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Department of Mines, Industry Regulation and Safety
Mineral House
100 Plain Street
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To Whom It May Concern

Application for a Native Vegetation Clearing Permit for the Castle Hill Project

Evolution Mining (Phoenix) Pty Ltd (Evolution), a wholly owned subsidiary of Evolution Mining Limited, proposes to expand the Castle Hill Project as part of the existing Mungari Gold Operations (MGO).

This letter has been prepared to support an application for a Native Vegetation Clearing Permit (NVCP) in pursuant to Section 51E of the *Environmental Protection Act 1986* (EP Act).

The total disturbance envelope comprises land within Mining Tenements M16/140, M16/15, M16/152, M16/189, M16/19, M16/195, M16/198, M16/24, M16/40, M16/444, M16/526, M16/532, M16/533, M16/537, M16/538 and Miscellaneous Leases L16/101, L16/108, L16/113, L16/126, L16/128, L16/84, L16/97. This application proposes a total allowable clearing area of **800 ha**. Whilst Evolution seeks to keep vegetation clearing to a minimum, this change is required to undertake clearing to accommodate a larger mine footprint.

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Appendix F: Botanica Targeted Arid Bronze Azure Butterfly and Inland Hairstreak Study 2021

ANNEXES

Annex I: Proof of Tenement Holdings

1.0 Background

The Castle Hill Project is located approximately 35 km north of the Township of Coolgardie and 25 km north-west of Evolution's existing Mungari Gold Operations (MGO). The MGO comprises the White Foil Open Pit, Cutters Ridge Open Pit, Frog's Leg Underground Mine and the Mungari Processing Plant (Mungari Mill) (**Figure 1-1**).

The Project Area exhibits historic disturbance attributed to intermittent mining of the area by various operating bodies. The site is currently under care and maintenance, with the Waste Rock Landforms (WRLs) rehabilitated to the standard of the day and abandonment bunding installed around all open pits to prevent inadvertent access. The site consists of 90.71 ha of disturbance at current, comprising of the following existing infrastructure:

- Pink, Mick Adam and Kiora Open Pits;
- Pink, Mick Adam and Kiora WRLs;
- Laydown area;
- Historical Heap Leach Facility (HLF);
- Low-grade ore stockpiles
- Transportation corridors; and
- Exploration disturbance.

The initial clearing permit (**CPS 5675/1**) application was submitted by Phoenix Gold Limited in 2016 and subsequently approved by the Department of Mines, Industry Regulation and Safety (DMIRS) on 22 August 2013. There have since been three amendments to the permit, with the current permit (**CPS 5675/4**) approved on 13 September 2018, allowing clearing up to 390.1 ha.

At the request of DMIRS, this application is proposing a new clearing permit, rather than amending the current permit.

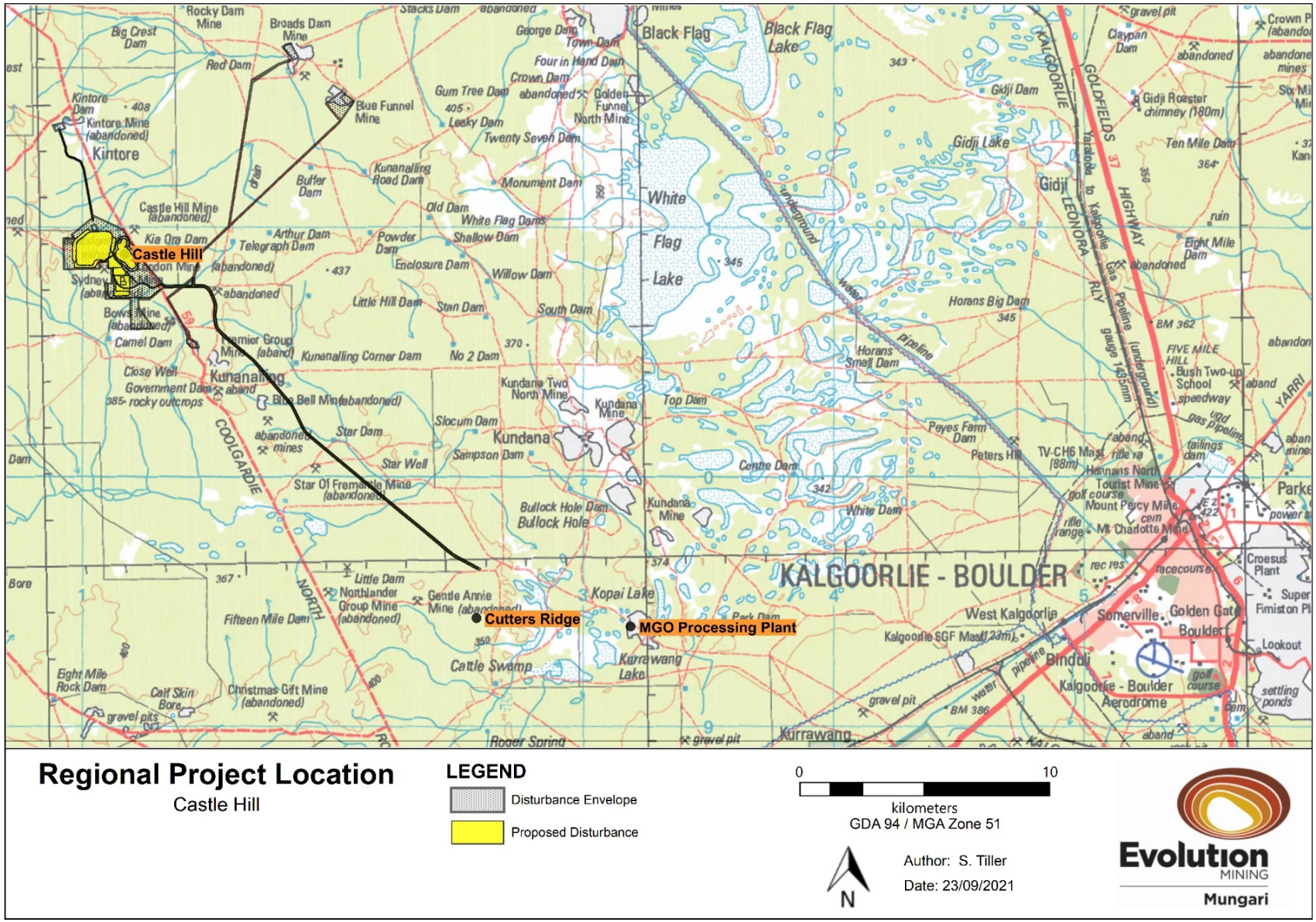

Figure 1-1: Regional Project Location

2.0 Proposed Works

The **Castle Hill Mining Proposal (REG ID 101286)** was submitted to DMIRS on 16 November 2021 and is currently pending assessment. The mining proposal provides for an indicative 406 ha of additional disturbance on top of the previously approved 250 ha.

Clearing will occur on the following Mining and Miscellaneous leases shown in **Figure 2-1:**

- M16/140
- M16/15
- M16/152
- M16/189
- M16/19
- M16/195
- M16/198
- M16/24
- M16/40
- M16/444
- M16/526
- M16/532
- M16/533
- M16/537
- M16/538
- L16/101
- L16/108
- L16/113
- L16/126
- L16/128
- L16/84
- L16/97

Proof of tenement holdings is provided in **Annex I**.

The mining proposal provides for an indicative 655 ha of total disturbance within the disturbance envelope. As there is potential for this project to expand in the future, Evolution is requesting a total allowable clearing area of **800 ha** on the clearing permit to allow the flexibility to expand the project footprint without the requirement for seeking amendment if changes to design remain within the proposed disturbance envelope.

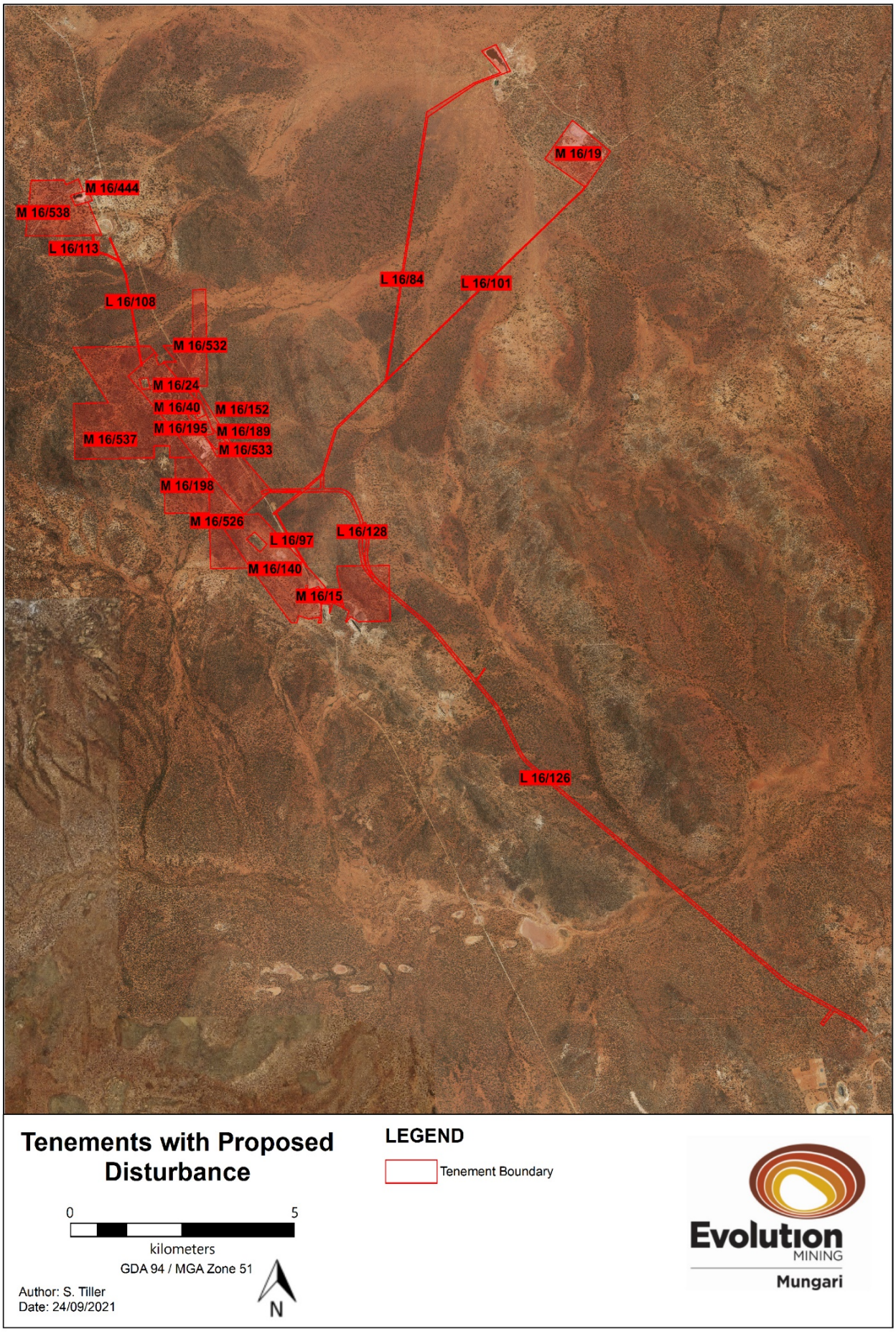

Figure 2-1: Tenements with Proposed Disturbance

2.1 Disturbance Envelope

The disturbance envelope encompasses an area of **1,065 ha** as shown in **Figure 2-2.** To ensure operational flexibility in both design and siting, Evolution proposes to undertake a predetermined area of clearing per tenement while remaining confined to the disturbance envelope. This clearing will facilitate the construction of the following:

- Open Pit Mining Void;
- Waste Rock Landform (WRL);
- ROM Pad;
- Saline water dam;
- Haul road;
- Explosives magazine;
- Laydown;
- Topsoil stockpiles;
- Pipelines;
- Transport and service infrastructure corridors;
- Abandonment bunding; and
- Miscellaneous buildings / support infrastructure.

The indicative site layout shown in **Figure 2-3** is subject to change with alterations to mine size and layout in the future which will also be subject to a Mining Proposal under the *Mining Act 1978*.

2.2 Haul Road

The Castle Hill Project will require the development of an 18 km haul road linking the Project to the MGO via the Mungari to Cutters Ridge Haul Road (**REG ID 80639**). The proposed haul road will start at tenement M16/24 (Castle Hill) and end at tenement M15/1827 (Cutters Ridge). Construction of this road will allow for the passage of mined ore to the Mungari Mill following commencement of mining. This haul road is part of a planned strategic haulage network for a number of projects as operations continue to move further north.

2.3 Pipelines

A series of roads to nearby existing open pit projects have been included in this Mining Proposal for the construction of pipelines for potential groundwater abstraction and discharge purposes. Approval for these pipelines will provide flexibility for future planning and will only be constructed as needed. A Works Approval application will be sought from the Department of Water and Environmental Regulation (DWER) for pipeline installation and operation. Pipeline disturbance will include a V-drain and scour pits where required.

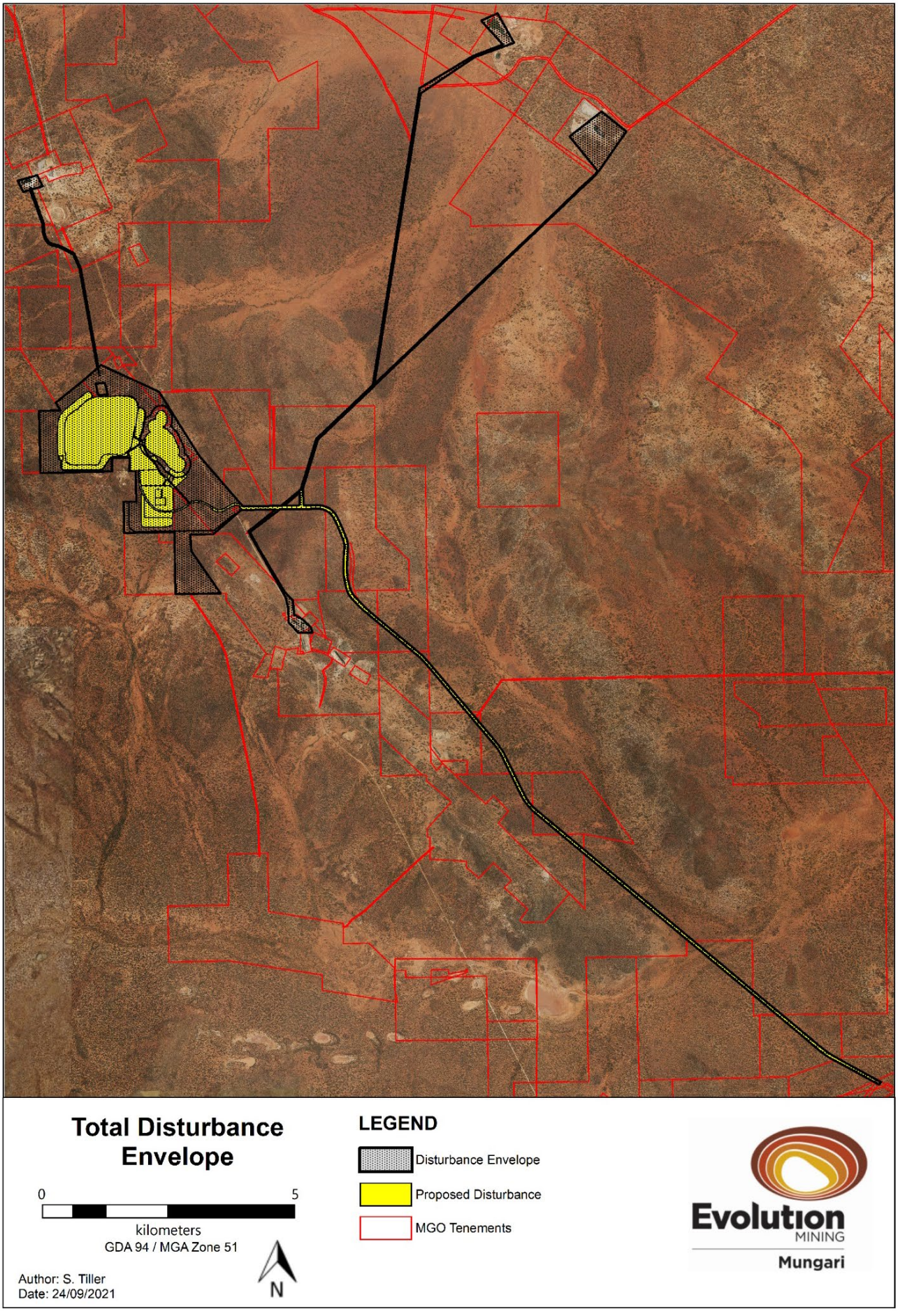

Figure 2-2: Total Disturbance Envelope

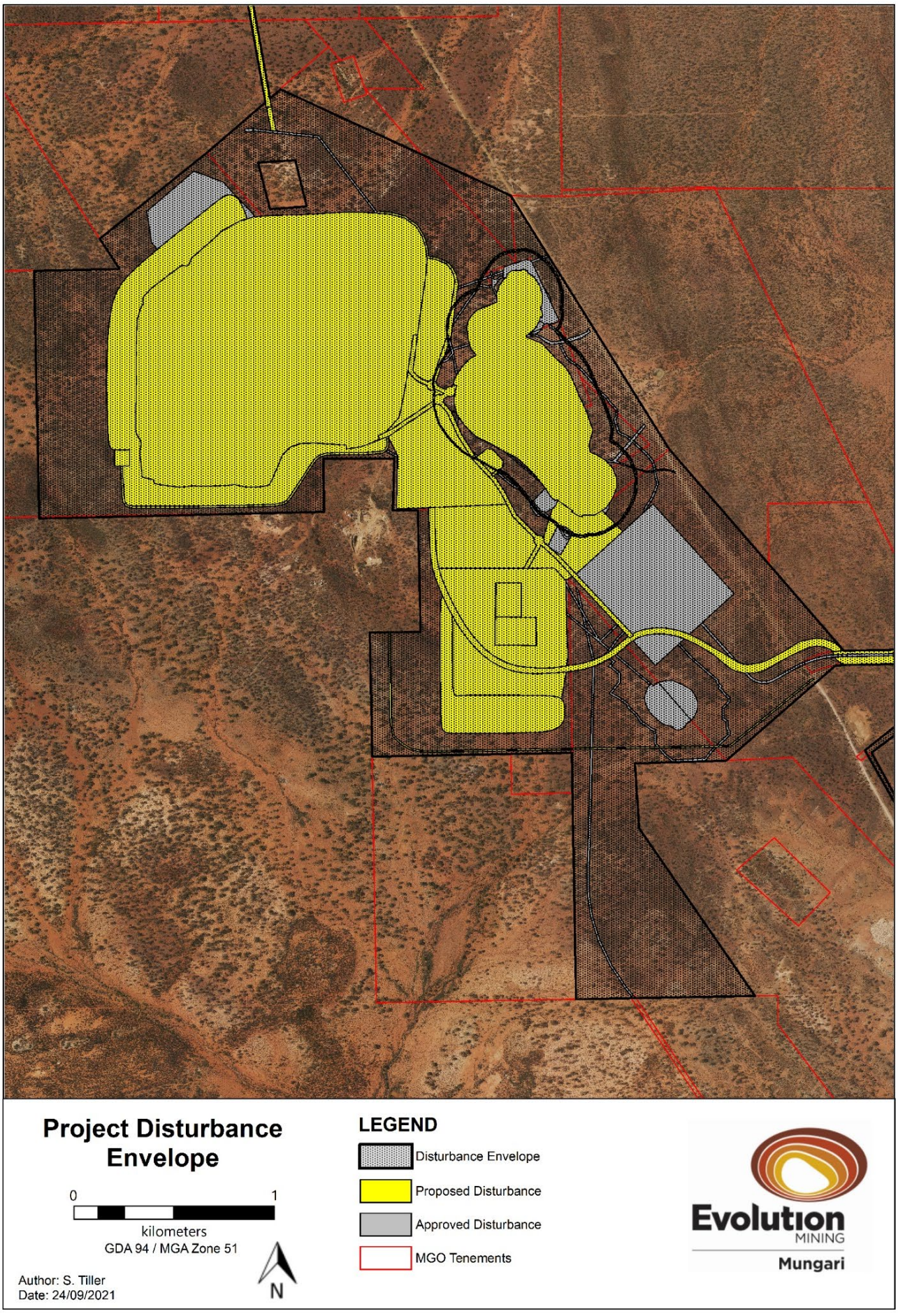

Figure 2-3: Project Disturbance Envelope with Indicative Site Layout

3.0 Existing Environment

3.1 Biogeography

The Project survey area lies within the Coolgardie Region of the Eremaean Province of WA in a region known as the Coolgardie Botanical District. The area consists of predominantly mulga low woodland on plains and reduces to scrub on hills (Beard, 1990). The Coolgardie Region is further divided into subregions, based on the Interim Biogeographic Regionalisation of Australia (IBRA), with the project area is located within the Eastern Goldfields (COO3) subregion (Cowan, 2001).

The subregion lies on the Yilgarn Craton's 'Eastern Goldfields Terrains'. The relief is subdued and comprised of gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposures of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half are the remnants of an ancient major drainage line (Cowan, 2001).

Vegetation of the Coolgardie Botanical District is predominantly Eucalyptus woodland in the valleys, with dense Acacia and Allocasuarina thickets dominating the rocky ironstone ridges found near the South-West Province border (Beard, 1990). The under-storey of the Eucalyptus woodland is primarily composed of sclerophyllous shrubs such as Melaleuca or soft-leaved, glaucous shrubs including Atriplex where soils are more alkaline (Beard, 1990).

The landscape consists of undulating plains and uplands (with some sandplains and salt lakes) on granitic rocks of the Yilgarn Craton. Soils include calcareous loamy earths, yellow sandy and loamy earths, red loamy earths, red deep sands and salt lake soils.

In accordance with soil landscape system mapping data (Government of Western Australia, 2019), the Kambalda and Norseman Zone are further divided into soil landscape systems, with the project area located within two soil landscape systems, as listed below and mapped in **Figure 3-1.**

- BB5 - Rocky ranges and hills of greenstones-basic igneous rocks
- Mx43 - Gently undulating valley plains and pediments; some outcrop of basic rock

The Project is not within proximity to any conservation parks or reserves. The nearest reserve is the Rowles Lagoon Class C Conservation Park, situated on the former Credo pastoral station, located 28 km to the north-west, along with the Clear and Muddy Lakes Cass C Nature Reserve. Kurrawang Nature Reserve is situated approximately 35 km south-east of the Castle Hill Project area

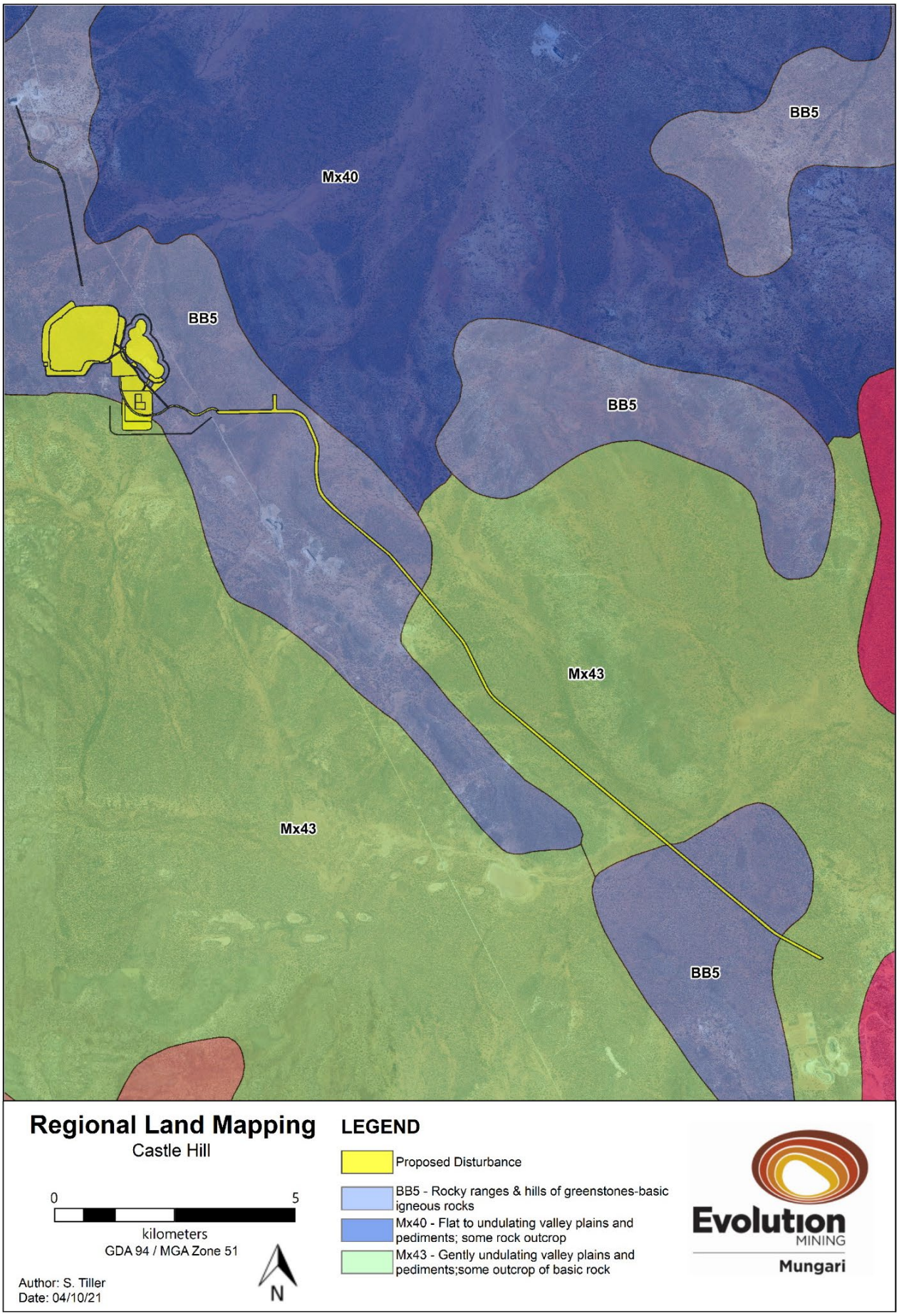

Figure 3-1: Regional Soil Landscape Units

3.2 Geology

The Project is located within the 2.7Ga late Archaean Eastern Goldfields Superterranean of the Yilgarn Craton, Western Australia. The province comprises a 700km NNW trending array of thin arcuate greenstone belts, collectively categorised as the regional Norseman-Wiluna Greenstone Belt. The greenstone stratigraphy is intruded, flanked, and inter-fingered by syn-post deformational granitoid complexes.

The greenstone geology is overlain by a terrigenous clastic sequence that originates from basin subsidence during orogenic collapse, or basin sedimentation through extensional doming during granite emplacement. Intrusions of differentiated doleritic sills/dykes, lamprophyres, porphyries and undeformed subvertical Proterozoic dykes are present across the succession (Botanica, 2014).

The Castle Hill deposits are located on or a short distance to the west of the Kunanalling Shear (**Figure 3-2**), which appears to have controlled mineralisation in the area. Most of the proposed disturbance area is underlain by igneous mafic or ultramafic rock with all three deposits being located within a mix of felsic volcanics, sedimentary siliciclastic and volcanic mafic materials. Some granitic material has also been mapped within the northern portion of the Castle Hill Project Area. The main host to the deposits is the Kintore Tonalite (RRR), which is a phaneritic feldspar porphyry. In addition to this main host are numerous shear zone hosted lodes within the adjacent basalt (Soilwater, 2013).

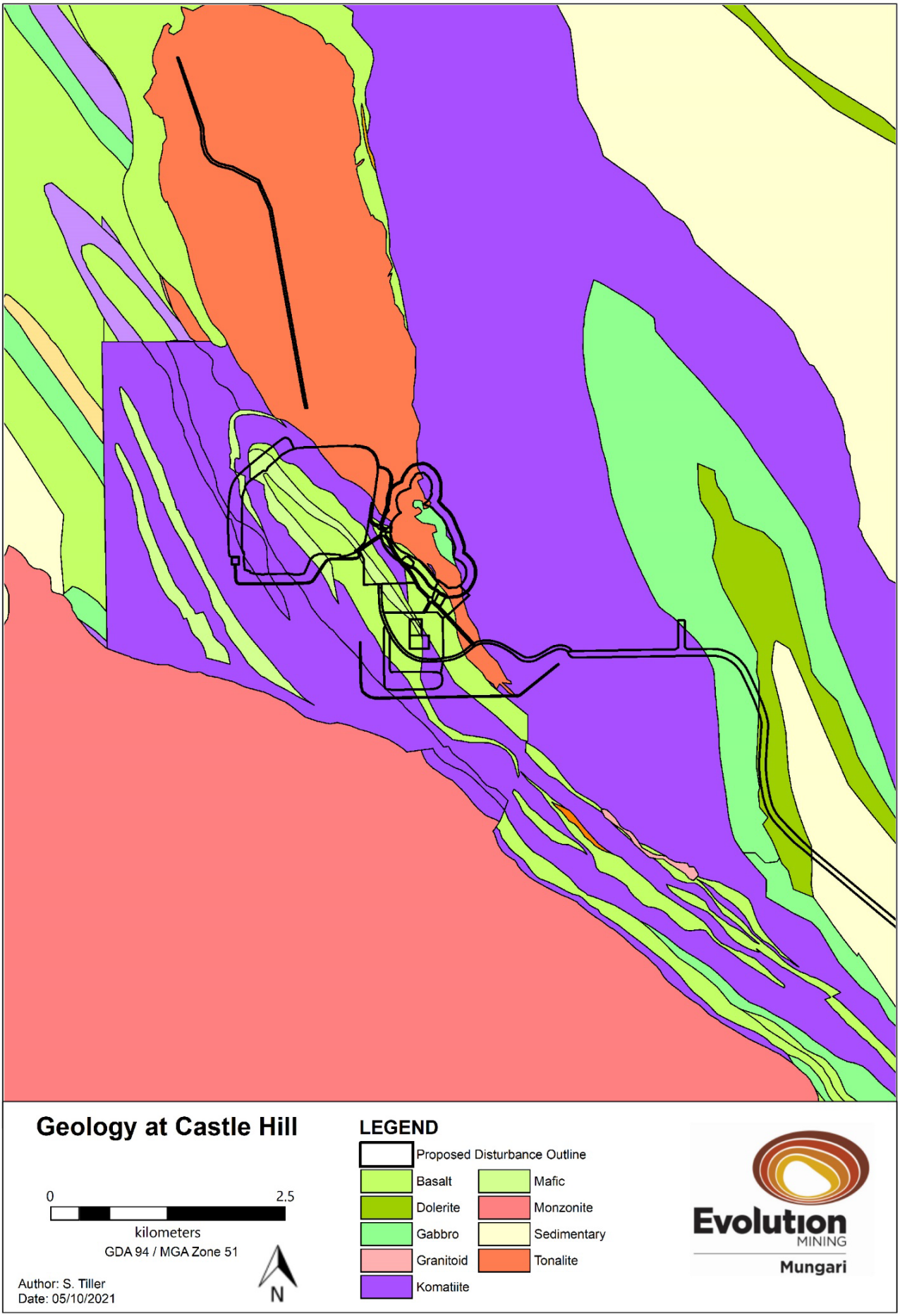

Figure 3-2: Geological Map of the Project Location

3.3 Soils

Soil characterisation was undertaken by Landloch in November 2020 (**Appendix A**). Soil sites were excavated for inspection and sampling. The number of samples per site varied with the depth of the soil pit achieved or number of soil horizons present. A total of 75 soil samples were collected from 20 sites to ensure a representative distribution of sampling sites across the Project Area. One sample of the topsoil (A) horizon and 1-3 samples from the diagnostic (B) horizons were collected at each location. The landscape and soil profile at all soil inspection sites were assessed in the field. All soil samples collected were transported to Landloch's soils facility in Bibra Lake, Perth for testing and analysis.

Soil inspection sites were grouped into soil mapping units (SMUs) based on their management requirements, particularly their morphological properties, sodicity, and salinity. Three SMUs were identified and are detailed in **Table 3-1** and mapped in **Figure 3-3**.

Table 3-1: Summary of Soil Mapping Units

SMU	Description
Deep Gradational Soils	Deep loamy soils throughout the profile, grading to clay at depth. This SMU is located in the low-lying areas of the Castle Hill survey area and is expected to have formed from alluvial or colluvial deposition from the surrounding hills.
Shallow Loam over Weathered Rock	Shallow loamy soils overlying weathered rock. This SMU is generally located in the mid-slope areas of the survey areas. The soils are expected to have formed from a combination of pedogenic and depositional origin.
Shallow Sodic Soils	Shallow Sodic Soils overlying a very firm calcrete layer. The topsoils are generally sodic with potential for clay dispersion. This SMU is located on the hill tops and ridges of the survey area.

The SMUs at Castle Hill are non-saline and exhibit good pH values that support vegetation in the region and on site. They display a good capacity to hold water and nutrients due to their elevated clay content and have low susceptibility to wind erosion. Unfortunately, the soils are considered potentially dispersive with a high potential for structural decline (Landloch, 2021).

The Deep Gradational Soil and Shallow Loam over Weathered Rock can be stripped to a depth of 100-150mm and stockpiled for rehabilitation purposes. The Shallow Sodic Soils are not recommended for use as rehabilitation material. When respreading these soils as part of rehabilitation works, risks associated with erosion must be considered. Placement of sodic and potentially dispersive materials on steep batter slopes can result in significant gullies and erosion.

As such, these soils should be utilised as follows:

- amendment of gypsum; and/or
- placement within a durable and competent rocky material to act as armouring of the batter; and/or
- adoption of short slope lengths.

If used on batter slopes these soils would benefit from the addition of a rock armour or tree debris to reduce the impact of overland flows on the materials (Landloch, 2021).

The nutrient status of the soils across the survey area is very low to moderate. However, native vegetation is adapted to grow in low nutrient status conditions. For rehabilitation, Landloch recommends to replace, or supplement nutrients lost through disturbance to encourage rapid establishment of vegetation. Application of fertiliser to the topsoil is recommended based on the loss of nutrients caused by the removal of vegetation, disturbance of the soil, and the likely respreading of soil in a thin layer over less fertile waste materials. A trial with the addition of gypsum to topsoil may be carried out to determine the effectiveness and feasibility of soil treatment.

Topsoil will be stripped to a depth of 150 mm and stockpiled 2-3 m high to maximise vegetation re-establishment and conserve biological integrity of the soil as per the current industry ‘best practice’. Sufficient volumes will be stockpiled to cover all batter surfaces, leaving the dispersive and structurally unstable subsoil to be used only on the berms and top of the WRD.

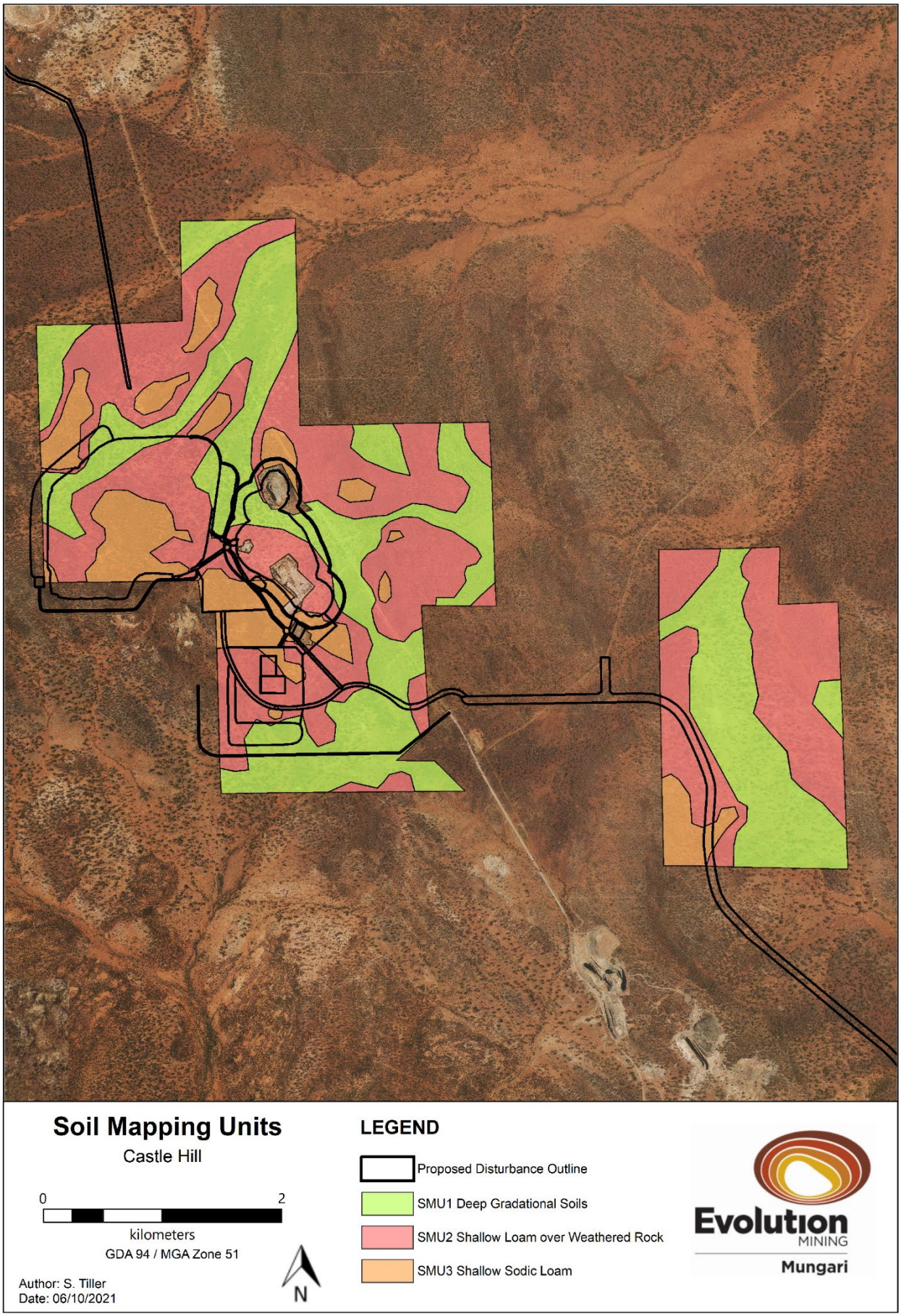

Figure 3-3: Soil Mapping Units (SMUs) of the Project

3.4 Hydrology

3.4.1 Groundwater

The Castle Hill Project area is located within the late Archaean Kalgoorlie Terrane of the Norseman-Wiluna Greenstone Belt. The regional stratigraphy consists of a lower basalt unit, followed by a komatiite unit, an upper basalt unit and a unit of felsic volcanic and sedimentary rocks (Swager et al., 1995). The mafic sequence has been subject to several major phases of deformation, during which granitoid rocks, such as the Kintore Tonalite and the Bali Monzogranite, have been emplaced. Deformation has led to a pronounced north-northwest structural trend defined by regional folds and major faults and shear zones, which further divide the basement rocks into tectono-stratigraphic domains (Rockwater, 2013).

The groundwater paleovalley in the region is the Roe paleovalley. The major aquifers in the Eastern Goldfields are typically fractured bedrock, partially weathered bedrock at the base of weathering profiles (especially over coarse-grained felsic rocks), vuggy secondary minerals such as a calcrete and silcrete developed within weathered mafic and ultramafic bedrock, alluvial sands and gravels deposited within the base of the tertiary palaeovalleys, and, where sufficiently thick and saturated, quaternary-age sediments deposited along modern drainage lines. Of these, only fractured bedrock and the Tertiary palaeovalley sand aquifers appear to be well developed in the Castle Hill Project area (Rockwater, 2014).

The salinity of groundwater varies from a minimum of about 30,000 mg/L TDS in the upland areas, such as the Mick Adam and Kintore, to a maximum of about 120,000 mg/L beneath salt lakes lying along the main valley floor.

The depth of proposed pit developments is located below the groundwater table and dewatering by sump pumping will be required to remove groundwater inflows and runoff from incident rainfall over the pit. Predicted groundwater inflows to the Castle Hill pits range from 14 L/s at Mick Adam to 0.7 L/s at Kiora. The amount of drawdown required is estimated to be 186 m (Rockwater 2014).

Regionally, the direction of groundwater flow is from the catchment divides and bedrock ridges to the valley floors. Other than the salt lakes, which are the main natural groundwater discharge areas, there are unlikely to be any wetlands or ecosystems in the Castle Hill area that are dependent on groundwater for their normal function (Rockwater 2014).

Approval to abstract groundwater has been obtained from the Department of Water and Environmental Regulation. **Groundwater Well Licence 178353(4)** authorises the taking of water for mining purposes and dust suppression.

A works approval for dewatering will be sought from Department of Water and Environmental Regulation. Saline (or brackish) dewatering discharge will either be used for dust suppression in the immediate Castle Hill mine area or as an additional source of water for ore processing.

Groundwater extraction associated with dewatering of the Castle Hill mine pits or development of the Kunanalling palaeovalley aquifer is highly unlikely to have adverse impacts on the respective aquifers, the environment (groundwater dependent ecosystems) or other groundwater users. This is mainly because the individual rates of extraction will be low and the lateral extents of drawdown will be limited by the low permeability of the bedrock. Furthermore, the groundwater is saline to hypersaline and unlikely to be essential for survival of the native vegetation (Rockwater, 2014).

3.4.2 Surface Water

A surface water management plan (SWMP) was developed by AQ2 in November 2021 to provide an assessment of surface water in the project area and management recommendations. The report is attaches as **Appendix B**. The Goldfields consists of several ephemeral salt lakes that are connected through paleochannels. Runoff in the region generally terminates in the salt lakes, where evaporation plays a major role in the hydrology of the region. During small to medium-sized rain events, runoff is likely to report to the nearest downstream salt lake, while the lakes tend to overtop during large events, where runoff is more likely to report to the terminal point of the catchment (AQ2, 2021).

There are no significant streams or available streamflow monitoring data in the region around the proposed mine sites. Two external catchments were identified in the SWMP as shown in **Figure 3-4.** There is an Unnamed Creek that will cross the planned haul road, which is ephemeral and drains in a south-easterly direction. The mine site areas also drain towards Unnamed Creek with the mine drainage areas representing a small portion of the catchment. The Unnamed Creek and several other creeks terminate at the collection of ephemeral salt lakes to the east of the project area (AQ2, 2021).

Furthermore, a number of local catchments in the mine and haul road areas were identified. Some minor drainage flow paths are located within the project area upstream of the mine sites and haul roads and may impact the project. The sub-catchments upstream of the haul road contribute to minor drainage lines that may require surface water management infrastructure to convey peak flows underneath or over the haul road. These local catchment areas are shown in **Figure 3-5** and **Figure 3-6** (AQ2, 2021).

Surface water is predominately rainwater and generally flows to the south-east. Water that intercepts mining activity is classified as “dirty” water and flows into sediment basins before being released. Evolution are aware that any change in infrastructure or project design can have a direct impact on surface water flows. Care will be taken to ensure surface water flows are recognised and managed correctly. Drainage channels will be installed to manage smaller, local flows to redirect them away from the pit and ensuring water does not pond against the WRL (AQ2, 2019).

The landscape can be subject to heavy rainfall, and there is a risk of erosion and sedimentation on disturbed or degraded lands subject to vegetation and topsoil removal, mining activities, spoil stockpiling and general construction activities. Significantly increased on-site erosion generates coarse and suspended sediment that can adversely affect water quality and ecological systems downstream. Landform design has been considered to minimise erosion and sediment run-off along with the preferential application of suitable topsoil resources and rock armouring (AQ2, 2019).

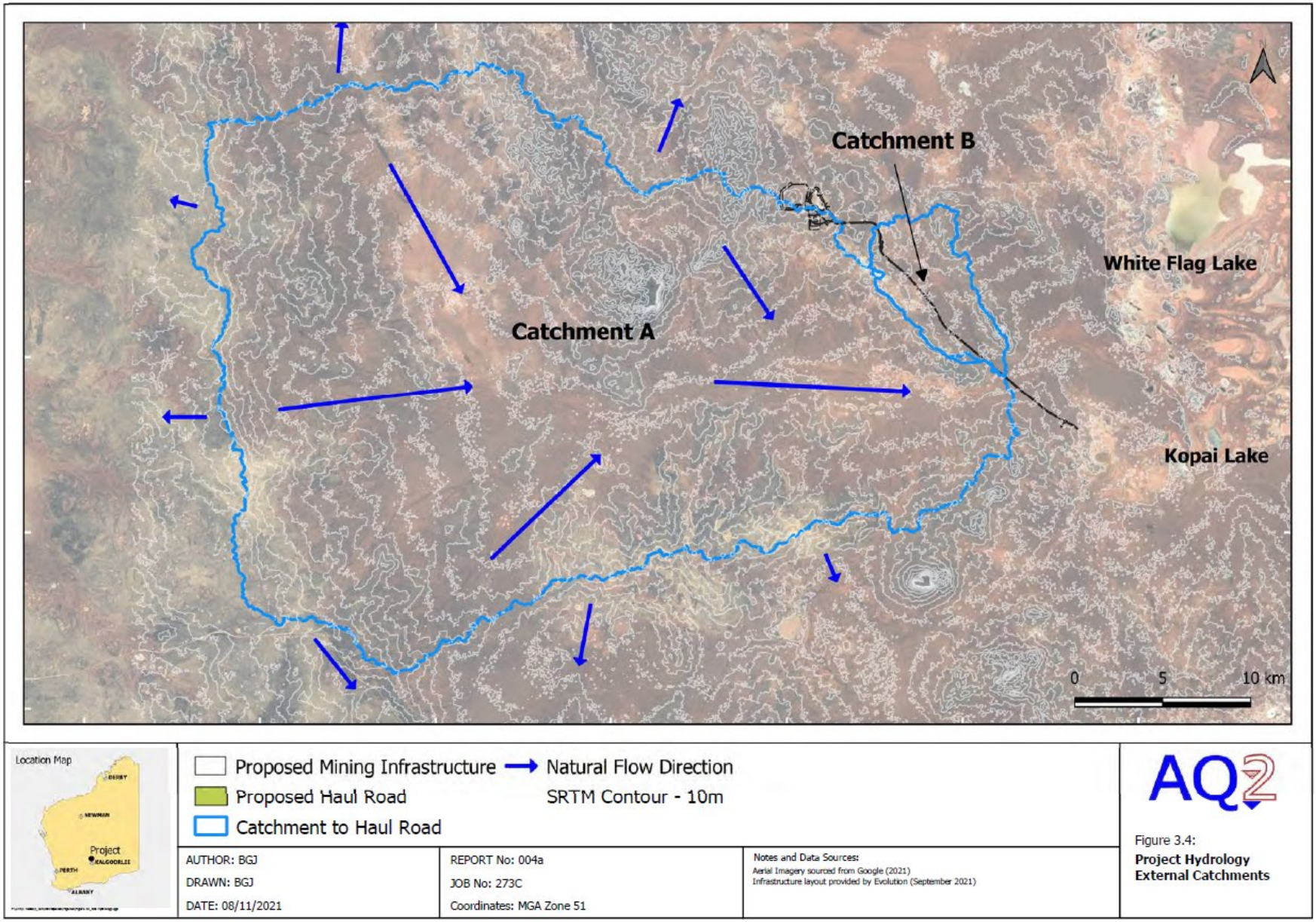

Figure 3-4: Regional Surface Water Catchments

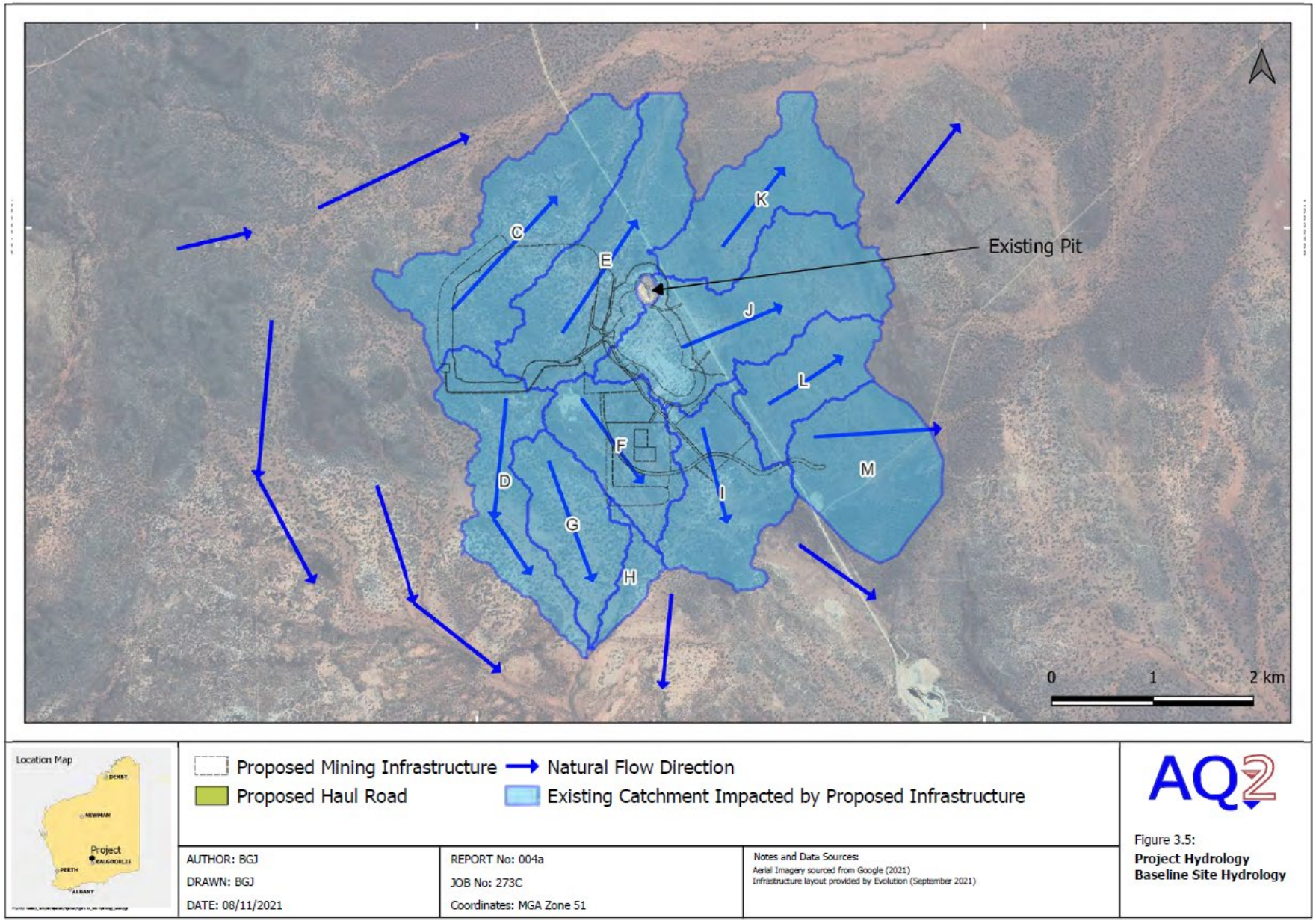

Figure 3-5: Mine Site Local Catchments

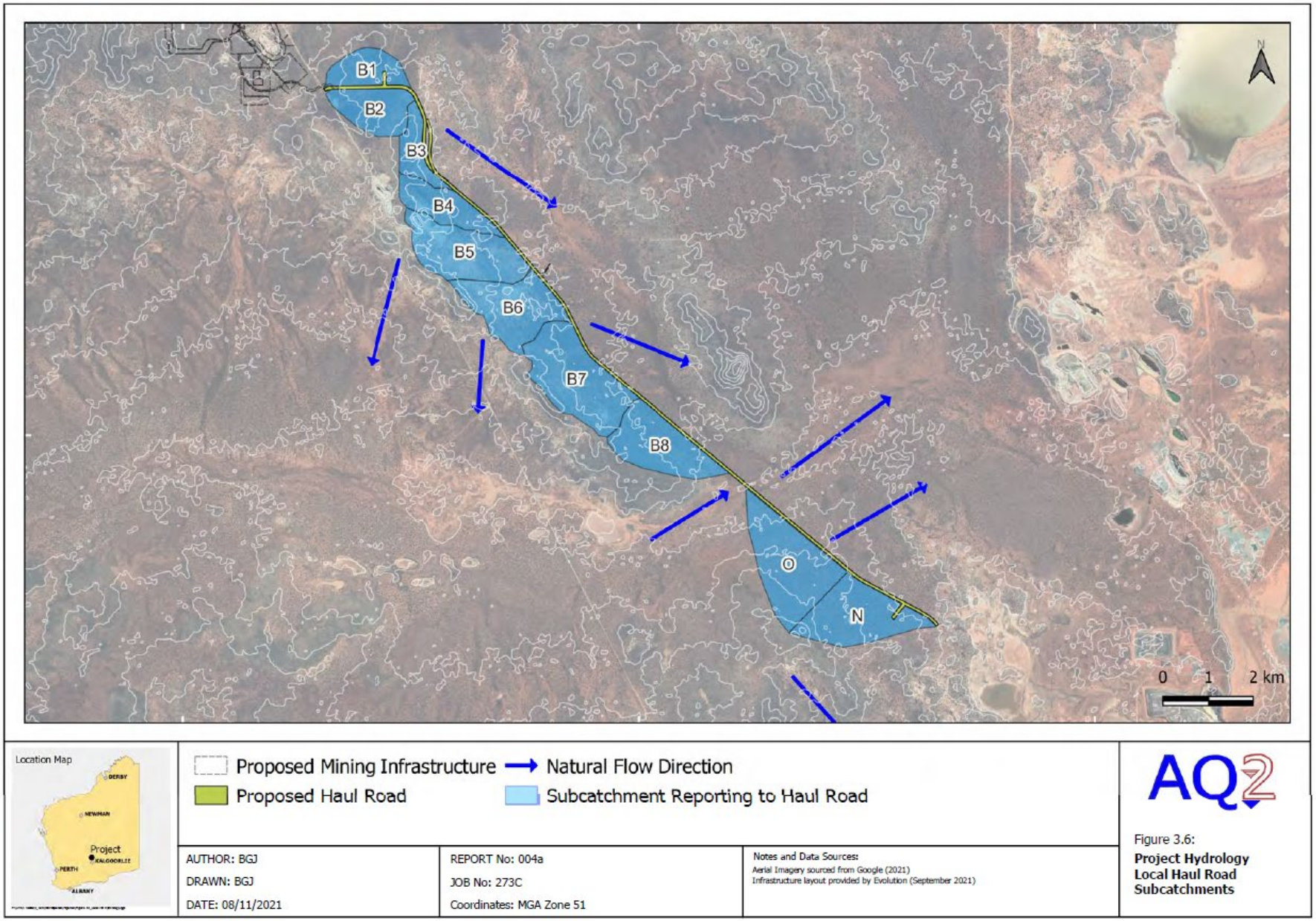

Figure 3-6: Haul Road Local Catchments

Mining operations will be managed such that natural depressions in and around areas are drained to prevent ponding during rainfall events. Flood mitigation measures may be required to prevent flooding entering the mining area (AQ2, 2021).

Storm water runoff around the mine area and associated infrastructure will be managed to limit the environmental impacts of the mine operations on the surface water regime and reduce the impacts of flooding on the mine operations. From a risk management perspective, surface water management infrastructure should reduce the total risk of an unwanted event occurring such that it becomes acceptable based on DMIRS environmental objectives and can be appropriately managed (AQ2, 2021). As such, the general management objectives for the Project relating to surface water are as follows:

- Maintain the existing hydrological regime as much as is practicable.
- Mitigate impacts on surface water quality from construction and operations and contain or treat any contaminated water on-site.
- Ensure the quality of the water released from the site will not lead to significant deterioration of the water resources and environment downstream.

Minor waterway crossings will be installed along the haul road, where required, to ensure areas upstream of the crossings are not unduly inundated, and that waterways at crossings are protected from erosion. Structures should be designed to impede flood flows as little as possible. Each crossing and its release zone should be designed to minimize erosion and potential head cutting of the stream bed.

Where runoff from waste dumps, pits and stockpile areas can discharge to the environment, capture bunding may be installed to collect runoff and direct it to sedimentation traps which will be located at key positions on the downstream sides of the mine disturbance areas to treat the surface water runoff prior to discharge to the natural watercourse. It is unlikely that the Castle Hill site will be inundated with vast volumes of water and will predominately receive water from rainfall only rather than receiving water from other sources. It is expected that only small localised flows will require diversion if necessary (AQ2, 2021).

Waste dump batter faces should be designed to minimise runoff erosion, and runoff captured from the waste dump and other sediment yielding infrastructure such as stockpile areas, ROM pad and laydown should be diverted through sedimentation traps prior to release to the natural watercourse. In general, “dirty” runoff should be treated close to the source disturbance area to reduce the volume of runoff requiring treatment and be kept separate from clean runoff from external catchment areas (AQ2, 2021).

Routine monitoring and review of aerial imagery as part of Evolution's annual environmental reporting will ensure that any potential risk to the environment from underperforming infrastructure or areas requiring additional engineering control to be established will be identified (AQ2, 2021).

The risk of hypersaline water for use as dust suppression on roads and open areas throughout the site will be managed through the establishment of v-drains and/or bunds along roads and around cleared areas. This will ensure that hypersaline water will be diverted and/or contained from entering the surrounding environment and natural surface water drainage line (AQ2, 2021).

There are very limited beneficial users of surface water within the vicinity of the Project Area. Cattle on the underlying pastoral lease obtain water from surface water dams located throughout the region.

3.5 Flora and Vegetation

The most recent flora and vegetation study of the Castle Hill Project area was undertaken by Botanica Consulting (Botanica) in November 2020, attached as **Appendix C**. The total survey area is 2,508 ha in extent comprising a detailed flora/vegetation survey (968 ha) and a targeted flora survey (1,540 ha) (Botanica, 2021).

3.5.1 Vegetation Associations

The Pre-European vegetation association spatial mapping dataset (DPIRD, 2018) identifies three vegetation associations as occurring within the survey area as described in **Table 3-2**. Areas retaining less than 30% of their pre-European vegetation extent generally experience exponentially accelerated species loss, while areas with less than 10% are considered "endangered" (EPA, 2000). All vegetation associations retain >98% of their Pre-European extent. Development within the survey area will not significantly reduce the pre-European extent of these vegetation associations (Botanica, 2021).

Table 3-2: Vegetation Associations in the Project Area

Vegetation Association	Floristic Description	Extent within survey area ha (%)
Kununalling 468	Medium woodland; salmon gum & goldfields blackbutt	2 ha (0.07%)
Kununalling 520	Shrublands; *Acacia quadrimarginea* thicket	1 ha (0.04%)
Kununalling 936	Medium woodland; salmon gum	2,505 ha (99.9%)

3.5.2 Vegetation Types

A total of 18 broad vegetation types were identified within the survey area. Vegetation type descriptions and extent are listed in **Table 3-3** and mapped in **Figure 3-7.** Vegetation type descriptions and extents were determined from field survey results, aerial imagery interpretation, statistical analysis of quadrat data and extrapolation of the communities.

The survey found CLP-EW1 was the most widespread community in the survey area, occupying 814 ha, while RH-CFW1 was the most restricted with 10 ha. CLP-EW1 and RH-MWS1 were the most diverse community, with 67 flora species recorded, and RH-AFW1 was the least diverse with 23 flora species recorded (Botanica, 2021).

Table 3-3: Description of Vegetation Types

Vegetation Code	Broad Floristic Formation (NVIS III)	Description
CLP-EW1	Eucalyptus woodland	Low woodland of *Eucalyptus campaspe/ E. salmonophloia* over mid shrubland of *Eremophila* spp. and low chenopod shrubland on clay-loam plain
CLP-EW2	Eucalyptus woodland	Low woodland of *Eucalyptus ravida/ E. salmonophloia* over mid shrubland of *Eremophila* spp. and low chenopod shrubland on clay-loam plain
CLP-OS1	Other shrubland	Mid sparse shrubland of *Atriplex nummularia subsp. spathulata* subsp. *spathulata/ Eremophila dempsteri* over sparse tussock grassland of *Austrostipa nitida* on clay-loam plain
CLP-OS2	Other shrubland	Mid open shrubland of *Eremophila alternifolia/ E. interstans* subsp. *virgata* over low chenopod shrubland on clay-loam plain
CoAtEd	Shrubland	Low to mid *Casuarina obesa* and *Eucalyptus griffithsii* woodland over mid to tall open *Acacia tetragonophylla*, *Exocarpos aphyllus* and *Cratystylis subspinescens* shrubland over isolated low *Eremophila decipiens* subsp. *decipiens*, *Grevillea acuaria* and *Rhagodia drummondii* shrubs.
EcDIOm	Eucalyptus woodland	Mid *Eucalyptus clelandiorum* woodland with other Eucalyptus trees, frequently *E. celastroides* subsp. *celastroides* or *E. griffithsii,* over isolated shrubs to mid open *Dodonaea lobulata*, *Eremophila scoparia* and *Exocarpos aphyllus* shrubland over isolated low to sparse *Olearia muelleri*, *Ptilotus obovatus* and *Westringia rigida* shrubland.
EgAhOm	Eucalyptus woodland	Mid *Eucalyptus griffithsii* woodland with other Eucalyptus trees including *E. oleosa* subsp. *oleosa* and *E. longicornis* over isolated shrubs to mid open *Acacia hemiteles, Exocarpos aphyllus* and *enna artemisioides* subsp. *filifolia* shrubland over isolated low *Olearia muelleri, Scaevola spinescens* and *Westringia rigida* shrubs
EIEaAv	Eucalyptus woodland	Mid *Eucalyptus longicornis* woodland with *E. clelandiorum* and *E. griffithsii* trees over mid to tall open *Exocarpos aphyllus, Eremophila* glabra and Senna artemisioides subsp. filifolia shrubland over isolated low Atriplex vesicaria, *Ptilotus obovatus* and *Rhagodia drummondii* shrubs.
EsEsAb	Eucalyptus woodland	Mid *Eucalyptus salmonophloia* and *E. salubris* woodland over mid *Eremophila scoparia, Senna artemisioides* subsp. *filifolia* and *Exocarpos aphyllus* shrubland over low open *Atriplex bunburyana, Maireana trichoptera* and *Ptilotus obovatus* shrubland.
OD-EW1	Eucalyptus woodland	Low woodland of *Eucalyptus salmonophloia/ E. transcontinentalis/ E. clelandiorum* over mid shrubland of *Eremophila* spp. and low samphire shrubland in open depression
RH-AFW1	Acacia woodland	Low woodland of *Acacia quadrimarginea* over mixed mid open shrubland and low open shrubland of *Ptilotus obovatus* on greenstone hillslope
RH-CFW1	Casuarina woodland	Low open woodland of *Allocasuarina acutivalvis/Casuarina pauper* over low mixed scrub on greenstone hillslope
RH-EW1	Eucalyptus woodland	Low woodland of *Eucalyptus clelandiorum* over mid shrubland of *Eremophila* spp. shrubland and low chenopod shrubland on greenstone hillslope
RH-EW2	Eucalyptus woodland	Low woodland of *Eucalyptus clelandiorum/Eucalyptus torquata* over low shrubland of *Eremophila* spp. on greenstone hillslope
RH-MWS1	Mallee woodland	Open mallee woodland of *Eucalyptus griffithsii* over mid shrubland of *Eremophila/ Dodonaea* spp. and low mixed shrubland on greenstone hillslope
SLP-AS1	Acacia shrubland	Tall open shrubland of *Acacia acuminata* over low mixed shrubland on sandy-loam plain
SLP-MWS1	Mallee woodland	Tall mallee woodland of *Eucalyptus griffithsii* over mid open shrubland of *Eremophila/ Senna* spp. And hummock grassland of *Triodia irritans* on sand-loam plain
CV	N/A	Cleared vegetation

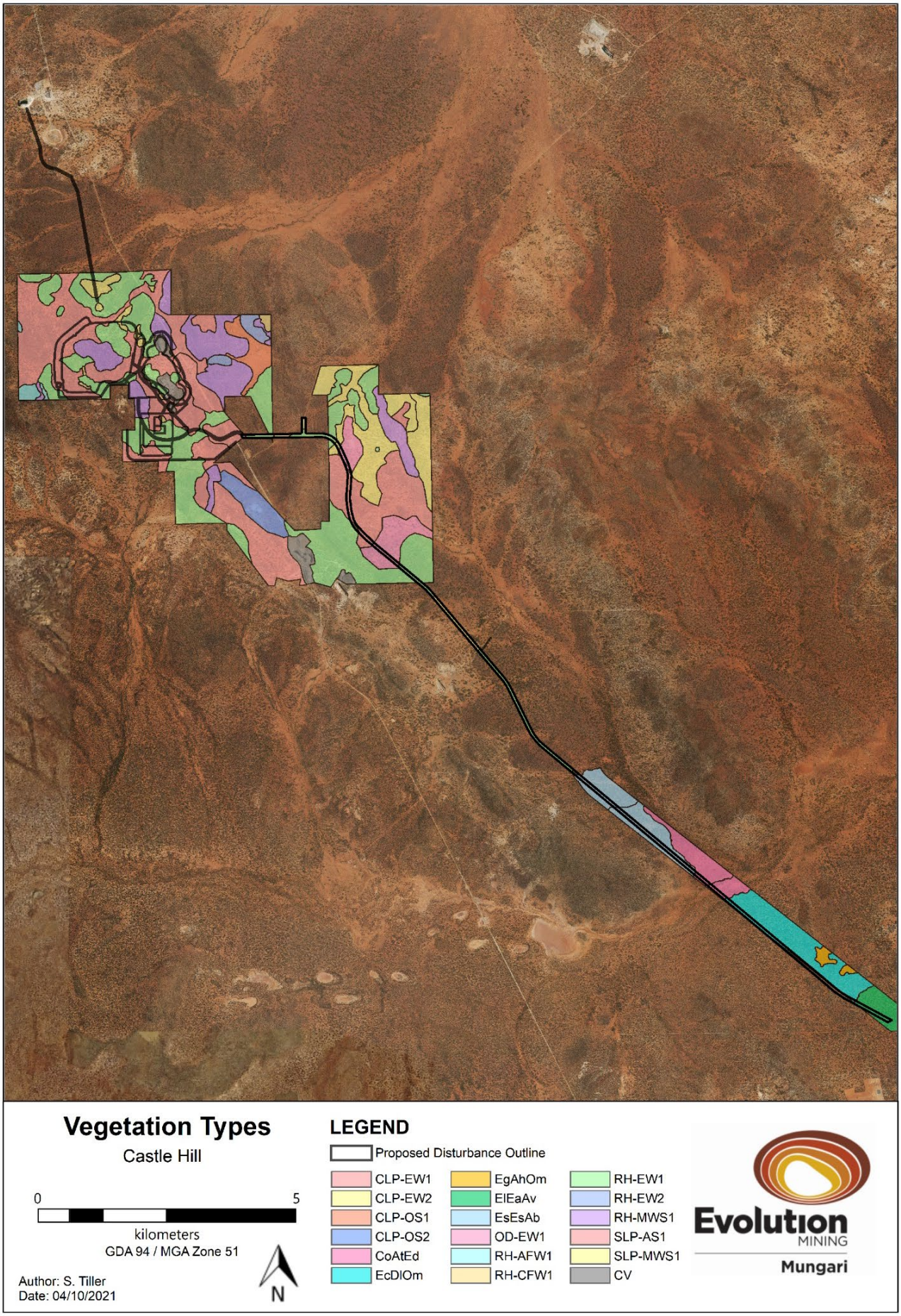

Figure 3-7: Map of Vegetation Types

3.5.3 Vegetation Condition

Based on the vegetation condition rating scale adapted from Keighery (1994) and Trudgen, (1988), native vegetation within the survey area ranged from 'good' to 'very good' (**Table 3-4**). Vegetation condition is for the most part in 'very good' condition (90.7%), displaying altered vegetation structure with obvious signs of disturbance. Approximately 6.8% of the survey area is in 'good' condition and the remaining 2.5% is cleared vegetation (Botanica, 2021a).

Table 3-4. Vegetation condition classifications

Vegetation condition	Area (ha)	% of Study Area	Description
Pristine	0	0	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Excellent	0	0	Vegetation structure intact, disturbance affecting individual species. Damage to trees caused by fire, the presence of non-aggressive wees and occasional vehicle tracks.
Very Good	2,275	90.7	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	171	6.8	Vegetation structure significantly altered by obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	0	0	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	0	0	The structure of the vegetation is no longer intact, and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

(Keighery, BJ (1994) Bushland Plant Survey

3.5.4 Conservation Significant Flora

No Threatened or Priority Ecological Communities or otherwise significant vegetation as described by the EPA were identified within the survey area (Botanica, 2021). No Threatened flora species were recorded within the survey area.

Two Priority flora species have been identified in previous studies within or adjacent to the project area.

Calandrinia sp.

A targeted study was conducted by Spectrum in August 2019 to assess the species populations of *Calandrinia lefroyensis* (**Figure 3-8**) and *C. quartzitica* in the regional area. Two individuals of Priority 1 (P1) species of *Calandrinia.?leforyensis/quartzitica* were recorded and sampled in the Castle Hill project area (Spectrum, 2019a).

Further studies were carried out in November 2019 (optimal flowering season) to verify the presence and population extent of the *Calandrinia* species (Spectrum, 2019b). Results indicated that there are three established populations of *Calandrinia lefroyensis* within 20 km of the project area, all in good condition with 75-99 individuals in each. These populations are well outside the project area and will not be impacted during operations (**Figure 3-9**).

In September 2021, Botanica Consulting conducted a further targeted survey to confirm the presence or absence of the priority species (**Appendix D**). The two previous locations of the P1 species identified in 2019 were visited. At both sites, *Calandrinia eremea* (not threatened) was seen and no *C. lefroyensis* or *C. quartzitica* were recorded. No Samphire or Frankenia shrubs were seen in these areas, and therefore it is assumed that *C. lefroyensis* is not present at these locations. No habitat that would suit the C. lefroyensis, salt-lake flats among samphire communities was seen anywhere in the Castle Hill survey area (Botanica, 2021c).

Figure 3-8: *Calandrinia lefroyensis*

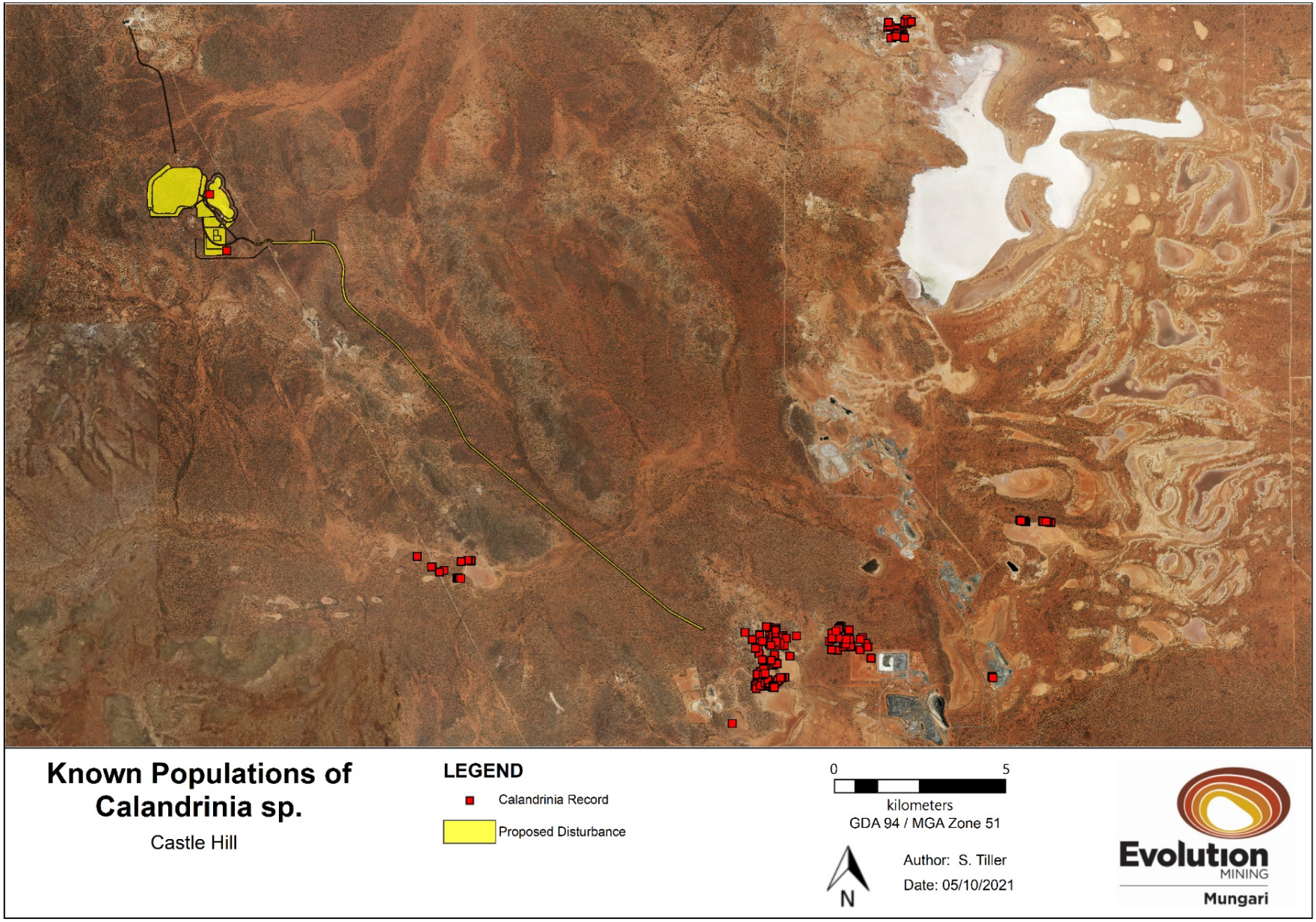

Figure 3-9: Map of *Calandrinia sp.* in the region

Eremophila praecox

One potential Priority 2 (P2) flora species *Eremophila praecox* (**Figure 3-10**) was recorded within project area during the Botanica survey (2021a). Due to the absence of flowering material (despite the survey being conducted during the known flowering period for this taxon), this specimen could not be positively identified or formally lodged with the Western Australian Herbarium.

A further targeted survey for this species was carried out in September 2021 (**Appendix D)**. Two individuals were confirmed along the proposed haul road. A map showing the *Eremophila praecox* records is provided in **Figure 3-11**.

Evolution submitted an application on 4 October 2021 for authorisation from the Department of Biodiversity, Conservation and Attractions (DBCA) to take the priority flora to proceed with the proposed works (Botanica, 2021c). The submission is attached as **Appendix E**.

Figure 3-10. *Eremophila praecox*

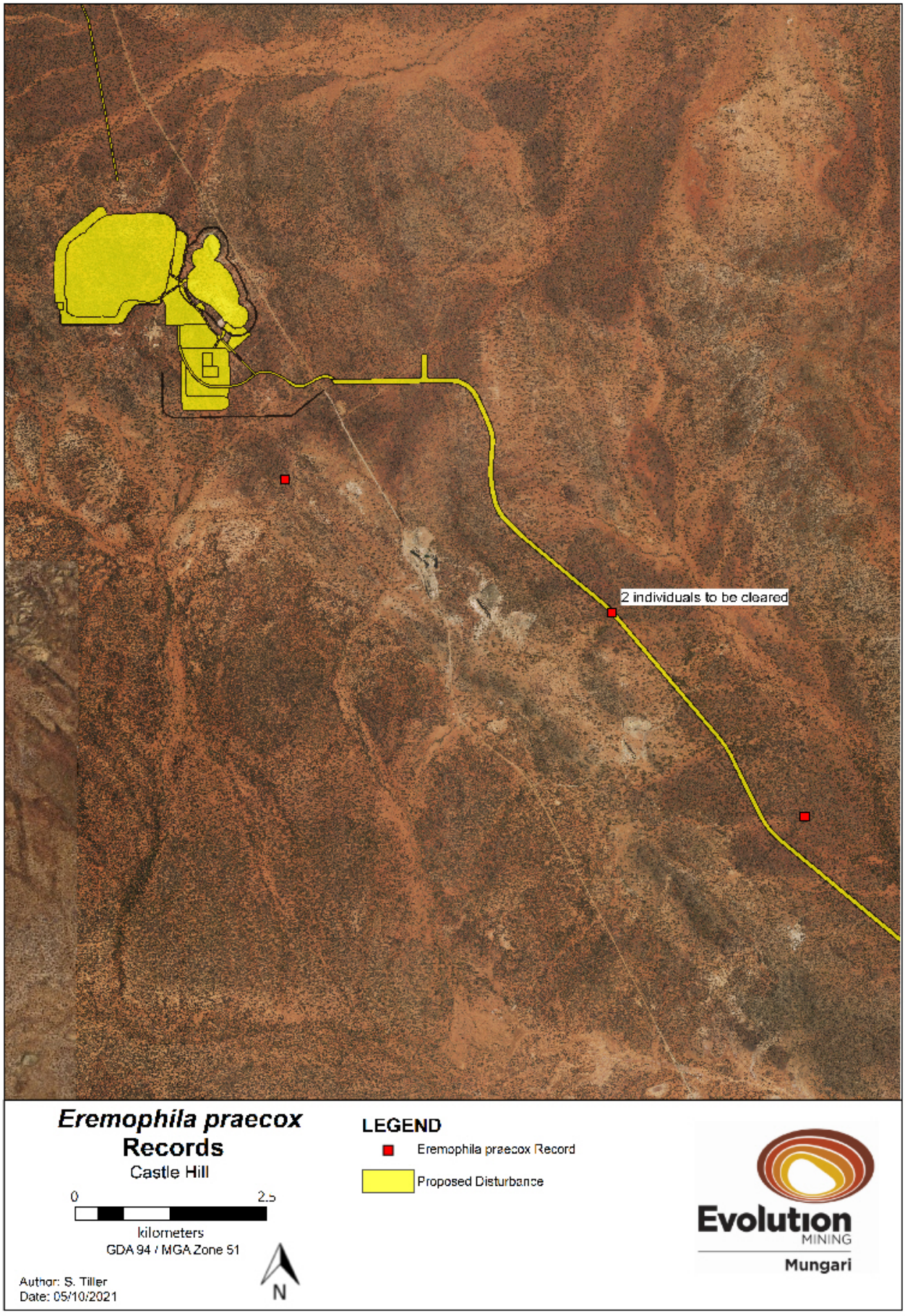

Figure 3-11: *Eremophila praecox* Records

3.5.5 Introduced Flora and Weeds

Eleven introduced (weed) species were recorded within the survey area (**Table 3-5**). None of these species are listed as Weeds of National Significance or a Declared Pest in Western Australia (Botanica, 2021a).

Table 3-5. Introduced Flora Species

Family	Species
Asphodelaceae	*Asphodelus fistulous*
Asteraceae	*Centaurea melitensis*
Asteraceae	*Dittrichia graveolens*
Asteraceae	*Sonchus oleraceus*
Brassicaceae	*Carrichtera annua*
Brassicaceae	*Sisymbrium irio*
Cucurbitaceae	*Cucumis myriocarpus*
Lamiaceae	*Salvia reflexa*
Lamiaceae	*Salvia verbenaca*
Poaceae	*Cenchrus ciliaris*
Primulaceae	*Lysimachia arvensis*

3.6 Fauna

A basic fauna survey was conducted by Botanica Consulting (2021a) in conjunction with their flora and vegetation survey (**Appendix C**). Vegetation and landform units identified during the flora assessment were used to define broad fauna habitat types across the site. This information was supplemented with observations made during the fauna assessment (Botanica, 2021a).

Opportunistic observations of fauna species were made during all field survey work which involved a series of transects across the study area during the day including observations of bird species with binoculars. Secondary evidence of a species presence such as tracks, scats, skeletal remains, foraging evidence or calls were also noted if observed/heard (Botanica, 2021a).

Suitable malleefowl habitat within the survey area was systematically searched on foot and by vehicle by two Botanica staff members to identify and record the locations of any malleefowl activity (i.e. mounds, footprints and feathers) (Botanica, 2021a).

3.6.1 Habitat

Based on vegetation and associated landforms identified during the flora and vegetation assessment, six broad scale terrestrial fauna habitats were identified as occurring within the survey area. **Table 3-6** lists the habitat types identified during the survey with their extent mapped in **Figure 3-12** (Botanica, 2021a).

Table 3-6: Fauna Habitat Types

Habitat Type	Extent (ha)
Eucalypt woodland on clay-loam plain/open depression (A)	1,156 ha
Open mixed shrubland on clay-loam plain	108 ha
Eucalypt woodland/ Mallee woodland on greenstone hillslope (B)	1,038 ha
Acacia/Casuarina woodland on greenstone hillslope (C)	25 ha
Acacia shrubland on sandy-loam plain (D)	94 ha
Mallee woodland over spinifex grassland on sand-loam plain	25 ha
Open eucalypt woodland	344 ha
Shrubland	77 ha
Cleared vegetation	62 ha

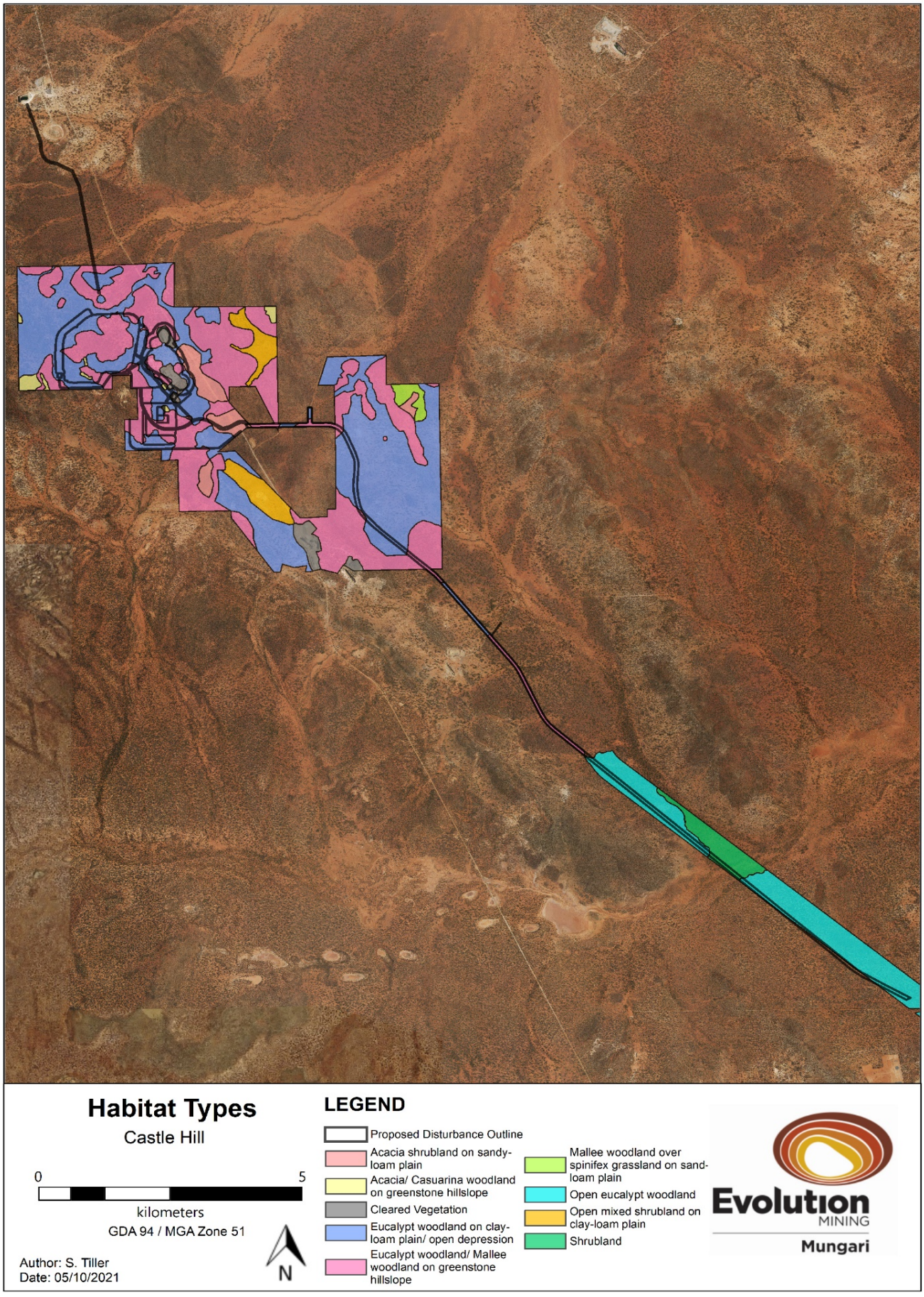

Figure 3-12: Map of Fauna Habitats

3.6.2 Conservation Significant Fauna

No significant fauna species were observed during the survey. The current status of some species on site and/or in the general area is difficult to determine, however, based on the habitats present and, in some cases, direct observations or recent nearby records, the following species of conservation significance can be regarded as possibly utilising the survey area for some purpose at times, these being:

Central Long-eared Bat (Nyctophilus major tor) – P4 (DBCA)

Listed as a potential species with potential roost sites present (e.g. tree hollows) however it is generally uncommon and significant impact unlikely (Botanica, 2021a).

Peregrine Falcon (Falco peregrinus) – OS (BC Act)

This species potentially utilises some sections of the survey area as part of a much larger home range, though records in this area are uncommon. It is considered unlikely to breed within the survey area. Significant impact unlikely (Botanica, 2021a).

Malleefowl (Leipoa ocellata) - Vulnerable (EPBC Act and BC Act)

This species is occasionally recorded in the Eastern Goldfields subregion. Two inactive (historical) malleefowl mounds were observed within the survey area (**Figure 3-13**). It was estimated that these mounds are at least 20 years old and in fact maybe much older than this as they deteriorate slowly. No active malleefowl mounds or other evidence of malleefowl activity (tracks, feathers or bird observations etc.) were observed during the field survey. Available information therefore suggests that a breeding population of this species is unlikely to be present in the survey area, though transient non-breeding individuals may occasionally occur. Significant impact unlikely (Botanica, 2021a).

It should be noted that while habitats onsite for one or more of the species listed above are considered possibly suitable, some or all may be marginal in extent/quality and therefore the fauna species considered as possibly occurring may in fact only visit the area for short periods as infrequent vagrants (Botanica, 2021a).

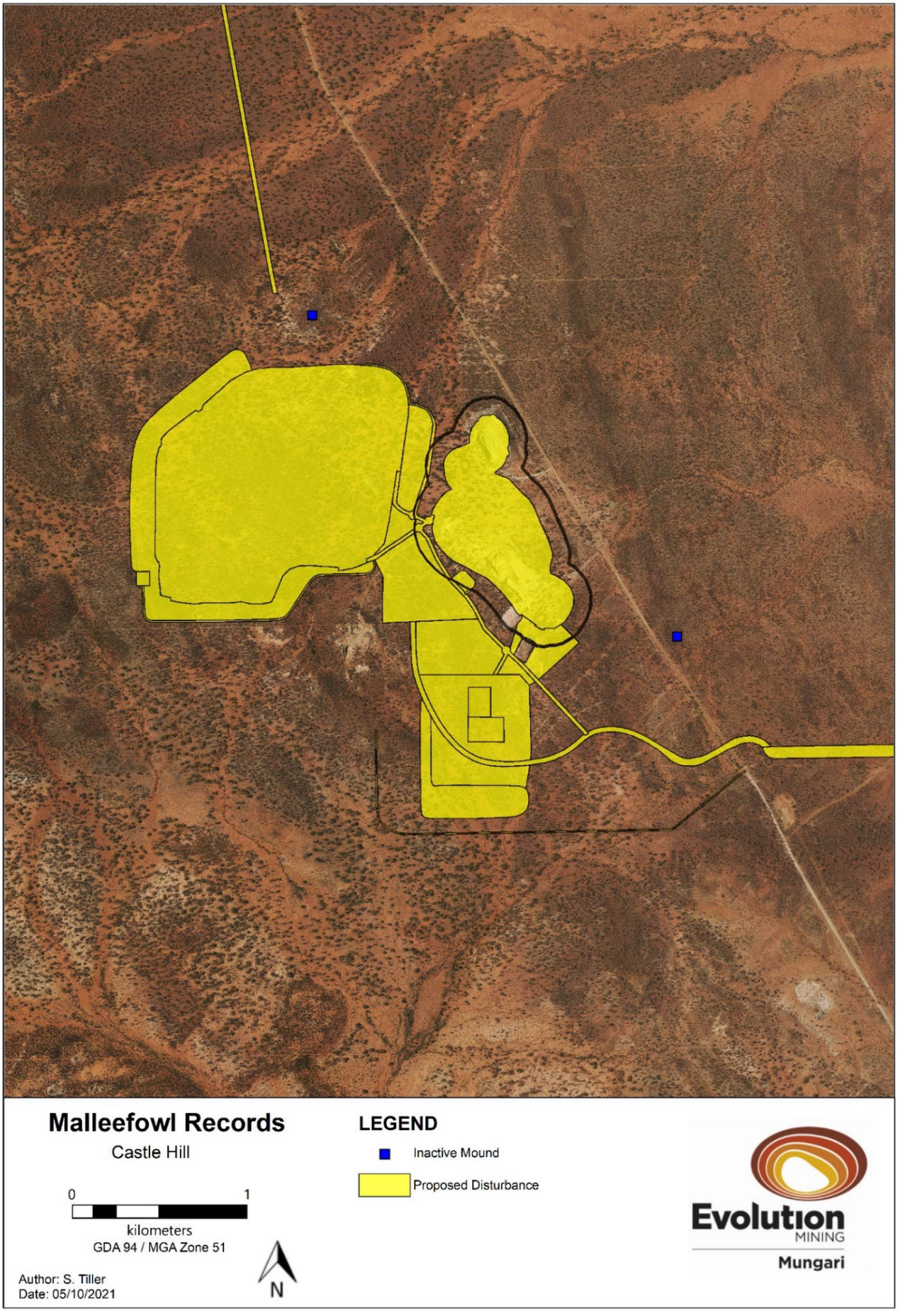

Figure 3-13: Malleefowl Records at Castle Hill

Further to the fauna assessment, Botanica was also engaged to complete a targeted survey for the arid bronze azure butterfly (Ogyris subterrestris petrina) and the inland hairstreak (Jalmenus aridus) attached as **Appendix F**.

Arid Bronze Azure Butterfly (Ogyris subterrestris petrina) – Critically Endangered (EPBC Act and BC Act)

The Arid Bronze Azure Butterfly (ABAB) is listed as critically endangered due to its severely fragmented distribution with only two extant subpopulations being recorded in Western Australia. The ABAB has an obligate association with a sugar ant *Camponotus sp. nr. terebrans*. The ABAB's larvae live entirely within the ant's nest during their development. The ants protect the larvae from predators and are thought to be rewarded with secretions produced by the larvae (Botanica, 2021b)

A total of 265 trees were searched for the host ant *Camponotus sp. nr. Terebrans*. At each tree, a hand trowel was used to disturb the leaf litter and soil to a depth of ~ 10 cm, and the following information was recorded:

- GPS location with a waypoint number,
- Photograph of the base of the tree,
- Tree species,
- The approximate diameter of the tree at a height of 1.5 m,
- If ants were present (Y/N), and
- If leafhoppers were present (Y/N).

No *Camponotus sp. nr. terebrans* were found in the Castle Hill survey area (Botanica, 2021b).

Inland Hairstreak (Jalmenus aridus) – P1 (BC Act)

Little is known about the biology or ecology of this species. Based on the historical records, the larva of this species is thought to feed on leaves and flowers of young shrubs of *Senna nemophila* (recent taxonomic revisions classify as *Senna artemisioides* subsp. × *coriacea*) and mature trees of *Acacia tetragonophylla*, which grow in shallow gullies with gentle slopes (Braby, 2016). The larvae of the butterfly are attended by the Froglet ant *Froggatella kirbii*. The adults are likely to stay close to the breeding habitats. There are likely two generations per year, although adults are absent in some years (Braby, 2016).

A total of 68 *Acacia tetragonophylla* were searched for the presence of larvae of the inland hairstreak and the ground surrounding these plants was dug up to search for any Froglet ants. No *Senna artemisioides* subsp. × *coriacea* were seen in the survey area. Nothing that appeared to be larvae or Froglet ants were seen on any of the *Acacia tetragonophylla* and no evidence of the inland hairstreak was seen in the survey area (Botanica, 2021b).

3.6.3 Short-Range Endemic (SRE) species

During the level 1 fauna survey carried out by Spectrum Ecology in 2019, 13 potential SRE invertebrate fauna taxa were collected from the Castle Hill study area. They consisted of six pseudoscorpions, two isopods, one centipede, three millipedes and one snail (**Table 3-7**). One of the five pseudoscorpions (*Chernetidae* sp.) and one of the three millipedes (*Unixenus* sp.) could not be identified to species level because the specimens were juveniles, and adult specimens are required for formal identification to species level (Phoenix 2019b).

Two individuals of the snail, *Basedowena cf. holoserica* were collected from the Castle Hill survey area and could potentially represent a new species, although resembling *Basedowena holoserica* (Phoenix 2019b).

Table 3-7. Recorded SRE Invertebrates

Order/Family	Taxa	Sampling Type	Abundance	SRE Category
Pseudoscorpiones				
Garypinidae	*Amblyoplium* 'BPS207'	Leaflitter	1	Potential SRE
Cheiridiidae	*Apocheriridium* `BPS208'	Leaflitter	4	Potential SRE
Olpiidae	*Beierolpium* 8/4 sp.	Leaflitter	1	Potential SRE
Chernetidae	*Chernetidae* sp.	Leaflitter	3	Potential SRE
Geogarypidae	*Geogarypus taylori*	Leaflitter	1	Potential SRE
Cheliferidae	*Protochelifer* 'BPS210'	Leaflitter	3	Potential SRE
Isopoda				
Armadillidae	*Buddelundia* 'BIS350'	Foraging, Leaflitter	3	Potential SRE
	Buddelundia 'BIS352'	Leaflitter	1	Potential SRE
Chilopoda				
Cryptopidae	*Cryptops* nr *hortensis*		1	Potential SRE
Diplopoda				
Polyxenidae	*Unixenus* sp.	Leaflitter	2	Potential SRE
Scutigerellidae	*Hanseniella* 'BSYM093'	Leaflitter	1	Potential SRE
Siphonotidae	*Siphonotidae* 'BDI064'	Leaflitter	5	Potential SRE
Mollusc				
Camaenidae	*Basedowena* cf. *holoserica*	Foraging, Leaflitter	1	Potential SRE

3.6.4 Subterranean Fauna

A desktop assessment of subterranean fauna values at Castle Hill was carried out by Bennelongia Environmental Consultants (2019) in coherence with the 2019 Spectrum Ecology Survey. It was determined that there is no highly prospective habitat for subterranean fauna in the study area. The primary limiting factor on the occurrence of subterranean species will be the apparent unavailability of well-developed underground spaces such as coarse interstices, vughs, fractures and caverns. The surficial cover of weathered laterite and saprolite is clayey and more or less devoid of significant subterranean spaces. The underlying rock types are not considered prospective for either stygofauna or troglofaunal (groundwater-dwelling organisms). The lithological profile of the area is also relatively impermeable and does not yield significant volumes of groundwater (Bennelongia, 2019).

3.7 Heritage

Evolution maintain cumulative records of all Aboriginal heritage surveys undertaken and ensure that prior to any clearing undertaken, a heritage survey has been undertaken within the previous 10-year period.

As Castle Hill is located in an area that has been subject to historic mining disturbance and activities the values of the area have been somewhat compromised. Aboriginal heritage surveys were carried out for the Castle Hill Project to determine any significant heritage factors. These surveys are listed in **Table 3-8.**

Table 3-8: Heritage Surveys undertaken at Castle Hill

Report	Date	Surveyor	Findings
Aboriginal Heritage Survey of 2020 Castle Hill Project Areas	Aug 2020	R. & E. O'Connor	No sites of Aboriginal heritage were recorded in the project vicinity.
Addendum to Aboriginal Heritage Surveys: Red Dam, Kintore and Castle Hill Prospects	Dec 2013	R. & E. O'Connor	No sites of Aboriginal heritage were recorded in the project vicinity.
Aboriginal Heritage Surveys: Red Dam, Kintore and Castle Hill Prospects	Apr 2013	R. & E. O'Connor	Four sites of Aboriginal heritage were recorded in the project vicinity: *Wadi Quarry* *Isolated Artefacts* (x 3)
Report of an Aboriginal Heritage Ethnographic Survey Castle Hill, Red Dam, Kintore in Western Australia	Apr 2013	Dr Christine Mathieu	No sites of Aboriginal heritage were recorded in the project vicinity.
Report on the Aboriginal Heritage Survey of the Phoenix Gold Ltd Bluebell, Emu and Wookie Survey Areas	Oct 2011	Deep Woods Surveys	One site of Aboriginal heritage was recorded in the project vicinity: *Wookie 01*

3.7.1 Native Title

Currently there are two registered native title claims in the Jaurdi Hills region: the Marlinyu Ghoorlie Claim, Number WC2017/007, and the Maduwongga Claim, Number WC2017/001 under the *Native Title Act 1993* (National Native Title Tribunal, 2019). Both claims cover the Project Area in its entirety.

Former native title claims lodged variously by the Sambo, Champion and Donaldson family groups, or by sub-groups of those families, also covered the Project Areas in their entirety. All those Native Title applications have been struck out in the past by the Federal Court of Australia. Members of the Sambo and Sceghi families lodged a further claim under the name "Kaparn" in 2017. It was subsequently withdrawn to enable the submission of further evidence and has not yet been re-lodged. Notwithstanding their native title status, family members from the Sambo, Champion and

Donaldson family groups assert rights over Aboriginal heritage sites in their former claim areas and have demonstrated relevant cultural knowledge of those areas in the past. Representatives of all the above groups were therefore involved in surveys.

3.7.2 Aboriginal Heritage Sites

Evolution Mining currently has a heritage agreement in place with the *Maduwongga* people. An agreement with the *Marlinyu Ghoorlie* people is still currently under negotiation pending finalisation.

All sites of Aboriginal heritage are protected under section 5 of the *Aboriginal Heritage Act 1972,* whether previously registered or not. The Department of Planning, Lands and Heritage (DPLH) maintains an online database known as the Aboriginal Heritage Inquiry System (AHIS) which spatially shows and provides information concerning Aboriginal heritage places in WA. A search of the AHIS database shows that there are no known Aboriginal Sites or Other Heritage Places recorded in the project vicinity.

Two Aboriginal Sites have been recorded in the project vicinity from heritage surveys carried out for Evolution Mining, listed in **Table 3-9** below. The locations of these sites are well-known to Evolution and will not be damaged or destroyed as a result of mining operations without the appropriate approvals from Aboriginal groups and the Government.

Table 3-9: Aboriginal Heritage Sites in the Project Vicinity

Site Name	Site Type	Report	Year
Wookie 01	Small stone artefact scatter	Report on the Aboriginal Heritage Survey of the Phoenix Gold Ltd Bluebell, Emu and Wookie Survey Areas	2011
Wadi Quarry	Quarry site	Aboriginal Heritage Surveys: Red Dam, Kintore and Castle Hill Projects	2013

3.7.3 European Heritage Sites

All European heritage places listed in the WA State Register are protected under the *Heritage Act 2018*. A search of the DPLH inHerit database shows that there are no heritage places located in the vicinity of the project area. The closest heritage place is the Kintore Town site (no. 7392) located approximately 3 km north-west followed by the Premier Hotel (Ruins) (no. 582) located approximately 3.5 km south-east. No European heritage places will be impacted as a result of mining operations.

4.0 Land Clearing Process

Clearing will be undertaken progressively using the following equipment and methodology.

4.1 Equipment

The equipment required to support and undertake clearing at the Project will include:

- Dozer;
- Loader;
- Excavator;
- Water Cart; and
- Service Vehicles.

4.2 Proposed Clearing Methodology

Prior to clearing, the disturbance footprint will be demarcated using high visibility tape or equivalent where suitable to ensure operators undertake clearing within the disturbance envelope. A maximum clearing footprint of 800 ha is required. This area is the existing clearing area approved under CPS 5675/4 plus the additional area applied for under this amendment. Clearing will be undertaken using dozer or loader to remove vegetation, topsoil and overburden. Any salvaged vegetation and topsoil will be stockpiled for rehabilitation purposes. A spotter may be present where required to ensure clearing and disturbance is undertaken within the proposed clearing boundaries.

5.0 Assessment against the Ten Clearing Principles

Evolution have undertaken an assessment against each of the ten clearing principles (**Table 5-1**) and engage qualified botanists and zoologists to survey the area of flora, fauna and endemic species where required.

This assessment demonstrates that the proposed total clearing of 800 ha (including the approved clearing of 390.1 ha) is not in variance with any of the ten clearing principles and where required, management measures will be established to mitigate any potential unacceptable detrimental environmental harm.

Table 5-1. Assessment against the Ten Clearing Principles

Clearing Principle	Assessment of Proposed Activities Against Clearing Principles
1. Native vegetation should not be cleared if it comprises a high level of biological diversity.	The Eastern Goldfields subregion is rich and diverse in its flora, however, most species (excluding Priority Flora species) are wide ranging and usually occur in at least one, and often several, adjoining subregions (Cowan, 2001). The Kunanalling EGS is not considered to comprise a high level of biological diversity as the vegetation is similar to the surrounding regions, hence it is not considered this project is at variance with this principle.
2. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Most fauna species occurring in the region tend to be wide ranging, with the exception of *Leipoa ocellata* (Malleefowl). Malleefowl are known to inhabit the Goldfields region, therefore, Evolution will commit to undertaking a targeted Malleefowl survey in areas known to support Malleefowl inhabitance prior to significant clearing occurring in the Kunanalling EGS to reduce impacts to the species and their breeding habitat. Strategies to reduce negative impact to this species include; monitoring active nests, removing inactive nests in high-risk areas (such as those located within the project's footprint or within 50m of an active haul road), reporting all Malleefowl sightings to DBCA, erecting signage warning of Malleefowl in the area and sharing information on Malleefowl to all employees via information posters and toolbox topic talks.
3. Native vegetation should not be cleared if it includes or is necessary for the continued existence of rare flora.	Two individuals of Priority 2 *Eremophila praecox* are located in the proposed disturbance footprint. An application for authorisation will be sought from DBCA to take priority flora. All clearing will be undertaken under an approved Clearing Permit in which a flora and vegetation survey will have been carried out in the proposed clearing areas within the previous five-year period. If any threatened flora were identified in the survey area, a targeted flora survey will be carried out prior to undertaking clearing to ensure no threatened species remain in the disturbance area.
4. Native vegetation should not be cleared if it comprises the whole or a part of or is necessary for the maintenance of a threatened ecological community.	There are no known Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) located within a 30 km radius of the Castle Hill project area.
5. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared	The area applied to be cleared is located within the Coolgardie bioregion (DSEWPaC, 2012). Dwarf shrublands of samphire's persist on salt lakes, surrounded by diverse *Eucalyptus* woodlands, which also occur on ranges and in valleys. It is not considered the proposed disturbance area represents a significant portion of remnant vegetation, especially as the entire area to be disturbed lies over an active pastoral lease which supports the grazing of cattle and other pastoral activities.
6. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	There are no watercourses or wetlands within or in close proximity to the application area. The nearest freshwater wetland is Rowles Lagoon, located approximately 25 km to the north west of the project area.
7. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Potential land degradation as a result of the proposed clearing may be minimised by the implementation of a staged clearing condition. All clearing under the Castle Hill project areas will be under an approved Clearing Permit and clearing will be conducted with a staged approach, to avoid unnecessary or over-clearing. Areas to be cleared will be pegged out by the Survey Department and overseen by the Environment Department and Open Pit Supervisors to ensure clearing is appropriately managed as per relevant approvals.
8. Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The nearest conservation area is the Credo Conservation Park located 75 km north of Coolgardie and Goongarrie National Park, 90 km North of Kalgoorlie and a significant distance from this mining proposal area.
9. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	There are no permanent watercourses or wetlands within or in close proximity to the application area. The climate of the region is semi-arid, with a low average rainfall of approximately 264 mm per year. Drainage lines in the area are dry for most of the year, only flowing briefly immediately following significant rainfall. The groundwater of the region is hypersaline which is unsuitable for humans and or animal consumption and is noted at a depth of greater than 20m below ground level.
10. Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The climate of the region is semi-arid, with a low average rainfall of approximately 264 mm per year. Drainage lines in the area are dry for most of the year, only flowing briefly immediately following significant rainfall. The project will not exacerbate or intensify incidences of flooding. Culverts will be installed under haul roads where necessary to ensure surface flows are allowed to follow their natural pathway and surface water management features such as drains, sumps and sediment traps may be included to direct water back to natural surface water flow systems and prevent flooding.

6.0 Environmental Management

Evolution does not propose any changes to environmental management under this amendment application.

6.1 Environmental Approvals

Disturbance has been carried out as per the approved Mining Proposals and the Clearing Permit listed in **Table 6-1**. Existing disturbance has occurred in the Castle Hill area under historical approvals issued under the *Mining Act 1978*.

Existing clearing approval has been issued under Section 51E of the EP Act, with **CPS 5675/4** granted on the 14 September 2018.

Table 6-1. Existing Environmental Approvals

Document ID	Document Type	Document Title	Date Approved
Reg ID 101286	Mining Proposal	Castle Hill Project Mining Proposal	Pending approval
Reg ID 45407	Mining Proposal	Phoenix Gold Limited Phase 1: Mill and Associates Infrastructure M16/198, M16/526, M16/140, M16/24	19 December 2013
Reg ID 35613	Mining Proposal	Mining Proposal - Mick Adam and Eureka Low Grade Dump Reclamation - Phoenix Gold Ltd	25 May 2012
File 2227/92	Mining Proposal	Notice of Intent to trial mine and heap leach on ML 16/24	28 July 1992
File 853/88	Mining Proposal	Notice of Intent to Mine of Mining Lease 16/24	4 July 1988
Reg ID 78351	Mine Closure Plan	Mine Closure Plan – Castle Hill & Burgundy Projects	10 May 2019
CPS 5675/4	Clearing Permit	Clearing Permit – Castle Hill Project	14 September 2018
GWL 178353(4)	Groundwater License	License to Take Water	10 March 2020

6.2 Threatened and Priority Flora

In the instance where the proposed works unexpectedly intercept Threatened or Priority flora, Evolution will cease work and seek independent management advice. Two individuals of P2 species *Eremophila praecox* have been identified within the disturbance footprint. Evolution submitted an application on 4 October 2021 for authorisation from DBCA to take the priority flora to proceed with the proposed works (Botanica, 2021c). The submission is attached as **Appendix E.**

6.3 Threatened and Priority Fauna

Baseline data indicates that the risks to local fauna species (including species of conservation significance) and the prospective habitat on which they depend is low. Malleefowl was not recorded in the survey area but have been sighted in surrounding areas. Available information therefore suggests that a breeding population of this species is unlikely to be present in the survey area, though transient non-breeding individuals may occasionally occur. The survey for the ABAB and Inland Hairstreak indicate that there is very little evidence to suggest that the species are present in the area. Any significant impact is considered unlikely (Botanica, 2021a)

In the instance where the proposed works unexpectedly intercept Threatened or Priority fauna, Evolution will cease work and seek independent management advice.

6.4 Weed Species

Eleven introduced (weed) species were recorded within the survey area. None of these species are listed as Weeds of National Significance or a Declared Pest in Western Australia (Botanica, 2021a).

To avoid the introduction of weeds, Evolution will carry out the following preventative strategies for weed management in the Project area, which will be implemented throughout the LoM:

- Inspect all vehicles and earth-moving machinery for soil/vegetation prior to entering and leaving the area to be cleared and clean;
- Ensure that no weed-affected soil or other material is brought into the area to be cleared; and
- Restrict the movement of machines and other vehicles to the limits of the areas to be cleared.

6.5 Surface Water

Local catchment areas are minor, and therefore will not require any specific management. Surface water management will be undertaken in accordance with the Castle Hill Surface Water Management Plan (AQ2, 2021) which involves directing any localised sheet flow around mine infrastructure.

From a risk management perspective, surface water management infrastructure should reduce the total risk of an unwanted event occurring such that it becomes acceptable based on DMIRS environmental objectives and can be appropriately managed (AQ2, 2021). As such, the general management objectives for the Project relating to surface water are as follows:

- Maintain the existing hydrological regime as much as is practicable.
- Mitigate impacts on surface water quality from construction and operations and contain or treat any contaminated water on-site.

- Ensure the quality of the water released from the site will not lead to significant deterioration of the water resources and environment downstream.

6.6 Hydrocarbon Spills

Due to the utilisation of heavy machinery and vehicles during the proposed works, there is a potential for minor hydrocarbon spills to occur at the Project. Hydrocarbon storage, handling, disposal, and spillage response will be managed in accordance with Evolution's existing hydrocarbon management procedures. Hydrocarbon spill kits will be available to manage any spills from machinery. Management measures include:

- Ensure hydrocarbon spill kits are closely available and fully stocked;
- Ensure all mining personnel are trained to handle the different types of spills and appropriate equipment;
- Ensure all mining personnel are aware of the procedure for reporting spills; and
- Ensure the bioremediation procedure is understood by all relevant personnel.

6.7 Fugitive Dust

Due to exposure of the ground surface as a result of the proposed works, there is a potential for fugitive dust to be generated on site. To ensure dust from the project area does not cause a breach of the relevant environmental legislation, Evolution have a number of management strategies and control measures in place. These include:

- Clearing conducted only under suitable climatic conditions;
- Clearing will be minimised, and protective vegetation that provides a wind barrier will not be cleared unless necessary;
- Blasting will be conducted only under suitable climatic conditions;
- Vehicle traffic will be confined to established roads and tracks as much as possible;
- Dust will be suppressed by water carts using hypersaline water sourced from the nearest open pit;
- Ensure water suppression is occurring within pits during open cut operations; and
- Inductions and training of employees and operators on site will identify the potential impact of dust generation on the nearby community.

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Appendix A:

Landloch Soil Characterisation

2021

MUNGARI GOLD OPERATION

SOIL CHARACTERISATION REPORT

Evolution Mining Pty Ltd

February 2021

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Project Number: 2251.20a

Report Title: Mungari Gold Operation - Soil Characterisation Report

Client: Evolution Mining Pty Ltd

Review History

Version Number	Prepared by:	Reviewed by:	Date
Rev 0 (Draft)	D. O'Riley, Evan Howard	C. Lison, E. Howard	16/02/2021
Rev 1 (Final)	D. O'Riley	E. Howard	25/02/2021

EXECUTIVE SUMMARY

Evolution Mining (Evolution) are currently undertaking a feasibility study for the proposed development areas of the Mungari Gold Operation. Landloch was engaged by Evolution to undertake a baseline soil characterisation assessment to support their mining proposal application. This report outlines the findings of the soil characterisation study.

The aim of this soil characterisation study is to:

- A description of the type and characteristics of the topsoils and subsoils;
- Classification of the soils in line with the Australian Soil Classification (ASC) and Soil Groups of WA (SGWA);
- Integration of previous soil mapping undertaken within the project areas;
- The allocation of Soil Mapping Units (SMUs) on the basis of soil's properties;
- Mapping of the ASC, SGWA, and SMUs;
- Estimations of soil stripping depth and useable soil volumes;
- Soil handling recommendations; and
- Beneficial soil properties and soil limitations, and associated soil amelioration recommendations.

In order to complete the soil characterisation a review of the existing information relating to soils including land system and broadscale soils mapping, previous soil assessments, vegetation mapping, available elevation data, and aerial imagery was undertaken to gain an understanding of the existing soils on site. Thereafter, a targeted soil and landform survey and sampling program was conducted. Site information, soil profile descriptions, and baseline soils data were recorded at each of the soil inspection sites

Seventy-five soil samples from soils found at 20 sites were collected. Soils were assessed for a range of parameters in line with the Draft Guidance – Material Characterisation Baseline Data Requirements for Mining Proposals (DMP 2016). An outline of the methods used is given in Section 2 of the report, and results and their interpretation are presented in Sections 3 and 4, respectively. Tables of the complete data are provided as appendices.

Three soil mapping units were defined within the survey areas:

- Deep Gradational Soils: These soils covered 38% of the Castle Hill survey area and 43% of the Burgundy survey area. Their key defining attribute is their deep profile that grades from loams at the surface to medium clays at depth.
- Shallow Loam over Weathered Rock: These soils covered 46% of the Castle Hill survey area and 49% of the Burgundy survey area. Their key defining attribute is their shallower profile that is underlain by a variety of weathered rock types.
- Shallow Sodic Soils: These soils covered 15 of the Castle Hill survey area and 7% of the Burgundy survey area. Their key defining attribute is their shallow sodic profile that is underlain by a firm calcrete layer.

The Deep Gradational Soils have a high potential for clay dispersion and structural decline. As such, these soils are not recommended to be recovered for use as a rehabilitation resource on sloping surfaces. Their use on low-gradient surfaces may also be of limited benefit due to the elevated potential to create a hardsetting and impermeable surface layer. They should only be stripped and stockpiled if absolutely necessary. If they are to be stripped, stripping should be limited to the surface 0.1m and the materials amended with gypsum, as outlined in section 4.6.

Subsoils (>0.15m) of the Shallow Loams over Weathered Rock are sodic to highly sodic, are likely to produce a low permeability surface if used as a surface material, and pose a risk in terms of increased erosion and reduced plant growth potential. As such, these materials were not recommended to be recovered for use as a rehabilitation resource. Topsoils (<0.15m depth) of the Shallow Loams over Weathered Rock are non-saline and sodic. Amendment using gypsum is recommended, as outlined in Section 4.6. If amended, these materials are recommended to be stripped and stockpiled for use as a future rehabilitation resource. The materials do contain an appreciable coarse fragment (that would act to reduce erosion potential). However, soils would benefit from the addition of a rock armour or tree debris to further increase their erosion resistance.

The Shallow Sodic Soils are highly sodic and contain relatively low coarse fragment abundance and small fragment sizes. These soils are prone to structural decline and have an elevated potential to create a hardsetting and impermeable surface layer. As such, these soils are not recommended to be recovered for use as a rehabilitation resource.

Particle size data for all soils at Mungari indicate that there is a low susceptibility to wind erosion.

The nutrient status for the topsoils of the Deep Gradational soils and Shallow Loam over Weathered Rock is very low to moderate (for soils of the area). Application of fertiliser is recommended. Nutrient status should be assessed for the stripped and mixed soils and compared with the results found in this study to identify fertilisation rates.

TABLE OF CONTENTS

1 INTRODUCTION

Evolution Mining Pty Ltd (Evolution) are currently undertaking feasibility studies for the proposed Mungari Gold Operation (the Project). The Project includes the development of the Castle Hill and Burgundy Mining Areas. A baseline soil characterisation survey is required to support the approvals documents and inform future management of soil resources.

Landloch Pty Ltd (Landloch) were engaged to characterise the soils within the survey area for the Project. This includes likely disturbance footprints and the land surrounding these footprints. This report presents the results of the soil characterisation survey and includes:

- A description of the type and characteristics of the topsoils and subsoils;
- Classification of the soils in line with the Australian Soil Classification (ASC) and Soil Groups of WA (SGWA);
- Integration of previous soil mapping undertaken within the project areas;
- The allocation of Soil Mapping Units (SMUs) on the basis of soil properties;
- Mapping of the ASC, SGWA, and SMUs;
- Estimations of soil stripping depth and useable soil volumes;
- Soil handling recommendations; and
- Beneficial soil properties and soil limitations, and associated soil amelioration recommendations.

1.1 Background

The Project is located ~50km north west of Kalgoorlie, within the eastern Goldfields region of Western Australia. Pre-disturbed mining areas exist within the Castle Hill mining area. These pre-disturbed areas do not contain *in-situ* (undisturbed) soils and have been excluded from the survey area. The area (in hectares) of the pre-disturbed mining areas and the total survey area, is provided in Table 1. The location of the Project and survey area is outlined in Figure 1.

Table 1: Pre-disturbed area and soil survey area.

Mining area	Pre-disturbed area (ha)	Survey area (ha)
Castle Hill	23	1,077
Burgundy	-	388
Total	**23**	**1,465**

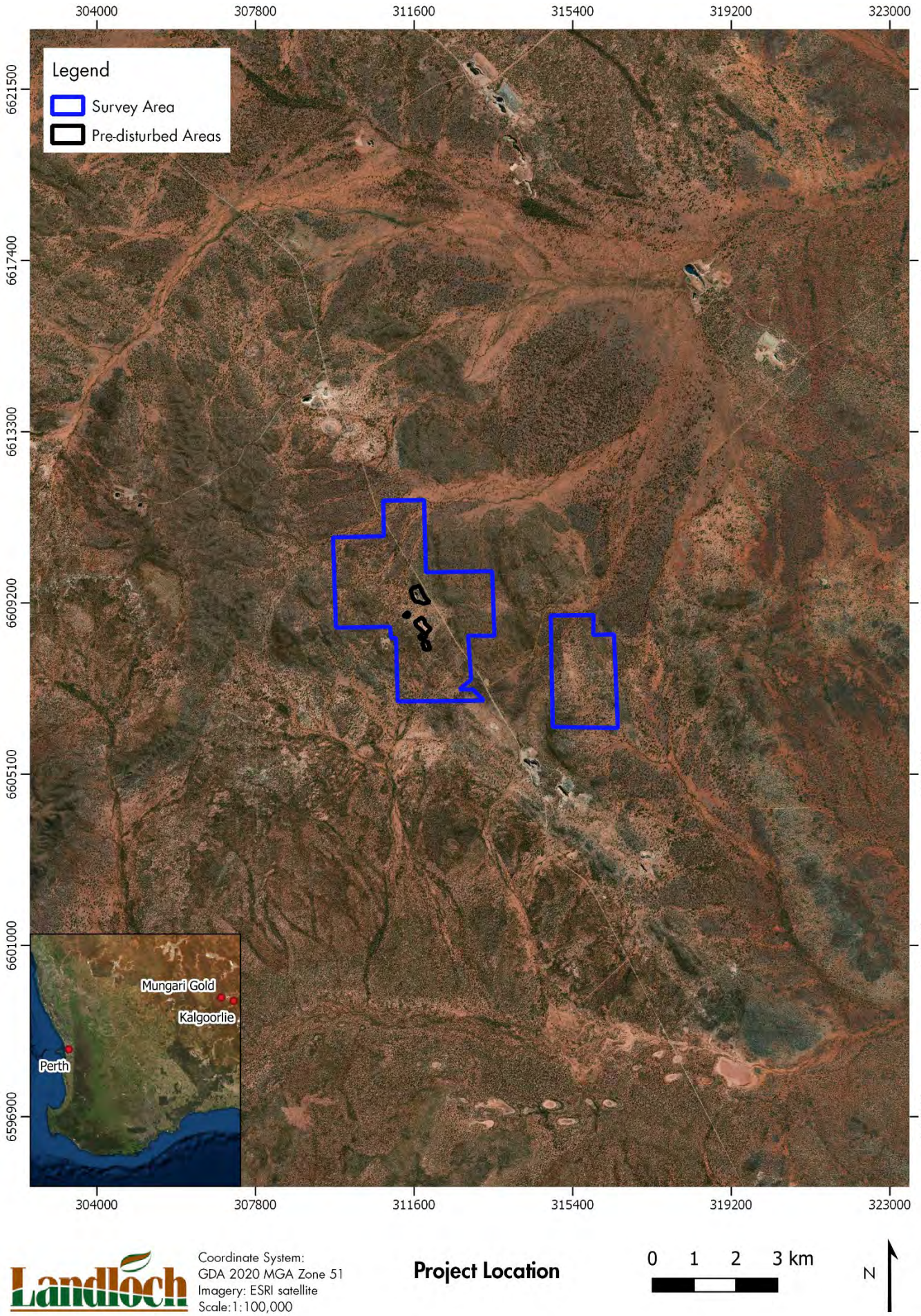


Figure 1: Project location and survey area

2 OUTLINE OF APPROACH

2.1 Regulatory requirements

The following regulatory requirements and guidelines were used to broadly guide the study.

The Department of Mines, Industry Regulation and Safety (DMIRS) Statutory Guidelines for Mine Closure Plans (DMIRS 2020a) state that, "*Comprehensive characterisation of materials (including soils and wastes) is critical to effective closure planning and successful progressive rehabilitation. This process should start during the exploration phase and continue throughout the life of the mine. Characterisation of material allows for separation and selective placement of materials considered beneficial to rehabilitation and materials that may inhibit rehabilitation.*"

Characterisation of the existing soil resource is vital, "*to maintain the variety and integrity of physical landforms so that environmental values are protected*" (EPA 2018). Soils provide both a growth medium for vegetation and influence the hydrological function of the land surface. Understanding the soil resource will assist in development of management techniques for stripping, handling, and storage of topsoil and subsoil. At closure, strategic placement of the soil resource can greatly increase the likelihood of successful rehabilitation and assist in meeting closure completion criteria.

DMIRS (formerly the Department of Mine and Petroleum, DMP (2016)) baseline soil characterisation is undertaken for the purpose of:

- Estimating the quantity and quality of the soil resource (topsoil and subsoil) including each major soil type;
- Characterising the baseline growth media attributes of each major soil type including nutrient status; and
- Evaluating potential risks associated with salinity, wind erosion, and water erosion.

The recently updated WA mining proposal guidelines (DMIRS 2020b) include the following comments (in italics) regarding materials characterisation.

Materials characterisation is a critical component of mine planning due to the large-scale physical disturbance that is associated with most mining activities. Appropriate materials characterisation:

- *helps ensure that the risk assessment is appropriately informed, and aids in responsible mine closure planning;*
- *assists in the cost-effective operation and closure of a mine;*
- *provides a basis for preventative management, appropriate use of materials and improved environmental outcomes; and*
- *can save on double handling and expensive remediation later in mine life.*

In regard to soils, it is recommended that the mining proposal addresses the following aspects:

- *A description of the major soils occurring in the project area including the indicative volume and characterisation of topsoil and subsoil available for rehabilitation.*
- *Where there are multiple soil types identified, a map showing the spatial extent of each identified soil type in the project area shall be provided. The map should include a scale bar, latitude and longitude coordinates, date of field survey, and regional map location. Soils may be classified according to the WA Soil Groups outlined in Schoknecht and Pathan (2013).*
- *Adequate characterisation of the soils to ensure that the risk posed by adverse components can be determined.*
- *Reference to the characterisation methodologies used.*
- *Interpretation of baseline data and broad implications for risk assessment and treatments.*
- *Relevant technical reports attached as appendices.*

To characterise the existing soils, a targeted soil survey and sampling program was conducted. The objective of the program was to define, map, and characterise the major soil types/associations within the Project Areas. In addition to the observations made during the field survey, laboratory analyses of selected soil samples were collected to assist with defining Soil Mapping Units (SMUs) and the limitations and opportunities that the soils present for rehabilitation and closure.

2.2 Desktop data review

A desktop data review was undertaken to consider background on landscape mapping, soils, and vegetation information for the survey area. The review is reported in the Sampling and Analysis Plan (Landloch 2020), provided in Appendix A. This information was used to identify previously collected soils data and broadly determine the variability of soils in the survey area, to assist in determining the location of soil inspection sites, and to assist in the subsequent mapping of SMUs. Locations for each of the sampling sites were selected with consideration of:

- Elevation contours;
- Landscape systems;
- Australian Soil Classification (ASC) mapping;
- Previous soil and vegetation mapping undertaken by Botanica Consulting (2014) and Soilwater Consultants (2014); and
- Aerial imagery.

2.3 Survey approach

The required scale of soil mapping and the size of the survey area dictates the number of soil inspection sites required. The inspection site density is defined in the Guidelines for Survey Soil and Land Resources (McKenzie *et al.* 2008). For the objective semi-detailed project planning, an inspection site every 20-100ha is required for the 'medium semi-detailed' (1:50,000) intensity level of assessment. This scale of mapping delineates areas of approximately 10ha in size, and details groups of soils with similar properties.

To achieve this intensity, 16 soil inspection sites at the Castle Hill area and 4 sites at Burgundy area were selected for inspection. The sites were found in the field using GPS and their location adjusted to be more representative of the surrounding areas, where deemed appropriate. In addition to the inspection sites, soil profiles at 3 pre-existing drill sump locations were photographed to provide additional profile data to assist with SMU mapping at Castle Hill. Samples were not collected from the drill sumps, only from the freshly dug soil inspection sites.

The co-ordinates and descriptions of the soil inspection sites, and drill sump/photo sites are provided in Table 2, and their locations are shown in Figure 2. All sites were positioned away from heritage exclusion zones, as provided by Evolution.

Table 2: Sample co-ordinates, site type, and assessment type (GDA 2020 Zone 51)

Site	Soil inspection site	Eastings (m)	Northings (m)	Assessment type
Castle Hill Mining Area	P1	311,569	6,610,995	Drill sump/photo
	P2	311,588	6,611,274	Drill sump/photo
	P3	311,536	6,608,982	Drill sump/photo
	S01	312,911	6,609,403	Soil survey site
	S02	312,833	6,608,831	Soil survey site
	S03	312,477	6,608,966	Soil survey site
	S04	312,139	6,609,508	Soil survey site
	S05	312,700	6,607,948	Soil survey site
	S06	311,458	6,609,278	Soil survey site
	S07	311,569	6,610,747	Soil survey site
	S08	311,118	6,610,939	Soil survey site
	S09	311,329	6,611,335	Soil survey site
	S10	310,671	6,610,191	Soil survey site
	S11	309,864	6,608,896	Soil survey site
	S12	309,755	6,609,968	Soil survey site
	S13	310,923	6,609,376	Soil survey site
	S14	310,492	6,609,388	Soil survey site
	S15	311,392	6,607,972	Soil survey site
	S16	311,321	6,607,348	Soil survey site
Burgundy Mining Area	S17	315,459	6,606,645	Soil survey site
	S18	315,965	6,606,809	Soil survey site
	S19	316,044	6,608,186	Soil survey site
	S20	315,072	6,608,489	Soil survey site

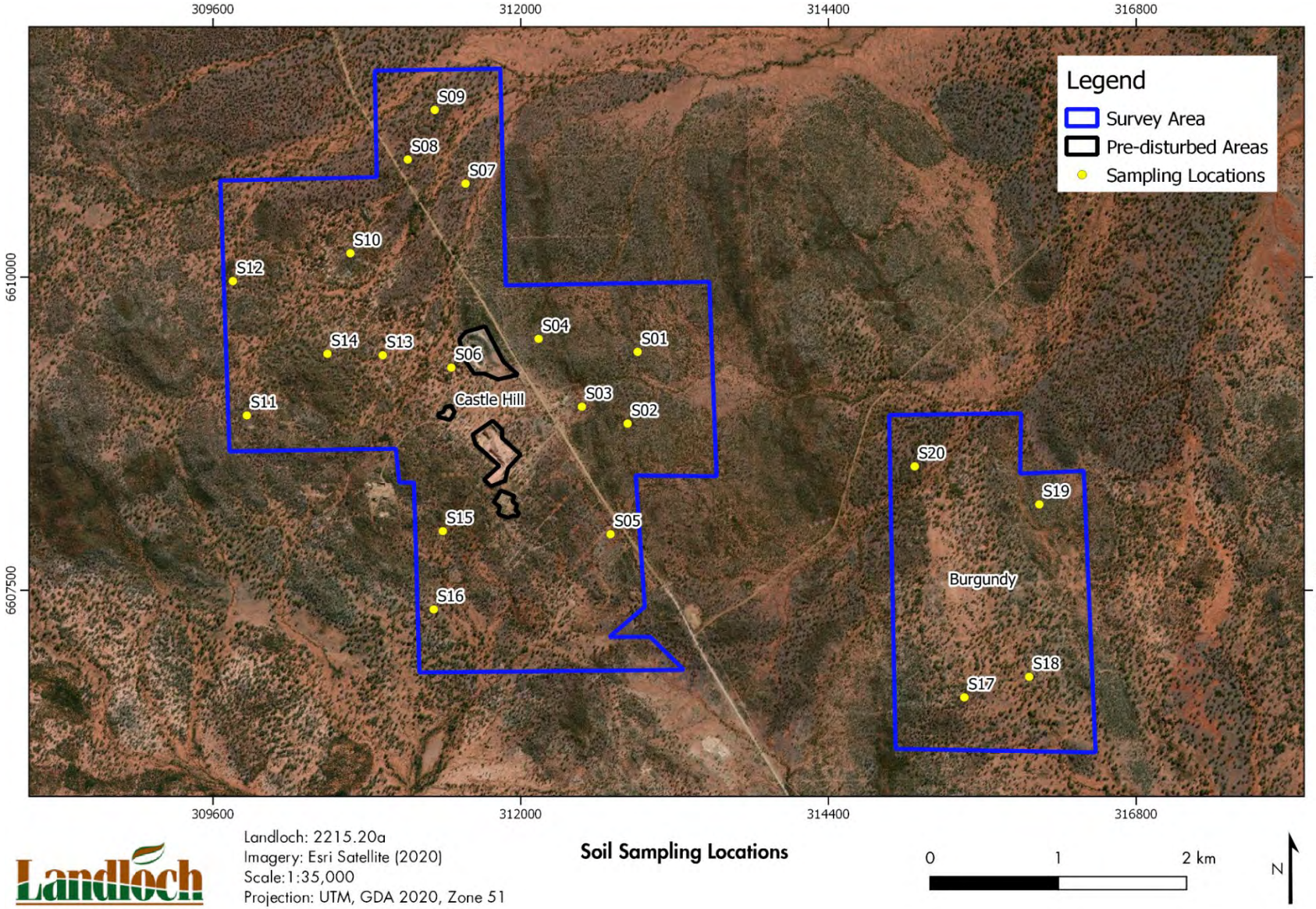


Figure 2: Soil sampling locations

2.4 Sampling methodology

The soil survey was conducted in November 2020. Images of the soil profile and surrounding areas were captured at all soil inspection sites. Site information, soil profile descriptions, and baseline soils data were recorded at each of the soil inspection sites according to the Australian Soil and Landscape Survey Field Handbook (NCST 2009).

Samples were collected from all soil inspection sites, with the number of samples varying with the depth of soil pit achieved or number of soil horizons present. A total of 75 soil samples were collected from 20 sites. One sample of the topsoil (A) horizon and 1-3 samples from the diagnostic (B) horizons were collected at each location. The landscape at all soil inspection sites were assessed in the field for:

- Vegetation forms;
- Vegetation density (estimated);
- Landform position;
- Soil surface condition;
- Surface coarse fragments;
- Rock outcropping;
- Land use;
- Erosion type, extent, and state; and
- Presence/absence of microrelief.

The soil profile at all soil inspection sites were assessed in the field for

- Horizonation;
- Horizon boundary type;
- Hand texture;
- Colour (Munsell);
- Mottling;
- Segregations;
- Coarse fragment abundance and size;
- Soil structure type and grade;
- Soil consistency; and
- Rooting depth and abundance.

All soil samples collected were transported to Landloch's soils facility in Bibra Lake, Perth and assessed for the following parameters:

- $pH_{1:5}$ (H_2O);
- $EC_{1:5}$;
- Water repellence;
- Presence of carbonates;
- Emerson dispersion test; and
- Coarse fraction percentage (>2mm diameter).

In addition to this, 19 soil samples were submitted for more detailed laboratory analysis (Table 3). The laboratory analyses were split into a topsoil characterisation suite and subsoil characterisation suite, in line with the Draft Guidance – Material Characterisation Baseline Data Requirements for Mining Proposals (DMP 2016).

Table 3: Soil laboratory analysis performed on a subset of samples.

Test Suite	Target samples	Analysis
Topsoil	'A' horizon (topsoil) generally the surface 100-200mm. Analyses include chemical and physical properties of the soil, and soil fertility. This is the soil depth that contains the majority of fertility and is supporting existing vegetation.	• $pH_{1:5}$ (H_2O) • $EC_{1:5}$ • Total Cl • Exchangeable cations (K^+, Ca^{2+}, Mg^{2+}, Na^+ & Al^{3+}) • Effective cation exchange capacity (ECEC) • Exchangeable sodium percentage (ESP) • Particle size distribution of the fine fraction (<2mm) • Organic Carbon • Total N and Total P • Available P and K (Colwell) • Available Sulphur (KCl) • Trace elements (Cu, Zn, Mn & Fe)
Subsoil	All other horizons below the topsoil. Analyses focus on chemical and physical properties of the soil, excluding fertility.	• $pH_{1:5}$ (H_2O) • $EC_{1:5}$ • Total Cl • Exchangeable cations (K^+, Ca^{2+}, Mg^{2+}, Na^+ & Al^{3+}) • Effective cation exchange capacity (ECEC) • Exchangeable sodium percentage (ESP) • Particle size distribution of the fine fraction (<2mm)

2.5 Soil classification systems

Three systems of classification were considered:

- Australian Soil Classification;
- Soil Groups and WA; and
- Soil Mapping Units.

The Australian Soil Classification (ASC) (NCST 2016) is the national system for soil classification. The scheme defines soil classes on real soil bodies using a key. Classes are allocated based on diagnostic horizons and the arrangement of materials in a vertical sequence as seen in an exposed soil profile and accounting for geographic attributes of the landform.

The Soil Groups of Western Australia (SGWA) (Schoknecht and Pathan 2013) is a Western Australia-specific standardised method that provides common names to the main soils of WA. SGWA were developed to assist with communicating information collected from land and rangeland mapping programs. Classes are allocated based on soil texture and depth.

The Soil Mapping Unit (SMU) is the basic geographic component of a soils map and can be associated with a single or multiple soil types with definable characteristics. SMUs are developed based on recurring landscape and soil attributes, with minor variations in soil properties allowable within each unit. The purpose of SMUs is to group soils by their management requirements (e.g., depth, salinity, sodicity).

3 SOIL CHARACTERISATION AND CLASSIFICATION

3.1 Soil characterisation data

Interpretation of values for pH, salinity ($EC_{1:5}$), and exchangeable cations, was based on available standards (e.g., Hazelton and Murphy 2016). Soil description sheets for each of the 13 inspection sites are provided in Appendix B. Laboratory results for the samples sent for detailed laboratory analyses are provided in Appendix C.

The soils characterisation data were used to assist in defining the different SMUs and developing boundaries for the ASC, SGWA and SMU mapping

3.2 Soil classifications

Soil classes identified by the ASC and SGWA classification schemes are presented in Tables 4 and 5, respectively. The location of ASC extents for the Castle Hill and Burgundy Mining Areas are given in Figure 3. The location of the SGWA extents is provided in Figure 4. The ASC and SGWA classifications were used to inform the classification of SMUs and correlate the soils to previous soil assessments, where possible.

3.3 Soil mapping units

Soil inspection sites were grouped into SMUs based on their management requirements, particularly their morphological properties, sodicity, and salinity.

Many subsoils at the Castle Hill and Burgundy Mining Areas, are classed as moderately to extremely saline (Hazelton and Murphy 2016). However, moderately, and extremely saline soils are not uncommon in the WA Goldfields region. Salinity tolerance values for many common rehabilitation species are consistent with high to very high soil salinity values. Salt tolerant species such as *Atriplex* and *Tecticornia* are likely to exhibit some adverse impacts on vegetation growth at $EC_{1:5}$ values greater than ~2dS/m. Salinity trials performed near Kalgoorlie indicated that soil salinity ($EC_{1:5}$) in excess of 4dS/m is likely to cause significant adverse impacts on germination and establishment of salt tolerant species. Landloch has observed poor vegetation performance – sparse vegetation that rarely grew taller than 0.1m – on waste landforms in the WA Goldfields where salinity of the growth media was approximately 7.0dS/m ($EC_{1:5}$). Given this, saline soils are defined in this report as those with $EC_{1:5}$ between 2-4dS/m. Highly saline soils have $EC_{1:5}$ >4dS/m, and non-saline soils have $EC_{1:5}$ <2dS/m.

Soils with ESP values >6% are classed as sodic (Hazelton and Murphy 2016) and may be prone to clay dispersion. Whether a soil will actually disperse and lead to structural decline (e.g., tunnelling, hardsetting, increase bulk density) is a function of not only ESP, but also clay content, coarse fragment content, total cation concentration, and salinity. Therefore, a sodic soil is defined as a soil with ESP >6%, coarse fragments (dominated by large fragments) <~40%), clay contents >10%, ECEC >3meq/100g, and exchangeable sodium concentrations >0.3meq/100g. Highly sodic soils are those with the same properties as above, but with ESP >10%.

Table 4: Australian Soil Classification of the soils within the Castle Hill and Burgundy survey areas.

Australian Soil Classification	Description	Castle Hill Sites	Castle Hill percentage of area (%)	Burgundy Sites	Burgundy percentage of area (%)
Calcarosol	Soils that are calcareous throughout the solum – or calcareous at least directly below the A1 horizon, or a depth of 0.2m (whichever is shallower).	S01, S02, S08 S09, S10, S13 S14, S16, S15	59	S17, S18, S19	5
Kandosol	Soils which lack strong texture contrast, have massive or only weakly structured B horizons, and are not calcareous throughout the profile.	S03, S04, S05 S06 S07, S11 S12	41	S20	95

Table 5: Soil Groups of WA classification of the soils within the Castle Hill and Burgundy survey areas .

Soil Group of WA	Description	Castle Hill Sites	Castle Hill percentage of area (%)	Burgundy Sites	Burgundy percentage of area (%)
Calcareous Shallow Loam	Calcareous loam over rock or hardpan at ≤0.8m.	S08, S10	14	S17	7
Calcareous Loamy Earth	Calcareous loam, may grade to calcareous clay.	S01, S02, S09 S13, S14, S16 S15	46	S18, S19	87
Red Loamy Earth	Red loam, may grade to clay, may have re/brown hardpan below 50cm.	S05, S11	15	-	-
Brown Loamy Earth	Brown loam (may be clayey at depth).	S03, S04, S06 S07, S12,	25	S20	5

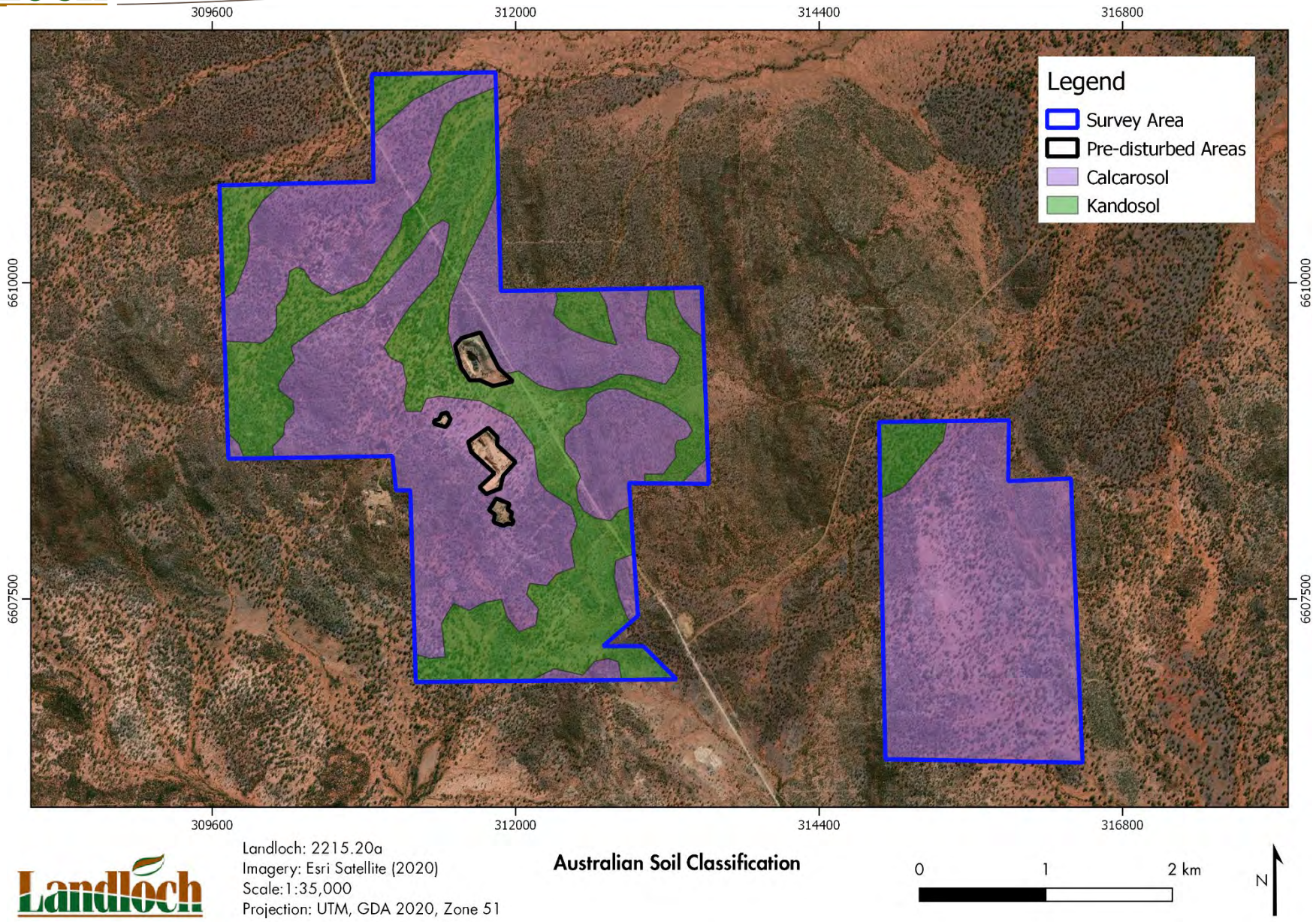


Figure 3: Australian Soil Classification

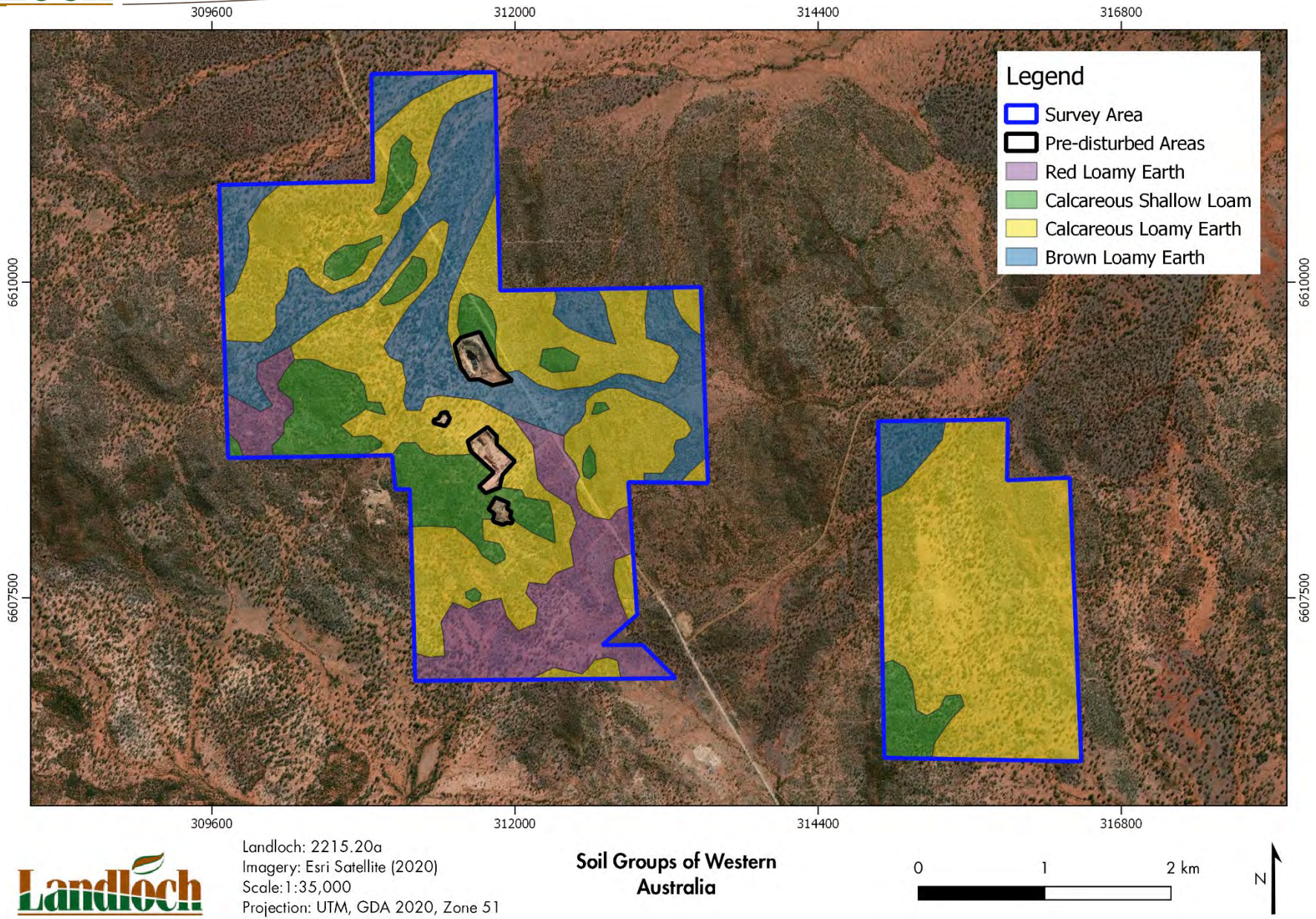


Figure 4: Soil Groups of Western Australia

Three SMUs were defined and can be broadly describes as:

- Deep Gradational Soils: Deep loamy soils throughout the profile, grading to clay at depth. This SMU is located in the low-lying areas of the Castle Hill survey area and is expected to have formed from alluvial or colluvial deposition from the surrounding hills.
- Shallow Loam over Weathered Rock: Shallow loamy soils overlying weathered rock. This SMU is generally located in the mid-slope areas of the survey areas. The soils are expected to have formed from a combination of pedogenic and depositional origin.
- Shallow Sodic Soils: Shallow Sodic Soils overlying a very firm calcrete layer. The topsoils are generally sodic with potential for clay dispersion. This SMU is located on the hill tops and ridges of the survey area.

The percentage of each area contained within each SMU and their associated soil inspection sites are provided in Table 6. The locations of SMUs for the Castle Hill and Burgundy Mining Areas are shown in Figure 5. Examples of a soil profile and detailed descriptions of the soils within each SMU are provided below.

Table 6: Percentage of area and associated soil inspection sites for each SMU.

SMU	Castle Hill		Burgundy	
	Inspection sites	% of area	Inspection sites	% of area
Deep Gradational Soils	S03, S05, S06, S07 S09, S12	38	S18	43
Shallow Loam over Weathered Rock	S01, S02, S04, S08 S11, S13, S14, S15 S16	46	S19, S20	49
Shallow Sodic Soils	S8, S10	15	S17	7

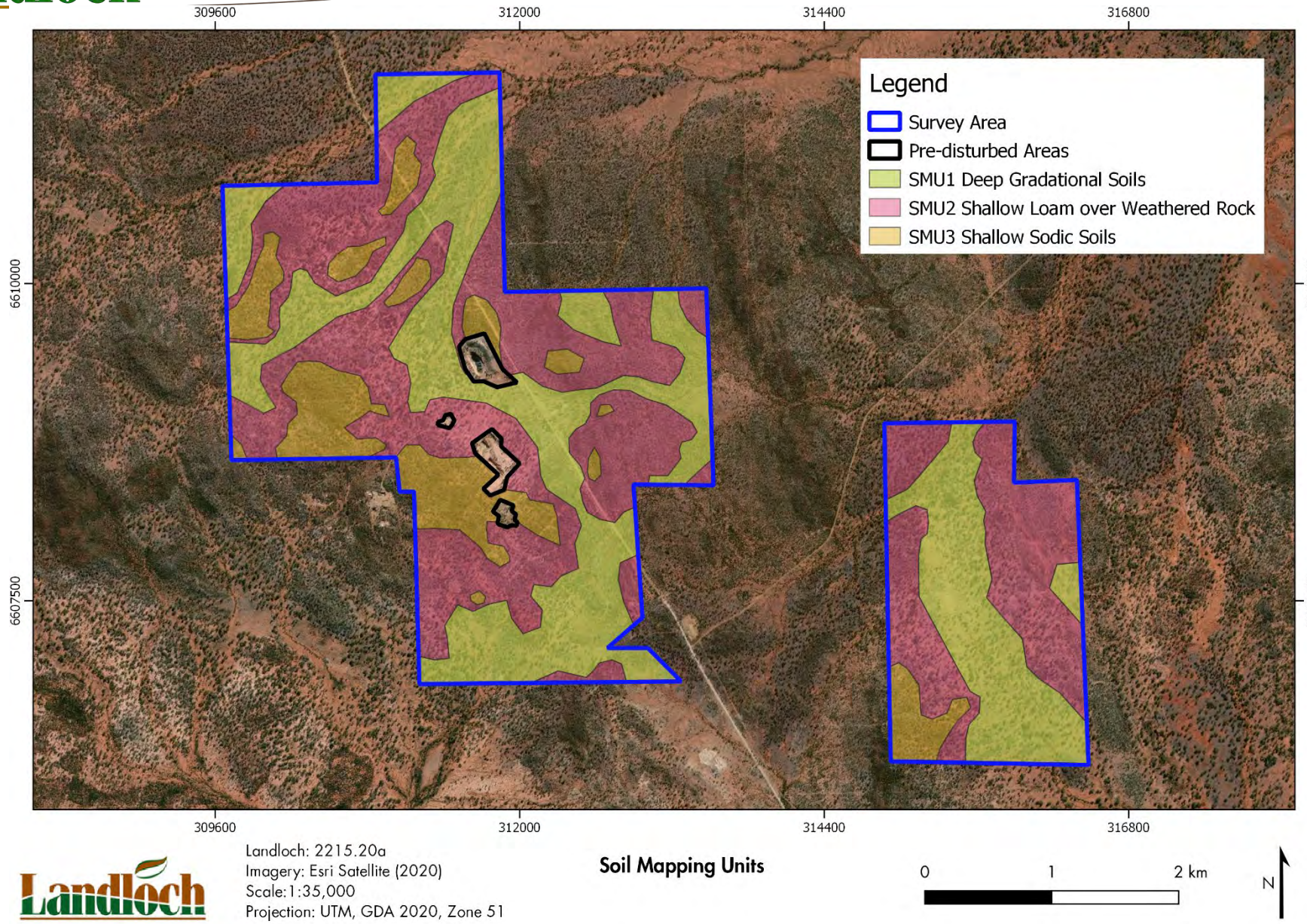


Figure 5: Soil Mapping Units

3.3.1 Deep Gradational Soils

Deep Gradational Soils were found in low lying areas or open depressions and are expected to have formed from deposition of eroded materials from the surrounding hills (although minor pedological development is present within some of the soil profiles). Coarse fragment abundance was found to be lower in these areas, likely due to the alluvial origin of the soils preferentially transporting and depositing smaller materials. Vegetation was sparse to very sparse.

The topsoils are non-saline and variably sodic, and the subsoils are variably saline and highly sodic. The soils were generally neutral to moderately alkaline throughout the profile with distinct layers of carbonates present at depths >200mm in some areas. The key defining attribute of the Deep Gradational Soils is their deep profile that grades from loams at the surface to medium clays at depth (Table 7).

The typical characteristics of the Deep Gradational Soils are:

- Loam surface texture grading to clay at depth.
- Subsoils generally consisted of calcareous nodules of varying quantities, with a developing calcrete layer present in some areas at depths >~200mm.
- Weak surface consistency grading to massive or single grain consistency at depth.
- Low abundance of surface coarse fragments, with a slight increase in size and abundance of coarse fragments with depth.
- Few very fine roots present at depths <450mm only, with the exception of inspection sites S05 and S06 where roots were observed at depths <850mm.
- Alkaline pH to highly alkaline throughout the profile (except for S06 where the B2 horizon soil is slightly acid).
- Non-saline topsoils, overlying variably saline subsoils ranging from non-saline to highly saline.
- Variably sodic topsoils ranging from non-sodic to highly sodic, overlying highly sodic subsoils.
- Very low to low fertility throughout the profile.

Table 7: Typical material characteristics of the Deep Gradational Soils.

Characteristics	Topsoil	Subsoil	Subsoil
Horizon	A	B1	B2
Depth (mm)	0-150	150-600	600-1200
Texture (class)	Sandy loam - clay loam	Sandy clay loam - light medium clay	Light clay - heavy medium clay
Structure (grade)	Weak	Weak - moderate	Massive - single grain
Consistency	Weak (dry)	Very weak - weak (dry)	Weak - very firm (dry)
Coarse fragments	2-10% 2-6mm	2-15% 2-10mm	2-20% 2-30mm
pH	8.5 - 9.3 (8.5)	8.0 - 9.0 (8.5)	6 - 9.5 (8.5)
Salinity (dS/m)	0.1 - 0.8 (0.3)	0.7 - 4.3 (1.9)	0.6 - 5.5 (3.3)
Sodicity, ESP (%)	3.9 - 19.1 (11.5)	14.2 - 43.2 (27.2)	33.8 - 37.7 (35.8)
Emerson Class	1 - 6	1 - 4	2 - 4
Fertility Class	Very low - moderate	Very low - moderate	-

Soil Mapping Unit: Deep Gradational Soils

Representative Site No: S03

Landform: Open depression

Micro-relief: N/A

Dominant Vegetation: Woody

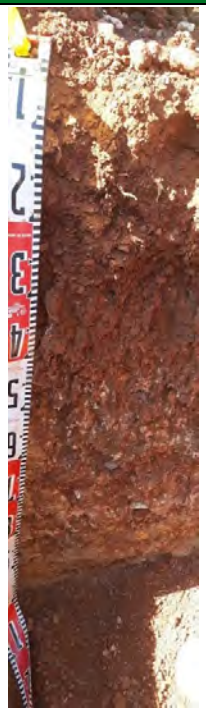
Surface condition: Cracking

Surface cover: Gravels 30%, leaf litter 5%. drainage line area

Site Drainage: Imperfectly drained

Australian Soil Classification: Kandosol

General comments: Ground cover very sparse – site subjected to grazing

Landscape Photos	Profile Photo	Horizon	Moist Colour	Texture	Structure	Consistence	Rooting depth	$pH_{1:5}$ & $EC_{1:5}$
		A	2.5YR 2.5/4 Dark reddish brown	Sandy Loam (fine)	Polyhedral	Weak (dry)	"Common (10-25)" "Medium (2-5 mm)"	pH: 7.6 EC: 0.1dS/m
		A1	2.5YR 2.5/4 Dark reddish brown	Sandy Clay Loam	Polyhedral	Weak (dry)	"Few (1-10)" "Very fine (<1 mm)"	pH: 8.6 EC: 0.7dS/m
		B	2.5YR 3/6 Dark Red	Light Medium Clay (coarse sandy)	Granular	Very firm (dry)	"No roots (0)"	pH: 9.5 EC: 0.6dS/m

3.3.2 Shallow Loam over Weathered Rock

Shallow Loam over Weather Rock was found on the mid-slope areas of the survey areas and are expected to have formed from a combination of pedogenic and depositional processes.

Appreciable coarse fragment abundance was observed. Vegetation was sparse. The topsoils are non-saline and variably sodic, and the subsoils are variably saline and highly sodic. The soils were generally neutral to highly alkaline throughout profile, with a trend of increasing pH with depth. The key defining attribute of the Shallow Loam over Weathered Rock is their shallower profile that is underlain by a variety of weathered rock types (Table 8).

The typical characteristics of the Shallow Loam over Weathered Rock are:

- Loam surface texture grading to clay at depth.
- Weak to moderate surface consistency grading to massive or single grain at depth.
- Moderate to high abundance of surface coarse fragments, with a slight increase in size and abundance of coarse fragments within the profile with depth.
- Few to common roots present at depths <200mm, with fewer finer roots below this depth.
- Slightly to highly alkaline pH in the surface, trending to highly alkaline throughout the profile.
- Non-saline topsoils, overlying variably saline subsoils ranging from non-saline to highly saline.
- Variably sodic topsoils ranging from non-sodic to highly sodic, overlying highly sodic subsoils.
- Very low to moderate fertility throughout the profile.

Table 8: Typical material characteristics of Shallow Loam over Weathered Rock with averages shown in brackets.

Characteristics	Topsoil	Subsoil	Subsoil
Horizon	A	B1	B2
Depth (mm)	0-150	150-500	500-1200
Texture (class)	Sandy clay loam - loam	Sandy clay loam - light clay	Sand - Medium clay
Structure (grade)	Weak - moderate	Massive - moderate	Massive - single grain
Consistency	Very weak - weak (dry)	weak (dry)	Loose - strong (dry)
Coarse fragments	12 - 43% 2-20mm	11.6 - 67.8% 6-50mm	26.0 - 70.6% 6-60mm
pH	7.5 - 8.8 (8.5)	8.0 - 9.0 (8.5)	8 - 9.6 (8.5)
Salinity (dS/m)	<0.1 - 0.3 (0.2)	0.1 - 4.7 (1.1)	0.4 - 3.0 (1.3)
Sodicity, ESP (%)	4.9 - 11.4 (8.1)	6.2 - 46.0 (17.0)	41.0 - 53.2 (47.1)
Emerson Class	4 - 5	2 - 5	2 - 4
Fertility Class	Very low - moderate	Very low - moderate	-

Soil Mapping Unit: Shallow Loam over Weathered Rock

Representative Site No: S01

Landform: Mid-slope

Micro-relief: N/A

Surface condition: Soft

Dominant Vegetation: Woody

Surface cover: 30% leaf litter, 15% coarse fragments.

Site Drainage: Moderately well-drained

Australian Soil Classification: Calcarosol

General comments: N/A

Landscape Photos	Profile Photo	Horizon	Moist Colour	Texture	Structure	Consistence	Rooting depth	$pH_{1:5}$ & $EC_{1:5}$
		A	2.5YR 2.5/4 Dark reddish brown	Sandy Clay Loam	Polyhedral	Weak (dry)	"Common (10-25)" "Fine (1-2 mm)"	pH: 7.5 EC: 0.1dS/m
		B1	2.5YR 4/4 Reddish brown	Clay Loam	Polyhedral	Weak (dry)	"Few (1-10)" "Medium (2-5 mm)"	pH: 8.5 EC: 0.2dS/m
		B2	2.5YR 5/4 Reddish brown	Light Clay (coarse sandy)	Platy	Firm (dry)	"Few (1-10)" "Very fine (<1 mm)"	pH: 8.5 EC: 0.4dS/m

3.3.3 Shallow Sodic Soils

Shallow Sodic Soils were shallow soil overlying a very firm calcrete layer found on the hill tops and ridges of the survey area. Appreciable coarse fragment abundance was observed. Vegetation was sparse. The topsoils are non-saline and highly sodic, and the subsoils are variably saline and highly sodic. The soils were generally slightly acidic to neutral in the surface, increasing to highly alkaline throughout profile. The key defining attribute of the Shallow Sodic Soils is their shallow sodic profile that is underlain by a firm calcrete layer (Table 9).

The typical characteristics of the Shallow Sodic Soils are:

- Loam surface texture through the profile above the calcrete layer.
- Very weak to weak surface consistency grading to very firm to rigid consistency at depth.
- Moderate to high abundance of surface coarse fragments, continuing to be abundant within the profile to a depth of ~150mm where coarse fragment abundance decreases.
- Few to common roots present at depths <150mm, with fewer to no roots below this depth.
- Slightly acidic to neutral pH in the surface, trending to highly alkaline in the profile.
- Non-saline topsoils, overlying variably saline subsoils ranging from non-saline to saline.
- Highly sodic topsoils and subsoils.
- Very low to low fertility throughout the profile.

Table 9: Typical material characteristics of Shallow Sodic Soils with averages shown in brackets.

Characteristics	Topsoil	Subsoil
Horizon	A	A1
Depth (mm)	0-150	150-1000
Texture (class)	Loam - sandy clay loam	Sandy clay loam - sand
Structure (grade)	Weak	Massive - single grain
Consistency	Very weak - weak (dry)	Very firm - rigid
Coarse fragments	~10-40% 2-6mm	2-5% 2-6mm
pH	6.5 - 7.6 (7.5)	8.0 - 9.1 (8.5)
Salinity (dS/m)	<0.1 - 0.6 (0.1)	0.3 - 1.28 (1.0)
Sodicity, ESP (%)	41	6.37 - 41.5 (23.9)
Emerson Class	3	3 - 5
Fertility Class	Very low - low	Very low

Soil Mapping Unit: Shallow Sodic Soils

Representative Site No: S10

Landform: Mid-slope

Micro-relief: N/A

Surface condition: Firm

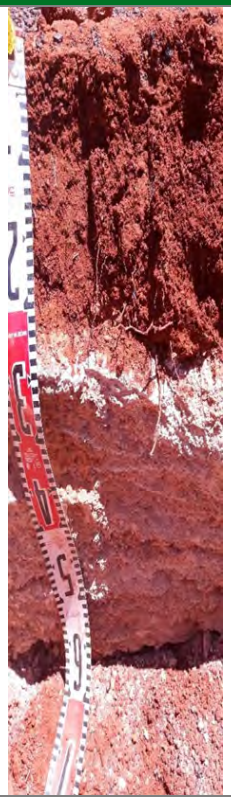
Dominant Vegetation: Woody

Surface cover: 70% gravels, 10% leaf litter. small trees thicker in this area.

Site Drainage: Moderately well-drained

Australian Soil Classification: Calcarosol

General comments: Slightly rocky, grazed

Landscape Photos	Profile Photo	Horizon	Moist Colour	Texture	Structure	Consistence	Rooting depth	$pH_{1:5}$ & $EC_{1:5}$
		A	2.5YR 3/6 Dark Red	Sandy Loam	Polyhedral	Very weak (dry)	"Common (10-25)" "Fine (1-2 mm)"	pH: 6.5 EC: 0.1dS/m
		B	2.5YR 4/6 Red	Loamy Sand (coarse)	Platy	Rigid (dry)	"No roots (0)"	pH: 8.5 EC: 0.3dS/m

4 SOIL MANAGEMENT

4.1 Limitations and benefits

4.1.1 Deep Gradational Soils

The Deep Gradational Soils are alkaline (8.0-9.5). These values are consistent with pH values that support vegetation in the region and on site. As such, it can be assumed that the pH of the Deep Gradational Soils will not adversely affect vegetation establishment or growth.

The salinity values of the Deep Gradational Soils are low in the surface 0.15m, and typically <2dS/m at depths less than 0.6m. The subsoils deeper than 0.5-0.6m are more saline and are likely to cause some adverse effects for plant growth and establishment, particularly where $EC_{1:5}$values exceed 4dS/m.

Sodic soils can be prone to clay dispersion provided that there is sufficient dispersive clay to cause structural decline. A high abundance of coarse fragments, a low clay content, or low total cation concentrations may mean that soils that are sodic by definition may not be prone to structural decline. The Deep Gradational Soils are typically highly sodic throughout the profile (ESP, 11.5-35.8%). They also have appreciable clay content and low abundance of coarse fragments. Therefore, these soils pose a high risk of clay dispersion and structural decline. Soil structural decline may manifest itself by the development of tunnel erosion, hardsetting surfaces, increased soil bulk densities, and lower water holding capacity and plant growth potential.

The arid zone soils in the region are characterised by their low fertility (Bettenay 1983). This reflects their deep weathering, strong leaching, overgrazing, low rainfall, and little input of organic material. The vegetation of the region has adapted to grow in these conditions. Fertility of the Deep Gradational Soils was assessed to a depth of 0.6m. Total Nitrogen and organic Carbon of the Sodic Saline Soils was low and may affect plant growth. Levels of Total Phosphorous and available Phosphorous and Potassium are considered to be sufficient for vegetation growth in the region.

4.1.2 Shallow Loam over Weathered Rock

The Shallow Loam over Weathered Rock soils are alkaline (8.5). Again, these values are consistent with pH values that support vegetation in the region and on site. As such, it can be assumed that the pH of the Sodic soils will not adversely affect vegetation establishment or growth.

The salinity values of the topsoils (0-0.15m) are low (<0.3dS/m) and will not cause adverse effects on plant growth or establishment. The subsoils (>0.15m) have variable salinity with average values of <1.3dS/m, meaning that salinity of the subsoils may limit the growth of some salt sensitive species, but they will not preclude growth of more salt tolerant species. Therefore, if salt tolerant species are included in rehabilitation plans, the salinity will not cause adverse effects on plant growth in soils shallower than 1.0-1.2m. Thorough mixing of the stripped subsoil materials during stripping and stockpiling is recommended to reduce the impact of the localised elevated levels of salinity in the materials at S11, S14 and S15.

Shallow Loam over Weathered Rock soils are sodic near the surface (0-0.15m) and highly sodic throughout the remainder of the profile (ESP: 17-47.1%). These sodic subsoils also tend to have high abundance of coarse fragments (10-70%) up to 50-60mm in diameter. This coarse fraction will counteract some of the impacts of dispersion (e.g., tunnel erosion). However, these subsoils are likely to set hard and be quite impermeable and resistant to root penetration.

In terms of fertility, levels of Total Nitrogen, Total Phosphorous, and available Phosphorous and Potassium are considered to be sufficient for vegetation growth in the region. However, there is expected to be considerable variation in these values within the SMU.

4.1.3 Shallow Sodic Soils

The Shallow Sodic Soils are slightly alkaline to moderately alkaline (7.5-8.5). These values are consistent with pH values that support vegetation in the region and on site. As such, it can be assumed that the pH of these soils will not adversely affect vegetation establishment or growth.

Shallow Sodic Soils are non-saline in the surface, and saline in the subsoils. That said, the salinity of the subsoils (1.0dS/m) will not have adverse effects on the growth of salt tolerant plant species. Salt sensitive species may be affected.

The topsoils (<0.15m) are highly sodic (ESP 41%), as are the subsoils (ESP 23.9%). The coarse fragment abundance within the topsoils can be appreciable, however the size of the fragments tends to be small (2-6mm). The coarse fragment size and abundance of the subsoils are both low. Therefore, these soils pose a high risk of clay dispersion and structural decline. Soil structural decline may manifest itself by the development of tunnel erosion, hardsetting surfaces, increased soil bulk densities, and lower water holding capacity and plant growth potential.

Fertility of the Shallow Sodic Soils was assessed to a depth of 0.5m. Levels of organic Carbon and Total Nitrogen were low. Levels of Total Phosphorous and Available Phosphorous and Potassium are considered to be sufficient for vegetation growth in the region.

4.2 Soil handling

4.2.1 Stripping

4.2.1.1 Deep Gradational Soils

Due to the high potential for structural decline of the topsoils and subsoils from this SMU, these soils are not recommended to be used as a rehabilitation resource on sloping surfaces. Their use on low-gradient surface may also be of limited benefit due to the elevated potential for hardsetting and impermeability. They should only be stripped and stockpiled if absolutely necessary. If they are to be stripped, stripping should be limited to the surface 0.1m and the materials amended with gypsum, as outlined in section 4.6.

For the purpose of estimating volumes of material available and considerations for these soils to be used as a rehabilitation resource, stripping of these materials have been limited to the surface 0.1m.

4.2.1.2 Shallow Loams over Weathered Rock

The topsoils of the Shallow Loams over Weathered Rock are non-saline and sodic, but do contain an appreciable coarse fragment. Gypsum can be applied to reduce sodicity of this topsoil (given that ESP values would only need to be reduced by 2-6% to render the soil non-sodic). The subsoils below 0.15m become increasingly sodic, though there remains an appreciable coarse fragment. The soils maintain suitable salinity within the surface 1.2m assessed.

These soils are likely to produce a low permeability surface if used as a surface material. Growth of vegetation into the subsoils layers is assumed to be unlikely due to the high probability that these soils would have increased bulk density that would limit root extensions. Therefore, stripping depth should be limited to the existing topsoil layer (0.15m). Use of these topsoils does pose a risk in terms of increased erosion risk and reduced plant growth potential.

4.2.1.3 Shallow Sodic Soils

These soils are highly sodic and contain relatively low coarse fragment abundance and small fragment sizes. They are prone to structural decline. Due to the high potential for structural decline of the topsoils and subsoils from this SMU, these soils are not recommended to be used as a rehabilitation resource on sloping surfaces. Their use on low-gradient surface is likely to result in poor rehabilitation outcomes due to the elevated potential for hardsetting and impermeability. Their stripping and stockpiling are not recommended.

4.2.2 Stockpiling

Topsoils are more likely to have a higher store of organic matter, soil biology, and seed bank than subsoils. As such, any topsoils that are stripped should be stockpiled separately from any other materials that are stockpiled for use. Stripping and stockpiling of subsoils below 0.15m depth is not recommended for any SMU. Generally, topsoil stockpiles are constructed to depths of ~1-2m to reduce the degradation of the seed bank and nutrient levels present.

Topsoil stockpiles could be actively managed to maintain their fertility and biomass by seeding. Soils shown to be sodic could also be amended with gypsum during stripping, with the gypsum being given time to be effective at reducing ESP while the soils are stockpiled. For amendment with gypsum to be effective as quickly as possible, shallow stockpiles are encouraged.

For the Shallow Loam over Weathered Rock SMU, a higher abundance of rock was observed at depth. Landloch recommends that this rock layer be further assessed to determine the rock durability and potential for structural decline. Based on the data

available and observations made in the field, it is expected that the rock will be weathered and not sufficiently durable to consider it for use as a rehabilitation resources. Hence these materials are currently not being recommended for stockpiling. If, however, they are shown to be useful through further testing, they could be considered for use as armouring and erosion protection.

4.3 Soil volumes

Estimated volumes of soils that can be stripped for rehabilitation are not provided because the disturbance footprints are yet to be defined. In order to calculate these volumes, the disturbance footprints from which soils can be stripped should be compared against the SMUs extents given in this report. The resultant areas of each SMU within the disturbance footprint should be multiplied by these values to give a soil reserve volume (m^3) available for future rehabilitation:

- Deep Gradational Soils – disturbance footprint (m^2) x 0.15m
- Shallow Loams over Weathered Rock – disturbance footprint (m^2) x 0.15m
- Shallow Sodic Soils – not to be stripped

4.4 Wind erosion

The susceptibility of a material to wind erosion is related to the aggregated PSD (other factors such as gravel content and soil moisture also have a controlling influence in wind erosion potential) (Hazelton and Murphy, 2016). Sandy soils (>90% sand by weight), particularly those with fine sand, tend to have high wind erodibility while sandy loams to clay loams have moderate wind erodibility, and clays have low wind erodibility. Gravels and rock within the soil matrix mitigate the wind erosion risk.

Particle size data for all soils at Mungari indicate that there is a low susceptibility to wind erosion.

4.5 Water erosion

The Deep Gradational Soils and Shallow Loams over Weathered Rock soils are characterised by elevated levels of sodicity and are considered to have potential for clay dispersion. When respreading these soils as part of rehabilitation works, risks associated with erosion must be considered. Placement of sodic and potentially dispersive materials on steep batter slopes can result in significant gullies and erosion. As such, these soils are not recommended for use on slopes without:

- amendment of gypsum; and/or
- placement within a durable and competent rocky material to act as armouring of the batter; and/or
- adoption of short slope lengths.

If used on batter slopes these soils would benefit from the addition of a rock armour or tree debris to reduce the impact of overland flows on the materials. Use of engineered structures such as cross-slope berms pose an increased risk of landform failure as these

materials may result in failure of these structures to retain the runoff they are designed to control.

Further erodibility testing would be required to confirm the limitations in terms of acceptable slope lengths, gradients, and batter profile shapes. This testing could also consider the impacts of the addition of rock or tree debris as armouring elements and the risks posed by berms and other flow control structures (sizing of these structures such that the risk of dispersion is reduced would form part of this testing and assessment).

4.6 Soil amendments

The nutrient status of the soils across the survey area is very low to moderate. However, native vegetation is adapted to grow in low nutrient status conditions. For rehabilitation, it is recommended to replace, or supplement nutrients lost through disturbance to encourage rapid establishment of vegetation.

Application of fertiliser to the topsoil is recommended based on the loss of nutrients caused by the removal of vegetation, disturbance of the soil, and the likely respreading of soil in a thin layer over less fertile waste materials. Rates of fertilisation should be assessed once the soils are stripped and mixed. Once collected, data for these disturbed soils could be usefully compared against the fertility found in this report.

Where the addition of gypsum is recommended, the following rate is suggested, though the response of the soils to treatment of gypsum, including the time taken for gypsum to be effective in reducing sodicity should be tested as part of a field trial:

- Topsoils (<0.15m), 3.0t/ha

These rates are calculated based on a bulk density of 1.4g/cm^3, and a target ESP value of 4%. Gypsum is not highly soluble, and is relatively slow to take effect. For that reason, it is highly desirable for gypsum to be applied to soils prior to stripping and stockpiling, rather than applied at the time of rehabilitation works and seeding. Prior to respreading the ESP of the soils should be reassessed to determine whether the gypsum has been effective in reducing ESP.

4.7 Summary

The limitations, opportunities, growth media potential, erosion potential and recommendations for use as rehabilitation materials for the soils found within each SMU are summarised in Table 10.

Table 10: Summary of the key limitations, opportunities and suitability for rehabilitation of the soils within each SMU.

Material	Topsoil/ subsoil	Limitation	Opportunities	Suitability for rehabilitation
Deep Gradational Soils	Topsoil	• Sodic - highly sodic topsoils. • High percentage of fines with little rock present. • Potentially dispersive with a high potential for structural decline.	• pH values that support vegetation in the region and on site. • Good capacity to hold water and nutrients due to their elevated clay content. • Non-saline. • Low susceptibility to wind erosion.	**Not recommended for use on sloping surfaces or flat areas due to their potential for clay dispersion and structural decline. If absolutely necessary, stripping should be limited to a depth of 0.1m and amendment with gypsum should be undertaken, as outlined in Section 4.6. Thereafter further analysis of the soils is recommended to assess the materials suitability as a rehabilitation material for slopes and low-gradient areas.**
	Subsoil	• Highly sodic subsoils. • Some areas of highly saline materials. • Potentially dispersive with a very high potential for structural decline. • Very low potential to support vegetation. • Very low potential to remain stable on any sloping surface.	• pH values that support vegetation in the region and on site. • Good capacity to hold water and nutrients due to their elevated clay content. • Low susceptibility to wind erosion.	Not recommended for use as a rehabilitation material.
Shallow loams over Weathered rock	Topsoil	• Sodic topsoils. • Potenially dispersive with potential for structural decline. • Reduced growth of vegetation into the subsoils is assumed to be unlikely due to the high probability that these soils would have increased bulk density that would limit root extensions.	• pH values that support vegetation in the region and on site. • Coarse fragments available (though requires further testing to determine their competence and durability. • Non-saline. • An appreciable coarse fragment portion that could reduce erosion potential if used on slopes.	This material is the preferred option on site as a rehabilitation material. Amendment using gypsum is likely to reduce the material's sodicity to suitable levels, as outlined in Section 4.6. Thereafter further analysis of the soils is recommended to assess the materials suitability as a rehabilitation material for slopes and low-gradient areas.
	Subsoil	• Highly sodic subsoils. • Potenially dispersive with potential for structural decline.	• pH values that support vegetation in the region and on site. • An appreciable coarse fragment portion that could reduce erosion potential if used on slopes.	Not recommended for use as a rehabilitation material.

Material	Topsoil/ subsoil	Limitation	Opportunities	Suitability for rehabilitation
		• Likely to produce a low permeability surface layer that could possible reduced plant growth potential and increase erosion potential. • Very low potential to support vegetation. • Very low potential to remain stable on any sloping surface. • Some saline sub-soils.		
Shallow Sodic Soils	Topsoils	• Sodic – highly sodic topsoils. • They are prone to structural decline, and have low potential to remain stable on any sloping surface. • Elevated potential to create a hardsetting and impermeable surface layer. • Nutrient status is very low-low. • Low potential to support vegetation.	• pH values that support vegetation in the region and on site. • Non-saline. • Moderate-high abundance of coarse fragments.	Not recommended for use as a rehabilitation material.
	Subsoils	• highly sodic topsoils. • Slightly elevated salinity levels that would effect non-salt tolerant species. • Prone to structural decline and have an elevated potential to create a hardsetting and impermeable surface layer. • Sandy layer with very little coarse fragments. • Rigid layer at depth decreasing vegetation growth. • Nutrient status is very low-low. • Very low potential to support vegetation.	• pH values that support vegetation in the region and on site. • Some saline subsoils that may effect non-salt tolerant species.	Not recommended for use as a rehabilitation material.

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APPENDIX A – SAMPLING AND ANALYSIS PLAN

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26 November 2020

Evolution Mining (Mungari) Pty Ltd
Kundana Road
Kalgoorlie, WA, 6430

2215.20a (Rev 0)

Attn: Tari Laatz – Superintendent Environment

Sampling and Analysis Plan: Mungari Gold Operation

1. Introduction

Evolution Mining are currently undertaking a feasibility study for the proposed development areas at the Mungari Gold Operation. As part of this, a baseline soil characterisation survey is required to support their approvals documentation. This Sampling and Analysis Plan (SAP) provides the methodology for the field-based soil survey and sampling program.

The objective of the SAP is to describe the field survey and sampling program, including:

- Review existing data for the Project Area;
- Outline the proposed soil inspection sites and numbers of samples; and
- Describe the sampling procedure and the resources required.

2. The survey areas

Landloch understands that the project incorporates two separate survey areas: the Castle Hill and Burgundy proposed mining areas. The total size of the survey area is 1,492ha. Within the survey area there are areas where disturbance is planned and an area where disturbance is not planned. The area of planned disturbance is ~486ha. The size of the area where disturbance is not planned is 1,006ha. The survey area and the planned disturbance areas are shown in Figure 1.

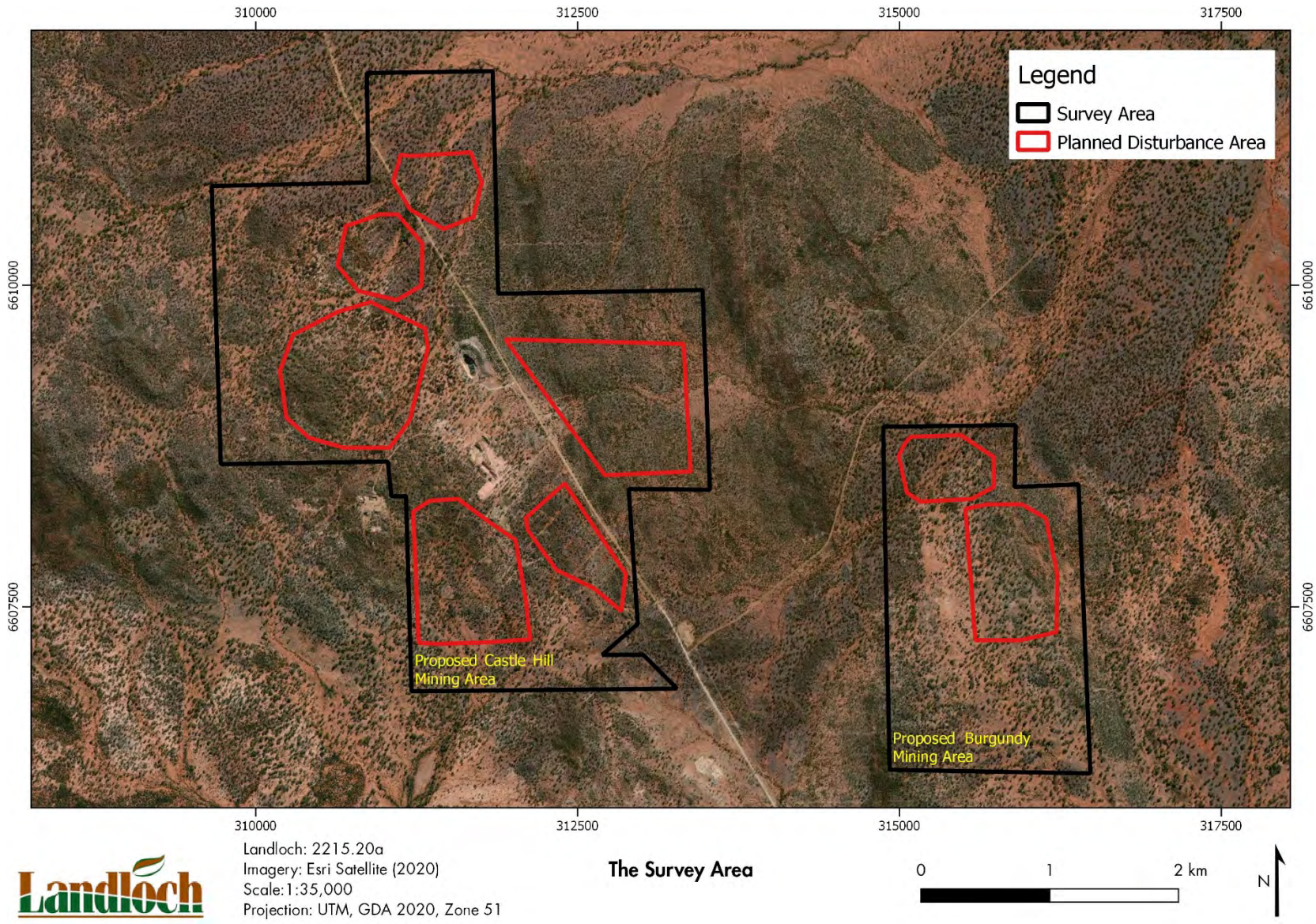


Figure 1: The survey area and areas of planned disturbance at the Castle Hill and Burgundy proposed mining areas.

3. Data review

3.1 Landscape mapping

Broadscale landscape mapping exists for the survey area. Mapping is limited to a scale of 1:3,000,000 and delineates only landscapes and broad soil types. The BB5, MX40, and MX43 landscape units are present within the survey area. They are summarised in Table 1 and shown in Figure 2.

Table 1: Summary of landscape units within the Project Area.

Landscape units	Soils (Major)	Estimated Proportion of Project Area (%)	Description
BB5	Calcareous loamy soils	78%	Rocky ranges and hills of greenstone-basic igneous rocks. Chief soils are shallow calcareous loamy soils, with shallow brown and grey-brown calcareous earths, below which weathered rock occurs at shallow depths. Associated soils include alkaline red earths, and narrow valleys with self-mulching cracking clays.
MX40	Red loamy earths	17%	Flat to undulating valley plains and pediments; some rock outcrop. Chief soils are alkaline and neutral red earths, often with a surface scatter of gravel. Red-brown hardpan frequently occurs beneath some of the soil types. Three key soil types are red loamy earths, red-brown hardpan shallow loam, and self-mulching cracking clays.
MX43	Red loamy earths	5%	Gently undulating valley plains and pediments; some outcrop of basic rock. Chief soils are alkaline red earths with limestone or limestone nodules at shallow depths on gently sloping slightly concave plains, with low gentle rises of soils. Associated soils are clay plains flanking ultrabasic rock outcrops. Soils include red loamy earths, red-brown hardpan shallow loams, calcareous loamy earths, red sandy earth, red loamy earth and self-mulching cracking clays.

3.2 Australian Soil Classification

The Australian Soil Classification (ASC) is the national system for soil classification. Broadscale ASC mapping is available on the Australian Soil Resource Information System (ASRIS)[1] which provides a high-level assessment of the soil types present across Australia. ASC mapping indicates the presence of Calcarosols and Kandosols across the survey area (Figure 3). Calcarosols are soils that are calcareous throughout the profile and do not have a clear or abrupt textural B horizon. Kandosols lack strong texture contrast and have a massive or weakly structured B horizon. These soils have a clay fraction >15% in the B horizon. Both soil types are associated with weakly structured soils with minor pedological development. As such, it can be anticipated that the soils encountered on site will be poorly developed.

[1] http://www.asris.csiro.au. accessed 14 October 2020.

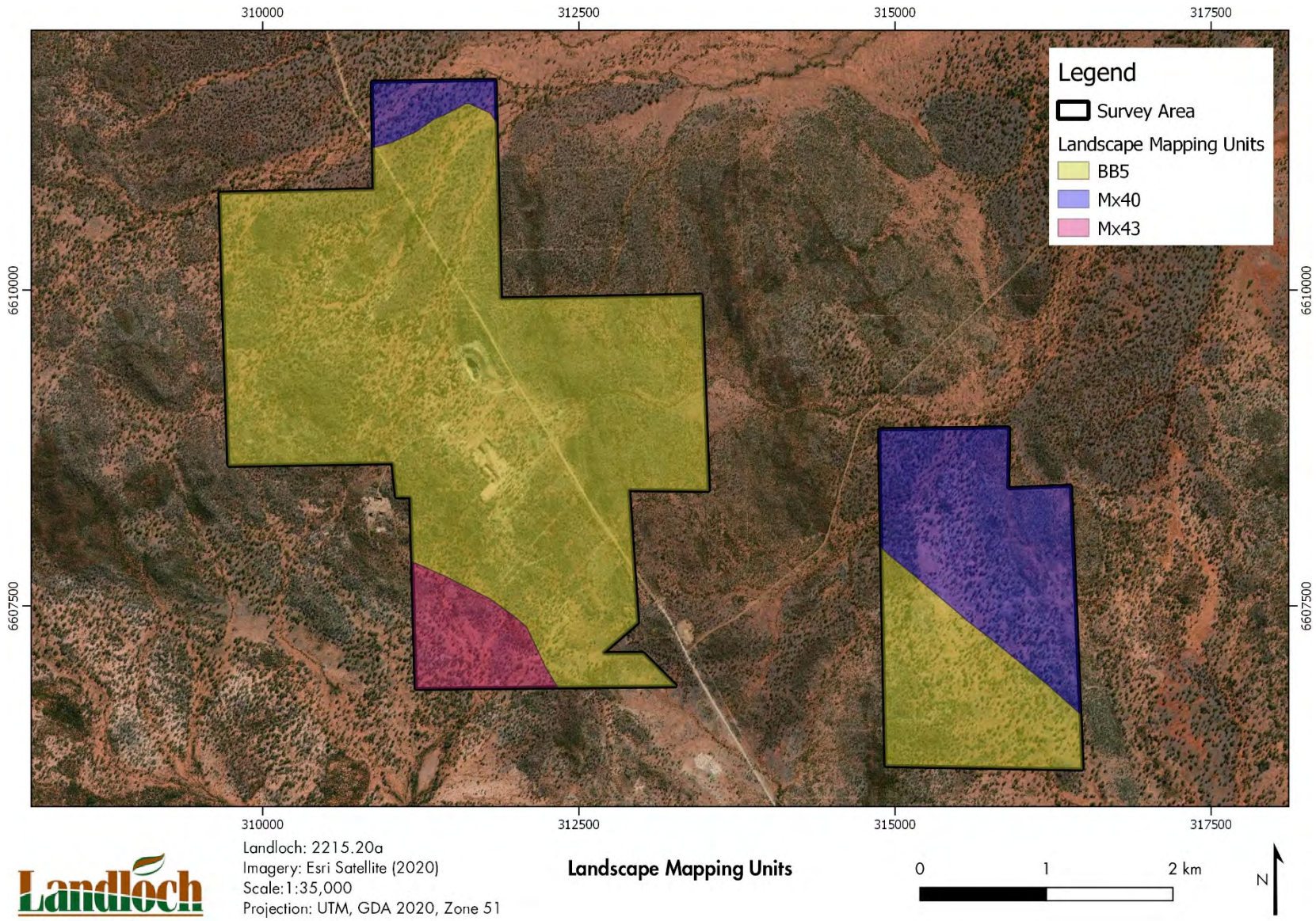


Figure 2: Landscape Mapping Units.

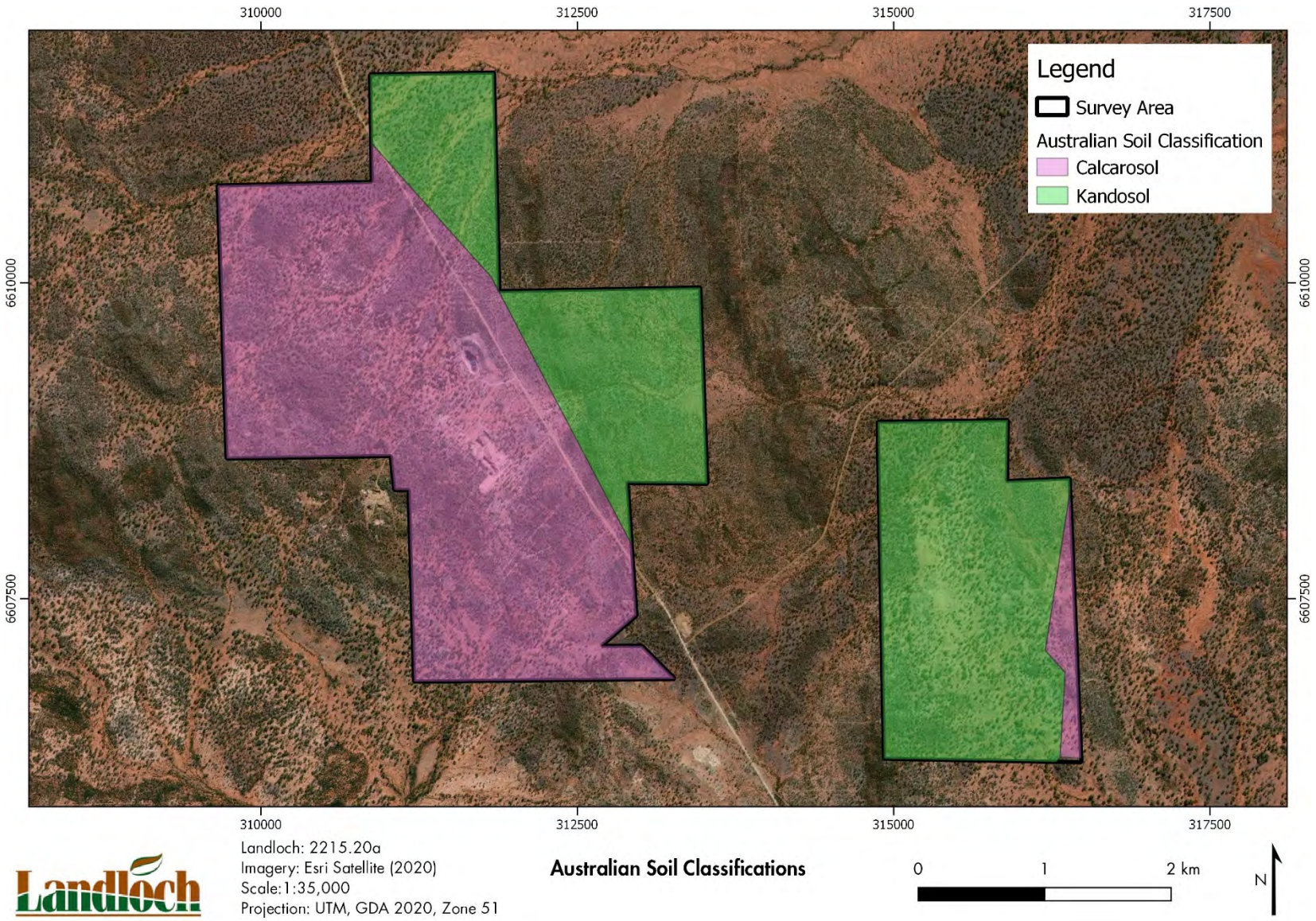


Figure 3: Australian Soil Classifications.

3.3 Previous soils mapping

Two previous soil characterisation studies of the project area have been undertaken[2,3]. Brief descriptions of the studies are given below. Botanica Consulting (Botanica) assessed the soils within the Burgundy Project Area in 2014. Soil samples were taken from depths of 0-20cm (topsoil) and 20-40cm (subsoil). The aim was to broadly characterise the physical and chemical properties of the soils within 3 vegetation communities previously identified. Soil Water Consultants (SWC) assessed the soils within the Castle Hill Project Area in 2013. The aim was to identify the soils present and to characterise their physical, chemical, and hydraulic properties. A strong correlation between soil type and landscape position was found to be prevalent in the area. A total of four Soil Mapping Units (SMUs) were mapped and defined. These are broadly outlined in Table 2. The sample locations from the Botanica and SWC soil assessments, as well as the location of SMUs identified in the SWC soil assessment, are given in Figure 4.

Table 2: SMUs identified in the SWC 2013 soils assessment.

Soil mapping unit	Description
Deep calcareous loamy earth	Typically found in the low-lying areas and consisted of a deep reddish-brown loamy profile, extending to >200cm depth, overlying a calcareous silty loam horizon at ~50cm depth.
Shallow loam over weathered rock	Typically found on the mid-slope areas and consisted of a shallow reddish-brown loam, overlying a weathered basalt at a depth of approximately 30-50cm.
Calcareous stony soil	Typically found in the hill tops and ridges and consisted of a shallow reddish-brown sandy loam, overlying a solid calcrete layer at approximately 10 – 30 cm depth.
Deep fluvial loam	Typically found within the lower plains and consisted of a deep, well-structured silty loam, overlying a series fluvial/alluvial deposition layers ranging from clays to sandy gravels.

3.4 Vegetation mapping

A change in vegetation community is often associated with a change in soil characteristics. As such, an understanding of the vegetation communities can be used as a guide for soil sampling and establishment of soil boundaries. Vegetation studies have been conducted at both the Castle Hill and Burgundy Project Areas by Botanica Consulting. Mapping and brief descriptions of the vegetation communities were provided to Landloch by Evolution and shown in Figures 5 and 6.

[2] Botanica Consulting (2014), Burgandy Project - Waste Rock and Soil Characterisation, Report Prepared for Phoenix Gold Limited.
[3] Soil Water Consultants (2013), Castle Hill Deposit Soil Characterisation, Report prepared for Phoenix Gold Limited.

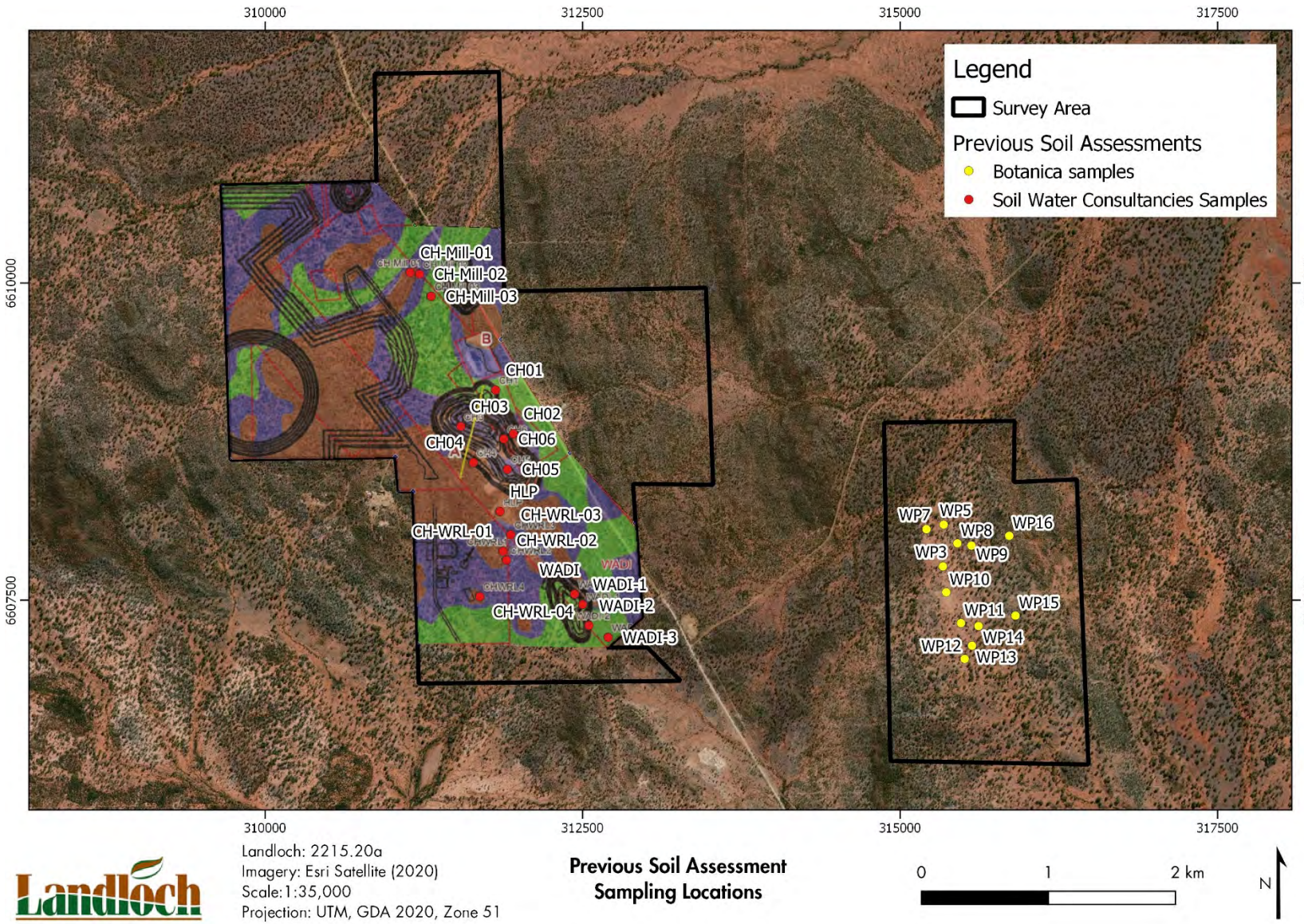


Figure 4: Previous soil assessment sample and SMU locations. SMU codes are colour coded in Table 2.

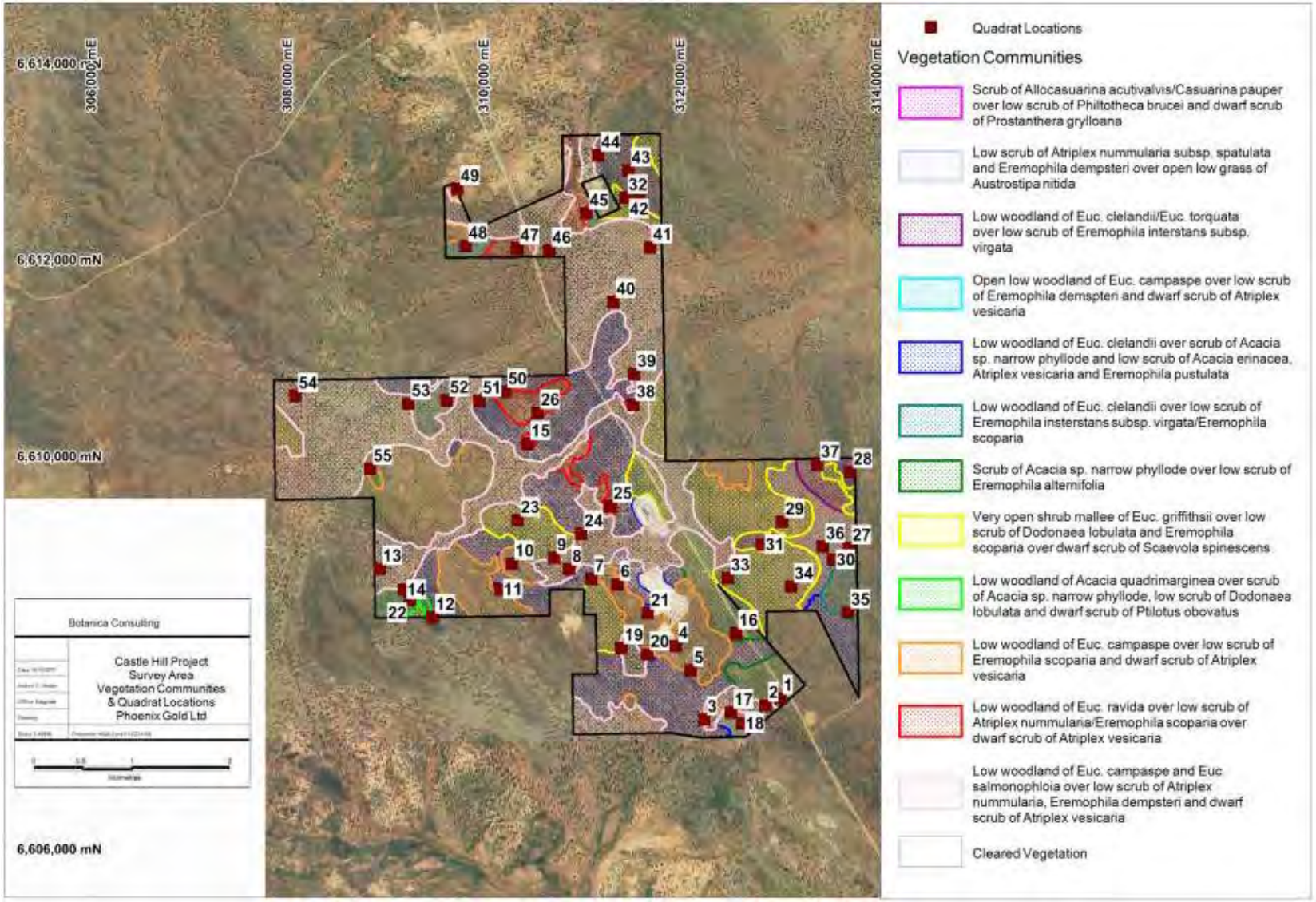


Figure 5: Vegetation mapping and descriptions of the Castle Hill Mining Area.

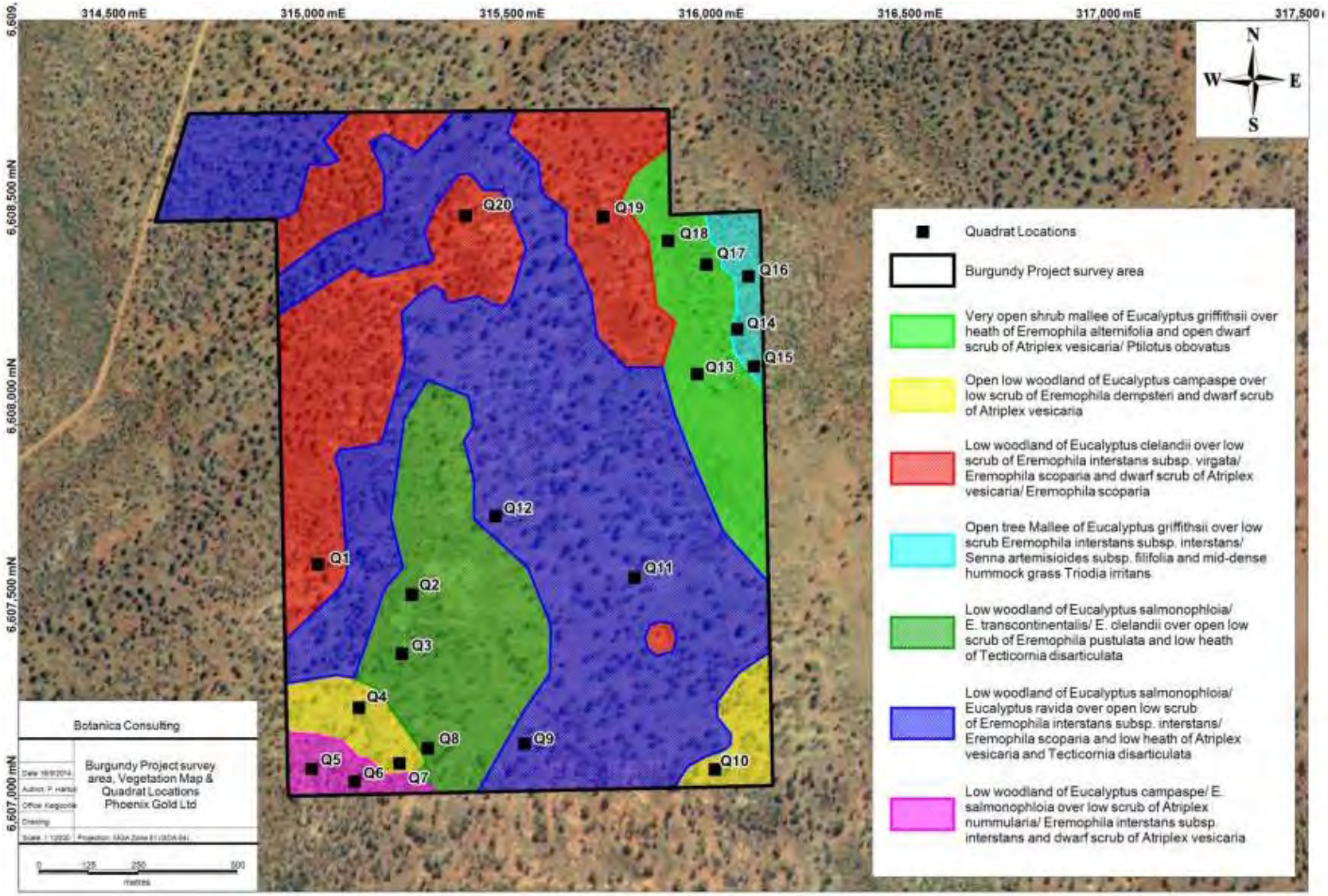


Figure 6: Vegetation mapping and descriptions of the Burgundy Mining Area.

4. Scope

4.1 Sampling density

The required scale of soil mapping and the size of the proposed survey area dictates the number of soil inspection sites required. The inspection site density is defined in the Guidelines for Survey Soil and Land Resources[4].

For the objective of semi-detailed project planning or for moderate land use planning, an inspection site every 20-100ha is required for the 'semi-detailed' (1:50,000) intensity of assessment. This scale of mapping will delineate areas approximately 10ha in size and will detail groups of soils with similar properties. For the objective of assessing project feasibility or for extensive land use planning, an inspection site every 100-400ha is required producing a map at 1:100,000 scale.

The survey area is comprised of 486ha that is planned to contain disturbance, and 1,006ha area that is not planned to be disturbed (Figure 1). As such, Landloch propose to conduct the soil survey at two scales:

- Medium 'semi-detailed' in the areas where disturbance could occur (e.g. pit, waste dump, infrastructure footprints); and
- Low 'semi-detailed' in the areas where disturbance is not planned.

Based on the above:

- ~15 soil inspection sites will be assessed in the medium 'semi-detailed' areas. This allows for more intense inspection of sites in the footprint of the potentially disturbed areas (and therefore likely to be stripped of their soil) to produce a higher resolution soils map over these areas.
- ~5 soil inspection sites will be assessed across the areas of where disturbance is not planned.

4.2 Soil inspection site locations

Proposed soil inspection site coordinates for the survey area are given in Table 3 and their locations are displayed in Figure 7. A total of 20 inspections sites are to be assessed.

Soil inspection site locations have been selected based on the results and site sampling locations of previous soil surveys undertaken within the survey area[2,3], available landscape mapping, ASC mapping, vegetation mapping, contour data, and aerial imagery. The inspection site locations are subject to in-field confirmation and may be slightly shifted where deemed appropriate (e.g. due to accessibility issues or representativeness of site location within the landscape). The inspection site locations are located outisde of heritage sites provided to Landloch by Evolution (Figure 7).

[4] McKenzie, N.J., Grundy, M.J., Webster, R. and Ringrose-Voase, A.J. (2008) Guidelines for surveying soil and land resources, CSIRO Publishing, Collingwood.

Table 3: Proposed inspection site coordinates for the Castle Hill and Burgundy proposed mining areas (GDA2020, Zone 51S).

Area	Site ID	Easting (m)	Northing (m)
Castle Hill	Mun1	313,118	6,609,509
	Mun2	312,988	6,608,624
	Mun3	312,476	6,608,937
	Mun4	312,199	6,609,523
	Mun5	312,659	6,607,886
	Mun6	311,426	6,609,306
	Mun7	311,590	6,610,853
	Mun8	311,144	6,610,933
	Mun9	311,311	6,611,323
	Mun10	310,689	6,610,174
	Mun11	309,857	6,608,851
	Mun12	309,792	6,610,419
	Mun13	310,936	6,609,360
	Mun14	310,524	6,609,180
	Mun15	311,404	6,607,904
Burgundy	Mun16	311,396	6,607,255
	Mun17	315,445	6,606,595
	Mun18	315,966	6,606,820
	Mun19	316,054	6,608,169
	Mun20	315,066	6,608,724

4.3 Data and sample collection

Soil inspection sites will be located in the field by GPS and their suitability field verified. At each inspection site, soil pits will be dug to a maximum depth of 1.2m (or depth of machinery refusal) by a ≥15t excavator and operator provided by Evolution.

Soil characterisation will be carried out in accordance with the Australian Soil and Land Survey Field Handbook (NCTS 2009). Good quality photographs of the soil profiles and the surrounding landscapes will be taken, and observations of the landform and vegetation recorded. Sites will be classified using the Australian Soil Classification Revised Edition (Isbell 2002) and WA Soil Groups. Approximately four samples from each site (maximum of 80 samples), weighing 3-5kg each will be taken from different depths and used in subsequent laboratory testing. Sampling depths will depend on the morphology of the soils. It is assumed that four samples per profile (1 topsoil and 3 subsoil) are sufficient to capture the changes within the soil profile. Sample depths will vary, but generally they will be taken at every 0.3m to a depth of 1.2m (or machinery refusal).

Soil pits will be backfilled prior to departure at each site. All samples will be packaged and transported from the survey areas to Landloch's soil processing facility in Perth.

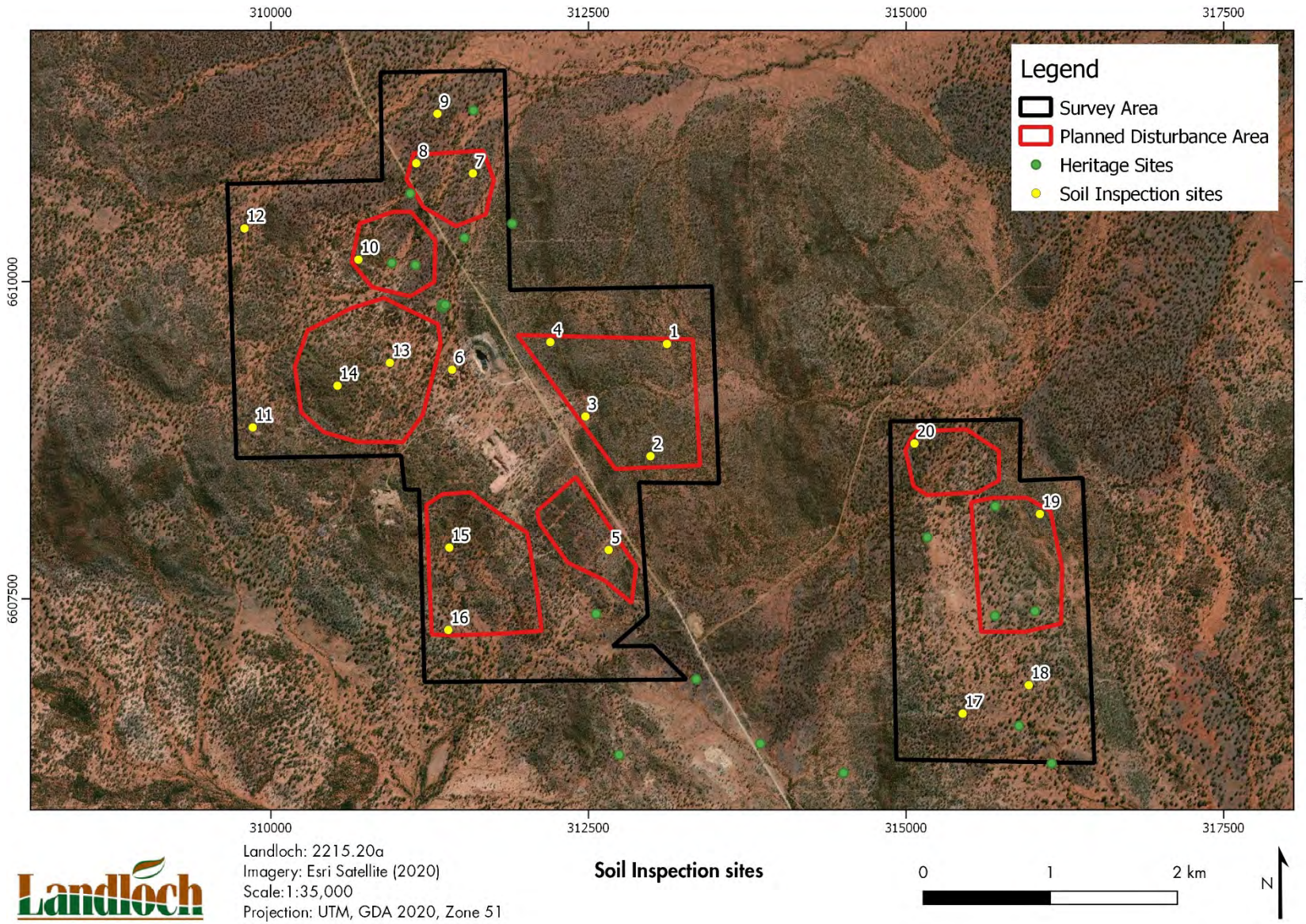


Figure 7: Soil inspection site locations and heritage site locations.

4.4 Laboratory analysis

All soil samples collected will be assessed for the parameters listed in Table 5.

In addition to this, soil samples from approximately ~25% of the 20 inspection sites (20 samples taken from 4 depths at 5 sites) will be submitted for external laboratory analysis. The suite of laboratory analyses will be split into a topsoil characterisation suite and subsoil characterisation suite (Table 6), in line with the Draft Guidance – Material Characterisation Baseline Data Requirements for Mining Proposals (March 2016). From each of the 5 sites a total of 10 subsoil samples will be analysed for the subsoil suite to provide baseline characterisation data. The remaining 10 samples (5 topsoil and 5 subsoil) will be analysed for the topsoil suite to establish a comparison between topsoil and subsoil fertility characteristics. This will provide guidance on potential re-use of subsoil and provide an indication of the amount and type of fertiliser amendments to be added if necessary.

Table 4: Soil internal laboratory analysis (all samples collected)

Analysis	
• Hand texture • Fine/coarse fraction • Colour (Munsell)	• $pH_{1:5}$ (H_2O) • $EC_{1:5}$ • Emerson dispersion

Table 5: Soil external laboratory analysis (~30% of all samples)

Laboratory Suite	Target samples	Analysis
Topsoil Suite	A horizon (topsoil fertility) generally between 0 – 100mm depth. Analyses include soil fertility as this is the 'growth media' depth of the soil profile and is a major factor in determining the soils' nutrient status. This will also include one sample from the subsoil for baseline comparison.	• $pH_{1:5}$ (H_2O) • $EC_{1:5}$ • Total Cl • Exchangeable cations (K^+, Ca^{2+}, Mg^{2+}, Na^+ & Al^{3+}) • Effective cation exchange capacity (ECEC) • Exchangeable sodium percentage (ESP) • Coarse fraction • Particle size distribution of the fine fraction • Organic Carbon • Total N & Total P • Available P and K (Colwell) • Available Sulphur (KCl) • Trace elements (Cu, Zn, Mn & Fe)
Subsoil Suite	All other horizons below the topsoil (>100 mm). Analyses focus on chemical and physical properties of the soil.	• $pH_{1:5}$ (H_2O) • $EC_{1:5}$ • Total Cl • Exchangeable cations (K^+, Ca^{2+}, Mg^{2+}, Na^+ & Al^{3+}) • Effective cation exchange capacity (ECEC) • Exchangeable sodium percentage (ESP) • Coarse fraction (>2mm) • Particle size distribution of the fine fraction

5. Health and safety

Prior to the site investigation, Landloch will complete all the required inductions and safety documentation to gain access to site. Given current circumstances, Landloch will undertake a risk assessment (as part of a JHA) specifically accounting for COVID-19 and align ourselves with site rules in this regard.

The investigation will be carried out in accordance with Landloch and site-specific health and safety requirements.

6. Closing

The detail in this SAP is sufficient to guide the necessary sampling for soil mapping of the project areas.

Thank you for the opportunity to assist you with this project. If you require any clarification on any of the information provided in this document, please do not hesitate to contact me on 08 9494 2835 or oriley@landloch.com.au.

Regards

Dylan O'Riley
Environmental Consultant

APPENDIX B – SOIL LOG SHEETS

Site Information

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
2215.20a	**8**/11/2020	D.O'Riley	**Mun01**	Soil pit			Kandosol

Dominant Vegetation Form	Ground Cover %	Aspect	Northing/ Longitude	Scale	ASC Ground Truth
Woody	Mid-dense (30-70%)				Calcarosol

Secondary Vegetation Form	Ground Cover %	Slope %	Rock Outcrop	Erosion Type
Non-woody	Isolated Plants (<0.2%)		Very slightly rocky	Water

Vegetation (species)	Drainage (site)	Erosion Extent
Shrubs and trees	Moderately well-drained	Minor or present

Landform	Soil Surface Condition (dry)	Land Use	Erosion State
Mid-slope	Soft	Grazing	Partially stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface: 30% leaf litter, 15% coarse fragments.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-200			Sandy Clay Loam	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Common (10-25) Fine (1-2 mm)			0-200
B1	200-600		Clear	Clay Loam	2.5YR 4/4 Reddish brown	None evident	10-20 % Carbonates	10-20 % 6-20 mm	Polyhedral	Weak	Weak (dry)	Few (1-10) Medium (2-5 mm)			400-600
B2	600-1200		Abrupt	Light Clay (coarse sandy)	2.5YR 5/4 Reddish brown	None evident	>50 % Carbonates	20-50 % 20-60 mm	Platy	Massive	Firm (dry)	Few (1-10) Very fine (<1 mm)			800-1000

Other information: Gradual decrease of topsoil and an increase in coarse fragments throughout the B1 horizon.

Soil Profile Description

Project 2215.20a	**Date** **8**/11/2020	**Scribe** D.O'Riley	**Location** **Mun02**	**Observation** Soil pit		**Easting/ Latitude**	**Zone**	**ASC Mapped** Kandosol
Dominant Vegetation Form Woody			**Ground Cover %** Mid-dense (30-70%)	**Aspect**		**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Calcarosol
Secondary Vegetation Form Non-woody			**Ground Cover %** Very sparse (0.2-10%)	**Slope %**		**Rock Outcrop** Very slightly rocky	**Erosion Type** Water	
Vegetation (species) Shrubs and trees						**Drainage (site)** Moderately well-drained	**Erosion Extent** Minor or present	
Landform Mid-slope			**Soil Surface Condition (dry)** Soft			**Land Use** Grazing	**Erosion State** Partially stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface: Gravels 15%, leaf litter 15%.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-200			Sandy Clay Loam	2.5YR 2.5/4 Dark reddish brown	None evident		2-10 % 6-20 mm	Polyhedral	Moderate	Weak (dry)	Common (10-25) Fine (1-2 mm)			0-200
B1	200-550		abrupt	Sandy Clay Loam	2.5YR 4/4 Reddish brown	None evident	2-10 % Carbonates	10-20 % 6-20 mm	Polyhedral	Weak	Very weak (dry)	Common (10-25) Very fine (<1 mm)			300-500
B2	550-1200		Gradual	Light Clay (coarse sandy)	2.5YR 4/4 Reddish brown	10% orange	10-20 % Carbonates	10-20 % 20-60 mm	Platy	Massive	Firm (dry)	Few (1-10) Very fine (<1 mm)			700-900 1000-1200

Other information: The a1 horizon is almost a grading from a-b but felt like it was a1 due to texture. roots only in top portion of b horizon.

Soil Profile Description

Project 2215.20a	**Date** **7**/11/2020	**Scribe** D.O'Riley	**Location** **Mun03**	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Calcarosol
Dominant Vegetation Form Woody			**Ground Cover %** Mid-dense (30-70%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Kandosol
Secondary Vegetation Form Non-woody			**Ground Cover %** Very sparse (0.2-10%)	**Slope %**	**Rock Outcrop** Very slightly rocky	**Erosion Type** Water	
Vegetation (species) Shrubs and trees					**Drainage (site)** Imperfectly drained	**Erosion Extent** Minor or present	
Landform Open depression			**Soil Surface Condition (dry)** Cracking		**Land Use** Grazing	**Erosion State** Partially stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface: gravels 30%, leaf litter 5%. drainage line area.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-150			Sandy Loam (fine)	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Common (10-25) Medium (2-5 mm)			0-150
A1	150-450		gradual	Sandy Clay Loam	2.5YR 2.5/4 Dark reddish brown	None evident	2-10 % Carbonates	10-20 % 6-20 mm	Polyhedral	Moderate	Weak (dry)	Few (1-10) Very fine (<1 mm)			150-400
B	450-1100		Clear	Light Medium Clay (coarse sandy)	2.5YR 3/6 Dark Red	orange in lower portion of horizon	20-50 % Carbonates	20-50 % 6-20 mm	Granular	Massive	Very firm (dry)	No roots (0)			500-700 900-1100

Other information:

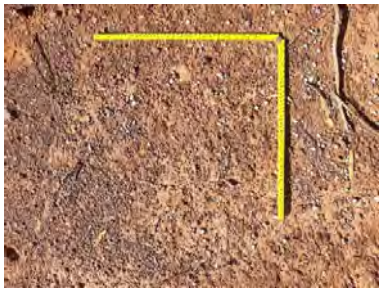
Soil Profile Description

Project 2215.20a	**Date** **7/11/2020**	**Scribe** D.O'Riley	**Location** **Mun04**	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Kandosol
Dominant Vegetation Form Woody			**Ground Cover %** Mid-dense (30-70%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Kandosol
Secondary Vegetation Form Non-woody			**Ground Cover %** Very sparse (0.2-10%)	**Slope %**	**Rock Outcrop** Very slightly rocky	**Erosion Type** Water	
Vegetation (species) shrubs and trees					**Drainage (site)** Moderately well-drained	**Erosion Extent** Minor or present	
Landform Mid-slope			**Soil Surface Condition (dry)** Soft		**Land Use** Grazing	**Erosion State** Stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo



Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface: leaf litter 10%, gravels 40%.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A1	0-100			Sandy Loam	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Few (1-10) Very fine (<1 mm)			0-100
A2	100-250		clear	Loam	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Granular	Weak	Firm (dry)	Common (10-25) Medium (2-5 mm)			100-250
B1	250-600		Gradual	Light Clay (coarse sandy)	5YR 4/6 Yellowish red	None evident	>50 % Carbonates	10-20 % 6-20 mm	Apedal	Massive	Firm (dry)	Few (1-10) Medium (2-5 mm)			250-500
B2	600-1200		Gradual	Light Clay	2.5YR 5/6 Red	orange 30%	>50 % Carbonates	10-20 % 6-20 mm	Apedal	Massive	Strong (dry)	No roots (0)			700-1000

Other information: Operator noted hard gravels at 900mm. Calcareous layer at >600mm.

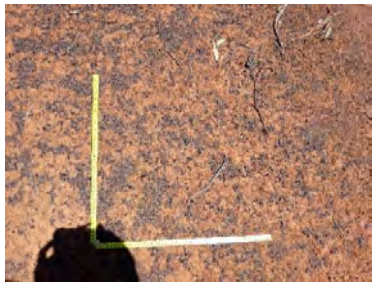
Soil Profile Description

Project 2215.20a	**Date** **8**/11/2020	**Scribe** D.O'Riley	**Location** **Mun05**	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Calcarosol
Dominant Vegetation Form Woody			**Ground Cover %** Sparse (10-30%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Kandosol
Secondary Vegetation Form Non-woody			**Ground Cover %** Isolated Plants (<0.2%)	**Slope %**	**Rock Outcrop** Very slightly rocky	**Erosion Type** Water	
Vegetation (species) shrubs and trees					**Drainage (site)** Imperfectly drained	**Erosion Extent** Minor or present	
Landform Flat			**Soil Surface Condition (dry)** Soft		**Land Use** Grazing	**Erosion State** Partially stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo



Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface: Gravels 10%, leaf litter 5%.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-200			Sandy Clay Loam	2.5YR 3/6 Dark Red	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Common (10-25) Coarse (>5 mm)			0-200
B	200-700		clear	Light Medium Clay	2.5YR 2.5/4 Dark reddish brown	None evident	10-20 % Carbonates	2-10 % 2-6 mm	Angular blocky	Moderate	Firm (dry)	Few (1-10) Fine (1-2 mm)			200-400 500-700
B1	700-1100		Diffuse	Medium Clay	2.5YR 2.5/4 Dark reddish brown	None evident	2-10 % Carbonates	2-10 % 2-6 mm	Granular	Massive	Firm (dry)	No roots (0)			900-1100

Other information:

Soil Profile Description

Project 2215.20a	**Date** **8**/11/2020	**Scribe** D.O'Riley	**Location** **Mun06**	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Calcarosol
Dominant Vegetation Form Woody			**Ground Cover %** Sparse (10-30%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Kandosol
Secondary Vegetation Form Non-woody			**Ground Cover %** Very sparse (0.2-10%)	**Slope %**	**Rock Outcrop** No rock outcrop	**Erosion Type** Water	
Vegetation (species) shrubs and trees					**Drainage (site)** Imperfectly drained	**Erosion Extent** Minor or present	
Landform Flat			**Soil Surface Condition (dry)** Cracking		**Land Use** Mining	**Erosion State** Partially stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface: gravels 5% leaf litter 40%.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-100			Clay Loam, Sandy	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Few (1-10) Fine (1-2 mm)			0-100
B1	100-850		gradual	Light Clay	2.5YR 3/6 Dark Red	None evident	<2 % Carbonates	None evident	Granular	Weak	Weak (dry)	Common (10-25) Medium (2-5 mm)			100-300 500-700
B2	850-1200		Sharp	Medium Clay	2.5YR 3/6 Dark Red	None evident	>50 % Carbonates	20-50 % 20-60 mm	Apedal	Massive	Very firm (dry)	No roots (0)			900-1100

Other information: Carbonates in B2 horizon are rocks. Carbonates in B1 horizon are in lower part of the horizon only.

Soil Profile Description

Project 2215.20a	**Date** **7**/11/2020	**Scribe** D.O'Riley	**Location** **Mun07**	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Kandosol
Dominant Vegetation Form Woody			**Ground Cover %** Sparse (10-30%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Kandosol
Secondary Vegetation Form Non-woody			**Ground Cover %** Very sparse (0.2-10%)	**Slope %**	**Rock Outcrop** Slightly rocky	**Erosion Type** Water	
Vegetation (species) shrubs and trees					**Drainage (site)** Well-drained	**Erosion Extent** None evident	
Landform Mid-slope			**Soil Surface Condition (dry)** Firm		**Land Use** Grazing	**Erosion State** Stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

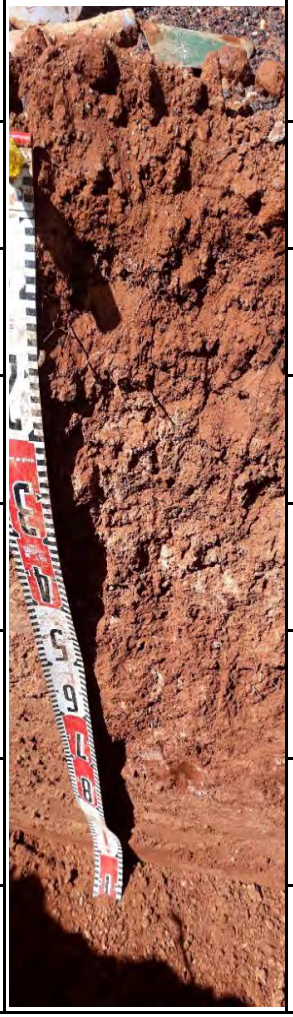
Other Information: Surface: 60% gravels, 5% leaf litter. Small amounts of quartz on surface 5% . Drill sumps present in area.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-150			Sandy Loam	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Common (10-25) Medium (2-5 mm)			0-150
B	150-700		clear	Sandy Clay Loam	2.5YR 3/6 Dark Red	None evident	10-20 % Carbonates	2-10 % 2-6 mm	Angular blocky	Weak	Firm (dry)	No roots (0)			200-600
B1	700-1100		Gradual	Medium Clay	2.5YR 3/6 Dark Red	None evident	2-10 % Carbonates	None evident	Apedal	Massive	Very firm (dry)	No roots (0)			700-900 900-1100

Other information: increase of clay at depth throughout entire profile to clay in lowest depth.

Soil Profile Description

Project 2215.20a	**Date** **7**/11/2020	**Scribe** D.O'Riley	**Location** **Mun08**	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Kandosol
Dominant Vegetation Form Non-woody			**Ground Cover %** Sparse (10-30%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Calcarosol
Secondary Vegetation Form Woody			**Ground Cover %** Sparse (10-30%)	**Slope %**	**Rock Outcrop** Slightly rocky	**Erosion Type** Water	
Vegetation (species) shrubs and trees					**Drainage (site)** Moderately well-drained	**Erosion Extent** None evident	
Landform Upper slope			**Soil Surface Condition (dry)** Firm		**Land Use** Grazing	**Erosion State** Stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface 70% gravel 5% leaf litter.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-150			Sandy Clay Loam	2.5YR 3/6 Dark Red	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Common (10-25) Medium (2-5 mm)			0-150
B	150-1100		abrupt	Sand (fine)	2.5YR 3/6 Dark Red	None evident	2-10 % Carbonates	<2 % 2-6 mm	Platy	Massive	Very firm (dry)	Few (1-10) Very fine (<1 mm)			300-500 700-900

Other information: Roots only in the top 100mm of b horizon. Not clayey in subsoils.

Soil Profile Description

Project 2215.20a	**Date** **7**/11/2020	**Scribe** D.O'Riley	**Location** **Mun09**	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Kandosol
Dominant Vegetation Form Woody			**Ground Cover %** Sparse (10-30%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Calcarosol
Secondary Vegetation Form Non-woody			**Ground Cover %** Very sparse (0.2-10%)	**Slope %**	**Rock Outcrop** Slightly rocky	**Erosion Type** Water	
Vegetation (species) trees and shrubs					**Drainage (site)** Well-drained	**Erosion Extent** Minor or present	
Landform Upper slope			**Soil Surface Condition (dry)** Firm		**Land Use** Mining	**Erosion State** Stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

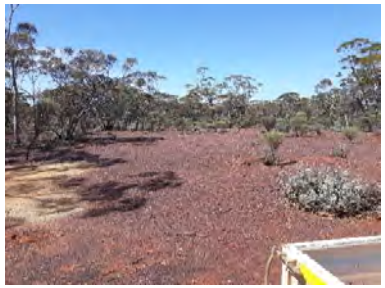
Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)



Landscape Photo (West)

Other Photo

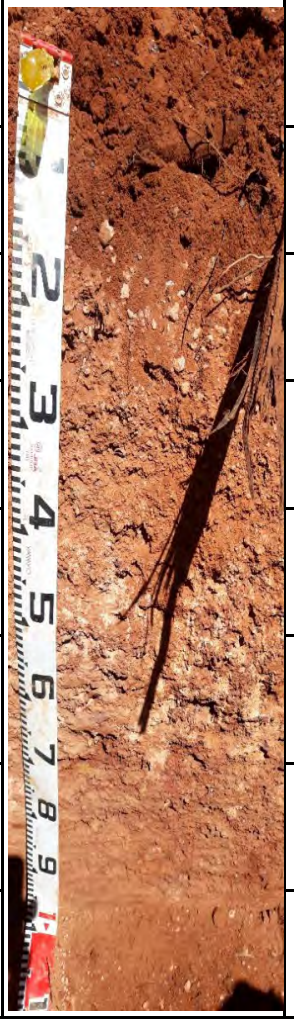
Other Information: Drill sumps present in area. Surface: 60% gravels, 50% leaf litter.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-150			Sandy Clay Loam	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Very weak (dry)	Common (10-25) Coarse (>5 mm)			0-150
A1	150-400		clear	Clay Loam	2.5YR 3/6 Dark Red	None evident	2-10 % Carbonates	10-20 % 6-20 mm	Granular	Weak	Loose (dry)	Few (1-10) Fine (1-2 mm)			150-400
B	400-900		Gradual	Light Clay	2.5YR 3/6 Dark Red	yellow 10%	20-50 % Carbonates	10-20 % 2-6 mm	Apedal	Massive	Firm (dry)	No roots (0)			600-800
B1	900-1100		Gradual	Medium Clay	2.5YR 3/6 Dark Red	yellow 5%	None evident	2-10 % 2-6 mm	Apedal	Massive	Firm (dry)	No roots (0)			900-1100

Other information:

Soil Profile Description

Project 2215.20a	**Date** **7**/11/2020	**Scribe** D.O'Riley	**Location** **Mun10**	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Calcarosol
Dominant Vegetation Form Woody			**Ground Cover %** Mid-dense (30-70%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Calcarosol
Secondary Vegetation Form Non-woody			**Ground Cover %** Very sparse (0.2-10%)	**Slope %**	**Rock Outcrop** Slightly rocky	**Erosion Type** Water	
Vegetation (species) Trees and shrubs					**Drainage (site)** Moderately well-drained	**Erosion Extent** Minor or present	
Landform Mid-slope			**Soil Surface Condition (dry)** Firm		**Land Use** Grazing	**Erosion State** Stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

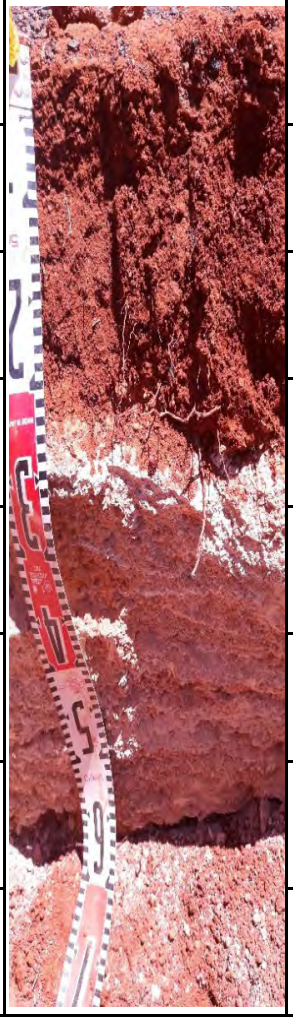
Other Information: Surface: 70% gravels, 10% leaf litter. small trees thicker in this area.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-200			Sandy Loam	2.5YR 3/6 Dark Red	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Very weak (dry)	Common (10-25) Fine (1-2 mm)			0-150
B	200-600		sharp	Loamy Sand (coarse)	2.5YR 4/6 Red	light orange 15%	2-10 % Carbonates	10-20 % 2-6 mm	Platy	Massive	Rigid (dry)	No roots (0)			300-600

Other information: Machine hit depth of refusal at 600mm. Gradual increase in texture at depth in the b horizon. Roots only present in lower A horizon.

Soil Profile Description

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
2215.20a	9/11/2020	D.O'Riley	Mun11	Soil pit			Calcarosol

Dominant Vegetation Form	Ground Cover %	Aspect	Northing/ Longitude	Scale	ASC Ground Truth
Woody	Sparse (10-30%)				Kandosol

Secondary Vegetation Form	Ground Cover %	Slope %	Rock Outcrop	Erosion Type
Non-woody	Very sparse (0.2-10%)		Rocky	Water

Vegetation (species)	Drainage (site)	Erosion Extent
trees and shrubs	Well-drained	Minor or present

Landform	Soil Surface Condition (dry)	Land Use	Erosion State
Upper slope	Firm	Grazing	Stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Other Information: Surface gravels 90%, leaf litter 5-10%. Elevated area.

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-100			Loam	2.5YR 3/6 Dark Red	None evident	None evident	2-10 % 6-20 mm	Granular	Weak	Weak (dry)	Common (10-25) Medium (2-5 mm)			0-100
B1	100-600		Gradual	Sandy Loam (coarse)	2.5YR 4/6 Red	5% orange	10-20 % Carbonates	20-50 % 6-20 mm	Polyhedral	Massive	Weak (dry)	Few (1-10) Fine (1-2 mm)			300-500
B2	600-1200		Diffuse	Loam	2.5YR 4/6 Red	None evident	2-10 % Carbonates	10-20 % 6-20 mm	Apedal	Single grain	Weak (dry)	No roots (0)			600-800 900-1100

Other information: Roots only present in A horizon and the top 150mm of b horizon.

Soil Profile Description

Project 2215.20a	**Date** 7/11/2020	**Scribe** D.O'Riley	**Location** **Mun12**	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Calcarosol
Dominant Vegetation Form Woody			**Ground Cover %** Mid-dense (30-70%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Kandosol
Secondary Vegetation Form Non-woody			**Ground Cover %** Very sparse (0.2-10%)	**Slope %**	**Rock Outcrop** Very slightly rocky	**Erosion Type** Water	
Vegetation (species) trees and shrubs					**Drainage (site)** Imperfectly drained	**Erosion Extent** Moderate	
Landform Open depression			**Soil Surface Condition (dry)** Soft		**Land Use** Grazing	**Erosion State** Partially stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface: Cryptogams on surface 25%, leaf litter 50%, coarse fragments 5%.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-50mm			Sandy Clay Loam	2.5YR 2.5/4 Dark reddish brown	none evident	none evident	2-10 % 2-6 mm	Polyhedral	Moderate	Weak (dry)	Few (1-10) Fine (1-2 mm)			0-50
A1	50-300		diffuse	Light Clay	2.5YR 3/6 Dark Red	none evident	2-10 % Carbonates	2-10 % 2-6 mm	Polyhedral	Weak	Firm (dry)	Few (1-10) Very fine (<1 mm)			50-300
B	300-700		Gradual	Medium Clay	5YR 4/6 Yellowish red	orange 40%	2-10 % Carbonates	2-10 % 2-6 mm	Polyhedral	Massive	Firm (dry)	No roots (0)			300-500
B1	700-1200		Gradual	Medium Heavy Clay	5YR 5/6 Yellowish red	orange 20%	2-10 % Carbonates	2-10 % 2-6 mm	Apedal	Single grain	Very firm (dry)	No roots (0)			700-1000

Soil Profile Description

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
2215.20a	8/11/2020	D.O'Riley	Mun13	Soil pit			Calcarosol

Dominant Vegetation Form	Ground Cover %	Aspect	Northing/ Longitude	Scale	ASC Ground Truth
Woody	Mid-dense (30-70%)				Calcarosol

Secondary Vegetation Form	Ground Cover %	Slope %	Rock Outcrop	Erosion Type
Non-woody	Very sparse (0.2-10%)		Very slightly rocky	Water

Vegetation (species)	Drainage (site)	Erosion Extent
Trees and shrubs	Moderately well-drained	Moderate

Landform	Soil Surface Condition (dry)	Land Use	Erosion State
Flat	Loose	Grazing	Partially stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface: Slight surface cracking, 10% gravels, leaf litter 5%.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-100			Sandy Loam	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Few (1-10) Medium (2-5 mm)			0-100
B1	100-400		Clear	Clay Loam	2.5YR 3/6 Dark Red	None evident	10-20 % Carbonates	20-50 % 6-20 mm	Apedal	Weak	Weak (dry)	Few (1-10) Fine (1-2 mm)			200-400
B2	400-1100		Clear	Loamy Sand (coarse)	5YR 5/8 Yellowish red	None evident	2-10 % Carbonates	20-50 % 6-20 mm	Apedal	Massive	Firm (dry)	No roots (0)			400-600 700-900

Other information: Texture in B horizon is coarse but i think there may be a fine fraction as well. roots only in the top of the B1 horizon.

Soil Profile Description

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
2215.20a	7/11/2020	D.O'Riley	Mun14	Soil pit			Calcarosol
Dominant Vegetation Form	Woody	**Ground Cover %**	Mid-dense (30-70%)	**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Calcarosol
Secondary Vegetation Form	Non-woody	**Ground Cover %**	Very sparse (0.2-10%)	**Slope %**	**Rock Outcrop** Rocky	**Erosion Type**	Water
Vegetation (species)	trees and shrubs				**Drainage (site)** Moderately well-drained	**Erosion Extent**	None evident
Landform	Ridge	**Soil Surface Condition (dry)**	Firm		**Land Use** Grazing	**Erosion State**	Stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface: rocky 50% gravels20%, leaf litter 15%.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-200			Sandy Loam (fine)	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Very weak (dry)	Common (10-25) Medium (2-5 mm)			0-200
B1	200-850		sharp	Light Clay	5YR 4/6 Yellowish red	below 500mm orange mottles 20%	20-50 % Carbonates	10-20 % 20-60 mm	Angular blocky	Weak	Firm (dry)	No roots (0)			200-400 500-700
B2	850-1100		Gradual	Light Clay	5YR 4/6 Yellowish red	orange 20%	10-20 % Carbonates	20-50 % 20-60 mm	Angular blocky	Massive	Firm (dry)	No roots (0)			900-1100

Other information: Orange mottles below 500mm in the B1 horizon only.

Soil Profile Description

Project 2215.20a	Date 8/11/2020	**Scribe** D.O'Riley	Location Mun15	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Calcarosol
Dominant Vegetation Form Woody		**Ground Cover %** Sparse (10-30%)		**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Calcarosol
Secondary Vegetation Form Non-woody		**Ground Cover %** Very sparse (0.2-10%)		**Slope %**	**Rock Outcrop** Slightly rocky	**Erosion Type** Water	
Vegetation (species) Trees and shrubs					**Drainage (site)** Imperfectly drained	**Erosion Extent** Moderate	
Landform Flat		**Soil Surface Condition (dry)** Loose			**Land Use** Grazing	**Erosion State** Active	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Landscape drainage area. Surface: 10% gravels 15% leaf litter.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A1	0-150			Loam	5YR 3/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Common (10-25) Medium (2-5 mm)			0-150
A2	150-400		gradual	Light Clay (coarse sandy)	2.5YR 3/4 Dark reddish brown	None evident	2-10 % Carbonates	10-20 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Few (1-10) Fine (1-2 mm)			200-400
B	400-1200		Abrupt	Sand (fine)	2.5YR 4/6 Dark Red	None evident	<2 % Carbonates	2-10 % 2-6 mm	Granular	Massive	Loose (dry)	Few (1-10) Very fine (<1 mm)			500-700 900-1100

Other information: A1 horizon grades to B over 150mm, no roots are present in the b horizon other than within that 150mm.

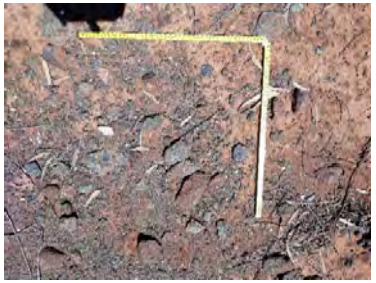
Soil Profile Description

Project 2215.20a	Date 8/11/2020	**Scribe** D.O'Riley	Location Mun16	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Calcarosol
Dominant Vegetation Form Woody		**Ground Cover %** Mid-dense (30-70%)		**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Calcarosol
Secondary Vegetation Form Non-woody		**Ground Cover %** Very sparse (0.2-10%)		**Slope %**	**Rock Outcrop** Rocky	**Erosion Type** Water	
Vegetation (species) Trees and shrubs					**Drainage (site)** Moderately well-drained	**Erosion Extent** Minor or present	
Landform Lower slope		**Soil Surface Condition (dry)** Firm			**Land Use** Grazing	**Erosion State** Partially stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo



Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

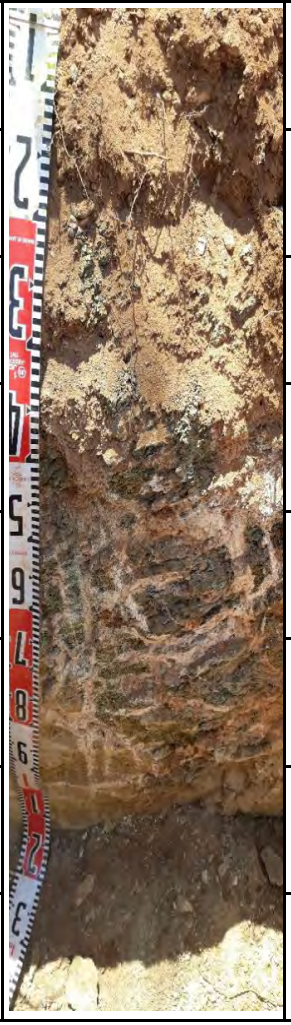
Other Information: Located on a small incline 1m relief from drainage area. Surface: gravels 40%, rock 20%, leaf litter 30%.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A1	0-100			Sandy Clay Loam	7.5YR 4/4 Brown	None evident	None evident	2-10 % 6-20 mm	Polyhedral	Weak	Weak (dry)	Common (10-25) Medium (2-5 mm)			0-100
A2	100-400		gradual	Sandy Clay Loam	7.5YR 4/6 Strong brown	None evident	None evident	2-10 % 2-6 mm	Granular	Weak	Very weak (dry)	Few (1-10) Coarse (>5 mm)			200-400
B	400-1200		Sharp	Clay Loam, Sandy (fine)	10YR 6/4 Light yellowish brown	orange 20%	20-50 % Carbonates	20-50 % 20-60 mm	Angular blocky	Massive	Firm (dry)	No roots (0)			500-700 900-1100

Other information: The subsoil has a grey material that could resemble some sort of mineral segregation.

Soil Profile Description

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
2433.20b	9/11/2020	D O'Riley	Mun17	Soil pit			Kandosol

Dominant Vegetation Form	Ground Cover %	Aspect	Northing/ Longitude	Scale	ASC Ground Truth
Woody	Sparse (10-30%)				Calcarosol

Secondary Vegetation Form	Ground Cover %	Slope %	Rock Outcrop	Erosion Type
Non-woody	Isolated Plants (<0.2%)		Slightly rocky	Water

Vegetation (species)	Drainage (site)	Erosion Extent
Trees and shrubs	Imperfectly drained	Minor or present

Landform	Soil Surface Condition (dry)	Land Use	Erosion State
Upper slope	Firm	Grazing	Partially stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface 60% gravels, leaf litter 5%.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-100			Sandy Clay Loam (coarse)	2.5YR 2.5/4 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Few (1-10) Medium (2-5 mm)			0-100
B	100-900		sharp	Sandy Clay Loam	5YR 5/8 Yellowish red	orange 20%	2-10 % Carbonates	20-50 % 2-6 mm	Apedal	Single grain	Firm (dry)	No roots (0)			300-500 600-800

Other information: Mottles in lower B horizon only.

Soil Profile Description

Project 2433.20b	Date 9/11/2020	**Scribe** I. Kelder	Location Mun18	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Kandosol
Dominant Vegetation Form Woody		**Ground Cover %** Sparse (10-30%)	**Aspect**		**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Calcarosol
Secondary Vegetation Form Non-woody		**Ground Cover %** Isolated Clumps (<0.2%)	**Slope %**		**Rock Outcrop** Slightly rocky	**Erosion Type** Water	
Vegetation (species) Trees and shrubs					**Drainage (site)** Moderately well-drained	**Erosion Extent** Moderate	
Landform Lower slope		**Soil Surface Condition (dry)** Soft			**Land Use** Grazing	**Erosion State** Partially stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface 10% gravels, 15% leaf litter.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-150			Sandy Clay Loam	2.5YR 2.5/3 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Common (10-25) Medium (2-5 mm)			0-150
B1	150-400		clear	Light Clay	5YR 3/4 Dark reddish brown	None evident	20-50 % Carbonates	2-10 % 2-6 mm	Polyhedral	Moderate	Firm (dry)	Few (1-10) Very fine (<1 mm)			200-400
B2	400-1100		Gradual	Light Medium Clay (coarse sandy)	5YR 3/4 Dark reddish brown	None evident	2-10 % Carbonates	10-20 % 20-60 mm	Apedal	Massive	Firm (dry)	No roots (0)			500-700 800-1000

Other information:

Soil Profile Description

Project 2433.20b	Date 9/11/2020	**Scribe** I. Kelder	Location Mun19	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Kandosol
Dominant Vegetation Form Woody		**Ground Cover %** Sparse (10-30%)		**Aspect**	**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Calcarosol
Secondary Vegetation Form Non-woody		**Ground Cover %** Very sparse (0.2-10%)		**Slope %**	**Rock Outcrop** Slightly rocky	**Erosion Type** Water	
Vegetation (species) Trees and shrubs					**Drainage (site)** Moderately well-drained	**Erosion Extent** Minor or present	
Landform Upper slope		**Soil Surface Condition (dry)** Soft			**Land Use** Grazing	**Erosion State** Partially stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Other Information: Surface 5% gravels, 10% leaf litter.

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A1	0-100			Sandy Clay Loam	2.5YR 2.5/3 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Common (10-25) Fine (1-2 mm)			0-100
A2	100-500		Abrupt	Light Clay (sandy)	5YR 4/4 Reddish brown	None evident	10-20 % Carbonates	10-20 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Few (1-10) Coarse (>5 mm)			200-400
B	500-1100		Clear	Light Clay	7.5YR 5/3 Brown	None evident	20-50 % Carbonates	10-20 % 20-60 mm	Apedal	Massive	Firm (dry)	No roots (0)			500-700 800-1000

Other information:

Soil Profile Description

Project 2215.20a	Date 9/11/2020	**Scribe** D.O'Riley	Location Mun20	**Observation** Soil pit	**Easting/ Latitude**	**Zone**	**ASC Mapped** Kandosol
Dominant Vegetation Form Woody		**Ground Cover %** Mid-dense (30-70%)	**Aspect**		**Northing/ Longitude**	**Scale**	**ASC Ground Truth** Kandosol
Secondary Vegetation Form Non-woody		**Ground Cover %** Very sparse (0.2-10%)	**Slope %**		**Rock Outcrop** Very slightly rocky	**Erosion Type** Water	
Vegetation (species) Trees and shrubs					**Drainage (site)** Moderately well-drained	**Erosion Extent** Minor or present	
Landform Upper slope		**Soil Surface Condition (dry)** Soft			**Land Use** Grazing	**Erosion State** Partially stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief N/A

Type

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information: Surface 30% gravels, 70% leaf litter, Vegetation different in this area, more trees of a different species, see photos.

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	pH	EC (dS/m)	Depth of Sample for Lab (mm)
A	0-100			Sandy Clay Loam	2.5YR 2.5/3 Dark reddish brown	None evident	None evident	2-10 % 2-6 mm	Polyhedral	Weak	Weak (dry)	Few (1-10) Fine (1-2 mm)			0-100
B	100-500		Abrupt	Light Clay (sandy)	5YR 3/4 Dark reddish brown	None evident	2-10 % Carbonates	20-50 % 6-20 mm	Polyhedral	Weak	Weak (dry)	Few (1-10) Coarse (>5 mm)			200-400
B1	500-1200		Gradual	Medium Clay	2.5YR 4/6 Red	None evident	>50 % Carbonates	10-20 % 2-6 mm	Apedal	Massive	Firm (dry)	No roots (0)			500-700 800-1000

Other information: minor gradual clay increase throughout b horizon.

APPENDIX C – LABORATORY RESULTS

Analyses		Unit	S02				S03		
			0-0.1	0.2-0.5	0.5-0.8	0.9-1.2	0-0.1	0.1-0.3	0.3-0.8
pH		pH units	8.4	8.4	8.4	8.5	8.5	8.9	8.9
Electrical Conductivity		dS/m	1.7	3.9	4.1	3.3	0.7	0.1	0.7
Chloride		mg/kg	1,747	2,846	2,385	2,340	403	9	334
Total Nitrogen		mg/kg	717	668	-	-	784	602	-
Total Phosphorus		mg/kg	93.7	71.6	-	-	129	119	-
Organic Carbon		%	0.85	0.83	-	-	0.69	0.43	-
Plant Available Nutrients	Phosphorus - Colwell	mg/kg	26.2	10.8	-	-	7.53	15.2	-
	Potassium - Colwell	mg/kg	182	96.6	-	-	69	158	-
	Sulphur - KCl	mg/kg	58.7	1132	-	-	30.7	6.68	-
	Copper – DTPA	mg/kg	0.86	0.78	-	-	1.48	1.29	-
	Iron – DTPA	mg/kg	1.66	0.85	-	-	0.65	1.29	-
	Manganese – DTPA	mg/kg	16.1	15.3	-	-	16.9	17.7	-
	Zinc – DTPA	mg/kg	0.4	0.24	-	-	0.25	0.35	-
Exchangeable Cations	Calcium	meq/100g	2.80	2.71	2.04	1.63	4.89	3.68	3.53
	Magnesium	meq/100g	1.35	2.63	2.47	1.95	0.96	0.45	1.17
	Potassium	meq/100g	0.28	0.16	0.32	0.19	0.03	0.25	0.13
	Sodium	meq/100g	1.09	2.35	3.20	2.60	0.73	0.11	1.97
	Aluminium	meq/100g	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Effective Cation Exchange Capacity		meq/100g	5.5	7.9	8.0	6.4	6.6	4.5	6.8
Exchangeable Sodium Percentage		%	19.6	30.0	39.8	40.7	11.0	2.4	29.0
Coarse Fragments > 2.0mm		%	49.9	73.1	74.9	69.7	64.3	37.6	57.5
Particle Size Distribution of Fine Fraction	Coarse Sand 0.2-2.0mm	%	24.7	20.1	17.9	18.5	41.4	34.2	52.6
	Fine Sand 0.02-0.2mm	%	40.2	28.8	25.9	20.8	40.3	42.1	29.2
	Silt 0.002-0.02mm	%	5.7	12.5	8.1	10.3	5.8	5.7	5.7
	Clay <0.002mm	%	29.4	38.6	48.0	50.4	12.6	18.1	12.4
Emerson class		Class	2	2	6*	2	4	4	4
Carbonates Fizz Test		Class	-	-	Fizz	-	Fizz	Fizz	Fizz

*A modified Emerson test was also completed for samples with $EC_{1:5}$ >1dS/m. In this test, the sample was pre-leached with deionised water to remove dissolved salts prior to assessment of aggregate stability.

Analyses		Unit	S06			S10			
			0-0.1	0.1-0.55	0.6-0.9	0-0.15	0.15-0.5	0.6-0.8	0.9-1.1
pH		pH units	6.6	6.9	8.6	8.6	8.8	9.1	9.1
Electrical Conductivity		dS/m	0.0	0.3	0.6	0.1	0.3	0.8	0.9
Chloride		mg/kg	6	109	273	9	188	512	623
Total Nitrogen		mg/kg	318	439	-	490	402	-	-
Total Phosphorus		mg/kg	194	185	-	127	116	-	-
Organic Carbon		%	0.34	0.42	-	0.41	1.1	-	-
Plant Available Nutrients	Phosphorus - Colwell	mg/kg	16.3	12.7	-	21.8	7.77	-	-
	Potassium - Colwell	mg/kg	180	77.9	-	299	81.6	-	-
	Sulphur - KCl	mg/kg	5.22	39.6	-	5.33	12.4	-	-
	Copper – DTPA	mg/kg	1.89	1.85	-	0.97	1.27	-	-
	Iron – DTPA	mg/kg	4.9	3.24	-	1.87	1.49	-	-
	Manganese – DTPA	mg/kg	25.3	22.3	-	17.6	17.1	-	-
	Zinc – DTPA	mg/kg	0.58	0.44	-	0.38	0.28	-	-
Exchangeable Cations	Calcium	meq/100g	4.09	8.35	3.61	4.73	3.21	1.26	1.11
	Magnesium	meq/100g	1.82	2.86	1.28	1.07	2.53	1.88	1.83
	Potassium	meq/100g	0.25	0.15	0.18	0.68	0.41	0.15	0.23
	Sodium	meq/100g	0.22	0.69	1.63	0.07	1.00	1.65	1.81
	Aluminium	meq/100g	0.01	0.02	0.02	0.02	0.02	0.01	0.01
Effective Cation Exchange Capacity		meq/100g	6.4	12.1	6.7	6.6	7.2	5.0	5.0
Exchangeable Sodium Percentage		%	3.4	5.7	24.2	1.1	14.0	33.4	36.3
Coarse Fragments > 2.0mm		%	28.5	68.7	57.3	12.5	23.5	33.6	35.7
Particle Size Distribution of Fine Fraction	Coarse Sand 0.2-2.0mm	%	27.3	35.5	53.8	31.4	23.1	21.4	16.8
	Fine Sand 0.02-0.2mm	%	47.3	44.8	33.9	41.5	39.7	29.1	25.0
	Silt 0.002-0.02mm	%	5.6	7.5	3.8	7.4	9.6	29.8	35.0
	Clay <0.002mm	%	19.8	12.3	8.6	19.6	27.7	19.7	23.2
Emerson class		Class	3	5	4	4	4	4	3*
Carbonates Fizz Test		Class	-	-	Fizz	Fizz	Fizz	Fizz	Fizz

*A modified Emerson test was also completed for samples with $EC_{1:5}$ >1dS/m. In this test, the sample was pre-leached with deionised water to remove dissolved salts prior to assessment of aggregate stability.

Analyses		Unit	S12				
			0-0.1	0.1-0.3	0.4-0.6	0.8-1.0	1.0-1.2
pH		pH units	8.2	8.0	8.3	8.3	6.1
Electrical Conductivity		dS/m	2.3	7.6	5.2	6.2	6.0
Chloride		mg/kg	2,230	7,601	5,630	5,259	4,521
Total Nitrogen		mg/kg	167	287	-	-	-
Total Phosphorus		mg/kg	148	112	-	-	-
Organic Carbon		%	0.22	0.24	-	-	-
Plant Available Nutrients	Phosphorus - Colwell	mg/kg	14.9	13	-	-	-
	Potassium - Colwell	mg/kg	145	103	-	-	-
	Sulphur - KCl	mg/kg	102	317	-	-	-
	Copper – DTPA	mg/kg	1.52	1.63	-	-	-
	Iron – DTPA	mg/kg	1.95	1.69	-	-	-
	Manganese – DTPA	mg/kg	20.3	17.2	-	-	-
	Zinc – DTPA	mg/kg	0.89	0.38	-	-	-
Exchangeable Cations	Calcium	meq/100g	1.65	2.99	2.47	2.28	52.14
	Magnesium	meq/100g	2.01	5.24	4.33	3.88	3.98
	Potassium	meq/100g	0.52	0.22	0.14	0.11	0.07
	Sodium	meq/100g	2.75	3.76	3.61	3.26	2.13
	Aluminium	meq/100g	0.01	0.03	0.01	0.01	0.01
Effective Cation Exchange Capacity		meq/100g	6.9	12.2	10.6	9.5	58.3
Exchangeable Sodium Percentage		%	39.6	30.7	34.2	34.2	3.7
Coarse Fragments > 2.0mm		%	21.1	9.0	32.8	22.3	25.0
Particle Size Distribution of Fine Fraction	Coarse Sand 0.2-2.0mm	%	24.8	18.3	36.1	24.8	23.5
	Fine Sand 0.02-0.2mm	%	44.2	27.0	21.8	19.3	20.3
	Silt 0.002-0.02mm	%	9.3	13.4	11.2	18.9	20.9
	Clay <0.002mm	%	21.6	41.3	31.0	36.9	35.3
Emerson class		Class	2*	4	4	4	2*
Carbonates Fizz Test		Class	Fizz	Fizz	Fizz	Fizz	-

*A modified Emerson test was also completed for samples with $EC_{1:5}$ >1dS/m. In this test, the sample was pre-leached with deionised water to remove dissolved salts prior to assessment of aggregate stability

Appendix B:

AQ2 Surface Water Management Plan

2021

CASTLE HILL MINE SITE

SURFACE WATER MANAGEMENT PLAN

Prepared for

EVOLUTION MINING LTD

November 2021

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Table of Abbreviations

AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
ASS	Acid Sulfate Soils
BoM	Bureau of Meteorology
DMIRS	Department of Mines, Industry Regulation and Safety
DWER	Department of Water and Environmental Regulation
DSM	Digital Surface Model
HECRAS	Hydrologic Engineering Centre's River Analysis System
IFD	Intensity-Frequency-Duration
RFFP	Regional Flood Frequency Procedure
ROM	Run-of-mine
SRTM	Shuttle Radar Topographic Mission

1 BACKGROUND

1.1 Background

AQ2 was commissioned by Evolution Mining Pty Ltd (EVN) to complete a Surface Water Management Plan (SWMP) for its proposed mine at Castle Hill as well as the proposed Haul Road between Castle Hill and Evolution's Mungari Operations. A SWMP for the mine expansion is required for mine development approval from WA Department of Mines, Industry Regulation and Safety (DMIRS).

The proposed Castle Hill mine is located approximately 40 km NWW of Kalgoorlie, in the Goldfields region of Western Australia (refer Figure 1.1) and 20 km west of the regional chain of salt lakes which includes Black Flag Lake, White Flag lake and Lake Kopai.

1.2 Scope of Work

This SWMP was completed as a hydrological desktop assessment to address relevant DMIRS (2020) Guidelines for preparing mine plans and EPA (2018) Environmental Factor Guideline 'Inland Waters', including the following:

- Characterisation and description of the regional climate and surface hydrology of the area.
- Definition of surface water catchment areas including maps identifying the Project in relation to regional and local catchment(s). This includes a high level desktop hydrological assessment for the proposed Castle Hill Mine site and the Haul Road between Castle Hill and Evolution's Mungari Operations, based on client-provided topography data as well as Shuttle Radar Topography Mission (SRTM) topography.
- Estimation of flood peak flows for various probabilities at key locations.
- 2-D Flood modelling of Existing Conditions for the 1% AEP event.
- Identification of potential impacts and unacceptable risks that the proposed development may have on the surface water regime.
- Identification of locations where surface water management measures are required (such as flood protection bunds, diversion drains, flood ways, erosion controls, sedimentation basins, etc.) to mitigate risks and assessment of residual risks following application of these.
- Estimate flood levels that may occur from a single design flood event (1% AEP flood event) through Unnamed Creek at the location of the Haul Road Crossing based on provided topography.
- A description of the beneficial uses of surface water and main water quality characteristics of the surface hydrology of the area.

2 ACTIVITY DETAILS

2.1 Proposed Mining Activities

The proposed mining activities for the Castle Hill development (the Project) include:

- Open cut mining.
- Operation of offices, workshops and laydown areas.
- Operation and maintenance of Waste Rock Dumps.
- Storage of topsoil.
- Transport of unprocessed ore to Mungari Operations.

2.2 Site Plan

Proposed mine pits and site infrastructure has been provided by Evolution Mining for use in this project and include the following:

- Multiple Stockpiles and Laydown Areas.
- Central ROM Pad.
- Offices and Workshop.
- Waste Dump.

The proposed site layout is shown in Figure 2.1.

2.3 Proposed Operations Footprint

The operating footprint areas of proposed infrastructure are shown in Table 2.1 and are based on the maximum extent of infrastructure plans provided by Evolution.

Table 2.1: Proposed Operations Footprint

Infrastructure	Footprint (km^2)
Open-cut Pit	0.5
Run of Mine (ROM) Pad	0.2
Laydown	0.3
Waste Dump	1.6
Stockpiles	0.2
Office and Workshop	0.1
Dam	0.001
Total	**2.9**

3 BASELINE ENVIRONMENTAL DATA

3.1 Regional Climate

The climate of the region is typically arid, with hot summers and cool winters. Temperatures can range from below 0°C in winter, to over 45°C in summer. In Kalgoorlie, east of the Project, a weather station has measured rainfall since 1939, providing 82 years of data. The mining area of Coolgardie is also relatively close to the Project (20 to 35km to the south), where a further long-term rainfall gauge exists with data since 1893, providing 125 years of rainfall record. The Ora Banda rainfall gauge 30km to the north of Castle Hill provides rainfall data from 1916 to 2016. Details for these rain gauges are presented in Table 3.1.

Table 3.1: Nearby BoM Rainfall Gauges

Site Name	BoM Site Number	Commencement Date	Latitude	Longitude	Operational Status
Kalgoorlie-Boulder Airport	012038	1939	30.79° S	122.45° E	Open
Coolgardie	012018	1893	30.96° S	121.17° E	Open
Ora Banda	012066	1916	30.38° S	121.06° E	Open, ceased rainfall in 2016

Kalgoorlie has an average rainfall of 265.9 mm per annum from 82 years of data (Bureau of Meteorology (BoM) Site 012038, 2021). The rainfall is highly variable with the larger rainfall events typically as a result of rainfall from ex-tropical lows during late summer. Temperature and rainfall statistics are displayed in Table 3.2 and Figure 3.1.

Table 3.2: Climate Conditions at Kalgoorlie (BoM site 012038)

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean max temp (°C)	33.7	32.1	29.4	25.3	20.7	17.6	16.8	18.7	22.3	25.9	29.1	32	25.3
Mean min temp (°C)	18.3	17.9	16.1	12.7	8.7	6.3	5.1	5.7	8	11.2	14.2	16.6	11.8
Mean rainfall (mm)	27.2	32.4	25.0	20.0	24.8	27.1	24.2	21.0	13.4	15.7	18.8	16.3	265.9

Pan evaporation data for the Project was extracted from the BoM gridded datasets (BoM, 2021), which provided annual pan evaporation total of 2,620 mm. Average monthly evaporation rates exceed average rainfall rates throughout the year (Figure 3.1).

3.2 Rainfall

3.2.1 Probability Terminology

Probability terminology from the 2019 Australian Rainfall and Runoff (Bell et al, 2019) has been adopted. In particular, the terms Annual Exceedance Probability (AEP) and Exceedances per Year (EY) are adopted rather than the previous ARR 1987 terminology of Average Recurrence Interval (ARI).

The equation below (BoM http://www.bom.gov.au/water/designRainfalls/ifd-arr87/glossary.shtml) shows how the terms relate to each other.

$$AEP = 1 - exp\left(\frac{-1}{ARI}\right)$$

AEP is defined as the probability of a rainfall event being equalled or exceeded within a year, usually expressed as a percentage (%) or for frequent events as EY. It is the chance that a rainfall event of a given size or larger will occur in any given year; for example a 1 in 100 AEP event has a 1% chance of occurring this year, while a 1 in 50 AEP event has a 2% chance of occurring. ARI is defined as the average, or expected, value of the periods between exceedances of a given rainfall total accumulated over a given duration.

3.2.2 Rainfall IFD and PMP Data

Intensity-Frequency-Duration (IFD) data characterises storm rainfall intensities and is available from BoM. IFD data was extracted from the BoM website for the Project from the 2016 datasets and is presented in Table 3.3. The data shows the depth of rainfall which is estimated to fall at the site under different design rainfall events for rainfall probabilities consistent with ARR 2019 Guidelines.

Table 3.3: Project Rainfall IFD Data

	AEP:	50%	20%	10%	5%	2%	1%
	ARI (year)	1.44	4.48	10	20	50	100
Duration	1 min	1.44	2.24	2.86	3.52	4.48	5.3
	2 min	2.49	3.85	4.85	5.9	7.47	8.78
	3 min	3.36	5.21	6.59	8.04	10.2	12
	4 min	4.09	6.37	8.07	9.88	12.6	14.8
	5 min	4.72	7.36	9.35	11.5	14.6	17.2
	10 min	6.94	10.9	13.9	17.1	21.9	25.9
	15 min	8.39	13.2	16.8	20.7	26.4	31.3
	20 min	9.48	14.8	18.9	23.3	29.8	35.2
	25 min	10.4	16.2	20.6	25.4	32.4	38.3
	30 min	11.1	17.3	22.1	27.1	34.5	40.8
	45 min	12.8	20	25.4	31.1	39.6	46.7
	1 hour	14.2	22	27.9	34.2	43.4	51.3
	1.5 hour	16.2	25.1	31.8	39	49.5	58.4
	2 hour	17.9	27.6	35	42.9	54.5	64.4
	3 hour	20.4	31.7	40.2	49.3	62.8	74.2
	4.5 hour	23.4	36.4	46.3	57.1	72.9	86.4
	6 hour	25.7	40.2	51.4	63.5	81.3	96.5
	9 hour	29.3	46.2	59.4	74	95.1	113
	12 hour	32.1	50.8	65.8	82.4	106	127
	18 hour	36.1	57.8	75.4	95.2	123	147
	24 hour	39	62.8	82.4	105	135	162

	AEP:	50%	20%	10%	5%	2%	1%
	ARI (year)	1.44	4.48	10	20	50	100
	30 hour	41.1	66.6	87.7	112	145	174
	36 hour	42.8	69.6	91.9	117	152	183
	48 hour	45.4	74	98	126	163	196
	72 hour	48.5	79.4	105	135	176	211
	96 hour	50.4	82.4	109	140	182	219
	120 hour	51.8	84.4	111	143	186	225
	144 hour	52.9	85.8	113	144	189	228
	168 hour	53.9	87	114	145	191	231

Closure of mines requires contemplation of rare storm events that could occur in time undefined after closure. In this regard, DMIRS has suggested the use of the Probable Maximum Precipitation (PMP), which is an estimate of the upper physical bound to the precipitation that the atmosphere can produce.

BoM has developed the following methods for estimating PMP rainfall depths depending on storm duration for the Project region:

- GSDM – Generalised Short Duration Method, implemented for storm durations up to 6 hours.
- GTSMR – Generalised Tropical Storm Method Revised, developed for storm durations greater than or equal to twenty-four hours.

Results from the PMP estimation methods (GSDM and GTSMR) for the Project location are shown in Table 3.4, along with other rare IFD's sourced from BoM (2020) for context.

Table 3.4: PMP and Rare Event IFD Data for Castle Hill Project

Duration / AEP (1 in X)	1hr Rainfall (mm)	3hr Rainfall (mm)	24hr Rainfall (mm)	48hr Rainfall (mm)	72hr Rainfall (mm)
1,000	85	122	263	326	367
2,000	98	141	303	377	429
PMP (Point Location)	420	600	994	1171	1260

3.3 Topography

Local topographic data was provided by Evolution covering the proposed Project (Refer Figure 3.2). The data was provided in contour format, from which a Digital Elevation Model (DEM) was generated for the purposes of 2-D modelling (refer Section XX). In all other areas of the project site, Shuttle Radar Topographic Mission (SRTM) elevation data was available to delineate upstream catchment extents and approximate streamline elevations.

Within the project areas, topography ranges as per the following:

- from 415 to 450 mAHD surrounding the proposed Castle Hill Mine;
- from 360 to 420 mAHD between the terminal points of the proposed Haul Road.

The Unnamed Creek has elevations ranging from 360 mAHD at the intersection with the Haul Road, up to 520 mAHD in the upper areas of the Creek's catchment over a 50 km length. Ground levels continue to fall along the creek as it travels east.

3.4 Potential Environmental Receptors

There are few Threated Ecological Communities (TECs) in proximity to the proposed Project (DBCA, 2021). Upstream of the Project, there are several smaller TECs adjacent to Lake Barlee, which was found in the late 1980s to be the breeding ground of the Banded Stilt waterbird species.

The TEC that could potentially be impacted by the proposed Castle Hill development is located downstream of Lake Minigwal in what appears to be a low-lying wetlands area (refer Figure 3.3). TEC mapping indicates the majority of the wetlands area is located outside of the regional catchment that would likely be affected by the proposed development.

3.5 Hydrology

3.5.1 Regional Hydrology

The Goldfields consists of several ephemeral salt lakes that are connected through paleochannels. Runoff in the region generally terminates in the salt lakes, where evaporation plays a major role in the hydrology of the region. During small to medium-sized rain events, runoff is likely to report to the nearest downstream salt lake, while the lakes tend to overtop during large events, where runoff is more likely to report to the terminal point of the catchment.

The proposed Castle Hill project lies in a catchment area of approximately 105,000km2 (DWER 2021), which is one of the largest catchments in the region (Refer Figure 3.3).

3.5.2 Project Hydrology

The following sections characterise the hydrology of the Project itself, as well as the surrounding areas that may be impacted by/impact on it, using catchment delineation and 2-D modelling.

Catchment delineations were carried out using the following datasets:

- Client-provided contour data of the Castle Hill project area;
- Aerial photography of local catchments; and
- STRM 10 m topographic contours (publicly available).

These datasets were imported into GIS packages for interpretation and for delineation of the catchment boundaries and drainage lines. The geometry and other characteristics of each catchment and drainage reach were extracted and documented using GIS packages.

3.5.2.1 External Catchment A - Unnamed Creek

Unnamed Creek is located approximately 9.2km downstream of the Castle Hill mine sites, which have a very low risk of flooding as they are located along the catchment divide.

Castle Hill Mine is on the catchment divide between Unnamed Creek to the south and Racetrack Creek to the north. The Mick Adam pits is a very small portion of the Racetrack Creek catchment.

The Unnamed Creek and several other creeks terminate at the collection of ephemeral salt lakes to the east of the project area.

Unnamed Creek crosses the proposed Castle Hill road location and will flow during rain events, creating a potential flood risk for the Haul Road. The Unnamed Creek catchment (Catchment A) is shown in Figure 3.4, with an estimated area of 1,025km^2 and characteristics displayed in Table 3.1.

3.5.2.2 External Catchment B

Figure 3.4 also shows Catchment B as the main drainage line is adjacent to or intersecting the eastern side of the Haul Road for a section near its forked or fanned confluence with Unnamed Creek (based on SRTM topographic data). Haul Road Catchment B details shown in Table 3.5.

Table 3.5: Regional Catchment Details

Catchment	Area (km²)	Mainstream Length (km)	Equal Area Slope (m/km)
Unnamed Creek - A	1,025 km^2	50	1.4
B	40 km^2	10.9	3.9

3.5.2.3 Local Catchments

3.5.2.3.1 Mine

Some minor drainage flow paths are located within the project area upstream of the mine sites and Haul Roads and may impact the project. Figure 3.5 and Table 3.2 presents local baseline catchments within the Castle Hill Mine project area.

3.5.2.3.2 Haul Road

Figure 3.6 presents local subcatchments upgradient to the Haul Road and catchment characteristics are provided in Table 3.6. The subcatchments upstream of the Haul Road contribute to minor drainage lines that may require surface water management infrastructure to convey peak flows underneath or over the Haul Road. Subcatchments B1 to B8 are within regional catchment B (refer Figure 3.6).

Table 3.6: Local Catchment Details

Area	Subcatchment ID	Area (km²)	Mainstream Length (km)	Equal Area Slope (m/km)
Mine Site	C	1.8	3.0	9.6
	D	1.7	3.3	12.0
	E	2.4	3.4	8.3
	F	1.4	1.6	14.1
	G	1.2	2.2	10.1
	H	0.33	1.6	4.8
	I	1.7	2.1	5.1
	J	1.6	2.2	9.4
	K	1.0	1.9	9.8
	L	1.1	1.9	6.3
	M	1.9	1.4	7.4
Haul Road	B1	1.2	1.1	4.9
	B2	1.49	1.28	11.07
	B3	0.97	0.78	22.47
	B4	1.24	2.30	10.49
	B5	2.63	2.56	16.54
	B6	2.42	1.97	27.56
	B7	3.3	2.41	19.2
	B8	1.15	1.79	17.25
	N	2.7	2.9	12.1
	O	3.2	3.6	9.7

The Regional Flood Frequency Procedure (RFFP) method developed by Flavell (2012) was used to estimate peak flow rates of design flood events for external and local catchments. The following peak flow estimates (Table 3.7) were determined for each of the catchments delineated in Section 3.

Table 3.7: Peak Flow Estimates (m³/s) for Subcatchments

Catchment ID	Average Recurrence Interval (ARI)					
	2	5	10	20	50	100
	Annual Exceedance Probability (AEP)					
	39.4%	18.1%	10%	5%	2%	1%
A	39	138	254	448	593	864
B	3.9	13.3	24.3	41.8	59.8	84.8
C	0.4	1.2	2.2	3.8	5.7	8.0
D	0.4	1.2	2.1	3.6	5.4	7.5
E	0.5	1.5	2.7	4.5	6.8	9.5
F	0.5	1.5	2.8	4.6	7.2	10.0
G	0.3	1.0	1.8	3.0	4.6	6.4
H	0.1	0.2	0.3	0.6	0.9	1.2
I	0.3	1.1	2.0	3.3	5.1	7.1

Catchment ID	Average Recurrence Interval (ARI)					
	2	5	10	20	50	100
	Annual Exceedance Probability (AEP)					
	39.4%	18.1%	10%	5%	2%	1%
J	0.4	1.3	2.4	3.9	6.1	8.4
K	0.3	0.8	1.5	2.6	4.0	5.6
L	0.3	0.8	1.4	2.4	3.8	5.2
M	0.6	1.8	3.3	5.5	8.9	12.1
B1	0.4	1.1	2.0	3.3	5.4	7.4
B2	0.5	1.1	2.8	4.6	7.5	10.2
B3	0.3	0.7	1.8	3.0	4.9	6.7
B4	0.3	0.7	1.67	2.8	4.4	6.0
B5	0.6	1.4	3.3	5.6	8.7	12.1
B6	0.6	1.4	3.6	5.9	9.4	12.9
B7	0.7	1.7	4.3	7.2	11.4	15.8
B8	0.3	0.7	1.8	3.0	4.7	6.5
N	0.7	2.2	4.0	6.7	10.2	14.1
O	0.6	2.1	3.8	6.5	9.7	13.6

3.5.3 2-D Modelling – Existing Conditions

Hydraulic 2D flood modelling of the project has been completed using the Hydrologic Engineering Center's (HEC) River Analysis System (HEC-RAS) modelling software to characterise baseline hydrological conditions of the Project area.

3.5.3.1 HECRAS Modelling

The HEC-RAS software is capable of simulating one-dimensional (1D), two-dimensional (2D), and combined 1D-2D unsteady surface water flow through a full network of open channels, floodplains, and alluvial fans. The system is comprised of a graphical user interface (GUI), separate hydraulic analysis components, data storage and management capabilities, graphics and reporting facilities. The 2D grid mesh can be modified in regions to provide variable grid sizes over the model domain and can incorporate irregular shapes. 2D Model Set-Up.

A 2D model was set up from Digital Elevation Model (DEM) data (1m Contours 'Castle Hill Topography' provided by Evolution) which represents existing conditions (i.e., no proposed infrastructure, but the existing pit and waste dump are represented) to predict inundation areas resulting from a 1% AEP estimated design storm event.

Detailed DEM coverage is available only for Mt. Gould itself. Additional SRTM data covering the terrain to the west and east of the project, was obtained in an attempt to model the flooding due to the tributary catchments identified in Section 3.3.2.1, but the quality of the data was low and therefore flood mapping results were unreliable. Modelling predictions were therefore restricted to the mine development area, which was covered by higher quality LIDAR data provided by Newcam Minerals.

The general model build details are as follows:

- 10m x10m grid within the model boundary (refer Figures 4.1 and 4.2).
- Rain-on-Grid hydrology was applied across the model using nested frequency storms.
- A Manning's 'n' value of 0.08 was applied across the model domain with the exception of concentrated flow paths, which had a value of 0.06.
- Outflows along the downstream boundary were allowed using normal depth based on the slope of the creek bed (0.002).
- Variable timestep calculated internally in the model.
- Solve Method = Shallow Water Equations, Eulerian-Lagrangian Method.
- Model simulation duration = 3 hours. Peak flow was reached prior to end of simulation.

3.5.3.2 Baseline 2-D Modelling Results

Flow depth and velocity predictions for existing conditions for the 1% AEP event is shown in Figures 4.1 and 4.2. Note flood mapping is screened to only show areas where flow depths exceeding 0.1m occur. Key observations from these predictions are as follows:

- Several smaller drainage channels are visible that drain from the catchment divide to the north, south and east.
- The flow channels are generally free draining, with no visible ponding occurring through the 3-hr model duration.
- The predicted maximum flood depth through the site, occurring through the drainage path on the southern end of the site, is expected to be around 0.75m.
- Predicted maximum velocities around the site for the 1% AEP event are expected to be around 1.5m/s and occur in multiple channels around the site.

4 HYDROLOGICAL IMPACT IDENTIFICATION

Potential hydrological impacts of the Project are identified in the section below, based on a comparison of the proposed infrastructure layout with existing catchment delineations and baseline flood modelling results. These potential impacts are also summarised in the left-hand side of the Hydrological Risk Matrix presented in Appendix B.

4.1 Potential Hydrological Impacts of Mining Operations (General)

Mining operations in general have the potential to impact the environmental values and hydrological behaviour of the surrounding areas. The greatest threats to the environment and hydrological behaviour of the surrounding area fall into the following categories:

- Modification of the existing hydrological regime, by increasing or reducing water availability within the environment.
- Erosion of disturbed areas relating to construction, stockpiles, laydowns and waste dumps (among others) that cause sedimentation in downstream areas.
- Degradation of water quality through discharge of chemicals, including hydrocarbons.

These impacts and their implications for environmental quality are discussed further below.

4.1.1 Modification of Existing Hydrological Regime

Construction of mine pits, waste dumps, Haul Roads and other associated infrastructure for proposed mines can potentially affect existing surface water drainage features, including creek lines, pools and flood plains. Modification of the existing catchments and drainage channels can reduce the volume and distribution of runoff to some areas, creating water shadows and increasing flows and periods of ponding in others. This disturbance has the potential to adversely impact downstream vegetation due to water starvation, drowning and/or sedimentation.

Haul Roads located in relatively flat areas of the floodplain or across shallow drainage areas have the potential to impede flow and create water shadows on the downstream side of the road. The dynamic loads imposed by heavy traffic loads potentially can result in compaction of the subgrade potentially decreasing permeability. The development of mine pits adjacent to or within major drainage channels poses significant flood risk to the mine pits and potential for water starvation downstream. Runoff from waste dumps and cleared or disturbed areas may increase the volume of runoff and adversely impact water quality.

The proposed Project may have the following impacts on the local hydrological regime if no surface water management infrastructure is implemented (noting that mitigation measures are discussed in Section 5):

- Capture of surface water by the pit and waste dump footprints is likely to reduce runoff to the downstream catchments.
- Runoff is likely to pond on the upstream side of the proposed haul and access roads, with water shadows potentially occurring downstream.
- Runoff is likely to be intercepted by the proposed Laydown Pad and Workshop/Offices, potentially creating ponding upstream and water shadows downstream.

4.1.2 Sediment Generation

Mining operations will inherently cause ground disturbance related to mining and construction of ancillary infrastructure, such as ROM pads and crushers, and waste landforms. The impacts of this ground disturbance can be significant, depending on several factors, including the location of the deposit, mine planning, and the terrain of the area, among others. These activities tend to increase sediment loads transported in runoff and could result in sedimentation of vegetated and other sensitive ecological areas.

The potential sources of sediment from the site are as follows:

- External runoff washing sediment from the ROM and laydown pad footprints.
- Runoff from the waste dump and topsoil stockpiles carrying sediment-laden water downstream.
- External runoff eroding the toe of the waste dump.

4.1.3 Water Quality

Mine development has potential for adverse impacts to surface and groundwater quality due to:

- Spillage of hydrocarbons and chemicals stored, handled or transported on site.
- Runoff from the mine pit, stockpiles, ROM pad and waste dump areas containing metals or other elements.
- Spillage from and/or erosion of the Heap Leach during rain events that could contribute contaminated water to the downstream environment.
- Discharge of water used for dust suppression.

Contaminated discharges have the potential to impact on vegetated areas, pools and other sensitive ecological areas downstream if allowed to enter nearby waterways. The management of hydrocarbons and other chemicals are typically dependent on implemented management practices.

4.1.4 Impacts to Operations from the Hydrological Regime

As well as impacting on local hydrology, mining operations can also be impacted by flooding. In this case, flooding of the development has potential to damage process infrastructure and restrict the serviceability of roads that cross drainage lines.

Flooding of the open cut pit from external flood waters is very unlikely to be significant given the 1% AEP flood mapping does not show flooding will impact the pit footprint.

5 HYDROLOGICAL RISK ANALYSIS

5.1 Introduction

The previous section identified the potential impacts of the proposed mining project to the hydrological regime. The following section assesses the inherent risk of the project to the hydrological and environmental values of the surrounding area, and the residual risk following application of proposed mitigation measures.

DMIRS suggests the evaluation of Inherent Risks associated with mine development be conducted through considering the objectives for different Environmental Factors shown in the excerpt below, of which, the Water Resources and Rehabilitation and Mine Closure factors are the most relevant for this report.

Table 5.1: DMIRS Environmental Objectives

Factor	Objective
Biodiversity	To maintain representation, diversity, viability and ecological function at the species, population and community level.
Water Resources	To maintain the hydrological regimes, quality and quantity of groundwater and surface water to the extent that existing and potential uses, including ecosystem maintenance, are protected.
Land and Soils	To maintain the quality of land and soils so that environmental values are protected.
Rehabilitation and Mine Closure	Mining activities are rehabilitated and closed in a manner to make them physically safe to humans and animals, geo-technically stable, geo-chemically non-polluting/non-contaminating, and capable of sustaining an agreed post-mining land use, and without unacceptable liability to the State.

The hydrological risk assessment has been completed using the qualitative risk matrix template shown in Appendix A1, which is based on templates provided in DMIRS 2020. Application of the matrix involves rating each impact on the following:

- Most credible consequence of the impact resulting from the mining operation.
- Likelihood of the adverse impact occurring.

DMIRS 2020 provides Descriptors for rating each of Consequence and Likelihood aspects of the risk assessment which have been adapted for this study (refer Appendix A2). Consequences focuses on both magnitude and duration of impact, ranging from insignificant to severe. The likelihood of an impact occurring due to the mining operations is focused on the frequency/probability of different scale rain events (i.e. Annual Exceedance Probability) in relation to the expected life of the project.

The likelihood of a flood event exceeding an AEP design criteria over the operational lifetime of the mine (5 years) was calculated. In the event the mine infrastructure remains longer to service other deposits (not currently planned), the exceedance probability for a nominal 10-year duration has also been calculated. The exceedance probability is computed using the following equation (as per ARR):

$$p = 1 - \exp\left(-\frac{L}{Y}\right)$$

Where:

Y = the return period of a given flood event (ARI)
L = the design life in years
P = the exceedance probability during the design life

Table 5.2: Exceedance Probability

Mine Life (years)	Probability of Exceedance (%) for AEP					
	39.4% (2yr ARI)	18.1% (5yr ARI)	10% (10yr ARI)	5% (20yr ARI)	2% (50yr ARI)	1% (100yr ARI)
5	92%	63%	39%	22%	10%	5%
10	99%	86%	63%	39%	18%	10%

With respect to surface water assessments, the likelihood of an event occurring is directly related to the probability that a certain size rain event (% AEP) will occur.

5.2 Inherent Unmitigated Hydrological Risks

An Inherent Risk Matrix was developed and includes a combined Risk Rating for each of the identified potential impacts, which accounts for both the consequence and likelihood of the impact event. Consequence and likelihood ratings were applied based on the adapted Descriptors shown in Appendix A2. The impacts shown in Table 5.2 as a result of the unwanted events represent the 'worst case scenarios' of that impact type under a no-management scenario.

From the inherent risk matrix (Appendix B), several potential impacts to the environment have a medium to high risk of short to medium-term impact to the hydrological environment of the area. These are mostly related to the development of infrastructure footprints within drainage lines and the resultant ponding upstream and surface water shadowing downstream. A number of the identified impacts pose a risk in the form of sediment or hydrocarbons being washed away from the Project to impact on downstream receptors. Operational risks to the Project itself relate to flooding of the pit and process infrastructure.

5.3 Mitigation Measures

The unmitigated risks of the Project on the hydrological environment have been presented in preceding section. The following section will provide the following:

- Recommendations on whether the levels of unmitigated risk are acceptable.
- Propose risk treatments (in the form of Surface Water Management Infrastructure) that can be used to achieve acceptable Residual Risk Ratings.
- Outline any risks which can't be reduced to acceptable levels through mitigation measures.

Storm water runoff around the mine area and associated infrastructure must be managed to limit the environmental impacts of the mine operations on the surface water regime and reduce the impacts of flooding on the mine operations. From a risk management perspective, surface water management infrastructure should reduce the total risk of an unwanted event occurring such that it becomes acceptable based on DMIRS environmental objectives and can be appropriately managed. As such, the general management objectives for the Project relating to surface water are as follows:

- Maintain the existing hydrological regime as much as is practicable.
- Mitigate impacts on surface water quality from construction and operations and contain or treat any contaminated water on-site.

- Ensure the quality of the water released from the site will not lead to significant deterioration of the water resources and environment downstream.

Generally, treatment measures should meet the above objectives and design philosophies (where possible):

- Clean water should be diverted around the disturbance footprints to the downstream environment to prevent contamination of clean water catchments.
- Dirty water should be captured and treated close to the source of dirty water (i.e., close to the disturbance area) to reduce the volume of water that needs to be treated. Where possible, treated water should be returned to the downstream environment.
- Surface water management infrastructure must incorporate measures to avoid excessive scour, erosion and sediment transport.
- Drainage around operational areas should be designed to prevent prolonged ponding following rainfall events.
- Flood mitigation measures are required to prevent flood ingress to open pits and mine infrastructure areas.

Based on the guidance outlined by DMIRS (2020), the risks associated with environmental impact events with risk ratings that are high are not acceptable and require treatment to reduce their risk rating. Where possible, mitigation measures should also be considered for events with a rating of medium.

5.4 Proposed Surface Water Management Infrastructure

5.4.1 Road Crossings

The design and implementation of works should incorporate management features to minimize or mitigate the adverse changes to existing flow regimes, flood characteristics, scour, siltation and erosion of the drainage channels, inundation of areas upstream and water starvation of areas downstream of the construction.

Maintenance of the existing flow regimes should be considered when designing drainage structures. Where linear infrastructure (such as the Haul Roads) cross flow paths or floodways, any culverts should be maintained to allow continuity of the existing flooding characteristics of the floodplain. Floodways may also be required along the Haul Road alignment.

Minor waterway crossings will be installed, where required, to ensure areas upstream of the crossings are not unduly inundated, and that waterways at crossings are protected from erosion. Structures should be designed to impede flood flows as little as possible. Each crossing and its release zone should be designed to minimize erosion and potential head cutting of the stream bed.

5.4.2 Flow Diversions

Diversions are proposed in the following locations (Refer Figure 5.1):

- Along the western boundary of the western stockpile.
- Western and northern boundaries of the southern stockpile.

- Along the eastern boundary of the Laydown.
- Along the northern boundary of the Office building footprint.

Flood mapping indicates runoff may be intercepted by the pit and thus would require flood bunding to divert any flow downstream.

5.4.3 Sediment Control

Where runoff from waste dumps, pits and stockpile areas can discharge to the environment, capture bunding will be installed to collect runoff and direct it to sedimentation traps which will be located at key positions on the downstream sides of the mine disturbance areas (including WDs and stockpiles) to treat the surface water runoff prior to discharge to the natural watercourse. Proposed nominal locations of sediment basins for the project are shown in Figure 5.1.

Waste dump batter faces should be designed to minimise runoff erosion, and runoff captured from the waste dump and other sediment yielding infrastructure such as Stockpile Areas, ROM pad and Laydown will be diverted through sedimentation traps prior to release to the natural watercourse. In general, “dirty” runoff should be treated close to the source disturbance area to reduce the volume of runoff requiring treatment and be kept separate from clean runoff from external catchment areas.

5.4.4 Water Quality

Hydrocarbons

Hydrocarbons should be managed to avoid leaks and spills. Fuel handling areas should be bunded to capture any spills for remediation and be located outside of floodplains or appropriately elevated to avoid the risk of flood inundation.

Stormwater runoff from workshop pavements, fuel unloading and storage areas and from vehicle washdown areas shall be directed to grit and oil interceptors to remove pollutants prior to discharge of the water. Accidental spills outside controlled areas must be remediated to avoid contamination of groundwater or surface water.

Acid Sulfate Soils (ASS)

At some mine sites, lowering of the water table during mine dewatering can generate ASS in nearby wetlands and pools. If exposed to air, ASS has the potential to cause acidification of these surface waters (low pH) which may impact on flora and fauna.

Dust Suppression Water

Dust suppression water has the potential to impact surrounding vegetation if not managed appropriately. Dust suppression activities need to avoid overspray. Dust suppression will be sourced from local groundwater supplies, which are likely to be fresh and therefore the risk of excessive dust suppression causing runoff that impacts vegetation health is minimal. However, dust suppression water should still be applied to avoid excess water running off to the environment.

5.4.5 Mine Dewatering

Dewatering management will be according to an approved DWER licence. This minimises any impacts as water can be used for mining purposes rather than discharge of excess water into the environment.

Surface water captured within the pits following a large rainfall event may need to be discharged to the environment following rare, large rainfall events. The catchment area reporting to the pit will only be from the pit footprint area given the pit locations at the top of the catchment. Captured water may be reused within the mine site area, but under rare events may require short-term discharge to a localised drainage line (following discharge through a sediment trap).

5.5 Design Standards

The following general design standards are proposed for the future design of flood mitigation and surface water management measures for the Project site:

Diversions / Floodways / Crossings

- Based on the position of the pit relative to the adjacent drainage paths, it is unlikely any flood protection will be required. If Flood protection bunding around the Pit were to be installed, typically infrastructure that will protect against predicted flood levels from a 1% AEP event would be installed. For this project, any flood protection is likely to be provided by the proposed abandonment bund (as shown in Figure 2.1).
- Diversion around the Waste Dump toe should be designed for the 5% AEP.
- Diversions around other mining infrastructure (i.e. to prevent flood damage) are to be designed for a minimum 5% AEP event.
- Road culverts/floodways, including the main Haul Road crossing over Unnamed Creek, are to be designed for a minimum 5% AEP rain event.
- Allowance for a minimum of 0.5m freeboard in all internal drainage channels and diversion drains to account for uncertainties, debris and rough construction.
- Drains would be either trapezoidal or v-shaped (dependent on base width requirements) with nominal 1:3 side slopes. Material excavated to construct the drain should be placed alongside and down gradient of the drain and compacted to form a bund with nominal 1:3 side slopes.
- Flood protection bunds/levees should be built with nominal 1:3 side slopes and a minimum top width of 3m.
- Water velocities in diversions should generally be kept below 2m/s to prevent the need for rock armouring throughout the diversion. It is noted that model results predict velocities through the existing drain through the eastern gully exceed 2m/s during the 10% AEP event. As a result, rock armouring will be required in locations where excessive velocities are predicted. In addition, rock aprons should be installed at the downstream end of diversions to prevent scour and erosion.
- Given the access roads can be impacted by both the floodplain to the west and drainage from the project, culverts are recommended. Culverts are to be no smaller than 450mm diameter to ensure that they do not get frequently blocked.

Sediment Basins

- Sedimentation traps are to be designed to drop sediment particles greater than or equal to 75 µm out of suspension prior to release into the environment during a 10% AEP flood event. The sedimentation traps will also be able to capture the runoff during the first flushing event.
- A higher concentration of fines are likely to be mobilised during the first flush rainfall, this is the equivalent to the 20% AEP, 20 minute duration flood event. As there is likely to be a high percentage of fines and salt within this first flush, sedimentation basins should be able to capture the first flush event completely.
- The basins should be constructed with nominal 1:3 side slopes and 3m wide at the crest. A nominal 0.5m storage depth should be allowed for sediment accumulation before clean out is required. Sediment levels should be monitored following significant flood events and sediment accumulation should be removed on a regular basis.
- The outlet structure should consist of a spillway that allows continuous seepage from the basin.
- Sediment should be removed from the trap after each significant rain event to prevent sediment transport during the next event.
- Settling ponds, sediment traps and waste dumps are to be placed outside the 1% AEP flood plain of major drainage lines.
- Bunds containing hydrocarbons should be capable of containing the combined volumes from a 20-year ARI (5% AEP) 72-hour duration design flood event and 110% of the tank contents in accordance with the DoW Water Quality Protection Guidelines (2000).

5.6 Pit Surface Water Management

The LOM footprint of the pit footprint resides along the ridgeline with minimal upstream external catchment. As such, no diversions are proposed for surface water management of the pit. Instead, it is proposed that rainfall collect within the pit footprint and be pumped out as required.

An estimate of the volume of water which may discharge into the pit has been completed for different design rainfall events based on the following assumptions:

- 24-hr rainfall event depths.
- Assumed volumetric runoff coefficients for small catchments in the Goldfields (Flavell 2012).
- Contributing catchment areas = pit footprint of 0.5km^2.

Depending on the pit development/progression plans, the catchment areas reporting to each pit and the pit footprint areas may vary as the mine develops. Additionally, the requirement to remove collected runoff from the pit will be dependent on the capacity of stormwater collection sumps to contain the runoff within the pit and pit priority/active mining areas.

Table 5.3: Estimated Pit Runoff Volumes (24-hr Duration)

	AEP Event					
	39.4% (2yr ARI)	18.1% (5yr ARI)	10% (10yr ARI)	5% (20yr ARI)	2% (50yr ARI)	1% (100yr ARI)
Runoff Volume – Total Pit Footprint (0.5 km^2)	8400	14100	20600	28900	43200	56700

To assist Evolution with selecting design capacity for any stormwater pumping system that may be required, estimates of the required pumping duration to remove different runoff volumes from the pit at different pumping rates have been estimated (refer Table 5.4). Used in conjunction with Table 5.3, this indicates an estimated pump-out duration of approximately 2 weeks to remove a 1% AEP event at 50L/s.

Table 5.4: Pumping Duration Required to Remove Runoff (Days)

Pumping Rate (L/s)	Runoff Volume (m^3)				
	10,000	20,000	50,000	80,000	100,000
25	4.6	9.3	23	37	46
50	2.3	4.6	12	19	23
75	1.5	3.1	7.7	12	15
100	1.2	2.3	5.8	9	12
200	0.6	1.2	2.9	5	6

5.7 Closure

Surface water management measures at closure generally aim to protect the hydrological environment and remaining landforms during the PMP event (refer Section 3.1.2). While 2-D modelling was not completed for closure conditions, given that closure landforms have not yet been identified, surface water management of the site at Closure should generally consist of the following:

- The Pit void will remain in place, with abandonment bunding along the pit perimeter. Where abandonment bunding is required to divert surface water, it shall be constructed in line with flood bund construction requirements.
- Final WD surfaces will be shaped to reduce runoff velocities and the potential for erosion from the WD face.
- Removal and rehabilitation of stockpiles, plant, camp and road alignments.
- Where required, protect toe of WD from erosive velocities of floodwater from extreme events (including flooding of Mine Creek).
- Diversion bunds and drains will remain in place to provide continued protection of the rehabilitated landforms in the immediate post-closure phase.

5.8 Mitigated Risk Analysis and Evaluation

The left hand part of the Risk Matrix in Section 5 (Appendix B) shows the calculated risk rating of potential unwanted events during mine operation without the implementation of any surface water

management infrastructure. The hydrological impacts to and from the project were re-assessed assuming implementation of the treatment measures described above to assess the Residual Risks (right hand side of the table in Appendix B).

The recommended residual risks are typically rated as Low, with the following exceptions, which had a residual risk rating of Medium:

- R3 – Reduction in catchment downstream of pit. There is no external catchment reporting to the pit; only direct rainfall will contribute runoff which cannot be mitigated. The total reduction in catchment area (0.5km2) is a small portion (<0.001%) of the total catchment reporting downstream and terminating at the collection of Salt Lakes to the southeast. While the overall impact would be minor, it is likely that a water shadow would occur on medium to large sized events.

The above risk has a very low consequence ranking but remains Medium risks because of the likelihood it would occur. Given the small upstream catchments for the pit and waste dump, and the recommended mitigation measure for the Haul Road crossing, these risks are considered acceptable.

6 SUMMARY AND CONCLUSIONS

Proposed mining activities associated with the Castle Hill Gold Project include open-cut mining, construction of stockpiles and waste dumps and operation of ancillary infrastructure.

The proposed development resides along a catchment divide, where runoff is drained through small channels to the north, east and south. With the exception of a few locations where access roads and other infrastructure intercept small drainage lines, most of the infrastructure related to mine development is unlikely to be impacted by these drainage channels.

A Hydrological Risk Assessment has been completed for the project and multiple medium to high-inherent risks to the hydrological environment were identified, and included the following:

- Water shadows due to interruption of surface and shallow groundwater flow paths.
- Increased downstream sedimentation due to water courses impacting on stockpiles and other infrastructure that have potential to be eroded.
- Runoff with elevated contaminant levels (sediments, hydrocarbons, metals and other elements released to the environment).

Mitigation measures have been proposed to reduce the hydrological risk of the project to acceptable levels. Measures have included:

- Diversion of flow (5% AEP) around potentially impacted infrastructure, namely Laydowns, Stockpiles and Waste Dump
- Construction of culverts or flood ways along the access road as well as the Unnamed Creek crossing for a 5% AEP event
- Construction of sediment basins at the downstream locations of all sediment generating disturbance areas (i.e., waste dump, pits, stockpiles, and ROM) will mitigate sediment generation and transport.

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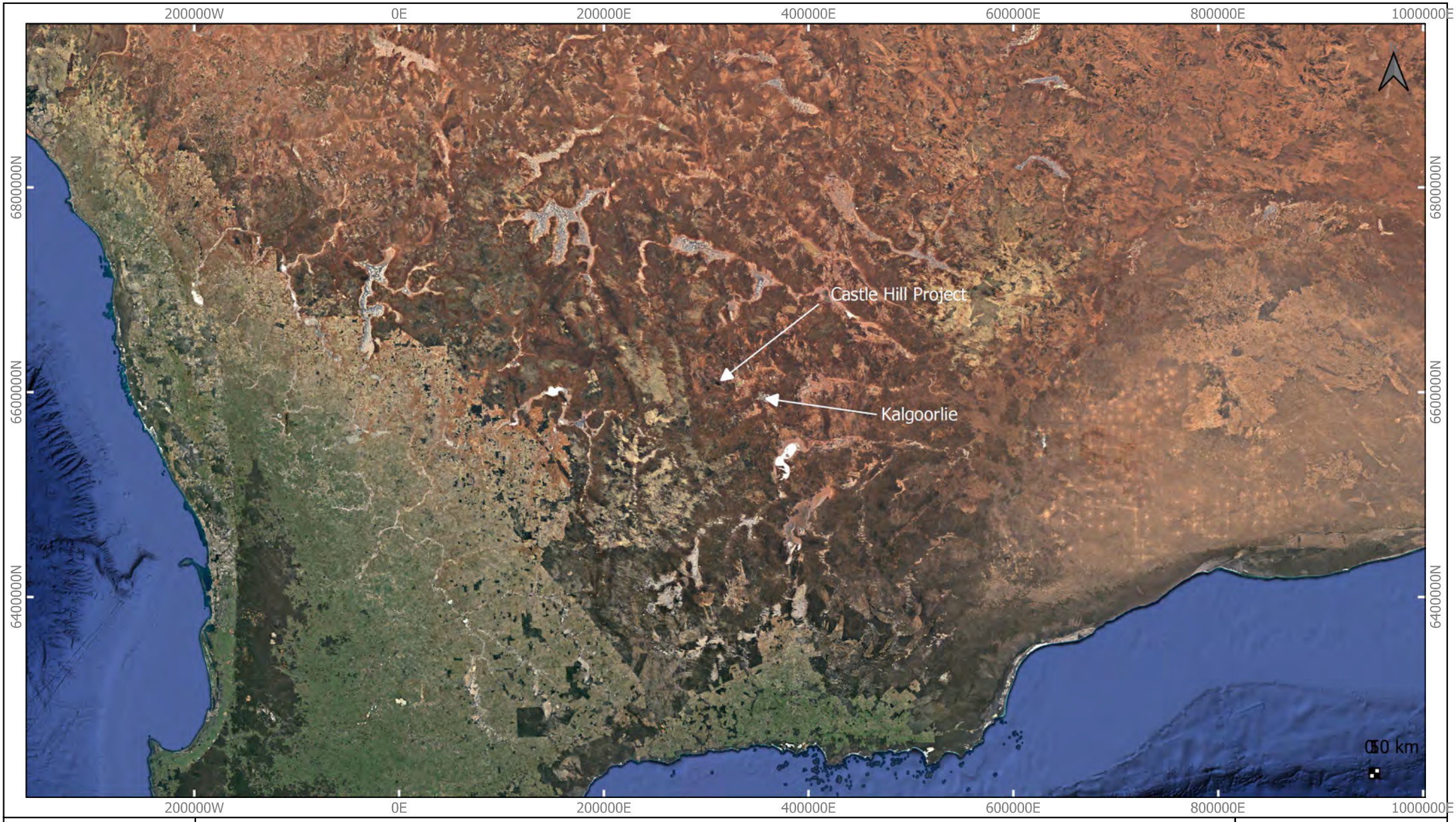
FIGURES



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DRAWN: BGJ

DATE: 08/11/2021

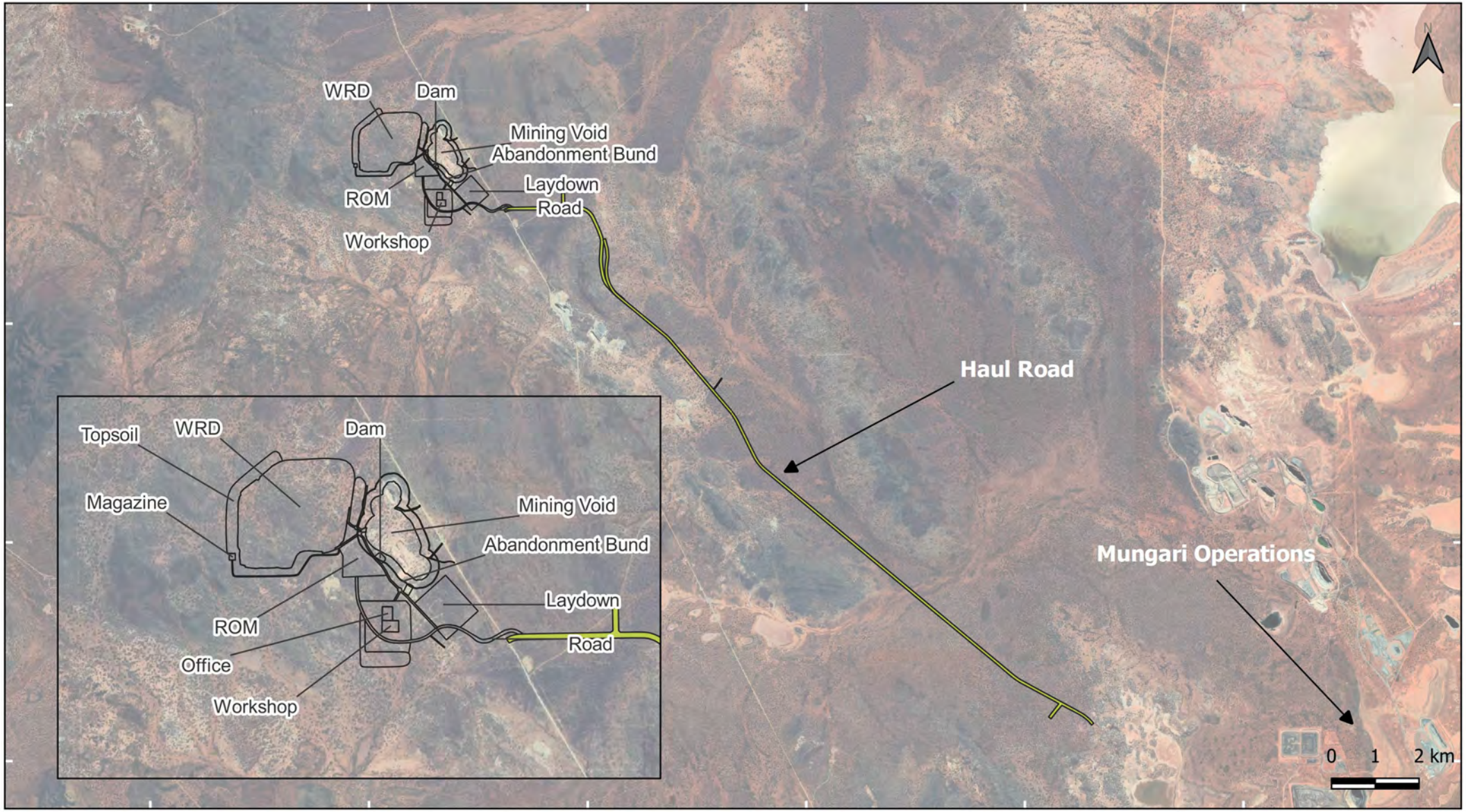
REPORT No: 004a

JOB No: 273C

Coordinates: MGA Zone 51

Notes and Data Sources:
Aerial Imagery sourced from Google (2021)

Figure 1.1:
Project Location



Proposed Mining Infrastructure

Proposed Haul Road

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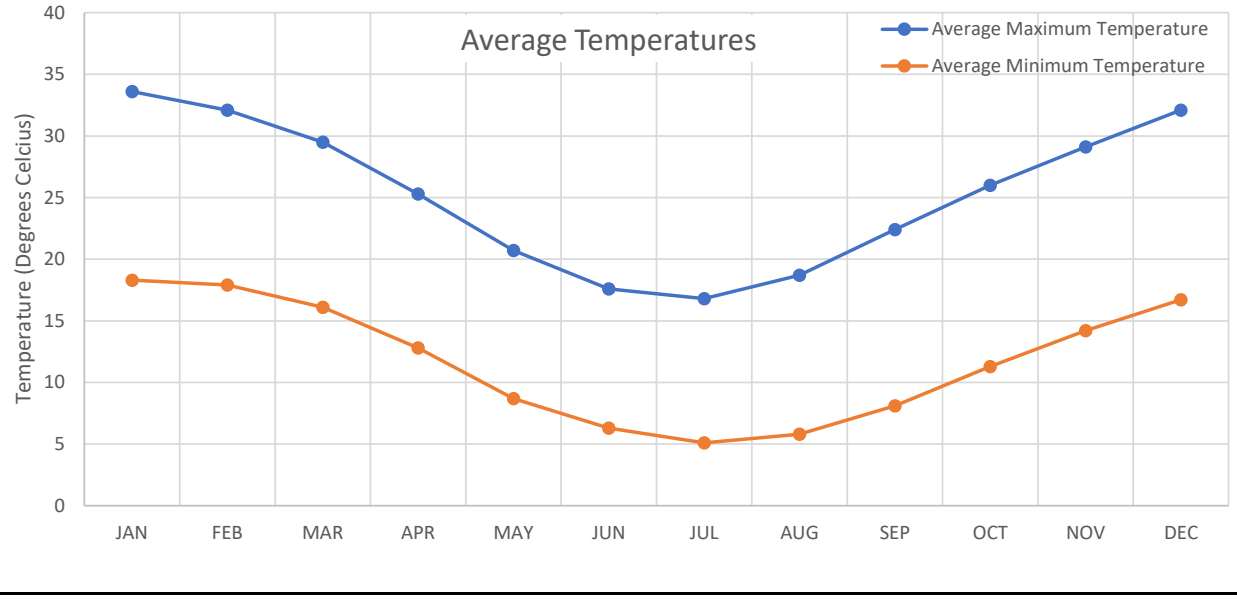
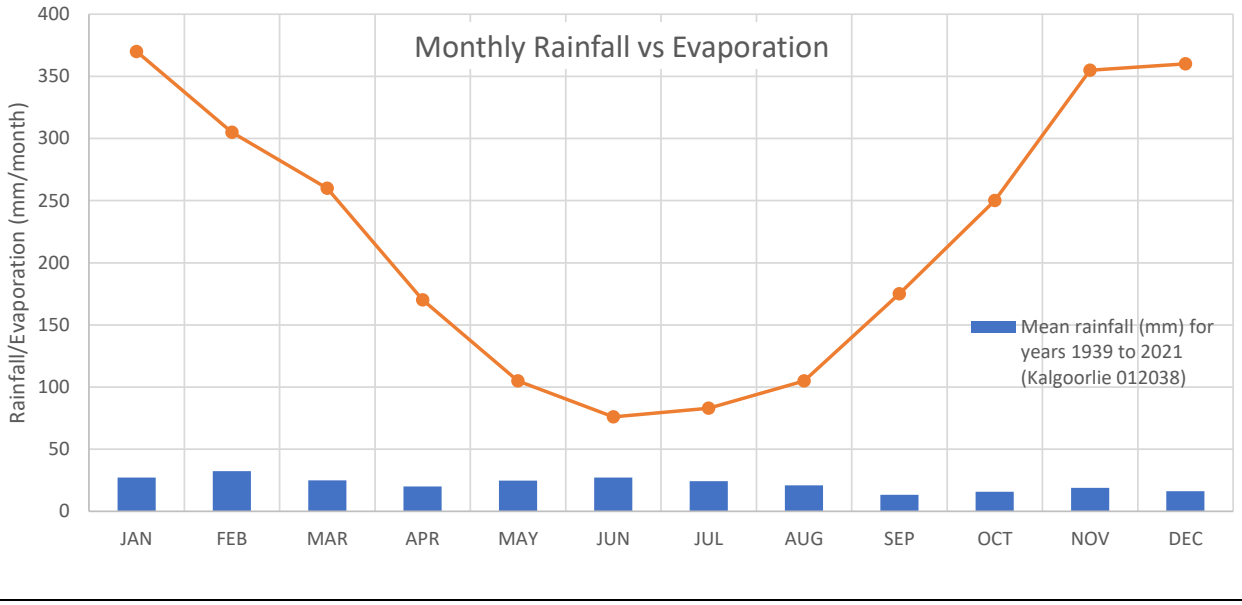
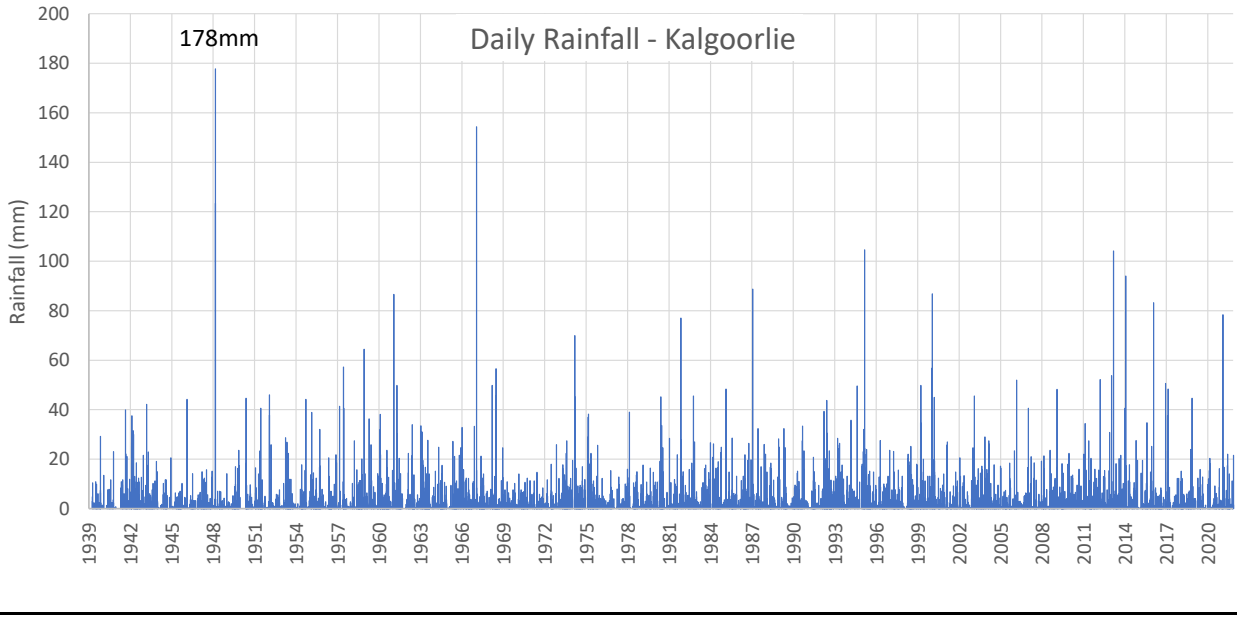
Figure 2.1:
Site Layout


Average Temperatures
Average Maximum Temperature
Average Minimum Temperature
Temperature (Degrees Celcius)
0
5
10
15
20
25
30
35
40
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC


Monthly Rainfall vs Evaporation
Rainfall/Evaporation (mm/month)
0
50
100
150
200
250
300
350
400
Mean rainfall (mm) for years 1939 to 2021 (Kalgoorlie 012038)
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC


178mm
Daily Rainfall - Kalgoorlie
Rainfall (mm)
0
20
40
60
80
100
120
140
160
180
200
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
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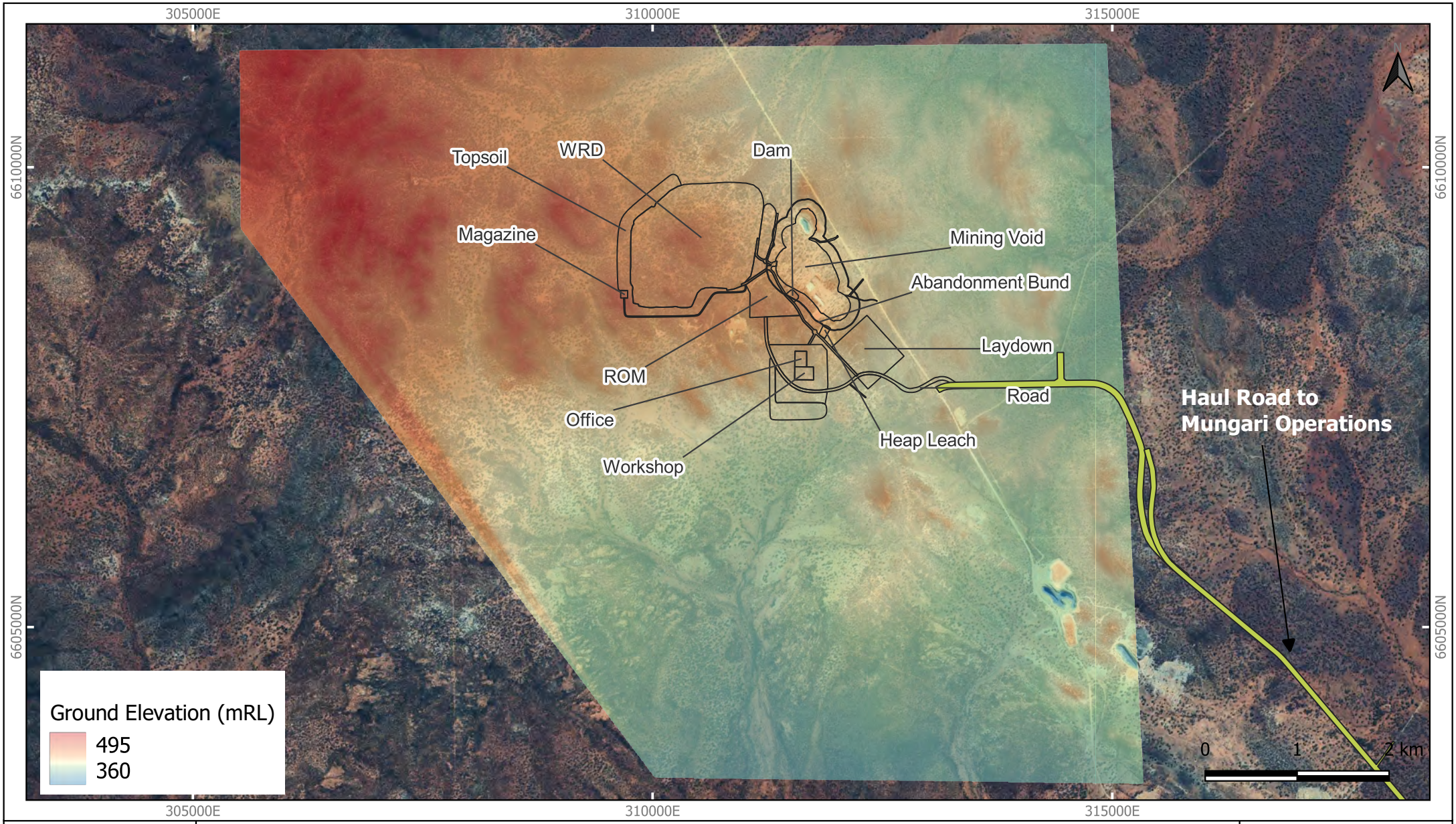
2014
2017
2020



Proposed Mining Infrastructure

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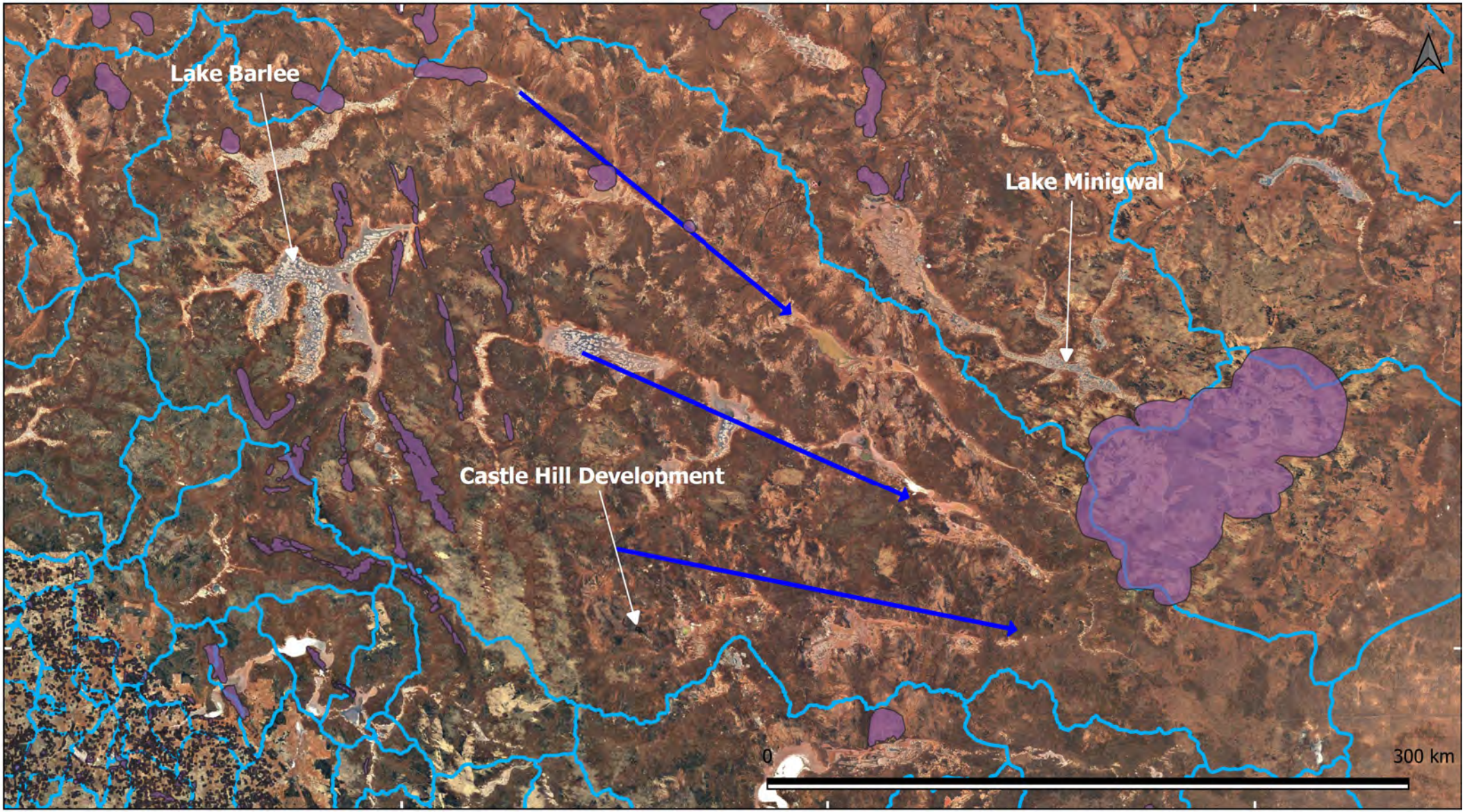
DATE: 08/11/2021	Coordinates: MGA Zone 51	Topography data (contours) provided by Evolution (October 2021)
		DEM generated by AQ2 from contour data

AQ2

Figure 3.2:
Topography Data



Location Map

Regional Catchment (DWER)

Threatened Ecological Community (TEC)

Flow Direction

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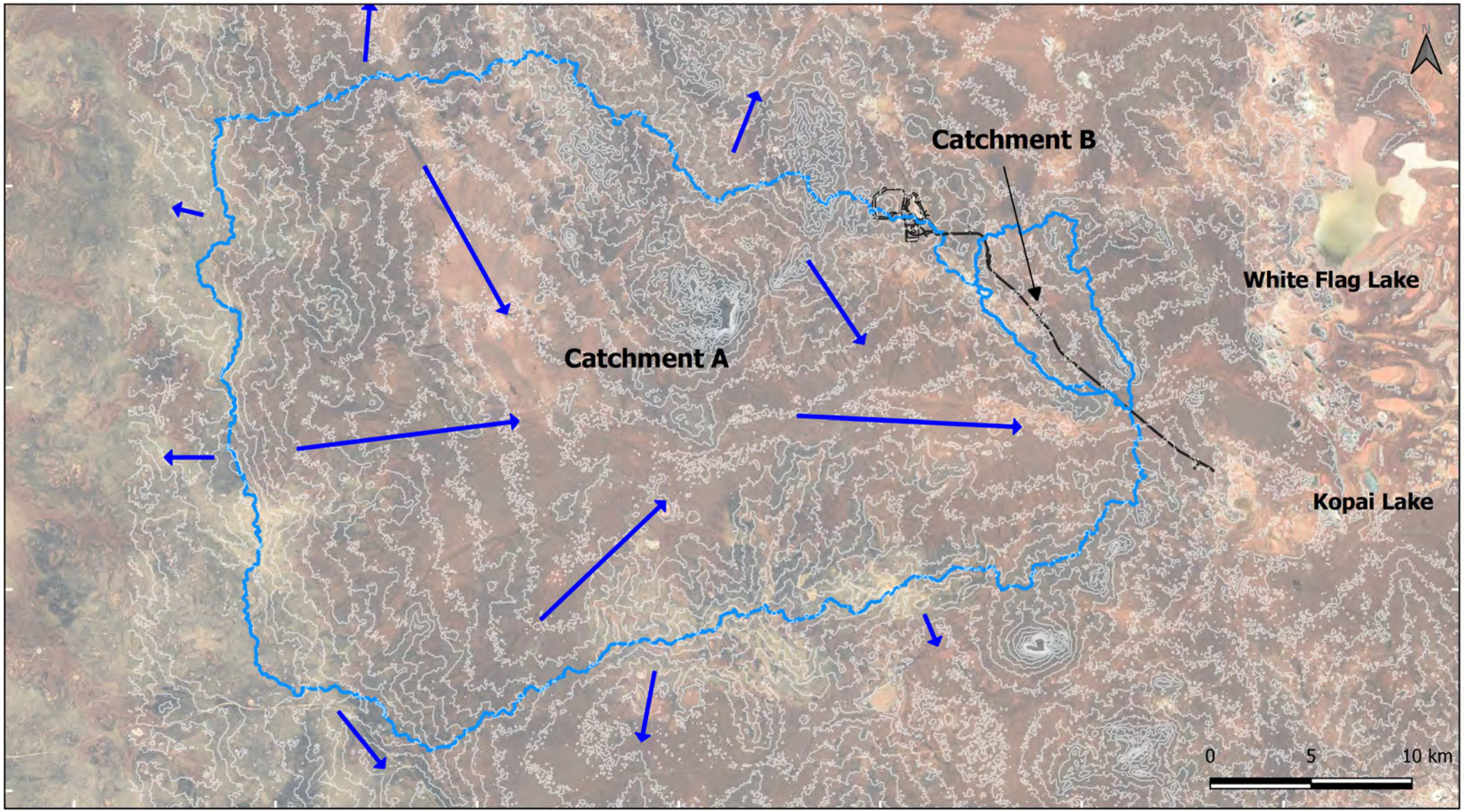
Figure 3.3:
Regional Hydrology



Proposed Mining Infrastructure
Proposed Haul Road
Catchment to Haul Road
Natural Flow Direction
SRTM Contour - 10m

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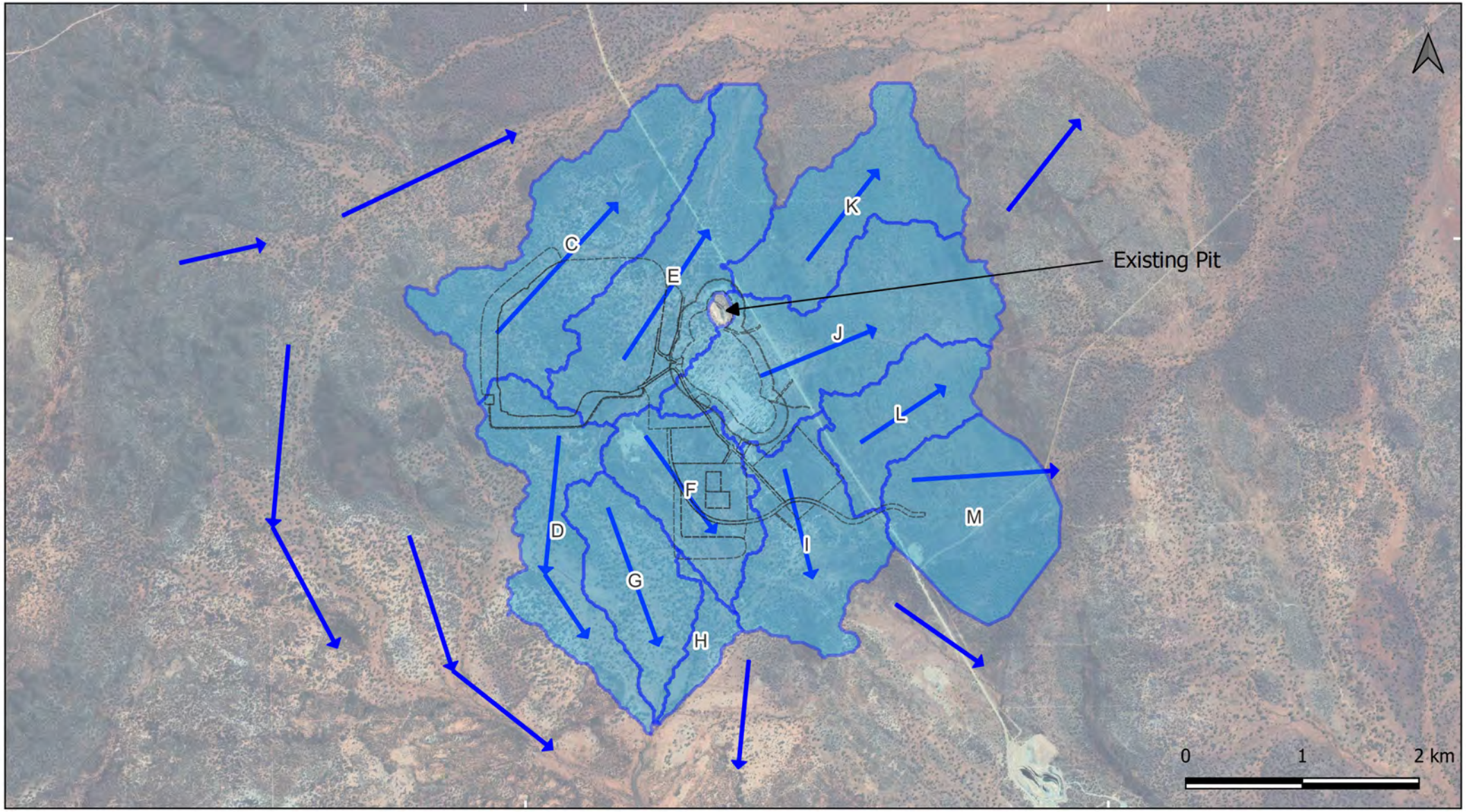
Figure 3.4:
Project Hydrology External Catchments



Proposed Mining Infrastructure
Natural Flow Direction
Proposed Haul Road
Existing Catchment Impacted by Proposed Infrastructure

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Coordinates: MGA Zone 51

Notes and Data Sources:
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Infrastructure layout provided by Evolution (September 2021)

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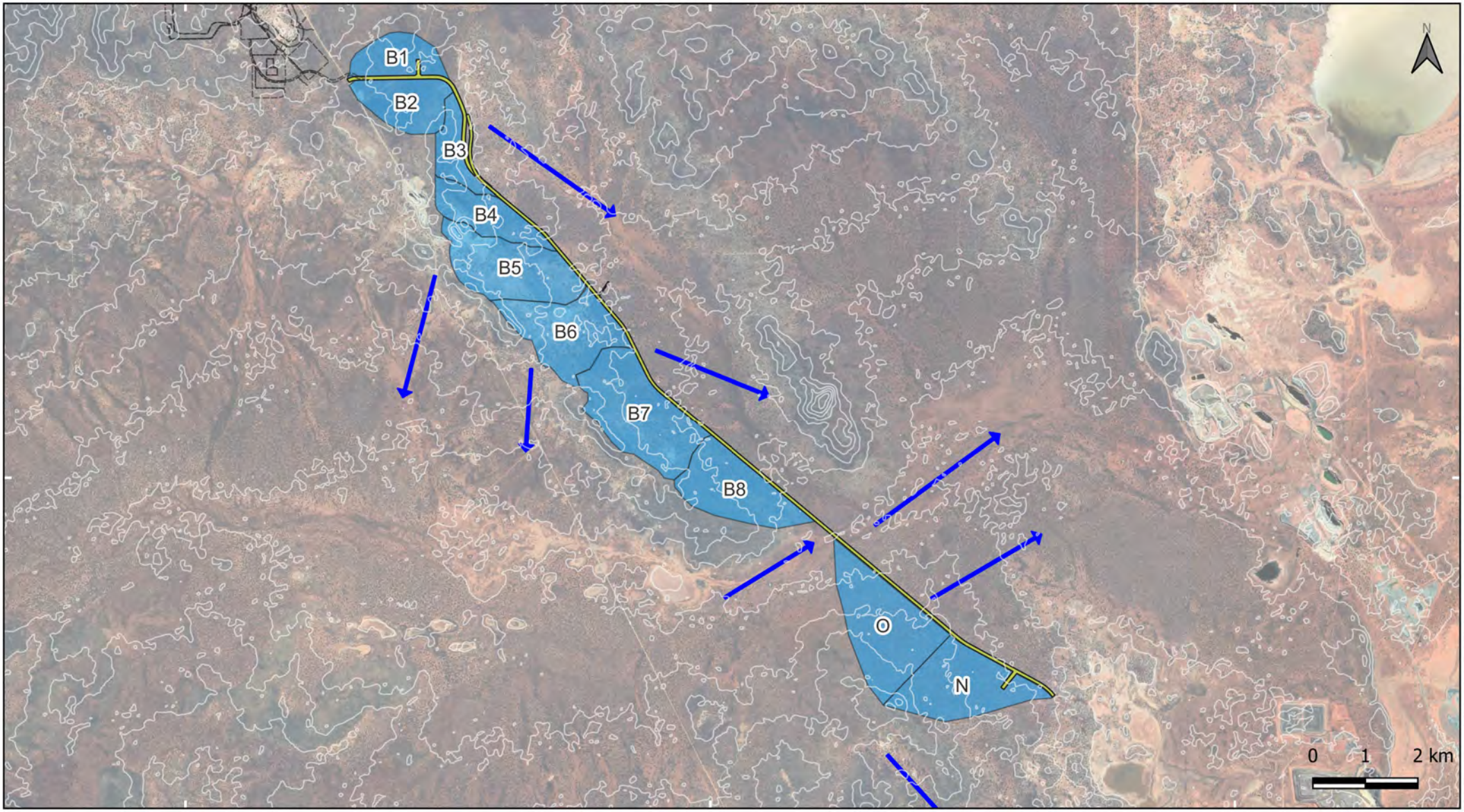
Figure 3.5:
Project Hydrology
Baseline Site Hydrology



Location Map

Proposed Mining Infrastructure

Natural Flow Direction

Proposed Haul Road

Subcatchment Reporting to Haul Road

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JOB No: 273C

Coordinates: MGA Zone 51

Notes and Data Sources:

Aerial Imagery sourced from Google (2021)

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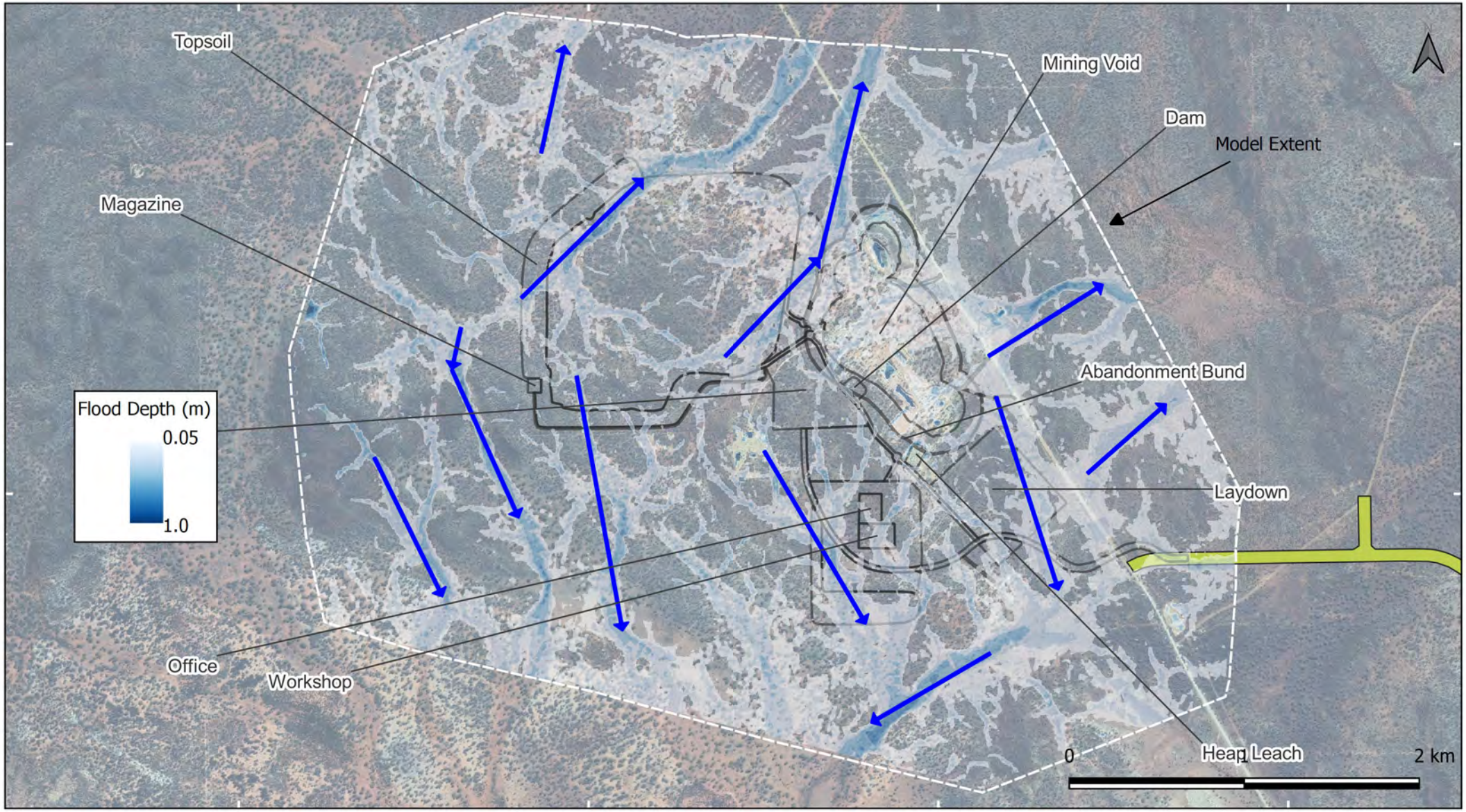
Figure 3.6:

Project Hydrology
Local Haul Road
Subcatchments



Proposed Mining Infrastructure → Flow Direction

Proposed Haul Road

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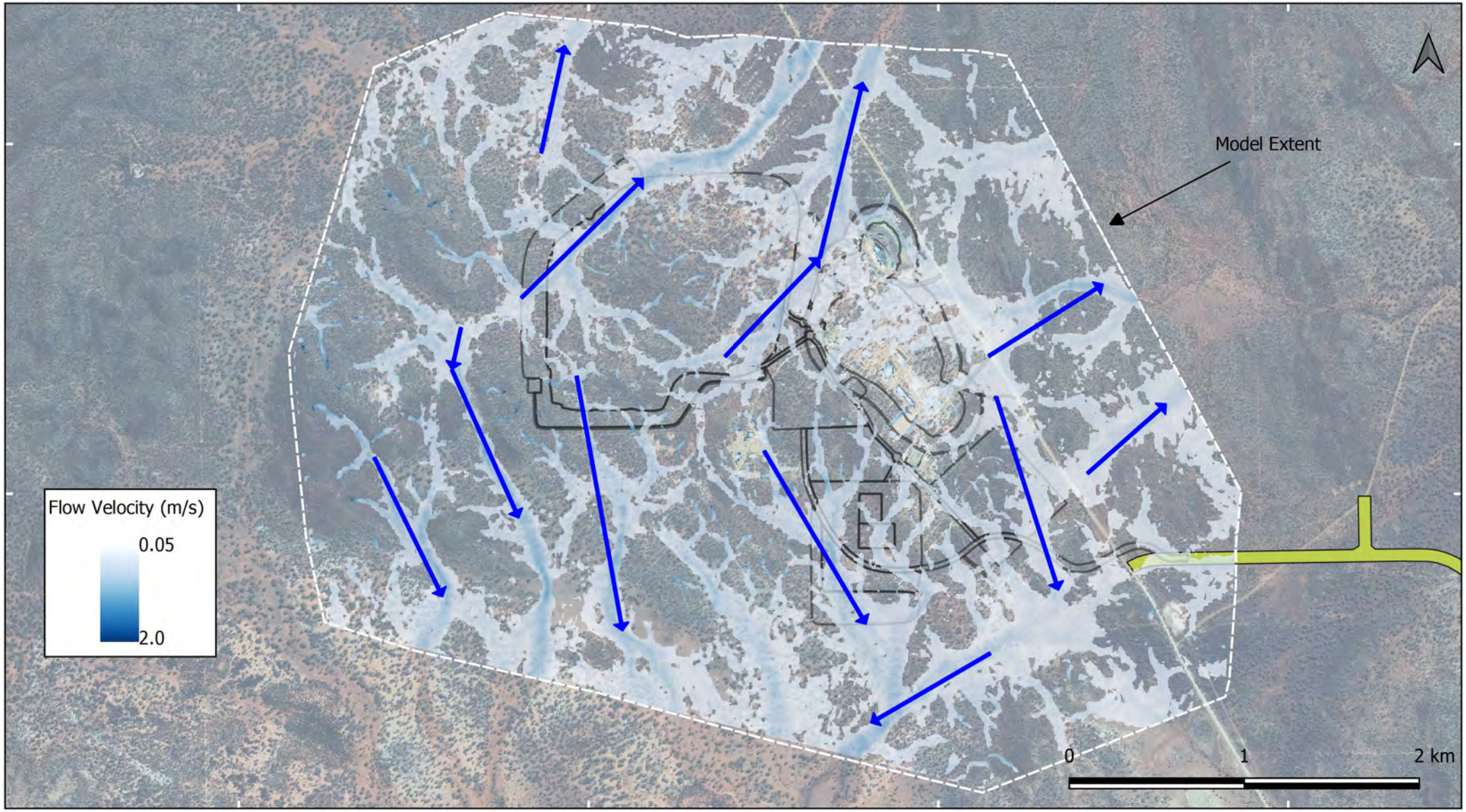
DATE: 08/11/2021	Coordinates: MGA Zone 51	Infrastructure layout provided by Evolution (September 2021)

Figure 4.1:
Castle Hill SWMP
1% AEP Flood Map
Existing Conditions



Location Map

Proposed Mining Infrastructure Proposed Haul Road

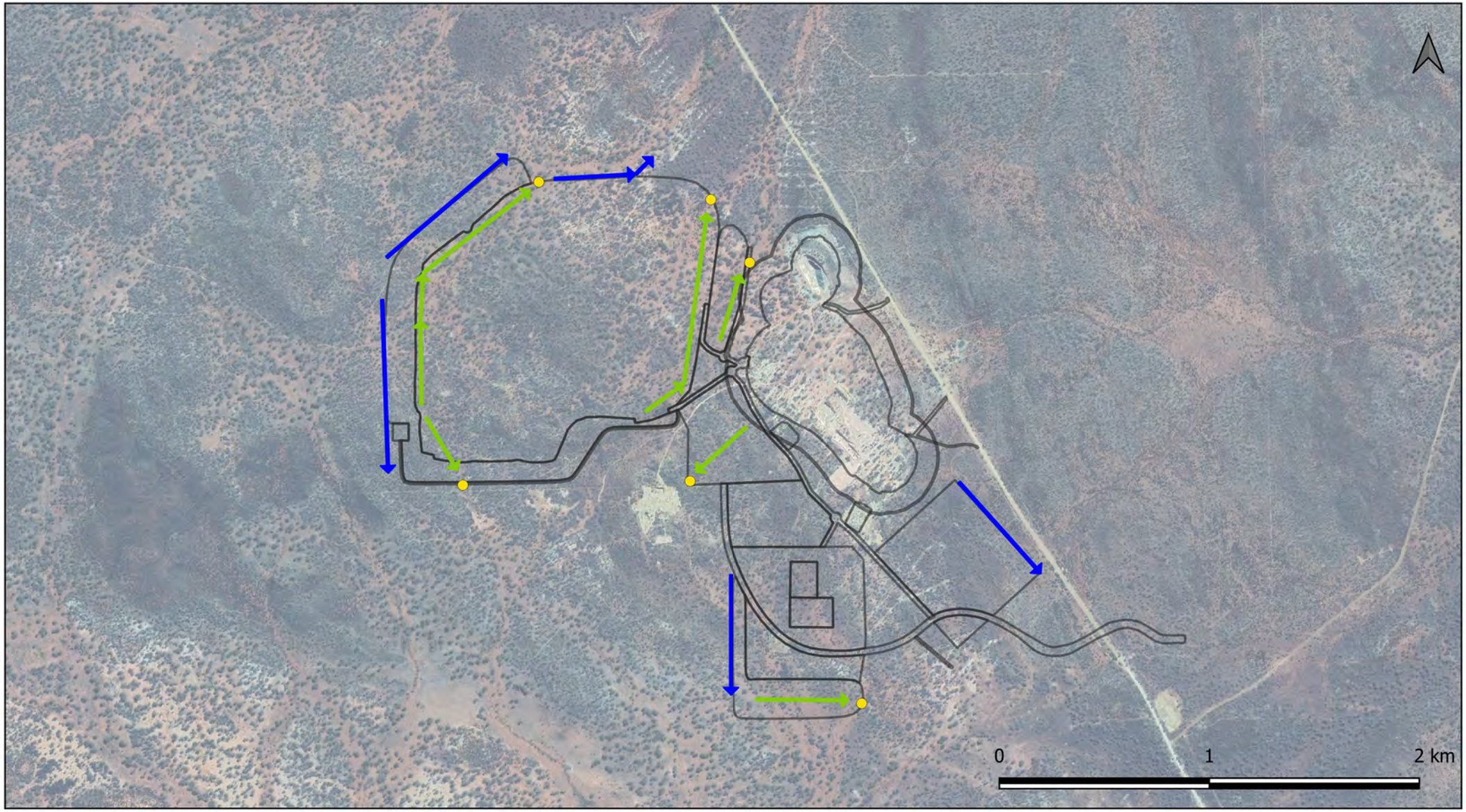
AUTHOR: BGJ
DRAWN: BGJ
DATE: 08/11/2021

REPORT No: 004a
JOB No: 273C
Coordinates: MGA Zone 51

Notes and Data Sources:
Aerial Imagery sourced from Google (2021)
Infrastructure layout provided by Evolution (September 2021)

AQ2

Figure 4.2:
Castle Hill SWMP
1% AEP Velocity Map
Existing Conditions



Proposed Mining Infrastructure
Clean Water Diversion
Dirty Water Flow Direction
Sediment Basin

AUTHOR: BGJ
DRAWN: BGJ
DATE: 08/11/2021

REPORT No: 004a
JOB No: 273C
Coordinates: MGA Zone 51

Notes and Data Sources:
Aerial Imagery sourced from Google (2021)
Infrastructure layout provided by Evolution (September 2021)

AQ2

Figure 5.1:
Castle Hill SWMP Surface Water Management Measures

APPENDIX A

Appendix A1 – Qualitative Risk Matrix Template

Example Risk Matrix

1. Qualitative Risk Assessment

Risk Matrix		Most Credible Consequence Level				
		Insignificant	Minor	Moderate	Major	Severe
Likelihood	Almost Certain	M	H	H	E	E
	Likely	M	M	H	H	E
	Possible	L	M	M	H	H
	Unlikely	L	L	M	M	H
	Rare	L	L	L	M	M

Extreme
High
Medium
Low

Source: DMIRS, 2020. Mining Proposal Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines for Mining Proposals; Appendix 6.

Appendix A2 – Likelihood and Consequence Descriptors

Likelihood Descriptors

Descriptor	Frequency	Probability
Almost Certain	Twice or more per year	Event will occur during the Project / period under review.
		High number of known incidents.
Likely	Once per year	Event likely to occur during the Project / period under review.
		Regular incidents known.
Possible	Once in 5 years	Event may occur in some instances during the Project / period under review.
		Occasional incidents known.
Unlikely	Once in 10 years	Event is not likely to occur during the Project / period under review.
		Some occurrences known.
Rare	Once in 20 years	Event will occur in exceptional circumstances during the Project / period under review
		Very few or no known occurrences.

Source: DMIRS, 2020. Mining Proposal Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines for Mining Proposals; Appendix 6.

Consequence Descriptors

Factor	Insignificant	Minor	Moderate	Major	Severe
Biodiversity	Alteration or disturbance to an isolated area with no effect on habitat or ecosystem. Loss of an individual plant / animal of conservation significance.	Alteration or disturbance to <10% of a habitat or ecosystem resulting in a recoverable impact within 2 years. Loss of multiple plants / animals of conservation significance.	Alteration or disturbance to 10-40% of a habitat or ecosystem resulting in a recoverable impact within 2-5 years. Loss of <50% known local population of plant / animal of conservation significance.	Alteration or disturbance to 40-70% of a habitat or ecosystem resulting in a recoverable impact within 5-15 years. Loss of >50% known local population of plant / animal species with possible loss of entire local population.	Alteration or disturbance to >70% of a habitat or ecosystem resulting in a recoverable impact >15 years. Local loss of conservation significant or listed species. Extinction of a species.
Water Resources	Negligible change to hydrological processes, water availability or water quality.	Short-term modification of hydrological processes, water availability and quality within project tenure, but no change in beneficial use.	Medium-term modification of hydrological processes, water availability and water quality within project tenure, but no change in beneficial use. Short-term modification of hydrological processes, water availability and water quality outside project tenure, but no change in beneficial use.	Long-term modification of hydrological processes, water availability and water quality within project tenure, but no change in beneficial use. Medium-term modification of hydrological processes, water availability and water quality outside project tenure, with change in beneficial use	Long-term or permanent modification of hydrological processes, water availability or water quality outside project tenure, with impacts to a water-dependent environmental value and/or change in beneficial use.
Land and Soils	Clean-up by site personnel, rectified immediately. Confined to immediate area around source.	Clean-up by site personnel, remediation within 1 year. Confined to operational area.	Clean-up by site personnel, remediation within 1-3 years. Minor impact outside disturbance envelope or minor impact to soil stockpiles.	Clean-up requiring external specialist, remediation within 3-10 years. Impact has migrated outside the disturbance envelope or contamination of soil stockpiles.	Clean-up requiring external specialist. Remediation >10 years, or permanent residual impact. Impact outside the tenement boundary.
Rehabilitation and Mine Closure	Site is safe, stable a non-polluting. Post mining land use is not adversely affected.	Site is safe, all major landforms are stable, and any stability or pollution issues are contained and require no residual management. Post mining land use is not adversely affected.	Site is safe, and any stability or pollution issues require minor, ongoing maintenance by end land-user. Post mining land use cannot proceed without some management.	Site cannot be considered safe, stable or non-polluting without long-term management or intervention. Post mining land use cannot proceed without ongoing management.	Site is unsafe, unstable and/or causing pollution or contamination that will cause an ongoing residual affect. Post mining land use cannot be achieved.

APPENDIX B

Appendix B – Castle Hill Mine Site Hydrological Risk Matrix

Type	ID	Risk Pathway / Unwanted Event	Description of Impact	Phase(s)	Inherent Unmitigated Consequence	Inherent Unmitigated Likelihood	Inherent Risk Rating	Mitigation Measure / Further Assessment	Residual Consequence	Residual Likelihood	Residual Risk Rating
Modification of Hydrological Regime	R1	Construction of laydown pad and Stockpiles in path of drainage line	Water shadow on downstream side of infrastructure and reduction of downstream flow. Ponding on upstream side of infrastructure.	Construction / Operations	Minor	Possible	Medium	Divert runoff around the Stockpiles and Laydown.	Minor	Rare	Low
	R2	Runoff captured on face/sides of waste dump	Water shadow on downstream side of dump and reduction of downstream flow.	Operations / Closure	Minor	Possible	Medium	Divert flow around the eastern side of the waste dump to divert flows downstream.	Minor	Rare	Low
	R3	Reduction in catchment downstream of pit	Water shadow on the downstream side of the pit	Operations	Minor	Likely	Medium	Small Portion of overall Downstream Catchment (<0.001%)	Minor	Likely	Medium
	R4	Construction of roads across drainage lines	Water shadow downstream of roads and ponding on upstream side. Potential for redirection of surface water flows along roads.	Construction / Operations	Minor	Possible	Medium	Construct waterway crossings (i.e. culvert, floodway for 5% AEP) at appropriate locations.	Minor	Rare	Low
	R5	Construction of Workshop and Offices in path of drainage lines	Ponding on upstream side of Workshop/Offices (if raised pad). Water shadow on downstream side.	Construction	Minor	Possible	Medium	Divert flows around or through Workshop/Offices area	Minor	Rare	Low
Sediment Generation	R6	Erosion of waste dump toe	Erosion of toe of waste dump potentially leading to dump failure and transport of large amount of sediment to downstream environment.	Operations / Closure	Moderate	Unlikely	Medium	Construct 5% AEP capacity diversion along the northern boundary of the footprint to divert flows. Rock armour toe at closure.	Moderate	Rare	Medium
	R7	Sediment-laden runoff from face of waste dump	Ongoing sediment release to downstream environment from frequent rainfall events impacting downstream water quality.	Operations	Moderate	Likely	High	Construction of containment bunding and sediment basins to remove particles greater than 75um from a 10% AEP event prior to discharge downstream.	Minor	Unlikely	Low
	R8	Sediment-laden runoff from face of waste dump	Sediment release to downstream environment from	Operations	Moderate	Rare	Low	Sediment basins from R7 act to remove some sediment There will be a	Minor	Rare	Low

Type	ID	Risk Pathway / Unwanted Event	Description of Impact	Phase(s)	Inherent Unmitigated Consequence	Inherent Unmitigated Likelihood	Inherent Risk Rating	Mitigation Measure / Further Assessment	Residual Consequence	Residual Likelihood	Residual Risk Rating
			large, rare rain events impacting downstream water quality.					natural high sediment load in the surface water environment following a large rainfall event.			
	R9	Runoff from external catchment through ROM Pad footprint washing sediment downstream	Potential to mobilise large quantities of sediment from the ROM Pad and impact downstream water quality.	Operations	Moderate	Likely	High	ROM Pad elevated. Construction of containment bunding and sediment basins to remove particles greater than 75um from a 10% AEP event prior to discharge downstream.	Moderate	Rare	Low
	R10	Runoff intercepted by stockpiles	Potential to mobilise large quantities of sediment from stockpile and impact downstream water quality	Operations	Moderate	Likely	High	Construct Diversions (5%) to re-direct flow around Stockpiles	Moderate	Rare	Low
Water Quality	R11	Release of hydrocarbons that are stored, handled or transported on site to the environment.	Pollution of downstream environment leading to environmental damage.	Operations	Moderate	Likely	High	Fuel handling areas to be located outside floodplain area and bunded to capture spills. Runoff from wash bays and fuel storage/handling areas to be directed to grit and oil separators prior to discharge to downstream environment. Fuel storage area bunds to contain internal runoff volume from 5% AEP 72-hour duration design flood event plus 110% of the tank contents.	Minor	Unlikely	Low
	R12	Dust suppression water to runoff to environment.	Vegetation adversely affected by runoff water.	Construction / Operations	Minor	Possible	Medium	Roads not to be overwatered.	Minor	Unlikely	Low
Impact to Operations	R13	Construction of workshop and offices across drainage lines	Damage to process plant and mine infrastructure by flood waters.	Construction / Operations	Minor	Possible	Medium	Construct diversion drain (5% AEP) around the workshop and office footprint.	Moderate	Rare	Low
	R14	Capture of upstream runoff from drainage channel adjacent to pit	Flooding of Pit impacting operations.	Operations	Minor	Likely	Medium	Minimal catchment reporting to pit. Dewatering as needed.	Minor	Unlikely	Low

Type	ID	Risk Pathway / Unwanted Event	Description of Impact	Phase(s)	Inherent Unmitigated Consequence	Inherent Unmitigated Likelihood	Inherent Risk Rating	Mitigation Measure / Further Assessment	Residual Consequence	Residual Likelihood	Residual Risk Rating
	R15	Construction of access roads across drainage lines	Flooding of roads restricting serviceability.	Construction / Operations	Minor	Possible	Medium	Construct waterway crossings (i.e. culvert, floodway at 5% AEP) at appropriate locations along impacted alignments to allow continuity of the existing flow regime.	Minor	Rare	Low
	R16	Construction of Haul Road across Unnamed Creek	Flooding of roads restricting operations	Construction /Operations	Minor	Possible	Medium	Construct waterway crossing (5% AEP) at crossing location	Minor	Unlikely	Low

Appendix C:

Botanica Flora and Fauna Study

2021

Castle Hill Project
Detailed Flora/ Vegetation Survey and Basic Fauna Survey

Prepared for Evolution Mining Ltd.

March 2021
FINAL

Prepared by:
Botanica Consulting Pty Ltd
PO Box 2027
Boulder WA 6432

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Glossary

Acronym	Description
BAM Act	*Biosecurity and Agriculture Management Act 2007*, WA Government.
BC Act	*Biodiversity Conservation Act 2016*, WA Government.
Botanica	Botanica Consulting Pty Ltd.
BoM	Bureau of Meteorology.
DAFWA	Department of Agriculture and Food (now DPIRD), WA Government.
DAWE	Department of the Agriculture, Water and Environment (formerly known as DotEE), Australian Government.
DBCA	Department of Biodiversity, Conservation and Attractions (formerly DPaW), WA Government.
DEC	Department of Environment and Conservation (now DBCA), WA Government.
DER	Department of Environment Regulation (now DWER), WA Government.
DMIRS	Department of Mines, Industry Regulation and Safety (formerly DMP), WA Government
DotEE	Department of the Environment and Energy (now known as DAWE), Australian Government.
DoW	Department of Water (now DWER), WA Government.
DPaW	Department of Parks and Wildlife (now DBCA), WA Government.
DPIRD	Department of Primary Industries and Regional Development, WA Government
DWER	Department of Water and Environmental Regulation (formerly EPA, DER and DoW), WA Government
EP Act	Environmental Protection Act 1986, WA Government.
EP Regulations	Environmental Protection (Clearing of Native Vegetation) Regulations 2004, WA Government.
EPA	Environmental Protection Authority, WA Government.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*, Australian Government.
ESA	Environmentally Sensitive Area.
Ha	Hectare (10,000 square meters).
IBRA	Interim Biogeographic Regionalization for Australia.
IUCN	International Union for the Conservation of Nature and Natural Resources – commonly known as the World Conservation Union.
JAMBA	*Japan Australia Migratory Bird Agreement 1981.*
Km	Kilometer (1,000 meters).
LGA	Local Government Area
NVIS	National Vegetation Information System.
PEC	Priority Ecological Community.
TEC	Threatened Ecological Community.
WA	Western Australia.
WAHERB	Western Australian Herbarium.
WAM	Western Australian Museum, WA Government.

Executive Summary

Botanica Consulting Pty Ltd (Botanica) was commissioned by Evolution Mining Ltd. (Evolution) to undertake the following flora/ vegetation and fauna surveys within the Castle Hill Project area (collectively referred to as the 'survey area'):

- Detailed flora/ vegetation survey encompassing an area of 968 ha;
- Basic fauna survey encompassing an area of 968 ha;
- Targeted flora and fauna survey encompassing an area of 1,540 ha.

The survey area is 2,508 ha in extent and is located approximately 40 km north-west of Kalgoorlie-Boulder, Western Australia. The survey was conducted to support a Native Vegetation Clearing Permit (NVCP) application and Mining Proposal with regards to the further development of the Castle Hill Project.

The survey area lies within the Eastern Goldfield (COO3) subregion of the Coolgardie Bioregion, as defined by the Interim Biogeographic Regionalisation of Australia (IBRA).

The Eastern Goldfield subregion (5,102,428 ha) lies on the Yilgarn Craton's Eastern Goldfields Terrain, which is described as gently undulating plains with a subdued relief, interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposures of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half are the remnants of an ancient major drainage line (Cowan 2001).

The vegetation consists of Mallees, Acacia thickets and shrub-heaths on sandplains, with diverse *Eucalyptus* woodlands occurring around salt lakes, on ranges, and in valleys. Salt lake support dwarf shrublands of samphire. Woodlands and *Dodonaea* shrubland occur on basic granulite of the Fraser Range, and the area is rich in endemic Acacias.

The dominant land uses of the Eastern Goldfield subregion includes Unallocated Crown Land (UCL) and Crown reserves and pastoral grazing, with conservation areas and mining leases also present (Cowan, 2001). The survey area is located within the Mt Burges Pastoral Lease.

Prior to the field assessment a literature review was undertaken of previous flora and fauna assessments conducted within the local region. Documents reviewed included:

- Botanica (2011). *Level 1 Flora & Vegetation Survey: Proposed Anthill open pit operation*. Prepared for Metaliko Resources Ltd, 2011.
- Botanica (2013). *Level 2 Flora & Vegetation Survey for the Castle Hill Project.* Prepared for Phoenix Gold Ltd, September 2013.
- Botanica (2014). *Level 2 Flora & Vegetation Survey for the Burgundy Project.* Prepared for Phoenix Gold Ltd, September 2014.
- Botanica (2020). *Ant Hill Reconnaissance Flora/ Vegetation Survey and Basic Fauna Survey.* Prepared for Northern Star Resources Ltd, December 2020.
- Harewood (2013). *Terrestrial vertebrate Fauna Assessment of the Castle Hill Project Area, .* Prepared for Phoenix Gold Ltd, October 2013.
- Harewood (2014a) *Fauna Assessment, Burgundy Project Area*. Prepared for Phoenix Gold Ltd, October 2014.
- Harewood (2014b). Clearing Permit CPS5675/2 *Malleefowl Assessment, Castle Hill Project Area*. Prepared for Phoenix Gold Ltd, October 2014.

- Harewood (2014c). Clearing Permit CPS6152/1 *Malleefowl Assessment, Burgundy Project Area*. Prepared for Phoenix Gold Ltd, October 2014.
- Phoenix Environmental Services (2019a). *Flora and vegetation survey for Mungari Gold Operations: Cutters Ridge Project*. Prepared for Evolution Mining Ltd, May 2019.
- Phoenix Environmental Services (2019b). *Fauna survey for Mungari Gold Operations: Cutters Ridge Project*. Prepared for Evolution Mining Ltd, May 2019.

In addition to the literature review, searches of the following databases were undertaken to aid in the compilation of a list of significant flora within the survey area:

- DBCA Threatened/ Priority Flora spatial data (DBCA, 2019);
- DBCA NatureMap database (DBCA, 2020); and
- EPBC Protected Matters search tool (DAWE, 2020a).

The NatureMap species search and EPBC Protected Matters search were conducted with a 40 km buffer from the survey area.

The desktop review identified 780 vascular flora species as occurring within 40 km of the survey area, representing 303 genera from 76 families. The most diverse families were Asteraceae (104 species), Fabaceae (99 species) and Myrtaceae (88 species). Significant genera include *Acacia* (54 species), *Eucalyptus* (47 species) and *Eremophila* (35 species). This total includes 71 introduced (weed) species (9.1%).

The desktop review identified 71 introduced flora (weed) species as potentially occurring in the vicinity of the survey area. These species consist of 26 families, with the most commonly represented being Asteraceae (14 species), Poaceae (13 species) and Fabaceae (six species). Of these, two are listed as a Declared Pest on the Western Australian Organism List (WAOL) under the *Biosecurity and Agriculture Management* (BAM) *Act 2007*, with one also listed as a Weed of National Significance.

The assessment of the DBCA Priority/ Threatened flora data (DBCA, 2019), NatureMap search (DBCA, 2020), Protected Matters searches (DAWE, 2020a) and previous relevant literature identified 49 significant flora species recorded within a 40 km radius of the survey area. These are comprised of three Endangered, 16 Priority 1, seven Priority 2, 19 Priority 3 and four Priority 4 taxa.

These taxa were assessed for distribution and known habitat to determine their likelihood of occurrence within the survey area. The assessment identified one Priority 2 flora species as previously recorded within the survey area. Five taxa were assessed as possibly occurring in the survey area, consisting of one Priority 1, two Priority 2 and two Priority 3 taxa.

The Protected Matters search (DAWE, 2020a) did not identify any Threatened Ecological Communities recorded within 40 km of the survey area. Analysis of the Priority Ecological Communities within the Goldfields region (DBCA, 2017) did not identify any significant vegetation assemblages as likely or possibly occurring within the survey area.

A total of 261 terrestrial vertebrate fauna taxa have been recorded within a 40 km radius of the survey area, consisting of 158 bird, 26 mammal, 71 reptile and six amphibian taxa. This total includes seven introduced (feral) species (2.7%).

The NatureMap and EPBC database searches identified 13 feral fauna species from nine families as potentially occurring in the survey area.

The desktop review identified 22 terrestrial vertebrate fauna species of conservation significance as previously being recorded in the regional area, consisting of seven Threatened, one Priority 3, one Priority 4, and three migratory or otherwise protected species. In addition, ten migratory wading/shorebird species were assessed collectively due to their similar habitat requirements. Habitat and distribution data was used to determine the likelihood of occurrence within the survey area. The assessment identified three significant fauna species as potentially occurring in the survey area.

There are no vested Conservation Reserves located within the survey area.

There are no DBCA managed lands located within the survey area.

There are no Environmentally Sensitive Areas located within the survey area.

There are no Nationally Important or RAMSAR wetlands located within the survey area.

The closest significant environmental feature is the Rowles Lagoon Conservation Park, which is DBCA-managed land located approximately 25 km north-west of the survey area. Disturbances within the survey area are unlikely to impact these areas.

Botanica conducted a detailed flora/ vegetation and basic fauna survey on the 30th October , 3rd to 5th November and 9th November 2020, with the area traversed on foot and ATV by three Botanica staff members; Jennifer Jackson (Senior Botanist, BSc (Honours) Environmental Management), Greg Harewood (Zoologist, BSc Zoology) and Matthew Newlands (Environmental Technician).

The field survey identified 145 flora taxa within the survey area. These taxa represented 70 genera across 32 families, with the most diverse genera being *Eremophila* (15 species), *Eucalyptus* (10 species) and *Acacia* (8 species). Dominant families include Chenopodiaceae (26 species), Asteraceae (17 species), Scrophulariaceae (15 species) and Fabaceae (14 species). Eleven introduced (weed) species were recorded, representing 8% of the total species richness.

No Threatened flora species were recorded within the survey area. One Priority 2 flora species (*Eremophila praecox*) was previously recorded within and adjacent to the survey area by Phoenix Environmental Services (2019a). An additional potential record of this taxon was recorded by Botanica within the survey area however due to absence of flowering material (despite the survey being conducted during the known flowering period for this taxon), this specimen could not be positively identified or formally lodged with the Western Australian Herbarium. Given this taxon has been previously recorded within/ adjacent to the survey area this record is tentatively considered as a Priority 2 flora record.

A total of twelve broad vegetation types were identified within the survey area. Vegetation type descriptions and extents were determined from field survey results, aerial imagery interpretation, statistical analysis of quadrat data and extrapolation of the communities. Native vegetation within the survey area ranged from ‘good’ to ‘very good’.

The survey found CLP-EW1 was the most widespread community in the survey area, occupying 814 ha (32.5%), while RH-CFW1 was the most restricted with 10 ha (0.4%). CLP-EW1 and RH-MWS1 were the most diverse community, with 67 flora species recorded, and RH-AFW1 was the least diverse with 23 flora species recorded.

No Threatened or Priority Ecological Communities or otherwise significant vegetation were identified within the survey area.

Based on vegetation and associated landforms identified during the flora and vegetation assessment, six broad scale terrestrial fauna habitats were identified as occurring within the survey area. Two inactive malleefowl mounds were recorded within the survey area however no evidence of current malleefowl activity (active mounds, tracks, feathers or bird observations etc.) were observed within the survey area. No evidence of any other significant fauna species was observed during the survey.

Based on the outcomes from the survey undertaken, Botanica assessed the results of the desktop and field survey with regards to the native vegetation clearing principles listed under Schedule 5 of the EP Act. The assessment found that the proposed vegetation clearing activities may be at variance with clearing principle (f).

1 INTRODUCTION

1.1 Project Description

Botanica Consulting Pty Ltd (Botanica) was commissioned by Evolution Mining Ltd. (Evolution) to undertake the following flora/ vegetation and fauna surveys (Figure 1-1) within the Castle Hill Project area (collectively referred to as the 'survey area'):

- Detailed flora/ vegetation survey encompassing an area of 968 ha;
- Basic fauna survey encompassing an area of 968 ha;
- Targeted flora and fauna survey encompassing an area of 1,540 ha.

The total survey area is 2,508 ha in extent and is located approximately 40 km north-west of Kalgoorlie in the City of Kalgoorlie-Boulder LGA, Western Australia (Figure 1-2). The survey was conducted to support a Native Vegetation Clearing Permit (NVCP) application and mining proposal with regards to the further development of the Castle Hill Project.

As shown in Figure 1-1, previous detailed flora/ vegetation surveys and basic fauna surveys were conducted in the survey area by Botanica in 2013 and 2014. Results of these previous assessments have been included in the current survey findings.

1.2 Objectives

The flora assessment was conducted in accordance with *Technical Guide - Flora and Vegetation Surveys for Environmental Impact Assessment – December 2016* (EPA, 2016a). The objectives of the assessment were to:

- Conduct a desktop review of available technical reports, relevant databases and spatial data to identify the potential flora and vegetation that may be present;
- Identify significant flora, vegetation/ecological communities potentially occurring in the area;
- Conduct a detailed flora and vegetation survey and targeted searches for populations of significant flora;
- Undertake floristic community mapping to a scale appropriate for the bioregion and described according to the National Vegetation Information System (NVIS) structure and floristics;
- Undertake vegetation condition mapping;
- Review the local and regional significance of flora and vegetation within the survey area;
- Assess the survey area's plant species diversity, density, composition, structure and weed cover, using NVIS classification system for vegetation description; and

Assess Matters of National Environmental Significance (MNES) and indicate whether potential impacts on MNES as protected under the EPBC Act are likely to require referral to the Commonwealth Department of Agriculture, Water and the Environment (DAWE).

The fauna assessment was conducted in accordance with the requirements for a basic terrestrial fauna survey as defined in *Technical Guidance - Terrestrial Fauna Surveys for Environmental Impact Assessment – June 2020* (EPA, 2020). The objectives of the assessment were to:

- Gather background information on fauna in the survey area (literature review, database and map-based searches);
- Delineate and characterise the faunal assemblages and fauna habitats present in the survey area; and
- Assess the likelihood of significant fauna occurring within the survey area.

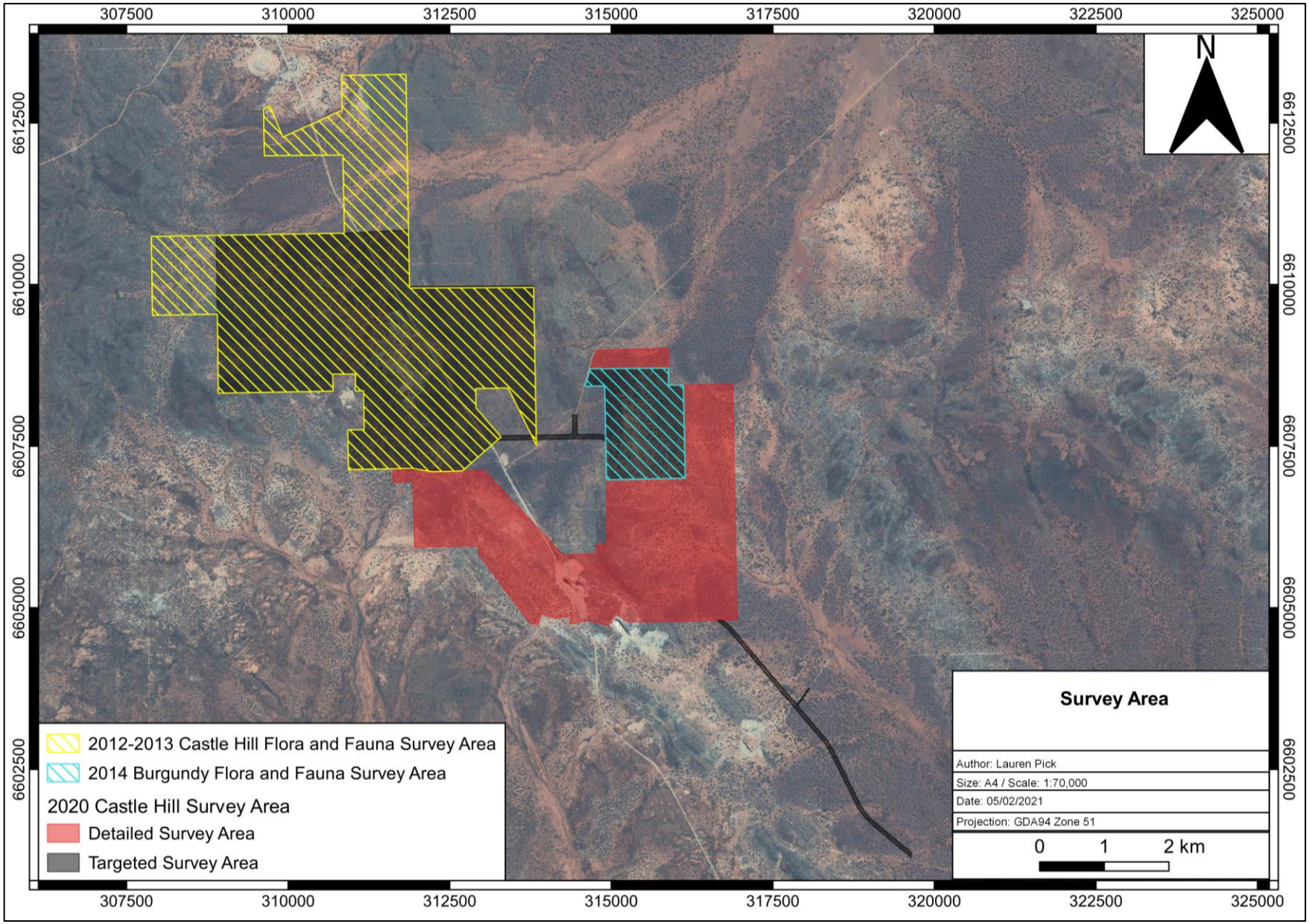


Figure 1-1: Castle Hill Project survey area

Figure 1-2: Regional map of the survey area

2 BIOPHYSICAL ENVIRONMENT

2.1 Regional Environment

The survey area lies within the Eastern Goldfield (COO3) subregion of the Coolgardie Bioregion, as defined by the Interim Biogeographic Regionalisation of Australia (IBRA).

The Eastern Goldfield subregion (5,102,428 ha) lies on the Yilgarn Craton's Eastern Goldfields Terrain, which is described as gently undulating plains with a subdued relief, interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposures of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half are the remnants of an ancient major drainage line (Cowan 2001).

The vegetation consists of Mallees, Acacia thickets and shrub-heaths on sandplains, with diverse *Eucalyptus* woodlands occurring around salt lakes, on ranges, and in valleys. Salt lake support dwarf shrublands of samphire. Woodlands and *Dodonaea* shrubland occur on basic granulite of the Fraser Range, and the area is rich in endemic Acacias.

In accordance with Beard (1990) the survey area is located in the Coolgardie Botanical District of the Southwestern Interzone Province. The landscape is described as gently undulating with occasional ranges of low hills, with sandplains in the western part and some large playa lakes. Soils are principally brown calcareous earths, which overlays the Proterozoic granite and gneiss of the Fraser Range block and Archaean granite, with infolded volcanics and meta-sediments, of the Yilgarn block. Vegetation is predominately *Eucalyptus* woodlands, with slopes and flats containing *E*. *longicornis* alongside *E. salubris* and *E*. *salmonophloia*. Woodland understories range from tall sclerophyll shrubland dominated by *Melaleuca pauperiflora* to soft-leaved saltbush shrubland of *Atriplex vesicaria* and *A*. *nummularia*. Some hill slopes contain mallees of *E*. *livida* or *E*. *loxophleba*, while ironstone ridges are covered in thickets of *Acacia quadrimarginea*, *Allocasuarina acutivalvis* and *A*. *campestris*. Other vegetation assemblages include species-rich scrub-heaths and *Allocasuarina* thickets on sandplains, merging into *Acacia* thickets and Kwongan vegetation to the north.

2.2 Land Use

The dominant land uses of the Eastern Goldfield subregion includes Unallocated Crown Land (UCL) and Crown reserves and pastoral grazing, with conservation areas and mining leases also present (Cowan, 2001). The survey area is located predominately within the Mt Burges Pastoral Lease, with a small portion within the Black Flag Pastoral Lease.

2.3 Soils and Landscape Systems

The survey area lies within the Kalgoorlie Province, located in the southern Goldfield between Paynes Find, Menzies, Southern Cross and Balladonia. The landscape consists of undulating plains (with some sandplains, hills and salt lakes) on the granitic rocks and greenstone of the Yilgarn Craton. Soils range from calcareous loamy earths and red loamy earths with some salt lake soils to red deep sands, yellow sandy earths, shallow loams and loamy duplexes. Vegetation communities are predominately Eucalypt woodlands with some acacia-casuarina thickets, mulga shrublands, halophytic shrublands and spinifex grasslands.

The Kalgoorlie Province is further divided into six soil-landscape zones, with the survey area located on the boundary of the Kambalda Zone (265), and Norseman Zone (266). The survey area lies predominately within the Kambalda Zone, which is located in the south-eastern Goldfield between Menzies, Norseman and the Fraser Range. It contains flat to undulating plains (with hills, ranges and some salt lakes and stony plains) on greenstone and granitic rocks of the Yilgarn Craton. Soils consist of calcareous loamy earths and red loamy earths with salt lakes soils and some redbrown hardpan shallow loams and red sandy duplexes. Vegetation includes red mallee, blackbutt-salmon gum-gimlet woodlands with mulga and halophytic shrublands (and some spinifex grasslands).

The Norseman zone is located in the southern Goldfields between Koolyanobbing, Menzies, Zanthus (Trans-Australian Railway), Norseman and Lake Hope. The landscape consists of undulating plains and uplands (with some sandplains and salt lakes) on granitic rocks of the Yilgarn Craton. Soils include calcareous loamy earths, yellow sandy and loamy earths, red loamy earths, red deep sands and salt lake soils. Vegetation consists of salmon gum-redwood-merrit-red mallee-gimlet woodland with acacia/casuarina thickets (and some mulga shrublands and spinifex grasslands).

In accordance with soil landscape system mapping data (Government of Western Australia, 2019), the Kambalda and Norseman Zone are further divided into soil landscape systems, with the survey area located within three soil landscape systems, as listed in Table 2-1 and shown spatially in Figure 2-1.

Table 2-1: Soil Landscape Systems within the survey area

Soil Landscape System	Description	Extent within Survey Area ha (%)
BB5	Rocky ranges and hills of greenstones-basic igneous rocks	2038 ha (81%)
Mx40	Flat to undulating valley plains and pediments; some rock outcrop	335 ha (14%)
Mx43	Gently undulating valley plains and pediments; some outcrop of basic rock	135 ha (5%)

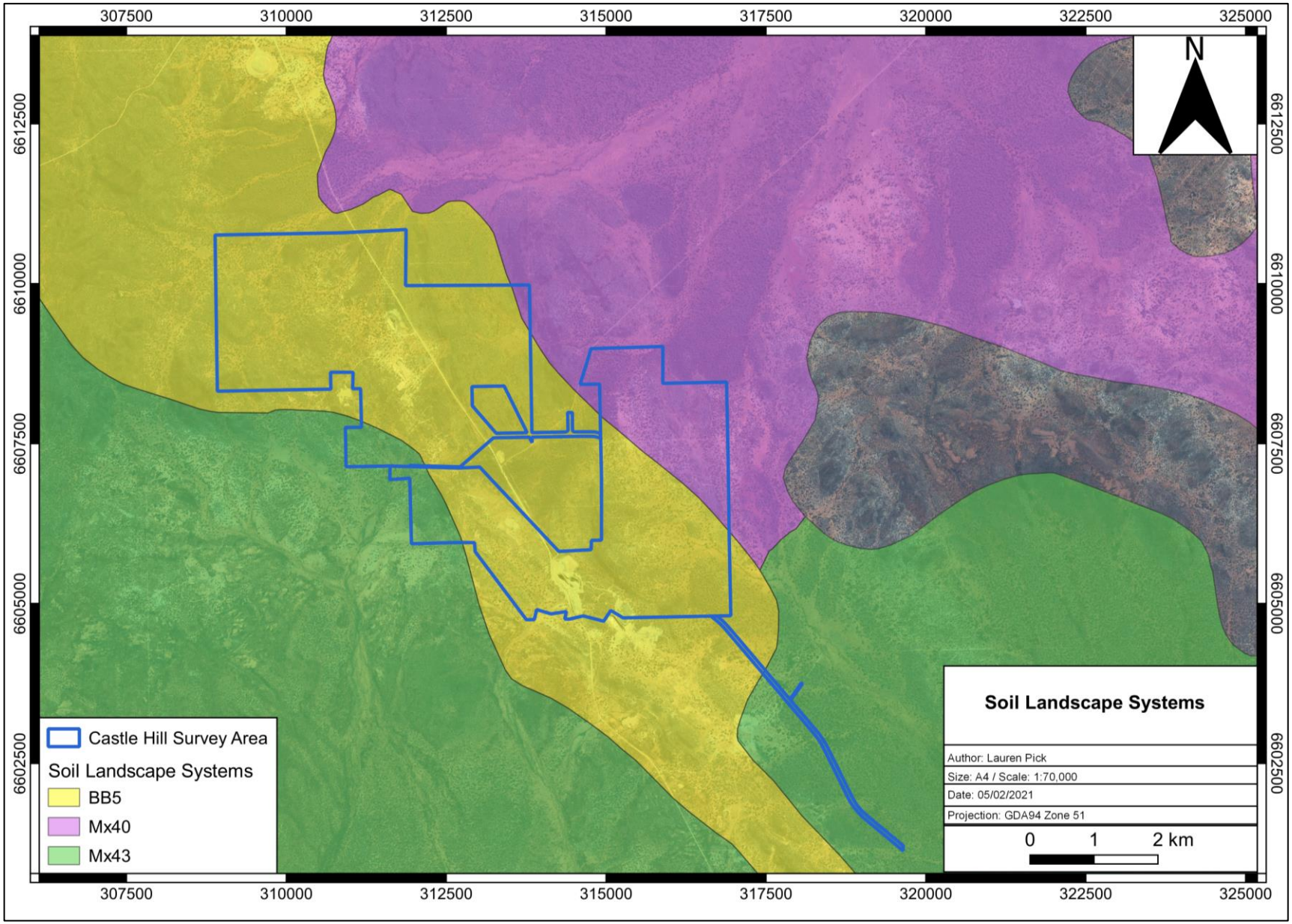


Figure 2-1: Soil Landscape Systems within the survey area

2.4 Regional Vegetation

In accordance with Tille (2006), the vegetation of the Kambalda Zone is typified by the preponderance of stony plains with acacia shrublands and halophytic shrublands, low hills with eucalypt or acacia woodlands with halophytic undershrubs, stony plains with acacia shrublands and alluvial plains with eucalypt woodlands and halophytic undershrubs rangeland. The vegetation of the Norseman zone is differentiated from the Kambalda zone by the presence of sandplains and occasional dunes with spinifex grasslands.

More broadly, the vegetation of the Kalgoorlie Province is described by Tille (2006) as woodlands of redwood (*Eucalyptus transcontinentalis*), red mallee (*E. oleosa*), Dundas blackbutt (*E. dundasii*), merrit (*E. flocktoniae*) and salmon gum (*E. salmonophloia*), found on undulating plains over granite. There are also some hummock grasslands with red mallee over spinifex (*Triodia scariosa*) and thickets of *Acacia*, *Casuarina* and *Melaleuca* spp. Plains on greenstone have woodlands of York gum (*E. loxophleba*), salmon gum and gimlet (*E. salubris*). The valley plains have woodlands of salmon gum, red mallee, Goldfields blackbutt (*E. lesouefii*), gimlet, York gum and morrel (*E. longicornis*). These sometimes have an understorey of saltbush (*Atriplex* spp.), pearl bluebush (*Maireana sedifolia*), sago bluebush (*M. pyramidata*) and *Eremophila* spp. There are areas of spinifex grasslands with red mallee, mallees (e.g. *E. youngiana*) and marble gum (*E. gongylocarpa*). Low woodlands of mulga (*Acacia aneura*) and black sheoak (*Casuarina pauper*) over bluebush and saltbush are also present. Apart from the bare salt lake surfaces, saline valley floors have shrublands of samphire (*Tecticornia* spp.) and *Frankenia* spp. in lower areas, shrublands of saltbush and bluebush on red deep sandy duplexes, and woodlands of salmon gum, merrit, red mallee, gimlet and York gum. *Acacia neurophylla*, *A. beauverdiana* and *A. resinimarginea* thickets grow on gently sloping uplands on granite, with thickets of acacia, casuarina and melaleuca. There are also scrub-heaths and York gum-salmon gum-gimlet woodlands on these uplands. The hilly terrain on greenstone supports woodlands of salmon gum, Goldfields blackbutt, coral gum (*E. torquata*), York gum, gimlet, morrel, Dundas blackbutt and black sheoak. Thickets of granite wattle (*Acacia quadrimarginea*) are also present. The stony plains support scattered woodlands of Goldfields blackbutt, gimlet and salmon gum, along with shrublands of saltbush and bluebush. Sandplains in the west have acacia (*A. coolgardiensis, A. ramulosa, A. aneura, A. burkittii* and *A. tetragonophylla*) shrublands, commonly with patchy native pine (*Callitris glaucophylla C. preissii*) and mallees (*E. leptopoda, E. longicornis* and *E. loxophleba*). Native box (*Bursaria occidentalis*), *Melaleuca uncinata* and *Hakea recurva* may also be present. Hard spinifex (*T. basedowii*) grasslands with mulga, marble gum and mallees (e.g. *E. kingsmillii*) are found on sandplains to the east. The sandy-surfaced plains support acacia, casuarina and melaleuca thickets; woodlands of York gum, cypress pine (*Callitris columellaris*), salmon gum, gimlet and mulga; and shrublands of bowgada (*A. ramulosa*).

2.5 Conservation Values

The Eastern Goldfield subregion contains 16 vegetation associations, predominately open *Eucalyptus* woodlands, that have at least 85 per cent of their total extent in the bioregion (Cowan 2001) The subregion is considered a centre of endemism for Eucalypts in the Goldfields Woodlands region, and is also noted for the diversity of *Acacia* spp. and ephemeral flora communities of the tertiary sandplain shrublands and the valley floors of woodland areas.

The subregion contains one wetland of national importance: Rowles Lagoon System, located approximately 40 km east of the survey area. In addition, there are seven wetlands of subregional importance (Cowan, 2001). Other significant assemblages in the region include plant assemblages of the Fraser Range and the Woodline Hills.

No ecosystems are listed as threatened under WA State legislation occur within the subregion, but 18 communities and vegetation associations are thought to be at risk for a variety of reasons. Grazing from livestock, goats and rabbits and impacts from mining are the main threatening processes in the region, with changed fire regimes, erosion and sedimentation also causing significant impacts.

2.5.1 Great Western Woodlands

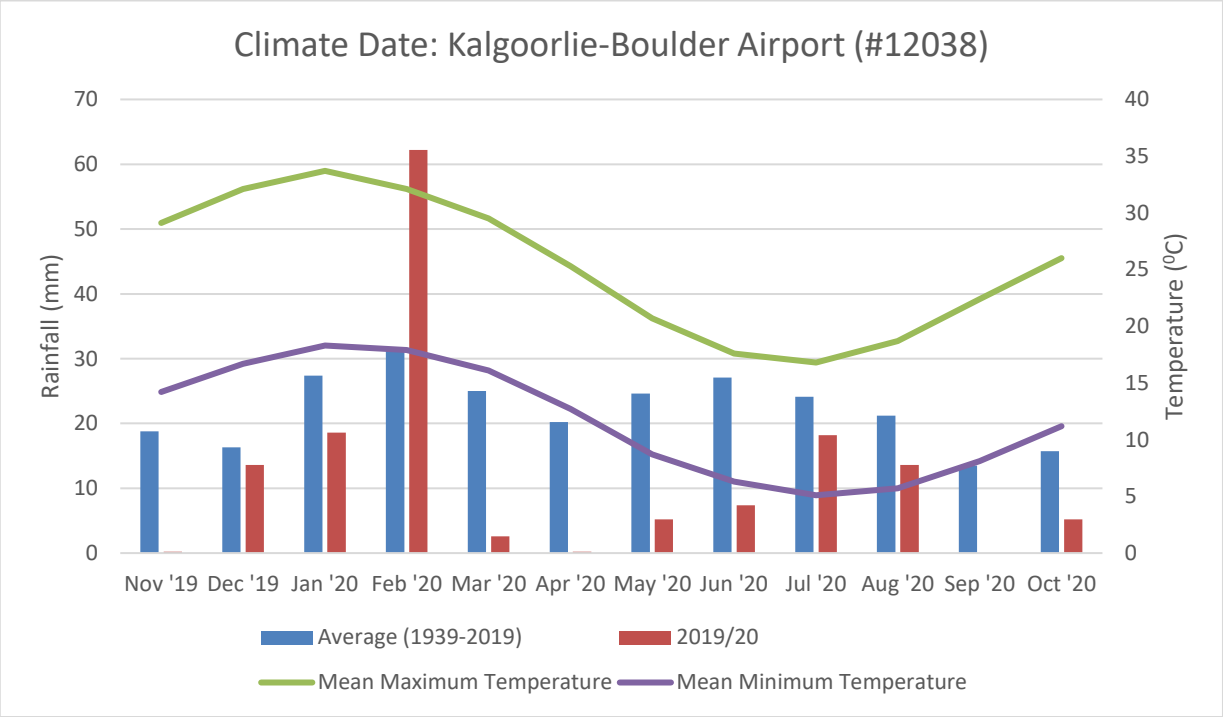
The survey area lies within the Great Western Woodlands, considered by The Wilderness Society of WA to be of global biological and conservation importance as one of the largest and healthiest temperate woodlands on Earth, containing many endemic taxa. The region covers almost 16 million hectares (160,000 square kilometres), from the southern edge of the Western Australian Wheatbelt to the pastoral lands of the Mulga country in the north, the inland deserts to the northeast, and the treeless Nullarbor Plain to the east.

The Great Western Woodlands provides a connection between southwest forests and inland deserts (Gondwana Link) as well as linking the north-west passage to Shark Bay. The majority of the Great Western Woodlands is unallocated crown land (61.1%) with other interests including pastoral leases (20.4%), conservation reserves (15.4%) unallocated crown land, ex pastoral (2%) managed by the Department of Biodiversity, Conservation and Attractions (DBCA) and private land (approximately 1%) (Watson *et. al.,* 2008).

No specific management strategy or formal conservation status applies to the Great Western Woodlands. The Great Western Woodlands currently includes towns, highways, roads, railways, private property, Crown Reserves, agricultural activities and mining tenements.

2.6 Climate

The climate of the Eastern Goldfield subregion is characterised as arid to semi-arid with 200-300 mm of rainfall, sometimes in summer but usually in winter (Cowan 2001). Rainfall data for the Kalgoorlie-Boulder Airport (#12038) weather station, located approximately 40 km south-east of the survey area, is shown in Graph 2-1 (BoM, 2020). Mean monthly rainfall ranges from 31.6 mm in February to 13.5 mm in September, with a mean annual rainfall of 264.9 mm. The survey was conducted in November 2020, with the preceding months (September and October) being characterised by significantly reduced rainfall. Although climate conditions are not considered optimal for the presence of flowering material and ephemeral species, this is unlikely to be a major survey constraint, with multiple surveys previously conducted by Botanica within the survey area over different seasons (spring/ autumn) over multiple years (2012-2014).



Graph 2-1: Average and recent rainfall and average temperature data (Kalgoorlie-Boulder Airport (#12038)) (BoM, 2020)

2.7 Hydrology

According to the Geoscience Australia database (2015), there are no permanent or ephemeral inland waters within the survey area, however multiple minor ephemeral drainage lines intersect the survey area (Figure 2-2).

Groundwater Dependent Ecosystems (GDE) includes biological assemblages of species such as wetlands or woodlands that use groundwater either opportunistically or as their primary water source. For the purposes of this report, a GDE is defined as any vegetation community that derives part of its water budget from groundwater and must be assumed to have some degree of groundwater dependency. According to the BoM *Atlas of Groundwater Dependent Ecosystems* database (BoM, 2020b) database, there are no aquatic GDE's within the survey area, however two low potential terrestrial GDEs intersect the north-eastern and south eastern extremity of the survey area, which are described below in Table 2-2 and spatially in Figure 2-2.

Table 2-2: Potential Terrestrial Groundwater Dependent Ecosystems (BoM, 2020b)

GDE Description	Potential GDE (according to BoM, 2020b)
Medium woodland; salmon gum	Low potential GDE
Shrublands; Acacia quadrimarginea thicket	Low potential GDE

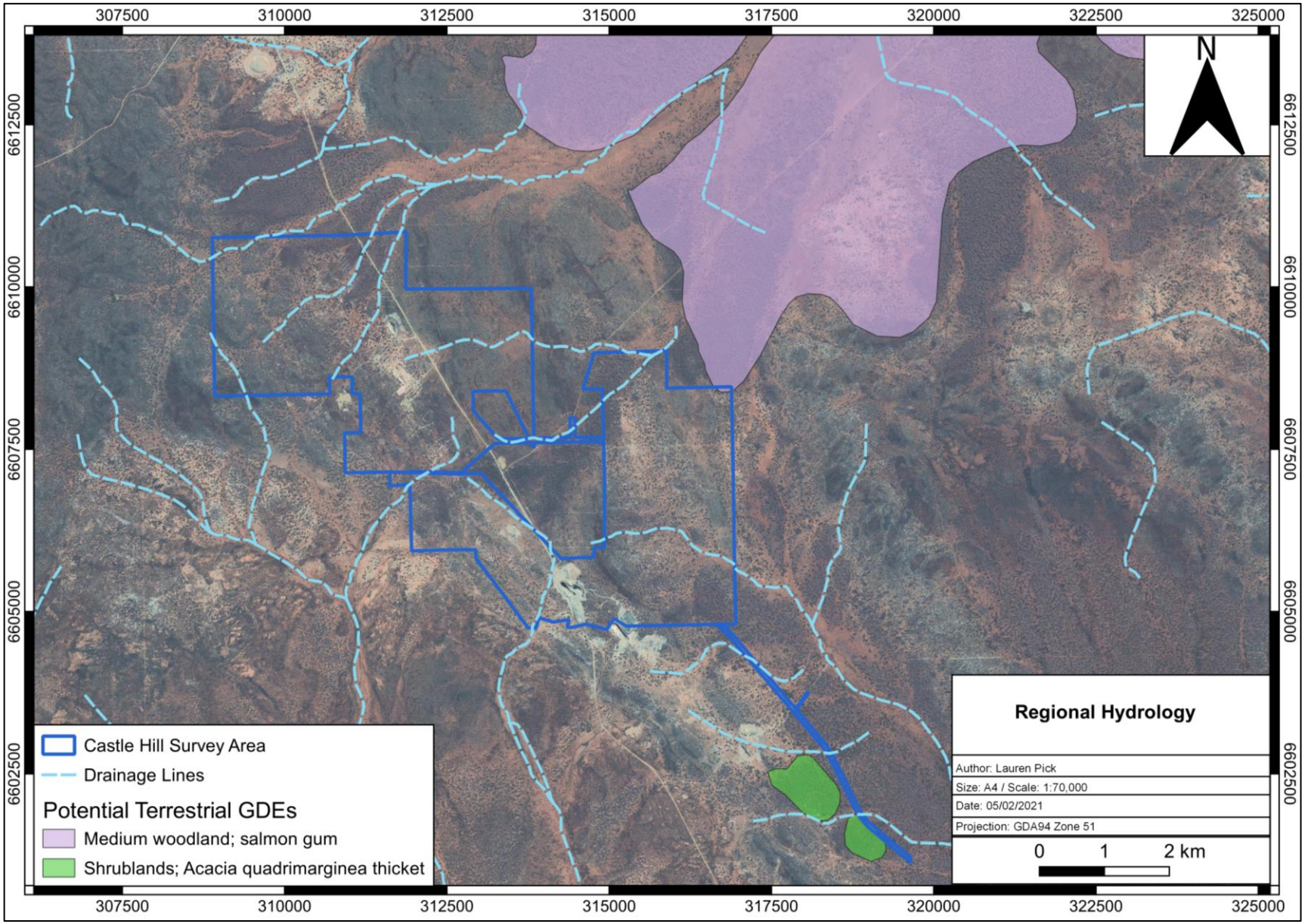


Figure 2-2: Regional hydrology of the survey area

3 SURVEY METHODOLOGY

3.1 Desktop Assessment

Prior to the field assessment a literature review was undertaken of previous flora and fauna assessments conducted within the local region. Documents reviewed included:

- Botanica (2011). *Level 1 Flora & Vegetation Survey: Proposed Anthill open pit operation*. Prepared for Metaliko Resources Ltd, 2011.
- Botanica (2013). *Level 2 Flora & Vegetation Survey for the Castle Hill Project.* Prepared for Phoenix Gold Ltd, September 2013.
- Botanica (2014). *Level 2 Flora & Vegetation Survey for the Burgundy Project.* Prepared for Phoenix Gold Ltd, September 2014.
- Botanica (2020). *Ant Hill Reconnaissance Flora/ Vegetation Survey and Basic Fauna Survey.* Prepared for Northern Star Resources Ltd, December 2020.
- Harewood (2013). *Terrestrial vertebrate Fauna Assessment of the Castle Hill Project Area, .* Prepared for Phoenix Gold Ltd, October 2013.
- Harewood (2014a) *Fauna Assessment, Burgundy Project Area*. Prepared for Phoenix Gold Ltd, October 2014.
- Harewood (2014b). Clearing Permit CPS5675/2 *Malleefowl Assessment, Castle Hill Project Area*. Prepared for Phoenix Gold Ltd, October 2014.
- Harewood (2014c). Clearing Permit CPS6152/1 *Malleefowl Assessment, Burgundy Project Area*. Prepared for Phoenix Gold Ltd, October 2014.
- Phoenix Environmental Services (2019a). *Flora and vegetation survey for Mungari Gold Operations: Cutters Ridge Project*. Prepared for Evolution Mining Ltd, May 2019.
- Phoenix Environmental Services (2019b). *Fauna survey for Mungari Gold Operations: Cutters Ridge Project*. Prepared for Evolution Mining Ltd, May 2019.

In addition to the literature review, searches of the following databases were undertaken to aid in the compilation of a list of significant flora within the survey area:

- DBCA Threatened/ Priority Flora spatial data (DBCA, 2019);
- DBCA NatureMap database (DBCA, 2020); and
- EPBC Protected Matters search tool (DAWE, 2020a).

The NatureMap species search and EPBC Protected Matters search were conducted with a 40 km buffer from the survey area.

Significant flora and fauna species identified by the desktop review were assessed with regards to their population extent and distribution and preferred habitat to determine their likelihood of occurrence within the survey area.

The assessment categorised flora species as follows:

- Unlikely- Suitable habitat is not expected to occur and/or the survey area is outside the known range of the species.
- Possible- Suitable habitat may be present, and the area is within the known range of the species. This option is also used when there is insufficient information to determine the preferred habitat of a species.
- Likely- Suitable habitat is expected to occur and there are records within 10 km of the survey area.
- Previously Recorded- A record for this species is located within the survey area. Field survey will ground-truth currently occurring individuals and populations.

Fauna species were categorised as follows:

- Would Not Occur: There is no suitable habitat for the species in the survey area and/or there is no documented record of the species in the general area since records have been kept and/or the species is generally accepted as being locally/regionally extinct (supported by a lack of recent records).
    - Locally Extinct: Populations no longer occur within a small part of the species natural range, in this case within 10 or 20km of the survey area. Populations do however persist outside of this area.
    - Regionally Extinct: Populations no longer occur in a large part of the species natural range, in this case within the Goldfields region. Populations do however persist outside of this area.
- Unlikely to Occur: The survey area is outside of the currently documented distribution for the species in question, or no suitable habitat (type, quality and extent) was identified as being present during the field assessment. Individuals of some species may occur occasionally as vagrants/transients especially if suitable habitat is located nearby but the site itself would not support a population or part population of the species.
- Possibly Occurs: Survey area is within the known distribution of the species in question and habitat of at least marginal quality was identified as likely to be present during the field survey and literature review, supported in some cases by recent records being documented in literature from within or near the survey area. In some cases, while a species may be classified as possibly being present at times, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.
- Known to Occur: The species in question has been positively identified as being present (for sedentary species) or as using the survey area as habitat for some other purpose (for non-sedentary/mobile species) during field surveys within or near the survey area. This information may have been obtained by direct observation of individuals or by way of secondary evidence (e.g. tracks, foraging debris, scats). In some cases, while a species may be classified as known to occur, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.

It should be noted that these lists are based on observations from a broader area than the assessment area (40 km radius) and therefore may include taxa not present. The databases also often include very old records that may be incorrect or in some cases the taxa in question have become locally or regionally extinct. Information from these sources should therefore be taken as indicative only and local knowledge and information also needs to be taken into consideration when determining what actual species may be present within the specific area being investigated.

The conservation significance of flora and fauna taxa was assessed using data from the following sources:

- *Environment Protection and Biodiversity and Conservation* (EPBC) *Act 1999*. Administered by the Australian Government (DAWE);
- *Biodiversity Conservation* (BC) *Act 2016*. Administered by the WA Government (DBCA);
- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List – the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and
- Priority Flora/ Fauna list. A non-legislative list maintained by DBCA for management purposes (fauna list released April 2019; flora list released December 2018).

The EPBC Act also requires the compilation of a list of migratory species that are recognized under international treaties including the:

- Japan Australia Migratory Bird Agreement 1981 (JAMBA)[1];
- China Australia Migratory Bird Agreement 1998 (CAMBA);
- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA); and
- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

Most but not all migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as Matters of National Environmental Significance (MNES) under the EPBC Act. Descriptions of conservation significant species and communities are provided in Appendix 1.

3.2 Field Assessment

Botanica conducted a detailed flora/ vegetation survey, basic fauna survey and targeted flora/ fauna surveys on the 30th October, 3rd to 5th November and 9th November 2020, with the area traversed on foot and 4WD by three Botanica staff members; Jennifer Jackson (Senior Botanist, BSc (Honours) Environmental Management), Greg Harewood (Zoologist, BSc Zoology) and Matthew Newlands (Environmental Technician).

3.2.1 Vegetation Mapping

Prior to the commencement of field work, aerial photography was inspected and obvious differences in the vegetation assemblages were identified. The different vegetation communities identified were then inspected during the field survey to assess their validity. A handheld GPS unit was used to record the coordinates of the boundaries between vegetation communities. At each sample point, the following information was recorded:

- GPS location;
- Photograph of vegetation;
- Dominant taxa for each stratum (including height and percentage cover of dominant taxa);
- All vascular taxa (including annual taxa);
- Landform classification;

[1] Most but not all species listed under JAMBA are also specially protected under Specially Protected Species of the BC Act.

- Vegetation condition rating;
- Collection and documentation of unknown plant specimens; and
- GPS location, photograph and collection of flora of significance if encountered.

Vegetation types were classified in accordance with NVIS classifications.

3.2.2 Flora Identification

Unknown specimens collected during the survey were identified by Jim Williams with the aid of samples housed at the Botanica Herbarium and WA Herbarium.

3.2.3 Sampling Quadrats

A total of 100 quadrats (20m X 20m) were established within the survey area, including 55 quadrats established in 2012-2013 (Castle Hill survey), 20 quadrats established in 2014 (Burgundy survey) and 25 quadrats established in 2020 (current survey). A map of all quadrats included in the statistical analysis is provided in Figure 3-1.

The quadrats were established by inserting metal pickets in each corner, and measuring the length of the resultant boundaries to verify the quadrats were 20 m x 20 m (square quadrats). Following their establishment and boundary verification, the location of each quadrat was recorded by GPS (Appendix 9) and photographed from the north-west corner of the quadrat (Appendix 11). All vascular plants within the quadrat were recorded (Appendix 10).

This included recording of dominant taxa from the upper, middle and lower stratum, and sampling of all unknown taxa. Unknown taxa were identified using Botanica's own reference herbarium and relevant taxonomical keys. Data on level of disturbance, presence of coarse fragments on surface, topographical position, elevation, aspect, percentage litter, percentage bare ground, percentage surface rock (bedrock and surface deposits), soil types (colour, profile, field texture and surface type), and vegetation structure were collected from each quadrat (Appendix 10). Methods of recording data from these quadrats largely follow those outlined in CSIRO's *Australian Soil and Land Survey Field Handbook* (McDonald *et al.* 1998) and in accordance with current EPA Guidelines (2016).

3.2.4 Targeted Searches

Suitable habitats for significant flora were systematically searched by Botanica staff members to identify and record the locations of Threatened and Priority Flora. Any locations of Threatened and Priority Flora were recorded using a hand-held GPS and a simple plant count (not differentiated between juvenile/mature plants, flowering or non-flowering plants) was conducted.

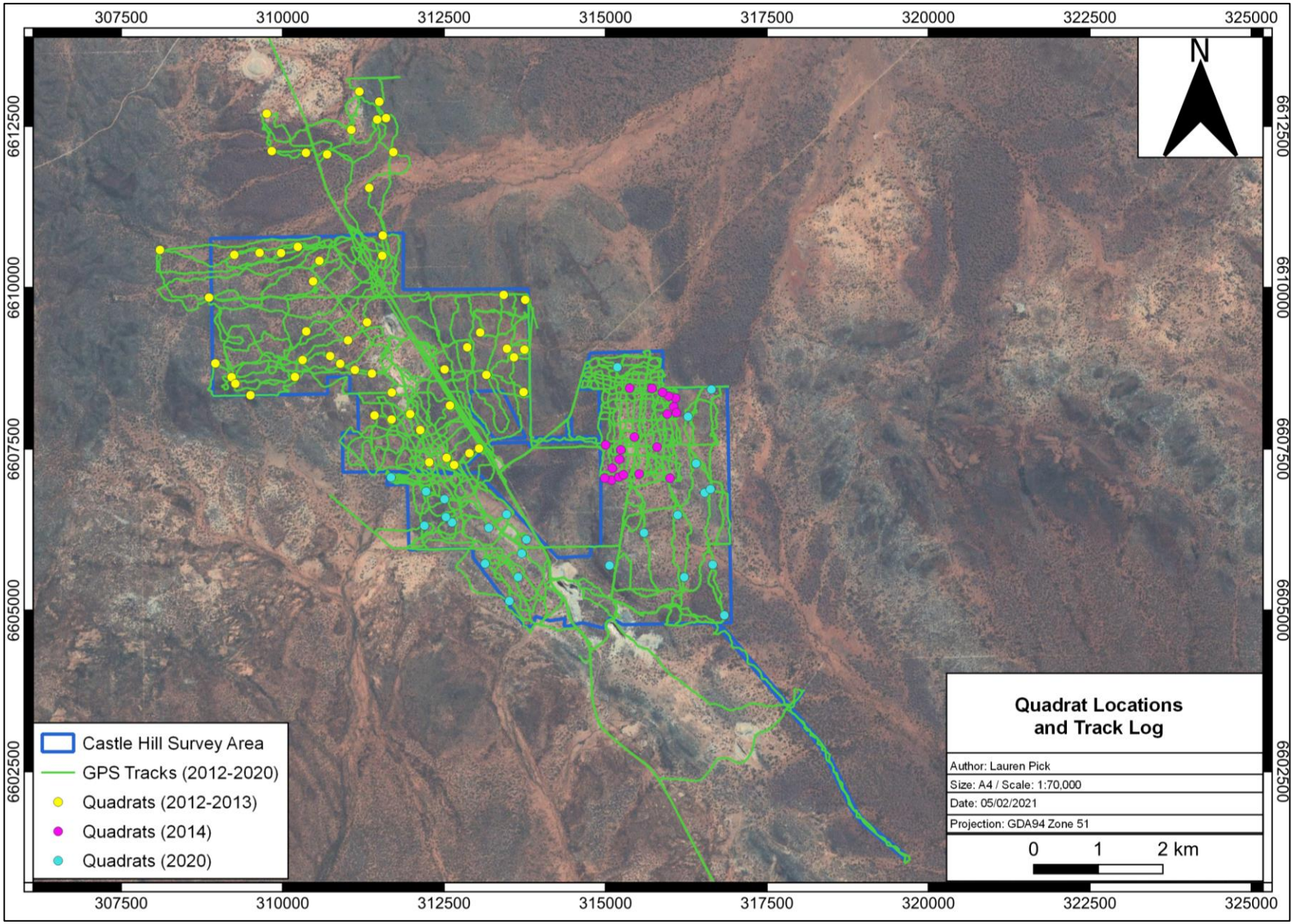


Figure 3-1: Quadrat Locations and track log

3.2.5 Fauna Assessment

Vegetation and landform units identified during the flora assessment have been used to define broad fauna habitat types across the site. This information has been supplemented with observations made during the fauna assessment.

The main aim of the fauna habitat assessment was to determine the likelihood of fauna species of conservation significance utilizing the areas that may be impacted during site development. The habitat information obtained was also used to aid in finalizing the overall potential fauna list.

As part of the desktop literature review, available information on the habitat requirements of the species of conservation significance listed as possibly occurring in the area was researched. During the field survey, the habitats within the study area were assessed and specific elements identified, if present, to determine the likelihood of listed threatened species utilizing the area and its significance to them.

Opportunistic observations of fauna species were made during all field survey work which involved a series of transects across the study area during the day including observations of bird species with binoculars. Secondary evidence of a species presence such as tracks, scats, skeletal remains, foraging evidence or calls were also noted if observed/heard.

3.2.6 Targeted Fauna Survey

Suitable malleefowl habitat within the survey area was systematically searched on foot and by vehicle by two Botanica staff members to identify and record the locations of any malleefowl activity (i.e. mounds, footprints and feathers). Any locations/ observations of malleefowl activity were recorded using a hand-held GPS.

3.2.7 Scientific Licences

Table 3-1: Scientific Licences of Botanica Staff coordinating the flora survey

Licensed staff	Permit Number	Valid Until
Jennifer Jackson	SW019268 (Licence to flora for scientific purposes)	18/02/2021

3.3 Data Analysis Tools

At the completion of the survey effort, the data obtained was analysed to generate a vegetation map (Figure 4-5) and complete list of flora species (Appendix 5). The statistical program PATN was used to assess species composition of the quadrats (Appendix 12).

3.3.1 PATN Analysis

The PATN software package was used to assess the similarities/ dissimilarities between quadrats based on presence/ absence of species. A total of 100 quadrats were included in the analysis, including 55 quadrats established in 2012-2013 (Castle Hill survey), 20 quadrats established in 2014 (Burgundy survey) and 25 quadrats established in 2020 (current survey).

Annual taxa (35 taxa) and sterile taxa (two taxa) were removed from the analysis. Singleton taxa (21 taxa) were also excluded from the analysis. Species reconciliation was conducted for four variant taxa. A total of 75 perennial taxa were included in the final analysis.

The analysis produced a quantitative estimate of the relationship between species composition of each quadrat. The classifications were based upon a Bray-Curtis association matrix using a flexible Unweighted Pair Group Arithmetic Mean (UPGMA) method (with a beta value of -0.1) which standardises the data enabling the analysis to be completed. Semi-strong hybrid (SSH) ordination of the quadrat is then undertaken to show spatial relationships between groups and to elucidate possible environmental correlates with the classification.

The analysis also produced a stress value which is a measure of the 'strength' of the analysis (i.e. how well the quadrats are grouped together into the appropriate floristic groups). The lower the stress value the greater the strength of the analysis with a value of less than 0.3 showing that the analysis appropriately grouped quadrats. A stress value greater than 0.3 suggests that the analysis was unable to group quadrats appropriately due to extraneous variables (i.e. other factors influencing differences in floristic groups other than species composition e.g. fire, clearing disturbance etc.).

3.3.2 EstimateS

EstimateS software was used to estimate species richness present using the Chao2 richness estimator. For any number of samples, the estimator uses the existing pattern of species accumulation to estimate the true number of species at a site. The estimators tend to under-estimate species number when sample size is small, hence the estimated number of true species can be seen to increase with sample size. This software was also used to compute Coleman rarefaction curves estimates which were used to calculate species accumulation curves.

3.4 Survey Limitations and Constraints

It is important to note that flora surveys will entail limitations notwithstanding careful planning and design. Potential limitations are listed in Table 3-2.

The conclusions presented in this report are based upon field data and environmental assessments and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of the field assessments. Also, it should be recognised that site conditions can change with time. Information not available at the time of this assessment which may subsequently become available may alter the conclusions presented.

Some species are reported as potentially occurring based on there being suitable habitat (quality and extent) within the survey area or immediately adjacent. The habitat requirements and ecology of many of the species known to occur in the wider area are however often not well understood or documented. It can therefore be difficult to exclude species from the potential list based on a lack of a specific habitats or microhabitats within the survey area. As a consequence of this limitation, the potential species list produced is most likely an overestimation of those species that actually utilise the survey area for some purpose.

In recognition of survey limitations, a precautionary approach has been adopted for this assessment. Any flora and fauna species that would possibly occur within the survey area (or immediately adjacent), as identified through ecological databases, publications, discussions with local experts/residents and the habitat knowledge of the author, has been listed as having the potential to occur.

Table 3-2: Limitations and constraints associated with the survey

Variable	Potential Impact on Survey	Details
Access problems	Not a constraint	The survey was conducted via ATV and on foot. Numerous tracks were located within the survey area, providing ease of access.
Competency/ Experience	Not a constraint	The BC personnel that conducted the survey were regarded as suitably qualified and experienced. **Coordinating Botanist/ Zoologist:** Jennifer Jackson & Greg Harewood **Data Interpretation:** Kelby Jennings & Lauren Pick
Timing of survey, weather & season	Minor constraint	Fieldwork was undertaken within the EPA's recommended survey period (September - November) for the South-West and Interzone Province. Reduced rainfall was recorded in the preceding months, with limited ephemeral species present. Although climate conditions are not considered optimal for the presence of flowering material and ephemeral species, this is unlikely to be a major survey constraint, with multiple surveys previously conducted by Botanica within the survey area over different seasons (spring/ autumn) over multiple years (2012-2014).
Area disturbance	Not a constraint	The area has been disturbed from exploration and mining operations, cattle grazing and other human impacts; however, vegetation was mostly intact and comprised of native vegetation.
Survey Effort/ Extent	Not a constraint	Survey intensity was appropriate for the size/significance of the area with a detailed flora/ vegetation survey and basic fauna survey completed to identify vegetation types/fauna habitats and conservation significant species/communities.
Availability of contextual information at a regional and local scale	Not a constraint	Threatened flora database searches provided by the DBCA were used to identify any potential locations of Threatened/Priority taxa. BoM, DWER, DPIRD, DBCA and DAWE databases were reviewed to obtain appropriate regional desktop information on the biophysical environment of the local region. Previous Flora/ Fauna surveys within the local area have been assessed for pertinent information and environmental context of the regional area.
Completeness	Not a constraint	In the opinion of Botanica, the survey area was covered sufficiently in order to identify vegetation assemblages. Only two flora specimens were unable to be positively identified to species level. The vegetation types for this study were based on visual descriptions of locations in the field. The distribution of these vegetation communities/ fauna habitats outside the study area is not known, however vegetation types identified were categorised via comparison to vegetation distributions throughout WA specified in the NVIS Major Vegetation Groups (DotEE, 2017b).

4 RESULTS

4.1 Desktop Assessment

4.1.1 Flora

The desktop review identified 780 vascular flora species as occurring within 40 km of the survey area, representing 303 genera from 76 families. The most diverse families were Asteraceae (104 species), Fabaceae (99 species) and Myrtaceae (88 species). Significant genera include *Acacia* (54 species), *Eucalyptus* (47 species) and *Eremophila* (35 species). This total includes 71 introduced (weed) species (9.1%).

4.1.1.1 Introduced Flora

The desktop review identified 71 introduced flora (weed) species as potentially occurring in the vicinity of the survey area. These species consist of 26 families, with the most commonly represented being Asteraceae (14 species), Poaceae (13 species) and Fabaceae (six species). Of these, two are listed as a Declared Pest on the Western Australian Organism List (WAOL) under the *Biosecurity and Agriculture Management* (BAM) *Act 2007*, with one also listed as a Weed of National Significance (Table 4-1).

The full list of potential weed species is contained in Appendix 2.

Table 4-1: Potentially occurring Declared Pests and Weeds of National Significance

Family	Species	Common Name	WAOL Status	Control Category	WONS
Boraginaceae	*Echium plantagineum*	Paterson's Curse	Declared Pest - s22(2)	No Control Category, Whole of State	No
Cactaceae	*Opuntia elata*	-	Declared Pest - s22(2)	C3 Management, Whole of State	Yes

4.1.1.2 Significant Flora

The assessment of the DBCA Priority/ Threatened flora data (DBCA, 2019), NatureMap search (DBCA, 2020), Protected Matters searches (DAWE, 2020a) and previous relevant literature identified 49 significant flora species recorded within a 40 km radius of the survey area. These are comprised of three Endangered, 16 Priority 1, seven Priority 2, 19 Priority 3 and four Priority 4 taxa (Appendix 3).

These taxa were assessed for distribution and known habitat to determine their likelihood of occurrence within the survey area. The assessment identified on Priority flora species as previously recorded within the survey area. Five taxa were assessed as possibly occurring in the survey area, consisting of one Priority 1, two Priority 2 and two Priority 3 taxa (Table 4-2). The full flora likelihood assessment is listed in Appendix 3. The locations of the DBCA database records are illustrated spatially in Figure 4-1.

Table 4-2: Potentially occurring significant flora species

Species	Rank	Habitat	Comments	Likelihood
Rhodanthe uniflora	P1	Brown earth. Open eucalyptus woodland.	Within species range, habitat may be present.	Possible
Eremophila praecox	P2	Red/brown sandy loam. Undulating plains.	Previously recorded within survey area by Phoenix Environmental Services (2019a)	Previously Recorded
Eucalyptus educta		Shallow soils. Granite rocks.	Within known range, habitat may be present.	Possible
Rumex crystallinus		Arid & semi-arid areas.	Within species range, habitat may be present.	Possible
Angianthus prostratus	P3	Red clay or loamy soils. Saline depressions.	Extreme of known range, habitat may be present.	Possible
Notisia intonsa		Red sand, disturbed areas.	Within species range, habitat may be present.	Possible

4.1.1.3 Significant Ecological Communities

The Protected Matters search (DAWE, 2020a) did not identify any Threatened Ecological Communities recorded within 40 km of the survey area. Analysis of the Priority Ecological Communities within the Goldfields region (DBCA, 2017) did not identify any significant vegetation assemblages as likely or possibly occurring within the survey area.

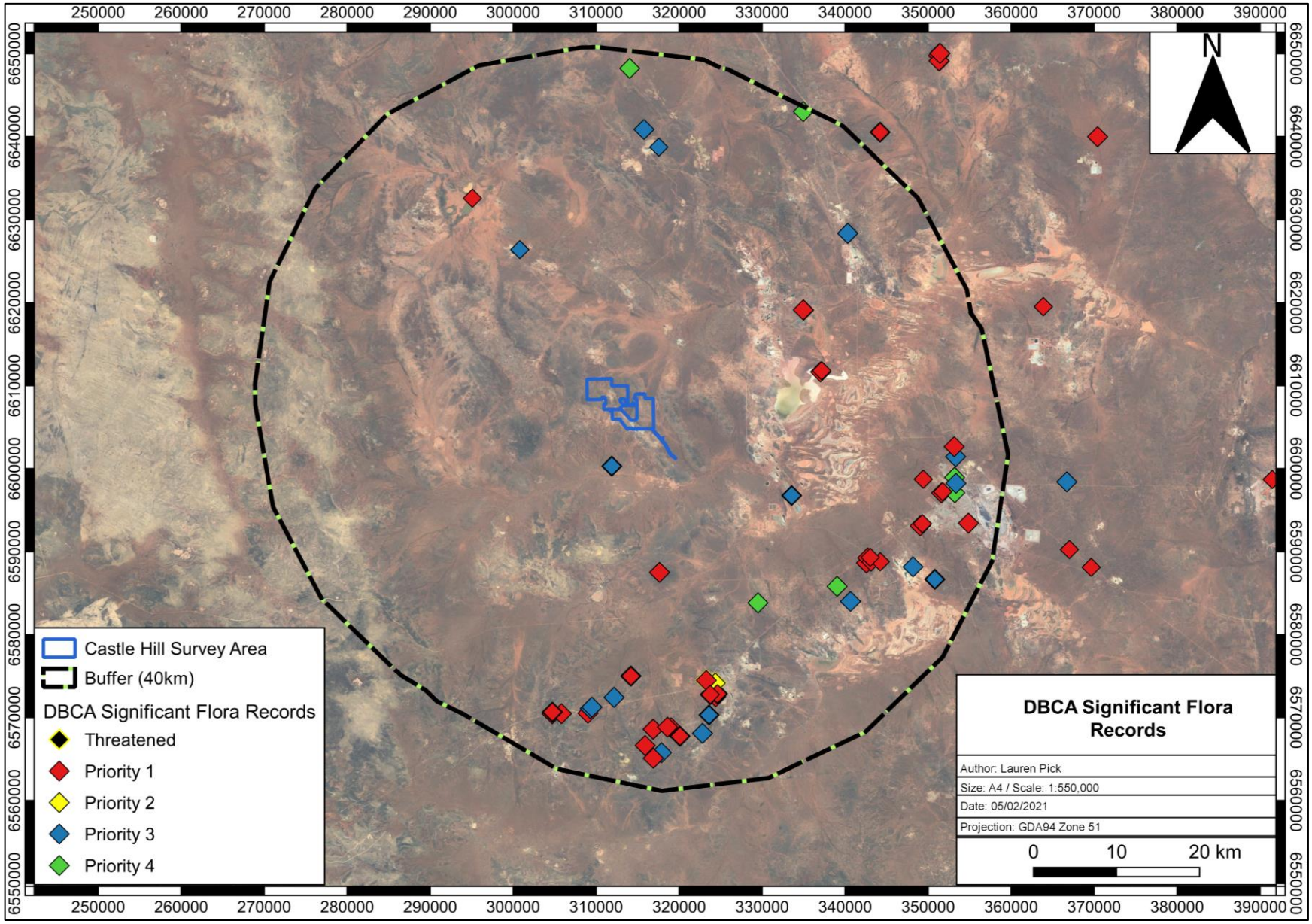


Figure 4-1: DBCA significant flora records

4.1.2 Vegetation Associations

The Pre-European vegetation association spatial mapping dataset (DPIRD, 2018) identifies three vegetation associations as occurring within the survey area (Figure 4-2). The association descriptions and their remaining extent, as specified in the 2018 Statewide Vegetation Statistics (DBCA, 2019) are provided in Table 4-3. Areas retaining less than 30% of their pre-European vegetation extent generally experience exponentially accelerated species loss, while areas with less than 10% are considered "endangered" (EPA, 2000). All vegetation associations retain >98% of their Pre-European extent. Development within the survey area will not significantly reduce the pre-European extent of these vegetation associations.

Table 4-3: Pre-European Vegetation Associations within the survey area

Vegetation Association	Current Extent (ha)	Pre-European extent remaining (%)	% in DBCA managed lands	Floristic Description	Extent within Survey Area ha (%)
Kununulling 468	181,666.52	98.30	0.04	Medium woodland; salmon gum & goldfields blackbutt	2 ha (0.07%)
Kununulling 520	1,424.70	100.00	0	Shrublands; *Acacia quadrimarginea* thicket	1 ha (0.04%)
Kununulling 936	13,907.76	99.55	0	Medium woodland; salmon gum	2,505 ha (99.9%)

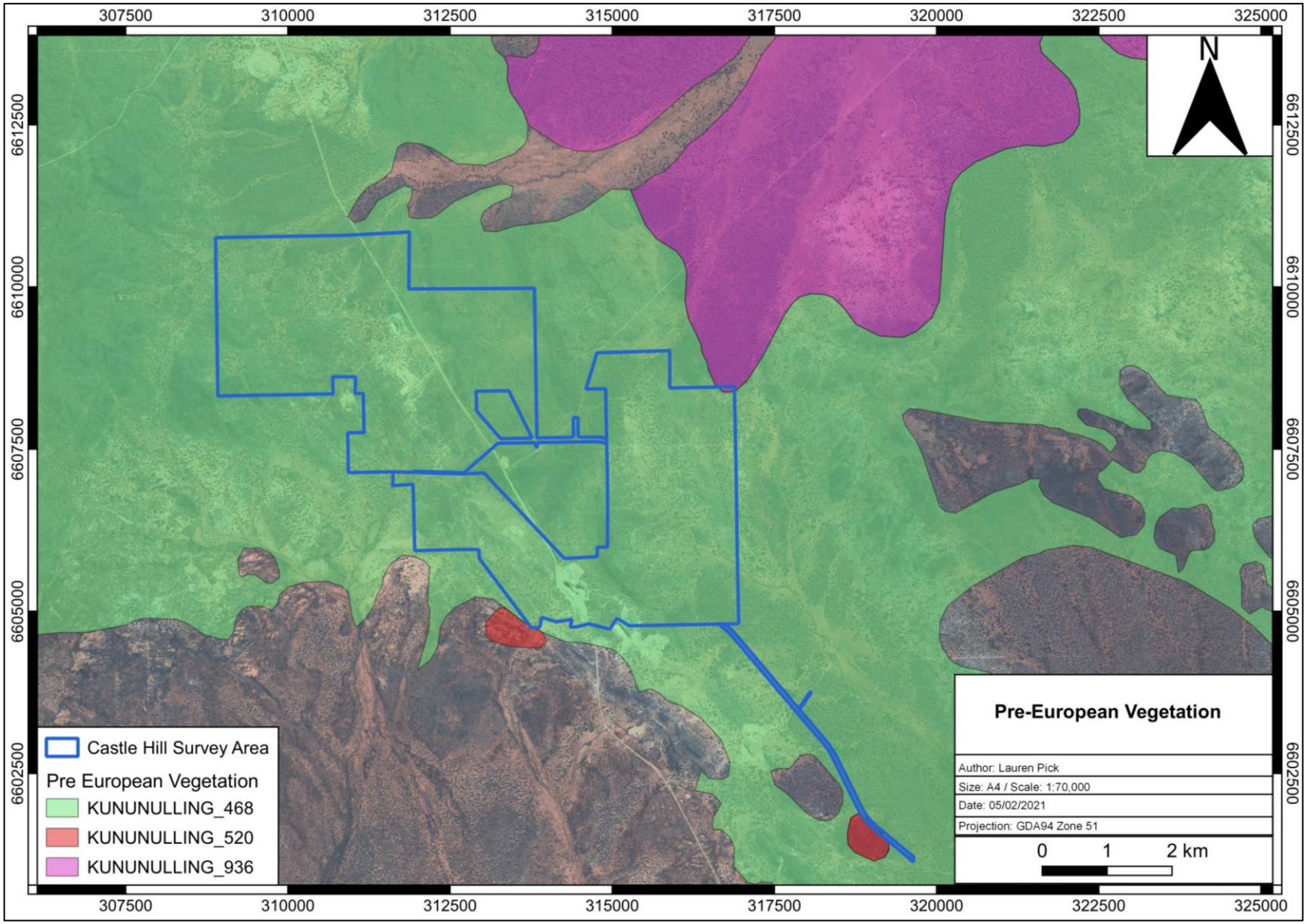


Figure 4-2: Pre-European Vegetation Associations within the survey area

4.1.3 Fauna

According to the results of the NatureMap search (DBCA, 2020), a total of 261 terrestrial vertebrate fauna taxa have been recorded within a 40 km radius of the survey area, consisting of 158 bird, 26 mammal, 71 reptile and six amphibian taxa. This total includes seven introduced (feral) species (2.7%).

4.1.3.1 Introduced (Feral) Fauna

The NatureMap and EPBC database searches identified 13 feral fauna species from nine families as potentially occurring in the survey area (Table 4-4).

Table 4-4: Potentially Occurring Introduced Fauna

Family	Species	Common Name
Bovidae	*Capra hircus*	Goat
Canidae	*Canis lupus familiaris*	Domestic Dog
	Vulpes	Red Fox
Columbidae	*Columba livia*	Domestic Pigeon
	Streptopelia chinensis	Spotted Turtle-Dove
	Streptopelia senegalensis	Laughing Turtle-Dove
Equidae	*Equus asinus*	Donkey, Ass
	Equus caballus	Horse
Felidae	*Felis catus*	Cat
Gekkonidae	*Hemidactylus frenatus*	Asian House Gecko
Leporidae	*Oryctolagus cuniculus*	Rabbit
Muridae	*Mus musculus*	House Mouse
Phasianidae	*Pavo cristatus*	Common Peafowl

4.1.3.2 Conservation Significant Fauna

The desktop review identified 22 terrestrial vertebrate fauna species of conservation significance as previously being recorded in the regional area, consisting of seven Threatened, one Priority 3, one Priority 4 and three migratory or otherwise protected species. In addition, ten migratory wading/shorebird species were assessed collectively due to their similar habitat requirements. The full fauna likelihood assessment is listed in Appendix 4

Habitat and distribution data was used to determine the likelihood of occurrence within the survey area. The assessment identified three significant fauna species as potentially occurring in the survey area (Table 4-5).

Table 4-5: Significant fauna species potentially occurring in survey area

Species	Status	Likelihood
Central Long-eared Bat (*Nyctophilus major tor*)	P3	Possible
Malleefowl (*Leipoa ocellata*)	T (VU)	Possible
Peregrine Falcon (*Falco peregrinus*)	OS	Possible

4.1.4 Conservation Areas

There are no vested Conservation Reserves located within the survey area.

There are no DBCA managed lands located within the survey area.

There are no Environmentally Sensitive Areas located within the survey area.

There are no Nationally Important or RAMSAR wetlands located within the survey area.

The closest significant environmental feature is the Rowles Lagoon Conservation Park, which is DBCA-managed land located approximately 25 km north-west of the survey area. Disturbances within the survey area are unlikely to impact this conservation reserve. The location of conservation areas in relation to the survey area is provided in Figure 4-3.

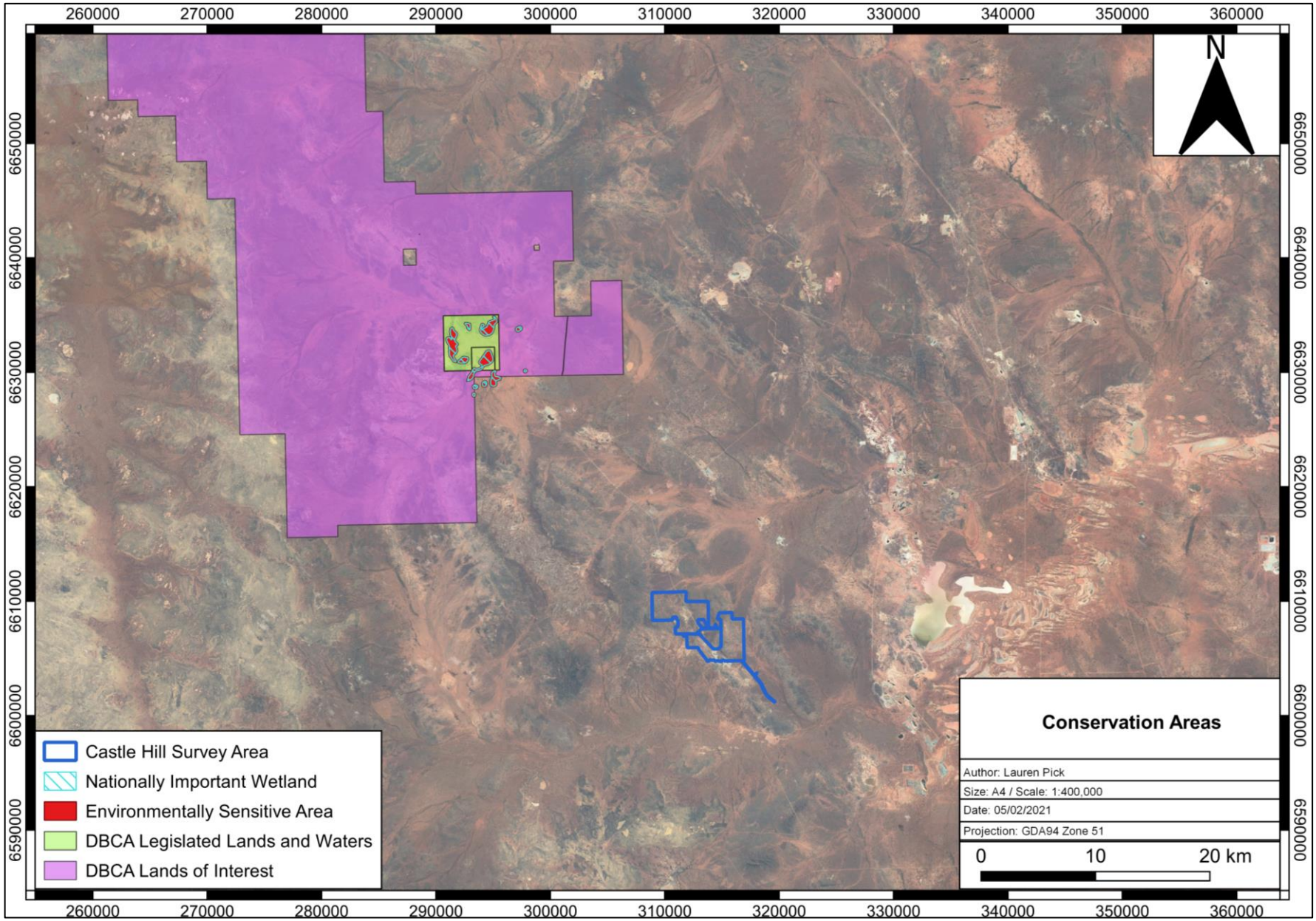


Figure 4-3: Conservation Areas

4.2 Field Assessment

4.2.1 Flora

The field survey identified 145 flora taxa within the survey area. These taxa represented 70 genera across 32 families, with the most diverse genera being *Eremophila* (15 species), *Eucalyptus* (10 species) and *Acacia* (8 species). Dominant families include Chenopodiaceae (26 species), Asteraceae (17 species), Scrophulariaceae (15 species) and Fabaceae (14 species). Eleven introduced (weed) species were recorded, representing 8% of the total species richness. The full field species inventory is listed in Appendix 5.

4.2.1.1 Introduced Flora

Eleven introduced (weed) species were recorded within the survey area (Table 4-6), none of these species are listed as a Weed of National Significance or a Declared Pest in Western Australia.

Table 4-6: Introduced flora species within the survey area

Family	Species
Asphodelaceae	*Asphodelus fistulous*
Asteraceae	*Centaurea melitensis*
Asteraceae	*Dittrichia graveolens*
Asteraceae	*Sonchus oleraceus*
Brassicaceae	*Carrichtera annua*
Brassicaceae	*Sisymbrium irio*
Cucurbitaceae	*Cucumis myriocarpus*
Lamiaceae	*Salvia reflexa*
Lamiaceae	*Salvia verbenaca*
Poaceae	*Cenchrus ciliaris*
Primulaceae	*Lysimachia arvensis*

4.2.1.2 Significant Flora

According to the EPA *Environmental Factor Guideline for Flora and Vegetation* (EPA, 2016b) significant flora includes:

- flora being identified as threatened or priority species;
- locally endemic flora or flora associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- new species or anomalous features that indicate a potential new species;
- flora 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
- flora with relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

No Threatened flora species were recorded within the survey area. One Priority 2 flora species (*Eremophila praecox*) was previously recorded within and adjacent to the survey area by Phoenix Environmental Services (2019a). An additional potential record of this taxon was recorded by Botanica within the survey area however due to absence of flowering material (despite the survey being conducted during the known flowering period for this taxon), this specimen could not be positively identified or formally lodged with the Western Australian Herbarium. Given this taxon has been previously recorded within/ adjacent to the survey area this record is tentatively considered as a Priority 2 flora record.

Coordinates for the *Eremophila praecox* (P2) records are provided in Table 4-7. A map showing the *Eremophila praecox* (P2) records is provided in Figure 4-4. No other significant flora (as described above) was identified within the survey area.

Table 4-7: Priority Flora Records within the survey area

Taxon	Recorded by	Coordinates
Eremophila praecox (P2)	Phoenix Environmental Services	51J 316881 6604620
Eremophila praecox (P2)	Phoenix Environmental Services	51J 319390 6601964
Eremophila ?praecox (P2)	Botanica	51J 312624 6606361

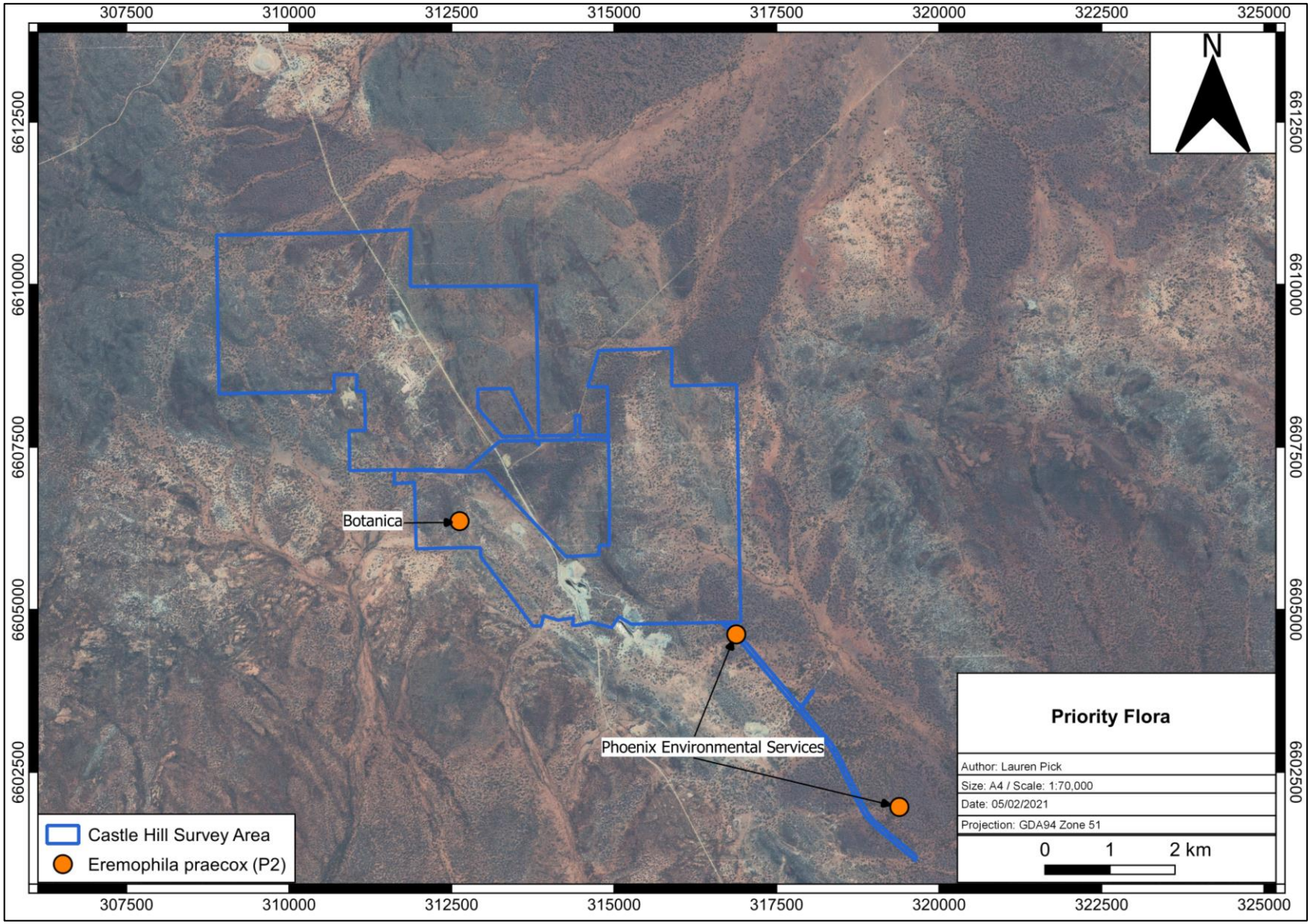


Figure 4-4: Priority Flora Records within the survey area

4.2.2 Vegetation Communities

A total of twelve broad vegetation types were identified within the survey area. Vegetation type descriptions and extent are listed below in Table 4-8 and illustrated spatially in Figure 4-5. Vegetation type descriptions and extents were determined from field survey results, aerial imagery interpretation, statistical analysis of quadrat data and extrapolation of the communities.

The survey found CLP-EW1 was the most widespread community in the survey area, occupying 814 ha (32.5%), while RH-CFW1 was the most restricted with 10 ha (0.4%). CLP-EW1 and RH-MWS1 were the most diverse community, with 67 flora species recorded, and RH-AFW1 was the least diverse with 23 flora species recorded.

Table 4-8: Vegetation Type Descriptions and Extent

Vegetation Code	Broad Floristic Formation (NVIS III)	Description	Landform	Image
CLP-EW1 814 ha (32.5%)	Eucalyptus woodland	Low woodland of *Eucalyptus campaspe/ E. salmonophloia* over mid shrubland of *Eremophila* spp. and low chenopod shrubland on clay-loam plain	Clay/loam plain	
CLP-EW2 245 ha (9.8%)	Eucalyptus woodland	Low woodland of *Eucalyptus ravida/ E. salmonophloia* over mid shrubland of *Eremophila* spp. and low chenopod shrubland on clay-loam plain	Clay/loam plain	

Vegetation Code	Broad Floristic Formation (NVIS III)	Description	Landform	Image
CLP-OS1 47 ha (1.9%)	Other Shrubland	Mid sparse shrubland of *Atriplex nummularia subsp. spathulata* subsp*. spathulata/ Eremophila dempsteri* over sparse tussock grassland of *Austrostipa nitida* on clay-loam plain	Clay/loam plain	
CLP-OS2 61 ha (2.4%)	Other Shrubland	Mid open shrubland of *Eremophila alternifolia/ E. interstans* subsp*. virgata* over low chenopod shrubland on clay-loam plain	Clay/loam plain	

Vegetation Code	Broad Floristic Formation (NVIS III)	Description	Landform	Image
OD-EW1 98 ha (3.9%)	Eucalyptus woodland	Low woodland of *Eucalyptus salmonophloia/ E. transcontinentalis/ E. clelandiorum* over mid shrubland of *Eremophila* spp. and low samphire shrubland in open depression	Open Depression	
RH-AFW1 15 ha (0.6%)	Acacia Woodland	Low woodland of *Acacia quadrimarginea* over mixed mid open shrubland and low open shrubland of *Ptilotus obovatus* on greenstone hillslope	Greenstone Hillslope	

Vegetation Code	Broad Floristic Formation (NVIS III)	Description	Landform	Image
RH-CFW1 10 ha (0.4%)	Casuarina Woodland	Low open woodland of *Allocasuarina acutivalvis/Casuarina pauper* over low mixed scrub on greenstone hillslope	Greenstone Hillslope	
RH-EW1 740 ha (29.5%)	Eucalyptus woodland	Low woodland of *Eucalyptus clelandiorum* over mid shrubland of *Eremophila* spp. shrubland and low chenopod shrubland on greenstone hillslope	Greenstone Hillslope	

Vegetation Code	Broad Floristic Formation (NVIS III)	Description	Landform	Image
RH-EW2 24 ha (1.0%)	Eucalyptus woodland	Low woodland of *Eucalyptus clelandiorum/Eucalyptus torquata* over low shrubland of *Eremophila* spp. on greenstone hillslope	Greenstone Hillslope	
RH-MWS1 273 ha (10.9%)	Mallee Woodland	Open mallee woodland of *Eucalyptus griffithsii* over mid shrubland of *Eremophila/ Dodonaea* spp. and low mixed shrubland on greenstone hillslope	Greenstone Hillslope	

Vegetation Code	Broad Floristic Formation (NVIS III)	Description	Landform	Image
SLP-AS1 94 ha (3.7%)	Acacia Shrubland	Tall open shrubland of *Acacia acuminata* over low mixed shrubland on sandy-loam plain	Sand/loam plain	
SLP-MWS1 25 ha (1.0%)	Mallee Woodland	Tall mallee woodland of *Eucalyptus griffithsii* over mid open shrubland of *Eremophila/ Senna* spp. And hummock grassland of *Triodia irritans* on sand-loam plain	Sand/loam plain	
CV 62 ha (2.5%)	N/A	Cleared Vegetation	N/A	No image available

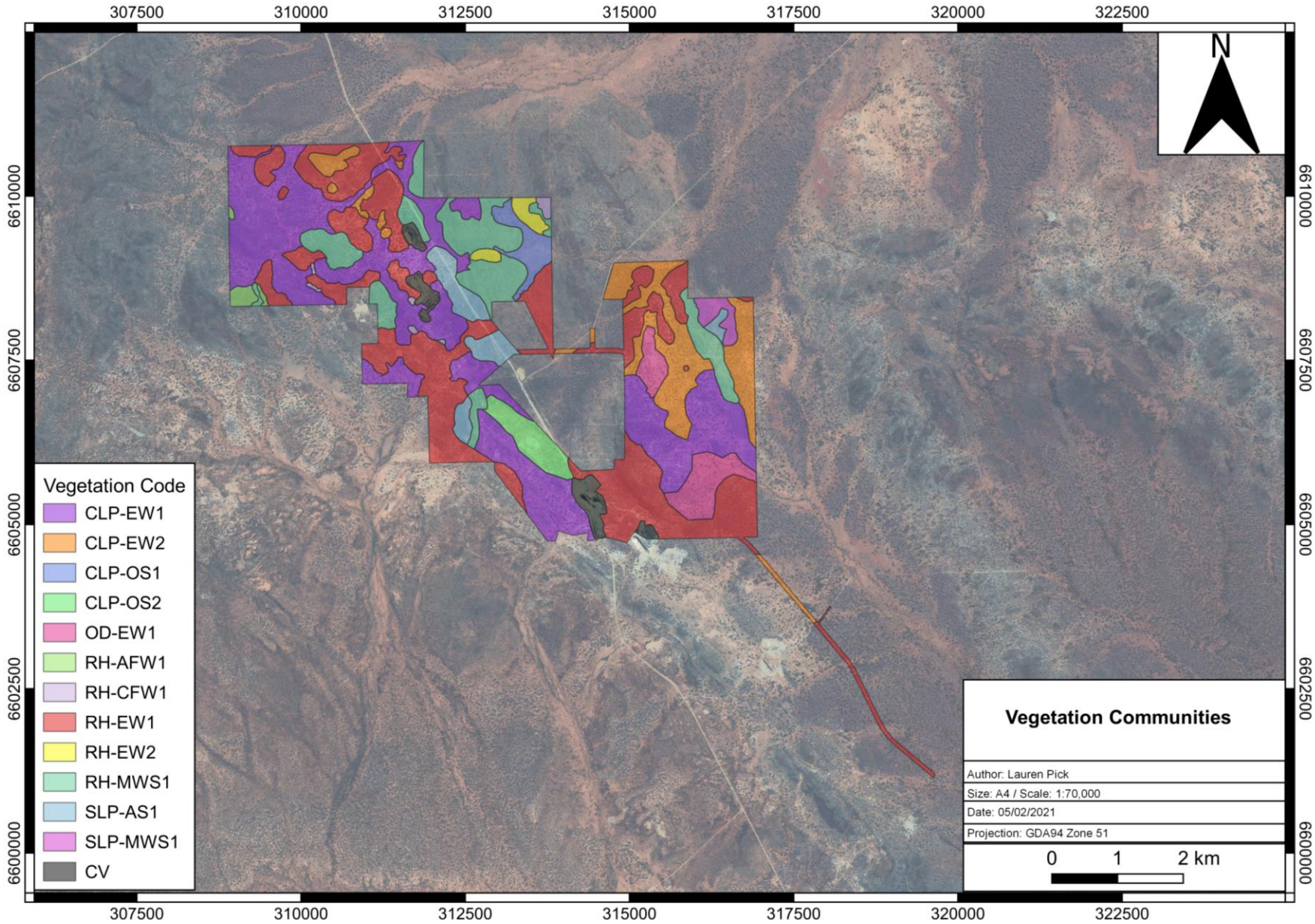


Figure 4-5: Vegetation Communities

4.2.3 Floristic Composition

PATN analysis was used to determine the similarities or differences between vegetation types identified within the survey area. Appendix 12 provides the dendrogram, two way-table (specifying species group) and ordination graph for all generated from the PATN statistical analysis. A list of the 100 quadrats and their respective vegetation types are provided in Table 4-9 below. The PATN analysis produced a stress value of 0.2379.

Table 4-9: Vegetation types identified within the survey area and corresponding quadrats

Vegetation Type	Vegetation Code	Quadrat 2012-2013	Quadrat 2014	Quadrat 2020
Low woodland *of Eucalyptus campaspe/ E. salmonophloia* over mid shrubland of *Eremophila* spp. and low chenopod shrubland on clay-loam plain	CLP-EW1	CH2, CH4, CH6, CH8, CH10, CH13, CH17, CH18, CH39, CH40, CH46, CH48, CH49, CH53, CH54	B4, B5, B6, B7, B10	QE5, QE9, QE12, QW1, QW6, QW9, QW10
Low woodland of *Eucalyptus ravida/ E. salmonophloia* over mid shrubland of *Eremophila* spp. and low chenopod shrubland on clay-loam plain	CLP-EW2	CH15, CH25, CH26, CH38, CH47, CH50	B9, B11, B12	QE8
Mid sparse shrubland of *Atriplex nummularia subsp. spathulata* subsp. *spathulata/ Eremophila dempsteri* over sparse tussock grassland of *Austrostipa nitida* on clay-loam plain	CLP-OS1	CH27, CH30, CH36		
Mid open shrubland of *Eremophila alternifolia/ E. interstans* subsp. *virgata* over low chenopod shrubland on clay-loam plain	CLP-OS2			QW7, QW12, QW13
Low woodland of *Eucalyptus salmonophloia/ E. transcontinentalis/ E. clelandiorum* over mid shrubland of *Eremophila* spp. and low samphire shrubland in open depression	OD-EW1		B2, B3, B8	QE10
Low woodland of *Acacia quadrimarginea* over mixed mid open shrubland and low open shrubland of *Ptilotus obovatus* on greenstone hillslope	RH-AFW1	CH12, CH14, CH22, CH55		
Low open woodland of *Allocasuarina acutivalvis/Casuarina pauper* over low mixed scrub on greenstone hillslope	RH-CFW1	CH11, CH20, CH21, CH28		
Low woodland of *Eucalyptus clelandiorum* over mid shrubland of *Eremophila* spp. shrubland and low chenopod shrubland on greenstone hillslope	RH-EW1	CH3, CH7, CH24, CH35, CH45, CH51, CH52	B1, B19, B20	QE1, QE2, QE3, QE11, QW2, QW8, QW11
Low woodland of *Eucalyptus clelandiorum/Eucalyptus torquata* over low shrubland of *Eremophila* spp. on greenstone hillslope	RH-EW2	CH31, CH37, CH42, CH43, CH44		

Vegetation Type	Vegetation Code	Quadrat 2012-2013	Quadrat 2014	Quadrat 2020
Open mallee woodland of *Eucalyptus griffithsii* over mid shrubland of *Eremophila/ Dodonaea* spp. and low mixed shrubland on greenstone hillslope	RH-MWS1	CH9, CH19, CH23, CH29, CH32, CH33, CH34, CH41	B13, B17, B18	QE4, QE6, QW5
Tall open shrubland of *Acacia acuminata* over low mixed shrubland on sandy-loam plain	SLP-AS1	CH1, CH5, CH16		QE7, QW3, QW4
Tall mallee woodland of *Eucalyptus griffithsii* over mid open shrubland of *Eremophila/ Senna* spp. and hummock grassland of *Triodia irritans* on sand-loam plain	SLP-MWS1		B14, B15, B16	

Two supergroups were identified from the PATN analysis:

1. Eucalypt Woodlands; *E. campaspe, E. salmonophloia, E. transcontinentalis* woodlands on clay-loam plain/ open depression and *E. clelandiorum* woodland on greenstone hillslope.
2. Eucalypt Woodlands; *E. clelandiorum* and *E. torquata* woodland on greenstone hillslope/ Mallee Woodlands on greenstone hillslope and sand-loam plains/ Other Shrublands on clay-loam plains/ Casuarina and Acacia Woodlands on greenstone hillslopes and Acacia Shrublands on sand-loam plain.

As shown in the dendrogram provided in Appendix 12, each supergroup comprised of six floristic groups.

The first floristic group included *Eucalyptus campaspe/ E. salmonophloia* woodland quadrats, *E. clelandiorum* woodland quadrats and one *Eucalyptus griffithsii* mallee woodland quadrat. This floristic group was characterised by species group C (see two-way table provided in Appendix 12) with an average species richness of twelve taxa per quadrat (ranged from eight to nineteen taxa per quadrat).

The second floristic group comprised of two *E. clelandiorum* woodland quadrats and was closely related to floristic group 1 and 3, however had a lower species composition. This floristic group was characterised by species group C, with an average species richness of eight taxa per quadrat (ranged from six to nine taxa per quadrat).

The third floristic group included *Eucalyptus campaspe/ E. salmonophloia* woodland quadrats, *E. clelandiorum* woodland quadrats, one *Eucalyptus griffithsii* mallee woodland quadrat and one *Eucalyptus salmonophloia/ E. transcontinentalis/ E. clelandiorum* woodland quadrat. Like the previous floristic groups, it was mostly characterised by species group 3, with an average species richness of nine taxa per quadrat (ranged from five to fifteen taxa per quadrat).

Floristic groups 4 to 6 were closely related to each other (see dendrogram in Appendix 12). Floristic group 4 comprised mostly of a combination of *Eucalyptus campaspe/ E. salmonophloia* woodland quadrats and *Eucalyptus salmonophloia/ E. transcontinentalis/ E. clelandiorum* woodland quadrats while floristic group 5 comprised mostly of a combination of *Eucalyptus campaspe/ E. salmonophloia* woodland quadrats and *Eucalyptus clelandiorum/Eucalyptus torquata* woodland quadrats. Floristic group 4 was mostly characterised by species group C and K with an average species richness of nine taxa per quadrat (ranged from five to fourteen taxa per quadrat). Floristic group 5 was mostly

characterised by species group C and J with an average species richness of eight taxa per quadrat (ranged from four to eleven taxa per quadrat).

Floristic group 6 included quadrats from three vegetation types; *Eucalyptus clelandiorum/Eucalyptus torquata* woodland quadrat, other shrubland and Acacia shrubland quadrats and was mostly characterised by species group C and H with an average species richness of eight taxa per quadrat (ranged from five to nine taxa per quadrat).

Floristic groups 7 and 8 of the second supergroup were found to be closely related to each other. Floristic group 7 included majority of the *Eucalyptus griffithsii* mallee woodland quadrats and one other shrubland quadrat. This group mostly characterised by species group C and G with an average species richness of twelve taxa per quadrat (ranged from eight to fifteen taxa per quadrat). Floristic group 8 comprised of the majority of the other shrubland and Acacia shrubland quadrats and was mostly characterised by species group C and L with an average species richness of twelve taxa per quadrat (ranged from seven to twenty-two taxa per quadrat).

Floristic group 9 included *Eucalyptus clelandiorum/Eucalyptus torquata* woodland quadrats and *Eucalyptus griffithsii* mallee woodland quadrats, including all three *Eucalyptus griffithsii* mallee woodland quadrats from the sand-loam plain landform. This floristic group was mostly characterised by species group C and D with an average species richness of eleven taxa per quadrat (ranged from nine to sixteen taxa per quadrat).

Floristic groups 10 and 11 were closely related to each other, with floristic group 10 comprising of two quadrats from the Casuarina woodland vegetation type. This floristic group was mostly characterised by species group A with an average species richness of six taxa per quadrat (ranged from four to eight taxa per quadrat). Floristic group 11 included the remaining Casuarina woodland and Acacia shrubland quadrats, which was mostly characterised by species group A and C with an average species richness of seven taxa per quadrat (ranged from four to twelve taxa per quadrat).

Floristic group 12 comprised entirely of Acacia woodland quadrats and was mostly characterised by species group B and C with an average species richness of six taxa per quadrat (ranged from five to six taxa per quadrat).

With the exception of the Acacia woodland vegetation type, based on the results of the PATN analysis, there was minimal heterogeneity in species composition with the majority of vegetation types intermixed into floristic groups despite differences in both dominant stratum taxa and landform.

4.2.3.1 Species Richness and accumulation estimates

The Chaos 2 richness estimator provided an estimated species richness of 148 species in 150 sample sites (quadrats). Species richness recorded for the 100 quadrats was 134 species (including annuals/ sterile taxa) which indicates survey intensity was adequate. A species accumulation curve was created to display the rate of species accumulation. The R^2 value (0.99) suggests that the data "fits" the species accumulation curve shown in Figure 4-6.

The rate of species accumulation for the first 12 quadrats ranged from eight to three species per quadrat. The rate of species accumulation between 13-22 quadrats was two species per quadrat. Species accumulation reduced to 1 species per quadrat as quadrat number increased beyond 22 quadrats. Beyond 75 quadrats, species accumulation reduced to <1 species per quadrat. Botanica has determined that according to this data a sufficient number of quadrats were established in the survey area to adequately assess the floristic composition of the area.

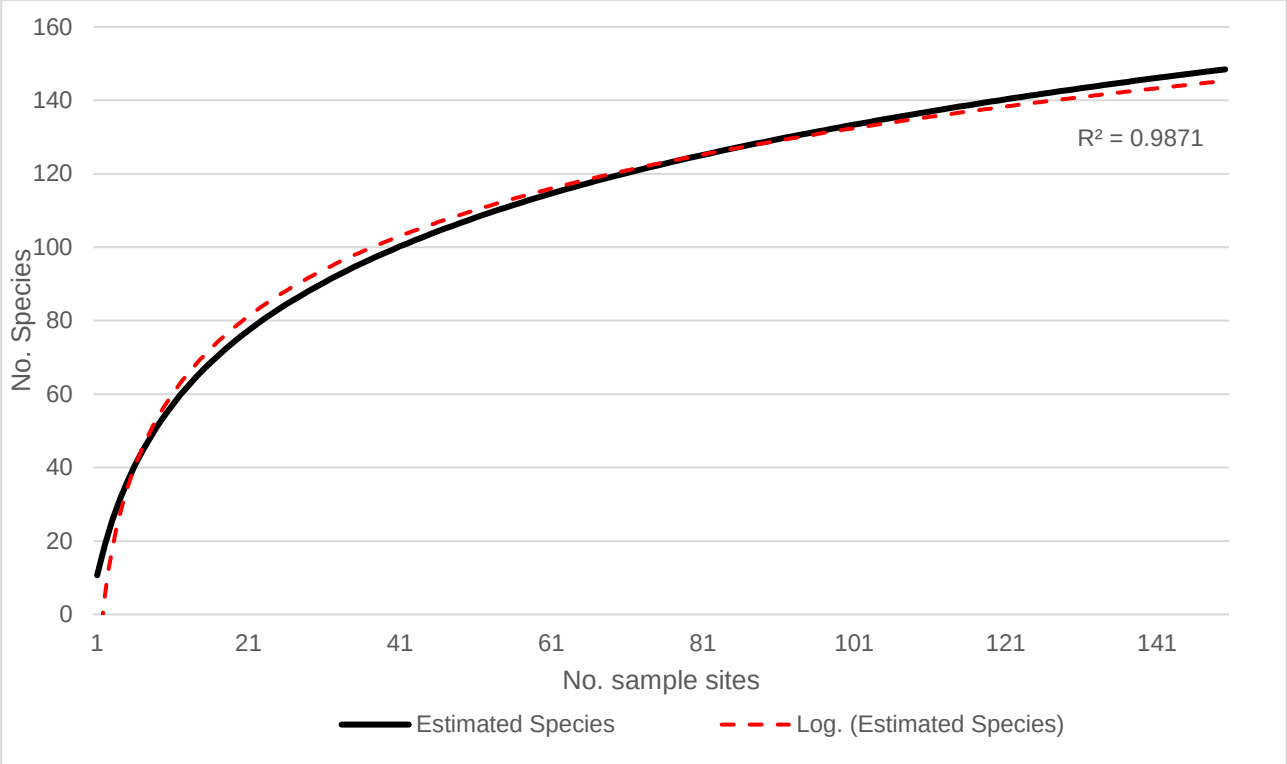


Figure 4-6: Species accumulation curve

4.2.4 Vegetation Condition

Based on the vegetation condition rating scale adapted from Keighery (1994) and Trudgen, (1988), native vegetation within the survey area ranged from 'good' to 'very good' (Table 4-10; Figure 4-7).

'Good' condition depicts vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

'Very Good' condition depicts vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Table 4-10: Vegetation Condition within the survey area

Condition Rating	Area (ha)	Area (%)
Cleared Vegetation	62	2.5
Good	171	6.8
Very Good	2,275	90.7
Total	**2,508**	**100.0**

Figure 4-7: Vegetation Condition within the survey area

4.2.5 Significant Vegetation

According to the EPA *Environmental Factor Guideline for Flora and Vegetation* (EPA, 2016b) significant vegetation includes:

- vegetation being identified as threatened or priority ecological communities;
- vegetation with restricted distribution;
- vegetation subject to a high degree of historical impact from threatening processes;
- vegetation which provides a role as a refuge; and
- vegetation providing an important function required to maintain ecological integrity of a significant ecosystem.

No Threatened or Priority Ecological Communities or otherwise significant vegetation were identified within the survey area.

4.2.6 Fauna Habitat

Based on vegetation and associated landforms identified during the flora and vegetation assessment, six broad scale terrestrial fauna habitats were identified as occurring within the survey area. Table 4-11 provides a visual representation of this habitat type, and the extent of fauna habitat is shown spatially in Figure 4-8.

Table 4-11: Terrestrial Fauna Habitats within the survey area

Fauna Habitat	Example Image
Eucalypt woodland on clay-loam plain/ open depression 1,156 ha (46.1%)	
Open mixed shrubland on clay-loam plain 108 ha (4.3%)	
Eucalypt woodland/ Mallee woodland on greenstone hillslope 1,038 ha (41.4%)	

Fauna Habitat	Example Image
Acacia/ Casuarina woodland on greenstone hillslope 25 ha (1.0%)	
Acacia shrubland on sandy-loam plain 94 ha (3.7%)	
Mallee woodland over spinifex grassland on sand-loam plain 25 ha (1.0%)	
Cleared Vegetation 62 ha (2.5%)	No image available

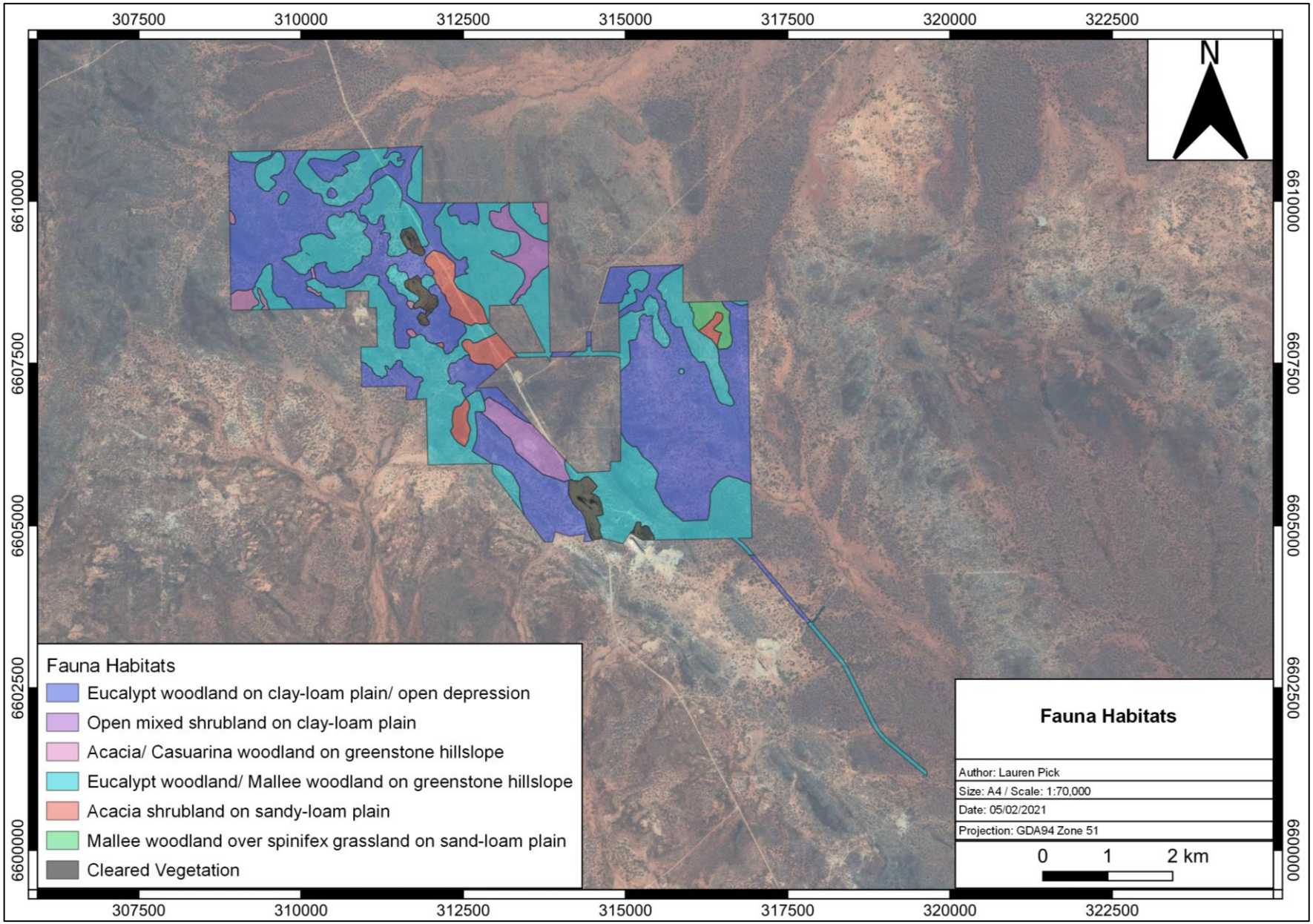


Figure 4-8: Terrestrial Fauna Habitats

4.2.7 Significant Fauna

According to the EPA *Environmental Factor Guideline for Terrestrial Fauna* (EPA, 2016d) significant fauna includes:

- Fauna being identified as a threatened or priority species;
- Fauna species with restricted distribution;
- Fauna subject to a high degree of historical impact from threatening processes; and
- Fauna providing an important function required to maintain the ecological integrity of a significant ecosystem.

No significant fauna were observed during the survey. The current status of some species on site and/or in the general area is difficult to determine, however, based on the habitats present and, in some cases, direct observations or recent nearby records, the following species of conservation significance can be regarded as possibly utilising the survey area for some purpose at times, these being:

- **Central Long-eared Bat (*Nyctophilus major tor*) – P4 (DBCA)**
  Listed as a potential species with potential roost sites present (e.g. tree hollows) however it is generally uncommon and significant impact unlikely.

- **Peregrine Falcon (*Falco peregrinus*) – OS (BC Act)**
  This species potentially utilises some sections of the survey area as part of a much larger home range, though records in this area are uncommon. It is considered unlikely to breed within the survey area. Significant impact unlikely.

- **Malleefowl (*Leipoa ocellata*) - Vulnerable (EPBC Act and BC Act)**
  This species is occasionally recorded in the Eastern Goldfields subregion. Two inactive (historical) malleefowl mounds were observed within the survey area (Table 4-12; Figure 4-9). It was estimated that these mounds were at least 20 years old and in fact maybe much older than this as they deteriorate slowly. No active malleefowl mounds or other evidence of malleefowl activity (tracks, feathers or bird observations etc.) were observed during the field survey. Available information therefore suggests that a breeding population of this species is unlikely to be present in the survey area, though transient non-breeding individuals may occasionally occur. Significant impact unlikely.

It should be noted that while habitats onsite for one or more of the species listed above are considered possibly suitable, some or all may be marginal in extent/quality and therefore the fauna species considered as possibly occurring may in fact only visit the area for short periods as infrequent vagrants.

Table 4-12: Inactive malleefowl mounds

Feature	Coordinates	Image
Inactive Mound (>20 years old)	51J 312741 6608288	
Inactive Mound (>20 years old)	51J 310657 6610116	

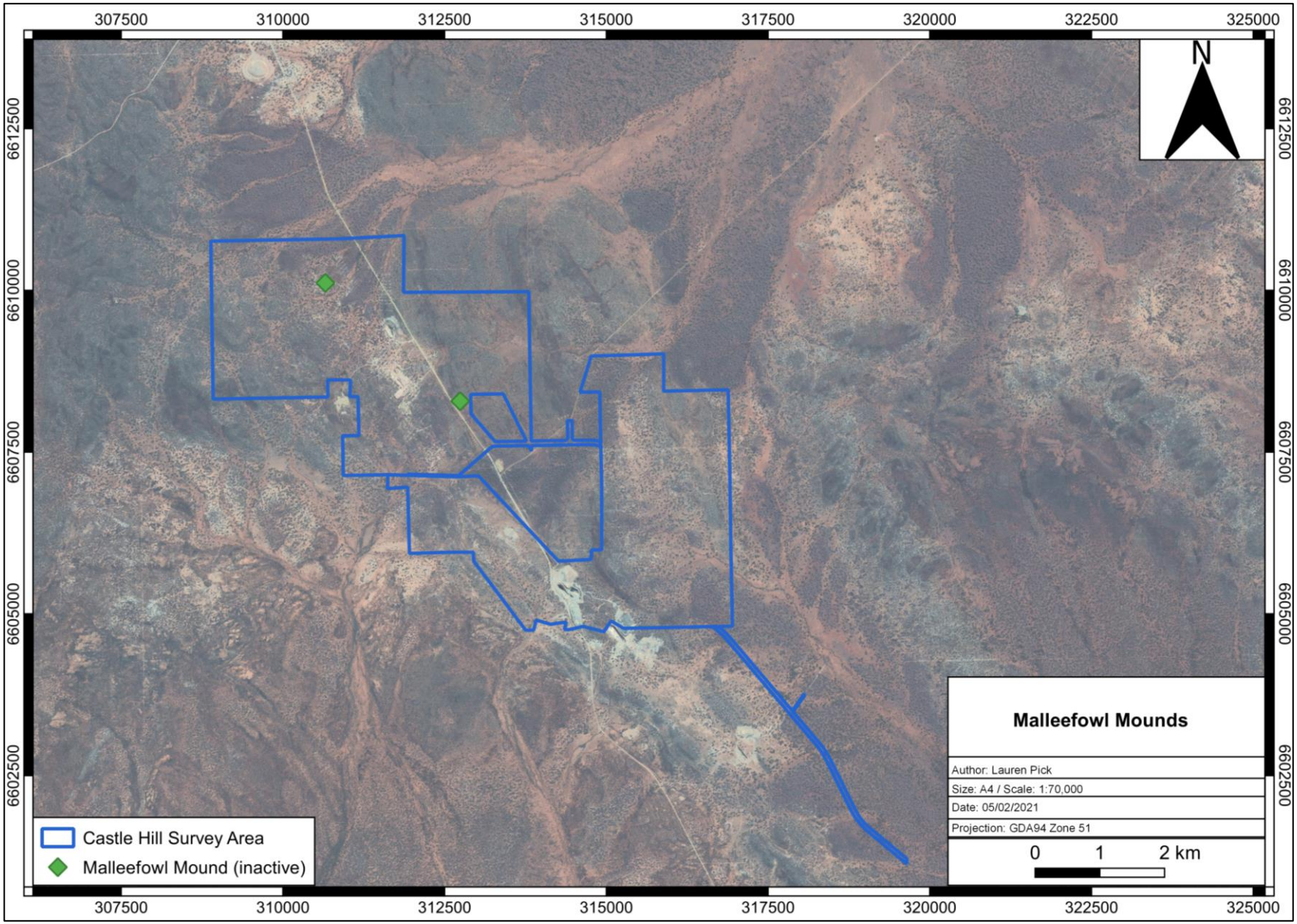


Figure 4-9: Inactive malleefowl mounds

4.3 Matters of National Environmental Significance

4.3.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act protects matters of national environmental significance, and is used by the Commonwealth DAWE to list threatened taxa and ecological communities into categories based on the criteria set out in the Act (www.environment.gov.au/epbc/index.html). The Act provides a national environmental assessment and approval system for proposed developments and enforces strict penalties for unauthorised actions that may affect matters of national environmental significance. Matters of national environmental significance as defined by the Commonwealth EPBC Act include:

- Nationally threatened flora species;
- World heritage properties;
- National heritage places;
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed);
- Nationally threatened ecological communities;
- Commonwealth marine area;
- The Great Barrier Reef Marine Park; and
- Nuclear actions (including uranium mining) a water resource, in relation to coal seam gas development and large coal mining development.

No matters of national environmental significance as defined by the Commonwealth EPBC Act were identified within the survey area.

4.4 Matters of State Environmental Significance

4.4.1 Environmental Protection Act WA 1986

The EP Act provides for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment. The Act is administered by The Department of Water and Environment Regulation (DWER), which is the State Government's environmental regulatory agency.

Under Section 51C of the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations (Regulations) WA 2004* any clearing of native vegetation in Western Australia that is not eligible for exemption under Schedule 6 of the *EP Act 1986* or under the Regulations 2004 requires a clearing permit from the DWER or DMIRS. Under Section 51A of the *EP Act 1986* native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native vegetation, but not vegetation planted in a plantation or planted with commercial intent. Section 51A of the *EP Act 1986* defines clearing as "the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage to some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above". Exemptions under Schedule 6 of the EP Act and the EP Regulations do not apply in ESAs as declared under Section 51B of the EP Act or TEC listed under State and Commonwealth legislation.

No evidence of the survey area containing any TEC or Threatened flora or fauna was found during the survey period. The survey area is not located within an ESA.

4.4.2 Biodiversity Conservation Act 2016

This Act is used by the Western Australian DBCA for the conservation and protection of biodiversity and biodiversity components in Western Australia and to promote the ecologically sustainable use of biodiversity components in the State. Taxa are classified as 'Threatened" when their populations are geographically restricted or are threatened by local processes (see following sections for Threatened definitions). Under this Act all native flora and fauna are protected throughout the State. Financial penalties are enforced under this Act if threatened species are collected without an appropriate licence.

Under Section 54(1) of the BC Act, habitat is eligible for listing as critical habitat if:

a) it is critical to the survival of a threatened species or a threatened ecological community; and
b) its listing is otherwise in accordance with the ministerial guidelines.

No threatened species or critical habitat listed under the BC Act were recorded within the survey area.

4.5 Native Vegetation Clearing Principles

Based on the outcomes from the survey undertaken, Botanica assessed the results of the desktop and field survey with regards to the native vegetation clearing principles listed under Schedule 5 of the EP Act (Table 4-13). The assessment found that the proposed vegetation clearing activities may be at variance with clearing principle (f).

Table 4-13: Assessment against native vegetation clearing principles

Letter	Principle	Assessment	Outcome
Native vegetation should not be cleared if it:			
(a)	comprises a high level of biological diversity.	Vegetation identified within the survey area is not considered to be of high biological diversity and is well represented outside of the survey area. The survey area does not occur within any mapped Priority Ecological Communities (PECs), Threatened Ecological Communities (TECs) or associated buffer zones and does not contain any Banded Ironstone Formations. No Threatened Flora taxa listed under the BC Act and EPBC Act are located within the survey area. No Priority Flora taxa were identified within the survey area.	Clearing is unlikely to be at variance to this principle
(b)	comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to WA.	No significant fauna were observed within the survey area. No significant fauna habitat was observed within the survey area.	Clearing is unlikely to be at variance to this principle
(c)	includes, or is necessary for the continued existence of rare flora.	No Threatened Flora taxa, pursuant to the BC Act and the EPBC Act were identified within the survey area.	Clearing is not at variance to this principle
(d)	comprises the whole or part of or is necessary for the maintenance of a	No TEC listed under the EPBC Act or by the BC Act occur within the survey area.	Clearing is not at variance to this principle

Letter	Principle	Assessment	Outcome
Native vegetation should not be cleared if it:			
	threatened ecological community (TEC).		
(e)	is significant as a remnant of native vegetation in an area that has been extensively cleared	All vegetation associations in the survey area retains >98% of their original pre-European vegetation extent.	Clearing is unlikely to be at variance to this principle
(f)	is growing, in, or in association with, an environment associated with a watercourse or wetland	Numerous ephemeral drainage lines were identified within the survey area. Of the twelve vegetation types identified, one was identified as growing in association with a watercourse; OD-EW1 which represents 3.9% of the total survey area.	Clearing may be at variance to this principle
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The survey area and surrounding region has not been extensively cleared. Clearing within the survey area is not considered likely to lead to land degradation issues such as salinity, water logging or acidic soils.	Clearing is unlikely to be at variance to this principle
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The survey area is not located within any conservation areas. The closest conservation area is the Rowles Lagoon Conservation Park, which is DBCA-managed land located approximately 25 km north-west of the survey area. Disturbances within the survey area are unlikely to impact this conservation reserve.	Clearing is unlikely to be at variance to this principle
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	No surface water bodies are located within the survey area. Clearing is unlikely to result in significant impacts to groundwater quality.	Clearing is unlikely to be at variance to this principle
(j)	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding	Rainfall in the Eastern Goldfield subregion has an average rainfall of 200-300mm and an evaporation rate of 2400 mm. Rainfall data for Kalgoorlie-Boulder indicates that rainfall is spread throughout the year and rainfall events are unlikely to result in localised flooding. Clearing within the survey area is not likely to increase the incidence or intensity of flooding within the survey area or surrounds.	Clearing is unlikely to be at variance to this principle

4.6 Conclusions

No Threatened Flora, Fauna or TEC's as listed under the Western Australian BC Act or Commonwealth EPBC Act were identified within the survey area. Two inactive (historical) malleefowl mounds were observed within the survey area which was estimated to be at least 20 years old. No active malleefowl mounds or other evidence of malleefowl activity (tracks, feathers or bird observations etc.) were observed during the field survey. Available information therefore suggests that a breeding population of this species is unlikely to be present in the survey area, though transient non-breeding individuals may occasionally occur.

No Priority Fauna or PEC's as listed by DBCA were identified within the survey area. One Priority 2 flora species (*Eremophila praecox)* was previously recorded within and adjacent to the survey area by Phoenix Environmental Services (2019a). An additional potential record of this taxon was recorded by Botanica within the survey area however due to absence of flowering material (despite the survey being conducted during the known flowering period for this taxon), this specimen could not be positively identified or formally lodged with the Western Australian Herbarium. Given this taxon has been previously recorded within/ adjacent to the survey area this record is tentatively considered as a Priority 2 flora record. No other significant flora, fauna or vegetation (as described by EPA) was identified within the survey area.

The survey area does not contain any world or national heritage places. There are no wetlands of international importance (Ramsar Wetlands), national importance (ANCA) Wetlands or conservation category wetlands within the survey area. The survey area does not contain any Environmentally Sensitive Areas (ESA) listed under the EP Act. The survey is not located within any proposed or gazetted Conservation Reserves.

The assessment found that the proposed vegetation clearing activities may be at variance with clearing principle (f); *native vegetation should not be cleared if it is growing, in, or in association with, an environment associated with a watercourse or wetland*. Numerous ephemeral drainage lines were identified within the survey area. Of the twelve vegetation types identified, one was identified as growing in association with a watercourse; OD-EW1 which represents 3.9% of the total survey area.

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Appendix 1: Conservation Ratings BC Act and EPBC Act

Definitions of Conservation Significant Species

Code	Category
State categories of threatened and priority species	
Threatened Species (T) Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the Biodiversity Conservation Act 2016 (BC Act).	
CR	**Critically Endangered** Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
EN	**Endangered** Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
VU	**Vulnerable** Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Extinct species Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.	
EX	**Extinct** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.
EW	**Extinct in the Wild** Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.	
IA	**International Agreement/ Migratory** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Code	Category
	Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
CD	**Species of special conservation interest** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
Priority species Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.	
P1	**Priority 1: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	**Priority 2: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	**Priority 3: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
Commonwealth categories of threatened species	
EX	**Extinct** Taxa where there is no reasonable doubt that the last member of the species has died.
EW	**Extinct in the Wild** Taxa where it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CR	**Critically Endangered** Taxa that are facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
EN	**Endangered**

Code	Category
	Taxa which are not critically endangered and is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
VU	**Vulnerable** Taxa which are not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which are the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Definitions of Conservation Significant Communities

Category Code	Category
State categories of Threatened Ecological Communities (TEC)	
PD	**Presumed Totally Destroyed**
	An ecological community will be listed as Presumed Totally Destroyed if there are no recent records of the community being extant and either of the following applies:
	• records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or;
	• all occurrences recorded within the last 50 years have since been destroyed.
CR	**Critically Endangered**
	An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one of the following criteria:
	The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification;
	The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area;
	The ecological community is highly modified with potential of being rehabilitated in the immediate future.
EN	**Endangered**
	An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. The ecological community must meet any one of the following criteria:
	The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short-term future, or is unlikely to be substantially rehabilitated in the short-term future due to modification;
	The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area;
	The ecological community is highly modified with potential of being rehabilitated in the short-term future.
VU	**Vulnerable**
	An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one of the following criteria:
	The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated;
	The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution;

Category Code	Category
	The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.
Commonwealth categories of Threatened Ecological Communities (TEC)	
CE	**Critically Endangered** If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
EN	**Endangered** If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
VU	**Vulnerable** If, at that time, an ecological community is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium–term future (indicative timeframe being the next 50 years).
Priority Ecological Communities (PEC)	
P1	**Poorly-known ecological communities**
	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist.
P2	**Poorly-known ecological communities**
	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, un-allocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.
P3	**Poorly known ecological communities**
	Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
	Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
	Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	**Ecological communities that are adequately known, rare but not threatened** or meet criteria for near threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.
P5	**Conservation Dependent ecological communities**
	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix 2: Potentially Occurring Introduced (Weed) Flora Species

Family	Species	Common Name	WAOL Status	Control Category	WONS
Fabaceae	*Acacia pycnantha*	Golden Wattle	Permitted - s11	No Control Category	No
Asparagaceae	*Agave americana*	Century Plant	Permitted - s11	No Control Category	No
Aizoaceae	*Aizoon pubescens*	-	Permitted - s11	No Control Category	No
Fabaceae	*Alhagi maurorum*	-	Permitted - s11	No Control Category	No
Amaranthaceae	*Amaranthus viridis*	Green Amaranth	Permitted - s11	No Control Category	No
Asteraceae	*Arctotheca calendula*	Cape Weed, African Marigold	Permitted - s11	No Control Category	No
Apocynaceae	*Asclepias curassavica*	Redhead Cottonbush	Permitted - s11	No Control Category	No
Brassicaceae	*Brassica tournefortii*	Mediterranean Turnip	Permitted - s11	No Control Category	No
Poaceae	*Bromus catharticus*	Prairie Grass	Permitted - s11	No Control Category	No
Poaceae	*Bromus rubens*	Red Brome	Permitted - s11	No Control Category	No
Boraginaceae	*Buglossoides arvensis*	Corn Gromwell	Permitted - s11	No Control Category	No
Brassicaceae	*Capsella bursa-pastoris*	Shepherd's Purse	Permitted - s11	No Control Category	No
Brassicaceae	*Carrichtera annua*	Ward's Weed	Permitted - s11	No Control Category	No
Asteraceae	*Carthamus lanatus*	Saffron Thistle	Permitted - s11	No Control Category	No
Poaceae	*Cenchrus ciliaris*	Buffel Grass	Permitted - s11	No Control Category	No
Asteraceae	*Centaurea melitensis*	Maltese Cockspur, Malta Thistle	Permitted - s11	No Control Category	No
Chenopodiaceae	*Chenopodium album*	Fat Hen	Permitted - s11	No Control Category	No
Chenopodiaceae	*Chenopodium murale*	Nettle-leaf Goosefoot	Permitted - s11	No Control Category	No
Asteraceae	*Cichorium intybus*	Chicory	Permitted - s11	No Control Category	No
Asteraceae	*Conyza bonariensis*	Flax-leaf Fleabane	Permitted - s11	No Control Category	No
Asteraceae	*Conyza sumatrensis*	-	Permitted - s11	No Control Category	No
Cactaceae	*Cylindropuntia tunicata*	-	Permitted - s11	No Control Category	No
Asteraceae	*Dittrichia graveolens*	Stinkwort	Permitted - s11	No Control Category	No
Boraginaceae	*Echium plantagineum*	Paterson's Curse	Declared Pest - s22(2)	No Control Category, Whole of State	No
Poaceae	*Ehrharta villosa*	Pyp Grass	Permitted - s11	No Control Category	No
Poaceae	*Eragrostis curvula*	African Lovegrass	Permitted - s11	No Control Category	No
Geraniaceae	*Erodium aureum*	-	Permitted - s11	No Control Category	No
Geraniaceae	*Erodium botrys*	Long Storksbill	Permitted - s11	No Control Category	No
Geraniaceae	*Erodium cicutarium*	Common Storksbill	Permitted - s11	No Control Category	No

Family	Species	Common Name	WAOL Status	Control Category	WONS
Fabaceae	*Erythrostemon gilliesii*	-	Permitted - s11	No Control Category	No
Verbenaceae	*Glandularia aristigera*	-	Permitted - s11	No Control Category	No
Asteraceae	*Helianthus annuus*	Sunflower, Common Sunflower	Permitted - s11	No Control Category	No
Boraginaceae	*Heliotropium europaeum*	Common Heliotrope	Permitted - s11	No Control Category	No
Poaceae	*Hordeum leporinum*	Barley Grass	Permitted - s11	No Control Category	No
Asteraceae	*Lactuca serriola forma serriola*	-	Permitted - s11	No Control Category	No
Plumbaginaceae	*Limonium sinuatum*	Perennial Sea Lavender	Permitted - s11	No Control Category	No
Primulaceae	*Lysimachia arvensis*	Pimpernel	Permitted - s11	No Control Category	No
Lythraceae	*Lythrum hyssopifolia*	Lesser Loosestrife	Permitted - s11	No Control Category	No
Malvaceae	*Malva parviflora*	Marshmallow	Permitted - s11	No Control Category	No
Lamiaceae	*Marrubium vulgare*	Horehound	Permitted - s11	No Control Category	No
Fabaceae	*Medicago laciniata*	Cut-leaf Medic	Permitted - s11	No Control Category	No
Fabaceae	*Medicago minima*	Small Burr Medic	Permitted - s11	No Control Category	No
Asteraceae	*Monoculus monstrosus*	-	Permitted - s11	No Control Category	No
Asteraceae	*Oligocarpus calendulaceus*	-	Permitted - s11	No Control Category	No
Asteraceae	*Oncosiphon suffruticosum*	Calomba Daisy	Permitted - s11	No Control Category	No
Cactaceae	*Opuntia elata*	-	Declared Pest - s22(2)	C3 Management, Whole of State	Yes
Oxalidaceae	*Oxalis bowiei*	Bowie Wood Sorrel	Permitted - s11	No Control Category	No
Oxalidaceae	*Oxalis pes-caprae*	Soursob	Permitted - s11	No Control Category	No
Papaveraceae	*Papaver hybridum*	Rough Poppy	Permitted - s11	No Control Category	No
Poaceae	*Phalaris paradoxa*	Paradoxa Grass	Permitted - s11	No Control Category	No
Verbenaceae	*Phyla canescens*	-	Permitted - s11	No Control Category	No
Polygonaceae	*Polygonum aviculare*	Wireweed	Permitted - s11	No Control Category	No
Poaceae	*Rostraria cristata*	-	Permitted - s11	No Control Category	No
Poaceae	*Rostraria pumila*	-	Permitted - s11	No Control Category	No
Polygonaceae	*Rumex hypogea*	-	Permitted - s11	No Control Category	No
Lamiaceae	*Salvia reflexa*	Mintweed	Permitted - s11	No Control Category	No
Lamiaceae	*Salvia verbenaca*	Wild Sage	Permitted - s11	No Control Category	No
Anacardiaceae	*Schinus molle var. areira*	-	Permitted - s11	No Control Category	No
Poaceae	*Schismus arabicus*	Araby Grass	Permitted - s11	No Control Category	No

Family	Species	Common Name	WAOL Status	Control Category	WONS
Poaceae	*Schismus barbatus*	Kelch Grass	Permitted - s11	No Control Category	No
Brassicaceae	*Sisymbrium irio*	London Rocket	Permitted - s11	No Control Category	No
Brassicaceae	*Sisymbrium orientale*	Indian Hedge Mustard	Permitted - s11	No Control Category	No
Solanaceae	*Solanum nigrum*	Black Berry Nightshade	Permitted - s11	No Control Category	No
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	Permitted - s11	No Control Category	No
Poaceae	*Sorghum halepense*	Johnson Grass	Permitted - s11	No Control Category	No
Caryophyllaceae	*Spergularia diandra*	Lesser Sand Spurry	Permitted - s11	No Control Category	No
Zygophyllaceae	*Tribulus terrestris*	Caltrop	Permitted - s11	No Control Category	No
Poaceae	*Urochloa panicoides*	-	Permitted - s11	No Control Category	No
Urticaceae	*Urtica urens*	Small Nettle	Permitted - s11	No Control Category	No
Fabaceae	*Vicia monantha* subsp. *triflora*	-	Permitted - s11	No Control Category	No
Asteraceae	*Xanthium spinosum*	-	Permitted - s11	No Control Category	No

Appendix 3: Significant Flora Likelihood Assessment

Species	Rank	Habitat	Comments	Likelihood
Gastrolobium graniticum	T (EN)	Sand, sandy loam, granite. Margins of rock outcrops, along drainage lines.	Outside known range of species.	Unlikely
Ricinocarpos brevis		Shallow sandy soils on rocky banded ironstone outcrops.	Outside known range of species.	Unlikely
Thelymitra stellata		Sand, gravel, lateritic loam.	Outside known range of species.	Unlikely
Acacia coatesii	P1	-	Outside known range of species.	Unlikely
Acacia epedunculata		Yellow sand. Sandplains.	Outside known range of species.	Unlikely
Acacia sclerophylla var. *teretiuscula*		Clay & loamy soils.	Outside known range of species.	Unlikely
Acacia websteri		Red sand, clay or loam. Low-lying areas, flats.	Outside known range of species.	Unlikely
Austrostipa sp. Carlingup Road (S. Kern & R. Jasper LCH 18459)		-	Outside known range of species.	Unlikely
Eucalyptus websteriana subsp. *norsemanica*		Rocky rises.	Outside known range of species.	Unlikely
Lepidosperma sp. Parker Range (N. Gibson & M. Lyons 2094)		-	Outside known range of species.	Unlikely
Melichrus sp. Coolgardie (K.R. Newbey 8698)		-	Outside known range of species.	Unlikely
Phebalium appressum		Yellow sandplain.	Extreme of known range, habitat unlikely to be present.	Unlikely
Philotheca pachyphylla		Sand, red loam, clay loam. Sandplains, hill tops.	Outside known range of species.	Unlikely
Ptilotus chortophytus		-	Outside known range of species.	Unlikely
Ptilotus procumbens		Red clay.	Outside known range of species.	Unlikely
Rhodanthe uniflora		Brown earth. Open eucalyptus woodland.	Within species range, habitat may be present.	Possible
Ricinocarpos digynus		Rocky hillslopes, breakaways.	Extreme of known range, habitat may be present.	Unlikely
Thryptomene planiflora		-	Outside known range of species.	Unlikely
Thryptomene sp. Coolgardie (E. Kelso s.n. 1902)		-	Outside known range of species.	Unlikely
Austrostipa sp. Dowerin (G. Wiehl F 8004)	P2	-	Outside known range of species.	Unlikely
Elachanthus pusillus		-	Sparse regional records.	Unlikely
Eremophila praecox		Red/brown sandy loam. Undulating plains.	Previously recorded within survey area by Phoenix Environmental Services (2019a)	Previously Recorded
Eucalyptus educta		Shallow soils. Granite rocks.	Within known range, habitat may be present.	Possible
Hakea rigida		Sandy soils, yellow sand.	Outside known range of species.	Unlikely
Lepidium merrallii		Clay loam.	Outside known range of species.	Unlikely

Species	Rank	Habitat	Comments	Likelihood
Rumex crystallinus		Arid & semi-arid areas.	Within species range, habitat may be present.	Possible
Acacia crenulata	P3	Clay, sandy clay, yellow sand. Rocky rises, granite outcrops, breakaways.	Outside known range of species.	Unlikely
Allocasuarina eriochlamys subsp. *grossa*		Stony loam, laterite clay. Granite outcrops.	Outside known range of species.	Unlikely
Alyxia tetanifolia		Sandy clay, loam, concretionary gravel. Drainage lines, near lakes.	Habitat unlikely to be present.	Unlikely
Angianthus prostratus		Red clay or loamy soils. Saline depressions.	Extreme of known range, habitat may be present.	Possible
Atriplex lindleyi subsp. *conduplicata*		Crabhole plains.	Habitat unlikely to be present.	Unlikely
Austrostipa blackii		-	Outside known range of species.	Unlikely
Chrysocephalum apiculatum subsp. *norsemanense*		-	Outside known range of species.	Unlikely
Cyathostemon verrucosus		Slopes of Red Hill, Kambalda	Outside known range of species.	Unlikely
Diocirea microphylla		Red-brown clay loam.	Outside known range of species.	Unlikely
Eremophila veronica		Stony clay, clay loam. Lateritic breakaways.	Outside known range of species.	Unlikely
Gompholobium cinereum		Yellow sand, clayey sand, brown loam, sandy gravel, laterite. Well-drained open sites, slopes, plains, roadsides.	Outside known range of species.	Unlikely
Grevillea georgeana		Stony loam/clay. Ironstone hilltops & slopes.	Outside known range of species.	Unlikely
Isolepis australiensis		Silty sand, sandy clay. Lake margins, pools.	Outside known range of species.	Unlikely
Lepidium fasciculatum		-	Sparse regional records.	Unlikely
Melaleuca coccinea		Sandy loam over granite. Granite outcrops, sandplain, river valleys.	Outside known range of species.	Unlikely
Notisia intonsa		Red sand, disturbed areas.	Within species range, habitat may be present.	Possible
Phlegmatospermum eremaeum		Stony loam.	Outside known range of species.	Unlikely
Rinzia triplex		-	Outside known range of species.	Unlikely
Styphelia saxicola		-	Outside known range of species.	Unlikely
Eremophila caerulea subsp. *merrallii*	P4	Sand, clay or loam. Undulating plains.	Outside known range of species.	Unlikely
Eucalyptus jutsonii subsp. *jutsonii*		Red to pale orange deep sands. Undulating areas and on dunes.	Outside known range of species.	Unlikely
Eucalyptus x brachyphylla		Sandy loam. Granite outcrops.	Outside known range of species.	Unlikely
Frankenia glomerata		White sand.	Outside known range of species.	Unlikely

Appendix 4: Significant Fauna Likelihood Assessment

Species	Conservation Status			Habitat Description	Assessment	Likelihood
	EPBC Act	BC Act	DBCA Priority			
Night Parrot *Pezoporus occidentalis*	EN	CR	-	Most habitat records are of Triodia (Spinifex) grasslands and/or chenopod shrublands in the arid and semi-arid zones, or *Astrebla* spp. (Mitchell grass), shrubby samphire and chenopod associations, scattered trees and shrubs, *Acacia aneura* (Mulga) woodland, treeless areas and bare gibber are associated with sightings of the species. Roosting and nesting sites are consistently reported as within clumps of dense vegetation, primarily old and large Spinifex (*Triodia*) clumps, but sometimes other vegetation types (DAWE, 2020b).	Would not occur. Very marginal habitat.	Would Not Occur
Carnaby's Cockatoo *Calyptorhynchus latirostris*	EN	EN	-	Carnaby's Cockatoo is endemic to, and widespread in, the south-west of Western Australia. It occurs from the wheatbelt, in areas that receive between 300 and 750 mm of rainfall annually, across to wetter regions in the extreme south-west, including the Swan Coastal Plain and the southern coast. Its range extends from Cape Arid in the south-east to Kalbarri in the north, and inland to Hatter Hill, Gibb Rock, Narembeen, Noongar, Wongan Hills, Nugadong, near Perenjori, Wilroy and Nabawa.	Would Not Occur. No documented records in the region.	Would Not Occur
Grey Falcon *Falco hypoleucos*	VU	VU	-	The Grey Falcon occurs at low densities across inland Australia. The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses. The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter. While breeding Grey Falcons feed almost exclusively on birds. Prey species include doves, pigeons, small parrots and cockatoos and finches, but a variety of other bird prey species has been recorded. Nonavian prey recorded by direct observation include small mammals and lizards.	Unlikely to occur. Outside of current documented distribution.	Unlikely
Malleefowl *Leipoa ocellata*	VU	VU	-	Scrublands and woodlands dominated by mallee and wattle species (DAWE, 2020b).	Possibly Occurs. Habitat likely marginal and unsuitable for breeding. Occasional transients only.	Possible
Fork-tailed Swift *Apus pacificus*	MI	MI	-	Low to very high airspace over varied habitat from rainforest to semi desert (Birdlife Australia, 2019).	Unlikely to occur. Very occasional transients only.	Unlikely
Migratory Shorebirds (Various species)	IA/MI	IA/MI	P3-P4	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland (DAWE, 2020b).	Habitat would not be present.	Would Not Occur
Grey Wagtail *Motacilla cinerea*	MI	MI	-	Running water in disused quarries, sandy, rocky streams in escarpments and rainforest, sewerage ponds, ploughed fields and airfields (Morecombe 2004).	Would Not Occur. No suitable habitat.	Would Not Occur

Species	Conservation Status			Habitat Description	Assessment	Likelihood
	EPBC Act	BC Act	DBCA Priority			
Peregrine Falcon *Falco peregrinus*	-	OS	-	The Peregrine Falcon is found in most habitats, from rainforests to the arid zone, and at most altitudes, from the coast to alpine areas. It requires abundant prey and secure nest sites, and prefers coastal and inland cliffs or open woodlands near water, and may even be found nesting on high city buildings (Birdlife Australia, 2018).	Possibly Occurs. Survey area may form part of larger home range but unlikely to breed in area	Possible
Freckled Duck *Stictonetta naevosa*	-	-	P4	Occurs in inland wetlands, lignum swamps, occasionally coastal wetlands. Breeding occurs from September to December, or after significant rains. The species is nomadic and often rare, but can have irruptive population booms when large numbers of birds form migratory groups.	Habitat would not be present.	Would Not Occur
Numbat *Myrmecobius fasciatus*	EN	EN	-	Previously widespread in arid and semi-arid Australia, the species is now restricted to two isolated wild populations in south-west Western Australia and a number of translocations to predator proof locations.	Would Not Occur. No documented records in the region.	Would Not Occur
Chuditch, Western Quoll *Dasyurus geoffroii*	VU	VU	-	Previously occurred throughout arid and semi-arid Australia but is now restricted to south-west Western Australia. (DAWE, 2020b).	Unlikely to Occur. Considered to be locally extinct.	Unlikely
Bilby *Macrotis lagotis*	VU	VU	-	In Western Australia, it is mainly restricted to the Gibson Desert, Little Sandy Desert, Great Sandy Desert and parts of the Pilbara and Southern Kimberley.	Would Not Occur. No documented records in the region.	Would Not Occur
Central long-eared bat *Nyctophilus major tor*	-	-	P3	*Nyctophilus major* occurs in the high rainfall southwest region of Western Australia. The trees of the upperstory of its habitat are the large to very tall eucalypt species, karri *Eucalyptus diversicolor*, jarrah *E. marginata*, tuart E. *gomphocephala*, and marri *Corymbia calophylla*. Other woodland types inhabited by the bat include stands of melaleuca, banksia and sheoak tees of genus *Allocasuarina*, and include a dense understory.	Possibly Occurs. Potential roost sites present (e.g. tree hollows).	Possible

Appendix 5: List of species identified within each vegetation type

(A) and blue text-Annual taxa; (W) and green text-Introduced taxa; (P) and red text-Priority Flora

Family	Taxon	CLP-EW1	CLP-EW2	CLP-OS1	CLP-OS2	OD-EW1	RH-AFW1	RH-CFW1	RH-EW1	RH-EW2	RH-MWS1	SLP-AS1	SLP-MWS1
Aizoaceae	*Disphyma crassifolium*	*	*			*							
Amaranthaceae	*Ptilotus aervoides (A)*		*	*		*						*	
	Ptilotus carlsonii (A)	*		*									
	Ptilotus exaltatus (A)	*	*	*	*	*			*			*	
	Ptilotus holosericeus (A)			*									
	Ptilotus obovatus var. *obovatus*	*	*	*	*	*	*	*	*	*	*	*	*
Apocynaceae	*Alyxia buxifolia*			*					*	*	*		
	Marsdenia australis	*		*			*		*		*	*	
Asphodelaceae	*Asphodelus fistulosus (W)*				*								
Asteraceae	*Brachyscome ciliocarpa (A)*	*		*									
	Centaurea melitensis (W)	*	*	*		*							
	Cephalipterum drummondii (A)		*	*		*							
	Cratystylis conocephala	*							*				
	Cratystylis subspinescens	*				*							
	Dittrichia graveolens (W)		*			*							
	Erymophyllum ramosum subsp. *ramosum (A)*	*											
	Olearia muelleri	*				*		*	*	*	*		*
	Olearia pimelioides											*	
	Rhodanthe floribunda (A)		*	*		*			*			*	
	Schoenia cassiniana (A)		*	*		*							
	Sonchus oleraceus (W)			*									
	Streptoglossa cylindriceps (A)	*										*	
	Streptoglossa decurrens (A)	*									*		
	Streptoglossa liatroides (A)	*	*	*		*							
	Vittadinia eremaea (A)										*		
	Waitzia acuminata (A)								*				*
Boraginaceae	*Halgania andromedifolia*											*	
Brassicaceae	*Carrichtera annua (W)*		*								*		
	Sisymbrium irio (W)										*		
Casuarinaceae	*Allocasuarina acutivalvis*							*					
	Allocasuarina helmsii											*	
	Casuarina pauper	*	*			*	*	*	*		*	*	
Chenopodiaceae	*Atriplex bunburyana*	*											
	Atriplex codonocarpa (A)	*	*			*							
	Atriplex nummularia subsp. spathulata subsp. *spatulata*	*	*	*	*	*			*	*	*	*	*
	Atriplex vesicaria	*	*	*	*	*			*	*	*	*	*
	Chenopodium curvispicatum										*		
	Enchylaena lanata		*	*		*							
	Enchylaena tomentosa	*	*	*		*			*		*		
	Eriochiton sclerolaenoides										*		
	Maireana carnosa	*			*						*		
	Maireana georgei	*	*	*		*			*	*		*	
	Maireana oppositifolia	*	*			*							
	Maireana pentatropis								*	*	*		

Family	Taxon	CLP-EW1	CLP-EW2	CLP-OS1	CLP-OS2	OD-EW1	RH-AFW1	RH-CFW1	RH-EW1	RH-EW2	RH-MWS1	SLP-AS1	SLP-MWS1
	Maireana pyramidata		*		*	*			*			*	
	Maireana sedifolia	*	*		*	*			*	*	*		
	Maireana thesioides								*				
	Maireana trichoptera	*	*	*		*			*		*		*
	Maireana triptera	*	*	*		*			*		*	*	
	Rhagodia drummondii	*		*									
	Rhagodia eremaea		*								*	*	
	Sclerolaena cuneata	*										*	
	Sclerolaena densiflora					*							
	Sclerolaena diacantha	*	*	*		*					*	*	
	Sclerolaena drummondii	*	*	*		*					*	*	
	Sclerolaena eurotioides			*									
	Sclerolaena parvifolia	*	*	*		*			*		*	*	
	Tecticornia disarticulata	*	*			*							
Cucurbitaceae	*Cucumis myriocarpus (W)*			*									
Euphorbiaceae	*Beyeria sulcata*										*		
Fabaceae	*Acacia acuminata*	*					*	*	*			*	*
	Acacia colletioides								*				
	Acacia erinacea	*				*			*	*	*		*
	Acacia hemiteles	*		*	*				*	*	*	*	*
	Acacia merrallii	*											*
	Acacia quadrimarginea						*						*
	Acacia ramulosa var. *ramulosa*											*	
	Acacia tetragonophylla	*						*	*		*	*	
	Dillwynia acerosa										*		*
	Senna artemisioides subsp. *filifolia*	*	*		*	*	*	*	*	*	*	*	*
	Senna artemisioides subsp. x *artemisioides*									*	*		*
	Senna cardiosperma				*				*				
	Templetonia egena										*		
	Templetonia sulcata	*											
Frankeniaceae	*Frankenia setosa*	*	*		*	*							
Geraniaceae	*Erodium crinitum*			*							*		
Goodeniaceae	*Goodenia havilandii (A)*			*									*
	Goodenia pinnatifida (A)		*			*						*	
	Goodenia xanthosperma (A)							*	*				
	Scaevola spinescens	*	*	*		*	*	*	*	*	*	*	*
Lamiaceae	*Prostanthera grylloana*							*					
	Salvia reflexa (W)												
	Salvia verbenaca (W)		*		*	*					*		
	Westringia rigida							*	*	*	*		*
Malvaceae	*Abutilon cryptopetalum*								*				
	Brachychiton gregorii	*					*						
	Sida calyxhymenia						*						*
Myrtaceae	*Eucalyptus campaspe*	*	*	*		*			*				
	Eucalyptus celastroides	*	*			*			*				
	Eucalyptus clelandiorum	*	*			*			*	*			
	Eucalyptus griffithsii			*					*		*	*	*
	Eucalyptus ravida	*	*			*							

Family	Taxon	CLP-EW1	CLP-EW2	CLP-OS1	CLP-OS2	OD-EW1	RH-AFW1	RH-CFW1	RH-EW1	RH-EW2	RH-MWS1	SLP-AS1	SLP-MWS1
	Eucalyptus salmonophloia	*	*			*			*		*		
	Eucalyptus torquata									*			
	Eucalyptus transcontinentalis	*	*			*			*				
	Eucalyptus websteriana						*						
	Eucalyptus yilgarnensis										*		
Pittosporaceae	*Pittosporum angustifolium*	*	*		*				*			*	
Poaceae	*Aristida contorta (A)*	*		*			*				*		
	Austrostipa elegantissima	*	*	*	*	*			*	*	*	*	
	Austrostipa eremophila			*									
	Austrostipa nitida	*		*			*	*	*	*	*	*	*
	Cenchrus ciliaris (W)										*		
	Enneapogon caerulescens		*			*					*		
	Eragrostis dielsii (A)			*									
	Eragrostis setifolia			*									
	Triodia irritans												*
Portulaceae	*Calandrinia polyandra (A)*	*											
Primulaceae	*Lysimachia arvensis (W)*			*									
Proteaceae	*Grevillea acuaria*			*				*		*	*		
	Grevillea huegelii							*			*		
	Grevillea nematophylla							*					
	Hakea kippistiana								*				
	Hakea sp. (sterile)											*	
Pteridaceae	*Cheilanthes sieberi (A)*						*						
Rhamnaceae	*Cryptandra aridicola*							*	*				
	Trymalium myrtillus							*					*
Rutaceae	*Philotheca brucei*							*					
Santalaceae	*Exocarpos aphyllus*	*				*			*	*	*	*	*
	Santalum acuminatum	*		*					*		*		
	Santalum spicatum	*					*		*		*	*	*
Sapindaceae	*Dodonaea adenophora*										*		
	Dodonaea lobulata	*			*	*	*	*	*	*	*	*	*
	Dodonaea stenozyga									*	*		
Scrophulariaceae	*Eremophila ?praecox (P2)*										*		
	Eremophila alternifolia	*	*		*				*		*	*	
	Eremophila clarkei			*			*	*	*				
	Eremophila decipiens					*							*
	Eremophila dempsteri	*	*	*								*	
	Eremophila georgei		*								*		
	Eremophila glabra	*	*			*			*	*	*	*	
	Eremophila interstans subsp. *interstans*	*	*			*			*	*	*		*
	Eremophila interstans subsp. *virgata*	*	*		*		*		*		*		
	Eremophila ionantha								*				
	Eremophila miniata										*		
	Eremophila oldfieldii subsp. *angustifolia*	*		*			*	*	*	*	*	*	*
	Eremophila parvifolia subsp. *auricampi*								*	*	*		*
	Eremophila pustulata	*				*			*		*		
	Eremophila scoparia	*	*	*	*	*	*		*		*	*	
Solanaceae	*Lycium australe*				*						*		

Family	Taxon	CLP-EW1	CLP-EW2	CLP-OS1	CLP-OS2	OD-EW1	RH-AFW1	RH-CFW1	RH-EW1	RH-EW2	RH-MWS1	SLP-AS1	SLP-MWS1
	Solanum hoplopetalum		*			*							
	Solanum lasiophyllum	*			*		*	*			*	*	
	Solanum nummularium	*			*				*		*	*	
Zygophyllaceae	*Roepera eremaea (A)*		*	*		*	*	*	*		*		
	Roepera sp. (sterile) (A)		*			*					*		

Appendix 6: Vegetation Condition Rating

Vegetation Condition Rating	South West and Interzone Botanical Provinces	Eremaean and Northern Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	N/A
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	N/A	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or ‘parkland cleared’ with their flora comprising weed or crop species with isolated native trees or shrubs.

Appendix 7: NatureMap Species List (40km buffer)

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 28/12/2020

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 121° 04' 03" E,30° 39' 26" S
Buffer 40km
Group By Family

Family	Species	Records
Acanthizidae	10	495
Acarosporaceae	2	6
Accipitridae	10	106
Actinopodidae	1	4
Aegothelidae	1	15
Aeshnidae	1	2
Agamidae	11	135
Aizoaceae	5	12
Amaranthaceae	14	89
Anacardiaceae	1	4
Anatidae	12	468
Anhingidae	1	2
Apiaceae	1	3
Apocynaceae	5	19
Araliaceae	1	1
Araneidae	8	21
Arcellidae	1	2
Arcyriaceae	1	2
Ardeidae	3	43
Artamidae	3	33
Asparagaceae	5	9
Asphodelaceae	1	2
Asteraceae	104	376
Baetidae	2	2
Barychelidae	1	1
Boidae	1	2
Boletaceae	1	1
Boraginaceae	9	34
Bothriuridae	1	1
Brachionidae	1	1
Branchipodidae	1	11
Brassicaceae	16	42
Bryaceae	1	1
Burramyidae	1	30
Buthidae	1	1
Cacatuidae	1	34
Cactaceae	2	3
Campanulaceae	2	4
Campephagidae	3	108
Caprimulgidae	1	7
Carphodactylidae	1	1
Caryophyllaceae	1	2
Casuariidae	1	29
Casuarinaceae	8	22
Celastraceae	2	3
Centropagidae	1	2
Centropyxidae	1	1
Ceratopogonidae	3	5
Charadriidae	6	71
Cheluidae	1	1
Chenopodiaceae	65	264
Chironomidae	5	8
Chydoridae	1	1
Cinclosomatidae	1	1
Cladoniaceae	2	4
Climacteridae	1	3
Collemataceae	1	1
Columbidae	4	197
Convolvulaceae	4	10
Corduliidae	1	2
Corixidae	3	6
Corvidae	3	273
Cracticidae	4	432
Crassulaceae	1	4
Cuculidae	4	19
Cupressaceae	2	15
Cyclopidae	3	6
Cyperaceae	5	6
Cyprididae	3	5
Cypridopsidae	1	1
Cyprinidae	1	1
Cyzicidae	1	4
Daphniidae	2	3
Dasyuridae	8	83
Desidae	2	2
Dicaeidae	1	16
Dicruridae	3	355

Dilleniaceae	2	2
Diplodactylidae	7	79
Droseraceae	1	1
Dytiscidae	9	12
Echinosteliaceae	1	3
Elaeocarpaceae	1	2
Elapidae	15	82
Elatinaceae	1	1
Ericaceae	6	7
Estrilidae	1	28
Euphorbiaceae	9	11
Fabaceae	99	389
Falconidae	5	87
Felidae	1	1
Frankeniaceae	9	19
Funariaceae	1	1
Gekkonidae	5	135
Geraniaceae	5	25
Gnaphosidae	1	1
Goodeniaceae	27	101
Graphidaceae	3	6
Grimmiaceae	1	1
Gyrostemonaceae	2	3
Haemodoraceae	1	1
Halcyonidae	2	12
Haliplidae	2	2
Haloragaceae	5	13
Hemerocallidaceae	1	1
Hersiliidae	1	1
Hexarthridae	1	1
Hirundinidae	4	171
Hydnaceae	1	1
Hydrachnidae	1	1
Hydrophilidae	2	4
Hylidae	1	1
Icmadophilaceae	1	1
Idiopidae	1	2
Juncaceae	2	2
Juncaginaceae	1	1
Lamiaceae	19	105
Lamponidae	2	5
Laridae	1	2
Lecideaceae	2	4
Leporidae	1	3
Leptoceridae	1	1
Lestidae	3	5
Libellulidae	3	3
Liceaceae	1	3
Limnadiidae	1	2
Limnodynastidae	4	42
Loganiaceae	2	2
Loranthaceae	6	9
Lycaenidae	3	23
Lycosidae	5	15
Lyncaeidae	1	1
Lynceidae	1	1
Lythraceae	2	2
Macropodidae	1	1
Macrotrichidae	2	2
Maluridae	3	115
Malvaceae	22	71
Marsileaceae	2	2
Megalosporaceae	3	5
Megapodiidae	1	39
Meliaceae	1	1
Meliphagidae	12	1014
Meropidae	1	28
Montiaceae	3	10
Motacillidae	1	2
Muridae	5	111
Myobatrachidae	1	38
Myrmecobiidae	1	1
Myrtaceae	88	465
Nemesiidae	2	3
Neosittidae	2	8
Nicodamidae	1	3
Notonectidae	2	3
Nyctaginaceae	1	1
Ophioglossaceae	1	1
Orchidaceae	9	12
Ostracoda	1	3
Otididae	1	4
Oxalidaceae	3	5
Oxyopidae	3	12
Pachycephalidae	5	313
Papaveraceae	1	1
Pardalotidae	3	223
Parmeliaceae	18	28
Peltulaceae	1	1
Petroicidae	6	109
Pezizaceae	1	1
Phalacrocoracidae	2	12
Phasianidae	2	2
Phelloriniaceae	1	1
Pholcidae	1	1
Physaraceae	1	1
Physciaceae	1	3
Pileolariaceae	1	2
Pittosporaceae	3	10
Plantaginaceae	2	11
Plumbaginaceae	1	1
Poaceae	52	138
Podargidae	1	3
Podicipedidae	2	128
Polygalaceae	2	4

Polygonaceae	6	10
Pomatostomidae	2	57
Portulacaceae	1	1
Pottiaceae	5	6
Primulaceae	1	1
Proteaceae	27	75
Psittacidae	9	74
Psoraceae	2	3
Pygopodidae	4	16
Rallidae	3	98
Ramalinaceae	1	1
Recurvirostridae	4	38
Restionaceae	2	2
Rhamnaceae	4	13
Rhizocarpaceae	1	1
Ricciaceae	1	1
Ruppiaceae	1	1
Rutaceae	9	34
Salticidae	4	15
Santalaceae	3	25
Sapindaceae	9	68
Scincidae	23	159
Scolopacidae	8	25
Scolopendridae	3	6
Scrophulariaceae	36	330
Sididae	1	2
Solanaceae	17	67
Sparassidae	2	14
Stemonitidaceae	2	3
Sternophoridae	1	1
Stratiomyidae	1	2
Stylidiaceae	3	8
Tachyglossidae	1	1
Teloschistaceae	2	4
Testudinellidae	1	1
Thamnocephalidae	3	4
Theraphosidae	1	3
Theridiidae	1	11
Threskiornithidae	2	24
Thylacomyidae	1	2
Thymelaeaceae	3	8
Trichiaceae	1	1
Trichocercidae	1	1
Triopsidae	1	2
Trochanteriidae	2	4
Turbellaria	1	1
Tytonidae	1	1
Urodacidae	3	3
Urticaceae	1	1
Varanidae	3	18
Verbenaceae	2	2
Verrucariaceae	6	10
Vespertilionidae	6	96
Violaceae	1	8
Zodariidae	1	1
Zosteropidae	1	22
Zygophyllaceae	6	13
TOTAL	**1229**	**9783**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acanthizidae					
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24264	*Acanthiza robustirostris (Slaty-backed Thornbill)*			
4.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
5.	25528	*Aphelocephala leucopsis (Southern Whiteface)*			
6.	24266	*Aphelocephala leucopsis subsp. castaneiventris (Southern Whiteface)*			
7.	25530	*Gerygone fusca (Western Gerygone)*			
8.	34001	*Hylacola cauta subsp. whitlocki (Shy Groundwren)*			
9.	24278	*Pyrrholaemus brunneus (Redthroat)*			
10.	30948	*Smicrornis brevirostris (Weebill)*			
Acarosporaceae					
11.	27574	*Acarospora citrina*			
12.	46014	*Myriospora smaragdula*			
Accipitridae					
13.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
14.	25536	*Accipiter fasciatus (Brown Goshawk)*			
15.	24285	*Aquila audax (Wedge-tailed Eagle)*			
16.	24288	*Circus approximans (Swamp Harrier)*			
17.	24289	*Circus assimilis (Spotted Harrier)*			
18.		*Elanus axillaris*			
19.	24290	*Elanus caeruleus subsp. axillaris (Australian Black-shouldered Kite)*			
20.	24295	*Haliastur sphenurus (Whistling Kite)*			
21.	47965	*Hieraaetus morphnoides (Little Eagle)*			
22.	25542	*Milvus migrans (Black Kite)*			
Actinopodidae					
23.		*Missulena occatoria*			
Aegothelidae					
24.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
Aeshnidae					
25.		*Anax papuensis*			
Agamidae					
26.	24871	*Ctenophorus cristatus (Bicycle Dragon)*			
27.	24873	*Ctenophorus fordi (Mallee Sand Dragon)*			
28.	24874	*Ctenophorus isolepis subsp. citrinus (Yellowy Military Dragon)*			
29.	24886	*Ctenophorus reticulatus (Western Netted Dragon)*			
30.	24888	*Ctenophorus salinarum (Salt Pan Dragon)*			
31.	24889	*Ctenophorus scutulatus (Lozenge-marked Dragon)*			
32.	30909	*Diporiphora amphiboluroides (Mulga Dragon)*			
33.	24904	*Moloch horridus (Thorny Devil)*			
34.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
35.	30814	*Tympanocryptis cephalus (Pebble Dragon)*			
36.	39408	*Tympanocryptis lineata (Lined Earless Dragon)*			
Aizoaceae					
37.	48513	*Aizoon pubescens*	Y		
38.	11681	*Disphyma crassifolium subsp. clavellatum*			
39.	2807	*Gunniopsis quadrifida (Sturts Pigface)*			
40.	2810	*Gunniopsis septifraga*			
41.	2822	*Tetragonia eremaea*			
Amaranthaceae					
42.	2648	*Alternanthera denticulata (Lesser Joyweed)*			
43.	2652	*Alternanthera nodiflora (Common Joyweed)*			
44.	2671	*Amaranthus viridis (Green Amaranth)*	Y		
45.	2690	*Ptilotus aervoides*			
46.	2707	*Ptilotus carlsonii*			
47.	38463	*Ptilotus chortophytus*		P1	
48.	48602	*Ptilotus eremita*			
49.	2721	*Ptilotus exaltatus (Tall Mulla Mulla)*			
50.	2727	*Ptilotus gaudichaudii*			
51.	2729	*Ptilotus grandiflorus*			
52.	2730	*Ptilotus helichrysoides*			
53.	2732	*Ptilotus holosericeus*			
54.	2747	*Ptilotus obovatus (Cotton Bush)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
55.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
Anacardiaceae					
56.	17056	*Schinus molle var. areira*	Y		
Anatidae					
57.	24312	*Anas gracilis (Grey Teal)*			
58.	24313	*Anas platyrhynchos (Mallard)*			
59.	24315	*Anas rhynchotis (Australasian Shoveler)*			
60.	24316	*Anas superciliosa (Pacific Black Duck)*			
61.	24318	*Aythya australis (Hardhead)*			
62.	24319	*Biziura lobata (Musk Duck)*			
63.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
64.	24322	*Cygnus atratus (Black Swan)*			
65.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
66.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
67.	24329	*Stictonetta naevosa (Freckled Duck)*			
68.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
Anhingidae					
69.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
Apiaceae					
70.	6218	*Daucus glochidiatus (Australian Carrot)*			
Apocynaceae					
71.	6565	*Alyxia buxifolia (Dysentery Bush)*			
72.	14636	*Alyxia tetanifolia*		P3	
73.	6580	*Asclepias curassavica (Redhead Cottonbush)*	Y		
74.	12949	*Marsdenia australis*			
75.	48986	*Vincetoxicum lineare*			
Araliaceae					
76.	6279	*Trachymene ornata (Spongefruit)*			
Araneidae					
77.		*Argiope protensa*			
78.		*Argiope trifasciata*			
79.		*Austracantha minax*			
80.		*Backobourkia heroine*			
81.		*Celaenia excavata*			
82.		*Cyrtophora parnasia*			
83.		*Eriophora biapicata*			
84.		*Nephila edulis*			
Arcellidae					
85.		*Arcella discoides*			
Arcyriaceae					
86.	38964	*Arcyria cinerea*			
Ardeidae					
87.	41324	*Ardea modesta (great egret, white egret)*			
88.	24341	*Ardea pacifica (White-necked Heron)*			
89.		*Egretta novaehollandiae*			
Artamidae					
90.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
91.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
92.	24356	*Artamus personatus (Masked Woodswallow)*			
Asparagaceae					
93.	1505	*Agave americana (Century Plant)*	Y		
94.	1215	*Chamaexeros fimbriata*			
95.	1216	*Chamaexeros macranthera*			
96.	1338	*Thysanotus manglesianus (Fringed Lily)*			
97.	1343	*Thysanotus patersonii*			
Asphodelaceae					
98.	1366	*Bulbine semibarbata (Leek Lily)*			
Asteraceae					
99.	7817	*Actinobole uliginosum (Flannel Cudweed)*			
100.	7834	*Angianthus prostratus*		P3	
101.	7836	*Angianthus tomentosus (Camel-grass)*			
102.	7838	*Arctotheca calendula (Cape Weed, African Marigold)*	Y		
103.	7846	*Asteridea athrixioides*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
104.	7871	*Brachyscome ciliaris*			
105.	7878	*Brachyscome iberidifolia*			
106.	7880	*Brachyscome lineariloba*			
107.	7882	*Brachyscome perpusilla*			
108.	7903	*Calotis hispidula (Bindy Eye)*			
109.	7905	*Calotis multicaulis (Many-stemmed Burr-daisy)*			
110.	7911	*Carthamus lanatus (Saffron Thistle)*	Y		
111.	7916	*Centaurea melitensis (Maltese Cockspur, Malta Thistle)*	Y		
112.	19759	*Centipeda crateriformis subsp. crateriformis*			
113.	7922	*Cephalipterum drummondii (Pompom Head)*			
114.	7924	*Ceratogyne obionoides (Wingwort)*			
115.	47074	*Chrysocephalum apiculatum subsp. norsemanense*		P3	
116.	13138	*Chrysocephalum puteale*			
117.	7933	*Chthonocephalus pseudevax (Woolly Groundheads)*			
118.	7935	*Cichorium intybus (Chicory)*	Y		
119.	7939	*Conyza bonariensis (Flaxleaf Fleabane)*	Y		
120.	20074	*Conyza sumatrensis*	Y		
121.	7943	*Cotula australis (Common Cotula)*			
122.	13353	*Craspedia haplorrhiza*			Y
123.	7949	*Cratystylis conocephala (Greybush)*			
124.	7950	*Cratystylis microphylla (Small-leaved Grey Bush)*			
125.	7961	*Dittrichia graveolens (Stinkwort)*	Y		
126.	7964	*Elachanthus pusillus (Elacanth)*		P2	
127.	12739	*Erymophyllum ramosum*			
128.	14377	*Erymophyllum ramosum subsp. ramosum*			
129.	12780	*Gilberta tenuifolia*			
130.	7988	*Gnephosis arachnoidea (Cobwebby-headed Gnephosis)*			
131.	7989	*Gnephosis brevifolia (Short-leaved Gnephosis)*			
132.	7998	*Gnephosis macrocephala*			
133.	8002	*Gnephosis tenuissima*			
134.	8008	*Helianthus annuus (Sunflower, Common Sunflower)*	Y		
135.	8045	*Helipterum craspedioides (Yellow Billy Buttons)*			
136.	15447	*Hyalosperma glutinosum subsp. glutinosum*			
137.	12756	*Hyalosperma zacchaeus*			
138.	8087	*Isoetopsis graminifolia (Cushion Grass)*			
139.	8094	*Kippistia suaedifolia*			
140.	29046	*Lactuca serriola forma serriola*	Y		
141.	13284	*Lawrencella rosea*			
142.	19237	*Leiocarpa websteri*			
143.	12628	*Lemooria burkittii*			
144.	8105	*Millotia myosotidifolia*			
145.	12631	*Millotia perpusilla*			
146.	8107	*Minuria cunninghamii (Bush Minuria)*			
147.	8108	*Minuria gardneri*			
148.	8110	*Minuria leptophylla (Minnie Daisy)*			
149.	29418	*Monoculus monstrosus*	Y		
150.	14186	*Myriocephalus pygmaeus*			
151.	48227	*Notisia intonsa*		P3	
152.	8134	*Olearia exiguifolia (Small-leaved Daisy Bush)*			
153.	8136	*Olearia homolepis*			
154.	19023	*Olearia incana*			
155.	8140	*Olearia muelleri (Goldfields Daisy)*			
156.	8145	*Olearia pimeleoides (Pimelea Daisybush, Burrobunga)*			
157.	8149	*Olearia rudis (Rough Daisybush)*			
158.	44401	*Olearia sp. Eremicola (Diels & Pritzel s.n. PERTH 00449628)*			
159.	8152	*Olearia subspicata (Spiked Daisy Bush)*			
160.	19828	*Oligocarpus calendulaceus*	Y		
161.	20661	*Oncosiphon suffruticosum (Calomba Daisy)*	Y		
162.	12642	*Ozothamnus cassiope*			
163.	45238	*Podolepis aristata subsp. affinis*			
164.	8173	*Podolepis capillaris (Wiry Podolepis)*			
165.	8180	*Podolepis rugata (Pleated Podolepis)*			
166.	8187	*Pogonolepis muelleriana*			
167.	8188	*Pogonolepis stricta*			
168.	8189	*Pseudognaphalium luteoalbum (Jersey Cudweed)*			
169.	13308	*Rhodanthe charsleyae*			
170.	13239	*Rhodanthe chlorocephala*			
171.	13241	*Rhodanthe chlorocephala subsp. rosea*			
172.	13242	*Rhodanthe chlorocephala subsp. splendida*			
173.	13301	*Rhodanthe floribunda*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
174.	13293	*Rhodanthe haigii*			
175.	13294	*Rhodanthe laevis*			
176.	13234	*Rhodanthe manglesii*			
177.	13249	*Rhodanthe oppositifolia subsp. oppositifolia*			
178.	13252	*Rhodanthe pygmaea*			
179.	13253	*Rhodanthe rubella*			
180.	13254	*Rhodanthe stricta*			
181.	13237	*Rhodanthe uniflora*		P1	
182.	8200	*Schoenia cassiniana (Schoenia)*			
183.	13287	*Schoenia filifolia subsp. filifolia*			
184.	20722	*Senecio dolichocephalus*			
185.	8207	*Senecio glossanthus (Slender Groundsel)*			
186.	25881	*Senecio lacustrinus*			
187.	8213	*Senecio magnificus (Showy Groundsel)*			
188.	20161	*Senecio pinnatifolius*			
189.	25883	*Senecio pinnatifolius var. pinnatifolius*			
190.	8217	*Senecio quadridentatus*			
191.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
192.	8238	*Streptoglossa liatroides*			
193.	12652	*Trichanthodium skirrophorum*			
194.	8253	*Triptilodiscus pygmaeus*			
195.	11387	*Vittadinia cervicularis var. cervicularis*			
196.	8265	*Vittadinia eremaea*			
197.	8273	*Vittadinia sulcata*			
198.	8275	*Waitzia acuminata (Orange Immortelle)*			
199.	13331	*Waitzia acuminata var. acuminata*			
200.	46093	*Waitzia fitzgibbonii*			
201.	13328	*Waitzia nitida*			
202.	8287	*Xanthium spinosum (Bathurst Burr, Common Cockleburr, Spiny Cockleburr, Spiny Clotburr)*	Y		
Baetidae					
203.		*Baetidae sp.*			
204.		*Cloeon sp.*			
Barychelidae					
205.		*Idiommata blackwalli*			
Boidae					
206.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
Boletaceae					
207.		*Boletus sp.*			
Boraginaceae					
208.	6675	*Buglossoides arvensis (Corn Gromwell)*	Y		
209.	6681	*Echium plantagineum (Paterson's Curse)*	Y		
210.	6684	*Halgania andromedifolia*			
211.	29840	*Halgania cyanea var. Allambi Stn (B.W. Strong 676)*			
212.	31117	*Halgania cyanea var. Charleville (R.W. Purdie +111)*			
213.	6691	*Halgania integerrima*			
214.	6707	*Heliotropium curassavicum (Smooth Heliotrope)*			
215.	6710	*Heliotropium europaeum (Common Heliotrope)*	Y		
216.	6723	*Omphalolappula concava (Burr Stickseed)*			
Bothriuridae					
217.		*Cercophonius michaelseni*			
Brachionidae					
218.		*Platyias quadricornis*			
Branchipodidae					
219.		*Parartemia sp.*			
Brassicaceae					
220.	31876	*Arabidella chrysodema*			
221.	2992	*Arabidella trisecta*			
222.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
223.	3004	*Capsella bursa-pastoris (Shepherd's Purse)*	Y		
224.	3008	*Carrichtera annua (Ward's Weed)*	Y		
225.	3026	*Lepidium fasciculatum (Bundled Peppercress)*		P3	
226.	3031	*Lepidium merrallii*		P2	
227.	3034	*Lepidium papillosum (Warty Peppercress)*			Y
228.	3037	*Lepidium phlebopetalum (Veined Peppercress)*			
229.	3050	*Menkea australis (Fairy Spectacles)*			

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230.	3053	*Menkea sphaerocarpa*			
231.	3059	*Phlegmatospermum eremaeum*		P3	
232.	3070	*Sisymbrium irio (London Rocket)*	Y		
233.	3072	*Sisymbrium orientale (Indian Hedge Mustard)*	Y		
234.	3076	*Stenopetalum filifolium*			
235.	3077	*Stenopetalum lineare (Narrow Thread Petal)*			
Bryaceae					
236.	32427	*Rosulabryum capillare*			
Burramyidae					
237.	24086	*Cercartetus concinnus (Western Pygmy-possum, Mundarda)*			
Buthidae					
238.		*Isometroides vescus*			
Cacatuidae					
239.		*Eolophus roseicapillus*			
Cactaceae					
240.	20281	*Cylindropuntia tunicata*	Y		Y
241.	31799	*Opuntia elata*	Y		
Campanulaceae					
242.	7397	*Isotoma petraea (Rock Isotome, Tundiwari)*			
243.	7386	*Wahlenbergia gracilenta (Annual Bluebell)*			
Campephagidae					
244.	24361	*Coracina maxima (Ground Cuckoo-shrike)*			
245.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
246.	24362	*Coracina novaehollandiae subsp. novaehollandiae (Black-faced Cuckoo-shrike)*			
Caprimulgidae					
247.	24368	*Eurostopodus argus (Spotted Nightjar)*			
Carphodactylidae					
248.	24971	*Nephrurus vertebralis*			
Caryophyllaceae					
249.	2914	*Spergularia diandra (Lesser Sand Spurry)*	Y		
Casuariidae					
250.	24470	*Dromaius novaehollandiae (Emu)*			
Casuarinaceae					
251.	13904	*Allocasuarina acutivalvis subsp. acutivalvis*			
252.	1721	*Allocasuarina campestris*			
253.	1722	*Allocasuarina corniculata*			
254.	13906	*Allocasuarina eriochlamys subsp. eriochlamys*			
255.	13897	*Allocasuarina eriochlamys subsp. grossa*		P3	
256.	1730	*Allocasuarina helmsii*			
257.	1742	*Casuarina obesa (Swamp Sheoak, Kuli)*			
258.	12658	*Casuarina pauper (Black Oak)*			
Celastraceae					
259.	4734	*Stackhousia muricata*			
260.	4737	*Tripterococcus brunonis (Winged Stackhousia)*			
Centropagidae					
261.		*Boeckella triarticulata*			
Centropyxidae					
262.		*Centropyxis aculeata*			
Ceratopogonidae					
263.		*Bezzia sp. 1 (SAP)*			
264.		*Bezzia sp. 2 (SAP)*			
265.		*Culicoides sp.*			
Charadriidae					
266.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
267.	24378	*Charadrius veredus (Oriental Plover)*		IA	
268.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
269.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
270.	48135	*Thinornis rubricollis (Hooded Plover, Hooded Dotterel)*		P4	
271.	24386	*Vanellus tricolor (Banded Lapwing)*			
Cheluidae					
272.	43380	*Chelodina colliei (South-western Snake-necked Turtle)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Chenopodiaceae					
273.	11435	*Atriplex acutibractea subsp. acutibractea*			
274.	11489	*Atriplex acutibractea subsp. karoniensis*			
275.	2453	*Atriplex codonocarpa (Flat-topped Saltbush)*			
276.	2455	*Atriplex eardleyae*			
277.	2459	*Atriplex holocarpa (Pop Saltbush)*			
278.	17520	*Atriplex lindleyi subsp. conduplicata*		P3	
279.	12042	*Atriplex lindleyi subsp. inflata*			
280.	2469	*Atriplex nummularia (Old Man Saltbush)*			
281.	11516	*Atriplex nummularia subsp. spathulata (Old Man Saltbush)*			
282.	2472	*Atriplex pumilio*			
283.	11791	*Atriplex quadrivalvata var. quadrivalvata*			
284.	2475	*Atriplex semibaccata (Berry Saltbush)*			
285.	2478	*Atriplex spongiosa (Pop Saltbush)*			
286.	2479	*Atriplex stipitata (Mallee Saltbush)*			
287.	2481	*Atriplex vesicaria (Bladder Saltbush)*			
288.	2483	*Chenopodium album (Fat Hen)*	Y		
289.	2487	*Chenopodium curvispicatum*			
290.	2494	*Chenopodium murale (Nettle-leaf Goosefoot)*	Y		
291.	2495	*Chenopodium nitrariaceum (Nitre Goosefoot)*			
292.	2499	*Dissocarpus paradoxus (Curious Saltbush)*			
293.	33501	*Dysphania cristata (Crested Goosefoot)*			
294.	33480	*Dysphania pumilio (Clammy Goosefoot)*			
295.	11704	*Einadia nutans subsp. eremaea (Climbing Saltbush)*			
296.	2510	*Enchylaena lanata*			
297.	2511	*Enchylaena tomentosa (Barrier Saltbush)*			
298.	12064	*Enchylaena tomentosa var. tomentosa (Barrier Saltbush)*			
299.	2514	*Eriochiton sclerolaenoides (Woolly Bindii)*			
300.	2533	*Maireana amoena*			
301.	2535	*Maireana appressa*			
302.	2536	*Maireana atkinsiana (Bronze Bluebush)*			
303.	2537	*Maireana brevifolia (Small Leaf Bluebush)*			
304.	2538	*Maireana carnosa (Cottony Bluebush)*			
305.	2542	*Maireana erioclada*			
306.	2543	*Maireana eriosphaera*			
307.	2544	*Maireana georgei (Satiny Bluebush)*			
308.	2545	*Maireana glomerifolia (Ball Leaf Bluebush)*			
309.	2550	*Maireana marginata*			
310.	2554	*Maireana pentagona (Hairy Bluebush)*			
311.	2555	*Maireana pentatropis*			
312.	2560	*Maireana pyramidata (Sago Bush)*			
313.	2561	*Maireana radiata*			
314.	2563	*Maireana sedifolia (Pearl Bluebush, Myall)*			
315.	2565	*Maireana suaedifolia*			
316.	2567	*Maireana tomentosa (Felty Bluebush)*			
317.	11662	*Maireana tomentosa subsp. tomentosa*			
318.	2568	*Maireana trichoptera (Downy Bluebush)*			
319.	2569	*Maireana triptera (Threewinged Bluebush)*			
320.	2570	*Maireana turbinata*			
321.	2572	*Malacocera tricornis (Soft Horns)*			
322.	2581	*Rhagodia drummondii*			
323.	30434	*Salsola australis*			
324.	2606	*Sclerolaena cuneata (Yellow Bindii)*			
325.	2609	*Sclerolaena diacantha (Grey Copperburr)*			
326.	2610	*Sclerolaena drummondii*			
327.	2615	*Sclerolaena fusiformis*			
328.	8877	*Sclerolaena gardneri*			
329.	2625	*Sclerolaena obliquicuspis (Limestone Bindii)*			
330.	2627	*Sclerolaena patenticuspis (Spear-fruit Saltbush)*			
331.	31719	*Tecticornia chartacea*			
332.	31492	*Tecticornia disarticulata*			
333.	46513	*Tecticornia doliiformis*			
334.	33319	*Tecticornia indica subsp. bidens*			
335.	33299	*Tecticornia pergranulata subsp. elongata*			
336.	33297	*Tecticornia pergranulata subsp. pergranulata (Blackseed Samphire)*			
337.	31717	*Tecticornia undulata*			
Chironomidae					
338.		*Chironomus aff. alternans (V24) (CB)*			
339.		*Chironomus tepperi*			

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340.		*Cryptochironomus griseidorsum*			
341.		*Polypedilum nubifer*			
342.		*Procladius paludicola*			
Chydoridae					
343.		*Maraura macracantha (formerly Alona macrocantha)*			
Cinclosomatidae					
344.	25580	*Cinclosoma castaneothorax (Chestnut-breasted Quail-thrush)*			
Cladoniaceae					
345.	48176	*Cladia beaugleholei*			
346.	48177	*Cladia muelleri*			
Climacteridae					
347.	25581	*Climacteris affinis (White-browed Treecreeper)*			
Collemataceae					
348.	27703	*Collema coccophorum*			
Columbidae					
349.	24399	*Columba livia (Domestic Pigeon)*	Y		
350.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
351.	24409	*Phaps chalcoptera (Common Bronzewing)*			
352.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
Convolvulaceae					
353.	6612	*Convolvulus clementii*			
354.	6614	*Convolvulus remotus*			
355.	6663	*Cuscuta epithymum (Lesser Dodder, Greater Dodder)*	Y		
356.	6621	*Ipomoea calobra (Weir Vine)*			
Corduliidae					
357.		*Hemicordulia tau*			
Corixidae					
358.		*Agraptocorixa parvipunctata*			
359.		*Micronecta gracilis*			
360.		*Micronecta robusta*			
Corvidae					
361.	24416	*Corvus bennetti (Little Crow)*			
362.	25592	*Corvus coronoides (Australian Raven)*			
363.	25593	*Corvus orru (Torresian Crow)*			
Cracticidae					
364.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
365.	25595	*Cracticus tibicen (Australian Magpie)*			
366.	25596	*Cracticus torquatus (Grey Butcherbird)*			
367.	25597	*Strepera versicolor (Grey Currawong)*			
Crassulaceae					
368.	11563	*Crassula colorata var. colorata*			
Cuculidae					
369.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
370.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
371.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
372.	24434	*Chrysococcyx osculans (Black-eared Cuckoo)*			
Cupressaceae					
373.	8466	*Callitris columellaris (White Cypress Pine)*			
374.	96	*Callitris preissii (Rottnest Island Pine, Maro)*			
Cyclopidae					
375.		*Australocyclops australis*			
376.		*Mesocyclops brooksi*			
377.		*Microcyclops varicans*			
Cyperaceae					
378.	765	*Chrysitrix distigmatosa*			
379.	903	*Gahnia deusta*			
380.		*Lepidosperma sp.*			
381.	954	*Mesomelaena preissii*			
382.	1015	*Schoenus subaphyllus*			
Cyprididae					
383.		*Bennelongia sp.*			
384.		*Cyprinotus cingalensis*			

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385.		*Ilyodromus sp.*			
Cypridopsidae					
386.		*Sarscypridopsis aculeata*			
Cyprinidae					
387.		*Carassius auratus*			
Cyzicidae					
388.		*Ozestheria packardi*			
Daphniidae					
389.		*Daphnia carinata*			
390.		*Daphnia cephalata*			
Dasyuridae					
391.	24087	*Antechinomys laniger (Kultarr)*			
392.	24094	*Ningaui ridei (Wongai Ningaui)*			
393.	24096	*Ningaui yvonneae (Southern Ningaui)*			
394.	24106	*Pseudantechinus woolleyae (Woolley's Pseudantechinus)*			
395.	24108	*Sminthopsis crassicaudata (Fat-tailed Dunnart)*			
396.	24109	*Sminthopsis dolichura (Little long-tailed Dunnart)*			
397.	24111	*Sminthopsis gilberti (Gilbert's Dunnart)*			
398.	24117	*Sminthopsis ooldea (Ooldea Dunnart)*			
Desidae					
399.		*Baiami tegenarioides*			
400.		*Corasoides australis*			
Dicaeidae					
401.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
Dicruridae					
402.	24443	*Grallina cyanoleuca (Magpie-lark)*			
403.	48096	*Rhipidura albiscapa (Grey Fantail)*			
404.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
Dilleniaceae					
405.	19692	*Hibbertia ancistrophylla*			
406.	5160	*Hibbertia pungens*			
Diplodactylidae					
407.	24929	*Diplodactylus granariensis subsp. granariensis*			
408.	24940	*Diplodactylus pulcher*			
409.	42408	*Hesperoedura reticulata*			
410.	30935	*Lucasium maini*			
411.	24982	*Rhynchoedura ornata (Western Beaked Gecko)*			
412.	24923	*Strophurus assimilis (Goldfields Spiny-tailed Gecko)*			
413.	24927	*Strophurus elderi*			
Droseraceae					
414.	49090	*Drosera sp. Branched styles (S.C. Coffey 193)*			
Dytiscidae					
415.		*Allodessus bistrigatus*			
416.		*Antiporus gilberti*			
417.		*Antiporus sp.*			
418.		*Hyphydrus elegans*			
419.		*Hyphydrus sp.*			
420.		*Megaporus howittii*			
421.		*Necterosoma sp.*			
422.		*Sternopriscus multimaculatus*			
423.		*Sternopriscus sp.*			
Echinosteliaceae					
424.	39027	*Echinostelium apitectum*			
Elaeocarpaceae					
425.	4530	*Tetratheca efoliata*			
Elapidae					
426.	25243	*Acanthophis pyrrhus (Desert Death Adder)*			
427.	42380	*Brachyurophis fasciolatus subsp. fasciolatus (Narrow-banded Shovel-nosed Snake)*			
428.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
429.	25247	*Demansia psammophis subsp. psammophis (Yellow-faced Whipsnake)*			
430.	25301	*Furina ornata (Moon Snake)*			
431.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
432.	25253	*Parasuta gouldii*			

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433.	25254	*Parasuta monachus*			
434.	25261	*Pseudechis australis (Mulga Snake)*			
435.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
436.	25263	*Pseudonaja modesta (Ringed Brown Snake)*			
437.	25264	*Pseudonaja nuchalis (Gwardar, Northern Brown Snake)*			
438.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
439.		*Simoselaps semifasciata*			Y
440.	25269	*Suta fasciata (Rosen's Snake)*			
Elatinaceae					
441.	5186	*Bergia trimera*			
Ericaceae					
442.	6336	*Astroloma serratifolium (Kondrung)*			
443.	6343	*Coleanthera myrtoides*			
444.	6401	*Leucopogon hamulosus*			
445.	16049	*Leucopogon sp. Clyde Hill (M.A. Burgman 1207)*			
446.	34736	*Lysinema pentapetalum*			
447.	41784	*Melichrus sp. Coolgardie (K.R. Newbey 8698)*		P1	
Estrilidae					
448.	30870	*Taeniopygia guttata (Zebra Finch)*			
Euphorbiaceae					
449.	34276	*Beyeria sulcata var. brevipes*			
450.	34257	*Beyeria sulcata var. sulcata*			
451.	42868	*Euphorbia philochalix*			
452.	42869	*Euphorbia porcata*			
453.	19587	*Monotaxis grandiflora var. obtusifolia*			
454.	4664	*Monotaxis luteiflora*			
455.	45075	*Ricinocarpos sp. Eastern Goldfields (A. Williams 3)*		P1	
456.	4701	*Ricinocarpos stylosus*			
457.	4704	*Ricinocarpos velutinus*			
Fabaceae					
458.	3200	*Acacia acuminata (Jam, Mangard)*			
459.	14584	*Acacia ancistrophylla var. ancistrophylla*			
460.	3216	*Acacia andrewsii*			
461.	3217	*Acacia aneura (Mulga, Wanari)*			
462.	3236	*Acacia beauverdiana (Pukkati)*			
463.	3248	*Acacia burkittii (Sandhill Wattle)*			
464.	3249	*Acacia calcarata*			
465.	3251	*Acacia camptoclada*			
466.	3256	*Acacia chrysella*			
467.	44469	*Acacia coatesii*		P1	
468.	44514	*Acacia collegialis*			
469.	3264	*Acacia colletioides (Wait-a-while)*			
470.	3269	*Acacia coolgardiensis (Spinifex Wattle)*			
471.	14623	*Acacia crenulata*		P3	
472.	15281	*Acacia desertorum var. desertorum*			
473.	3315	*Acacia duriuscula*			
474.	32118	*Acacia effusifolia*			
475.	3318	*Acacia enervia*			
476.	12257	*Acacia enervia subsp. explicata*			
477.	16020	*Acacia eremophila var. eremophila*			
478.	3324	*Acacia erinacea*			
479.	15282	*Acacia gibbosa*			
480.	3366	*Acacia hemiteles*			
481.	3378	*Acacia inaequiloba*			
482.	16164	*Acacia inceana subsp. inceana*			
483.	3393	*Acacia jennerae*			
484.	3394	*Acacia jensenii*			
485.	3395	*Acacia jibberdingensis*			
486.	14610	*Acacia kalgoorliensis*			
487.	3408	*Acacia lasiocalyx (Silver Wattle, Wilyurwur)*			
488.	3416	*Acacia leptopetala*			
489.	3419	*Acacia ligulata (Umbrella Bush, Watarka)*			
490.	3426	*Acacia longispinea*			
491.	13503	*Acacia masliniana*			
492.	3440	*Acacia merrallii*			
493.	36416	*Acacia mulganeura*			
494.	3451	*Acacia multispicata*			
495.	3452	*Acacia murrayana (Sandplain Wattle)*			

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496.	3463	*Acacia nyssophylla*			
497.	3478	*Acacia pachypoda*			
498.	3495	*Acacia prainii (Prain's Wattle)*			
499.	3504	*Acacia pycnantha (Golden Wattle)*	Y		
500.	19483	*Acacia ramulosa var. linophylla*			
501.	19499	*Acacia ramulosa var. ramulosa*			
502.	3512	*Acacia rendlei*			
503.	3513	*Acacia resinimarginea*			
504.	3514	*Acacia resinistipulea*			
505.	11765	*Acacia sclerophylla var. teretiuscula*		P1	
506.	13078	*Acacia sclerosperma subsp. sclerosperma*			
507.	3539	*Acacia sericocarpa*			
508.	3577	*Acacia tetragonophylla (Kurara, Wakalpuka)*			
509.	3600	*Acacia websteri*		P1	
510.	16157	*Acacia xerophila var. brevior*			
511.	15292	*Acacia yorkrakinensis subsp. acrita*			
512.	3682	*Alhagi maurorum*	Y		Y
513.	17417	*Cullen discolor*			
514.	17118	*Cullen leucanthum*			
515.	8977	*Daviesia aphylla*			
516.	3813	*Daviesia grahamii*			
517.	3823	*Daviesia nematophylla*			
518.	19854	*Dillwynia sp. Coolgardie (V.E. Sands 637.3.1)*			
519.	48860	*Erythrostemon gilliesii*	Y		
520.	11034	*Gastrolobium graniticum*		T	
521.	3943	*Glycyrrhiza acanthocarpa (Native Liquorice)*			
522.	29285	*Gompholobium cinereum*		P3	
523.	10777	*Gompholobium gompholobioides*			
524.	3963	*Hovea acanthoclada (Thorny Hovea)*			
525.	4043	*Kennedia prorepens*			
526.	4056	*Leptosema daviesioides*			
527.	4061	*Lotus cruentus (Redflower Lotus)*			
528.	4074	*Medicago laciniata (Cutleaf Medic)*	Y		
529.	4077	*Medicago minima (Small Burr Medic)*	Y		
530.	4089	*Mirbelia depressa*			
531.	4094	*Mirbelia microphylla*			
532.	4097	*Mirbelia ramulosa*			
533.	4099	*Mirbelia seorsifolia*			
534.	3674	*Petalostylis cassioides*			
535.	17645	*Senna artemisioides*			
536.	12276	*Senna artemisioides subsp. filifolia*			
537.	18430	*Senna cardiosperma*			
538.	18444	*Senna charlesiana*			
539.	16378	*Senna pleurocarpa*			
540.	12315	*Senna pleurocarpa var. angustifolia*			
541.	12314	*Senna pleurocarpa var. pleurocarpa*			
542.	14579	*Senna sp. Austin (A. Strid 20210)*			
543.	18446	*Senna stowardii*			
544.	12355	*Swainsona affinis*			
545.	4217	*Swainsona beasleyana*			
546.	4220	*Swainsona canescens (Grey Swainsona)*			
547.	4229	*Swainsona gracilis*			
548.	13590	*Swainsona halophila*			
549.	4230	*Swainsona incei*			
550.	4231	*Swainsona kingii*			
551.	4233	*Swainsona leeana*			
552.	13581	*Swainsona paradoxa*			
553.	12357	*Swainsona purpurea*			
554.	4243	*Swainsona rostellata*			
555.	4316	*Trigonella suavissima (Sweet Fenugreek)*			
556.	17261	*Vicia monantha subsp. triflora*	Y		
Falconidae					
557.	25621	*Falco berigora (Brown Falcon)*			
558.	24471	*Falco berigora subsp. berigora (Brown Falcon)*			
559.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
560.	25623	*Falco longipennis (Australian Hobby)*			
561.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
Felidae					
562.	24041	*Felis catus (Cat)*	Y		

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Frankeniaceae					
563.	5191	*Frankenia cinerea*			
564.	5197	*Frankenia desertorum*			
565.	5202	*Frankenia glomerata (Cluster Head Frankenia)*		P4	
566.	5204	*Frankenia interioris*			
567.	11592	*Frankenia interioris var. interioris*			
568.	5209	*Frankenia pauciflora (Seaheath)*			
569.	14297	*Frankenia pauciflora var. pauciflora*			
570.	5212	*Frankenia setosa (Bristly Frankenia)*			
571.	5213	*Frankenia tetrapetala (Four Petaled Frankenia)*			
Funariaceae					
572.		*Funaria sp.*			Y
Gekkonidae					
573.	24957	*Gehyra purpurascens*			
574.	24959	*Gehyra variegata*			
575.	25232	*Hemidactylus frenatus (Asian House Gecko)*	Y		
576.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
577.	24983	*Underwoodisaurus milii (Barking Gecko)*			
Geraniaceae					
578.	4331	*Erodium aureum*	Y		
579.	4332	*Erodium botrys (Long Storksbill)*	Y		
580.	4333	*Erodium cicutarium (Common Storksbill)*	Y		
581.	4334	*Erodium crinitum (Corkscrew)*			
582.	4335	*Erodium cygnorum (Blue Heronsbill)*			
Gnaphosidae					
583.		*Hemicloea sublimbata*			
Goodeniaceae					
584.	7413	*Brunonia australis (Native Cornflower)*			
585.	19069	*Brunonia sp. Goldfields (K.R. Newbey 6044)*			
586.	7419	*Coopernookia strophiolata*			
587.	7438	*Dampiera eriocephala (Woolly-headed Dampiera)*			
588.	13155	*Dampiera latealata*			
589.	7451	*Dampiera lavandulacea*			
590.	7456	*Dampiera luteiflora (Yellow Dampiera)*			
591.	7477	*Dampiera stenostachya (Narrow-spiked Dampiera)*			
592.	7480	*Dampiera tenuicaulis (Slender-stemmed Dampiera)*			
593.	13158	*Dampiera tenuicaulis var. curvula*			
594.	13159	*Dampiera tenuicaulis var. tenuicaulis*			
595.	7499	*Goodenia concinna (Elegant Goodenia)*			
596.	7504	*Goodenia dyeri*			
597.	7506	*Goodenia elderi*			
598.	7514	*Goodenia havilandii*			
599.	12523	*Goodenia helmsii*			
600.	7527	*Goodenia mimuloides*			
601.	7531	*Goodenia occidentalis*			
602.	7535	*Goodenia pinnatifida (Cutleaf Goodenia)*			
603.	7541	*Goodenia pusilliflora (Smallflower Goodenia)*			
604.	7565	*Goodenia xanthosperma (Yellow-seeded Goodenia)*			
605.	7569	*Lechenaultia brevifolia*			
606.	7644	*Scaevola spinescens (Currant Bush, Maroon)*			
607.	7656	*Velleia cycnopotamica*			
608.	7658	*Velleia discophora (Cabbage Poison)*			
609.	7664	*Velleia rosea (Pink Velleia)*			
610.	38061	*Verreauxia dyeri (Hairy Verreauxia)*			
Graphidaceae					
611.	32976	*Diploschistes elixii*			
612.	27720	*Diploschistes hensseniae*			
613.	27725	*Diploschistes thunbergianus*			
Grimmiaceae					
614.	32386	*Grimmia laevigata*			
Gyrostemonaceae					
615.	2780	*Gyrostemon brownii*			
616.	2783	*Gyrostemon racemiger*			
Haemodoraceae					
617.	1439	*Conostylis lepidospermoides (Sedge Conostylis)*		T	

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Halcyonidae					
618.	42351	*Todiramphus pyrrhopygius (Red-backed Kingfisher)*			
619.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
Haliplidae					
620.		*Haliplidae sp.*			
621.		*Haliplus sp.*			
Haloragaceae					
622.	33620	*Glischrocaryon angustifolium*			
623.	6143	*Glischrocaryon aureum (Common Popflower)*			
624.	11801	*Gonocarpus confertifolius var. helmsii*			
625.	20669	*Haloragis maierae*			
626.	6180	*Haloragis trigonocarpa*			
Hemerocallidaceae					
627.	11636	*Dianella revoluta var. divaricata*			
Hersiliidae					
628.		*Tamopsis circumvidens*			
Hexarthridae					
629.		*Hexarthra intermedia*			
Hirundinidae					
630.	47909	*Cheramoeca leucosterna (White-backed Swallow)*			
631.	24491	*Hirundo neoxena (Welcome Swallow)*			
632.	48060	*Petrochelidon ariel (Fairy Martin)*			
633.	48061	*Petrochelidon nigricans (Tree Martin)*			
Hydnaceae					
634.	38794	*Hydnum repandum*			
Hydrachnidae					
635.		*Hydrachna sp.*			
Hydrophilidae					
636.		*Berosus nutans*			
637.		*Enochrus elongatulus*			
Hylidae					
638.	25388	*Litoria moorei (Motorbike Frog)*			
Icmadophilaceae					
639.	28060	*Siphula coriacea*			
Idiopidae					
640.		*Anidiops villosus*			
Juncaceae					
641.	1176	*Juncus aridicola*			
642.	1195	*Juncus subsecundus (Finger Rush)*			
Juncaginaceae					
643.	33276	*Triglochin isingiana*			
Lamiaceae					
644.	19437	*Brachysola coerulea*			
645.	6747	*Cyanostegia angustifolia (Tinsel-flower)*			
646.	6751	*Cyanostegia microphylla (Tinsel Flower)*			
647.	41025	*Dasymalla terminalis (Native Foxglove)*			
648.	6771	*Dicrastylis parvifolia*			
649.	6776	*Hemiphora elderi (Red Velvet)*			
650.	6779	*Lachnostachys coolgardiensis*			
651.	6881	*Marrubium vulgare (Horehound)*	Y		
652.	17206	*Physopsis viscida*			
653.	6812	*Pityrodia lepidota*			
654.	15822	*Prostanthera althoferi subsp. althoferi*			
655.	6912	*Prostanthera campbellii*			
656.	6916	*Prostanthera grylloana*			
657.	6917	*Prostanthera incurvata*			
658.	6928	*Salvia reflexa (Mintweed)*	Y		
659.	6929	*Salvia verbenaca (Wild Sage)*	Y		
660.	6937	*Teucrium sessiliflorum (Camel Bush)*			
661.	6938	*Westringia cephalantha*			
662.	9247	*Westringia rigida (Stiff Westringia)*			

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Lamponidae					
663.		*Lampona cylindrata*			
664.		*Lamponina scutata*			
Laridae					
665.		*Chroicocephalus novaehollandiae*			
Lecideaceae					
666.	27825	*Lecidea ochroleuca*			
667.		*Lecidea sp.*			
Leporidae					
668.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
Leptoceridae					
669.		*Triplectides australis*			
Lestidae					
670.		*Austrolestes analis*			
671.		*Austrolestes annulosus*			
672.		*Austrolestes io*			
Libellulidae					
673.		*Diplacodes bipunctata*			
674.		*Orthetrum caledonicum*			
675.		*Pantala flavescens*			
Liceaceae					
676.	39041	*Licea kleistobolus*			
Limnadiidae					
677.		*Limnadopsis tatei*			
Limnodynastidae					
678.	25425	*Neobatrachus kunapalari (Kunapalari Frog)*			
679.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
680.	25427	*Neobatrachus sutor (Shoemaker Frog)*			
681.	25428	*Neobatrachus wilsmorei (Plonking Frog)*			
Loganiaceae					
682.	46313	*Orianthera flaviflora*			
683.	46253	*Orianthera tortuosa*			
Loranthaceae					
684.	2369	*Amyema benthamii*			
685.	11614	*Amyema gibberula var. gibberula*			
686.	13267	*Amyema linophylla subsp. linophylla*			
687.	2383	*Amyema preissii (Wireleaf Mistletoe)*			
688.	2396	*Lysiana casuarinae*			
689.	12051	*Lysiana exocarpi subsp. exocarpi (Harlequin Mistletoe)*			
Lycaenidae					
690.	33979	*Jalmenus aridus (inland hairstreak, desert blue butterfly)*		P1	Y
691.		*Jalmenus icilius*			Y
692.	33987	*Ogyris subterrestris subsp. petrina (Arid Bronze Azure Butterfly)*		T	
Lycosidae					
693.		*Hoggicosa castanea*			
694.		*Hoggicosa forresti*			
695.		*Hoggicosa storri*			
696.		*Lycosa ariadnae*			
697.		*Tasmanicosa leuckartii*			
Lyncaeidae					
698.		*Lynceus sp.*			
Lynceidae					
699.		*Lynceus macleayanus*			Y
Lythraceae					
700.	5281	*Lythrum hyssopifolia (Lesser Loosestrife)*	Y		
701.	17848	*Lythrum wilsonii*			
Macropodidae					
702.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
Macrotrichidae					
703.		*Macrothrix breviseta*			
704.		*Macrothrix sp.*			

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Maluridae					
705.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
706.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
707.	25654	*Malurus splendens (Splendid Fairy-wren)*			
Malvaceae					
708.	4889	*Abutilon cryptopetalum*			
709.	4902	*Abutilon oxycarpum (Flannel Weed)*			
710.	40903	*Androcalva aphrix*			
711.	40910	*Androcalva luteiflora (Yellow-flowered Rulingia)*			
712.	4999	*Brachychiton gregorii (Desert Kurrajong, Ngalta)*			
713.	40923	*Commersonia craurophylla (Brittle Leaved Rulingia)*			
714.	40927	*Commersonia magniflora subsp. oblongifolia*			
715.	17725	*Hannafordia bissillii subsp. latifolia*			
716.	4941	*Hibiscus solanifolius*			
717.	4954	*Lawrencia diffusa*			
718.	4955	*Lawrencia glomerata*			
719.	4957	*Lawrencia repens*			
720.	4959	*Lawrencia squamata*			
721.	4961	*Malva parviflora (Marshmallow)*	Y		
722.	41544	*Malva weinmanniana*			
723.	4964	*Radyera farragei (Knobby Hibiscus)*			
724.	46815	*Seringia cacaobrunnea (Chocolate fire-bush)*			
725.	46824	*Seringia velutina (Velvet firebush)*			
726.	4970	*Sida calyxhymenia (Tall Sida)*			
727.	4977	*Sida fibulifera (Silver Sida)*			
728.	4981	*Sida intricata (Tangled Sida)*			
729.	16924	*Sida spodochroma*			
Marsileaceae					
730.	76	*Marsilea hirsuta (Nardoo)*			
731.		*Marsilea sp.*			
Megalosporaceae					
732.	27587	*Aspicilia calcarea*			
733.	48911	*Aspicilia contorta*			
734.		*Aspicilia sp.*			
Megapodiidae					
735.	24557	*Leipoa ocellata (Malleefowl)*		T	
Meliaceae					
736.	4516	*Melia azedarach (White Cedar)*			
Meliphagidae					
737.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
738.	24561	*Anthochaera carunculata (Red Wattlebird)*			
739.	24564	*Certhionyx variegatus (Pied Honeyeater)*			
740.	24567	*Epthianura albifrons (White-fronted Chat)*			
741.	24570	*Epthianura tricolor (Crimson Chat)*			
742.	42314	*Gavicalis virescens (Singing Honeyeater)*			
743.	25659	*Lichenostomus leucotis (White-eared Honeyeater)*			
744.	24576	*Lichenostomus leucotis subsp. novaenorciae (White-eared Honeyeater)*			
745.	25661	*Lichmera indistincta (Brown Honeyeater)*			
746.	24583	*Manorina flavigula (Yellow-throated Miner)*			
747.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
748.	42344	*Purnella albifrons (White-fronted Honeyeater)*			
Meropidae					
749.	24598	*Merops ornatus (Rainbow Bee-eater)*			
Montiaceae					
750.	2853	*Calandrinia eremaea (Twining Purslane)*			
751.	2865	*Calandrinia pumila*			
752.	40824	*Calandrinia sculpta*			
Motacillidae					
753.	24599	*Anthus australis subsp. australis (Australian Pipit)*			
Muridae					
754.	24223	*Mus musculus (House Mouse)*	Y		
755.	24229	*Notomys mitchellii (Mitchell's Hopping-mouse)*			
756.	24230	*Pseudomys albocinereus (Ash-grey Mouse)*			
757.	24232	*Pseudomys bolami (Bolam's Mouse)*			
758.	24237	*Pseudomys hermannsburgensis (Sandy Inland Mouse)*			

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Myobatrachidae					
759.	25434	*Pseudophryne occidentalis (Western Toadlet)*			
Myrmecobiidae					
760.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
Myrtaceae					
761.	19467	*Aluta appressa*			
762.	19466	*Aluta aspera subsp. aspera*			
763.	5344	*Baeckea elderiana*			
764.	36038	*Baeckea sp. Koonadgin (B.L. Rye & M.E. Trudgen BLR 241137)*			
765.	5408	*Calothamnus gilesii*			
766.	5442	*Calytrix birdii*			
767.	13654	*Calytrix breviseta subsp. stipulosa*			
768.	44081	*Cyathostemon verrucosus*		P3	
769.	45244	*Ericomyrtus serpyllifolia*			
770.	19508	*Eucalyptus calycogona subsp. calycogona*			
771.	5581	*Eucalyptus campaspe (Silver Gimlet)*			
772.	14300	*Eucalyptus celastroides subsp. celastroides (Mirret)*			
773.	48436	*Eucalyptus clelandiorum*			
774.	5595	*Eucalyptus comitae-vallis (Comet Vale Mallee)*			
775.	5596	*Eucalyptus concinna (Victoria Desert Mallee)*			
776.	5607	*Eucalyptus corrugata (Rough-fruited Mallee)*			
777.	5612	*Eucalyptus cylindrocarpa (Woodline Mallee)*			
778.	34811	*Eucalyptus distuberosa subsp. distuberosa*			
779.	13549	*Eucalyptus ebbanoensis subsp. ebbanoensis*			
780.	18349	*Eucalyptus ebbanoensis subsp. glauciramula*			
781.	13097	*Eucalyptus educta*		P2	
782.	5636	*Eucalyptus eremicola*			
783.	5637	*Eucalyptus eremophila (Tall Sand Mallee)*			
784.	15667	*Eucalyptus eremophila subsp. eremophila (Sand Mallee)*			
785.	5641	*Eucalyptus ewartiana (Ewart's Mallee)*			
786.	12886	*Eucalyptus flavida (Yellow-flowered Mallee)*			
787.	5648	*Eucalyptus flocktoniae (Merrit, Merid)*			
788.	18521	*Eucalyptus flocktoniae subsp. flocktoniae*			
789.	14277	*Eucalyptus fraseri subsp. fraseri*			
790.	5665	*Eucalyptus griffithsii (Griffith's Grey Gum)*			
791.	5673	*Eucalyptus horistes*			
792.	31815	*Eucalyptus jutsonii subsp. jutsonii*		P4	
793.	13056	*Eucalyptus leptopoda subsp. subluta*			
794.	5697	*Eucalyptus lesouefii (Goldfields Blackbutt)*			
795.	5701	*Eucalyptus longicornis (Red Morrel, Moril)*			
796.	20802	*Eucalyptus longissima*			
797.	13037	*Eucalyptus loxophleba subsp. lissophloia*			
798.	19323	*Eucalyptus moderata*			
799.	5726	*Eucalyptus oleosa (Giant Mallee)*			
800.	20091	*Eucalyptus oleosa subsp. oleosa*			
801.	5745	*Eucalyptus pileata (Capped Mallee)*			
802.	18580	*Eucalyptus planipes*			
803.	5747	*Eucalyptus platycorys (Boorabbin Mallee)*			
804.	12380	*Eucalyptus ravida (Silver-topped Gimlet)*			
805.	5761	*Eucalyptus rigidula (Stiff-leaved Mallee)*			
806.	12693	*Eucalyptus salicola (Salt Gum)*			
807.	5766	*Eucalyptus salmonophloia (Salmon Gum, Wurak)*			
808.	5767	*Eucalyptus salubris (Gimlet)*			
809.	29701	*Eucalyptus sp. Mulga Rock (K.D. Hill & L.A.S. Johnson KH 2668)*			
810.	46828	*Eucalyptus sp. Southern smooth-bark (D. Nicolle & M. French DN 6916)*			
811.	13027	*Eucalyptus tenera*			
812.	5792	*Eucalyptus torquata (Coral Gum)*			
813.	5793	*Eucalyptus transcontinentalis (Redwood, Pungul)*			
814.	18293	*Eucalyptus urna*			
815.	18269	*Eucalyptus x brachyphylla*		P4	
816.	5802	*Eucalyptus yilgarnensis (Yorrell)*			
817.	16722	*Euryomyrtus maidenii*			
818.	5815	*Homalocalyx thryptomenoides*			
819.	48651	*Hysterobaeckea ochropetala subsp. reliqua*			
820.	5840	*Kunzea pulchella (Granite Kunzea, Silky Kunzea)*			
821.	5848	*Leptospermum fastigiatum*			
822.	12692	*Leptospermum subtenue*			
823.	5864	*Malleostemon peltiger*			
824.	5865	*Malleostemon roseus*			

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825.	5866	*Malleostemon tuberculatus*			
826.	19380	*Melaleuca calyptroides*			
827.	5896	*Melaleuca cordata*			
828.	5909	*Melaleuca elliptica (Granite Bottlebrush, Ngow)*			
829.	15603	*Melaleuca fulgens subsp. fulgens*			
830.	5916	*Melaleuca halmaturorum*			
831.	19486	*Melaleuca hamata*			
832.	5922	*Melaleuca lanceolata (Rottnest Teatree, Moonah)*			
833.	5925	*Melaleuca lateriflora (Gorada)*			
834.	14700	*Melaleuca macronychia subsp. macronychia*			
835.	15663	*Melaleuca pauperiflora subsp. fastigiata*			
836.	17144	*Melaleuca phoidophylla*			
837.	5966	*Melaleuca sheathiana (Boree, Buri)*			
838.	9187	*Micromyrtus erichsenii*			
839.	19787	*Micromyrtus monotaxis*			
840.	5999	*Micromyrtus obovata*			
841.	6018	*Rinzia carnosa (Fleshy-leaved Rinzia)*			
842.	6058	*Thryptomene kochii*			
843.	20680	*Thryptomene sp. Coolgardie (E. Kelso s.n. 1902)*		P1	Y
844.	36017	*Thryptomene sp. Londonderry (R.H. Kuchel 1763)*		P1	
845.	6068	*Thryptomene urceolaris*			
846.	6073	*Verticordia chrysantha*			
847.	6109	*Verticordia picta (Painted Featherflower)*			
848.	6113	*Verticordia pritzelii (Pritzel's Featherflower)*			
Nemesiidae					
849.		*Aname armigera*			
850.		*Aname mainae*			
Neosittidae					
851.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
852.	24606	*Daphoenositta chrysoptera subsp. pileata (Varied Sittella, Black-capped Sitella)*			
Nicodamidae					
853.		*Nicodamus mainae*			
Notonectidae					
854.		*Anisops hyperion*			
855.		*Anisops stali*			
Nyctaginaceae					
856.	2770	*Boerhavia coccinea (Tar Vine, Wituka)*			
Ophioglossaceae					
857.	18	*Ophioglossum polyphyllum*			
Orchidaceae					
858.	15502	*Caladenia footeana*			
859.	17760	*Caladenia nobilis*			
860.	1614	*Caladenia roei (Ant Orchid)*			
861.	30797	*Caladenia saxicola*			
862.	15400	*Cyanicula amplexans*			
863.	44161	*Diuris hazeliae*			
864.	18657	*Pterostylis sp. inland (A.C. Beauglehole 11880)*			
865.	1701	*Thelymitra antennifera (Vanilla Orchid)*			
866.	20732	*Thelymitra petrophila*			
Ostracoda					
867.		*Ostracoda (unident.)*			
Otididae					
868.	24610	*Ardeotis australis (Australian Bustard)*			
Oxalidaceae					
869.	33256	*Oxalis bowiei (Bowie Wood Sorrel)*	Y		
870.	4355	*Oxalis perennans*			
871.	4356	*Oxalis pes-caprae (Soursob)*	Y		
Oxyopidae					
872.		*Oxyopes amoenus*			
873.		*Oxyopes dingo*			
874.		*Oxyopes variabilis*			
Pachycephalidae					
875.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
876.	24618	*Oreoica gutturalis (Crested Bellbird)*			

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877.	34011	*Oreoica gutturalis subsp. gutturalis (Crested Bellbird (southern))*			
878.	24619	*Pachycephala inornata (Gilbert's Whistler)*			
879.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
Papaveraceae					
880.	2964	*Papaver hybridum (Rough Poppy)*	Y		
Pardalotidae					
881.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
882.	25682	*Pardalotus striatus (Striated Pardalote)*			
883.	24630	*Pardalotus striatus subsp. westraliensis (Striated Pardalote)*			
Parmeliaceae					
884.	28102	*Xanthoparmelia alternata*			
885.	28132	*Xanthoparmelia filarszkyana*			
886.	28137	*Xanthoparmelia glareosa*			
887.	28326	*Xanthoparmelia incantata*			
888.	28142	*Xanthoparmelia incerta*			
889.	28144	*Xanthoparmelia isidiigera*			
890.	28331	*Xanthoparmelia luteonotata*			
891.	28158	*Xanthoparmelia neorimalis*			
892.	29984	*Xanthoparmelia paratasmanica*			Y
893.	28166	*Xanthoparmelia pertinax*			
894.	28170	*Xanthoparmelia pustuliza*			
895.	28172	*Xanthoparmelia reptans*			
896.	28327	*Xanthoparmelia semiviridis*			
897.	29020	*Xanthoparmelia subbarbatica*		P1	
898.	28182	*Xanthoparmelia tasmanica*			
899.	28356	*Xanthoparmelia verrucella*			
900.	28186	*Xanthoparmelia versicolor*			
901.	28189	*Xanthoparmelia willisii*			
Peltulaceae					
902.	27940	*Peltula patellata*			
Petroicidae					
903.	24650	*Drymodes brunneopygia (Southern Scrub-robin)*			
904.	24651	*Eopsaltria australis subsp. griseogularis (Western Yellow Robin)*			
905.	47997	*Melanodryas cucullata (Hooded Robin)*			
906.	25693	*Microeca fascinans (Jacky Winter)*			
907.	24654	*Microeca fascinans subsp. assimilis (Jacky Winter)*			
908.	24659	*Petroica goodenovii (Red-capped Robin)*			
Pezizaceae					
909.		*Peziza sp.*			
Phalacrocoracidae					
910.		*Microcarbo melanoleucos*			
911.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
Phasianidae					
912.	24671	*Coturnix pectoralis (Stubble Quail)*			
913.	24674	*Pavo cristatus (Common Peafowl, Indian Peafowl)*	Y		
Phelloriniaceae					
914.		*Phellorinia herculeana*			
Pholcidae					
915.		*Trichocyclus balladong*			
Physaraceae					
916.	39068	*Physarum decipiens*			
Physciaceae					
917.	42104	*Buellia albula*			
Pileolariaceae					
918.		*Uromycladium tepperianum*			
Pittosporaceae					
919.	25798	*Billardiera fusiformis (Australian Bluebell)*			
920.	19421	*Marianthus bicolor (Painted Marianthus)*			
921.	19744	*Pittosporum angustifolium*			
Plantaginaceae					
922.	7300	*Plantago drummondii (Sago Weed)*			
923.	14198	*Plantago sp. Mt Magnet (A.S. George 6793)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Plumbaginaceae					
924.	6489	*Limonium sinuatum (Perennial Sea Lavender)*	Y		
Poaceae					
925.	12025	*Amphipogon caricinus var. caricinus*			
926.	207	*Aristida contorta (Bunched Kerosene Grass)*			
927.	12063	*Aristida holathera var. holathera*			
928.	17232	*Austrostipa blackii*		P3	
929.	17237	*Austrostipa elegantissima*			
930.	17238	*Austrostipa eremophila*			
931.	17241	*Austrostipa hemipogon*			
932.	17246	*Austrostipa nitida*			
933.	17247	*Austrostipa platychaeta*			
934.	17251	*Austrostipa scabra*			
935.	44509	*Austrostipa sp. Mt Burgess (A.A. Mitchell & P.J. Waddell 10499)*			Y
936.	17255	*Austrostipa trichophylla*			
937.	247	*Bromus arenarius (Sand Brome)*			
938.	248	*Bromus catharticus (Prairie Grass)*	Y		
939.	253	*Bromus rubens (Red Brome)*	Y		
940.	258	*Cenchrus ciliaris (Buffel Grass)*	Y		
941.	271	*Chloris truncata (Windmill Grass)*			
942.	290	*Dactyloctenium radulans (Button Grass)*			
943.	11964	*Dichanthium sericeum subsp. sericeum*			
944.	308	*Digitaria ammophila (Silky Umbrella Grass)*			
945.	310	*Digitaria brownii (Cotton Panic Grass)*			
946.	351	*Ehrharta villosa (Pyp Grass)*	Y		
947.	356	*Enneapogon avenaceus (Bottle Washers)*			
948.	357	*Enneapogon caerulescens (Limestone Grass)*			
949.	358	*Enneapogon cylindricus (Jointed Nineawn)*			
950.	368	*Enteropogon ramosus (Windmill Grass, Curly Windmill Grass)*			
951.	369	*Eragrostis australasica (Canegrass)*			
952.	376	*Eragrostis curvula (African Lovegrass)*	Y		
953.	378	*Eragrostis dielsii (Mallee Lovegrass)*			
954.	381	*Eragrostis falcata (Sickle Lovegrass)*			
955.	385	*Eragrostis lacunaria (Purple Lovegrass)*			
956.	393	*Eragrostis setifolia (Neverfail Grass)*			
957.	399	*Eragrostis xerophila (Knotty-butt Neverfail)*			
958.	417	*Eriachne pulchella (Pretty Wanderrie)*			
959.	449	*Hordeum leporinum (Barley Grass)*	Y		
960.	471	*Leptochloa digitata (Whorled Cane Grass)*			
961.	490	*Monachather paradoxus*			
962.	503	*Panicum decompositum (Native Millet, Kaltu-kaltu)*			
963.	519	*Paspalidium constrictum (Knottybutt Grass)*			
964.	524	*Paspalidium reflexum*			
965.	552	*Phalaris paradoxa (Paradoxa Grass)*	Y		
966.	10970	*Rostraria cristata*	Y		
967.	11151	*Rostraria pumila*	Y		
968.	40425	*Rytidosperma caespitosum*			
969.	40427	*Rytidosperma setaceum*			
970.	596	*Schismus arabicus (Araby Grass)*	Y		
971.	597	*Schismus barbatus (Kelch Grass)*	Y		
972.	606	*Setaria dielsii (Diels' Pigeon Grass)*			
973.	617	*Sorghum halepense (Johnson Grass)*	Y		
974.	699	*Triodia scariosa*			
975.	13041	*Triodia tomentosa*			
976.	18326	*Urochloa panicoides*	Y		
Podargidae					
977.	25703	*Podargus strigoides (Tawny Frogmouth)*			
Podicipedidae					
978.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
979.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
Polygalaceae					
980.	4553	*Comesperma drummondii (Drummond's Milkwort)*			
981.	4561	*Comesperma scoparium (Broom Milkwort)*			
Polygonaceae					
982.	44508	*Duma florulenta*			
983.	11052	*Persicaria prostrata*			
984.	2419	*Polygonum aviculare (Wireweed)*	Y		
985.	2425	*Polygonum plebeium (Small Knotweed)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
986.	2434	*Rumex crystallinus (Shiny Dock)*		P2	
987.	46434	*Rumex hypogaeus*	Y		
Pomatostomidae					
988.	24683	*Pomatostomus superciliosus (White-browed Babbler)*			
989.	34013	*Pomatostomus superciliosus subsp. ashbyi (White-browed Babbler (western wheatbelt))*			
Portulacaceae					
990.	2884	*Portulaca oleracea (Purslane, Wakati)*			
Pottiaceae					
991.	32319	*Barbula luteola*			
992.		*Didymodon sp.*			Y
993.	32408	*Phascopsis rubicunda*			
994.	48474	*Stonea oleaginosa*			
995.	32438	*Syntrichia pagorum*			
Primulaceae					
996.	36375	*Lysimachia arvensis (Pimpernel)*	Y		
Proteaceae					
997.	1815	*Banksia elderiana (Swordfish Banksia)*			
998.	15611	*Conospermum stoechadis subsp. stoechadis (Common Smokebush)*			
999.	1946	*Grevillea acacioides*			
1000.	1949	*Grevillea acuaria*			
1001.	1962	*Grevillea beardiana (Red Combs)*			
1002.	1971	*Grevillea cagiana (Red Toothbrushes)*			
1003.	13453	*Grevillea didymobotrya subsp. didymobotrya*			
1004.	8832	*Grevillea excelsior (Flame Grevillea)*			
1005.	2009	*Grevillea georgeana*		P3	
1006.	14413	*Grevillea haplantha subsp. haplantha*			
1007.	19314	*Grevillea hookeriana subsp. apiciloba*			
1008.	19541	*Grevillea nematophylla subsp. nematophylla*			
1009.	15978	*Grevillea oligomera*			
1010.	2056	*Grevillea paniculata*			
1011.	2077	*Grevillea pterosperma*			
1012.	12822	*Grevillea sarissa subsp. bicolor*			
1013.	13458	*Grevillea sarissa subsp. sarissa*			
1014.	2104	*Grevillea teretifolia (Round Leaf Grevillea)*			
1015.	2116	*Grevillea uncinulata (Hook-leaf Grevillea)*			
1016.	2163	*Hakea francisiana (Emu Tree)*			
1017.	2182	*Hakea minyma*			
1018.	2184	*Hakea multilineata (Grass Leaf Hakea)*			
1019.	2199	*Hakea recurva (Djarnokmurd)*			
1020.	16047	*Hakea rigida*		P2	
1021.	16812	*Isopogon scabriusculus subsp. pubifloris*			
1022.	2274	*Persoonia saundersiana*			
1023.	2308	*Petrophile seminuda*			
Psittacidae					
1024.		*Barnardius zonarius*			
1025.	25716	*Cacatua sanguinea (Little Corella)*			
1026.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
1027.	24736	*Melopsittacus undulatus (Budgerigar)*			
1028.	24742	*Nymphicus hollandicus (Cockatiel)*			
1029.	24748	*Platycercus varius (Mulga Parrot)*			
1030.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
1031.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
1032.	30854	*Polytelis anthopeplus subsp. westralis (Regent Parrot)*			
Psoraceae					
1033.	27999	*Psora crystallifera*			
1034.	28000	*Psora decipiens*			
Pygopodidae					
1035.	24995	*Delma australis*			
1036.	24997	*Delma butleri*			
1037.	25005	*Lialis burtonis*			
1038.	25009	*Pygopus nigriceps*			
Rallidae					
1039.	25727	*Fulica atra (Eurasian Coot)*			
1040.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1041.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
Ramalinaceae					
1042.	28073	*Toninia australis*			
Recurvirostridae					
1043.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
1044.	25734	*Himantopus himantopus (Black-winged Stilt)*			
1045.	24775	*Himantopus himantopus subsp. leucocephalus (Black-winged Stilt)*			
1046.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
Restionaceae					
1047.	1073	*Lepidobolus chaetocephalus (Bristle-headed Chaff Rush)*			
1048.	1074	*Lepidobolus deserti*			
Rhamnaceae					
1049.	16183	*Cryptandra aridicola*			
1050.	4809	*Cryptandra pungens*			
1051.	4815	*Pomaderris forrestiana*			
1052.	16986	*Trymalium myrtillus subsp. myrtillus*			
Rhizocarpaceae					
1053.	28042	*Rhizocarpon tinei*			
Ricciaceae					
1054.		*Riccia limbata*			
Ruppiaceae					
1055.	116	*Ruppia polycarpa*			
Rutaceae					
1056.	4409	*Boronia coerulescens*			
1057.	4445	*Boronia ternata*			
1058.	11201	*Boronia ternata var. ternata*			
1059.	16621	*Phebalium appressum*		P1	
1060.	4497	*Phebalium canaliculatum*			
1061.	14883	*Phebalium laevigatum*			
1062.	4504	*Phebalium tuberculosum*			
1063.	18537	*Philotheca brucei subsp. brucei*			
1064.	18506	*Philotheca tomentella*			
Salticidae					
1065.		*Afraflacilla stridulator*			
1066.		*Holoplatys kalgoorlie*			Y
1067.		*Holoplatys planissima*			
1068.		*Sandalodes scopifer*			
Santalaceae					
1069.	10977	*Exocarpos aphyllus (Leafless Ballart)*			
1070.	2356	*Santalum acuminatum (Quandong, Warnga)*			
1071.	2359	*Santalum spicatum (Sandalwood, Wilarak)*			
Sapindaceae					
1072.	11730	*Alectryon oleifolius subsp. canescens*			
1073.	4752	*Dodonaea adenophora*			
1074.	4753	*Dodonaea amblyophylla*			
1075.	4769	*Dodonaea lobulata (Bead Hopbush)*			
1076.	4770	*Dodonaea microzyga*			
1077.	12034	*Dodonaea microzyga var. acrolobata*			
1078.	4779	*Dodonaea rigida*			
1079.	4780	*Dodonaea stenozyga*			
1080.	11247	*Dodonaea viscosa subsp. angustissima*			
Scincidae					
1081.	30893	*Cryptoblepharus buchananii*			
1082.	25020	*Cryptoblepharus plagiocephalus*			
1083.	25026	*Ctenotus atlas*			
1084.	25052	*Ctenotus leonhardii*			
1085.	25074	*Ctenotus schomburgkii*			
1086.	25465	*Ctenotus uber (Spotted Ctenotus)*			
1087.	25080	*Ctenotus uber subsp. uber (Spotted Ctenotus)*			
1088.	25089	*Cyclodomorphus melanops subsp. elongatus (Slender Blue-tongue)*			
1089.	25092	*Egernia depressa (Southern Pygmy Spiny-tailed Skink)*			
1090.	25094	*Egernia formosa*			
1091.	25104	*Egernia richardi*			
1092.	25109	*Eremiascincus richardsonii (Broad-banded Sand Swimmer)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1093.	25115	*Hemiergis initialis subsp. initialis*			
1094.		*Lerista kingi*			
1095.	25162	*Lerista picturata*			
1096.	42411	*Lerista timida*			
1097.	41411	*Liopholis inornata (Desert Skink)*			
1098.	41417	*Liopholis striata (Night Skink)*			
1099.	25184	*Menetia greyii*			
1100.	25188	*Morethia adelaidensis*			
1101.	25190	*Morethia butleri*			
1102.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
1103.	25207	*Tiliqua rugosa subsp. rugosa*			
Scolopacidae					
1104.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
1105.	25736	*Arenaria interpres (Ruddy Turnstone)*		IA	
1106.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
1107.	24784	*Calidris ferruginea (Curlew Sandpiper)*		T	
1108.	24788	*Calidris ruficollis (Red-necked Stint)*		IA	
1109.	24803	*Tringa brevipes (Grey-tailed Tattler)*		P4	
1110.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
1111.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
Scolopendridae					
1112.		*Cormocephalus bungalbinensis*			
1113.		*Scolopendra laeta*			
1114.		*Scolopendra morsitans*			
Scrophulariaceae					
1115.	7180	*Eremophila alternifolia (Poverty Bush)*			
1116.	16377	*Eremophila caerulea subsp. caerulea*			
1117.	13641	*Eremophila caerulea subsp. merrallii*		P4	
1118.	13807	*Eremophila caperata*			
1119.	7189	*Eremophila clarkei (Turpentine Bush)*			
1120.	7193	*Eremophila decipiens (Slender Fuchsia)*			
1121.	14895	*Eremophila decipiens subsp. decipiens*			
1122.	7195	*Eremophila dempsteri*			
1123.	7198	*Eremophila deserti*			
1124.	7200	*Eremophila drummondii*			
1125.	7212	*Eremophila gibbosa*			
1126.	14340	*Eremophila glabra subsp. glabra*			
1127.	7219	*Eremophila granitica (Thin-leaved Poverty Bush)*			
1128.	15112	*Eremophila interstans subsp. interstans*			
1129.	15111	*Eremophila interstans subsp. virgata*			
1130.	7226	*Eremophila ionantha (Violet-flowered Eremophila)*			
1131.	7234	*Eremophila longifolia (Berrigan, Tulypurpa)*			
1132.	16363	*Eremophila maculata subsp. brevifolia (Native Fuchsia)*			
1133.	7242	*Eremophila miniata (Kopi Poverty Bush)*			
1134.	14632	*Eremophila oblonga*			
1135.	15003	*Eremophila oldfieldii subsp. angustifolia*			
1136.	17168	*Eremophila oldfieldii subsp. oldfieldii*			
1137.	18570	*Eremophila oppositifolia subsp. angustifolia*			
1138.	7250	*Eremophila pantonii*			
1139.	14594	*Eremophila parvifolia subsp. auricampa*			
1140.	14516	*Eremophila praecox*		P1	
1141.	7259	*Eremophila pustulata (Warted Eremophila)*			
1142.	7264	*Eremophila saligna (Willowy Eremophila)*			
1143.	7267	*Eremophila scoparia (Broom Bush ()*			
1144.	7269	*Eremophila serrulata (Serrate-leaved Eremophila)*			
1145.		*Eremophila sp.*			
1146.	19528	*Eremophila sp. Mt Jackson (G.J. Keighery 4372)*			
1147.	17162	*Eremophila subfloccosa subsp. lanata*			
1148.	7278	*Eremophila veronica*		P3	
1149.	7283	*Eremophila weldii*			
1150.	17158	*Myoporum montanum (Native Myrtle)*			
Sididae					
1151.		*Diaphanosoma unguiculatum*			
Solanaceae					
1152.	6955	*Crenidium spinescens*			
1153.	10823	*Datura inoxia*	Y		
1154.	6966	*Duboisia hopwoodii (Pituri, Kundugu)*			
1155.	6967	*Lycium australe (Australian Boxthorn)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1156.	6978	*Nicotiana rotundifolia (Round-leaved Tobacco)*			
1157.	6979	*Nicotiana simulans*			
1158.	6998	*Solanum cleistogamum*			
1159.	7007	*Solanum esuriale (Quena)*			
1160.	7013	*Solanum hoplopetalum (Thorny Solanum)*			
1161.	7018	*Solanum lasiophyllum (Flannel Bush, Mindjulu)*			
1162.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
1163.	7023	*Solanum nummularium (Money-leaved Solanum)*			
1164.	7026	*Solanum orbiculatum (Wild Tomato)*			
1165.	11241	*Solanum orbiculatum subsp. orbiculatum (Round-leaved Solanum)*			
1166.	7028	*Solanum petrophilum (Rock Nightshade)*			
1167.	7030	*Solanum plicatile*			
1168.	7038	*Solanum terraneum*			
Sparassidae					
1169.		*Isopeda magna*			
1170.		*Isopedella saundersi*			
Stemonitidaceae					
1171.	38987	*Comatricha ellae*			
1172.	39030	*Enerthenema papillatum*			
Sternophoridae					
1173.		*Afrosternophorus hirsti*			Y
Stratiomyidae					
1174.		*Stratiomyidae sp.*			
Stylidiaceae					
1175.	7685	*Stylidium arenicola*			
1176.	7714	*Stylidium dielsianum (Tangle Triggerplant)*			
1177.	7751	*Stylidium limbatum (Fringed-leaved Triggerplant)*			
Tachyglossidae					
1178.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
Teloschistaceae					
1179.	48195	*Caloplaca scarlatina*			
1180.		*Caloplaca sp.*			
Testudinellidae					
1181.		*Testudinella patina*			
Thamnocephalidae					
1182.	33934	*Branchinella denticulata (fairy shrimp (Carnarvon to Kalgoorlie))*		P3	
1183.		*Branchinella halsei*			
1184.		*Branchinella occidentalis*			
Theraphosidae					
1185.		*Selenotholus foelschei*			
Theridiidae					
1186.		*Latrodectus hasseltii*			
Threskiornithidae					
1187.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
1188.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
Thylacomyidae					
1189.	24168	*Macrotis lagotis (Bilby, Dalgyte, Ninu)*		T	
Thymelaeaceae					
1190.	5231	*Pimelea angustifolia (Narrow-leaved Pimelea)*			
1191.	11185	*Pimelea microcephala subsp. microcephala*			
1192.	11910	*Pimelea suaveolens subsp. flava*			
Trichiaceae					
1193.	39059	*Perichaena vermicularis*			
Trichocercidae					
1194.		*Trichocerca cf. rattus*			
Triopsidae					
1195.		*Triops australiensis australiensis*			
Trochanteriidae					
1196.		*Corimaethes campestrus*			
1197.		*Fissarena castanea*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Turbellaria					
1198.		*Turbellaria sp.*			
Tytonidae					
1199.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
Urodacidae					
1200.		*Urodacus armatus*			
1201.		*Urodacus hoplurus*			
1202.		*Urodacus yaschenkoi*			
Urticaceae					
1203.	1767	*Urtica urens (Small Nettle)*	Y		
Varanidae					
1204.	25211	*Varanus caudolineatus*			
1205.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
1206.	25526	*Varanus tristis (Racehorse Monitor)*			
Verbenaceae					
1207.	29836	*Glandularia aristigera*	Y		
1208.	13557	*Phyla canescens*	Y		
Verrucariaceae					
1209.	27736	*Endocarpon helmsianum*			
1210.	27737	*Endocarpon macrosporum*			
1211.	27741	*Endocarpon simplicatum*			
1212.		*Placidium lacinulatum*			
1213.	27984	*Placidium squamulosum*			
1214.		*Verrucaria sp.*			
Vespertilionidae					
1215.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
1216.	24187	*Chalinolobus morio (Chocolate Wattled Bat)*			
1217.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
1218.	24199	*Scotorepens balstoni (Inland Broad-nosed Bat)*			
1219.	24202	*Vespadelus baverstocki (Inland Forest Bat)*			
1220.	24206	*Vespadelus regulus (Southern Forest Bat)*			
Violaceae					
1221.	11973	*Hybanthus floribundus subsp. curvifolius*			
Zodariidae					
1222.		*Storena sinuosa*			
Zosteropidae					
1223.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			
Zygophyllaceae					
1224.	48887	*Roepera billardierei*			
1225.	48890	*Roepera eremaea*			
1226.	48892	*Roepera glauca (Pale Twinleaf, Pale Twin-leaf)*			
1227.	48898	*Roepera ovata*			
1228.	48903	*Roepera tetraptera*			
1229.	4383	*Tribulus terrestris (Caltrop)*	Y		

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix 8: EPBC Protected Matters Search (40km buffer)

Australian Government

Department of Agriculture, Water and the Environment

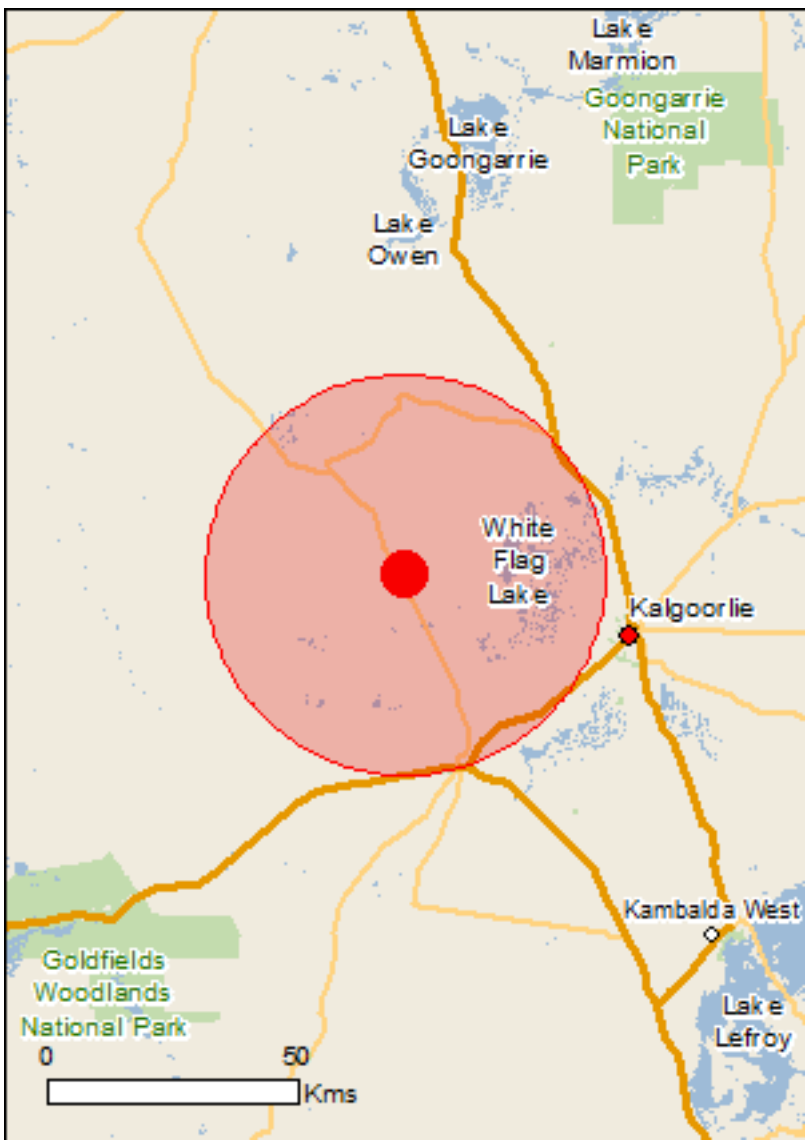
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

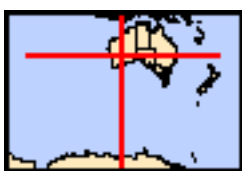
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 29/12/20 01:13:38



Coordinates

Buffer: 40.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	9
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	12
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	5
Regional Forest Agreements:	None
Invasive Species:	15
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Historic		
Goldfields Water Supply Scheme, Western Australia	WA	Listed place

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Insects		
Ogyris subterrestris petrina Arid Bronze Azure [77743]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
Plants		
Gastrolobium graniticum Granite Poison [14872]	Endangered	Species or species habitat likely to occur within area
Ricinocarpos brevis [82879]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Clear And Muddy Lakes	WA
Credo	WA
Kangaroo Hills Timber Reserve	WA
Kurrawang	WA
Rowles Lagoon	WA

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Carrichtera annua Ward's Weed [9511]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Rowles Lagoon System	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-30.65805 121.06526

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix 9: GPS coordinates of Quadrat locations (GDA94, Zone 51)

Quadrat	Zone	Easting	Northing
CH1	51J	313042	6607508
CH2	51J	312893	6607434
CH3	51J	312270	6607294
CH4	51J	311975	6608041
CH5	51J	312132	6607793
CH6	51J	311383	6608669
CH7	51J	311119	6608725
CH8	51J	310892	6608821
CH9	51J	310736	6608940
CH10	51J	310309	6608878
CH11	51J	310191	6608617
CH12	51J	309502	6608333
CH13	51J	308958	6608826
CH14	51J	309209	6608613
CH15	51J	310472	6610098
CH16	51J	312591	6608173
CH17	51J	312540	6607363
CH18	51J	312656	6607252
CH19	51J	311423	6608020
CH20	51J	311688	6607957
CH21	51J	311690	6608375
CH22	51J	309268	6608512
CH23	51J	310366	6609322
CH24	51J	311012	6609184
CH25	51J	311308	6609463
CH26	51J	310570	6610415
CH27	51J	313745	6609039
CH28	51J	313757	6609812
CH29	51J	313059	6609305
CH30	51J	313583	6608920
CH31	51J	312859	6609075
CH32	51J	311465	6612605
CH33	51J	312508	6608733
CH34	51J	313155	6608648
CH35	51J	313731	6608382
CH36	51J	313474	6609054
CH37	51J	313423	6609887
CH38	51J	311543	6610495
CH39	51J	311551	6610808
CH40	51J	311341	6611546
CH41	51J	311714	6612100
CH42	51J	311602	6612627
CH43	51J	311497	6612881
CH44	51J	311188	6613038
CH45	51J	311064	6612446
CH46	51J	310689	6612065

Quadrat	Zone	Easting	Northing
CH47	51J	310361	6612089
CH48	51J	309832	6612116
CH49	51J	309754	6612696
CH50	51J	310235	6610632
CH51	51J	309976	6610536
CH52	51J	309643	6610540
CH53	51J	309252	6610508
CH54	51J	308100	6610584
CH55	51J	308860	6609846
B1	51J	315003	6607564
B2	51J	315239	6607487
B3	51J	315214	6607339
B4	51J	315106	6607203
B5	51J	315095	6607017
B6	51J	314987	6607048
B7	51J	315208	6607062
B8	51J	315279	6607100
B9	51J	315522	6607112
B10	51J	316000	6607047
B11	51J	315798	6607530
B12	51J	315448	6607685
B13	51J	315956	6608042
B14	51J	316056	6608155
B15	51J	316098	6608062
B16	51J	316085	6608288
B17	51J	315979	6608318
B18	51J	315883	6608378
B19	51J	315720	6608438
B20	51J	315374	6608441
QE1	51J	315185	6608766
QE2	51J	316840	6604923
QE3	51J	316660	6605707
QE4	51J	316625	6606877
QE5	51J	316536	6606822
QE6	51J	316403	6607275
QE7	51J	316278	6608000
QE8	51J	316640	6608423
QE9	51J	316118	6606477
QE10	51J	316219	6605514
QE11	51J	315063	6605695
QE12	51J	315597	6606200
QW1	51J	311678	6607059
QW2	51J	312222	6606841
QW3	51J	312506	6606722
QW4	51J	312529	6606445
QW5	51J	312624	6606361
QW6	51J	313192	6606279

Quadrat	Zone	Easting	Northing
QW7	51J	313469	6606486
QW8	51J	312195	6606311
QW9	51J	313511	6605145
QW10	51J	313646	6605515
QW11	51J	313135	6605723
QW12	51J	313703	6605880
QW13	51J	313776	6606097

Appendix 10: Quadrat Datasheets

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 1	
Quadrat size: 20x20		
Photo number: 2-4		
Landform: Flat		
Land surface/disturbance: Plain/Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): moderately; many/ medium gravelly; medium pebbles/ subrounded **Rock outcrop (abundance/runoff):** no bedrock exposed/ moderately rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ soft		
%Cover leaf litter: 20		
%Cover bare ground: 30		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <1	**Crown cover %:** <1
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia acuminata	*Eremophila alternifolia*	*Olearia pimeleoides*

ALL SPECIES
Acacia acuminata
Austrostipa nitida
Eremophila alternifolia
Eremophila dempsteri
Goodenia pinnatifida
Olearia pimeleoides
Ptilotus aervoides (A)
Rhagodia eremaea
Rhodanthe floribunda (A)
Scaevola spinescens
Sclerolaena drummondii
Streptoglossa cylindriceps (A)

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 2	
Quadrat size: 20x20		
Photo number: 10-12		
Landform: Midslope		
Land surface/disturbance: Hillslope/ Limited clearing		
Coarse fragments on the surface (abundance/size/shape): extremely; very abundant/ medium gravelly; medium pebbles/ subrounded **Rock outcrop (abundance/runoff): n**o bedrock exposed/ moderately rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 15		
%Cover bare ground: 95		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <1	**Crown cover %:** <10	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe *Eucalyptus salmonophloia*	*Atriplex nummularia* subsp. *spathulata*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Austrostipa elegantissima		
Eucalyptus campaspe		
Eucalyptus salmonophloia		
Olearia muelleri		
Ptilotus exaltatus (A)		
Ptilotus obovatus		
Sclerolaena drummondii		
Sclerolaena parvifolia		
Senna artemisioides subsp. *filifolia*		

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 3	
Quadrat size: 20x20		
Photo number: 26-28		
Landform: Midslope		
Land surface/disturbance: Hillslope/Limited Clearing		
Coarse fragments on the surface (abundance/size/shape):moderately; many/ cobbly; cobble stones/ subrounded **Rock outcrop (abundance/runoff):** no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 50		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <10	**Crown cover %:** <1	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila pustulata*	*Atriplex vesicaria*

ALL SPECIES
Atriplex vesicaria
Eremophila pustulata
Eucalyptus clelandiorum
Maireana pentatropis
Ptilotus obovatus
Sclerolaena parvifolia
Roepera eremaea (A)

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 4	
Quadrat size: 20x20		
Photo number: 46-48		
Landform: Midslope		
Land surface/disturbance: Hillslope/Extensive Clearing		
Coarse fragments on the surface (abundance/size/shape): moderately; many/ coarse gravelly; large pebbles; subangular **Rock outcrop (abundance/runoff):** no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 50		
%Cover bare ground: 70		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <10	**Crown cover %:** 10-30	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Eremophila scoparia*	*Atriplex vesicaria*
ALL SPECIES		
Alyxia buxifolia		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Austrostipa nitida		
Enchylaena tomentosa		
Eremophila oldfieldii subsp. *angustifolia*		
Eremophila pustulata		
Eremophila scoparia		
Erymophyllum ramosum subsp. *ramosum* (A)		
Eucalyptus campaspe		
Olearia muelleri		
Ptilotus exaltatus (A)		
Sclerolaena drummondii		

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 5	
Quadrat size: 20x20		
Photo number: 49-51		
Landform: Lowerslope		
Land surface/disturbance: Hillslope/Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): slightly; few/ fine gravelly; small pebbles; subrounded **Rock outcrop (abundance/runoff):** no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 10		
%Cover bare ground: 15		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <1	**Crown cover %:** <10	**Crown cover %:** <1
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila dempsteri*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Austrostipa nitida		
Eremophila dempsteri		
Eucalyptus griffithsii		
Exocarpos aphyllus		
Ptilotus exaltatus (A)		
Sclerolaena diacantha		
Sclerolaena drummondii		
Sclerolaena parvifolia		

Project Name: Castle Hill	
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton
Location: Castle Hill	**Quadrat:** 6
Quadrat size: 20x20	
Photo number: 57-59	
Landform: Lowerslope	
Land surface/disturbance: Hillslope/Limited Clearing	
Coarse fragments on the surface (abundance/size/shape): moderately; many/ medium gravelly; medium pebbles; subrounded **Rock outcrop (abundance/runoff):** no bedrock exposed/ moderately rapid	
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm	
%Cover leaf litter: 40	
%Cover bare ground: 60	

Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <10	**Crown cover %:** 10-30	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Eremophila scoparia*	*Atriplex vesicaria*

ALL SPECIES
Acacia erinacea
Atriplex nummularia subsp. *spathulata*
Atriplex vesicaria
Eremophila dempsteri
Eremophila oldfieldii subsp. *angustifolia*
Eremophila pustulata
Eremophila scoparia
Eucalyptus campaspe
Maireana georgei
Olearia muelleri
Ptilotus obovatus
Sclerolaena diacantha
Sclerolaena drummondii
Senna artemisioides subsp. *filifolia*

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 7	
Quadrat size: 20x20		
Photo number: 60-62		
Landform: Midrslope		
Land surface/disturbance: Hillslope/Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): moderately; many/ cobbly; or cobbles/ subrounded **Rock outcrop (abundance/runoff):** no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 75		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <1	**Crown cover %:** <1
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila oldfieldii* subsp. *angustifolia*	*Acacia erinacea*

ALL SPECIES
Acacia erinacea
Eremophila glabra
Eremophila oldfieldii subsp. *angustifolia*
Eremophila scoparia
Eucalyptus clelandiorum
Olearia muelleri
Santalum spicatum
Scaevola spinescens

Project Name: Castle Hill	
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton
Location: Castle Hill	**Quadrat:** 8
Quadrat size: 20x20	
Photo number: 63-65	
Landform: Flat	
Land surface/disturbance: Plain/ Limited clearing	
Coarse fragments on the surface (abundance/size/shape): slight; few/ cobbly; or cobbles/ subrounded **Rock outcrop (abundance/runoff):** no bedrock exposed/ moderately rapid	
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm	
%Cover leaf litter: 30	
%Cover bare ground: 40	

Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <1	**Crown cover %:** <10	**Crown cover %:** <1
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Eremophila scoparia*	*Atriplex vesicaria*

ALL SPECIES
Atriplex nummularia subsp. *spathulata*
Atriplex vesicaria
Eremophila pustulata
Eremophila scoparia
Eucalyptus salmonophloia
Exocarpos aphyllus
Maireana georgei
Marsdenia australis (A)
Ptilotus obovatus
Sclerolaena drummondii
Senna artemisioides subsp. *filifolia*

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 9	
Quadrat size: 20x20		
Photo number: 70-72		
Landform: Crest		
Land surface/disturbance: Hillcrest/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): extremely; very abundant/ cobbly; or cobbles/ subangular **Rock outcrop (abundance/runoff):** no bedrock exposed/ rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 15		
%Cover bare ground: 95		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** 10-30	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Dodonaea lobulata*	*Scaevola spinescens*
ALL SPECIES		
Acacia erinacea		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Dodonaea lobulata		
Enchylaena tomentosa		
Eremophila glabra		
Eremophila oldfieldii subsp. *angustifolia*		
Eremophila scoparia		
Eucalyptus griffithsii		
Olearia muelleri		
Santalum spicatum		
Scaevola spinescens		
Senna artemisioides subsp. *filifolia*		

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 10	
Quadrat size: 20x20		
Photo number: 73-75		
Landform: Upper slope		
Land surface/disturbance: Hillslope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): very abundant/ coarse gravelly; large pebbles/ subangular **Rock outcrop (abundance/runoff):** no bedrock exposed/ rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 80		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** <1
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Eremophila pustulata*	*Olearia muelleri*
ALL SPECIES		
Acacia merrallii		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Eremophila pustulata		
Eucalyptus campaspe		
Olearia muelleri		

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 11	
Quadrat size: 20x20		
Photo number: 73-75		
Landform: Crest		
Land surface/disturbance: Hillcrest/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): very abundant/ cobbly; or cobbles/ subangular **Rock outcrop (abundance/runoff):** no bedrock exposed/ moderately rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 80		
%Cover bare ground: 95		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub	**Growth form:** Shrub	**Growth form:** Shrub
Height: 1-3m	**Height:** 0.5-1m	**Height:** 0.25-0.5m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Allocasuarina acutivalvis	*Philotheca brucei*	*Prostanthera grylloana*
ALL SPECIES		
Allocasuarina acutivalvis		
Cryptandra aridicola		
Grevillea acuaria		
Philotheca brucei		
Prostanthera grylloana		

Project Name: Castle Hill	
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton
Location: Castle Hill	**Quadrat:** 12
Quadrat size: 20x20	
Photo number: 93-95	
Landform: Upper slope	
Land surface/disturbance: Hillslope/ No effective disturbance except grazing by hoofed animals	
Coarse fragments on the surface (abundance/size/shape): Moderately; many/ coarse gravelly; large pebbles/ subangular **Rock outcrop (abundance/runoff):** no bedrock exposed/ rapid	
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm	
%Cover leaf litter: 10	
%Cover bare ground: 50	

Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 0.5-1m	**Height:** 0.25-0.5m
Crown cover %: <10	**Crown cover %:** <1	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia quadrimarginea	*Dodonaea lobulata*	*Ptilotus obovatus*

ALL SPECIES
Acacia quadrimarginea
Austrostipa nitida
Dodonaea lobulata
Eremophila oldfieldii subsp. *angustifolia*
Ptilotus obovatus

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 13	
Quadrat size: 20x20		
Photo number: 96-98		
Landform: Flat		
Land surface/disturbance: Plain/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Nil **Rock outcrop (abundance/runoff):** no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 50		
%Cover bare ground: 50		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Atriplex nummularia* subsp. *spathulata*	*Atriplex vesicaria*

ALL SPECIES
Atriplex nummularia subsp. *spathulata*
Atriplex vesicaria
Enchylaena tomentosa
Eremophila scoparia
Eucalyptus salmonophloia
Frankenia setosa
Pittosporum angustifolium

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 14	
Quadrat size: 20x20		
Photo number: 101-103		
Landform: Upper slope		
Land surface/disturbance: Hillslope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Moderately; many/ Cobbly; or cobbles/ Angular Tabular		
Rock outcrop (abundance/runoff): no bedrock exposed/ rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 10		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia quadrimarginea	*Dodonaea lobulata*	*Ptilotus obovatus*
ALL SPECIES		
Acacia quadrimarginea		
Austrostipa nitida		
Cheilanthes sieberi		
Dodonaea lobulata		
Eremophila oldfieldii subsp. *angustifolia*		
Marsdenia australis (A)		
Ptilotus obovatus		
Sida calyxhymenia		

Project Name: Castle Hill		
Date: 06/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 15	
Quadrat size: 20x20		
Photo number: 107-109		
Landform: Flat		
Land surface/disturbance: Plain/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Nil **Rock outcrop (abundance/runoff):** no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 60		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <1	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus ravida	*Eremophila scoparia*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex vesicaria		
Eremophila scoparia		
Eucalyptus ravida		
Frankenia setosa		
Maireana georgei		
Maireana oppositifolia		
Sclerolaena diacantha		

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 16	
Quadrat size: 20x20		
Photo number: 117-119		
Landform: Flat		
Land surface/disturbance: Plain/ Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Very slightly; very few/ medium gravelly; medium pebbles/ subangular		
Rock outcrop (abundance/runoff): no bedrock exposed/ moderately rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 5		
%Cover bare ground: 10		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Acacia acuminata*	*Ptilotus obovatus*
ALL SPECIES		
Acacia acuminata		
Atriplex nummularia subsp. *spathulata*		
Austrostipa nitida		
Dodonaea lobulata		
Eremophila dempsteri		
Eucalyptus griffithsii		
Ptilotus exaltatus (A)		
Ptilotus obovatus		
Sclerolaena drummondii		
Sclerolaena parvifolia		

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 17	
Quadrat size: 20x20		
Photo number: 120-122		
Landform: Flat		
Land surface/disturbance: Plain/ Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Moderately; many/ medium gravelly; medium pebbles/ subrounded		
Rock outcrop (abundance/runoff): no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 5		
%Cover bare ground: 40		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Shrub
Height: N/A	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: N/A	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa: N/A	**Dominant taxa:**	**Dominant taxa:**
	Eremophila dempsteri	*Atriplex vesicaria*
ALL SPECIES		
Atriplex vesicaria		
Calandrinia polyandra (A)		
Cratystylis subspinescens		
Eremophila dempsteri		
Eremophila scoparia		
Frankenia setosa		
Maireana triptera		
Ptilotus exaltatus (A)		
Sclerolaena diacantha		
Sclerolaena cuneata		
Streptoglossa cylindriceps (A)		

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 18	
Quadrat size: 20x20		
Photo number: 123-125		
Landform: Flat		
Land surface/disturbance: Plain/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Very abundant/ fine gravelly; small pebbles/ subrounded		
Rock outcrop (abundance/runoff): no bedrock exposed/ very slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 5		
%Cover bare ground: 95		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Shrub
Height: N/A	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: N/A	**Crown cover %:** <10	**Crown cover %:** 10-30
Dominant taxa: N/A	**Dominant taxa:**	**Dominant taxa:**
	Eremophila dempsteri	*Atriplex vesicaria*
ALL SPECIES		
Atriplex vesicaria		
Austrostipa nitida		
Cratystylis subspinescens		
Enchylaena tomentosa		
Eremophila dempsteri		
Sclerolaena cuneata		
Tecticornia disarticulata		

Project Name: Castle Hill		
	Botanist: Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 19	
Quadrat size: 20x20		
Photo number: 127-129		
Landform: Lower slope		
Land surface/disturbance: Hillslope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Extremely; very abundant/ medium gravelly; medium pebbles/ subrounded		
Rock outcrop (abundance/runoff): no bedrock exposed/ moderately rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 20		
%Cover bare ground: 95		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila oldfieldii* subsp. *angustifolia*	*Acacia erinacea*
ALL SPECIES		
Acacia erinacea		
Acacia hemiteles		
Austrostipa nitida		
Eremophila oldfieldii subsp. *angustifolia*		
Eucalyptus griffithsii		
Grevillea acuaria		
Olearia muelleri		
Santalum spicatum		
Senna artemisioides subsp. *filifolia*		
Westringia rigida		

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 20	
Quadrat size: 20x20		
Photo number: 130-132		
Landform: Upper slope		
Land surface/disturbance: Hillslope/ Extensive clearing		
Coarse fragments on the surface (abundance/size/shape): Extremely; very abundant/ medium gravelly; medium pebbles/ subrounded		
Rock outcrop (abundance/runoff): no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 30		
%Cover bare ground: 95		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Casuarina pauper	*Acacia acuminata*	*Dodonaea lobulata*
ALL SPECIES		
Acacia acuminata		
Casuarina pauper		
Dodonaea lobulata		
Eremophila oldfieldii subsp. *angustifolia*		
Olearia muelleri		
Scaevola spinescens		

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 21	
Quadrat size: 20x20		
Photo number: 133-135		
Landform: Upper slope		
Land surface/disturbance: Hillslope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Very; abundant/ medium gravelly; medium pebbles/ subrounded		
Rock outcrop (abundance/runoff): no bedrock exposed/ moderately rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 15		
%Cover bare ground: 95		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Allocasuarina acutivalvis	*Acacia acuminata*	*Prostanthera grylloana*
Casuarina pauper		
ALL SPECIES		
Acacia acuminata		
Allocasuarina acutivalvis		
Casuarina pauper		
Dodonaea lobulata		
Eremophila clarkei		
Eremophila oldfieldii subsp. *angustifolia*		
Philotheca brucei		
Prostanthera grylloana		

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 22	
Quadrat size: 20x20		
Photo number: 136-138		
Landform: Upper slope		
Land surface/disturbance: Hillslope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Very; abundant/ cobbly; or cobble stones/ subangular		
Rock outcrop (abundance/runoff): no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 50		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <1	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia quadrimarginea	*Dodonaea lobulata*	*Ptilotus obovatus*
ALL SPECIES		
Acacia quadrimarginea		
Austrostipa nitida		
Cheilanthes sieberi		
Dodonaea lobulata		
Ptilotus obovatus		
Sida calyxhymenia		
Solanum lasiophyllum		

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 23	
Quadrat size: 20x20		
Photo number: 140-142		
Landform: Upper slope		
Land surface/disturbance: Hillslope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Very; abundant/ cobbly; or cobble stones/ subrounded		
Rock outcrop (abundance/runoff): no bedrock exposed/ no runoff		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 60		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila interstans* subsp. *virgata*	*Atriplex vesicaria*
ALL SPECIES		
Acacia erinacea		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Austrostipa nitida		
Eremophila glabra		
Eremophila interstans subsp. *virgata*		
Eucalyptus griffithsii		
Maireana pentatropis		
Olearia muelleri		
Senna artemisioides subsp. *filifolia*		

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 24	
Quadrat size: 20x20		
Photo number: 143-145		
Landform: Lower slope		
Land surface/disturbance: Hillslope/ Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Very; abundant/ coarse gravelly; large pebbles/ subangular		
Rock outcrop (abundance/runoff): no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 50		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <10	**Crown cover %:** <1
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila pustulata*	*Atriplex vesicaria*

ALL SPECIES
Acacia colletioides
Atriplex vesicaria
Cratystylis conocephala
Eremophila glabra
Eremophila interstans subsp. *virgata*
Eremophila pustulata
Eremophila scoparia
Eucalyptus clelandiorum
Maireana pentatropis
Maireana thesioides
Santalum spicatum
Senna cardiosperma

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 25	
Quadrat size: 20x20		
Photo number: 146-148		
Landform: Flat		
Land surface/disturbance: Plain/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Nil		
Rock outcrop (abundance/runoff): no bedrock exposed/ very slow		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 90		
%Cover bare ground: 95		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <1	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus ravida	*Eremophila glabra*	*Atriplex vesicaria*

ALL SPECIES
Atriplex vesicaria
Eremophila glabra
Eremophila interstans subsp. *virgata*
Eremophila scoparia
Eucalyptus celastroides
Eucalyptus ravida
Frankenia setosa
Ptilotus exaltatus (A)
Scaevola spinescens

Project Name: Castle Hill		
Date: 07/11/12	**Botanist:** Jim Williams & Samantha Stapleton	
Location: Castle Hill	**Quadrat:** 26	
Quadrat size: 20x20		
Photo number: 149-151		
Landform: Flat		
Land surface/disturbance: Plain/ Limited clearing		
Coarse fragments on the surface (abundance/size/shape): very slightly; few/ coarse gravelly; large pebbles/ subrounded		
Rock outcrop (abundance/runoff): no bedrock exposed/ moderately rapid		
Soil (profile/field texture/soil surface): uniform/ medium clay/ firm		
%Cover leaf litter: 90		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <1	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus ravida	*Eremophila dempsteri*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex vesicaria		
Eremophila dempsteri		
Eremophila scoparia		
Eucalyptus ravida		
Maireana georgei		
Pittosporum angustifolium		
Ptilotus exaltatus (A)		
Ptilotus obovatus		
Sclerolaena parvifolia		
Roepera eremaea (A)		

Project Name: Castle Hill		
Date: 27/08/13	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat: Q27**	
Quadrat size: 20x20		
Photo number: 5-7		
Landform: Flat		
Land surface/disturbance: Plain/No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Moderately; many/medium gravelly; medium pebbles/subrounded		
Rock outcrop (abundance/runoff): no bedrock exposed/ slow		
Soil (profile/field texture/soil surface): Uniform/ Clay Loam/ Firm		
%Cover leaf litter:10		
%Cover bare ground: 50		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Tussock grass
Height: N/A	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: N/A	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa: N/A	**Dominant taxa:**	**Dominant taxa:**
	Atriplex nummularia subsp. *spathulata*	*Austrostipa nitida*
ALL SPECIES		
Acacia hemiteles		
Alyxia buxifolia		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Austrostipa elegantissima		
Austrostipa nitida		
Centaurea melitensis (W)		
Cephalipterum drummondii (A)		
Cucumis myriocarpus (W)		
Enchylaena tomentosa		
Eragrostis setifolia		
Eremophila dempsteri		
Eremophila scoparia		
Erodium crinitum		
Eucalyptus campaspe		
Eucalyptus griffithsii		
Goodenia havilandii (A)		
Grevillea acuaria		
Maireana georgei		
Maireana trichoptera		
Maireana triptera		
Ptilotus aervoides (A)		
Ptilotus carlsonii (A)		
Ptilotus holosericeus		
Ptilotus nobilis		
Rhagodia drummondii		
Rhodanthe floribunda (A)		
Salvia verbenaca (W)		
Santalum acuminatum		
Scaevola spinescens		
Sclerolaena diacantha		
Sclerolaena eurotioides		
Roepera eremaea (A)		

Project Name: Castle Hill		
Date: 27/08/13	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** Q28	
Quadrat size: 20x20		
Photo number: 12-14		
Landform: Upper Slope		
Land surface/disturbance: Hillslope/ No effective disturbance		
Coarse fragments on the surface (abundance/size/shape): Slightly; few/coarse gravelly; large pebbles; angular		
Rock outcrop (abundance/runoff): No bedrock exposed/Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Clay Loam/ Firm		
%Cover leaf litter: 25		
%Cover bare ground: 40		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Tussock grass
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 30-70	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia acuminata	*Dodonaea lobulata*	*Austrostipa nitida*
Casuarina pauper		

ALL SPECIES
Acacia acuminata
Austrostipa nitida
Casuarina pauper
Dodonaea lobulata
Goodenia xanthosperma
Olearia muelleri
Philotheca brucei
Prostanthera grylloana
Ptilotus obovatus
Scaevola spinescens
Senna artemisioides subsp. *filifolia*
Solanum lasiophyllum
Westringia rigida
Roepera eremaea (A)

Project Name: Castle Hill		
Date: 27/08/13	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 29	
Quadrat size: 20x20		
Photo number: 18-20		
Landform: Upper Slope		
Land surface/disturbance: Hill slope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Very slightly; very few/fine gravelly; small pebbles/angular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Slow		
Soil (profile/field texture/soil surface): Uniform/ Clay Loam/ Firm		
%Cover leaf litter:15		
%Cover bare ground: 50		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 3-6m	**Height:** 1-3m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila interstans* subsp. *interstans*	*Acacia hemiteles*
	Eremophila scoparia	*Scaevola spinescens*

ALL SPECIES
Acacia hemiteles
Atriplex nummularia subsp. *spathulata*
Austrostipa nitida
Dodonaea adenophora
Dodonaea lobulata
Eremophila interstans subsp. *interstans*
Eremophila scoparia
Eucalyptus griffithsii
Eucalyptus yilgarnensis
Grevillea acuaria
Maireana pentatropis
Maireana trichoptera
Olearia muelleri
Santalum acuminatum
Scaevola spinescens
Senna artemisioides subsp. *filifolia*
Senna artemisioides subsp. x *artemisioides*
Westringia rigida

Project Name: Castle Hill		
Date: 27/08/13	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 30	
Quadrat size: 20x20		
Photo number: 30-32		
Landform: Flat		
Land surface/disturbance: Plain/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Moderately; many/medium gravelly; medium pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Slow		
Soil (profile/field texture/soil surface): Uniform/ Clay Loam/ Firm		
%Cover leaf litter: 5		
%Cover bare ground: 40		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Tussock grass
Height: N/A	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: N/A	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
N/A	*Atriplex nummularia* subsp. *spathulata*	*Austrostipa nitida*
	Eremophila dempsteri	
ALL SPECIES		
Acacia hemiteles		
Alyxia buxifolia		
Aristida contorta (A)		
Atriplex nummularia subsp. *spathulata*		
Austrostipa eremophila		
Austrostipa nitida		
Brachyscome ciliocarpa (A)		
Cephalipterum drummondii		
Eragrostis setifolia		
Eremophila clarkei		
Eremophila oldfieldii subsp. *angustifolia*		
Lysimachia arvensis (W)		
Maireana trichoptera		
Marsdenia australis (A)		
Ptilotus carlsonii (A)		
Ptilotus obovatus		
Rhagodia drummondii		
Rhodanthe floribunda (A)		
Sclerolaena diacantha		
Sclerolaena eurotioides		
Sonchus oleraceus (W)		

Project Name: Castle Hill		
Date: 27/08/13	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 31	
Quadrat size: 20x20		
Photo number: 43-45		
Landform: Upper Slope		
Land surface/disturbance: Hill slope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Very slightly; very few/ medium gravelly; medium pebbles/ angular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Clay Loam/ Firm		
%Cover leaf litter: 20		
%Cover bare ground: 40		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 3-6m	**Height:** 1-3m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila interstans subsp. interstans*	*Dodonaea lobulata*
Eucalyptus torquata		*Senna artemisioides* subsp. x *artemisioides*
ALL SPECIES		
Acacia erinacea		
Acacia hemiteles		
Alyxia buxifolia		
Austrostipa nitida		
Dodonaea lobulata		
Eremophila interstans subsp. *interstans*		
Eremophila interstans subsp. *virgata*		
Eremophila oldfieldii subsp. *angustifolia*		
Eremophila parvifolia		
Eucalyptus clelandiorum		
Eucalyptus torquata		
Exocarpos aphyllus		
Grevillea acuaria		
Maireana pentatropis		
Scaevola spinescens		
Senna artemisioides subsp. *filifolia*		
Senna artemisioides subsp. x *artemisioides*		
Westringia rigida		

Project Name: Castle Hill		
Date: 28/08/2013	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 32	
Quadrat size: 20x20		
Photo number: 60-62		
Landform: Upper slope		
Land surface/disturbance: Hill slope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Moderately; many/ coarse gravelly; large pebbles/ angular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Clay Loam/ Firm		
%Cover leaf litter: 30		
%Cover bare ground: 50		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 3-6m	**Height:** 1-3m
Crown cover %: 10-30	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila oldfieldii* subsp. *angustifolia*	*Dodonaea lobulata*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Austrostipa nitida		
Dodonaea lobulata		
Dodonaea stenozyga		
Eremophila georgei		
Eremophila glabra		
Eremophila interstans subsp. *interstans*		
Eremophila oldfieldii subsp. *angustifolia*		
Eremophila scoparia		
Eucalyptus griffithsii		
Exocarpos aphyllus		
Olearia muelleri		
Ptilotus obovatus		
Scaevola spinescens		
Senna artemisioides subsp. x *artemisioides*		
Westringia rigida		

Project Name: Castle Hill		
Date: 28/08/2013	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 33	
Quadrat size: 20x20		
Photo number: 1-3		
Landform: Upper slope		
Land surface/disturbance: Hill slope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): No qualifier; common/coarse gravelly; large pebbles/ subrounded tabular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Silt Clay Loam/ Firm		
%Cover leaf litter: 30		
%Cover bare ground: 45		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub Mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height:3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Dodonaea lobulata*	*Olearia muelleri*
ALL SPECIES		
Acacia hemiteles		
Austrostipa nitida		
Beyeria sulcata		
Dodonaea lobulata		
Eremophila oldfieldii subsp. *angustifolia*		
Eucalyptus griffithsii		
Goodenia havilandii		
Grevillea acuaria		
Olearia muelleri		
Ptilotus obovatus		
Senna artemisioides subsp. *filifolia*		

Project Name: Castle Hill		
Date: 28/08/2013	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 34	
Quadrat size: 20x20		
Photo number: 4-6		
Landform: Lower slope		
Land surface/disturbance: Hill slope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Very slightly; very few/ medium gravellly; medium pebbles/ subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Silt Clay Loam/ Firm		
%Cover leaf litter: 30		
%Cover bare ground: 45		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub Mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height:6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** 10-30	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Scaevola spinescens*	*Westringia rigida*
ALL SPECIES		
Acacia hemiteles		
Austrostipa nitida		
Eremophila scoparia		
Eucalyptus griffithsii		
Exocarpos aphyllus		
Grevillea acuaria		
Scaevola spinescens		
Senna artemisioides subsp. filifolia		
Westringia rigida		

Project Name: Castle Hill		
Date: 28/08/2013	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 35	
Quadrat size: 20x20		
Photo number: 7-9		
Landform: Mid slope		
Land surface/disturbance: Hill slope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Very slightly; very few/ fine gravelly; small pebbles/ angular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Slow		
Soil (profile/field texture/soil surface): Uniform/ Silt Clay Loam/ Firm		
%Cover leaf litter: 60		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height:6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila interstans* subsp. *virgata*	*Acacia hemiteles*
ALL SPECIES		
Acacia hemiteles		
Atriplex nummularia subsp. *spathulata*		
Austrostipa nitida		
Casuarina pauper		
Eremophila glabra		
Eremophila interstans subsp. *virgata*		
Eremophila scoparia		
Eucalyptus clelandiorum		
Maireana pentatropis		
Olearia muelleri		
Ptilotus obovatus		
Santalum spicatum		
Scaevola spinescens		

Project Name: Castle Hill		
Date: 28/08/2013	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 36	
Quadrat size: 20x20		
Photo number: 10-12		
Landform: Flat		
Land surface/disturbance: Plain/Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Moderately; many/fine gravelly; small pebbles/ angular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Very slow		
Soil (profile/field texture/soil surface): Uniform/ Heavy Clay/ Self-mulching		
%Cover leaf litter: 5		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Tussock grass
Height: N/A	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: N/A	**Crown cover %:** 10-30	**Crown cover %:** 10-30
Dominant taxa: N/A	**Dominant taxa:**	**Dominant taxa:**
	Atriplex nummularia subsp. *spathulata*	*Austrostipa nitida*
ALL SPECIES		
Acacia hemiteles		
Atriplex nummularia subsp. *spathulata*		
Austrostipa elegantissima		
Austrostipa nitida		
Centaurea melitensis (W)		
Cephalipterum drummondii		
Enchylaena lanata		
Eragrostis dielsii		
Eremophila dempsteri		
Maireana triptera		
Marsdenia australis (A)		
Ptilotus carlsonii		
Ptilotus holosericeus		
Rhagodia drummondii		
Rhodanthe floribunda (A)		
Schoenia cassiniana		
Sclerolaena drummondii		
Sclerolaena parvifolia		
Sonchus oleraceus (W)		
Streptoglossa liatroides		

Project Name: Castle Hill		
Date: 28/08/2013	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 37	
Quadrat size: 20x20		
Photo number: 13-15		
Landform: Lower slope		
Land surface/disturbance: Hill slope/Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Very slightly; very few/ medium gravelly; medium pebbles/ angular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Light Medium Clay/ Firm		
%Cover leaf litter: 20		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 3-6m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila interstans* subsp. *virgata*	*Dodonaea stenozyga*
Eucalyptus torquata		
ALL SPECIES		
Austrostipa nitida		
Dodonaea stenozyga		
Eremophila interstans subsp. *virgata*		
Eremophila oldfieldii subsp. *angustifolia*		
Eucalyptus clelandiorum		
Eucalyptus torquata		
Exocarpos aphyllus		
Grevillea acuaria		
Scaevola spinescens		
Westringia rigida		

Project Name: Castle Hill		
Date: 28/08/2013	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 38	
Quadrat size: 20x20		
Photo number: 16-18		
Landform: Flat		
Land surface/disturbance: Plain/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Extremely; very abundant/ fine gravelly; small pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/Medium Clay/ Firm		
%Cover leaf litter: 40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** 10-30	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus ravida	*Eremophila dempsteri*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Eremophila dempsteri		
Eremophila georgei		
Eremophila scoparia		
Eucalyptus ravida		
Sclerolaena drummondii		
Sclerolaena parvifolia		

Project Name: Castle Hill		
Date: 28/08/2013	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 39	
Quadrat size: 20x20		
Photo number: 19-21		
Landform: Flat		
Land surface/disturbance: Valley Flat/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Extremely; very abundant/ fine gravelly; small pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/Heavy Clay/ Firm		
%Cover leaf litter: 40		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 3-6m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** 10-30	**Crown cover %:** 30-70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Eremophila scoparia*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex vesicaria		
Austrostipa nitida		
Eremophila scoparia		
Eucalyptus salmonophloia		
Exocarpos aphyllus		
Olearia muelleri		

Project Name: Castle Hill		
Date: 28/08/2013	**Botanist:** Andrea Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 40	
Quadrat size: 20x20		
Photo number: 22-24		
Landform: Flat		
Land surface/disturbance: Valley Flat/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Extremely; very abundant/ fine gravelly; small pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/Heavy Clay/ Firm		
%Cover leaf litter: 40		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	Height: 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** <10	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Eremophila interstans* subsp. *virgata*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Austrostipa nitida		
Eremophila interstans subsp. *virgata*		
Eucalyptus salmonophloia		
Maireana sedifolia		
Ptilotus nobilis		
Senna artemisioides subsp. *filifolia*		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 41	
Quadrat size: 20x20		
Photo number: 25-27		
Landform: Flat		
Land surface/disturbance: Valley Flat/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): **V**ery abundant/ fine gravelly; small pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Heavy Clay/ Cracking		
%Cover leaf litter: 10		
%Cover bare ground: 70		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub Mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila alternifolia*	*Atriplex nummularia* subsp. *spathulata*
ALL SPECIES		
Acacia hemiteles		
Atriplex nummularia subsp. *spathulata*		
Austrostipa nitida		
Carrichtera annua (W)		
Eremophila alternifolia		
Eremophila interstans subsp. *virgata*		
Eriochiton sclerolaenoides		
Eucalyptus griffithsii		
Maireana triptera		
Ptilotus obovatus		
Salvia verbenaca (W)		
Sclerolaena drummondii		
Solanum lasiophyllum		
Roepera eremaea (A)		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 42	
Quadrat size: 20x20		
Photo number: 28-30		
Landform: Mid slope		
Land surface/disturbance: Hill slope/Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Moderately; many/ coarse gravelly; large pebbles/ angular tabular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Light Clay/ Cracking		
%Cover leaf litter: 80		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 3-6m	**Height:** 0.5-1m
Crown cover %: 30-70	**Crown cover %:** <10	**Crown cover %:** <1
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus torquata	*Eremophila interstans* subsp. *virgata*	*Dodonaea stenozyga*
ALL SPECIES		
Atriplex vesicaria		
Austrostipa nitida		
Dodonaea stenozyga		
Eremophila glabra		
Eremophila interstans subsp. *virgata*		
Eucalyptus torquata		
Maireana pentatropis		
Olearia muelleri		
Ptilotus obovatus		
Scaevola spinescens		
Westringia rigida		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 43	
Quadrat size: 20x20		
Photo number: 31-33		
Landform: Mid slope		
Land surface/disturbance: Hill slope/Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Moderately; many/ coarse gravelly; large pebbles/ angular tabular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Light Clay/ Cracking		
%Cover leaf litter: 60		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus torquata	*Eremophila interstans* subsp. *virgata*	*Scaevola spinescens*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Austrostipa elegantissima		
Austrostipa nitida		
Dodonaea stenozyga		
Eremophila interstans subsp. *virgata*		
Eucalyptus torquata		
Exocarpos aphyllus		
Ptilotus obovatus		
Scaevola spinescens		
Westringia rigida		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 44	
Quadrat size: 20x20		
Photo number: 37-39		
Landform: Mid slope		
Land surface/disturbance: Hill slope/Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Moderately; many/ coarse gravelly; large pebbles/ subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Light Clay/ Firm		
%Cover leaf litter:60		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 30-70	**Crown cover %:** 10-30	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila interstans* subsp. *virgata*	*Dodonaea stenozyga*
Eucalyptus torquata		
ALL SPECIES		
Atriplex vesicaria		
Austrostipa nitida		
Dodonaea stenozyga		
Eremophila interstans subsp. virgata		
Eremophila parvifolia		
Eucalyptus clelandiorum		
Eucalyptus torquata		
Maireana georgei		
Maireana sedifolia		
Scaevola spinescens		
Senna artemisioides subsp. *filifolia*		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 45	
Quadrat size: 20x20		
Photo number: 40-42		
Landform: Mid slope		
Land surface/disturbance: Hill slope/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Very slightly; very few/ medium gravelly; medium pebbles/ angular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Clay Loam/ Firm		
%Cover leaf litter: 80		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 0.5-1m	**Height:** 0-0.5m
Crown cover %: >70	**Crown cover %:** <1	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila scoparia*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Austrostipa nitida		
Eremophila interstans subsp. *virgata*		
Eremophila scoparia		
Eucalyptus clelandiorum		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 46	
Quadrat size: 20x20		
Photo number: 43-45		
Landform: Flat		
Land surface/disturbance: Valley Flat/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Extremely; very abundant/ fine gravelly; small pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Heavy Clay/ Firm		
%Cover leaf litter: 40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 30-70	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Atriplex nummularia* subsp. *spathulata*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Eremophila dempsteri		
Eremophila scoparia		
Eucalyptus ravida		
Eucalyptus salmonophloia		
Sclerolaena drummondii		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 47	
Quadrat size: 20x20		
Photo number: 46-48		
Landform: Flat		
Land surface/disturbance: Plain/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Extremely; very abundant/ fine gravelly; small pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Heavy Clay/ Firm		
%Cover leaf litter: 60		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: >70	**Crown cover %:** <10	**Crown cover %:** <1
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus ravida	*Eremophila interstans* subsp. *virgata*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Austrostipa elegantissima		
Eremophila interstans subsp. *virgata*		
Eucalyptus ravida		
Maireana oppositifolia		
Ptilotus nobilis		
Rhagodia eremaea		
Sclerolaena parvifolia		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 48	
Quadrat size: 20x20		
Photo number: 49-51		
Landform: Flat		
Land surface/disturbance: Valley Flat/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Extremely; very abundant/ medium gravelly; medium pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Heavy Clay/ Firm		
%Cover leaf litter: 60		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: >70	**Crown cover %:** 10-30	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Eremophila dempsteri*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex vesicaria		
Eremophila dempsteri		
Eucalyptus campaspe		
Frankenia setosa		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 49	
Quadrat size: 20x20		
Photo number: 52-54		
Landform: Flat		
Land surface/disturbance: Plain/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Very abundant/ fine gravelly; small pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Heavy Clay/ Soft		
%Cover leaf litter: 60		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 0.5-1m	**Height:** 0-0.5m
Crown cover %: >70	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Eremophila pustulata*	*Atriplex vesicaria*
	Eremophila scoparia	*Tecticornia disarticulata*
ALL SPECIES		
Atriplex vesicaria		
Disphyma crassifolium		
Eremophila pustulata		
Eremophila scoparia		
Eucalyptus campaspe		
Sclerolaena drummondii		
Sclerolaena parvifolia		
Tecticornia disarticulata		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 50	
Quadrat size: 20x20		
Photo number: 55-57		
Landform: Simple slope		
Land surface/disturbance: Hill slope/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Very abundant/ medium gravelly; medium pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Heavy Clay/ Soft		
%Cover leaf litter: 60		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: >70	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus ravida	*Eremophila dempsteri*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex vesicaria		
Carrichtera annua (W)		
Eremophila dempsteri		
Eucalyptus ravida		
Maireana trichoptera		
Ptilotus nobilis		
Sclerolaena parvifolia		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 51	
Quadrat size: 20x20		
Photo number: 58-60		
Landform: Simple slope		
Land surface/disturbance: Hill slope/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Very abundant/ medium gravelly; medium pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Medium Clay/ Firm		
%Cover leaf litter: 10		
%Cover bare ground: 90		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Shrub
Height: N/A	**Height:** 3-6m	**Height:** 1-3m
Crown cover %: N/A	**Crown cover %:** 30-70	**Crown cover %:** <10
Dominant taxa: N/A	**Dominant taxa:**	**Dominant taxa:**
	Acacia acuminata	*Scaevola spinescens*
ALL SPECIES		
Acacia hemiteles		
Acacia acuminata		
Dodonaea lobulata		
Eremophila clarkei		
Eremophila oldfieldii subsp. *angustifolia*		
Scaevola spinescens		
Waitzia acuminata (A)		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 52	
Quadrat size: 20x20		
Photo number: 61-63		
Landform: Lower slope		
Land surface/disturbance: Hill slope/ Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Very abundant/ medium gravelly; medium pebbles/subrounded		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Loam/ Firm		
%Cover leaf litter: 60		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** <1	**Crown cover %:** <1
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila scoparia*	*Senna artemisioides* subsp. *filifolia*
ALL SPECIES		
Atriplex vesicaria		
Austrostipa nitida		
Eremophila scoparia		
Eucalyptus clelandiorum		
Senna artemisioides subsp. *filifolia*		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 53	
Quadrat size: 20x20		
Photo number: 64-66		
Landform: Flat		
Land surface/disturbance: Valley Flat/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Nil		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Heavy Clay/ Soft		
%Cover leaf litter: 40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 30-70	**Crown cover %:** <1	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Eremophila scoparia*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Eremophila dempsteri		
Eremophila scoparia		
Eucalyptus salmonophloia		
Exocarpos aphyllus		
Pittosporum angustifolium		
Ptilotus nobilis		
Scaevola spinescens		
Sclerolaena parvifolia		
Senna artemisioides subsp. *filifolia*		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 54	
Quadrat size: 20x20		
Photo number: 67-69		
Landform: Flat		
Land surface/disturbance: Valley Flat/ Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Nil		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Medium Clay/ Firm		
%Cover leaf litter: 20		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Atriplex nummularia* subsp. *spathulata*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Austrostipa nitida		
Eremophila glabra		
Eremophila interstans subsp. *virgata*		
Eremophila scoparia		
Eucalyptus salmonophloia		
Exocarpos aphyllus		
Scaevola spinescens		
Sclerolaena parvifolia		

Project Name: Castle Hill		
Date: 20/09/13	**Botanist:** Jim Williams & Pat Harton	
Location: Castle Hill	**Quadrat:** 55	
Quadrat size: 20x20		
Photo number: 70-72		
Landform: Mid slope		
Land surface/disturbance: Hill slope/ No effective disturbance except grazing by hoofed animals		
Coarse fragments on the surface (abundance/size/shape): Extremely; very abundant/ coarse gravelly; large pebbles/subrounded tabular		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Uniform/ Silty Clay Loam/ Firm		
%Cover leaf litter: 10		
%Cover bare ground: 80		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub	**Growth form:** Shrub	**Growth form:** Shrub
Height:3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 30-70	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia quadrimarginea	*Dodonaea lobulata*	*Ptilotus obovatus*
ALL SPECIES		
Acacia quadrimarginea		
Aristida contorta (A)		
Dodonaea lobulata		
Eremophila clarkei		
Ptilotus obovatus		
Santalum spicatum		
Solanum lasiophyllum		
Roepera eremaea (A)		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 1	
Quadrat size: 20x20		
Photo number: 2-3		
Landform: Simple Slope/ Middle third/ Hill slope		
Land surface/disturbance: Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Moderately (20-50%)/ coarse gravel, large pebbles (20-60mm)/ Angular		
Rock outcrop (abundance/runoff): No bedrock exposed/ moderately rapid		
Soil (profile/field texture/soil surface): Brown/ uniform/ silty clay loam/ firm		
%Cover leaf litter:40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** shrub	**Growth form:** shrub
Height:6-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: 30-70%	**Crown cover %:** 10-30%	**Crown cover %:** 30-70%
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila scoparia*	*Atriplex vesicaria*
ALL SPECIES		
Acacia erinacea		
Acacia hemiteles		
Atriplex nummularia subsp. *spatulata*		
Atriplex vesicaria		
Eremophila interstans subsp. *interstans*		
Eremophila scoparia		
Eucalyptus celastroides		
Eucalyptus clelandiorum		
Maireana georgei		
Maireana pentatropis		
Maireana trichoptera		
Olearia muelleri		
Ptilotus obovatus		
Sclerolaena parvifolia		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 2	
Quadrat size: 20x20		
Photo number: 6-8		
Landform: Upper slope/ top third/ hill slope		
Land surface/disturbance: No effective disturbance		
Coarse fragments on the surface (abundance/size/shape): very abundant (50-90%)/ cobbly or cobbles (60-200mm)/Angular		
Rock outcrop (abundance/runoff): No exposed bedrock/ moderately rapid		
Soil (profile/field texture/soil surface): Brown/ uniform/ silty clay loam/ soft		
%Cover leaf litter:40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height:6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30%	**Crown cover %:** <10%	**Crown cover %:** 30-70%
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus transcontinentalis	*Eremophila scoparia*	*Tecticornia disarticulata*
ALL SPECIES		
Acacia erinacea		
Atriplex vesicaria		
Eremophila decipiens		
Eremophila scoparia		
Eucalyptus transcontinentalis		
Sclerolaena densiflora		
Sclerolaena drummondii		
Sclerolaena parvifolia		
Tecticornia disarticulata		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 3	
Quadrat size: 20x20		
Photo number: 9-11		
Landform: Simple slope/ middle third/ hill slope		
Land surface/disturbance: limited clearing		
Coarse fragments on the surface (abundance/size/shape): Moderately (20-50%)/ medium Gravel, medium pebbles (6-20mm)/sub rounded tabular		
Rock outcrop (abundance/runoff): No exposed bedrock/ moderately rapid		
Soil (profile/field texture/soil surface): Brown/ uniform/ silty clay loam/ soft		
%Cover leaf litter:40		
%Cover bare ground: 70		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height:6-12m	**Height:** 1-3m	**Height:** 0.25-0.5
Crown cover %: 10-30%	**Crown cover %:** <10%	**Crown cover %:** 10-30%
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Atriplex nummularia* subsp. *spatulata*	*Tecticornia disarticulata*
ALL SPECIES		
Atriplex nummularia subsp. *spatulata*		
Atriplex vesicaria		
Austrostipa elegantissima		
Eucalyptus clelandiorum		
Maireana georgei		
Maireana trichoptera		
Ptilotus obovatus		
Sclerolaena diacantha		
Sclerolaena parvifolia		
Tecticornia disarticulata		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 4	
Quadrat size: 20x20		
Photo number: 12-14		
Landform: Flat/ Middle third/ Plain		
Land surface/disturbance: Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Slightly, few (2-10%)/ coarse gravel (20-60mm)/ Angular		
Rock outcrop (abundance/runoff): No bedrock/ Moderately Rapid		
Soil (profile/field texture/soil surface): Brown/ Uniform/ Silty clay loam/ soft		
%Cover leaf litter:40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** shrub	**Growth form:** shrub
Height:3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30%	**Crown cover %:** 10-30%	**Crown cover %:** <10%
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Eremophila dempsteri*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex vesicaria		
Chenopodium curvispicatum		
Eremophila dempsteri		
Eremophila scoparia		
Eucalyptus campaspe		
Exocarpos aphyllus		
Frankenia setosa		
Lycium australe		
Maireana georgei		
Maireana oppositifolia		
Maireana trichoptera		
Ptilotus exaltatus (A)		
Sclerolaena parvifolia		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 5	
Quadrat size: 20x20		
Photo number: 16/18		
Upper slope/ Top third/ Hill slope		
Land surface/disturbance: Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Quartz/ No qualifier (10-20%)/ Coarse gravel, large pebbles (20-60mm)/ Angular Tabular		
Rock outcrop (abundance/runoff): Slightly rocky (2-10%)/ Moderately rapid		
Soil (profile/field texture/soil surface): Brown/ uniform/ medium clay/ firm		
%Cover leaf litter:40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** shrub	**Growth form:** shrub
Height:3-6	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10%	**Crown cover %:** 10-30%	**Crown cover %:** <10%
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Eremophila interstans* subsp. *interstans*	*Atriplex vesicaria*
ALL SPECIES		
Acacia hemiteles		
Atriplex nummularia subsp. *Spatulata*		
Atriplex vesicaria		
Eremophila interstans subsp. *interstans*		
Eremophila oldfieldii subsp. *angustifolia*		
Eremophila pustulata		
Eucalyptus campaspe		
Eucalyptus celastroides		
Exocarpos aphyllus		
Maireana georgei		
Maireana trichoptera		
Maireana triptera		
Olearia muelleri		
Ptilotus exaltatus (A)		
Ptilotus obovatus		
Scaevola spinescens		
Sclerolaena parvifolia		
Senna artemisioides subsp. *filifolia*		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 6	
Quadrat size: 20x20		
Photo number: 20-22		
Landform: Upper slope/ Middle third/ Hill slope		
Land surface/disturbance: Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): No coarse fragments		
Rock outcrop (abundance/runoff): No bedrock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Brown/ Duplex/ Medium Clay/ Firm		
%Cover leaf litter:40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** shrub	**Growth form:** shrub
Height:3-6	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30%	**Crown cover %:** <10%	**Crown cover %:** <10%
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Atriplex nummularia* subsp. *spatulata*	*Atriplex vesicaria*
ALL SPECIES		
Acacia tetragonophylla		
Atriplex nummularia subsp. *spatulata*		
Atriplex vesicaria		
Eremophila decipiens		
Eremophila pustulata		
Eucalyptus campaspe		
Eucalyptus salmonophloia		
Maireana georgei		
Olearia muelleri		
Ptilotus exaltatus (A)		
Scaevola spinescens		
Sclerolaena parvifolia		
Senna artemisioides subsp. *filifolia*		
Tecticornia disarticulata		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 7	
Quadrat size: 20x20		
Photo number: 23-25		
Landform: Flat/ middle third/ Plain		
Land surface/disturbance: Limited clearing		
Coarse fragments on the surface (abundance/size/shape): No qualifier, common (10-20%)/ Coarse gravel, large pebbles (20-60mm)/ sub rounded tabular		
Rock outcrop (abundance/runoff): No bed rock exposed/ Moderately rapid		
Soil (profile/field texture/soil surface): Brown/ uniform/ Medium heavy clay/ soft		
%Cover leaf litter:40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** shrub	**Growth form:** shrub
Height:6-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: 10-30%	**Crown cover %:** <10%	**Crown cover %:** 10-30%
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Eremophila dempsteri*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spatulata*		
Atriplex vesicaria		
Eremophila dempsteri		
Eucalyptus campaspe		
Maireana georgei		
Olearia muelleri		
Sclerolaena drummondii		
Sclerolaena parvifolia		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 8	
Quadrat size: 20x20		
Photo number: 26-28		
Landform: Simple Slope/ Bottom Third/ Hill slope		
Land surface/disturbance: Limited clearing		
Coarse fragments on the surface (abundance/size/shape): No qualifier, common (10-20%)/ medium gravel, medium pebbles (6-20mm)/ Angular platy		
Rock outcrop (abundance/runoff): No bedrock exposed/ moderately rapid		
Soil (profile/field texture/soil surface): Brown/ Duplex/ Medium heavy clay/ firm		
%Cover leaf litter:20		
%Cover bare ground: 40		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** shrub	**Growth form:** shrub
Height:6-12m	**Height:** 1-3m	**Height: 0.5-1m**
Crown cover %: 10-30%	**Crown cover %:** <1	**Crown cover %:** 30-70%
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus transcontinentalis	*Atriplex nummularia* subsp. *spatulata*	*Tecticornia disarticulata*
ALL SPECIES		
Atriplex nummularia subsp. *spatulata*		
Atriplex vesicaria		
Eucalyptus transcontinentalis		
Maireana georgei		
Ptilotus exaltatus (A)		
Sclerolaena parvifolia		
Tecticornia disarticulata		
Roepera sp. (Sterile)		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 9	
Quadrat size: 20x20		
Photo number: 29-31		
Landform: Flat/ Bottom third/ Valley Flat		
Land surface/disturbance: Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): No coarse fragments		
Rock outcrop (abundance/runoff): No bedrock exposed/ Rapid		
Soil (profile/field texture/soil surface): Uniform/ medium heavy clay/ firm		
%Cover leaf litter:30		
%Cover bare ground: 50		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** shrub	**Growth form:** shrub
Height:6-12m	**Height:** 1-3m	**Height: 0.5-1m**
Crown cover %: <10%	**Crown cover %:** <10%	**Crown cover %:** 30-70%
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Atriplex nummularia* subsp. *spathulata*	*Atriplex vesicaria*
ALL SPECIES		
Eucalyptus salmonophloia		
Atriplex nummularia subsp. *spathulata*		
Atriplex vesicaria		
Maireana sedifolia		
Tecticornia disarticulata		
Sclerolaena parvifolia		
Maireana trichoptera		
Maireana georgei		
Enchylaena tomentosa		
Maireana oppositifolia		
Roepera sp. (Sterile)		

Project Name: Burgundy	
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton
Location: Burgundy	**Quadrat:** 10
Quadrat size: 20x20	
Photo number: 33-35	
Landform: Simple Slope/Middle Third/Hill slope	
Land surface/disturbance: Limited Clearing	
Coarse fragments on the surface (abundance/size/shape): Iron/No qualifier, common (10-20%)/Medium gravelly; medium pebbles (6-20mm) / Sub rounded	
Rock outcrop (abundance/runoff): No bed rock exposed /Moderately rapid	
Soil (profile/field texture/soil surface): Red/ Uniform / Silty clay loam / Firm	
%Cover leaf litter: 30	
%Cover bare ground: 50	

Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: 10-30	**Crown cover %:** <1	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus campaspe	*Atriplex nummularia* subsp. *spatulata*	*Atriplex vesicaria*

ALL SPECIES
Atriplex nummularia subsp. *spatulata*
Atriplex vesicaria
Eriochiton sclerolaenoides
Eucalyptus campaspe
Eucalyptus celastroides
Maireana georgei
Maireana sedifolia
Sclerolaena drummondii
Roepera sp. (Sterile)

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 11	
Quadrat size: 20x20		
Photo number: 36-38		
Landform: Flat / Bottom Third / Valley Flat		
Land surface/disturbance: Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Very slightly, very few 2-10% / Fine gravelly; small pebbles 2-6mm / Angular Tabular		
Rock outcrop (abundance/runoff): No bed rock exposed/ Moderately Rapid		
Soil (profile/field texture/soil surface): Brown/ Uniform / Medium heavy clay / Firm		
%Cover leaf litter: 40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12 m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** <1	**Crown cover %:** 30-70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Atriplex nummularia* subsp. *spatulata*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex codonocarpa (A)		
Atriplex nummularia subsp. *spatulata*		
Atriplex vesicaria		
Enchylaena lanata		
Eucalyptus salmonophloia		
Frankenia setosa		
Maireana pyramidata		
Scaevola spinescens		
Sclerolaena diacantha		
Sclerolaena parvifolia		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 12	
Quadrat size: 20x20		
Photo number: 39-41		
Landform: Flat / Middle third / Valley flat		
Land surface/disturbance: Limited clearing		
Coarse fragments on the surface (abundance/size/shape): Vey slightly; very few <2% / Medium gravelly; medium pebbles / Angular Tabular		
Rock outcrop (abundance/runoff): No bedrock exposed / Moderately rapid		
Soil (profile/field texture/soil surface): Red/ Duplex / Medium Heavy Clay / Firm		
%Cover leaf litter: 60		
%Cover bare ground: 70		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** <1	**Crown cover %:** 30-70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus salmonophloia	*Maireana sedifolia*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex vesicaria		
Eucalyptus salmonophloia		
Maireana pyramidata		
Maireana sedifolia		
Sclerolaena diacantha		
Sclerolaena parvifolia		
Tecticornia disarticulata		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 13	
Quadrat size: 20x20		
Photo number: 42-44		
Landform: Flat / Middle Third / Valley Flat		
Land surface/disturbance: Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): Very Slightly; very few <2% / Coarse gravelly; Large pebbles 6-20mm / Angular		
Rock outcrop (abundance/runoff): No bedrock exposed / moderately Rapid		
Soil (profile/field texture/soil surface): Brown/ Duplex / Medium heavy clay / Soft		
%Cover leaf litter: 20		
%Cover bare ground: 30		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub Mallee <8m	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** <10	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila alternifolia*	*Atriplex vesicaria*
ALL SPECIES		
Acacia tetragonophylla		
Aristida contorta (A)		
Atriplex nummularia subsp. *spatulata*		
Atriplex vesicaria		
Austrostipa nitida		
Carrichtera annua (W)		
Cenchrus ciliaris (W)		
Enneapogon caerulescens		
Eremophila alternifolia		
Eriochiton sclerolaenoides		
Erodium crinitum		
Eucalyptus griffithsii		
Lycium australe		
Maireana trichoptera		
Marsdenia australis (A)		
Ptilotus obovatus		
Rhagodia eremaea		
Salvia verbenaca (W)		
Senna artemisioides subsp. *filifolia*		
Streptoglossa liatroides		
Vittadinia eremaea		
Roepera sp. (Sterile)		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 14	
Quadrat size: 20x20		
Photo number: 47-49		
Landform: Crest / Top Third/ Hill Crest		
Land surface/disturbance: Limited clearing		
Coarse fragments on the surface (abundance/size/shape): No qualifier; common 10-20% / Fine gravelly; small pebbles 2-6mm / Sub rounded		
Rock outcrop (abundance/runoff): No bedrock exposed / Moderately rapid		
Soil (profile/field texture/soil surface): Brown/ Uniform/ Silty loam/ Firm		
%Cover leaf litter: 40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree mallee >8m	**Growth form:** Shrub	**Growth form:** Hummock Grass
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** 10-30	**Crown cover %:** 30-70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila interstans* subsp. *interstans*	*Triodia irritans*
ALL SPECIES		
Atriplex nummularia subsp. *spatulata*		
Dodonaea lobulata		
Eremophila interstans subsp. *interstans*		
Eremophila parvifolia		
Eucalyptus griffithsii		
Dillwynia acerosa		
Maireana trichoptera		
Santalum spicatum		
Scaevola spinescens		
Senna artemisioides subsp. *filifolia*		
Triodia irritans		
Westringia rigida		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 15	
Quadrat size: 20x20		
Photo number: 50-52		
Landform: Simple Slope / Middle Third / Hill slope		
Land surface/disturbance: Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): No qualifier; common 10-20% / Fine gravelly; small pebbles 2-6mm / Sub angular		
Rock outcrop (abundance/runoff): No bedrock exposed / Moderately rapid		
Soil (profile/field texture/soil surface): Brown / Uniform / Silty clay loam / Firm		
%Cover leaf litter: 40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub Mallee <8m	**Growth form:** Shrub	**Growth form:** Hummock grass
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** <10	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila interstans* subsp. *interstans*	*Olearia muelleri*
ALL SPECIES		
Atriplex vesicaria		
Austrostipa nitida		
Dodonaea lobulata		
Eremophila interstans subsp. *interstans*		
Eremophila oldfieldii subsp. *angustifolia*		
Eremophila parvifolia		
Eucalyptus griffithsii		
Olearia muelleri		
Ptilotus obovatus		
Senna artemisioides subsp. *filifolia*		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 16	
Quadrat size: 20x20		
Photo number: 53-55		
Landform: Simple slope / Middle third / Hill slope		
Land surface/disturbance: Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): No qualifier; common / Coarse gravelly; medium pebbles / Angular		
Rock outcrop (abundance/runoff): No bedrock exposed / Moderately rapid		
Soil (profile/field texture/soil surface): Brown / Uniform / Silty clay loam / Firm		
%Cover leaf litter: 30		
%Cover bare ground: 50		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree Mallee	**Growth form:** Shrub	**Growth form:** Hummock Grass
Height: 3-5m	**Height:** 0.5-1m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** <10	**Crown cover %:** 30-70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila interstans* subsp. *interstans*	*Triodia irritans*
ALL SPECIES		
Acacia hemiteles		
Atriplex nummularia subsp. *spatulata*		
Eremophila decipiens		
Eremophila interstans subsp. *interstans*		
Eremophila parvifolia		
Eucalyptus griffithsii		
Exocarpos aphyllus		
Olearia muelleri		
Scaevola spinescens		
Senna artemisioides subsp. *filifolia*		
Triodia irritans		
Westringia rigida		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 17	
Quadrat size: 20x20		
Photo number: 56-58		
Landform: Flat / Middle Third / Plain		
Land surface/disturbance: Limited clearing		
Coarse fragments on the surface (abundance/size/shape): No coarse fragments		
Rock outcrop (abundance/runoff): No bedrock exposed / Moderately rapid		
Soil (profile/field texture/soil surface): Brown / Uniform / Medium heavy clay / Soft		
%Cover leaf litter: 40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub Mallee >8	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila interstans* subsp. *interstans*	*Atriplex vesicaria*
ALL SPECIES		
Acacia erinacea		
Acacia tetragonophylla		
Atriplex vesicaria		
Austrostipa elegantissima		
Eremophila alternifolia		
Eremophila interstans subsp. *interstans*		
Eremophila oldfieldii subsp. *angustifolia*		
Eremophila scoparia		
Eucalyptus griffithsii		
Maireana trichoptera		
Olearia muelleri		
Ptilotus obovatus		
Scaevola spinescens		
Sclerolaena parvifolia		
Senna artemisioides subsp. *filifolia*		
Templetonia sulcata		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 18	
Quadrat size: 20x20		
Photo number: 59, 61		
Landform: Flat / Middle Third / Valley flat		
Land surface/disturbance: Limited clearing		
Coarse fragments on the surface (abundance/size/shape): No qualifier; common 10-20% / Medium gravelly; Medium pebbles 6-20mm / Sub rounded tabular		
Rock outcrop (abundance/runoff): No bedrock exposed / Moderately rapid		
Soil (profile/field texture/soil surface): Uniform / Medium heavy clay / Soft		
%Cover leaf litter: 40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree Mallee >8m	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 3-5m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** 10-30	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus griffithsii	*Eremophila alternifolia*	*Ptilotus obovatus*
ALL SPECIES		
Acacia hemiteles		
Aristida contorta (A)		
Austrostipa nitida		
Dodonaea lobulata		
Eremophila alternifolia		
Eremophila glabra		
Eremophila interstans subsp. *interstans*		
Eremophila scoparia		
Eriochiton sclerolaenoides		
Eucalyptus griffithsii		
Exocarpos aphyllus		
Ptilotus obovatus		
Santalum spicatum		
Senna artemisioides subsp. *filifolia*		
Solanum lasiophyllum		
Templetonia sulcata		
Roepera sp. (Sterile) (A)		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 19	
Quadrat size: 20x20		
Photo number: 62-64		
Landform: Crest / Middle third / Hill slope		
Land surface/disturbance: Extensive clearing		
Coarse fragments on the surface (abundance/size/shape): Moderately; many 20-50% / Coarse gravelly; large pebbles 20-60mm / Angular tabular		
Rock outcrop (abundance/runoff): Very slightly rocky / Moderately Rapid		
Soil (profile/field texture/soil surface): Uniform / Silty clay loam / Firm		
%Cover leaf litter: 40		
%Cover bare ground: 70		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** 10-30	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila scoparia*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spatulata*		
Atriplex vesicaria		
Dodonaea lobulata		
Eremophila dempsteri		
Eremophila parvifolia		
Eremophila scoparia		
Eucalyptus clelandiorum		
Eucalyptus griffithsii		
Exocarpos aphyllus		
Olearia muelleri		
Senna artemisioides subsp. *filifolia*		

Project Name: Burgundy		
Date: 01/09/14	**Botanist:** Jim Williams & Pat Harton	
Location: Burgundy	**Quadrat:** 20	
Quadrat size: 20x20		
Photo number: 65-67		
Landform: Flat / Bottom third / Valley Flat		
Land surface/disturbance: Limited Clearing		
Coarse fragments on the surface (abundance/size/shape): No qualifier; common 10-20% / Coarse gravelly; large pebbles 20-60mm / Angular tabular		
Rock outcrop (abundance/runoff): Slightly rocky / Moderately rapid		
Soil (profile/field texture/soil surface): Brown / Uniform / Silty clay loam / Firm		
%Cover leaf litter: 40		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: 10-30	**Crown cover %:** <10	**Crown cover %:** <10
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus clelandiorum	*Eremophila scoparia*	*Atriplex vesicaria*
ALL SPECIES		
Atriplex nummularia subsp. *spatulata*		
Atriplex vesicaria		
Eremophila scoparia		
Eucalyptus clelandiorum		
Eucalyptus transcontinentalis		
Maireana georgei		
Maireana trichoptera		
Maireana triptera		
Ptilotus exaltatus (A)		
Scaevola spinescens		
Sclerolaena parvifolia		

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 187-189
Quadrat: QE1	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 220
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Plain		
Coarse fragments on the surface: Ironstone, quartz, calcrete, 10%-20%, 6-20mm		
Rock outcrop (abundance/runoff): Nil/ Very slow		
Soil (profile/field texture/soil surface): Brown/ Clay Loam/ Soft		
Cover leaf litter: 50%		
Cover bare ground: 35%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 12-20m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: <10%	**Crown cover:** 10-30%	**Crown cover:** <1%
Dominant taxa		
Eucalyptus salmonophloia	*Senna artemisioides* subsp. *filifolia*	*Olearia muelleri*
Other Taxa		
Eucalyptus clelandiorum	*Acacia hemiteles*	
	Atriplex nummularia subsp. *spathulata*	
	Atriplex vesicaria	
	Eremophila glabra	
	Eremophila scoparia	
	Exocarpos aphyllus	
	Santalum acuminatum	
	Scaevola spinescens	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 190-192
Quadrat: QE2	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 221
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Plain		
Coarse fragments on the surface: Ironstone, 50%-80%, 2-6mm		
Rock outcrop (abundance/runoff): Nil/ Very slow		
Soil (profile/field texture/soil surface): Brown/ Clay Loam/ Firm		
Cover leaf litter: 60%		
Cover bare ground: 30%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** N/A
Height: 5-12m	**Height:** 1-3m	**Height: -**
Crown cover: 10-30%	**Crown cover:** 10-30%	**Crown cover: -**
Dominant taxa		
Eucalyptus transcontinentalis	*Eremophila scoparia*	-
Other Taxa		
Eucalyptus celastroides	*Atriplex nummularia* subsp. *spathulata*	
Eucalyptus salmonophloia	*Eremophila parvifolia* subsp. *auricampi*	
	Exocarpos aphyllus	
	Maireana sedifolia	
	Scaevola spinescens	
	Senna cardiosperma	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 193-195
Quadrat: QE3	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 222
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Plain		
Coarse fragments on the surface: Ironstone, 20-50%, 2-6mm		
Rock outcrop (abundance/runoff): Nil/ Very slow		
Soil (profile/field texture/soil surface): Brown/ Clay Loam/ Firm		
Cover leaf litter: 75%		
Cover bare ground: 20%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 5-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: 10-30%	**Crown cover:** 10-30%	**Crown cover:** 10-30%
Dominant taxa		
Eucalyptus salmonophloia	*Eremophila scoparia*	*Ptilotus obovatus* var. *obovatus*
Other Taxa		
Eucalyptus clelandiorum	*Atriplex nummularia* subsp. *spathulata*	*Maireana pyramidata*
	Atriplex vesicaria	
	Eremophila glabra	
	Eremophila interstans subsp. *interstans*	
	Eremophila ionantha	
	Maireana sedifolia	
	Scaevola spinescens	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 198-200
Quadrat: QE4	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 223
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Plain		
Coarse fragments on the surface: 10-20%, 6-20mm		
Rock outcrop (abundance/runoff): Nil/ Very slow		
Soil (profile/field texture/soil surface): Brown/ Medium clay/ Soft		
Cover leaf litter: 10%		
Cover bare ground: 70%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Shrub
Height: -	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: -	**Crown cover:** 30-70%	**Crown cover:** 10-30%
Dominant taxa		
-	*Dodonaea lobulata*	*Ptilotus obovatus* var. *obovatus*
Other Taxa		
	Acacia hemiteles	
	Atriplex nummularia subsp. *spathulata*	
	Atriplex vesicaria	
	Eremophila alternifolia	
	Eremophila oldfieldii subsp. *angustifolia*	
	Senna artemisioides subsp. *filifolia*	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 201-203
Quadrat: QE5	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 224
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Hillslope		
Coarse fragments on the surface: Quartz, 20-50%, 20-50mm		
Rock outcrop (abundance/runoff): Nil/ Slow		
Soil (profile/field texture/soil surface): Brown/ Clay-loam		
Cover leaf litter: 40%		
Cover bare ground: 50%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 5-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: <10%	**Crown cover:** <10%	**Crown cover:** <10%
Dominant taxa		
Eucalyptus griffithsii	*Dodonaea lobulata*	*Olearia muelleri*
Other Taxa		
Casuarina pauper	*Eremophila interstans* subsp. *interstans*	*Westringia rigida*
	Acacia hemiteles	
	Atriplex nummularia subsp. *spathulata*	
	Eremophila oldfieldii subsp. *angustifolia*	
	Eremophila parvifolia subsp. *auricampa*	
	Senna artemisioides subsp. *filifolia*	
	Solanum nummularium	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 204-206
Quadrat: QE6	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 225
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Hillslope		
Coarse fragments on the surface: Mixed, <2%, 2-6mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/ Medium clay/ Hard-setting		
Cover leaf litter: 10%		
Cover bare ground: 80%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-5m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: <10%	**Crown cover:** <10%	**Crown cover:** <10%
Dominant taxa		
Eremophila miniata	*Maireana sedifolia*	*Ptilotus obovatus* var. *obovatus*
Other Taxa		
Eremophila oldfieldii subsp. *angustifolia*	*Atriplex vesicaria*	*Austrostipa elegantissima*
	Dodonaea lobulata	*Maireana carnosa*
	Eremophila scoparia	*Marsdenia australis*
		Solanum lasiophyllum

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 207-209
Quadrat: QE7	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 226
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Plain		
Coarse fragments on the surface: 2-10%, 6-20mm		
Rock outcrop (abundance/runoff): Nil/ Very slow		
Soil (profile/field texture/soil surface): Brown/ Medium heavy clay/ Cracking		
Cover leaf litter: 15%		
Cover bare ground: 70%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-5m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: 10-30%	**Crown cover:** <1%	**Crown cover:** <1%
Dominant taxa		
Acacia acuminata	*Atriplex nummularia* subsp. *spathulata*	*Ptilotus obovatus* var. *obovatus*
Other Taxa		
Eremophila oldfieldii subsp. *angustifolia*	*Maireana pyramidata*	*Austrostipa elegantissima*
	Rhagodia drummondii	*Maireana triptera*
		Marsdenia australis
		Sclerolaena cuneata
		Solanum lasiophyllum
		Solanum nummularium

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 210-212
Quadrat: QE8	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 227
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Plain		
Coarse fragments on the surface: 10-20%, 6-20mm		
Rock outcrop (abundance/runoff): Nil/ Very slow		
Soil (profile/field texture/soil surface): Brown/ Light medium clay/ Soft		
Cover leaf litter: 65%		
Cover bare ground: 30%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-5m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: 10-30%	**Crown cover:** 10-30%	**Crown cover:** <1%
Dominant taxa		
Eucalyptus ravida	*Atriplex nummularia* subsp. *spathulata*	*Maireana pyramidata*
Other Taxa		
Eucalyptus celastroides	*Atriplex vesicaria*	
	Enchylaena tomentosa	
	Eremophila alternifolia	
	Eremophila interstans subsp. *virgata*	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 213-215
Quadrat: QE9	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 228
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Floodout		
Coarse fragments on the surface: Quartz, ironstone/ 10-20%, 20-60mm		
Rock outcrop (abundance/runoff): Nil/ Very slow		
Soil (profile/field texture/soil surface): Brown/ Clay-loam		
Cover leaf litter: 30%		
Cover bare ground: 60%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 5-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: 10-30%	**Crown cover:** 10-30%	**Crown cover:** <10%
Dominant taxa		
Eucalyptus salmonophloia	*Eremophila scoparia*	*Maireana pyramidata*
Other Taxa		
	Acacia jennerae	*Austrostipa elegantissima*
	Atriplex nummularia subsp. *spathulata*	*Ptilotus obovatus* var. *obovatus*
	Atriplex vesicaria	
	Exocarpos aphyllus	
	Scaevola spinescens	
	Senna artemisioides subsp. *filifolia*	
	Solanum nummularium	
	Pimelea microcephala subsp. *microcephala*	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 219-221
Quadrat: QE10	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 229
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Plain		
Coarse fragments on the surface: Quartz, ironstone/ 10-20%, 6-20mm		
Rock outcrop (abundance/runoff): Nil/ Very slow		
Soil (profile/field texture/soil surface): Brown/ Clay-loam/ Firm		
Cover leaf litter: 70%		
Cover bare ground: 20%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Chenopod
Height: 5-12m	**Height:** 1-3m	**Height:** <0.25m
Crown cover: 10-30%	**Crown cover:** <10%	**Crown cover:** <1%
Dominant taxa		
Eucalyptus salmonophloia	*Atriplex nummularia* subsp. *spathulata*	*Maireana triptera*
Other Taxa		
Eucalyptus transcontinentalis	*Atriplex vesicaria*	*Austrostipa elegantissima*
	Cratystylis subspinescens	*Olearia muelleri*
	Eremophila glabra	*Ptilotus obovatus* var. *obovatus*
	Eremophila interstans subsp. *interstans*	
	Eremophila oldfieldii subsp. *angustifolia*	
	Eremophila scoparia	
	Maireana sedifolia	
	Senna artemisioides subsp. *filifolia*	
	Tecticornia disarticulata	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 222-224
Quadrat: QE11	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 230
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Hillslope		
Coarse fragments on the surface: Laterite/ 50-90%, 60-200mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/ Clay-loam/ Soft		
Cover leaf litter:		
Cover bare ground:		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 5-12m	**Height:** 1-3m	**Height:** <0.25m
Crown cover: <10%	**Crown cover:** <10%	**Crown cover:** <1%
Dominant taxa		
Eucalyptus clelandiorum	*Eremophila pustulata*	*Olearia muelleri*
Other Taxa		
	Acacia erinacea	*Maireana triptera*
	Atriplex nummularia subsp. *spathulata*	*Ptilotus obovatus* var. *obovatus*
	Dodonaea lobulata	
	Scaevola spinescens	
	Senna artemisioides subsp. *filifolia*	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 227-229
Quadrat: QE12	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 231
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Floodout		
Coarse fragments on the surface: 2-10%, 2-5mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/ Light-medium clay/ Soft		
Cover leaf litter: 40%		
Cover bare ground: 50%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Chenopod
Height: 5-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: 10-30%	**Crown cover:** <10%	**Crown cover:** <10%
Dominant taxa		
Eucalyptus transcontinentalis	*Atriplex nummularia subsp. spathulata*	*Maireana triptera*
Other Taxa		
Eucalyptus clelandiorum	*Atriplex vesicaria*	*Maireana georgei*
	Eremophila pustulata	*Ptilotus obovatus* var. *obovatus*
	Eremophila scoparia	
	Maireana sedifolia	
	Scaevola spinescens	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 133-135
Quadrat: QW01	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 207
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Floodout		
Coarse fragments on the surface: Laterite/ 2-10%, 6-20mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/ Clay-loam/ Soft		
Cover leaf litter: 30%		
Cover bare ground: 50%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Chenopod
Height: 5-12m	**Height:** 1-3m	**Height:** <0.25m
Crown cover: <10%	**Crown cover:** 10-30%	**Crown cover:** <10%
Dominant taxa		
Eucalyptus salmonophloia	*Atriplex nummularia* subsp. *spathulata*	*Maireana triptera*
Other Taxa		
	Atriplex vesicaria	*Maireana carnosa*
	Enchylaena tomentosa	*Ptilotus obovatus* var. *obovatus*
	Eremophila scoparia	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 136-138
Quadrat: QW02	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 208
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Hillslope		
Coarse fragments on the surface: Laterite/ 20-50%, 6-20mm		
Rock outcrop (abundance/runoff):		
Soil (profile/field texture/soil surface): Brown/ Clay-loam		
Cover leaf litter: 50%		
Cover bare ground: 20%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Chenopod
Height: 5-12m	**Height:** 1-3m	**Height:** <0.25m
Crown cover: 10-30%	**Crown cover:** <10%	**Crown cover:** <10%
Dominant taxa		
Eucalyptus clelandiorum	*Eremophila scoparia*	*Maireana triptera*
Other Taxa		
	Acacia erinacea	
	Atriplex nummularia subsp. *spathulata*	
	Eremophila glabra	
	Eremophila pustulata	
	Scaevola spinescens	
	Senna artemisioides subsp. *filifolia*	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 139-141
Quadrat: QW03	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 209
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Hillslope		
Coarse fragments on the surface: Laterite/ 50-80%, 6-20mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/ Clay-loam/ Firm		
Cover leaf litter: 10%		
Cover bare ground: 85%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub	**Growth form:** Shrub	**Growth form:** N/A
Height: 1-3m	**Height:**	**Height:** -
Crown cover: 10-30%	**Crown cover:**	**Crown cover:** -
Dominant taxa		
Acacia acuminata	*Atriplex nummularia* subsp. *spathulata*	-
Other Taxa		
Casuarina pauper	*Dodonaea lobulata*	
Eremophila oldfieldii subsp. *angustifolia*	*Eremophila glabra*	
Exocarpos aphyllus	*Halgania andromedifolia*	
	Scaevola spinescens	
	Senna artemisioides subsp. *filifolia*	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 142-144
Quadrat: QW04	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 210
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Hillslope		
Coarse fragments on the surface: Laterite/ >90%, 20-50mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/ Clay-loam/ Firm		
Cover leaf litter: 10%		
Cover bare ground: 80%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Shrub	**Growth form:** Shrub	**Growth form:** N/A
Height: 3-5m	**Height:** 1-3m	**Height:** -
Crown cover: 10-30%	**Crown cover:** 10-30%	**Crown cover:** -
Dominant taxa		
Acacia acuminata	*Dodonaea lobulata*	
Other Taxa		
Acacia ramulosa var. *ramulosa*	*Eremophila glabra*	
Allocasuarina helmsii	*Scaevola spinescens*	
Hakea kippistiana		

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 152-154
Quadrat: QW05	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 211
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Hillslope		
Coarse fragments on the surface: Laterite/ >90%, 20-60mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/ Clay-loam/ Firm		
Cover leaf litter: 50		
Cover bare ground: 50		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 5-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: <10%	**Crown cover:** <10%	**Crown cover:** <10%
Dominant taxa		
Eucalyptus griffithsii	*Senna artemisioides subsp. filifolia*	*Olearia muelleri*
Other Taxa		
Casuarina pauper	*Acacia hemiteles*	*Westringia rigida*
	Atriplex nummularia subsp. *spathulata*	
	Atriplex vesicaria	
	Dodonaea lobulata	
	Eremophila interstans subsp. *interstans*	
	Eremophila oldfieldii subsp. *angustifolia*	
	Eremophila parviflora	
	Eremophila ?praecox (P2)	
	Solanum nummularium	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 155-157
Quadrat: QW06	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 212
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Hillslope		
Coarse fragments on the surface: Laterite/ 50-90%, 20-60mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/ Clay-loam/ Firm		
Cover leaf litter: 25%		
Cover bare ground: 50%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 5-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: <10%	**Crown cover:** <10%	**Crown cover:** <10%
Dominant taxa		
Eucalyptus salmonophloia	*Eremophila alternifolia*	*Atriplex vesicaria*
Other Taxa		
Pittosporum angustifolium	*Acacia erinacea*	
	Atriplex nummularia subsp. *spathulata*	
	Dodonaea lobulata	
	Eremophila glabra	
	Scaevola spinescens	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 158-160
Quadrat: QW07	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 212
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Floodout		
Coarse fragments on the surface: Laterite/ 10-20%, 20-60mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/Heavy clay / Hard setting		
Cover leaf litter: 5%		
Cover bare ground: 90%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Shrub
Height: -	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: -	**Crown cover:** <10%	**Crown cover:** <10%
Dominant taxa		
-	*Eremophila alternifolia*	*Mariana carnosa*
Other Taxa		
	Acacia hemiteles	*Asphodelus fistulous (W)*
	Atriplex nummularia subsp. *spathulata*	*Austrostipa elegantissima*
	Atriplex vesicaria	*Ptilotus obovatus* var. *obovatus*
	Dodonaea lobulata	*Salvia verbenaca (W)*
	Eremophila alternifolia	
	Eremophila scoparia	
	Lycium australe	
	Pittosporum angustifolium	
	Senna artemisioides subsp. *filifolia*	
	Senna cardiosperma	
	Solanum lasiophyllum	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 161-163
Quadrat: QW08	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 214
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Hillslope		
Coarse fragments on the surface: Laterite/ 50-90%, 20-60mm		
Rock outcrop (abundance/runoff): Nil/ Moderate		
Soil (profile/field texture/soil surface): Brown/ Clay-loam/ Firm		
Cover leaf litter: 70%		
Cover bare ground: 20%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree mallee	**Growth form:** Shrub	**Growth form:** Shrub
Height: 3-5m	**Height:** 1-3m	**Height:** <0.25-0.5m
Crown cover: 10-30%	**Crown cover:** 10-30%	**Crown cover:** <1%
Dominant taxa		
Eucalyptus ravida	*Atriplex nummularia* subsp. *spathulata*	*Maireana sedifolia*
Other Taxa		
Eucalyptus celastroides	*Atriplex vesicaria*	
	Enchylaena tomentosa	
	Eremophila alternifolia	
	Eremophila interstans subsp. *virgata*	
	Eremophila scoparia	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 164-167
Quadrat: QW09	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 215
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Plain		
Coarse fragments on the surface: Quartz/ <2%, 6-20mm		
Rock outcrop (abundance/runoff): Nil/ Very Slow		
Soil (profile/field texture/soil surface): Brown/ Clay-loam/ Soft		
Cover leaf litter: 40%		
Cover bare ground: 30%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 12-20m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: <10%	**Crown cover:** 10-30%	**Crown cover:** <1%
Dominant taxa		
Eucalyptus salmonophloia	*Eremophila scoparia*	*Olearia muelleri*
Other Taxa		
	Atriplex nummularia subsp. *spathulata*	*Ptilotus obovatus* var. *obovatus*
	Atriplex vesicaria	
	Exocarpos aphyllus	
	Pittosporum angustifolium	
	Scaevola spinescens	
	Senna artemisioides subsp. *filifolia*	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 168-170
Quadrat: QW10	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 216
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Plain		
Coarse fragments on the surface: Quartz, ironstone/ 20-50%, 20-50mm		
Rock outcrop (abundance/runoff): Nil/ Very Slow		
Soil (profile/field texture/soil surface): Brown/ Light medium clay/ Soft		
Cover leaf litter: <10%		
Cover bare ground: 80%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 12-20m	**Height:** 1-3m	**Height:** <0.25m
Crown cover: <10%	**Crown cover:** <10%	**Crown cover:** <1%
Dominant taxa		
Eucalyptus salmonophloia	*Eremophila scoparia*	*Frankenia setosa*
Other Taxa		
	Atriplex nummularia subsp. *spathulata*	*Austrostipa elegantissima*
	Atriplex vesicaria	*Marsdenia australis*
	Olearia muelleri	
	Senna artemisioides subsp. *filifolia*	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 171-173
Quadrat: QW11	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 217
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Floodout		
Coarse fragments on the surface: Ironstone/ 20-50%, 6-20mm		
Rock outcrop (abundance/runoff): Nil/ Very Slow		
Soil (profile/field texture/soil surface): Brown/ Clay-loam		
Cover leaf litter: 75%		
Cover bare ground: 20%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: Tree	**Growth form:** Shrub	**Growth form:** Shrub
Height: 5-12m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: 30-70%	**Crown cover:** 10-30	**Crown cover:** 10-30
Dominant taxa		
Eucalyptus celastroides	*Atriplex nummularia* subsp. *spathulata*	*Olearia muelleri*
Other Taxa		
	Alyxia buxifolia	*Austrostipa elegantissima*
	Atriplex vesicaria	
	Eremophila alternifolia	
	Eremophila interstans subsp. *interstans*	
	Eremophila scoparia	
	Exocarpos aphyllus	
	Maireana sedifolia	
	Pittosporum angustifolium	
	Senna artemisioides subsp. *filifolia*	
	Solanum nummularium	

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 176-178
Quadrat: QW12	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 218
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Floodout		
Coarse fragments on the surface: Mixed/ 20-50%, 20-50mm		
Rock outcrop (abundance/runoff): Nil/ Very Slow		
Soil (profile/field texture/soil surface): Brown/ Medium heavy clay/ Cracking, hard-setting		
Cover leaf litter: <10%		
Cover bare ground: 70%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Shrub
Height: -	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover: -	**Crown cover:** 30-70%	**Crown cover:** <10%
Dominant taxa		
-	*Eremophila interstans* subsp. *virgata*	*Sclerolaena cuneata*
Other Taxa		
	Atriplex nummularia subsp. *spathulata*	*Asphodelus fistulous (W)*
	Atriplex vesicaria	*Frankenia setosa*
	Solanum lasiophyllum	*Maireana pyramidata*
		Salvia verbenaca (W)
		Ptilotus exaltatus (A)

Project Name: Castle Hill		
Date: 3/11/2020	**Botanist:** JJ	**Photo (NW corner):** 184-186
Quadrat: QW13	**Quadrat size:** 20m x 20m	**Waypoint (NW corner):** 219
Aspect: SW	**Fire (yrs):** >40	**Condition rating:** Very Good
Landform: Floodout		
Coarse fragments on the surface: Mixed/ 20-50%, 20-50mm		
Rock outcrop (abundance/runoff): Nil/ Very Slow		
Soil (profile/field texture/soil surface): Brown		
Cover leaf litter: <10%		
Cover bare ground: 70%		
Upper stratum	**Mid-stratum**	**Lower stratum**
Growth form: N/A	**Growth form:** Shrub	**Growth form:** Shrub
Height: -	**Height:** 1-3m	**Height:** <1m
Crown cover: -	**Crown cover:** 30-70%	**Crown cover:** <10%
Dominant taxa		
-	*Eremophila interstans* subsp. *virgata*	*Maireana pyramidata*
Other Taxa		
	Atriplex nummularia subsp. *spathulata*	*Asphodelus fistulous (W)*
	Atriplex vesicaria	*Frankenia setosa*
	Eremophila scoparia	*Salvia verbenaca (W)*
	Solanum nummularium	*Sclerolaena cuneata*
		Solanum lasiophyllum

Appendix 11: Quadrat Photos

CH 1



CH 2



CH 3



CH 4



CH 5



CH 6



CH 7



CH 8



CH 9



CH 10



CH 11



CH 12



CH 13



CH 14



CH 15



CH 16



CH 17



CH 18



CH 19



CH 20



CH 21



CH 22



CH 23



CH 24



CH 25



CH 26



CH 27



CH 28



CH 29



CH 30



CH 31



CH 32



CH 33



CH 34



CH 35



CH 36



CH 37



CH 38



CH 39



CH 40



CH 41



CH 42



CH 43



CH 44



CH 45



CH 46



CH 47



CH 48



CH 49



CH 50



CH 51



CH 52



CH 53



CH 54



CH 55

B 1



B 2



B 3



B 4



B 5



B 6



B 7



B 8



B 9



B 10



B 11



B 12



B 13



B 14



B 15



B 16



B 17



B 18



B 19



B 20



QE 1



QE 2



QE 3



QE 4



QE 5



QE 6



QE 7



QE 8



QE 9



QE 10



QE 11



QE 12



QW 1



QW 2



QW 3



QW 4



QW 5



QW 6



QW 7



QW 8



QW 9



QW 10



QW 11



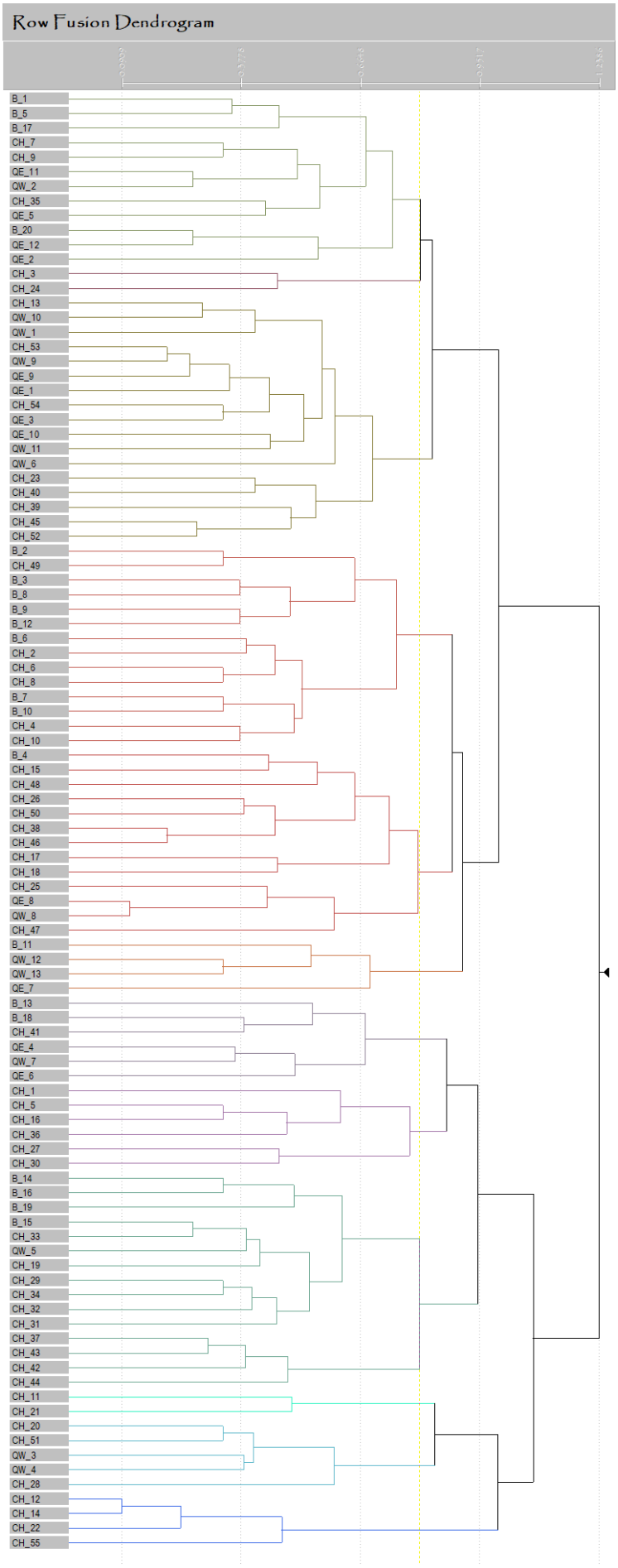
QW 12

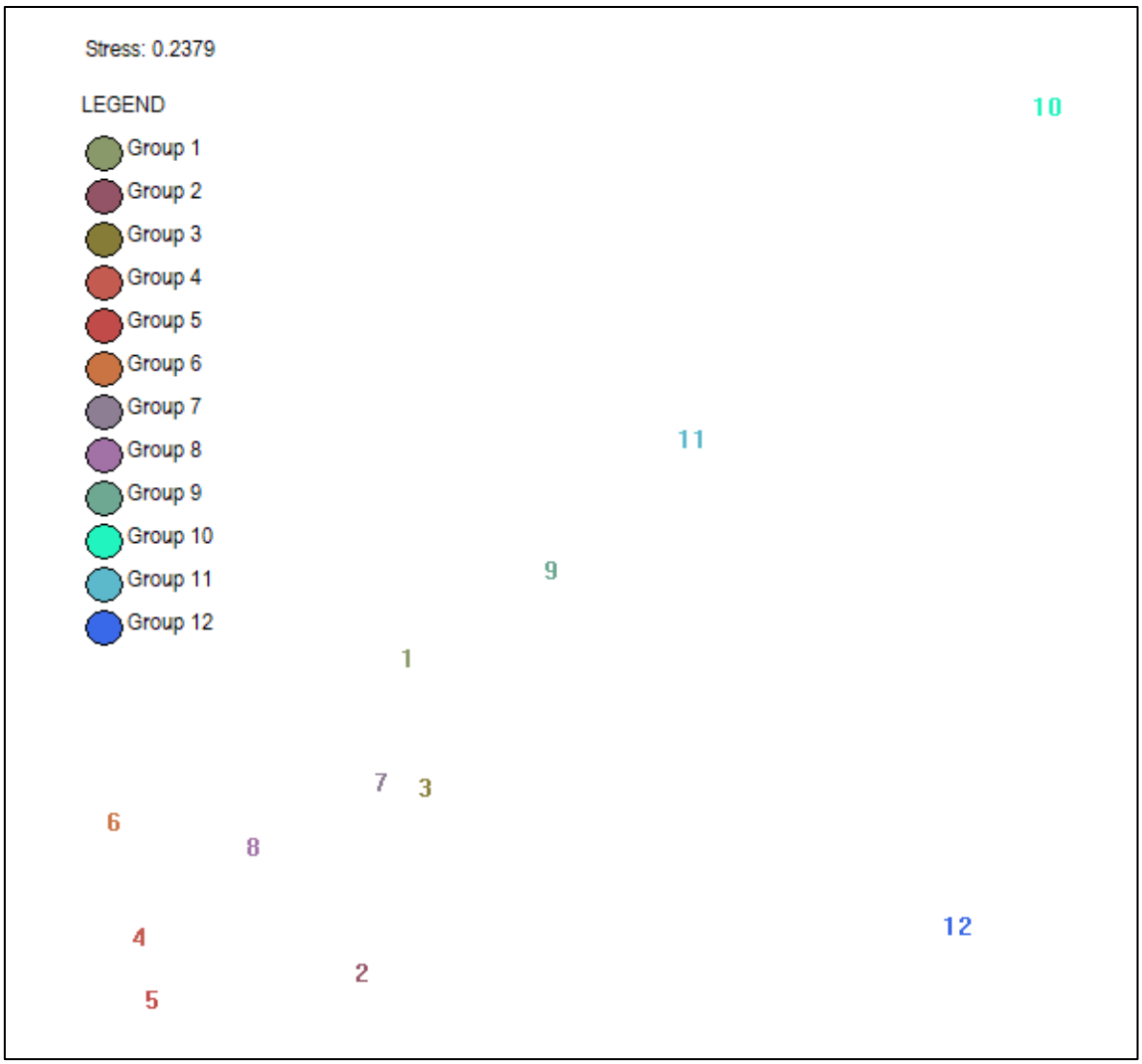


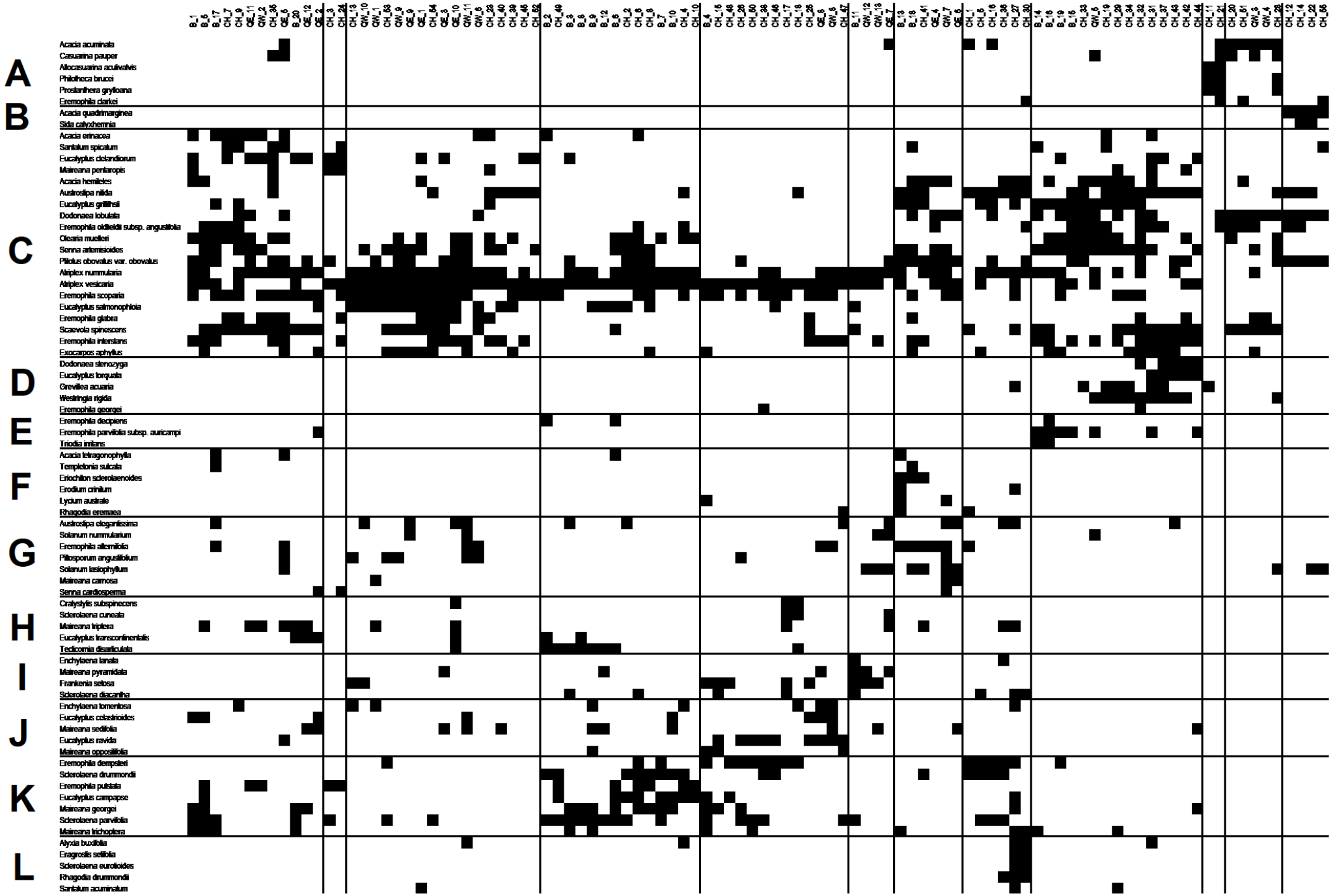
QW 13



Appendix 12: PATN Analysis




Stress: 0.2379
LEGEND
Group 1
Group 2
Group 3
Group 4
Group 5
Group 6
Group 7
Group 8
Group 9
Group 10
Group 11
Group 12
10
11
9
1
7
3
6
8
12
4
2
5


A
B
C
D
E
F
G
H
I
J
K
L
Acacia acuminata
Casuarina pauper
Allocasuarina acutivalvis
Philotheca brucei
Prostanthera grylloana
Eremophila clarkei
Acacia quadrimarginea
Sida calyxhemnia
Acacia erinacea
Santalum spicatum
Eucalyptus clelandiorum
Maireana pentaropis
Acacia hemiteles
Austrostipa nitida
Eucalyptus grillihsii
Dodonaea lobulata
Eremophila oldfieldii subsp. angustifolia
Olearia muelleri
Senna artemisioides
Ptilotus obovatus var. obovatus
Atriplex nummularia
Atriplex vesicaria
Eremophila scoparia
Eucalyptus salmonophloia
Eremophila glabra
Scaevola spinescens
Eremophila interstans
Exocarpos aphyllus
Dodonaea stenozyga
Eucalyptus torquata
Grevillea acuaria
Westringia rigida
Eremophila georgei
Eremophila decipiens
Eremophila parvifolia subsp. auricampi
Triodia irritans
Acacia tetragonophylla
Templetonia sulcata
Eriochiton sclerolaenoides
Erodium crinitum
Lycium australe
Rhagodia eremaea
Austrostipa elegantissima
Solanum nummularium
Eremophila alternifolia
Pittosporum angustifolium
Solanum lasiophyllum
Maireana carnosa
Senna cardiosperma
Cratystylis subspinescens
Sclerolaena cuneata
Maireana triptera
Eucalyptus transcontinentalis
Tecticornia disarticulata
Enchylaena lanata
Maireana pyramidata
Frankenia setosa
Sclerolaena diacantha
Enchylaena tomentosa
Eucalyptus celastrioides
Maireana sedifolia
Eucalyptus ravida
Maireana oppositifolia
Eremophila dempsteri
Sclerolaena drummondii
Eremophila pulstata
Eucalyptus campaspe
Maireana georgei
Sclerolaena parvifolia
Maireana trichoptera
Alyxia buxifolia
Eragrostis setifolia
Sclerolaena eurotioides
Rhagodia drummondii
Santalum acuminatum

Appendix D:

Botanica Targeted Priority Flora Study 2021

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Tari Laatz
Superintendent - Environment
Evolution Mining Limited
Tari.Laatz@evolutionmining.com

28th September 2021

Memorandum: Targeted Priority Flora Survey-Castle Hill

Botanica Consulting Pty Ltd (Botanica) was commissioned by Evolution Mining Limited (Evolution) to undertake a targeted Priority flora survey to visit previous records of two Priority flora species and search suitable habitat for potential new populations within the Castle Hill Project Area. The findings of the survey will be used to support a Native Vegetation Clearing Permit (NVCP) application and Mining Proposal (MP) with regards to the further development of the Castle Hill Project.

The survey area is 2,692 ha in extent and is located approximately 40 km north-west of Kalgoorlie-Boulder, Western Australia (Figure 1). Detailed flora/ vegetation surveys and basic fauna surveys were conducted in the survey area by Botanica in 2013, 2014 and 2020 (Figure 2). Phoenix Environmental Sciences surveyed the Haul Road section of this survey area in 2018 (Phoenix 2019), and Spectrum surveyed part of the Castle Hill survey area in 2019 (Spectrum 2019).

Fieldwork for this targeted Priority flora survey was conducted on the 1st September 2021 by two Botanica personnel; Jennifer Jackson (Senior Botanist, BSc Environmental Management (Honours)), and Michelle Luinstra (Environmental Consultant, BSc Biology). A handheld GPS was used to record the locations of tracks traversed (Figure 3) and locations of any conservation significant flora/ vegetation (recorded in GDA 94 format). The survey area was traversed on foot and four wheel drive vehicle.

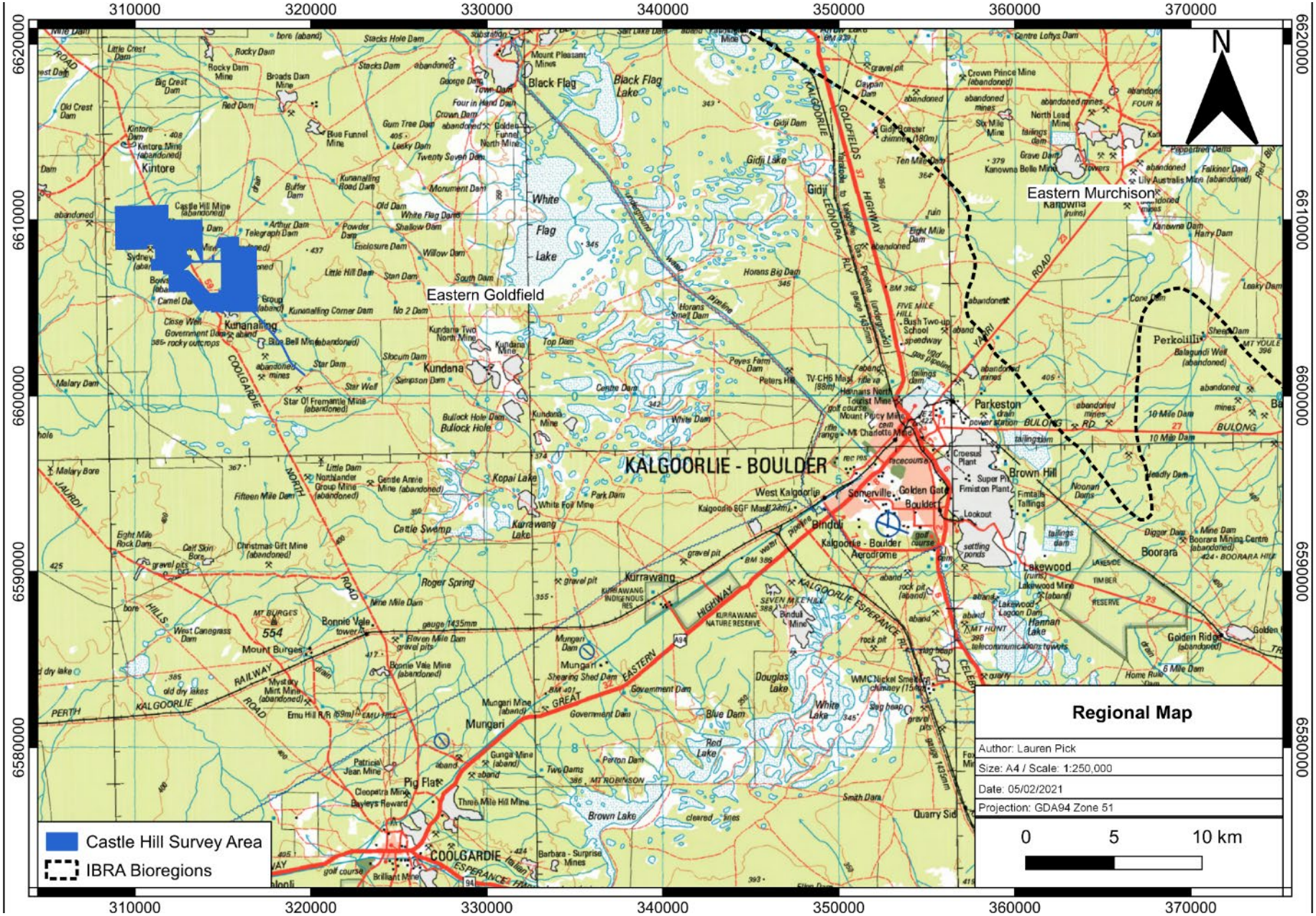

Figure 1. Regional Map

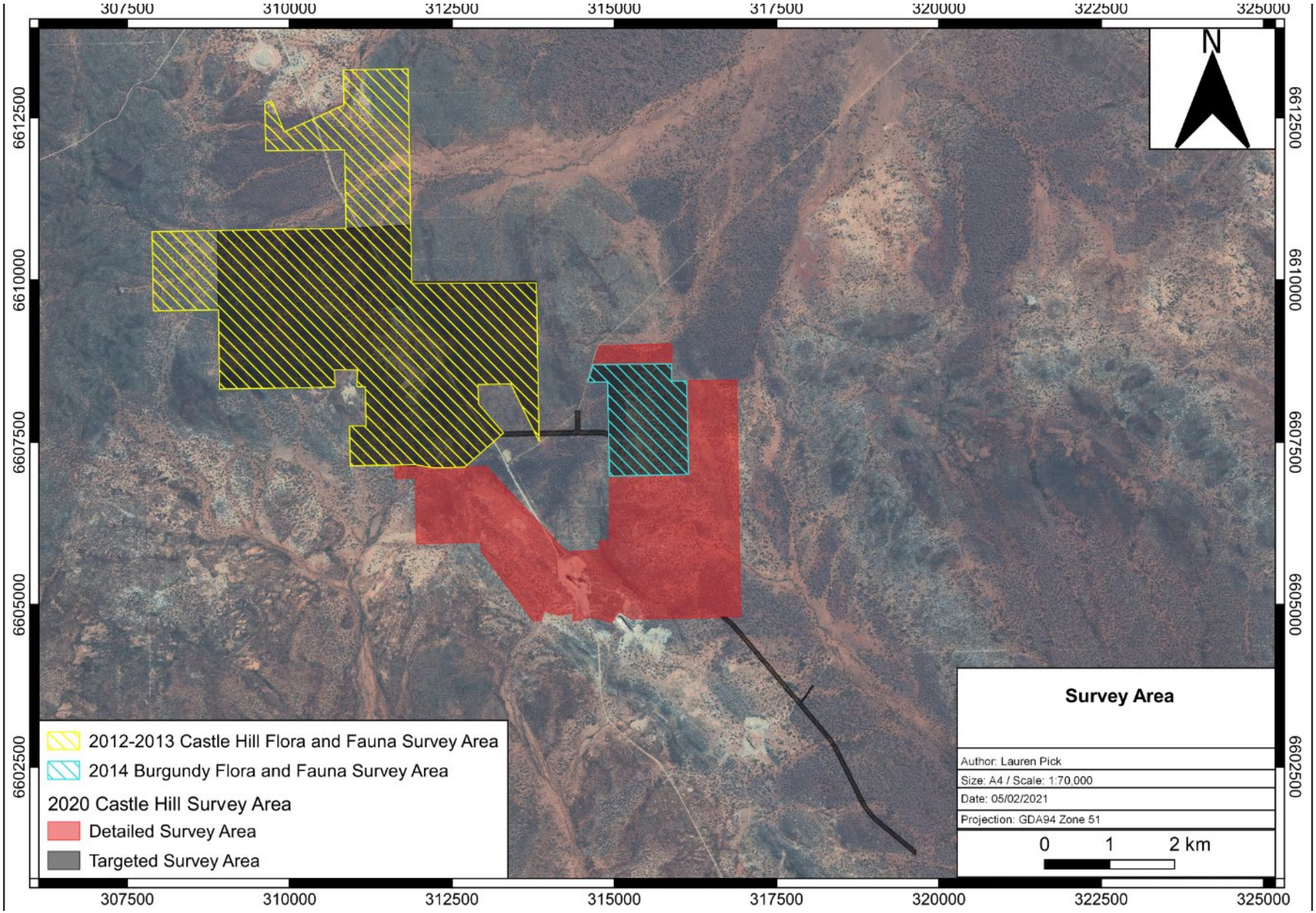

Figure 2: Castle Hill Survey area

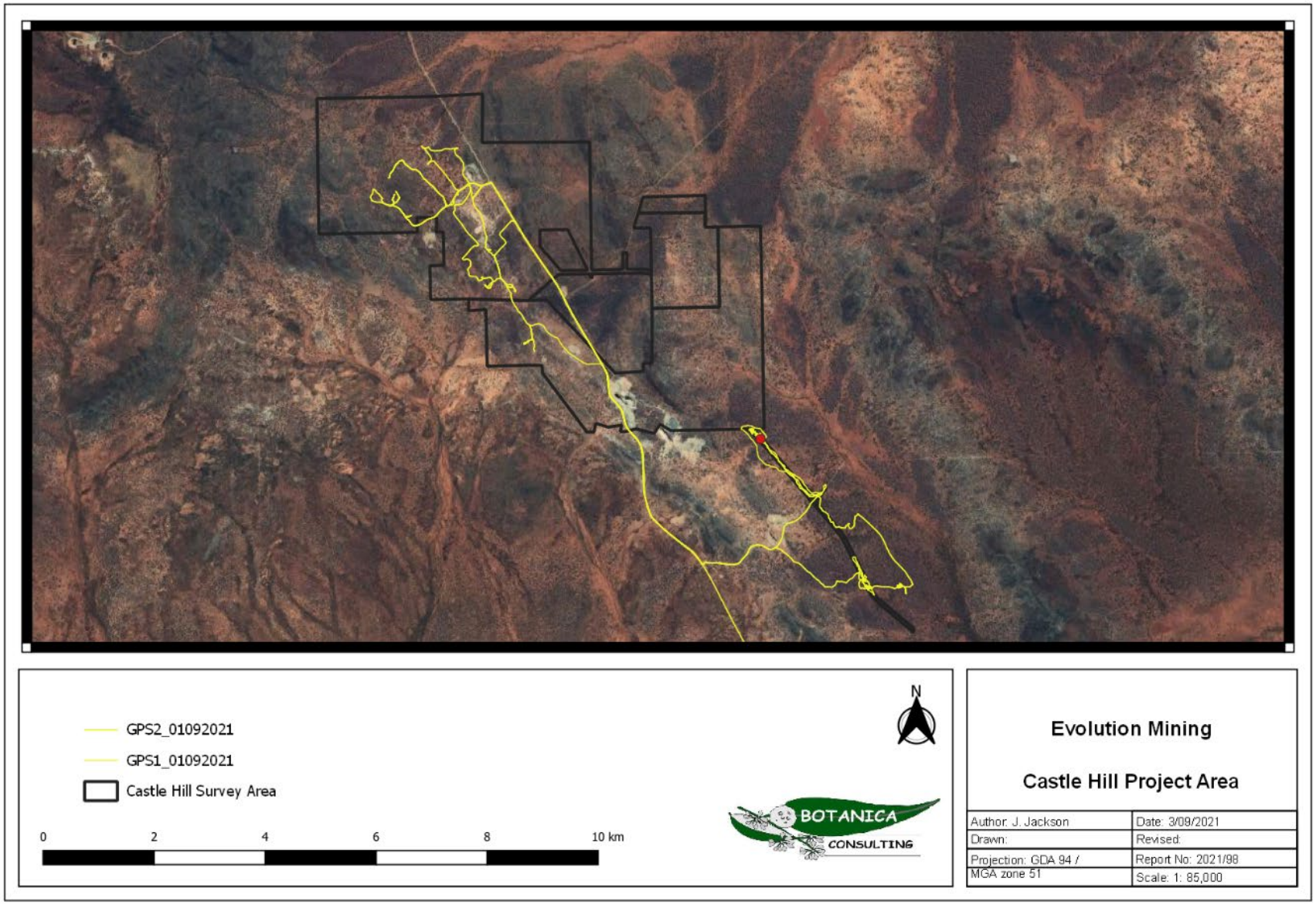

Figure 3: Tracks traversed

1 Background Information

Prior to the field assessment a literature review was undertaken of previous flora and vegetation assessments conducted within the local region and references related to the two Priority flora. Documents reviewed included:

- Botanica (2013). *Level 2 Flora & Vegetation Survey for the Castle Hill Project.* Prepared for Phoenix Gold Ltd, September 2013.
- Botanica (2014). *Level 2 Flora & Vegetation Survey for the Burgundy Project*. Prepared for Phoenix Gold Ltd, September 2014.
- Botanica (2021). *Castle Hill Project: Detailed Flora/ Vegetation Survey and Basic Fauna Survey.* Prepared for Evolution Mining Ltd, February 2021.
- Brown, A. & Buirchell, B. (2011). A Field Guide to the Eremophilas of Western Australia. *(1st ed.).* Hamilton Hill, W.A.: Simon Nevill Publications.
- Chinnock, R.J. (Bob) (2007). *Eremophila and allied genera: a monograph of the plant family* Myoporaceae (1st ed.). Dural, NSW: Rosenberg.
- Obbens, F. J. (2018). Three new perennial species of *Calandrinia* (Montiaceae) from southern Western Australia. Nuytsia 29: 193-204.
- Phoenix (2019). *Flora and vegetation survey for Mungari Gold Operations Cutters Ridge Project.* Prepared for Evolution Mining Ltd, May 2019.
- Spectrum Ecology (2019a). *Rayjax & Castle Hill Reconnaissance Flora & Level 1 Fauna Survey.* Prepared for Evolution Mining Ltd, September 2019.
- Spectrum Ecology (2019b). *Evolution Mining Targeted Flora Search Calandrinia lefroyensis/quartzitica: Memorandum*. Prepared for Evolution Mining Ltd, November 2019.
- Spectrum Ecology (2019c). *Cutters Ridge Haul Road Calandrinia Targeted Flora Survey Memorandum.* Prepared for Evolution Mining Ltd, September 2019.

The two Priority flora targeted for this survey were *Eremophila praecox* (P2), and *Calandrinia lefroyensis* (P1).

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Unlike Threatened flora, Priority flora do not need approval from the Minister for the Environment to take, however permission to take is usually considered and granted by the Department of Biodiversity, Conservation and Attractions (DBCA).

1.1 Eremophila praecox

Eremophila praecox is Priority 2 flora, meaning it is a poorly known species.

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

E. praecox is a broom-shaped shrub which grows to a height of between 0.3 and 1.5 m. The flowers are purple, tinged white on the outside. Flowering occurs from October to December and is followed by fruits which are dry, woody, cone-shaped to oval-shaped (ALA, 2021).

E. praecox is known from approximately 13 populations in the general Kalgoorlie area. There are 34 collections of *E. praecox* in the WA Herbarium, and together with records from DBCA's Threatened and Priority Flora database (TPFL), these represent approximately 13 populations (DBCA, 2021b). 12 of these populations are within a 50 km radius of Kalgoorlie-Boulder, one of these populations is approximately 40 km southeast of Kambalda (Figure 4). It is It is also known to occur in the western part of the Eyre Peninsula in South Australia. It generally grows in red-brown sandy loam with other eremophila species. The total number of plants is not known, but it usually grows as scattered individuals and no large population is known (Chinnock, 2007).

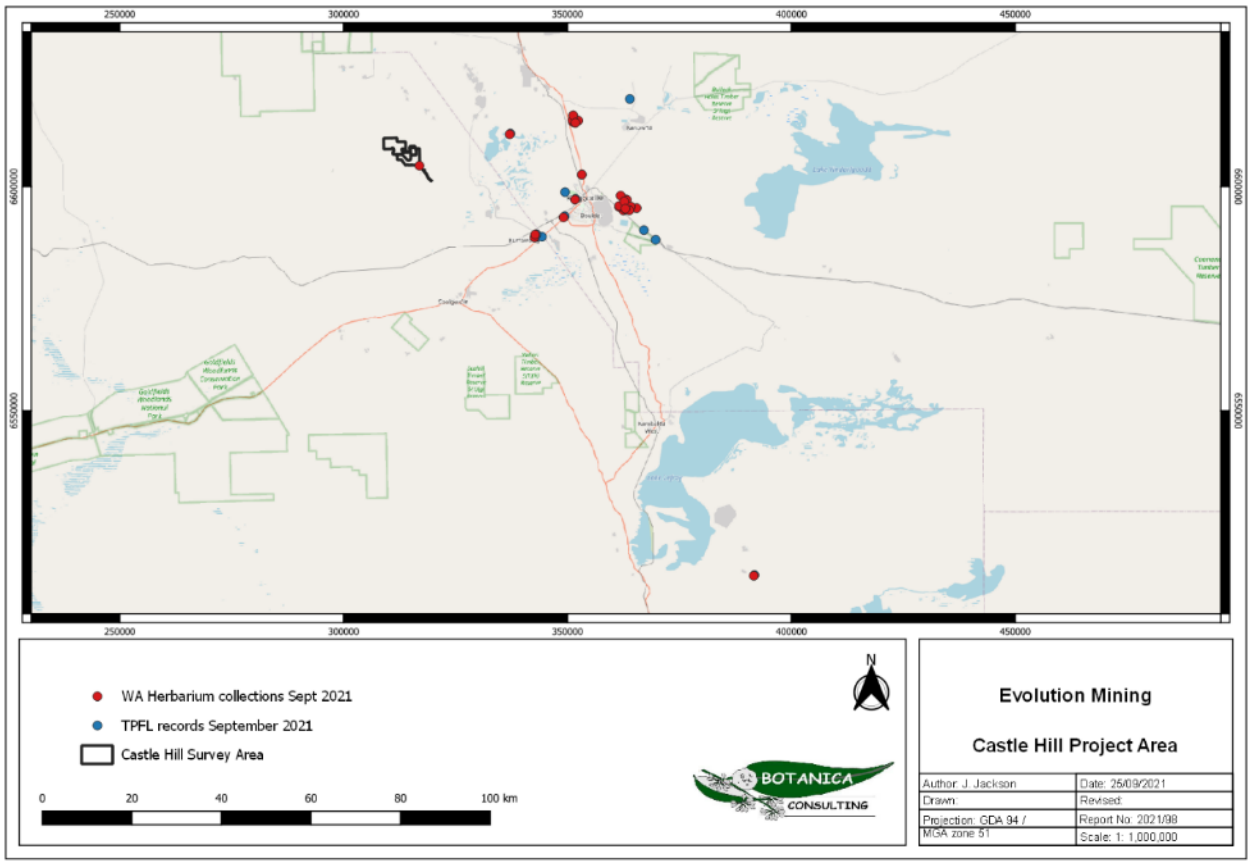

Figure 4. *Eremophila praecox* in relation to the Castle Hill Project Area.

This species was first formally described by Robert Chinnock in 2007 from specimens he collected north of Kalgoorlie in 1986. It is thought that *E. praecox* is a hybrid of *E. ionantha* and *E. parvifolia* and these species are usually found growing with *E. praecox* (Brown and Buirchell, 2011). However Chinnock (2007) notes that the possible species combination that may result in a hybrid are not present in both WA and SA. Genetic work would be needed to resolve this issue.

Phoenix (2019) identified three *E. praecox* plants during their 2018 surveys, which were in or near the proposed haul road envelope of the Castle Hill survey area. Botanica (2021) identified what may have been *E. praecox* during the 2020 surveys of the Castle Hill survey area. It wasn't flowering at the time of the survey so it was not conclusive that it was *E. praecox*. These previous records were targeted for this survey, and the areas surrounding these locations were searched for more *E. praecox* plants.

1.2 Calandrinia lefroyensis

Calandrinia lefroyensis is Priority 1 flora, meaning it is a poorly known species.

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

C. lefroyensis is a semi-erect to erect perennial herb with a scrambling habit and is usually found scrambling through other plants. It grows to 135–260 mm tall and has very fleshy, narrowly obovate to obovate, occasionally broader stem leaves. It flowers and fruits from early October to mid- November, but a longer flowering/fruiting period is possible. The flowers are mid pink to dark pink (Obbens, 2018).

C. lefroyensis occurs on salt-lake flats among samphire communities. The soils are brown silty loams or brown-grey sandy clays. In general, *C. lefroyensis* appears to favour the outer edges of samphire communities including within the ecotone of adjacent communities where there are open assemblages of taller species such as *Casuarina obesa* and *Eucalyptus* spp. It has also been collected up to several hundred metres from the lake shoreline. Associated species at the known sites include *Atriplex nana*, *Maireana glomerifolia*, *Tecticornia doliiformis*, *Frankenia setosa*, *Senecio pinnatifolius* and *Austrostipa* sp (Obbens, 2018).

C. lefroyensis is known from nine populations over a range of about 180 km, from northwest of Kalgoorlie to northeast of Norseman (DBCAa, 2021).

Phoenix (2019) found what potentially was *C. lefroyensis* in an area south of the Castle Hill survey area and at two sites within the survey area. Evolution engaged Spectrum Ecology to undertake a targeted survey for *Calandrinia* species within and surrounding the Cutters Ridge Haul Road. The aim of these targeted searches was to determine the taxonomy of the *Calandrinia* species present, its local and regional extent and the potential impact of the construction of the Cutters Ridge Haul Road. Specimens recorded during this targeted *Calandrinia* survey were identified as *Calandrinia eremaea, C. disperma* and *C. ?hortiorum*; no *C. lefroyensis* were recorded.

Evolution also engaged Spectrum Ecology to complete a Targeted Flora Survey for the two Priority 1 Flora species, *C. lefroyensis* and *C. quartzitica* in an area immediately surrounding the proposed Rayjax mine and the Mungari Operations. Three populations of *Calandrinia lefroyensis* were recorded during this survey totalling 253 individual plants. No populations of *Calandrinia quartzitica* were recorded. The plants were always found growing up through a low shrub, usually a Samphire or *Frankenia* sp and the habitat they were found in was described as salt-lake flats among samphire communities.

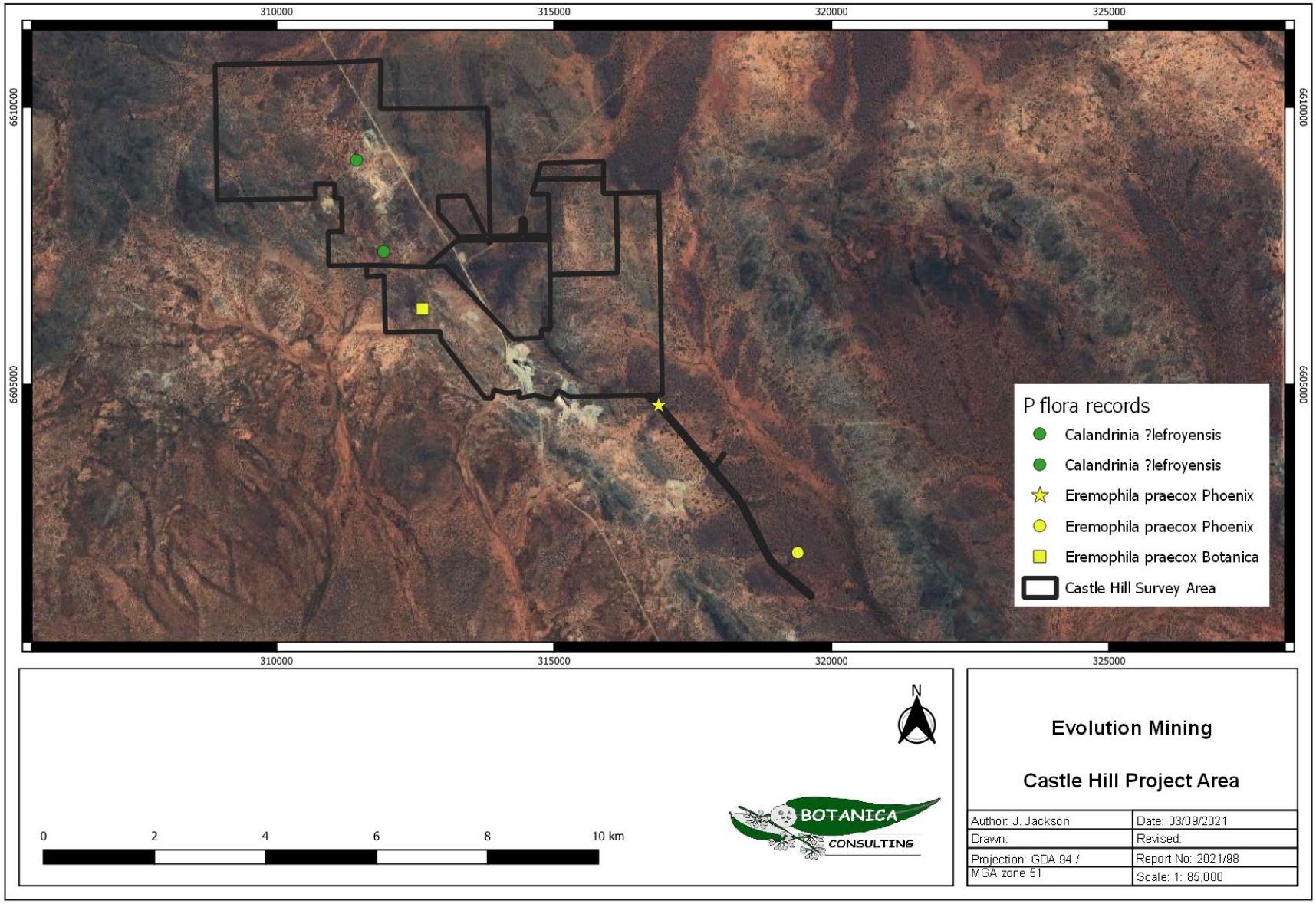

Figure 5: Priority Flora records targeted for this survey

2 Results

2.1 *Eremophila praecox*

The record from the Botanica 2020 survey (51J 312624 6606361) was revisited and was confirmed to be *Hybanthus floribundus.*

The first record from the Phoenix survey (51J 319390 6601964) was searched for and no *Eremophila praecox* were found. An area of approximately 100 m surrounding this point was searched, and no *E. praecox* were seen.

The second record (51J 316881 6604620) was revisited and two *E. praecox* plants were found growing amongst a mixed Eucalypt woodland of *Eucalyptus transcontinentalis* and *E. clelandiorum* woodland over *Eremophila scoparia, E. interstans* subsp. *interstans, E. parvifolia*, *E. ionantha, Senna artemisioides* subsp. *filifolia*, *Atriplex nummularia*, *Maireana sedifolia* and *Olearia muelleri.* An area of approximately 300 m surrounding these plants was searched and no more *E. praecox* were seen.

An area of the proposed Haul Road envelope was walked, and no more *E. praecox* were seen. This area was also surveyed previously by Botanica in 2020 and partly by Phoenix in 2018. The Botanica tracks traversed and locations of the *E. praecox* plants are presented in Figure 5**.**

2.2 *Calandrinia ?lefroyensis*

The two previous locations of *Calandrinia ?lefroyensis/quartzitica* in the Castle Hill survey area were visited. At both sites *Calandrinia eremaea* was seen. This aligns with the findings from the Spectrum memo (2019c), where the specimens collected by Spectrum were identified as *Calandrinia eremaea, C. disperma* and/or *C. ?hortiorum*; and no *C. lefroyensis* or *C. quartzitica* were recorded. No Samphire or Frankenia shrubs were seen in these areas, and therefore it is assumed that *C. lefroyensis* is not present at these locations. No habitat that would suit the *C. lefroyensis*, salt-lake flats among samphire communities was seen anywhere in the Castle Hill survey area.

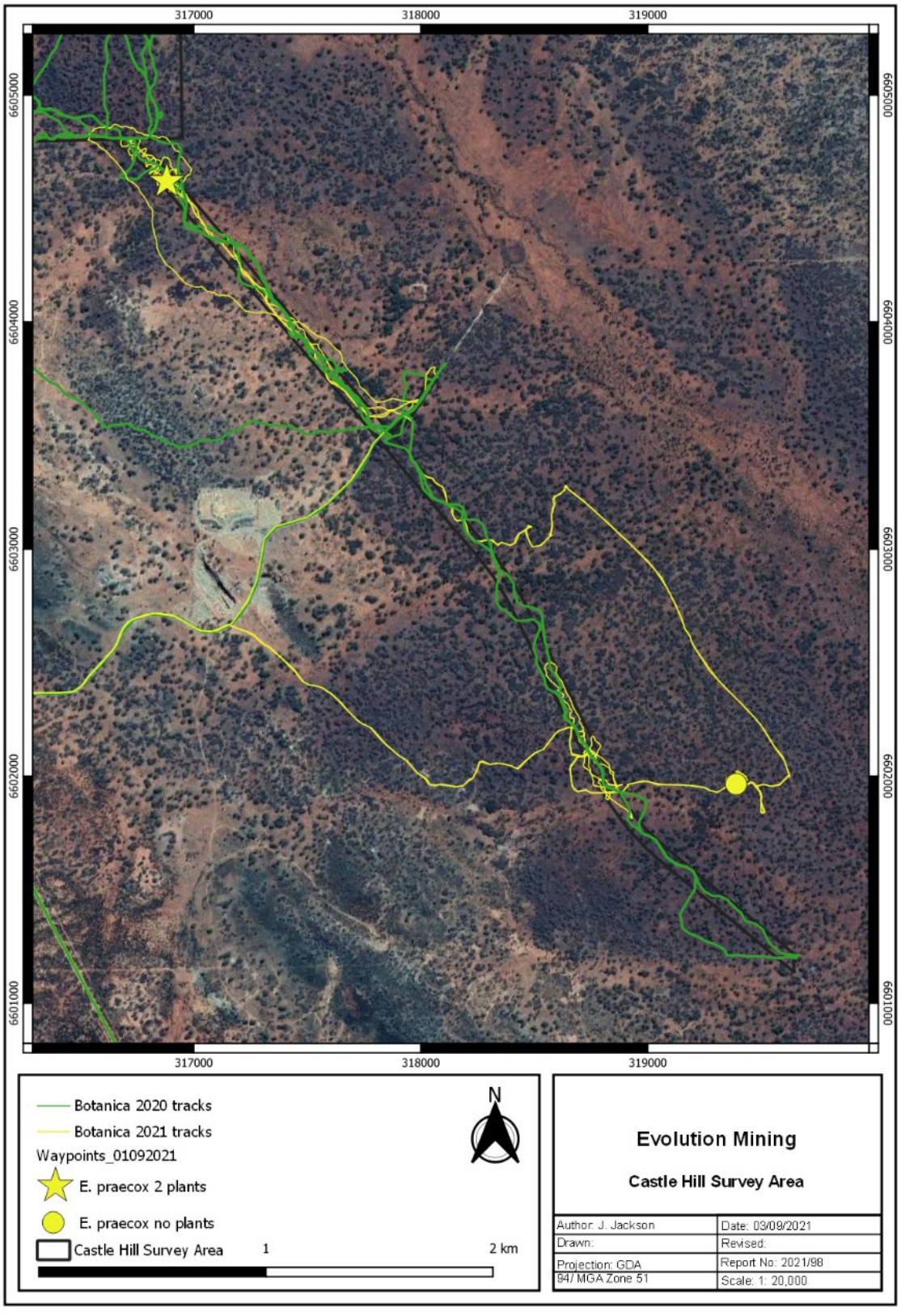

Figure 6: *Eremophila praecox* records and tracks traversed in the Haul Road envelope

3 Conclusions and Recommendations

The two plants of *Eremophila praecox* are within the proposed Haul Road and Evolution have advised this alignment can't be moved. *E. praecox* is generally only known from one or two plants in each population, and the populations known are scattered and there appears to be no consistency to its growing patterns. Given that a large area of the Castle Hill survey area has been traversed previously and no more *E. praecox* were seen, this is likely correct.

It is very unlikely that *Calandrinia lefroyensis* is present in the Castle Hill survey area given that no suitable habitat is present.

It is recommended that:

- Evolution applies to DBCA to take two plants of Priority flora *Eremophila praecox* (P2),
- Consider salvaging the plants to donate to Kalgoorlie Boulder Urban Landcare Group to grow plants from cuttings.

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Botanica (2014). *Level 2 Flora & Vegetation Survey for the Burgundy Project*. Prepared for Phoenix Gold Ltd, September 2014.

Botanica (2021). *Castle Hill Project: Detailed Flora/ Vegetation Survey and Basic Fauna Survey.* Prepared for Evolution Mining Ltd, February 2021.

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Spectrum Ecology (2019a). *Rayjax & Castle Hill Reconnaissance Flora & Level 1 Fauna Survey.* Prepared for Evolution Mining Ltd, September 2019.

Spectrum Ecology (2019b). *Evolution Mining Targeted Flora Search Calandrinia lefroyensis/quartzitica: Memorandum*. Prepared for Evolution Mining Ltd, November 2019.

Spectrum Ecology (2019c). *Cutters Ridge Haul Road Calandrinia Targeted Flora Survey Memorandum.* Prepared for Evolution Mining Ltd, September 2019.

Appendix E:

Application to Take Priority Flora – Submission to DBCA

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ABN 47141175297

Attention: Katherine Hope

4th October 2021

Regional Leader Nature Conservation
Goldfields Region
Parks and Wildlife Service
Department of Biodiversity, Conservation and Attractions
32 Brookman Street, Kalgoorlie

RE: Proposed Clearing-Evolution Mining Castle Hill Project

Evolution Mining Ltd (Evolution) propose to develop the Castle Hill Project as part of the Mungari operations. The Mungari operation is a key asset in the Evolution portfolio which consists of underground mining at Frog's Leg, open pit mining at White Foil and Cutters Ridge with a substantial regional tenement package to the north around Castle Hill hosting a total Mineral Resource of 51 million tonnes grading 1.47g/t gold for 2.4 million ounces.The Castle Hill Project is located within the Eastern Goldfield (COO3) subregion of the Coolgardie Bioregion, approximately 40 km north-west of Kalgoorlie-Boulder.

Detailed flora/ vegetation surveys and basic fauna surveys were conducted in the Project area by Botanica in 2013, 2014 and 2020. Phoenix Environmental Sciences surveyed the Haul Road section of this survey area in 2018, and Spectrum surveyed part of the Castle Hill survey area in 2019.

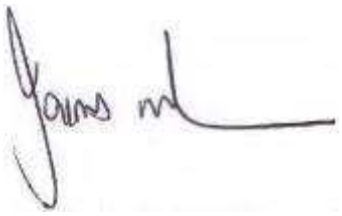
Botanica Consulting Pty Ltd (Botanica) was commissioned by Evolution to undertake a targeted Priority flora survey to revisit records of Priority flora species identified from these surveys. This Priority flora survey was conducted on the 31st August 2021 by two Botanica personnel; Jennifer Jackson (Senior Botanist, BSc Environmental Management (Honours)), and Michelle Luinstra (Environmental Consultant, BSc Biology).

Evolution propose to submit a Native Vegetation Clearing Permit (NVCP) application and Mining Proposal with regards to the further development of the Castle Hill Project. However, the targeted Priority flora survey conducted by Botanica identified that one Priority Flora taxon (*Eremophila praecox*) is located within the clearing permit area, with 2 plants located within the area of the proposed haul road.

On behalf of Evolution, Botanica are submitting this letter to notify DBCA of the proposed clearing and to seek approval to impact one Priority Flora. The proposed clearing will result in impacts to 2 plants of *Eremophila praecox* (P2). An Application for Authorisation to take Priority flora has been completed and is attached with this letter. The Memo detailing the Priority flora survey is also attached.

We appreciate the DBCA's time and consideration of this application and if you wish to discuss further, please don't hesitate to contact me.

Regards,



Jim Williams
Director
Botanica Consulting

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

APPLICATION FOR AUTHORISATION
UNDER SECTION 40 OF THE *BIODIVERSITY CONSERVATION ACT 2016*
TO TAKE PRIORITY FLORA

IN A MANAGEMENT OPERATION (NON-DBCA)

NOTE TO APPLICANTS:

- Please complete ALL sections.
- Applications for Threatened Flora Authorisations must be submitted at least 6 weeks prior to the proposed "taking" of the species.
- **Completed application form to be scanned and emailed** to: flora.data@dbca.wa.gov.au with all relevant attachments, or forwarded to: Flora Administrative Officer, Species and Communities Program, Department of Biodiversity, Conservation and Attractions, Locked Bag 104 Bentley Delivery Centre WA 6983.
- To take includes to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means.
- An application for a Threatened Flora Authorisation should also be completed for any activity that has the potential, whether directly or indirectly, of taking Threatened Flora for a determination as to whether Authorisation is required.
- A submission will be forwarded to the Hon Minister for Environment (or their delegate), based on this application.
- Information on the location of Threatened Flora populations can be requested through Species and Communities Program by emailing flora.data@dbca.wa.gov.au
- A list of the current Threatened Flora can be obtained from DBCA's website at http://www.dbca.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants
- Further information may be obtained from the department's Flora Administrative Officer, **9219 9513**. Species & Communities Program, Department of Biodiversity, Conservation and Attractions.

SECTION 1

1. Applicant details (Name of the individual to whom a permit is to be issued):		
Title: Ms	Surname: Laatz	First name: Tari
Job title: Environment Superintendent	Contact phone number: 9268 4072	
Company/group/institution (if applicable): Evolution Mining Ltd		
Residential/Street address: Kundana Road, Kalgoorlie		Postcode: 6430
Postal address: PO Box 10398, Kalgoorlie		Postcode 6433
Previous permit no. Expiry date: NA	Email address: Tari.Laatz@evolutionmining.com	

2. **Signed:**		**Date:**	**30 September 2021**

SECTION 2

3. Scientific name(s) of Threatened Flora to be taken: (if more than one taxon please list all)

Eremophila praecox Chinnock

4. Date(s) of the proposed activity which will result in taking of Threatened Flora:

Anticipated approximately Q4 of 2023	to	Q1 of 2024 pending project approval

5. Location of proposed activity: (please attach a map)

Castle Hill, 40 km NW of Kalgoorlie, Shire of Coolgardie. The specific location is miscellaneous license L16/126, which is also overlain by the Mt Burges Pastoral Lease (N050354).

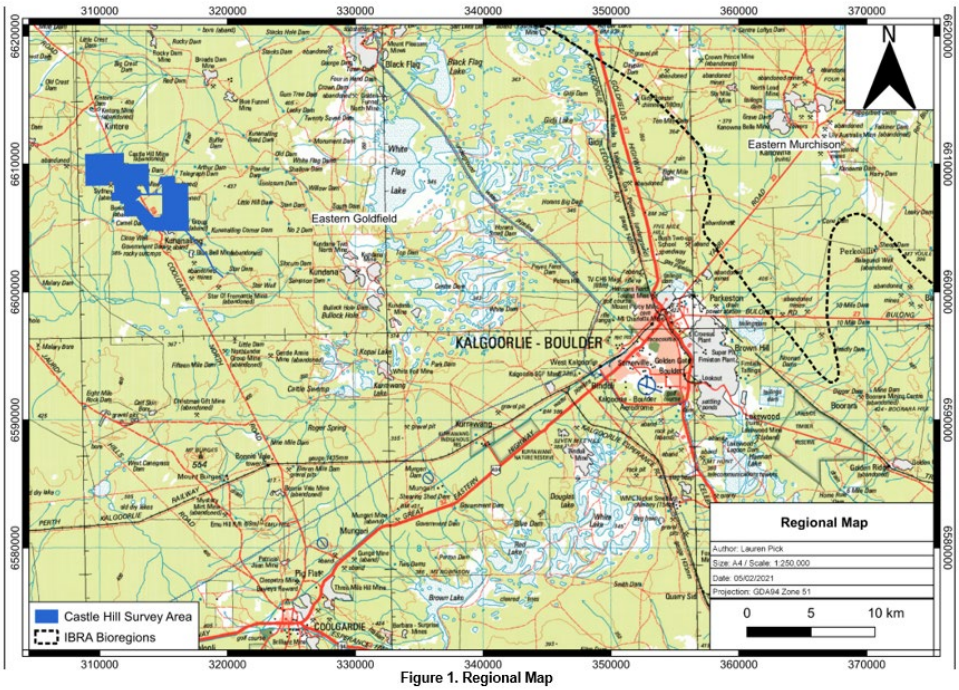


Figure 1. Regional Map

6. Nature of the proposed activity (for burning indicate likely fire intensity and relevant information such as ignition plan, time since last fire):

Note: "to take" also refers to inadvertent or accidental impact to the Threatened Flora and surrounding habitat. If renewing a Threatened Flora Authorisation, also include details here of what was taken under the previous authorisation and why you require the authorisation to be renewed.

Vegetation clearing, 2 plants of *Eremophila praecox* will be cleared.

(a) Purpose of and need for the proposed activity:

To develop the Castle Hill mine as part of the Mungari operations.

The Mungari operation is a key asset in the Evolution portfolio and consists of underground mining at Frog's Leg, open pit mining at White Foil and Cutters Ridge with a substantial regional tenement package to the north around Castle Hill hosting a total Mineral Resource of 51 million tonnes grading 1.47g/t gold for 2.4 million ounces.

(b) Consequence of not carrying out the operation:

The Evolution mining employs approximately 620 people at the Mungari Operations and contributes on average around $40M to the Kalgoorlie-Boulder economy through mostly local procurement, and also to sponsorships and donations. Not carrying out the operation will jeopardise this and have a negative impact on the Kalgoorlie -Boulder and Western Australian economies and employment prospects.

(c) Mitigation process:

Demonstrate that impacts to the Threatened Flora have been avoided or minimised where possible. Where a significant impact to the Threatened Flora may occur as a result of the proposed activity, detail what steps will be taken to reduce the longer-term impact.

The haul road is constrained by an approximately 60m wide miscellaneous tenement boundary, and hence is unable to be rediverted to avoid the plant location.

(d) Cost of alternative measures: (eg. to exclude Threatened Flora from burning; include any change in fire risks)

There are no alternative measures.

7. Registered DBCA Database Population Number/s of the Threatened Flora (if known):	New population, first identified and collected from in 2018 (PERTH 09274804).

(a) Total number(s) and condition of plants in Priority Flora population(s) subject to the proposed activity (include reproductive maturity):

There are two plants in this population.

(b) Number(s) of plants and parts of plants likely to be taken (e.g. leaves, flowers, fruits, seeds on ground, stem, roots, above ground plants, whole plants) **at the time proposed:**

The two plants will be taken.

8. Total number of populations, number of plants and condition of the species:

(a) in the local context:

Locally there is only this population known, of 2 plants.

(b) on all lands if known: (attach a table if necessary)

Table attached

9. Detail regenerative characteristics of the Threatened Flora as applicable to activity, e.g. recovery after fire:

Not known

10. Detail proposals for monitoring the effect of the activity on the Threatened Flora:

There will be no monitoring as both plants will be taken.

11. Presence of other conservation significant species or communities

A. Are there any known or potential populations of **Priority Flora** on the lands to be affected by the activity?:
NO ☒ YES ☐ Please complete question 12.

B. Are there any known or potential **Threatened and/or Priority Ecological Communities** within lands to be affected by the activity?:
NO ☒ YES ☐ You may require a Threatened Ecological Community Authorisation. Please refer to [https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities]

Detail the species and its critical habitat

12. Please list known or potential Priority flora which occur within area under application and whether the proposed activity has the potential to impact these species. This is to ensure that Priority Flora will not be adversely impacted under the authorisation.

There are no other Priority flora within the Castle Hill Project area.

13. Other relevant information: (e.g. whether the proposed activity is going through any other approvals process e.g. clearing permit application, PoW, EPA Assessment).

A Native Vegetation Clearing Permit (NVCP) application and Mining Proposal with regards to the further development of the Castle Hill Project will be submitted to DMIRS.

13. Additional comments in support of application: (e.g. discussion with DBCA District staff, Species and Communities Program).

Letter to be sent to Katherine Hope, Regional Leader, Nature Conservation, Kalgoorlie Regional Office.

Appendix F:

Botanica Targeted Arid Bronze Azure Butterfly and Inland Hairstreak Study

2021

Survey for the Arid Bronze Azure Butterfly and the Inland Hairstreak

Castle Hill Project

Prepared for Evolution Mining Group

July 2021

Version 1

Prepared by:
Botanica Consulting Pty Ltd
PO Box 2027
Boulder WA 6432

Disclaimer

Quality Assurance

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

Job number: 2021/66

Prepared by:
Jennifer Jackson
Senior Environmental Consultant
Botanica Consulting

Reviewed by:
Andrea Williams
Director
Botanica Consulting

Approved by:
Jim Williams
Director
Botanica Consulting

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1 INTRODUCTION

Botanica Consulting Pty Ltd (Botanica) was commissioned by Evolution Mining Ltd. (Evolution) to undertake a survey for the Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*) and the Inland Hairstreak (*Jalmenus aridus*) within the Castle Hill Project area and proposed haul road (referred to as the 'survey area') (Figure 1). The survey area is approximately 2,686 ha in extent and is located approximately 36 km northwest of Kalgoorlie-Boulder, Western Australia. The survey was conducted in response to a request from the Department of Mines, Industry Regulation and Safety (DMIRS) in relation to a Native Vegetation Clearing Permit for clearing at the Castle Hill Project. DMIRS had determined that there was the potential for both the Arid Bronze Azure Butterfly (ABAB) and the Inland Hairstreak to be present in the survey area based on the presence of suitable habitat in the application area (smooth bark Eucalyptus such as *Eucalyptus salmonophloia* and *Eucalyptus salubris* for ABAB and *Acacia tetragonophylla* for the Inland Hairstreak) and their potential distribution (both species have been historically recorded from Lake Douglas). Lake Douglas is approximately 40 km southeast of the Castle Hill Project area.

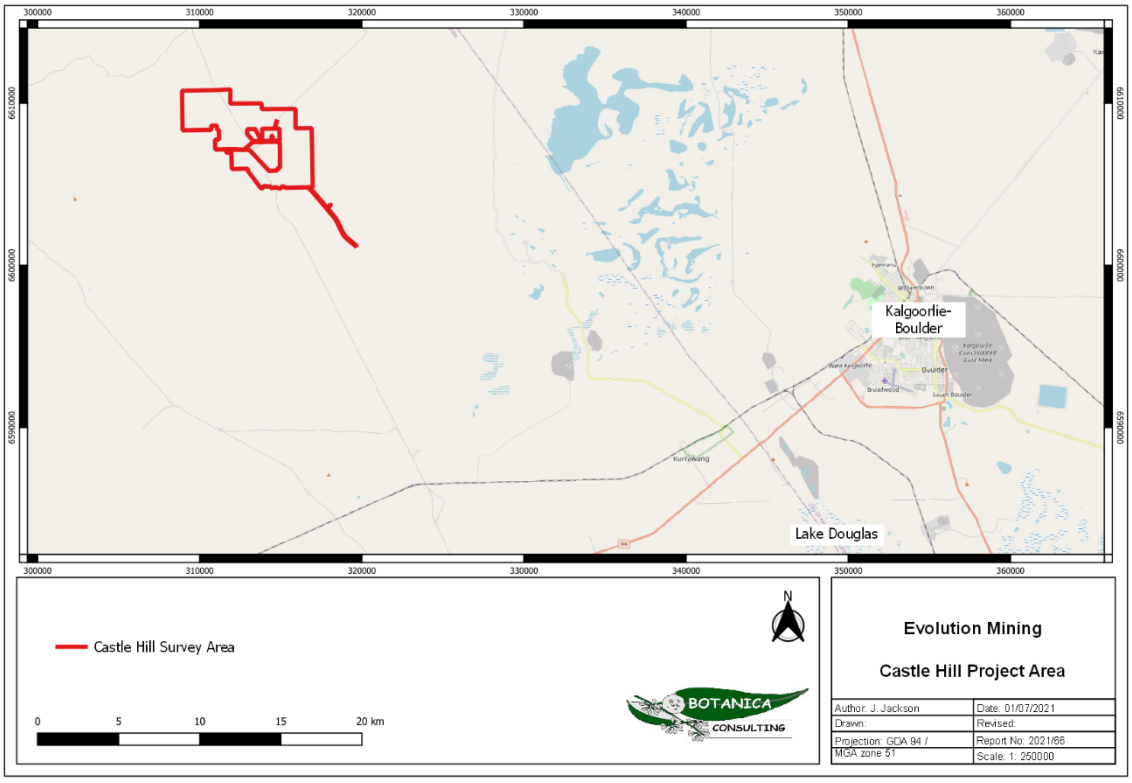

Figure 1: Regional map of the Castle Hill Project Area in relation to Kalgoorlie-Boulder and Lake Douglas

1.1 Arid Bronze Azure Butterfly

The arid bronze azure butterfly is a threatened species that is listed as critically endangered under the national *Environment Protection and Biodiversity Protection Act 1999* and the state *Biodiversity Conservation Act 2016*. The ABAB is listed due to its severely fragmented distribution with only two extant subpopulations being recorded in Western Australia. These subpopulations are at Barbalin Nature Reserve west of Mukinbudin in the Western Australian wheatbelt, and at a second site ~100 km from Barbalin. A third subpopulation (the first discovered, in the 1980s) occurred near Lake Douglas, 12 km southwest of Kalgoorlie but is now locally extinct and no ABAB have been recorded there since 1993 (DBCA, 2021a).

The ABAB has an obligate association with a sugar ant *Camponotus* sp. nr. *terebrans*. The ABAB's larvae live entirely within the ant's nest during their development. The ants protect the larvae from predators and are thought to be rewarded with secretions produced by the larvae. The most critical factor for habitat occupancy by the butterfly is the presence of large colonies of the host ant; only large colonies can support the ABAB because, being a parasitic species, it requires large numbers of hosts.

1.2 Inland Hairstreak

The Inland Hairstreak is endemic to Western Australia and is listed as Priority 1 fauna under the state *Biodiversity Conservation Act 2016*. Only 16 collections are known, 15 of these are from near Kalgoorlie, one is from the Gibson desert (ALA, 2020). It was last sighted in Western Australia at Karamindie, which is about 28 km south of Kalgoorlie (DBCA, 2021a). Little is known about its biology or ecology. Based on the historical records, the larva of this species is thought to feed on leaves and flowers of young shrubs of *Senna nemophila* (recent taxonomic revisions classify as *Senna artemisioides* subsp. × *coriacea*) and mature trees of *Acacia tetragonophylla*, which grow in shallow gullies with gentle slopes (Braby, 2016). The larvae of the butterfly are attended by the Froglet ant *Froggatella kirbii*. The adults are likely to stay close to the breeding habitats. There are likely two generations per year, although adults are absent in some years (Braby, 2016).

2 METHODS

2.1 Desktop review

Prior to the field assessment a review was undertaken of literature related to the Project area, the ABAB and the Inland Hairstreak. Documents reviewed included:

- Braby, M. (2016) *The Complete Field Guide to Butterflies of Australia*. 2nd Edition. Clayton South VIC: CSIRO Publishing.
- Botanica Consulting. (2020). Castle Hill Project, detailed flora/ vegetation survey and basic fauna survey. Prepared for Evolution Mining Ltd.
- Botanica Consulting. (2021). Survey for the Arid Bronze Azure Butterfly and the Inland Hairstreak, Rayjax Project. Prepared for Evolution Mining Ltd.
- Department of Biodiversity, Conservation and Attractions. (2020a). *Guideline for the survey of arid bronze azure butterfly (ABAB) in Western Australia*. Perth, WA.
- Department of Biodiversity, Conservation and Attractions. (2020b). *Arid bronze azure butterfly (ABAB) survey in Western Australia: additional information*. Perth, WA.
- Gamblin, T., Williams, M. R., Williams, A. A. E., and Richardson, J. (2009). *The ant, the butterfly and the bulldozer.* Department of Environment and Conservation, Kensington, WA.
- McArthur, A. J., Adams, M., and Shattuck, S. O. (1997). A Morphological and Molecular Review of *Camponotus terebrans* (Lowne) (Hymenoptera :Formicidae). Australian Journal of Zoology. 45 (579-598).

These documents included survey guidelines for the ABAB prepared by the Department of Biodiversity, Conservation and Attractions (DBCA) and previous surveys for the ABAB. These assisted in designing a survey methodology for field assessment.

The survey protocol recommended by DBCA for the ABAB has two components:

i) A survey to detect if the host ant is present in large numbers, and
ii) If the ant is present, then a survey should be conducted to determine if the ABAB is present.

To survey for the host ant, sampling of smooth barked Eucalypts by disturbing the soil at the base of trees to a depth of approximately 10 cm will determine if a colony is present. Nocturnal surveys are recommended; however ants should be clearly apparent in nests when disturbed at the base of trees during the day.

The number of trees to be sampled and the approximate spacing between trees can be determined from Table 1 in the *Arid bronze azure butterfly (ABAB) survey in Western Australia:*

additional information document. For a 200 ha area to be surveyed, a minimum of 140 trees is recommended with a spacing of ~120m, for a 500 ha area to be surveyed, a minimum of 225 trees is recommended with a spacing of ~150m. Assuming that the availability of smooth barked mature Eucalypts is not a limiting factor. For this survey, a 200 m tree spacing was determined to be adequate. The plan was to traverse lines north to south through the survey area, stopping every 200 m and sampling the nearest mature smooth barked Eucalypt (e.g. *Eucalyptus salmonophloia* and *Eucalyptus salubris).* For this survey Eucalyptus yilgarnensis trees will also be targeted, as the *Camponotus* sp. nr. *terebrans* were found at the base of this tree in the Rayjax Project Area (Botanica, 2021).

A plan for surveying for the ABAB was not developed as this would only be done if the host ants were present, and the DBCA survey guidelines recommend these surveys are conducted in weather where the forecast maximum is ≥23ºC.

For the Inland Hairstreak, there are no published survey guidelines however, this species also has an association with an ant species; *Froggattella kirbii* which can also be searched for near known habitat trees for the species (*Acacia tetragonophylla* and *Senna artemisioides* subsp. x *coriacea*).

2.2 Field assessment

Botanica conducted a targeted survey for the ABAB and the Inland Hairstreak from the 22nd to 28th June 2021, with the area traversed with an ATV by two Botanica staff members; Jennifer Jackson (Senior Environmental Consultant, BSc (Honours, Environmental Management) and Matthew Newlands (Environmental Technician).

2.3 Tree sampling

Lines were traversed north to south through the survey area, stopping approximately every 200 m and sampling the nearest mature smooth barked Eucalypt (e.g. *Eucalyptus salmonophloia* and *Eucalyptus salubris).* A handheld GPS unit was used to record the tracks traversed and the 200m spacing was determined from these handheld GPS units.

At each point, a smooth barked Eucalypt was located, and a hand trowel was used to disturb the leaf litter and soil to a depth of ~ 10 cm, and the following information was recorded:

- GPS location with a waypoint number,
- Photograph of the base of the tree,
- Tree species,
- The approximate diameter of the tree at a height of 1.5 m,
- If ants were present (Y/N), and
- If leafhoppers were present (Y/N).

Due to there being two people conducting the survey, at many points two trees were sampled.

3 RESULTS

3.1 Arid Bronze Azure Butterfly

A total of 265 trees were searched for the host ant *Camponotus* sp. nr. *terebrans.* The area covered and locations of trees sampled is shown in Figure 2.

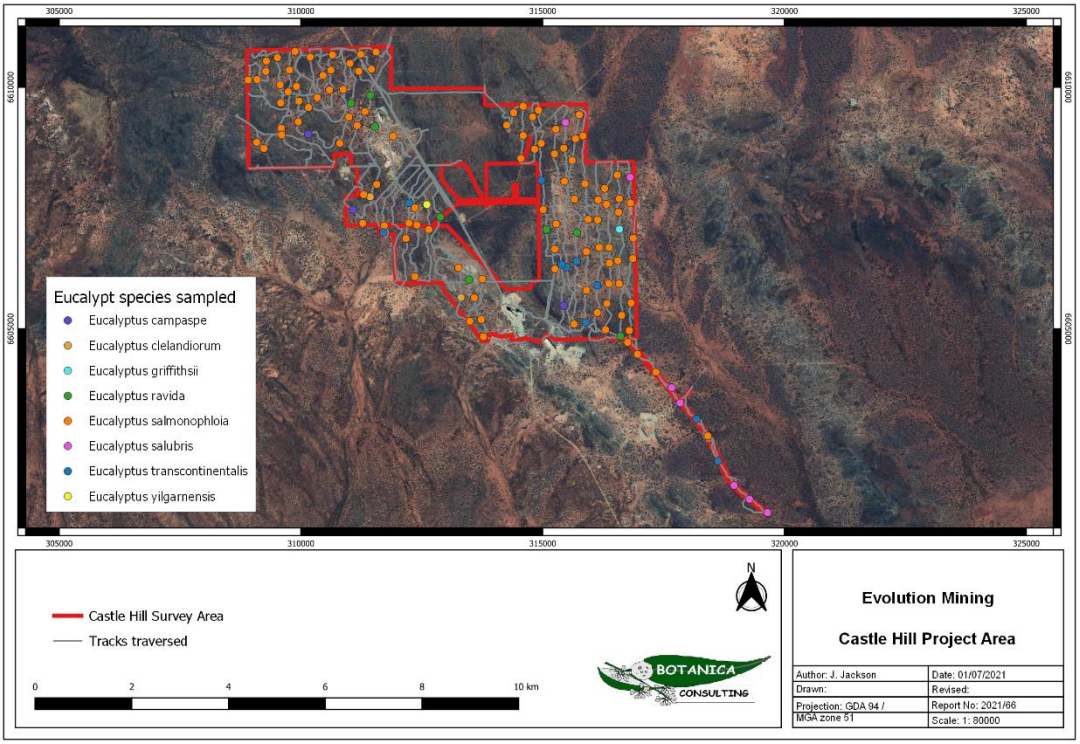

Figure 2. Map showing the tracks traversed and trees sampled within the Castle Hill survey area.

Eight species of Eucalypt trees were sampled, with the numbers of each species sampled presented in Table 1. 220 *Eucalyptus salmonophloia* were sampled, and these were the most abundant tree present throughout the survey area. Only 12 *Eucalyptus salubris* trees were sampled, and these were more abundant in the southeast haul road part of the survey area. In many areas no trees were sampled, and this was due to there not being any smooth barked Eucalypts being present in those general areas. A large area in the middle of the north of the survey area and several large areas west of the Coolgardie North Road were not traversed, as satellite imagery, previous Botanica flora surveys (Botanica, 2020) and ground truthing suggested these areas were mallee or shrub vegetation over a rocky slope.

No *Camponotus* sp. nr. *terebrans* were found in the Castle Hill survey area.

Table 1. Eucalypt species sampled and the number of each sampled in the Castle Hill survey area.

Eucalypt species	# of each sampled
Eucalyptus campaspe	3
Eucalyptus clelandiorum	2
Eucalyptus griffithsii	1
Eucalyptus ravida	10
Eucalyptus salmonophloia	220
Eucalyptus salubris	12
Eucalyptus transcontinentalis	16
Eucalyptus yilgarnensis	1
Total	265

3.2 Inland Hairstreak

A total of 68 *Acacia tetragonophylla* were searched for the presence of larvae of the inland hairstreak and the ground surrounding these plants was dug up to search for any Froglet ants. No *Senna artemisioides* subsp. × *coriacea* were seen in the survey area.

Nothing that appeared to be larvae or Froglet ants were seen on any of the *Acacia tetragonophylla.*

4 SUMMARY

No *Camponotus* sp. nr. *terebrans* were found in the Castle Hill survey area. No evidence of the inland hairstreak was seen in the survey area.

The habitat in this survey area was very different to the Rayjax Project Area which was surveyed in May 2021 (Botanica 2021). There were no vegetation communities present that were similar to where the *Camponotus* sp. nr. *terebrans* was found in the Rayjax Project Area.

5 REFERENCES

ALA. (2020). Atlas of Living Australia website. Species page: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:5551a54a-2ff6-49c7-9b26-62f2484449b5 . Accessed 3 August 2020.

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DBCA (2021c). *Nature Map Database search,* Department of Biodiversity, Conservation and Attractions. Accessed May 2021.
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McArthur, A. J., Adams, M., and Shattuck, S. O. (1997). A Morphological and Molecular Review of *Camponotus terebrans* (Lowne) (Hymenoptera :Formicidae). Australian Journal of Zoology. 45 (579-598).

Appendix 1. Raw data

Waypoint	Date	Zone	Easting	Northing	Tree species	DBH	Ants present Y/N	Photo #
2	22/06/2021	51J	6604720.57	316760.266	*Eucalyptus salmonophloia*	0.45	N	698
2	22/06/2021	51J	6604720.57	316760.266	*Eucalyptus salmonophloia*	0.6	N	
4	22/06/2021	51J	6604474.45	316963.9	*Eucalyptus salmonophloia*	0.55	N	699
4	22/06/2021	51J	6604474.45	316963.9	*Eucalyptus salmonophloia*	0.5	N	
5	22/06/2021	51J	6604104.69	317343.95	*Eucalyptus salmonophloia*	0.35	N	
5	22/06/2021	51J	6604104.69	317343.95	*Eucalyptus salmonophloia*	0.4	N	
6	22/06/2021	51J	6603784.03	317671.201	*Eucalyptus salmonophloia*	0.4	N	702
6	22/06/2021	51J	6603784.03	317671.201	*Eucalyptus salubris*	0.3	N	
7	22/06/2021	51J	6603468.09	317845.41	*Eucalyptus salubris*	.3 x3	N	703
7	22/06/2021	51J	6603468.09	317845.41	*Eucalyptus salubris*	.2 x3	N	
8	22/06/2021	51J	6603135.9	318180.201	*Eucalyptus salmonophloia*	.3 x2	N	704
8	22/06/2021	51J	6603135.9	318180.201	*Eucalyptus transcontinentalis*	0.4	N	
9	22/06/2021	51J	6602786.22	318418.485	*Eucalyptus salmonophloia*	1	N	705
9	22/06/2021	51J	6602786.22	318418.485	*Eucalyptus salmonophloia*	0.9	N	
10	22/06/2021	51J	6602264.78	318630.142	*Eucalyptus transcontinentalis*	0.3	N	706
10	22/06/2021	51J	6602264.78	318630.142	*Eucalyptus transcontinentalis*	0.25	N	
11	22/06/2021	51J	6601759.12	318962.813	*Eucalyptus salubris*	0.3	N	707
11	22/06/2021	51J	6601759.12	318962.813	*Eucalyptus salubris*	0.3	N	
12	22/06/2021	51J	6601474.5	319279.663	*Eucalyptus salubris*	0.3	N	708
12	22/06/2021	51J	6601474.5	319279.663	*Eucalyptus salubris*	0.2	N	
13	22/06/2021	51J	6601197.02	319652.52	*Eucalyptus salubris*	0.3	N	710
13	22/06/2021	51J	6601197.02	319652.52	*Eucalyptus salubris*	0.4	N	
14	22/06/2021	51J	6602966.52	318320.286	*Acacia tetragonophylla*	1	N	
15	22/06/2021	51J	6604966.31	316794.416	*Eucalyptus salmonophloia*	.25 x4	N	
15	22/06/2021	51J	6604966.31	316794.416	*Eucalyptus salmonophloia*	0.6	N	
16	22/06/2021	51J	6605538.43	316831.828	*Eucalyptus salmonophloia*	.3; .25	N	713
16	22/06/2021	51J	6605538.43	316831.828	*Eucalyptus salmonophloia*	0.4	N	
17	22/06/2021	51J	6606453.9	316866.471	*Eucalyptus salmonophloia*	.3 x3	N	714
18	22/06/2021	51J	6606878.07	316875.453	*Eucalyptus salmonophloia*	1	N	717
18	22/06/2021	51J	6606878.07	316875.453	*Eucalyptus salmonophloia*	.3; .4; .2	N	
19	22/06/2021	51J	6607605.33	316816.393	*Eucalyptus salmonophloia*	0.8	N	718
19	22/06/2021	51J	6607605.33	316816.393	*Eucalyptus salmonophloia*	.6; .3	N	
20	22/06/2021	51J	6608139.02	316811.243	*Eucalyptus salmonophloia*	0.9	N	719
20	22/06/2021	51J	6608139.02	316811.243	*Eucalyptus salubris*	0.4	N	
21	22/06/2021	51J	6608184.4	316545.961	*Eucalyptus salmonophloia*	1.2	N	721
21	22/06/2021	51J	6608184.4	316545.961	*Eucalyptus salmonophloia*	0.3	N	
22	22/06/2021	51J	6607693.36	316587.69	*Eucalyptus salmonophloia*	.2 x3	N	723
22	22/06/2021	51J	6607693.36	316587.69	*Eucalyptus salmonophloia*	0.2	N	
23	22/06/2021	51J	6607412.33	316571.388	*Eucalyptus salmonophloia*	0.7	N	724
23	22/06/2021	51J	6607412.33	316571.388	*Eucalyptus salmonophloia*	.3 x3	N	
24	22/06/2021	51J	6607062.74	316592.299	*Eucalyptus salmonophloia*	0.65	N	725
24	22/06/2021	51J	6607062.74	316592.299	*Eucalyptus griffithsii*	0.4	N	

25	22/06/2021	51J	6606411.68	316555.371	*Eucalyptus salmonophloia*	0.35	N	726
25	22/06/2021	51J	6606411.68	316555.371	*Eucalyptus salmonophloia*	0.6	N	
26	22/06/2021	51J	6605935.28	316584.772	*Eucalyptus salmonophloia*	1.3	N	727
26	22/06/2021	51J	6605935.28	316584.772	*Eucalyptus salmonophloia*	.8; .6	N	
27	22/06/2021	51J	6605279.39	316635.347	*Eucalyptus salmonophloia*	0.3	N	731
27	22/06/2021	51J	6605279.39	316635.347	*Eucalyptus salmonophloia*	.2 x4	N	
28	22/06/2021	51J	6604848.01	316612.702	*Eucalyptus salmonophloia*	1.3	N	732
28	22/06/2021	51J	6604848.01	316612.702	*Eucalyptus ravida*	0.25	N	
29	22/06/2021	51J	6605017.24	316004.181	*Acacia tetragonophylla*	1	N	
30	23/06/2021	51J	6604925.37	316305.357	*Acacia tetragonophylla*	1	N	
31	23/06/2021	51J	6604983.42	316301.97	*Eucalyptus salmonophloia*	.3 x2	N	734
31	23/06/2021	51J	6604983.42	316301.97	*Eucalyptus salmonophloia*	.5; .2	N	
32	23/06/2021	51J	6605022.89	316282.702	*Acacia tetragonophylla*	1	N	
33	23/06/2021	51J	6605524.12	316330.308	*Eucalyptus salmonophloia*	0.5	N	735
33	23/06/2021	51J	6605524.12	316330.308	*Eucalyptus salmonophloia*	0.6	N	
34	23/06/2021	51J	6605868.39	316388.171	*Acacia tetragonophylla*	1	N	
35	23/06/2021	51J	6605935.15	316368.916	*Eucalyptus salmonophloia*	0.6	N	736
36	23/06/2021	51J	6606362.31	316384.343	*Eucalyptus salmonophloia*	.7; .3	N	737
36	23/06/2021	51J	6606362.31	316384.343	*Eucalyptus salmonophloia*	.7 x2	N	
37	23/06/2021	51J	6606684.59	316375.106	*Eucalyptus salmonophloia*	0.6	N	738
37	23/06/2021	51J	6606684.59	316375.106	*Eucalyptus salmonophloia*	0.6	N	
38	23/06/2021	51J	6607578.29	316322.854	*Eucalyptus salmonophloia*	1	N	739
38	23/06/2021	51J	6607578.29	316322.854	*Eucalyptus salmonophloia*	1	N	
39	23/06/2021	51J	6607906.84	316284.461	*Eucalyptus salmonophloia*	0.65	N	740
39	23/06/2021	51J	6607906.84	316284.461	*Eucalyptus salmonophloia*	.3 x2	N	
40	23/06/2021	51J	6607667.8	316149.341	*Eucalyptus salmonophloia*	0.6	N	741
40	23/06/2021	51J	6607667.8	316149.341	*Eucalyptus salmonophloia*	0.5	N	
41	23/06/2021	51J	6607255.58	316138.263	*Eucalyptus salmonophloia*	.4 x3	N	742
41	23/06/2021	51J	6607255.58	316138.263	*Eucalyptus salmonophloia*	1	N	
42	23/06/2021	51J	6606684.79	316172.553	*Eucalyptus salmonophloia*	.3; .6; .4	N	743
42	23/06/2021	51J	6606684.79	316172.553	*Eucalyptus salmonophloia*	0.4	N	
43	23/06/2021	51J	6606343.43	316227.175	*Acacia tetragonophylla*	6	N	
44	23/06/2021	51J	6606292.83	316205.034	*Acacia tetragonophylla*	1	N	
45	23/06/2021	51J	6605901.84	316126.405	*Eucalyptus transcontinentalis*	.4; .2	N	744
45	23/06/2021	51J	6605901.84	316126.405	*Eucalyptus transcontinentalis*	0.3	N	
46	23/06/2021	51J	6605335.78	316131.958	*Eucalyptus salmonophloia*	0.45	N	745
46	23/06/2021	51J	6605335.78	316131.958	*Eucalyptus salmonophloia*	.3 x2	N	
47	23/06/2021	51J	6604974.28	316104.88	*Acacia tetragonophylla*	4	N	
48	23/06/2021	51J	6605131.84	315897.174	*Eucalyptus salmonophloia*	0.7	N	746
48	23/06/2021	51J	6605131.84	315897.174	*Eucalyptus transcontinentalis*	0.5	N	
50	23/06/2021	51J	6605799.57	315910.092	*Eucalyptus salmonophloia*	0.9	N	747
50	23/06/2021	51J	6605799.57	315910.092	*Eucalyptus salmonophloia*	0.4	N	
51	23/06/2021	51J	6606599.65	315907.427	*Eucalyptus salmonophloia*	0.8	N	748
51	23/06/2021	51J	6606599.65	315907.427	*Eucalyptus salmonophloia*	0.6	N	
52	23/06/2021	51J	6607267.24	315944.802	*Eucalyptus salmonophloia*	1.1	N	749
52	23/06/2021	51J	6607267.24	315944.802	*Eucalyptus salmonophloia*	0.4	N	

53	23/06/2021	51J	6608003	315876.714	*Eucalyptus salmonophloia*	0.75	N	750
53	23/06/2021	51J	6608003	315876.714	*Eucalyptus salmonophloia*	0.3	N	
54	23/06/2021	51J	6608098.39	315897.996	*Acacia tetragonophylla*	1	N	
55	23/06/2021	51J	6608995.23	315835.011	*Eucalyptus salmonophloia*	0.8	N	751
55	23/06/2021	51J	6608995.23	315835.011	*Eucalyptus salmonophloia*	0.5	N	
56	23/06/2021	51J	6609431.06	315760.92	*Eucalyptus salmonophloia*	1.3	N	752
56	23/06/2021	51J	6609431.06	315760.92	*Eucalyptus salmonophloia*	0.4	N	
57	23/06/2021	51J	6608935.55	315684.638	*Eucalyptus salmonophloia*	0.7	N	753
57	23/06/2021	51J	6608935.55	315684.638	*Eucalyptus salmonophloia*	0.8	N	
58	23/06/2021	51J	6608486.14	315613.041	*Eucalyptus salmonophloia*	0.45	N	755
58	23/06/2021	51J	6608486.14	315613.041	*Eucalyptus salmonophloia*	0.7	N	
59	23/06/2021	51J	6607688.25	315658.82	*Eucalyptus salmonophloia*	.6 x3	N	756
60	23/06/2021	51J	6606990.72	315712.273	*Eucalyptus salmonophloia*	0.8	N	757
60	23/06/2021	51J	6606990.72	315712.273	*Eucalyptus ravida*	0.3	N	
61	23/06/2021	51J	6606399.96	315706.956	*Eucalyptus transcontinentalis*	0.55	N	758
61	23/06/2021	51J	6606399.96	315706.956	*Eucalyptus transcontinentalis*	0.2	N	
62	23/06/2021	51J	6606226.52	315718.937	*Acacia tetragonophylla*	1	N	
63	23/06/2021	51J	6605485.29	315674.316	*Acacia tetragonophylla*	2	N	
64	23/06/2021	51J	6605098.61	315653.147	*Eucalyptus salmonophloia*	0.6	N	759
64	23/06/2021	51J	6605098.61	315653.147	*Eucalyptus salmonophloia*	0.5	N	
66	23/06/2021	51J	6606276.94	315497.223	*Eucalyptus salmonophloia*	1	N	761
66	23/06/2021	51J	6606276.94	315497.223	*Eucalyptus transcontinentalis*	0.5	N	
67	23/06/2021	51J	6606605.44	315449.317	*Acacia tetragonophylla*	1	N	
68	23/06/2021	51J	6608055.63	315453.693	*Eucalyptus salmonophloia*	0.65	N	763
68	23/06/2021	51J	6608055.63	315453.693	*Eucalyptus salmonophloia*	0.25	N	
69	23/06/2021	51J	6608739.4	315438.522	*Eucalyptus salmonophloia*	0.9	N	764
69	23/06/2021	51J	6608739.4	315438.522	*Eucalyptus salmonophloia*	1	N	
70	23/06/2021	51J	6609271.58	315474.468	*Eucalyptus salubris*	0.3	N	765
70	23/06/2021	51J	6609271.58	315474.468	*Eucalyptus salubris*	0.25	N	
71	23/06/2021	51J	6609282.34	315280.601	*Acacia tetragonophylla*	1	N	
72	23/06/2021	51J	6609132.54	315274.157	*Eucalyptus salmonophloia*	0.7	N	766
72	23/06/2021	51J	6609132.54	315274.157	*Eucalyptus salmonophloia*	0.3	N	
73	23/06/2021	51J	6608621.57	315246.775	*Eucalyptus salmonophloia*	0.5	N	767
73	23/06/2021	51J	6608621.57	315246.775	*Eucalyptus salmonophloia*	0.6	N	
74	23/06/2021	51J	6607170.48	315280.302	*Eucalyptus salmonophloia*	0.8	N	768
74	23/06/2021	51J	6607170.48	315280.302	*Eucalyptus salmonophloia*	0.3	N	
75	23/06/2021	51J	6606650.94	315251.067	*Eucalyptus salmonophloia*	0.8	N	769
76	23/06/2021	51J	6606241.18	315254.555	*Eucalyptus salmonophloia*	0.7	N	770
76	23/06/2021	51J	6606241.18	315254.555	*Eucalyptus salmonophloia*	0.3	N	
77	23/06/2021	51J	6605934.11	315213.914	*Acacia tetragonophylla*	1	N	
78	23/06/2021	51J	6605366.92	315115.732	*Acacia tetragonophylla*	1	N	
79	23/06/2021	51J	6605106.05	315117.724	*Acacia tetragonophylla*	1	N	
80	24/06/2021	51J	6605171.13	315400.98	*Acacia tetragonophylla*	2	N	
81	24/06/2021	51J	6605480.88	315436.592	*Eucalyptus salmonophloia*	0.4	N	
81	24/06/2021	51J	6605480.88	315436.592	*Eucalyptus campaspe*	0.25	N	
82	24/06/2021	51J	6606332.36	315399.074	*Eucalyptus transcontinentalis*	.2 x2	N	771

82	24/06/2021	51J	6606332.36	315399.074	*Eucalyptus transcontinentalis*	0.3	N	
83	24/06/2021	51J	6607056.82	315079.983	*Eucalyptus ravida*	0.3	N	772
83	24/06/2021	51J	6607056.82	315079.983	*Eucalyptus ravida*	0.2	N	
84	24/06/2021	51J	6607467.03	315011.964	*Eucalyptus salmonophloia*	0.9	N	773-4
84	24/06/2021	51J	6607467.03	315011.964	*Eucalyptus salmonophloia*	0.3	N	
85	24/06/2021	51J	6607729.93	315038.029	*Acacia tetragonophylla*	1	N	
86	24/06/2021	51J	6608074.99	314973.14	*Eucalyptus transcontinentalis*	0.7	N	775
86	24/06/2021	51J	6608074.99	314973.14	*Eucalyptus transcontinentalis*	0.3	N	
87	24/06/2021	51J	6608839.39	314971.415	*Eucalyptus salmonophloia*	0.5	N	777
87	24/06/2021	51J	6608839.39	314971.415	*Eucalyptus salmonophloia*	.3 x2	N	
88	24/06/2021	51J	6609524.25	314916.406	*Eucalyptus salmonophloia*	0.7	N	778
89	24/06/2021	51J	6609387.76	314794.103	*Eucalyptus salmonophloia*	0.75	N	780
89	24/06/2021	51J	6609387.76	314794.103	*Eucalyptus salmonophloia*	0.9	N	
90	24/06/2021	51J	6608719.18	314835.225	*Eucalyptus salmonophloia*	0.8	N	781
90	24/06/2021	51J	6608719.18	314835.225	*Eucalyptus salmonophloia*	0.4	N	
91	24/06/2021	51J	6608424.2	314614.606	*Acacia tetragonophylla*	2	N	
92	24/06/2021	51J	6608527.81	314552.612	*Eucalyptus salmonophloia*	1	N	782
92	24/06/2021	51J	6608527.81	314552.612	*Eucalyptus salmonophloia*	0.7	N	
93	24/06/2021	51J	6608999.76	314599.425	*Eucalyptus salmonophloia*	0.8	N	783
93	24/06/2021	51J	6608999.76	314599.425	*Eucalyptus salmonophloia*	0.7	N	
94	24/06/2021	51J	6609607.25	314597.791	*Eucalyptus salmonophloia*	1	N	784
94	24/06/2021	51J	6609607.25	314597.791	*Eucalyptus salmonophloia*	0.4	N	
95	24/06/2021	51J	6609472.5	314402.779	*Eucalyptus salmonophloia*	0.8	N	785
95	24/06/2021	51J	6609472.5	314402.779	*Eucalyptus salmonophloia*	0.5	N	
96	24/06/2021	51J	6609217.84	314257.206	*Eucalyptus salmonophloia*	0.6	N	786
96	24/06/2021	51J	6609217.84	314257.206	*Eucalyptus salmonophloia*	0.5	N	
97	24/06/2021	51J	6610156.82	311570.14	*Acacia tetragonophylla*	1	N	
98	24/06/2021	51J	6610884.33	311830.061	*Acacia tetragonophylla*	1	N	
99	24/06/2021	51J	6610730.64	311557.038	*Eucalyptus salmonophloia*	1	N	787
99	24/06/2021	51J	6610730.64	311557.038	*Eucalyptus salmonophloia*	0.6	N	
100	24/06/2021	51J	6610681.23	311236.261	*Eucalyptus salmonophloia*	.6; .4	N	788
100	24/06/2021	51J	6610681.23	311236.261	*Eucalyptus salmonophloia*	0.3	N	
101	24/06/2021	51J	6610375.14	311461.701	*Eucalyptus salmonophloia*	0.65	N	789
101	24/06/2021	51J	6610375.14	311461.701	*Eucalyptus salmonophloia*	0.7	N	
102	24/06/2021	51J	6604838.96	313775.906	*Eucalyptus salmonophloia*	1	N	790
102	24/06/2021	51J	6604838.96	313775.906	*Eucalyptus salmonophloia*	0.8	N	
103	24/06/2021	51J	6605193.46	313731.717	*Eucalyptus salmonophloia*	0.9	N	791-2
103	24/06/2021	51J	6605193.46	313731.717	*Eucalyptus salmonophloia*	0.6	N	
104	24/06/2021	51J	6606029.95	313756.341	*Eucalyptus salmonophloia*	1	N	793
104	24/06/2021	51J	6606029.95	313756.341	*Eucalyptus salmonophloia*	0.7	N	
105	24/06/2021	51J	6606019.27	313478.74	*Eucalyptus ravida*	0.25	N	794
105	24/06/2021	51J	6606019.27	313478.74	*Eucalyptus ravida*	0.25	N	
106	24/06/2021	51J	6605644.82	313587.888	*Eucalyptus salmonophloia*	0.9	N	795
106	24/06/2021	51J	6605644.82	313587.888	*Eucalyptus salmonophloia*	0.8	N	
107	24/06/2021	51J	6605159.35	313496.908	*Eucalyptus salmonophloia*	.3 x2	N	796
107	24/06/2021	51J	6605159.35	313496.908	*Eucalyptus salmonophloia*	0.3	N	

108	24/06/2021	51J	6605651.49	313314.021	*Eucalyptus salmonophloia*	0.6	N	797
108	24/06/2021	51J	6605651.49	313314.021	*Eucalyptus clelandiorum*	0.3	N	
109	24/06/2021	51J	6606264.59	313258.042	*Eucalyptus salmonophloia*	0.4	N	798
109	24/06/2021	51J	6606264.59	313258.042	*Eucalyptus salmonophloia*	0.6	N	
1	25/06/2021	51J	6606837.75	312670.908	*Acacia tetragonophylla*	1	N	
2	25/06/2021	51J	6607314.06	312885.125	*Eucalyptus salmonophloia*	0.3	N	799
2	25/06/2021	51J	6607314.06	312885.125	*Eucalyptus ravida*	multi	N	
3	25/06/2021	51J	6607464.42	312776.386	*Acacia tetragonophylla*	1	N	
4	25/06/2021	51J	6607572.22	312605.589	*Eucalyptus salmonophloia*	0.9	N	800
4	25/06/2021	51J	6607572.22	312605.589	*Eucalyptus yilgarnensis*	0.2	N	
5	25/06/2021	51J	6607056.66	312647.062	*Eucalyptus salmonophloia*	0.8	N	801
5	25/06/2021	51J	6607056.66	312647.062	*Eucalyptus salmonophloia*	0.5	N	
6	25/06/2021	51J	6606945.12	312615.644	*Acacia tetragonophylla*	2	N	
7	25/06/2021	51J	6606852	312623.208	*Acacia tetragonophylla*	1	N	
8	25/06/2021	51J	6605987.26	312664.242	*Acacia tetragonophylla*	1	N	
9	25/06/2021	51J	6606082.98	312359.862	*Eucalyptus salmonophloia*	0.8	N	802
9	25/06/2021	51J	6606082.98	312359.862	*Eucalyptus salmonophloia*	.3 x2	N	
10	25/06/2021	51J	6606363.19	312284.232	*Acacia tetragonophylla*	1	N	
11	25/06/2021	51J	6607149.06	312400.326	*Eucalyptus salmonophloia*	1.4	N	803-4
11	25/06/2021	51J	6607149.06	312400.326	*Eucalyptus salmonophloia*	0.7	N	
12	25/06/2021	51J	6607507.34	312356.789	*Eucalyptus salmonophloia*	.4 x5	N	805
12	25/06/2021	51J	6607507.34	312356.789	*Eucalyptus salmonophloia*	0.7	N	
13	25/06/2021	51J	6607607.11	312234.254	*Eucalyptus salmonophloia*	0.75	N	806
13	25/06/2021	51J	6607607.11	312234.254	*Eucalyptus transcontinentalis*	0.5	N	
14	25/06/2021	51J	6607189.11	312236.273	*Eucalyptus salmonophloia*	0.9	N	808
14	25/06/2021	51J	6607189.11	312236.273	*Eucalyptus salmonophloia*	.3 x3	N	
15	25/06/2021	51J	6606869.55	312173.113	*Eucalyptus salmonophloia*	.3 x3	N	809
15	25/06/2021	51J	6606869.55	312173.113	*Eucalyptus salmonophloia*	.3 x2	N	
16	25/06/2021	51J	6606277.93	312151.518	*Acacia tetragonophylla*	6	N	
17	25/06/2021	51J	6606786.42	311965.775	*Acacia tetragonophylla*	1	N	
18	25/06/2021	51J	6607501.9	311873.513	*Acacia tetragonophylla*	1	N	
19	25/06/2021	51J	6608377.52	312265.593	*Acacia tetragonophylla*	1	N	
20	25/06/2021	51J	6608160.2	312030.941	*Acacia tetragonophylla*	3	N	
21	25/06/2021	51J	6607136.37	311724.407	*Eucalyptus salmonophloia*	0.7	N	810
21	25/06/2021	51J	6607136.37	311724.407	*Eucalyptus salmonophloia*	0.2	N	
22	25/06/2021	51J	6606995.96	311703.568	*Eucalyptus salmonophloia*	0.6	N	811
22	25/06/2021	51J	6606995.96	311703.568	*Eucalyptus transcontinentalis*	0.6	N	
23	25/06/2021	51J	6608985.86	311905.018	*Eucalyptus salmonophloia*	0.7	N	812-13
23	25/06/2021	51J	6608985.86	311905.018	*Eucalyptus salmonophloia*	0.4	N	
24	25/06/2021	51J	6609183.34	311530.594	*Eucalyptus salmonophloia*	0.5	N	814
24	25/06/2021	51J	6609183.34	311530.594	*Eucalyptus ravida*	0.5	N	
25	25/06/2021	51J	6607989.78	311568.738	*Eucalyptus salmonophloia*	0.7	N	815
25	25/06/2021	51J	6607989.78	311568.738	*Eucalyptus salmonophloia*	0.3	N	
26	25/06/2021	51J	6607732.76	311436.045	*Eucalyptus salmonophloia*	0.8	N	816
26	25/06/2021	51J	6607732.76	311436.045	*Eucalyptus clelandiorum*	0.7	N	
27	25/06/2021	51J	6607185.83	311281.788	*Eucalyptus salmonophloia*	0.6	N	817

27	25/06/2021	51J	6607185.83	311281.788	*Eucalyptus salmonophloia*	0.6	N	
28	25/06/2021	51J	6607461.14	311078.417	*Eucalyptus salmonophloia*	0.7	N	818-19
28	25/06/2021	51J	6607461.14	311078.417	*Eucalyptus campaspe*	0.6	N	
29	25/06/2021	51J	6607735.45	310963.446	*Acacia tetragonophylla*	6	N	
30	25/06/2021	51J	6607779.06	311300.629	*Eucalyptus salmonophloia*	0.6	N	
30	25/06/2021	51J	6607779.06	311300.629	*Eucalyptus salmonophloia*	0.6	N	820
31	25/06/2021	51J	6608897.41	311058.105	*Acacia tetragonophylla*	3	N	
32	25/06/2021	51J	6609209.19	311163.862	*Eucalyptus salmonophloia*	0.8	N	
32	25/06/2021	51J	6609209.19	311163.862	*Eucalyptus salmonophloia*	0.4	N	
33	25/06/2021	51J	6609498.56	311326.305	*Eucalyptus salmonophloia*	0.7	N	
33	25/06/2021	51J	6609498.56	311326.305	*Eucalyptus salmonophloia*	0.6	N	
34	25/06/2021	51J	6609830.47	311435.752	*Eucalyptus salmonophloia*	0.4	N	
34	25/06/2021	51J	6609830.47	311435.752	*Eucalyptus ravida*	0.2	N	
35	25/06/2021	51J	6610329.94	311197.919	*Eucalyptus salmonophloia*	0.8	N	
35	25/06/2021	51J	6610329.94	311197.919	*Eucalyptus salmonophloia*	0.6	N	
36	25/06/2021	51J	6610492.96	311015.449	*Eucalyptus salmonophloia*	0.7	N	
36	25/06/2021	51J	6610492.96	311015.449	*Eucalyptus salmonophloia*	0.5	N	
37	25/06/2021	51J	6610409.27	311004.642	*Acacia tetragonophylla*	3	N	
38	25/06/2021	51J	6609670.11	311036.017	*Eucalyptus salmonophloia*	0.8	N	
38	25/06/2021	51J	6609670.11	311036.017	*Eucalyptus ravida*	.2 x5	N	
39	25/06/2021	51J	6609385.29	310994.412	*Eucalyptus salmonophloia*	.6; .2; .3	N	
39	25/06/2021	51J	6609385.29	310994.412	*Eucalyptus salmonophloia*	0.25	N	
40	25/06/2021	51J	6608838.54	310805.819	*Eucalyptus salmonophloia*	.3 x4	N	
40	25/06/2021	51J	6608838.54	310805.819	*Eucalyptus salmonophloia*	.2 x2	N	
41	25/06/2021	51J	6609029.3	310152.664	*Eucalyptus salmonophloia*	0.6	N	
41	25/06/2021	51J	6609029.3	310152.664	*Eucalyptus campaspe*	0.4	N	
42	25/06/2021	51J	6609283.38	309947.4	*Eucalyptus salmonophloia*	0.7	N	
42	25/06/2021	51J	6609283.38	309947.4	*Eucalyptus salmonophloia*	0.6	N	
43	25/06/2021	51J	6609581.51	310159.137	*Eucalyptus salmonophloia*	0.9	N	
43	25/06/2021	51J	6609581.51	310159.137	*Eucalyptus salmonophloia*	0.8	N	
44	25/06/2021	51J	6609954.04	310875.118	*Eucalyptus salmonophloia*	0.6	N	
44	25/06/2021	51J	6609954.04	310875.118	*Eucalyptus salmonophloia*	0.75	N	
45	25/06/2021	51J	6610669.78	310653.306	*Eucalyptus salmonophloia*	0.7	N	
45	25/06/2021	51J	6610669.78	310653.306	*Eucalyptus salmonophloia*	0.7	N	
46	28/06/2021	51J	6610354.2	310621.643	*Eucalyptus transcontinentalis*	0.7	N	
46	28/06/2021	51J	6610354.2	310621.643	*Eucalyptus salmonophloia*	0.7	N	
47	28/06/2021	51J	6609946.2	310593.046	*Eucalyptus salmonophloia*	0.7	N	
47	28/06/2021	51J	6609946.2	310593.046	*Eucalyptus salmonophloia*	0.3	N	
48	28/06/2021	51J	6609916.93	310612.164	*Acacia tetragonophylla*	2	N	
49	28/06/2021	51J	6609787.6	310338.848	*Eucalyptus salmonophloia*	0.7	N	
49	28/06/2021	51J	6609787.6	310338.848	*Eucalyptus salmonophloia*	0.5	N	
50	28/06/2021	51J	6610244.69	310459.876	*Eucalyptus salmonophloia*	0.65	N	
50	28/06/2021	51J	6610244.69	310459.876	*Eucalyptus salmonophloia*	0.3	N	
51	28/06/2021	51J	6610623.91	310194.857	*Eucalyptus salmonophloia*	0.6	N	
51	28/06/2021	51J	6610623.91	310194.857	*Eucalyptus salmonophloia*	0.7	N	
52	28/06/2021	51J	6610232.94	310258.704	*Acacia tetragonophylla*	3	N	

53	28/06/2021	51J	6609715.82	309959.332	*Eucalyptus salmonophloia*	0.4	N	
53	28/06/2021	51J	6609715.82	309959.332	*Eucalyptus salmonophloia*	0.7	N	
54	28/06/2021	51J	6610019.95	309907.747	*Eucalyptus salmonophloia*	0.6	N	
54	28/06/2021	51J	6610019.95	309907.747	*Eucalyptus salmonophloia*	0.2	N	
55	28/06/2021	51J	6610744	309880.494	*Eucalyptus salmonophloia*	0.5	N	
55	28/06/2021	51J	6610744	309880.494	*Eucalyptus salmonophloia*	0.3	N	
56	28/06/2021	51J	6610357.63	309765.138	*Eucalyptus salmonophloia*	0.5	N	
56	28/06/2021	51J	6610357.63	309765.138	*Eucalyptus salmonophloia*	1.1	N	
57	28/06/2021	51J	6609905.73	309737.349	*Eucalyptus salmonophloia*	0.7	N	
57	28/06/2021	51J	6609905.73	309737.349	*Eucalyptus salmonophloia*	0.7	N	
58	28/06/2021	51J	6609154.64	309595.662	*Eucalyptus salmonophloia*	1	N	
59	28/06/2021	51J	6609014.15	309602.173	*Eucalyptus salmonophloia*	0.9	N	
59	28/06/2021	51J	6609014.15	309602.173	*Eucalyptus salmonophloia*	0.7	N	
60	28/06/2021	51J	6608733.78	309236.066	*Eucalyptus salmonophloia*	0.8	N	
60	28/06/2021	51J	6608733.78	309236.066	*Eucalyptus salmonophloia*	0.7	N	
61	28/06/2021	51J	6608860.11	309087.607	*Eucalyptus salmonophloia*	0.7	N	
61	28/06/2021	51J	6608860.11	309087.607	*Eucalyptus salmonophloia*	0.6	N	
62	28/06/2021	51J	6610160.06	309095.734	*Eucalyptus salmonophloia*	.4 x2	N	
62	28/06/2021	51J	6610160.06	309095.734	*Eucalyptus salmonophloia*	1	N	
63	28/06/2021	51J	6610150.33	308909.391	*Eucalyptus salmonophloia*	1.1	N	
63	28/06/2021	51J	6610150.33	308909.391	*Eucalyptus salmonophloia*	0.5	N	
64	28/06/2021	51J	6610328.02	309275.633	*Eucalyptus salmonophloia*	0.9	N	
64	28/06/2021	51J	6610328.02	309275.633	*Eucalyptus salmonophloia*	0.7	N	
65	28/06/2021	51J	6610543.33	309286.015	*Eucalyptus salmonophloia*	0.8	N	
65	28/06/2021	51J	6610543.33	309286.015	*Eucalyptus salmonophloia*	0.9	N	
66	28/06/2021	51J	6610611.47	309514.966	*Eucalyptus salmonophloia*	0.7	N	
66	28/06/2021	51J	6610611.47	309514.966	*Eucalyptus salmonophloia*	0.7	N	
67	28/06/2021	51J	6610050.07	309572.261	*Eucalyptus salmonophloia*	0.8	N	
67	28/06/2021	51J	6610050.07	309572.261	*Eucalyptus salmonophloia*	0.6	N	
68	28/06/2021	51J	6609676.24	309583.087	*Eucalyptus salmonophloia*	0.75	N	

*Note, the number in the DBH column for *Acacia tetragonophylla* is the number of plants sampled at that point.

Annex I:

Proof of Tenement Holdings

ASIC
Australian Securities & Investments Commission

Current Company Extract

Name: EVOLUTION MINING (MUNGARI) PTY LTD
ACN: 002 124 745

Date/Time: 20 September 2021 AEST 10:51:25 AM

This extract contains information derived from the Australian Securities and Investments Commission's (ASIC) database under section 1274A of the Corporations Act 2001.

Please advise ASIC of any error or omission which you may identify.

EXTRACT

Organisation Details		Document Number
Current Organisation Details		
Name:	EVOLUTION MINING (MUNGARI) PTY LTD	029331401
ACN:	002 124 745	
ABN:	90002124745	
Registered in:	New South Wales	
Registration date:	23/04/1981	
Next review date:	08/10/2021	
Name start date:	31/08/2015	
Previous state number:	26749313	
Status:	Registered	
Company type:	Australian Proprietary Company	
Class:	Limited By Shares	
Subclass:	Proprietary Company	

Address Details		Document Number
Current		
Registered address:	Level 24, 175 Liverpool Street, SYDNEY NSW 2000	7E9992690
Start date:	21/03/2018	
Principal Place Of Business address:	Level 24, 175 Liverpool Street, SYDNEY NSW 2000	7E9992690
Start date:	05/03/2018	

Contact Address	
Section 146A of the Corporations Act 2001 states 'A contact address is the address to which communications and notices are sent from ASIC to the company'.	
Current	
Address:	Level 24, 175 Liverpool Street, SYDNEY NSW 2000
Start date:	19/04/2018

Officeholders and Other Roles		Document Number
Director		
Name:	JACOB KLEIN	029331403
Address:	61 Wentworth Road, VAUCLUSE NSW 2030	
Born:	15/08/1965, CAPE TOWN, SOUTH AFRICA	
Appointment date:	24/08/2015	
Name:	LAWRENCE CONWAY	029331403
Address:	10 Clermiston Avenue, ROSEVILLE NSW 2069	
Born:	01/10/1969, ROCKHAMPTON, QLD	
Appointment date:	24/08/2015	
Secretary		
Name:	EVAN MARK ELSTEIN	029331403
Address:	43 Clyde Street, NORTH BONDI NSW 2026	
Born:	26/07/1965, CAPE TOWN, SOUTH AFRICA	
Appointment date:	24/08/2015	

Appointed Auditor

Name:	ROBERT GAMBITTA	7E6898858
Address:	'Kpmg' 235 St Georges Terrace PERTH WA 6000	
Start date:	14/02/2014	

Ultimate Holding Company

Name:	EVOLUTION MINING LIMITED	029331403
ACN:	084 669 036	
ABN:	74084669036	

Share Information

Share Structure

Class	Description	Number issued	Total amount paid	Total amount unpaid	Document number
ORD	ORDINARY SHARES	200000	200000.00	0.00	001779857

Members

Note: For each class of shares issued by a proprietary company, ASIC records the details of the top twenty members of the class (based on shareholdings). The details of any other members holding the same number of shares as the twentieth ranked member will also be recorded by ASIC on the database. Where available, historical records show that a member has ceased to be ranked amongst the top twenty members. This may, but does not necessarily mean, that they have ceased to be a member of the company.

Name: TOLEDO HOLDING (AUSCO) PTY LIMITED
ACN: 159 264 598
Address: Level 24, 175 Liverpool Street, SYDNEY NSW 2000

Class	Number held	Beneficially held	Paid	Document number
ORD	200000	yes	FULLY	7E9992690

Financial Reports

Balance date	Report due date	AGM due date	Extended AGM due	AGM held date	Outstanding	Document number
31/12/1995					no	011259429
31/12/2004	31/05/2005				no	022870703
31/12/2005	31/05/2006				no	023170081
31/12/2006	30/04/2007				no	023952191
31/12/2008	30/04/2009				no	026242241
31/12/2009	30/04/2010				no	7E3815883
31/12/2010	30/04/2011				no	7E3816008
31/12/2011	30/04/2012				no	7E4413943

31/12/2012	30/04/2013				no	7E5222159
31/12/2013	30/04/2014				no	7E6898858
31/12/2014	30/04/2015				no	7E6898948

Documents

Note: Where no Date Processed is shown, the document in question has not been processed. In these instances care should be taken in using information that may be updated by the document when it is processed. Where the Date Processed is shown but there is a zero under No Pages, the document has been processed but a copy is not yet available.

Date received	Form type	Date processed	Number of pages	Effective date	Document number
14/12/2018	488M Application To Change Review Date Of A Company Or Scheme Synchronise Review Date With Holding Company - No Fee	30/01/2019	4	14/12/2018	030516372
21/01/2019	484E Change To Company Details Appointment Or Cessation Of A Company Officeholder	21/01/2019	2	21/01/2019	7EAH88066

*****End of Extract of 3 Pages*****

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MISCELLANEOUS LICENCE 16/126

Status: Live

TENEMENT SUMMARY

Area: 103.90436 HA
Death Reason :
Mark Out : N/A
Death Date :
Received : 27/02/2019 16:12:11
Commence : 14/09/2021
Term Granted : 21 Years

CURRENT HOLDER DETAILS

Name and Address
EVOLUTION MINING (MUNGARI) PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Jaurdi
Datum: Datum situated at GDA co-ordinates in zone 51
6604610.794 mN 316934.274 mE
Boundary: From Datum: 6603504.384 mN 317872.686 mE Thence 6603610.621 mN 317952.157 mE Thence 6603760.578 mN 318054.762 mE Thence 6603747.983 mN 318069.962 mE Thence 6603611.088 mN 317976.166 mE Thence 6603487.393 mN 317887.097 mE Thence 6603476.372 mN 317896.444 mE Thence 6603092.608 mN 318221.937 mE Thence 6603027.123 mN 318277.500 mE Thence 6602968.253 mN 318327.109 mE Thence 6602911.367 mN 318368.781 mE Thence 6602851.836 mN 318407.146 mE Thence 6602788.733 mN 318444.981 mE Thence 6602032.861 mN 318819.566 mE Thence 6601950.509 mN 318860.576 mE Thence 6601894.616 mN 318893.650 mE Thence 6601838.392 mN 318931.353 mE Thence 6601769.931 mN 318987.907 mE Thence 6601716.683 mN 319044.132 mE Thence 6601675.673 mN 319091.095 mE Thence 6600693.829 mN 320273.525 mE Thence 6598558.981 mN 322840.544 mE Thence 6598021.612 mN 323485.600 mE Thence 6597680.563 mN 323896.763 mE Thence 6597300.065 mN 324357.002 mE Thence 6597047.123 mN 324659.686 mE Thence 6596965.631 mN 324760.228 mE Thence 6596920.122 mN 324820.024 mE Thence 6596887.263 mN 324866.549 mE Thence 6596856.571 mN 324918.407 mE Thence 6596828.047 mN 324969.779 mE Thence 6596624.796 mN 325340.683 mE Thence 6596322.626 mN 325901.511 mE Thence 6596248.542 mN 326037.771 mE Thence 6596194.159 mN 326139.938 mE Thence 6596151.296 mN 326214.551 mE Thence

6596116.371 mN 326278.051 mE Thence 6596092.737 mN 326317.476 mE Thence 6596059.929 mN 326369.334 mE Thence 6595998.545 mN 326447.651 mE Thence 6595933.688 mN 326517.993 mE Thence 6595902.954 mN 326544.098 mE Thence 6595866.984 mN 326573.822 mE Thence 6595824.651 mN 326525.536 mE Thence 6595851.771 mN 326503.046 mE Thence 6595876.906 mN 326484.525 mE Thence 6595915.167 mN 326450.522 mE Thence 6595959.387 mN 326401.084 mE Thence 6596009.129 mN 326337.584 mE Thence 6596044.638 mN 326282.474 mE Thence 6596079.563 mN 326220.032 mE Thence 6596109.197 mN 326166.057 mE Thence 6596147.297 mN 326095.148 mE Thence 6596179.047 mN 326033.765 mE Thence 6596207.622 mN 325978.732 mE Thence 6596237.255 mN 325921.582 mE Thence 6596257.364 mN 325884.540 mE Thence 6596277.472 mN 325847.498 mE Thence 6596241.489 mN 325817.865 mE Thence 6596199.155 mN 325782.940 mE Thence 6596140.947 mN 325733.198 mE Thence 6595970.257 mN 325600.090 mE Thence 6596013.649 mN 325541.881 mE Thence 6596314.689 mN 325775.833 mE Thence 6596352.614 mN 325707.798 mE Thence 6596572.195 mN 325305.271 mE Thence 6596793.122 mN 324892.520 mE Thence 6596824.872 mN 324841.191 mE Thence 6596865.883 mN 324780.337 mE Thence 6596912.185 mN 324718.159 mE Thence 6596990.237 mN 324622.909 mE Thence 6597248.207 mN 324321.019 mE Thence 6597627.884 mN 323861.569 mE Thence 6597973.193 mN 323447.500 mE Thence 6598512.415 mN 322796.094 mE Thence 6600647.792 mN 320231.456 mE Thence 6601627.386 mN 319054.053 mE Thence 6601674.019 mN 319000.475 mE Thence 6601742.480 mN 318935.983 mE Thence 6601800.027 mN 318888.027 mE Thence 6601867.827 mN 318839.079 mE Thence 6601920.082 mN 318806.006 mE Thence 6602001.772 mN 318764.665 mE Thence 6602762.010 mN 318389.154 mE Thence 6602836.623 mN 318346.292 mE Thence 6602876.972 mN 318320.495 mE Thence 6602930.550 mN 318280.146 mE Thence 6602992.727 mN 318229.213 mE Thence 6603061.519 mN 318169.682 mE Thence 6604576.927 mN 316883.474 mE Thence 6604623.891 mN 316842.728 mE Thence 6604642.412 mN 316825.265 mE Thence 6604661.991 mN 316805.686 mE Thence 6604678.395 mN 316789.811 mE Thence 6604691.095 mN 316776.053 mE Thence 6604710.675 mN 316753.827 mE Thence 6604896.677 mN 316526.815 mE Thence 6605005.818 mN 316396.507 mE Thence 6605103.714 mN 316278.635 mE Thence 6605202.933 mN 316159.704 mE Thence 6605339.194 mN 315996.985 mE Thence 6605425.183 mN 315891.152 mE Thence 6605512.496 mN 315787.303 mE Thence 6605574.012 mN 315714.542 mE Thence 6605615.022 mN 315667.578 mE Thence 6605658.678 mN 315621.276 mE Thence 6605692.678 mN 315586.880 mE Thence 6605719.665 mN 315563.862 mE Thence 6605753.796 mN 315540.049 mE Thence 6605779.196 mN 315524.174 mE Thence 6605821.265 mN 315499.568 mE Thence 6605855.397 mN 315481.311 mE Thence 6605910.165 mN 315455.911 mE Thence 6605984.778 mN 315426.543 mE Thence 6606043.516 mN 315411.461 mE Thence 6606089.553 mN 315402.730 mE Thence 6606123.685 mN 315397.968 mE Thence 6606176.866 mN 315393.205 mE Thence 6606221.316 mN

315392.411 mE Thence 6606262.591 mN 315392.411 mE Thence 6606293.548 mN 315394.792 mE Thence 6606330.854 mN 315397.967 mE Thence 6606369.748 mN 315401.936 mE Thence 6606409.435 mN 315407.493 mE Thence 6606516.592 mN 315420.192 mE Thence 6606557.073 mN 315417.811 mE Thence 6606634.861 mN 315412.255 mE Thence 6606720.586 mN 315402.730 mE Thence 6606809.486 mN 315378.918 mE Thence 6606928.409 mN 315346.421 mE Thence 6606946.401 mN 315405.688 mE Thence 6606806.311 mN 315443.211 mE Thence 6606729.638 mN 315464.405 mE Thence 6606695.186 mN 315470.199 mE Thence 6606648.354 mN 315473.374 mE Thence 6606583.267 mN 315478.136 mE Thence 6606541.198 mN 315480.518 mE Thence 6606506.273 mN 315478.930 mE Thence 6606472.142 mN 315474.961 mE Thence 6606414.991 mN 315467.024 mE Thence 6606367.366 mN 315460.674 mE Thence 6606326.091 mN 315456.705 mE Thence 6606299.898 mN 315454.324 mE Thence 6606272.116 mN 315451.943 mE Thence 6606241.954 mN 315451.943 mE Thence 6606207.029 mN 315451.149 mE Thence 6606162.578 mN 315455.118 mE Thence 6606112.572 mN 315460.674 mE Thence 6606077.647 mN 315467.024 mE Thence 6606035.578 mN 315477.343 mE Thence 6605991.128 mN 315490.043 mE Thence 6605963.347 mN 315501.155 mE Thence 6605917.309 mN 315518.618 mE Thence 6605874.447 mN 315539.255 mE Thence 6605843.490 mN 315557.512 mE Thence 6605811.740 mN 315577.355 mE Thence 6605778.403 mN 315600.374 mE Thence 6605744.271 mN 315623.393 mE Thence 6605714.628 mN 315647.934 mE Thence 6605687.783 mN 315678.823 mE Thence 6605658.678 mN 315708.589 mE Thence 6605610.392 mN 315764.813 mE Thence 6605550.199 mN 315833.605 mE Thence 6605429.813 mN 315979.126 mE Thence 6605160.599 mN 316304.564 mE Thence 6605036.906 mN 316452.731 mE Thence 6604879.479 mN 316645.216 mE Thence 6604755.654 mN 316791.928 mE Thence 6604737.662 mN 316813.623 mE Thence 6604722.845 mN 316830.028 mE Thence 6604699.562 mN 316853.311 mE Thence 6604673.104 mN 316879.769 mE Thence back to datum

Area :

Type	Dealing No	Start Date	Area
Granted		14/09/2021	103.90436 HA
Applied For		27/02/2019	104.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	27/02/2019		103.90473 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MISCELLANEOUS LICENCE 16/128

Status: Live

TENEMENT SUMMARY

Area: 32.13506 HA
Death Reason :
Mark Out : N/A
Death Date :
Received : 17/09/2019 12:14:57
Commence : 14/09/2021
Term Granted : 21 Years

CURRENT HOLDER DETAILS

Name and Address
EVOLUTION MINING (MUNGARI) PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxx997

DESCRIPTION

Locality: JAURDI
Datum: Datum situated at GDA coordinates in Zone 51 6607703.853mN 314475.640mE
Boundary: GDA coordinates in Zone 51 From Datum thence 6607683.968 mN 314497.520 mE Thence 6607686.300 mN 314712.033 mE Thence 6607685.600 mN 314769.806 mE Thence 6607683.516 mN 314811.810 mE Thence 6607681.783 mN 314830.694 mE Thence 6607675.435 mN 314861.674 mE Thence 6607664.906 mN 314900.066 mE Thence 6607652.259 mN 314932.948 mE Thence 6607635.036 mN 314969.347 mE Thence 6607619.895 mN 314994.423 mE Thence 6607587.979 mN 315038.130 mE Thence 6607568.160 mN 315059.698 mE Thence 6607540.280 mN 315085.940 mE Thence 6607515.584 mN 315105.558 mE Thence 6607485.101 mN 315125.709 mE Thence 6607454.742 mN 315142.605 mE Thence 6607398.871 mN 315170.105 mE Thence 6607322.820 mN 315205.561 mE Thence 6607215.842 mN 315253.752 mE Thence 6607138.868 mN 315286.032 mE Thence 6607105.188 mN 315299.897 mE Thence 6606992.320 mN 315339.430 mE Thence 6606930.468 mN 315354.741 mE Thence 6606892.554 mN 315358.925 mE Thence 6606858.815 mN 315360.056 mE Thence 6606745.330 mN 315352.307 mE Thence 6606591.777 mN 315340.890 mE Thence 6606483.735 mN 315334.297 mE Thence 6606409.975 mN 315335.369 mE Thence 6606318.862 mN 315344.228 mE Thence 6606225.307 mN 315357.665 mE Thence 6606121.457 mN 315377.882 mE Thence 6606036.816 mN 315401.349 mE Thence 6605993.781 mN 315419.752 mE Thence 6605940.463 mN 315450.475 mE Thence

6605901.520 mN 315480.399 mE Thence 6605852.706 mN 315524.360 mE Thence 6605795.627 mN 315578.894 mE Thence 6605705.991 mN 315667.926 mE Thence 6605685.305 mN 315688.472 mE Thence 6605638.463 mN 315747.883 mE Thence 6605564.946 mN 315836.519 mE Thence 6605510.078 mN 315791.769 mE Thence 6605604.847 mN 315676.582 mE Thence 6605642.184 mN 315631.521 mE Thence 6605712.567 mN 315561.687 mE Thence 6605781.861 mN 315494.178 mE Thence 6605836.565 mN 315443.089 mE Thence 6605880.399 mN 315406.626 mE Thence 6605944.654 mN 315365.572 mE Thence 6606018.809 mN 315333.019 mE Thence 6606112.778 mN 315307.398 mE Thence 6606213.186 mN 315288.001 mE Thence 6606319.741 mN 315272.794 mE Thence 6606416.117 mN 315264.089 mE Thence 6606498.127 mN 315263.934 mE Thence 6606604.490 mN 315270.817 mE Thence 6606741.506 mN 315281.011 mE Thence 6606873.972 mN 315289.584 mE Thence 6606919.098 mN 315286.173 mE Thence 6606993.349 mN 315266.609 mE Thence 6607125.419 mN 315217.052 mE Thence 6607254.483 mN 315160.364 mE Thence 6607382.644 mN 315099.717 mE Thence 6607446.983 mN 315066.122 mE Thence 6607509.259 mN 315018.534 mE Thence 6607546.108 mN 314977.160 mE Thence 6607581.887 mN 314917.910 mE Thence 6607605.202 mN 314852.516 mE Thence 6607613.383 mN 314802.633 mE Thence 6607615.178 mN 314640.899 mE Thence 6607606.686 mN 314105.878 mE Thence 6607592.218 mN 313272.995 mE Thence 6607586.889 mN 313214.641 mE Thence 6607576.082 mN 313169.896 mE Thence 6607552.020 mN 313120.008 mE Thence 6607609.562 mN 313078.025 mE Thence 6607638.666 mN 313137.537 mE Thence 6607654.064 mN 313189.207 mE Thence 6607660.658 mN 313240.109 mE Thence 6607663.872 mN 313321.421 mE Thence 6607682.015 mN 314371.677 mE Thence 6607702.713 mN 314404.773 mE Thence 6607986.883 mN 314399.724 mE Thence 6607987.299 mN 314471.313 mE Back to Datum

Area :

Type	Dealing No	Start Date	Area
Granted		14/09/2021	32.13506 HA
Applied For		17/09/2019	33.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	17/09/2019		32.13513 HA

ASIC
Australian Securities & Investments Commission

Current Company Extract

Name: EVOLUTION MINING (PHOENIX) PTY LIMITED
ACN: 140 269 316

Date/Time: 12 October 2021 AEST 01:49:52 PM

This extract contains information derived from the Australian Securities and Investments Commission's (ASIC) database under section 1274A of the Corporations Act 2001.

Please advise ASIC of any error or omission which you may identify.

EXTRACT

Organisation Details		Document Number
Current Organisation Details		
Name:	EVOLUTION MINING (PHOENIX) PTY LIMITED	029474378
ACN:	140 269 316	
ABN:	55140269316	
Registered in:	Western Australia	
Registration date:	28/10/2009	
Next review date:	08/10/2022	
Name start date:	23/03/2016	
Status:	Registered	
Company type:	Australian Proprietary Company	
Class:	Limited By Shares	
Subclass:	Proprietary Company	

Address Details		Document Number
Current		
Registered address:	Level 24, 175 Liverpool Street, SYDNEY NSW 2000	7E9992782
Start date:	21/03/2018	
Principal Place Of Business address:	Level 24, 175 Liverpool Street, SYDNEY NSW 2000	7E9992782
Start date:	05/03/2018	

Contact Address	
Section 146A of the Corporations Act 2001 states 'A contact address is the address to which communications and notices are sent from ASIC to the company'.	
Current	
Address:	Level 24, 175 Liverpool Street, SYDNEY NSW 2000
Start date:	19/04/2018

Officeholders and Other Roles		Document Number
Director		
Name:	JACOB KLEIN	7E7573040
Address:	61 Wentworth Road, VAUCLUSE NSW 2030	
Born:	15/08/1965, CAPE TOWN, SOUTH AFRICA	
Appointment date:	18/12/2015	
Name:	LAWRENCE CONWAY	7E7573040
Address:	10 Clermiston Avenue, ROSEVILLE NSW 2069	
Born:	01/10/1969, ROCKHAMPTON, QLD	
Appointment date:	18/12/2015	
Secretary		
Name:	EVAN MARK ELSTEIN	7E7650743
Address:	43 Clyde Street, NORTH BONDI NSW 2026	
Born:	26/07/1965, CAPE TOWN, SOUTH AFRICA	
Appointment date:	28/01/2016	
Appointed Auditor		

Name:	PKF MACK	029232582
Address:	Level 4 35-37 Havelock Street WEST PERTH WA 6005	
Start date:	01/12/2014	

Ultimate Holding Company

Name:	EVOLUTION MINING LIMITED	7E7663426
ACN:	084 669 036	
ABN:	74084669036	

Share Information

Share Structure

Class	Description	Number issued	Total amount paid	Total amount unpaid	Document number
ORD	ORDINARY	470087333	70748424.75	0.00	1F0404214

Members

Note: For each class of shares issued by a proprietary company, ASIC records the details of the top twenty members of the class (based on shareholdings). The details of any other members holding the same number of shares as the twentieth ranked member will also be recorded by ASIC on the database. Where available, historical records show that a member has ceased to be ranked amongst the top twenty members. This may, but does not necessarily mean, that they have ceased to be a member of the company.

Name: EVOLUTION MINING LIMITED
ACN: 084 669 036
Address: Level 24, 175 Liverpool Street, SYDNEY NSW 2000

Class	Number held	Beneficially held	Paid	Document number
ORD	470087333	yes	FULLY	7E9992782

Financial Reports

Balance date	Report due date	AGM due date	Extended AGM due	AGM held date	Outstanding	Document number
30/06/2010	30/09/2010				no	027377344

Documents

Note: Where no Date Processed is shown, the document in question has not been processed. In these instances care should be taken in using information that may be updated by the document when it is processed. Where the Date Processed is shown but there is a zero under No Pages, the document has been processed but a copy is not yet available.

Date received	Form type	Date processed	Number of pages	Effective date	Document number
14/12/2018	488M Application To Change Review Date Of A Company Or Scheme Synchronise Review Date With Holding Company - No Fee	30/01/2019	4	14/12/2018	030516375
21/01/2019	484E Change To Company Details Appointment Or Cessation Of A Company Officeholder	21/01/2019	2	21/01/2019	7EAH88515

End of Extract of 3 Pages

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MISCELLANEOUS LICENCE 16/97

Status: Live

TENEMENT SUMMARY

Area: 3.00000 HA
Mark Out : 01/08/2012 09:30:00
Received : 01/08/2012 16:15:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 20/12/2012

CURRENT HOLDER DETAILS

Name and Address
EVOLUTION MINING (PHOENIX) PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Kunanalling
Datum: Datum situated at GDA 94 Zone 51 313402 metres East 6607145 metres North
Boundary: Thence to 313567 metres East 6606846 metres North
Thence to 314086 metres East 6605968 metres North
Thence to 314108 metres East 6605979 metres North
Thence to 313585 metres East 6606855 metres North
Thence to 313419 metres East 6607158 metres North
Thence to 313402 metres East 6607145 metres North
Back to Datum

Area :

Type	Dealing No	Start Date	Area
Granted		20/12/2012	3.00000 HA
Application To Amend	Application to Amend 404583	01/08/2012	3.00000 HA
Applied For		01/08/2012	30.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	01/08/2012		3.00000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MISCELLANEOUS LICENCE 16/101

Status: Live

TENEMENT SUMMARY

Area: 13.00000 HA
Mark Out : 10/08/2012 14:10:00
Received : 17/08/2012 14:45:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 20/12/2012

CURRENT HOLDER DETAILS

Name and Address
EVOLUTION MINING (PHOENIX) PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Blue Funnel
Datum: Datum is situated at GDA 94 Zone 51 315867 metres East 6610032 metres North
Boundary: Thence to 317809 metres East 6611878 metres North
Thence to 318123 metres East 6612177 metres North
Thence to 318431 metres East 6612466 metres North
Thence to 319549 metres East 6613522 metres North
Thence to 319955 metres East 6613915 metres North
Thence to 320110 metres East 6614054 metres North
Thence to 320251 metres East 6614189 metres North
Thence to 320288 metres East 6614235 metres North
Thence to 320314 metres East 6614281 metres North
Thence to 320296 metres East 6614291 metres North
Thence to 320271 metres East 6614245 metres North
Thence to 320237 metres East 6614203 metres North
Thence to 320096 metres East 6614069 metres North
Thence to 319941 metres East 6613930 metres North
Thence to 319535 metres East 6613537 metres North
Thence to 318417 metres East 6612481 metres North
Thence to 318109 metres East 6612192 metres North
Thence to 317795 metres East 6611893 metres North
Thence to 315853 metres East 6610046 metres North
Thence to 315867 metres East 6610032 metres North
Back to datum

Area :

Type	Dealing No	Start Date	Area
Granted		20/12/2012	13.00000 HA
Applied For		10/08/2012	13.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	17/08/2012		13.00000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MISCELLANEOUS LICENCE 16/108

Status: Live

TENEMENT SUMMARY

Area: 8.00000 HA
Mark Out : N/A
Received : 09/08/2013 14:05:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 25/09/2014

CURRENT HOLDER DETAILS

Name and Address
EVOLUTION MINING (PHOENIX) PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Kintore
Datum: Datum situated 6613152.700 metres North 309692.300 metres East MGA 94 Zone 51
Boundary: Thence 6613162.630 metres North 309715.238 metres East 0.000, Thence 6612349.463 metres North 310076.050 metres East 0.000, Thence 6610360.031 metres North 310433.370 metres East 0.000, Thence 6610356.600 metres North 310408.600 metres East 0.000, Thence 6612341.100 metres North 310052.200 metres East 0.000, Thence 6613152.700 metres North 309692.300 metres East 0.000, back to datum

Area :

Type	Dealing No	Start Date	Area
Granted		25/09/2014	8.00000 HA
Applied For		09/08/2013	8.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	09/08/2013		8.00000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MISCELLANEOUS LICENCE 16/113

Status: Live

TENEMENT SUMMARY

Area: 2.84000 HA
Death Reason :
Mark Out : N/A
Death Date :
Received : 28/11/2014 12:00:00
Commence : 04/08/2015
Term Granted : 21 Years

CURRENT HOLDER DETAILS

Name and Address
EVOLUTION MINING (PHOENIX) PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Kintore
Datum: Datum situated at MGA 94 Zone 51 Co-ords 309938.6 metres East 6612619.3 metres North
Boundary: Thence 309657.1 metres East 6612766.37 metres North
Thence 309511.7 metres East 6612801.2 metres North
Thence 309429.5 metres East 6612845.4 metres North
Thence 309364.6 metres East 6612929.2 metres North
Thence 309331.4 metres East 6613038.3 metres North
Thence 309320.4 metres East 6613210.7 metres North
Thence 309321.9 metres East 6613223.3 metres North
Thence 309351.7 metres East 6613219.6 metres North
Thence 309350.5 metres East 6613209.8 metres North
Thence 309361.2 metres East 6613043.7 metres North
Thence 309391.7 metres East 6612943.2 metres North
Thence 309449.3 metres East 6612868.8 metres North
Thence 309522.5 metres East 6612829.4 metres North
Thence 309667.7 metres East 6612794.5 metres North
Thence 309952.5 metres East 6612645.9 metres North
Thence 309938.6 metres East 6612619.3 metres North
Back to datum

Area :

Type	Dealing No	Start Date	Area
Granted		04/08/2015	2.84000 HA
Applied For		28/11/2014	2.84000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	28/11/2014		2.84000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/19

Status: Live

TENEMENT SUMMARY

Area: 109.05000 HA
Mark Out : 20/03/1985 14:12:00
Received : 25/03/1985 09:45:00
Term Granted : 21 Years (Renewed)
Death Reason :
Death Date :
Commence : 16/10/1985

CURRENT HOLDER DETAILS

Name and Address

EVOLUTION MINING (PHOENIX) PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

CEREP PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxx977

DESCRIPTION

Locality: KINTORE; EAST OF
Datum: DATUM PEG IS LOCATED 400 METRES BEARING 312 DEGREES FROM NORTH EAST CORNER OF SURRENDERED GML 16/1356
Boundary: THENCE 1100 metres bearing 124 degrees 1000 metres bearing 214 degrees 1100 metres bearing 304 degrees 1000 metres bearing 034 degrees BACK TO DATUM PEG. (transition of P 16/90)

Area :

Type	Dealing No	Start Date	Area
Surveyed		08/06/1986	109.05000 HA
Granted		16/10/1985	110.00000 HA
Applied For		20/03/1985	110.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	25/03/1985		109.05000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/444

Status: Live

TENEMENT SUMMARY

Area: 9.66100 HA
Mark Out : 27/01/2001 10:15:00
Received : 29/01/2001 09:34:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 08/05/2001

CURRENT HOLDER DETAILS

Name and Address
EVOLUTION MINING (PHOENIX) PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: KINTORE
Datum: DATUM SITUATED AT APPROXIMATE GDA 94 COORDINATES 309318 METRES EAST AND 6613973 METRES NORTH IN ZONE 51 WHICH IS THE MOST EASTERN CORNER OF SURVEYED GML 16/1163
Boundary: THENCE THE BOUNDARIES ARE IDENTICAL TO SURVEYED GML 16/1163 (CONVERSION OF GML 16/1163)

Area :

Type	Dealing No	Start Date	Area
Surveyed		04/03/2009	9.66100 HA
Granted		08/05/2001	9.70000 HA
Applied For		27/01/2001	9.70000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	27/01/2001		9.66100 HA

ASIC
Australian Securities & Investments Commission

Current Company Extract

Name: HAYES MINING PTY LTD
ACN: 107 985 606

Date/Time: 12 October 2021 AEST 01:49:52 PM

This extract contains information derived from the Australian Securities and Investments Commission's (ASIC) database under section 1274A of the Corporations Act 2001.

Please advise ASIC of any error or omission which you may identify.

EXTRACT

Organisation Details		Document Number
Current Organisation Details		
Name:	HAYES MINING PTY LTD	0E9592323
ACN:	107 985 606	
ABN:	54107985606	
Registered in:	Western Australia	
Registration date:	13/02/2004	
Next review date:	08/10/2022	
Name start date:	13/02/2004	
Status:	Registered	
Company type:	Australian Proprietary Company	
Class:	Limited By Shares	
Subclass:	Proprietary Company	

Address Details		Document Number
Current		
Registered address:	Level 24, 175 Liverpool Street, SYDNEY NSW 2000	7E9993195
Start date:	21/03/2018	
Principal Place Of Business address:	Level 24, 175 Liverpool Street, SYDNEY NSW 2000	7E9993195
Start date:	05/03/2018	

Contact Address	
Section 146A of the Corporations Act 2001 states 'A contact address is the address to which communications and notices are sent from ASIC to the company'.	
Current	
Address:	Level 24, 175 Liverpool Street, SYDNEY NSW 2000
Start date:	19/04/2018

Officeholders and Other Roles		Document Number
Director		
Name:	JACOB KLEIN	7E7573010
Address:	61 Wentworth Road, VAUCLUSE NSW 2030	
Born:	15/08/1965, CAPE TOWN, SOUTH AFRICA	
Appointment date:	18/12/2015	
Name:	LAWRENCE CONWAY	7E7573010
Address:	10 Clermiston Avenue, ROSEVILLE NSW 2069	
Born:	01/10/1969, ROCKHAMPTON, QLD	
Appointment date:	18/12/2015	
Secretary		
Name:	EVAN MARK ELSTEIN	7E7650845
Address:	43 Clyde Street, NORTH BONDI NSW 2026	
Born:	26/07/1965, CAPE TOWN, SOUTH AFRICA	
Appointment date:	28/01/2016	
Ultimate Holding Company		

Name:	EVOLUTION MINING LIMITED	7E7663384
ACN:	084 669 036	
ABN:	74084669036	

Share Information

Share Structure

Class	Description	Number issued	Total amount paid	Total amount unpaid	Document number
ORD	ORDINARY	1	1.00	0.00	0E9592323

Members

Note: For each class of shares issued by a proprietary company, ASIC records the details of the top twenty members of the class (based on shareholdings). The details of any other members holding the same number of shares as the twentieth ranked member will also be recorded by ASIC on the database. Where available, historical records show that a member has ceased to be ranked amongst the top twenty members. This may, but does not necessarily mean, that they have ceased to be a member of the company.

Name: EVOLUTION MINING (PHOENIX) PTY LIMITED
ACN: 140 269 316
Address: Level 24, 175 Liverpool Street, SYDNEY NSW 2000

Class	Number held	Beneficially held	Paid	Document number
ORD	1	yes	FULLY	7E9993195

Documents

Note: Where no Date Processed is shown, the document in question has not been processed. In these instances care should be taken in using information that may be updated by the document when it is processed. Where the Date Processed is shown but there is a zero under No Pages, the document has been processed but a copy is not yet available.

Date received	Form type	Date processed	Number of pages	Effective date	Document number
14/12/2018	488M Application To Change Review Date Of A Company Or Scheme Synchronise Review Date With Holding Company - No Fee	30/01/2019	4	14/12/2018	030516378
21/01/2019	484E Change To Company Details Appointment Or Cessation Of A Company Officeholder	21/01/2019	2	21/01/2019	7EAH88573

*****End of Extract of 2 Pages*****

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MISCELLANEOUS LICENCE 16/84

Status: Live

TENEMENT SUMMARY

Area: 66.00000 HA
Mark Out : 28/07/2009 00:45:00
Received : 31/07/2009 08:30:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 13/07/2012

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Black Flag
Datum: Situated at GDA Coordinates Zone 51 313344 metres East and 6607137 metres North
Boundary: Thence from Datum 313971 metres East and 6607632 metres North 313272 metres East and 6607620 metres North 313272 metres East and 6607663 metres North 314030 metres East and 6607676 metres North 314420 metres East and 6607993 metres North 314730 metres East and 6608995 metres North 315848 metres East and 6610052 metres North 316770 metres East and 6615900 metres North 317831 metres East and 6616537 metres North 318415 metres East and 6616758 metres North 317990 metres East and 6617230 metres North 318313 metres East and 6617375 metres North 318637 metres East and 6616792 metres North 317864 metres East and 6616515 metres North 316793 metres East and 6615798 metres North 315874 metres East and 6610029 metres North 314763 metres East and 6608980 metres North 314459 metres East and 6607986 metres North 314053 metres East and 6607637 metres North 313367 metres East and 6607119 metres North Back to datum

Area :

Type	Dealing No	Start Date	Area
Granted		13/07/2012	66.00000 HA
Applied For		28/07/2009	66.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	31/07/2009		66.00000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/15

Status: Live

TENEMENT SUMMARY

Area: 9.34300 HA
Mark Out : 23/06/1984 12:05:00
Received : 27/06/1984 14:20:00
Term Granted : 21 Years (Renewed)
Death Reason :
Death Date :
Commence : 10/04/1985

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: KUNANALLING
Datum: DATUM SITUATED AT NORTH EAST CORNER OF LATE SURVEYED GML 16/1052
Boundary: THENCE boundaries being identical to late surveyed GML 16/1052.

Area :

Type	Dealing No	Start Date	Area
Surveyed		01/05/1986	9.34300 HA
Granted		10/04/1985	9.70000 HA
Applied For		23/06/1984	9.70000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	27/06/1984		9.34300 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/24

Status: Live

TENEMENT SUMMARY

Area: 269.40000 HA
Mark Out : 23/12/1985 09:15:00
Received : 23/12/1985 11:15:00
Term Granted : 21 Years (Renewed)
Death Reason :
Death Date :
Commence : 24/07/1986

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: KUNANALLING
Datum: DATUM PEG LOCATED AT SOUTHERN MOST CORNER OF SURVEYED M16/1.
Boundary: THENCE Boundaries and area thence identical to surveyed M 16/1 and 16/3. (Amalgamation of leases)

Area :

Type	Dealing No	Start Date	Area
Surveyed		26/07/1990	269.40000 HA
Granted		24/07/1986	269.40000 HA
Applied For		23/12/1985	269.40000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	23/12/1985		269.40000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/40

Status: Live

TENEMENT SUMMARY

Area: 8.31550 HA
Mark Out : 19/11/1986 11:45:00
Received : 20/11/1986 10:10:00
Term Granted : 21 Years (Renewed)
Death Reason :
Death Date :
Commence : 17/03/1987

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: 700M NW KIA ORA DAM
Datum: DATUM AT SOUTHEAST CORNER OF LATE SURVEYED GML 16/1136
Boundary: THENCE 241.1 metres bearing 248 degrees 32 minutes 360.8 metres bearing 337 degrees 34 minutes 231.4 metres bearing 72 degrees 33 minutes 345.0 metres bearing 155 degrees 49 minutes BACK TO DATUM. (boundaries being identical to late surveyed GML 16/1136)

Area :

Type	Dealing No	Start Date	Area
Surveyed		05/09/1987	8.31550 HA
Granted		17/03/1987	8.31550 HA
Applied For		19/11/1986	8.31550 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	19/11/1986		8.31550 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/140

Status: Live

TENEMENT SUMMARY

Area: 373.70000 HA
Mark Out : 09/08/1989 13:24:00
Received : 09/08/1989 14:23:00
Term Granted : 21 Years (Renewed)
Death Reason :
Death Date :
Commence : 12/04/1991

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: KUNANALLING
Datum: DATUM PEG IS SITUATED AT THE SOUTH WEST CORNER OF SURVEYED MC 16/148S
Boundary: THENCE 878.6 metres bearing 269 degrees 47 minutes along Southern boundary of surveyed MC16/147S 116.6 metres bearing 269 degrees 49 minutes along Southern boundary of surveyed MC16/147S 1224.8 metres bearing 269 degrees 55 minutes along Southern boundaries of MC's 16/147S, 16/146S and 16/145S 2540 metres bearing 324 degrees 340 metres bearing 0 degrees 800 metres bearing 90 degrees 2820 metres bearing 138 degrees to a point on the Northern boundary of late surveyed GML16/1222 940 metres bearing 348 degrees to the Southern boundary of surveyed MC16/154S 160 metres bearing 90 degrees to the South Western corner of surveyed MC16/155S 1220.9 metres bearing 360 degrees along surveyed boundary of MC16/155S 12.5 metres bearing 90 degrees along surveyed boundary of MC16/155S 1216 metres bearing 0 degrees along surveyed boundary of MC16/164S 995.8 metres bearing 90 degrees along surveyed boundary of MC16/164S 1215.2 metres bearing 180 degrees to the South Eastern corner of MC16/164S 900 metres bearing 137 degrees 600 metres bearing 180 degrees to the Northern boundary of MC16/148S 600 metres bearing 270 degrees to the North Western corner of MC16/148S 1219.7 metres bearing 180 degrees along surveyed boundary of MC16/148S BACK TO DATUM. (excluding existing mining tenements with the exception of Mining Lease 16/100 conditionally surrendered in favour of this application.)

Area :	Type	Dealing No	Start Date	Area
	Surveyed		03/02/2005	373.70000 HA
	Dealing	Partial Surrender - Voluntary 293783	27/04/1993	411.00000 HA
	Granted		12/04/1991	713.00000 HA
	Applied For		09/08/1989	713.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	09/08/1989		373.70000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/152

Status: Live

TENEMENT SUMMARY

Area: 21.64000 HA
Mark Out : 05/12/1989 16:30:00
Received : 06/12/1989 08:30:00
Term Granted : 21 Years (Renewed)
Death Reason :
Death Date :
Commence : 28/03/1990

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: KUNANALLING
Datum: DATUM PEG IS SITUATED SOUTH EAST CORNER OF LATE SURVEYED M16/3
Boundary: THENCE 375 metres bearing 330 degrees 200 metres bearing 134 degrees 225 metres bearing 50 degrees 375 metres bearing 320 degrees 675 metres bearing 340 degrees 95 metres bearing 250 degrees 350 metres bearing 360 degrees 1500 metres bearing 152 degrees 400 metres bearing 230 degrees BACK TO DATUM.

Area :

Type	Dealing No	Start Date	Area
Surveyed		25/04/2005	21.64000 HA
Granted		28/03/1990	15.00000 HA
Applied For		05/12/1989	15.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	05/12/1989		21.64000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/189

Status: Live

TENEMENT SUMMARY

Area: 9.68650 HA
Mark Out : 17/07/1992 15:30:00
Received : 17/07/1992 16:15:00
Term Granted : 21 Years (Renewed)
Death Reason :
Death Date :
Commence : 27/01/1993

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: London Group
Datum: Dautm peg situated 32 metres bearing 195 degrees from southerly peg of late GML 9145
Boundary: Thence 241 metres bearing north east Thence 401 metres bearing south east Thence 241 metres bearing south west Thence 401 metres bearing north west Back to datum All bearings identical to P 16/1415 and GML 16/1135 as surveyed

Area :

Type	Dealing No	Start Date	Area
Surveyed		24/04/2005	9.68650 HA
Granted		27/01/1993	9.70000 HA
Applied For		17/07/1992	9.70000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	17/07/1992		9.68650 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/195

Status: Live

TENEMENT SUMMARY

Area: 4.62100 HA
Mark Out : 08/06/1993 14:15:00
Received : 08/06/1993 15:00:00
Term Granted : 21 Years (Renewed)
Death Reason :
Death Date :
Commence : 20/10/1993

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: LONDON GROUP
Datum: DATUM POST IS SITUATED AT THE SOUTH WEST CORNER OF SURVEYED GOLD MINING LEASE 16/1135
Boundary: THENCE 550 METRES BEARING 320 DEGREES ALONG SURVEYED BOUNDARY OF MINING LEASE 16/24 THENCE 150 METRES BEARING 50 DEGREES ALONG SURVEYED BOUNDARY OF MINING LEASE 16/24 THENCE 580 METRES BEARING 155 DEGREES ALONG SURVEYED BOUNDARY OF GOLD MINING LEASES 16/1136 AND 16/1135 BACK TO DATUM

Area :

Type	Dealing No	Start Date	Area
Surveyed		24/04/2005	4.62100 HA
Granted		20/10/1993	5.00000 HA
Applied For		08/06/1993	5.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	08/06/1993		4.62100 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/198

Status: Live

TENEMENT SUMMARY

Area: 100.65000 HA
Mark Out : 28/10/1993 11:32:00
Received : 05/11/1993 08:55:00
Term Granted : 21 Years (Renewed)
Death Reason :
Death Date :
Commence : 14/04/1994

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: 1KM south of London Group
Datum: Datum situated south east corner of late surveyed MC 160S
Boundary: THENCE: west 1000 metres north 600 metres east 250 metres north 600 metres east 750 metres south 1200 metres back to datum

Area :

Type	Dealing No	Start Date	Area
Surveyed		27/09/2004	100.65000 HA
Granted		14/04/1994	101.00000 HA
Applied For		28/10/1993	101.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	28/10/1993		100.65000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/526

Status: Live

TENEMENT SUMMARY

Area: 96.76500 HA
Mark Out : 24/04/2009 09:27:00
Received : 24/04/2009 10:10:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 14/07/2011

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Kunanalling
Datum: Situated at GDA Coordinates Zone 51 6605951.638 metres North and 312838.247 metres East
Boundary: Thence 6605935.643 metres North and 311949.107 metres East 6608016.379 metres North and 311913.642 metres East 6607118.041 metres North and 312695.148 metres East 6607105.175 metres North and 312241.386 metres East 6606781.688 metres North and 312263.395 metres East Back to datum THIS APPLICATION IS MADE UNDER SECTION 49 OF THE MINING ACT

Area :

Type	Dealing No	Start Date	Area
Surveyed		21/03/2014	96.76500 HA
Granted		14/07/2011	97.00000 HA
Applied For		24/04/2009	97.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	24/04/2009		96.76500 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/532

Status: Live

TENEMENT SUMMARY

Area: 109.75000 HA
Mark Out : 06/03/2013 11:05:00
Received : 07/03/2013 15:29:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 04/02/2014

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Kintore South East
Datum: GDA94 Zone 51 coordinates 310898 metres East and 6610450 metres North
Boundary: THence 289 metres at bearing 90 degrees 456 metres at bearing 320 degrees 672 metres at bearing 90 degrees along portion of surveyed boundary of MC190S 1215 metres at bearing 0 degrees 302 metres at bearing 89 degrees and 22 minutes along portion of surveyed boundary of MC190S 2110 metres at bearing 180 degrees along surveyed boundaries of MC180S and MC190S 250 metres at bearing 270 degrees 330 metres at bearing 176 degrees and 23 minutes along surveyed boundary of M16/152 1145 metres at bearing 319 degrees and 58 minutes along surveyed boundary of M16/24 Back to datum This application is a Section 49 conversion of Prospecting Licence 16/2429

Area :

Type	Dealing No	Start Date	Area
Surveyed		09/04/2014	109.75000 HA
Granted		04/02/2014	110.00000 HA
Applied For		06/03/2013	110.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	07/03/2013		109.75000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/533

Status: Live

TENEMENT SUMMARY

Area: 9.83550 HA
Mark Out : 06/03/2013 11:00:00
Received : 07/03/2013 15:29:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 04/02/2014

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Kia Ora Dam, Kunanalling North
Datum: GDA Zone 51 coordinates 312313.3m East and 6608685.2m North
Boundary: Thence 312071.2 metres East and 6608533.7 metres North along Surveyed boundary of M16/152 311809.5 metres East and 6608836.9 metres North along Surveyed boundary of M16/1582 and portion of M16/24 312026.1 metres East and 6608880.0 metres North along Surveyed boundary of M16/189 311973.6 metres East and 6609017.1 metres North along Surveyed boundary of M16/189 312313.3 metres East and 6608685.2 metres North along Surveyed boundary of M16/152 Back to datum This application is a Section 49 conversion of Prospecting Licence 16/2426 and is identical to late surveyed Mining Lease 16/247.

Area :

Type	Dealing No	Start Date	Area
Surveyed		10/04/2014	9.83550 HA
Granted		04/02/2014	9.00000 HA
Applied For		06/03/2013	9.00000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	07/03/2013		9.83550 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/537

Status: Live

TENEMENT SUMMARY

Area: 397.90000 HA
Mark Out : 23/12/2013 10:44:00
Received : 24/12/2013 09:40:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 14/08/2014

CURRENT HOLDER DETAILS

Name and Address
HAYES MINING PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Castlehill Kintore South
Datum: Datum situated at Zone 51 GDA 94 co-ordinates 6609547.7 metres North 308900.4 metres East
Boundary: Thence to 6609561.8 metres North 309696.4 metres East Thence to 6610762.4 metres North 308881.5 metres East Thence to 6610780.6 metres North 309867.6 metres East along surveyed boundary of MC829S Thence to 6610793.7 metres North 310599.1 metres East along part surveyed boundary of MC828S Thence to 6610658.1 metres North 310717 metres East Thence to 6610132.8 metres North 310113.6 metres East along surveyed boundary of M16/24 Thence to 6608974.5 metres North 311119.4 metres East along part surveyed boundary of M16/24 Thence to 6608368.6 metres North 311605.7 metres East along part surveyed boundary of M16/24 Thence to 6608358.3 metres North 311036.9 metres East along part surveyed boundary of M16/198 Thence to 6608615.6 metres North 311044.4 metres East along part surveyed boundary of M16/177 Thence to 6608616 metres North 310691.6 metres East along surveyed boundary of M16/177 Thence to 6608352.2 metres North 310696.3 metres East along part surveyed boundary of M16/177 Thence to 6608338.2 metres North 309916.6 metres East Thence to 6608325.8 metres North 308915.1 metres East Thence 6609547.7 metres North 308900.4 metres East Back to datum This application is a Section 49 Conversion of Prospecting Licences 16/2419, 16/2428, 16/2430, 16/2799and a conversion of General Purpose lease 16/18

Area :	Type	Dealing No	Start Date	Area
	Surveyed		03/03/2015	397.90000 HA
	Granted		14/08/2014	397.90000 HA
	Applied For		23/12/2013	397.90000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	24/12/2013		397.90000 HA

Government of Western Australia
Department of Mines, Industry Regulation and Safety

eMiTS MINERAL TITLES ONLINE

MINING TENEMENT SUMMARY REPORT

MINING LEASE 16/538

Status: Live

TENEMENT SUMMARY

Area: 159.30000 HA
Mark Out : 22/04/2014 13:50:00
Received : 23/04/2014 12:05:00
Term Granted : 21 Years
Death Reason :
Death Date :
Commence : 04/11/2014

CURRENT HOLDER DETAILS

Name and Address
EVOLUTION MINING (PHOENIX) PTY LTD
MCMAHON MINING TITLE SERVICES PTY LTD, C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 592, MAYLANDS, WA, 6931, xxxx@mmts.net.au, xxxxxxxxxxx997

DESCRIPTION

Locality: Kintore NW

Datum: Datum situated at Zone 51 GDA 94 co-ordinates 6613185.8 metres North and 307827.8 metres East (being the South West Corner of late surveyed MC836S

Boundary: Thence to 6614405 metres North 307953 metres East Thence to 6614419 metres North 308680 metres East Thence to 6614319 metres North 308725 metres East Thence to 6614441 metres North 308999 metres East Thence to 6614166 metres North 309117 metres East along surveyed boundary M16/215 Thence to 6614081 metres North 308823 metres East alond part surveyed boundary M16/444 Thence to 6613862 metres North 308933 metres East along surveyed boundary M16/444 Thence to 6613942 metres North 309212 metres East along part surveyed boundary M16/444 Thence to 6613214 metres North 309524 metres East along part surveyed boundary M16/215 Thence to 6613202 metres North 308831 metres East Thence to 6613185.8 metres North 307827.8 metres East Back to datum This application is a Section 49 conversion of Prospecting Licence 16/2682

Area :

Type	Dealing No	Start Date	Area
Surveyed		26/11/2014	159.30000 HA
Granted		04/11/2014	159.10000 HA
Applied For		22/04/2014	159.10000 HA

SHIRE DETAILS

Shire	Shire No	Start	End	Area
COOLGARDIE SHIRE	1960	22/04/2014		159.30000 HA