila latrobei</i> , <i>Eriachne mucronata</i> , <i>Cymbopogon ambiguus</i> , <i>Solanum lasiophyllum</i> and <i>Gomphrena cunninghamii</i> . Dominant vegetation type: <i>Eremophila phyllopoda</i> , <i>Eremophila cuneifolia</i> , <i>Acacia tetragonophylla</i> , <i>Acacia synchronicia</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> .	AtGc and EpAc
WRL	n/a	EeAc and EpAc	North-western section: <i>Eremophila exilifolia</i> , <i>Acacia tetragonophylla</i> , <i>Eremophila phyllopoda</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Acacia curryana</i> (P1) and <i>Eremophila fraseri</i> . Dominant vegetation type: <i>Eremophila phyllopoda</i> , <i>Eremophila exilifolia</i> , <i>Acacia tetragonophylla</i> , <i>Senna glutinosa</i> x <i>luerssenii</i> and <i>Aristida contorta</i> .	EeAc and EpAc

Plant site

Validation of vegetation types was undertaken across 1 polygon within the Plant site area (inclusive of the ROM pad), with results shown in Table .

Table 4. Vegetation types occurring in the Plant site area (inclusive of ROM pad)

Type	Area	Ecoscape (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecoscape (2015) vegetation mapping units(s)
Plant site	n/a	EpAc, AcEt and AxExAc	Southern section: <i>Eucalyptus victrix</i> , <i>Acacia cyperophylla</i> , <i>Grevillea berryana</i> , <i>Trachymene oleracea</i> , <i>Trichodesma zeylanicum</i> , * <i>Bidens bipinnata</i> and <i>Eragrostis tenellula</i> . South east and south western sections: <i>Acacia xiphophylla</i> , <i>Acacia synchronicia</i> , <i>Eremophila cuneifolia</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Aristida contorta</i> . Northern and central sections: <i>Eremophila phyllopoda</i> , <i>Eremophila exilifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Acacia curryana</i> (P1), <i>Acacia tetragonophylla</i> , <i>Senna glutinosa</i> x <i>luerssenii</i> and <i>Aristida contorta</i> . Eastern section: <i>Frankenia hispidula</i> , <i>Acacia synchronicia</i> , <i>Eremophila cuneifolia</i> and <i>Senna artemisioides</i> subsp. <i>oligophylla</i> .	EpAc, AcEt, AxExAc and AsFh

Bald Hill SE pit and waste rock landform areas

Validation of vegetation types was undertaken across 2 polygons within the Bald Hill SE area (1 pit and 1 WRL area), with results shown in Table 2.

Table 2. Vegetation types occurring in the Bald Hill SE pit and waste rock landform (WRL) areas

Type	Area	Ecoscape (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecoscape (2015) vegetation mapping units(s)
Pit	n/a	EpAc and AcEt	Northern-most section: <i>Acacia cyperophylla</i> , <i>Acacia</i> spp. * <i>Bidens bipinnata</i> and * <i>Cenchrus ciliaris</i> (No <i>Eucalyptus victrix</i> present). Dominant vegetation type: <i>Eremophila phyllopoda</i> , <i>Eremophila exilifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Acacia tetragonophylla</i> and <i>Aristida contorta</i> .	EpAc and AcEt
WRL	n/a	EeAc and EpAc	Northern section: <i>Eremophila exilifolia</i> , <i>Acacia tetragonophylla</i> , <i>Eremophila phyllopoda</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Aristida contorta</i> . Southern section: <i>Eremophila phyllopoda</i> , <i>Eremophila cuneifolia</i> , <i>Acacia tetragonophylla</i> , <i>Acacia curryana</i> (1), <i>Acacia synchronicia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Aristida contorta</i> .	EeAc and EpAc

Bald Hill pit and waste rock landform areas

Validation of vegetation types was undertaken across 2 polygons within the Bald Hill area (1 pit and 1 WRL area), with results shown in Table 3.

Table 3. Vegetation types occurring in the Bald Hill pit and waste rock landform (WRL) areas

Type	Area	Ecoscape (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecoscape (2015) vegetation mapping units(s)
Pit	n/a	AxEcAc and EpAc	Southern and eastern sections: <i>Acacia xiphophylla</i> , <i>Acacia synchronicia</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila cuneifolia</i> and <i>Aristida contorta</i> . Northern and western sections: <i>Eremophila phyllopoda</i> , <i>Eremophila exilifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Acacia tetragonophylla</i> and <i>Aristida contorta</i> .	AxEcAc and EpAc
WRL	n/a	EeAc and AxEcAc	Northern-most section: <i>Acacia xiphophylla</i> , <i>Acacia synchronicia</i> , <i>Eremophila cuneifolia</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Aristida contorta</i> . Dominant vegetation type: <i>Eremophila exilifolia</i> , <i>Acacia tetragonophylla</i> , <i>Eremophila fraseri</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Aristida contorta</i> .	EeAc and AxEcAc

Yangibana N pit and waste rock landform areas

Validation of vegetation types was undertaken across 2 polygons within the Yangibana N area (1 pit and 1 WRL area), with results shown in Table 4.

Table 4. Vegetation types occurring in the Yangibana N pit and waste rock landform (WRL) areas

Type	Area	Ecoscope (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecoscope (2015) vegetation mapping units(s)
Pit	n/a	AtGc and EpAc	Northern-most section: <i>Acacia tetragonophylla</i> , <i>Dodonaea petiolaris</i> , <i>Eremophila latrobei</i> , <i>Eriachne mucronata</i> , <i>Cymbopogon ambiguus</i> and <i>Gomphrena cunninghamii</i> . Dominant vegetation type: <i>Eremophila phyllopoda</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila exilifolia</i> , <i>Acacia tetragonophylla</i> , <i>Acacia macraneura</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Aristida contorta</i> .	AtGc and EpAc
WRL	n/a	EeAc, AcEt and EpAc	Western and north-eastern sections: <i>Acacia cyperophylla</i> , <i>Acacia tetragonophylla</i> , <i>Grevillea berryana</i> , <i>*Bidens bipinnata</i> and <i>*Cenchrus ciliaris</i> (No <i>Eucalyptus victrix</i> present). Dominant vegetation type: <i>Eremophila exilifolia</i> , <i>Acacia tetragonophylla</i> , <i>Eremophila fraseri</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Aristida contorta</i> .	AcEt and EeAc

Yangibana W pit and waste rock landform area

Validation of vegetation types was undertaken across 2 polygons within the Yangibana W area (1 pit and 1 WRL area), with results shown in Table 5.

Table 5. Vegetation types occurring in the Yangibana N pit and waste rock landform (WRL) areas

Type	Area	Ecoscope (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecoscope (2015) vegetation mapping units(s)
Pit	n/a	AtGc, AcEt, ApSgAc and EpAc	Northern-most section: <i>Acacia tetragonophylla</i> , <i>Dodonaea petiolaris</i> , <i>Eremophila latrobei</i> , <i>Eriachne mucronata</i> , <i>Cymbopogon ambiguus</i> and <i>Gomphrena cunninghamii</i> . Central section: <i>Acacia cyperophylla</i> , <i>Acacia tetragonophylla</i> , <i>Grevillea berryana</i> , <i>*Bidens bipinnata</i> and <i>*Cenchrus ciliaris</i> (No <i>Eucalyptus victrix</i> present). Dominant vegetation type: <i>Eremophila phyllopoda</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila exilifolia</i> , <i>Acacia tetragonophylla</i> , <i>Acacia macraneura</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Aristida contorta</i> .	AtGc, AcEt and EpAc
WRL	n/a	EeAc and ApSgAc	Dominant vegetation type: <i>Eremophila phyllopoda</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila exilifolia</i> , <i>Acacia tetragonophylla</i> , <i>Acacia macraneura</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Aristida contorta</i> .	EpAc

3.2 Future development areas

Auer pit and waste rock landform areas

Validation of vegetation types was undertaken across seven polygons within the Auer area (4 pits and 3 WRL areas), with results shown in Table 6. No claypans, potential groundwater dependent ecosystems or riparian areas were recorded within these footprints.

Table 6. Vegetation types occurring in the Auer pit and waste rock landform (WRL) areas

Type	Area	Ecoscope (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecoscope (2015) vegetation mapping units(s)
Pit	South	AcAc	<i>Acacia curryana</i> (P1), <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila exilifolia</i> and <i>Solanum lasiophyllum</i> .	AcAc
	Central (A)	AcAc	<i>Acacia curryana</i> (P1), <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila exilifolia</i> , <i>Acacia macraneura</i> and <i>Aristida contorta</i> . <i>Acacia cyperophylla</i> along minor rocky dissections, but not dominant.	AcAc
	Central (B)	AcAc and AxEcAc	Southern section: <i>Acacia curryana</i> (P1), <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila exilifolia</i> , <i>Eremophila fraseri</i> , <i>Ptilotus obovatus</i> , <i>Senna glutinosa</i> x <i>luerssenii</i> and <i>Aristida contorta</i> . Northern section: <i>Acacia xiphophylla</i> , <i>Acacia synchronicia</i> , <i>Eremophila cuneifolia</i> , <i>Acacia macraneura</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Aristida contorta</i> .	AcAc and AxEcAc
	North	AxEcAc	<i>Acacia xiphophylla</i> , <i>Acacia synchronicia</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila cuneifolia</i> and <i>Aristida contorta</i> .	AxEcAc
WRL	South	AcAc	<i>Acacia curryana</i> (P1), <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila exilifolia</i> , <i>Acacia macraneura</i> , <i>Tribulus suberosus</i> , <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Senna glutinosa</i> x <i>luerssenii</i> and <i>Aristida contorta</i> .	AcAc
	Central	AcAc	Southern section: <i>Acacia curryana</i> (P1), <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila exilifolia</i> , <i>Tribulus suberosus</i> , <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> and <i>Aristida contorta</i> . Northern section: <i>Acacia xiphophylla</i> , <i>Acacia synchronicia</i> , <i>Eremophila cuneifolia</i> , <i>Acacia macraneura</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Aristida contorta</i> .	AcAc and AxEcAc
	North	AcEt and AxEcAc	Southern section: <i>Acacia cyperophylla</i> , <i>Eucalyptus victrix</i> , <i>Acacia citrinoviridis</i> and <i>*Cenchrus ciliaris</i> . Northern section: <i>Acacia xiphophylla</i> , <i>Acacia synchronicia</i> , <i>Eremophila cuneifolia</i> , <i>Acacia macraneura</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Aristida contorta</i> .	AcEt and AxEcAc

Yangibana pit and waste rock landform areas

Validation of vegetation types was undertaken across 2 polygons within the Yangibana area (1 pit and 1 WRL area), with results shown in Table 7. No claypans, potential groundwater dependent ecosystems or riparian areas were recorded within these footprints.

Table 7. Vegetation types occurring in the Yangibana pit and waste rock landform (WRL) areas

Type	Area	Ecoscape (2015) vegetation mapping unit(s)	Dominant species present	Confirmed Ecoscape (2015) vegetation mapping units(s)
Pit	n/a	EpAc	<p>Southern and eastern sections: <i>Acacia xiphophylla</i>, <i>Acacia synchronicia</i>, <i>Senna artemisioides</i> subsp. <i>oligophylla</i>, <i>Senna artemisioides</i> subsp. <i>helmsii</i>, <i>Senna glutinosa</i> x <i>luerssenii</i>, <i>Eremophila cuneifolia</i> and <i>Aristida contorta</i>.</p> <p>Dominant vegetation type: <i>Eremophila phyllopoda</i>, <i>Eremophila exilifolia</i>, <i>Senna artemisioides</i> subsp. <i>helmsii</i>, <i>Acacia tetragonophylla</i>, <i>Solanum lasiophyllum</i>, <i>Acacia curryana</i> (P1) and <i>Aristida contorta</i>.</p>	AxEcAc and EpAc
WRL	n/a	AcEt, EpAc and AxEcAc	<p>North-western section: <i>Acacia cyperophylla</i>, <i>Acacia</i> sp., <i>Grevillea berryana</i>, <i>Acacia citrinoviridis</i>, *<i>Bidens bipinnata</i> and *<i>Cenchrus ciliaris</i> (No <i>Eucalyptus victrix</i> present).</p> <p>North-eastern section: <i>Eremophila phyllopoda</i>, <i>Senna artemisioides</i> subsp. <i>helmsii</i>, <i>Acacia tetragonophylla</i>, <i>Solanum lasiophyllum</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i> and <i>Aristida contorta</i>.</p> <p>Dominant vegetation type: <i>Acacia xiphophylla</i>, <i>Acacia synchronicia</i>, <i>Eremophila cuneifolia</i>, <i>Maireana triptera</i>, <i>Hakea</i> sp. and <i>Aristida contorta</i>.</p>	AcEt, EpAc, and AxEcAc

Desktop assessment of potential GDE

Using aerial photography, ELA validated additional areas likely to contain potential GDE vegetation types. While additional areas within the development envelope have been identified, equivalent areas have also been identified outside of the development envelope (Figure 3).

4. Conclusions

This survey has verified the vegetation types within all key disturbance areas planned for development. The survey verified that vegetation types in the majority of areas are as mapped by Ecoscape (2015). Those that showed variation included:

- Yangibana West pit and waste rock landform (common vegetation types; no potential GDE's);
- Yangibana North pit and waste rock landform (common vegetation types; no potential GDE's); and
- Plant site (included AsFh).

Several dominant species that define vegetation type AtGc are also present in the surrounding vegetation types. The dominance of these species in the rockier habitat type may be due to collection of seeds trapped amongst the rocks, reduced grazing pressure (protection by the rocks) and/or the mineralogy of the ironstone outcrops. The species that define AtGc are not known to be and unlikely to be dependent on groundwater.

The areas that may be considered for future development also verified the majority of areas were as mapped by Ecoscape (2015). Areas where the vegetation type differed from that mapped by Ecoscape included:

- Yangibana pit (the vegetation type AxEcAc was also found in this area; common and not considered a GDE); and
- Auer Central Waste Rock Landform (the vegetation type AxEcAc was also found in this area; common and not considered a GDE).

ELA have recently conducted vegetation surveys in the broader regional area (beyond the boundaries of the Project tenements and not a component of the scope of this report). Observations infer that GDE's and potential GDE vegetation types similar to those recorded within the Project area have been recorded up to 100 km away (as have some other vegetation types recorded within the Project area), and are likely to be present within the broader Lyons River catchment, which is a component of the Gascoyne River catchment (area of 68,326 sq. km).

References

Ecoscape. 2015. Yangibana Project Biological Assessment: Flora and Vegetation. Unpublished report prepared for Hastings Rare Minerals Ltd, December 2015.

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