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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 3-2: Vegetation Communities of the Project Area

Legend

- Mine site dam
- Dcir
- East
- Ecli
- Efal
- Efal/Eple
- Eflo/Espp
- Eflo/Esug
- Eflo/Mbra
- Eflo/Mcuc
- Eflo/Mgor
- Elep/Mrig
- Eocc
- Eole/Mpau
- Epil
- Epla
- Epla/Mcuc
- Epla/Mhap
- Eple/Bmed
- Epro/Mspp
- Espo
- Macu
- Mallee/Mspp
- Mine site/cleared
- Mosaic_Ecer_and_Ecli
- Mstr
- Mx
- Ravensthorpe Gold/Copper Project Tenements
- Major roads

Date: 12/12/2016

Scale: 1:10,000

0.45 0.9

Kilometres

ems@animalplantmineral.com.au

GDA 1994 MGA Zone 51

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Document Name: 20161212_ACH_Kundip Gold Project_Fig 3-2 Bio Report

3.2.2 Threatened and Priority Ecological Communities

During the ground-truthing of the Craig mapping (Craig *et al* 2008) each community was assessed to determine whether it was representative of any one of the TECs or PECs that have the potential to occur based on the databases search (Table 3-4). Craig's (2008) mapping, which provided synoptic table of species occurrence within each vegetation unit, was important (in conjunction with field survey) in comparison to the vegetation units detected during the database searches (eg. The specific pattern of dominance of proteaceous species could be compared to the TEC 'Proteaceae Dominated Kwongkan Shrublands').

Based on the description of each of the TEC or PEC communities, field observation and formal descriptions published in Craig's (2008) mapping of the Ravensthorpe range, four communities present in the Project area were determined to potentially represent one or more of the TECs or PECs. The full description of these vegetation units is presented in Table 3-4.

Table 3-4: Full description of the Craig et al. (2008) vegetation communities that could be representative of local TECs and PECs

Vegetation Unit	Vegetation Unit Code	Muir vegetation structure	Geology	Vegetation description
Dcir	*Banksia cirsioides*: Proteaceous mallee-heaths	Heath, Low Heath C and D	Colluvium of deeply eroded surfaces - Qrg (228.8 ha); Sandplain - Czs (101.9 ha), Cemented ironstone gravel and laterite - Czl (67.6 ha); Gravel plain - Czg (64.1 ha); Colluvium and minor alluvium - Qrt (21.5 ha); Ultramafic rock, altered - Ae (6.9 ha); Pelitic metasediments - Alp (3.5 ha)	**Mallees:** *Eucalyptus pleurocarpa, Eucalyptus incrassata, Eucalyptus tetraptera, Eucalyptus uncinata* **Tall shrubs**: *Allocasuarina acutivalvis subsp. acutivalvis, Banksia lemanniana, Hakea pandanicarpa subsp. crassifolia, Melaleuca hamata* **Mid shrubs:** *Banksia cirsioides, Banksia pallida, Gastrolobium parviflorum forma 'broad', Petrophile seminude, Taxandria spathulata* **Low shrubs:** *Allocasuarina humilis, Beaufortia schaueri, Beaufortia micrantha var. micrantha, Melaleuca rigidifolia, Melaleuca subtrigona, Petrophile glauca* **Dwarf shrubs**: *Hibbertia pungens, Leucopogon conostephioides* **Sedges:** *Gahnia ancistrophylla, Mesomelaena stygia subsp. stygia* **Landform:** Lower and simple slopes and flat
Efal/Eple	*Eucalyptus falcata / E. pleurocarpa*: Proteaceous mallee-heath	Open Shrub Mallee, Scrub, Heath, Low Heath C, Open Dwarf D	Colluvium of deeply eroded surfaces; contains rock fragments and minor outcrops - Qrg (1135.6 ha); Cemented ironstone gravel and laterite - Czl (779.2 ha); Metamorphosed sedimentary rock - As (405.1 ha); Fine-grained mafic rock - Ab (144.1 ha); Serpentinite - Au (81.3 ha), Pelitic metasediments - Alp (79.7 ha); Colluvium and minor alluvium - Qrt (78.0 ha); Gravel plain - Czg (52.2 ha)	**Mallees**: *Eucalyptus pleurocarpa, Eucalyptus falcata subsp. falcata, Eucalyptus uncinata, Eucalyptus incrassata, Eucalyptus phaenophylla* **Tall shrubs:** *Banksia lemanniana, Banksia laevigata subsp. laevigata, Beaufortia orbifolia, Banksia quercifolia, Grevillea coccinea subsp. coccinea, Melaleuca hamata* **Mid shrubs:** *Acacia fragilis, Acacia heterochroa subsp. heterochroa, Allocasuarina humilis, Beyeria brevifolia var. brevifolia, Calothamnus quadrifidus, Banksia cirsioides, Banksia pallida, Gastrolobium parviflorum forma 'broad', Hakea lissocarpha, Hakea obtusa, Hakea verrucosa, Isopogon polycephalus, Jacksonia viscosa, Kunzea cincinnata, Leptospermum spinescens, Melaleuca rigidifolia, Melaleuca subtrigona, Petrophile seminuda, Taxandria spathulata* **Low shrubs:** *Beaufortia schaueri, Hibbertia mucronata, Lasiopetalum compactum, Leucopogon cuneifolius, Petrophile glauca, Petrophile fastigiata, Philotheca gardneri subsp. Ravensthorpe (G.F. Craig 6902)* **Dwarf shrubs:** *Hibbertia pungens, Leucopogon*

Vegetation Unit	Vegetation Unit Code	Muir vegetation structure	Geology	Vegetation description
				conostephioides, Rinzia communis **Sedges:** *Gahnia ancistrophylla, Lepidosperma sp. Mt Benson (RL Barrett 3553), Lepidosperma sp. Cordingup (GF Craig 6138), Mesomelaena stygia subsp. stygia* **Landform:** Crest, upper to lower slope, flat, and open depression
Eple/Bmed	*Eucalyptus pleurocarpa / Banksia media*	Open Shrub Mallee, Open Scrub, Heath, Low Heath C, Open Dwarf Scrub D	Sandplain - mostly loam/ clay, with ironstone pebbles and limonite nodules - Czc (95.9 ha); Sandplain - Czs (61.9 ha); Drainage/ Alluvium of mature drainage - Qpv (59.2 ha); Colluvium of deeply eroded surfaces; contains rock fragments and minor outcrops - Qrg (59.2 ha); Colluvium and minor alluvium - Qrt (57.8 ha); Fine-grained mafic rock - Ab (18.8 ha); Felsic extrusives, mainly dacite - Al (11.0 ha)	**Mallees**: *Eucalyptus falcata subsp. falcata, Eucalyptus flocktoniae subsp. flocktoniae, Eucalyptus incrassata, Eucalyptus pleurocarpa, Eucalyptus phaenophylla, Eucalyptus proxima, Eucalyptus suggrandis subsp. suggrandis, Eucalyptus uncinata* **Tall shrubs:** *Banksia media, Melaleuca hamata, Hakea laurina, Hakea pandanicarpa subsp. crassifolia, Hakea pandanicarpa subsp. pandanicarpa* **Mid shrubs:** *Allocasuarina humilis, Calothamnus gibbosus, Calothamnus gracilis, Banksia cirsioides, Grevillea oligantha, Hakea corymbosa, Melaleuca bracteosa, Melaleuca glaberrima, Melaleuca rigidifolia, Melaleuca lateriflora subsp. lateriflora, Melaleuca subfalcata, Melaleuca subtrigona, Taxandria spathulata* **Low shrubs:** *Acacia gonophylla, Baeckea corynophylla, Beaufortia micrantha var. micrantha, Beaufortia schaueri, Boronia inornata, Hakea marginata, Isopogon sp. Fitzgerald River (DB Foreman 813), Leucopogon fimbriatus, Lysinema ciliatum, Petrophile squamata subsp. northern (J Monks 40)* **Dwarf shrubs:** *Acacia ingrata, Hibbertia pungens, Rinzia communis* **Sedges:** *Gahnia ancistrophylla* **Landform:** Simple lower slopes and flats
Mx	Mx	Low Woodland, Very Open Shrub Mallee, Dense Heath	Colluvium of deeply eroded surfaces; contains rock fragments and minor outcrops - Qrg (10.6 ha)	**Mallets:** *Eucalyptus cernua* **Mallees:** *Eucalyptus flocktoniae subsp. flocktoniae, Eucalyptus phaenophylla* **Mid shrubs:** *Baeckea corynophylla, Melaleuca bracteosa, Melaleuca haplantha, Melaleuca sp. Kundip (GF Craig 6020), Melaleuca stramentosa* **Low shrubs:** *Pultenaea craigiana* **Dwarf shrubs:** *Andersonia parvifolia, Coopernookia polygalacea, Hibbertia psilocarpa, Leucopogon infuscatus* **Sedges:** *Gahnia aristata* **Landform**: Gently undulating, lower slopes

The relevance of the four communities to the communities of conservation significance are discussed in the following text and Table 3-5 outlines impacts of the proposed disturbance on these vegetation communities.

Dcir

The *Banksia cirsioides*: Proteaceous mallee-heaths are a vegetation community representative of the Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia TEC. *Hakea pandanicarpa* supsp. *crassifolia* and *Banksia cirsioides*, species known to occur in the TEC, have been detected within the Dcir vegetation community. Throughout the Ravensthorpe Range, this vegetation community is present as 37 discrete units one of which is located within the Project area and within the proposed impact footprint. Under the original mine plan / design this community would have been 100 percent (%) impacted. However and in response to the findings of this current survey, ACH have engaged a

mining engineer to develop a new mine layout to avoid impact to this vegetation unit. That new layout will be included in the EPA referral.

Efal/Eple

Eucalyptus falcata / *E. pleurocarpa*: Proteaceous mallee-heath vegetation community has elements of TECs Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia TEC and *Banksia laevigata* - *Banksia lemanniana* proteaceous thicket TEC. *Banksia cirsioid*es, a characteristic species of the Kwongkan TEC, and several species including *Banksia laevigata* subsp. *laevigata*, *Banksia lemanniana, Adenanthos oreophilus, Leptospermum maxwellii, Beaufortia orbifolia, Taxandria spathulata* and *Stylidium albomontis* occur within the *Banksia laevigata – Banksia lemanniana* proteaceous thicket TEC.

The Efal/Eple community is represented within 99 discrete units in the Ravensthorpe Range area. This vegetation community is found throughout the Project area, particularly to the north and east of the proposed footprint. A total of 94.16% of this vegetation community in the Project area will be cleared. However, this represents only 4.84% of the TEC/PEC in the Ravensthorpe Range area. The proposed waste dump, originally located in the north of the Project area, will be moved so as to minimise impacts to this vegetation community.

Eple/Bmed

The *Eucalyptus pleurocarpa* / *Banksia media* vegetation community is representative of the Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia TEC. Whilst this community's structure is formed by Myrtaceous species (*E. pleurocarpa*) and could be considered as non-proteaceous dominated vegetation, a large number of subordinate (constant) species are characteristic of the Kwongkan TEC. These species, known to be obligate seeders (another characteristic of the TEC) include; *Banksia media, Hakea pandanicarpa* subsp. *crassifolia, Hakea pandanicarpa* subsp. *pandanicarpa, Dryandra cirsioides,* and *Hakea corymbosa*. Lastly, the vegetation community falls within the recorded geological niche – constrained by its underlying formation of sand with clay / loam.

The *Eucalyptus pleurocarpa* / *Banksia media* vegetation community is represented within 31 discrete units within the Ravensthorpe Range. It is found across the Project area and has been mapped within nine polygons. Six of these polygons will be impacted by the proposed footprint. This equates to 83.01% of the total vegetation community in the Project area and 7.78% of the vegetation community in the Ravensthorpe Range.

Mx

Melaleuca sp. Kundip vegetation (Mx) community is representative of the PEC – 'Very open mallee over Melaleuca sp. Kundip dense heath (P1)'. In addition to the occurrence of *Melaleuca sp. Kundip'*, known subordinate species, including; *Melaleuca haplantha, Melaleuca stramentosa, Melaleuca rigidifolia, Melaleuca bracteosa, Melaleuca sp. Gorse, Eucalyptus cernua, Eucalyptus phaenophylla, Eucalyptus pileata, Dodonaea trifida, Acacia durabilis, Leucopogon infuscatus, Hibbertia psilocarpa* described within the PEC occur within Mx. Additionally, the vegetation community occurs on pale loamy sand with quartz rubble – also matching formal description of the PEC.

Mx is found within three discrete units in the Ravensthorpe Range, all of which are within the Project area. One of these polygons intersects the proposed development envelope for the Kundip Mine Site. However, this PEC is not within the area proposed to be disturbed and will not be directly impacted.

Table 3-5: Threatened and Priority Ecological Communities impact assessment

Vegetation Code	Summary Description	TEC/PEC Representation	Amount in the Ravensthorpe Range (ha)	Amount in the Project Area (ha)	Amount in Proposed Disturbance Footprint (ha)	Disturbance to TEC/ PEC in the Ravensthorpe Range (%)	Disturbance to TEC / PEC within the Project Area (%)
Dcir	*Dryandra cirsioides*: Proteaceous mallee-heaths	TEC - Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia	521.11	1.76	1.76	0.33	0[1]
Efal/Eple	*Eucalyptus falcata* / *E. pleurocarpa*: Proteaceous mallee-heath	TEC - Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia	2932.99	150.99	142.18	4.84	94.16
Eple/Bmed	*Eucalyptus pleurocarpa*/ *Banksia media*	TEC - Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia	332.81	31.20	25.90	7.78	83.01
Mx	*Melaleuca* sp. Kundip	PEC (P1): Very open mallee over Melaleuca sp. Kundip dense heath	11.26	11.01	9.93	88.18	90.19

[1] Relocating the waste rock dump will result in no impact to this vegetation community

3.2.3 Vegetation Condition

Within the project area there is longstanding legacy of mining practice stemming from the early 19th century to present day exploration projects. Subsequently, the vegetation within the survey area reflects a mosaic of conditions (Keighery, 1994). Specifically, recently disturbed areas (i.e from exploration drill lines at 50-25 m resolution, vegetation clearing & infrastructure construction) are of 'Good' to 'Degraded' condition (respectively), historically disturbed areas (i.e. clearing of trees for mine shafts, infrastructure construction & historic dwellings) of 'Very Good' condition, and the remaining undisturbed vegetation of 'Excellent' condition (Keighery, 1994). Vegetation condition of the Project area is shown in Figure 3-3.

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 3-3: Vegetation Condition of the Project Area

Legend

- *Ravensthorpe Gold/Copper Project Tenements*
- Good to Degraded
- Very Good
- *Excellent*
- *Major roads*

Date: 12/12/2016

Scale: 1:10,000

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Kilometres

ems@animalplantmineral.com.au

GDA 1994 MGA Zone 51

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Document Name: 20161212_ACH_Kundip Gold Project_Fig 3-3 Bio Report

3.2.4 Conservation Significant Flora

No Threatened Flora of conservation significance, pursuant to Subsection 2 of Section 23F of the WC Act were located during the floristic survey. One plant taxa pursuant to section 179 of the EPBC Act was located during the floristic survey, *Marianthus mollis* (Plate 1). This species is also listed as Priority (P4) under the WC Act. All records of *M. mollis* were in the north-east and east of the proposed disturbance footprint . Three historical records from the WA herbarium of *Hydrocotyle* sp. *decipiens,* listed as Priority 2 under the WA Act,. were confirmed still present during the survey. These individuals are located within what was proposed to be disturbed in the original mine layout. However, under the current revised site layout the population will not be directly impacted. The location of conservation significant flora observed is presented in Figure 3-4 and Appendix 12.

Plate 1: *Marianthus mollis* (DPaW, 2016)

3.2.5 Introduced Flora

A total of seven weed species were detected in during the survey over the projected disturbance footprint; **Arctotheca calendula, *Asparagus asparagoides, *Hypochaeris glabra, *Oxalis pes-caprae, *Cotula coronopifolia, *Trifolium* spp., **Carpobrotus aequilaterus*. Whilst present within the proposed disturbance area APM hypothesises the presence of these and additional weeds present along the heritage trail that runs north-south on the western side of the Kundip Mine Site, and can be found along the road verge of Hopetoun-Ravensthorpe Road.

**Asparagus asparagoides* is classified as a Weed of National Significance (WONS) under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). The locality of this species is isolated to areas of high disturbance and is associated with annual weed species. These visually homogenous weed patches appear as isolated a-zonal patches (Figure 3-5 and Plate 2). Localised management practices could be developed and applied.

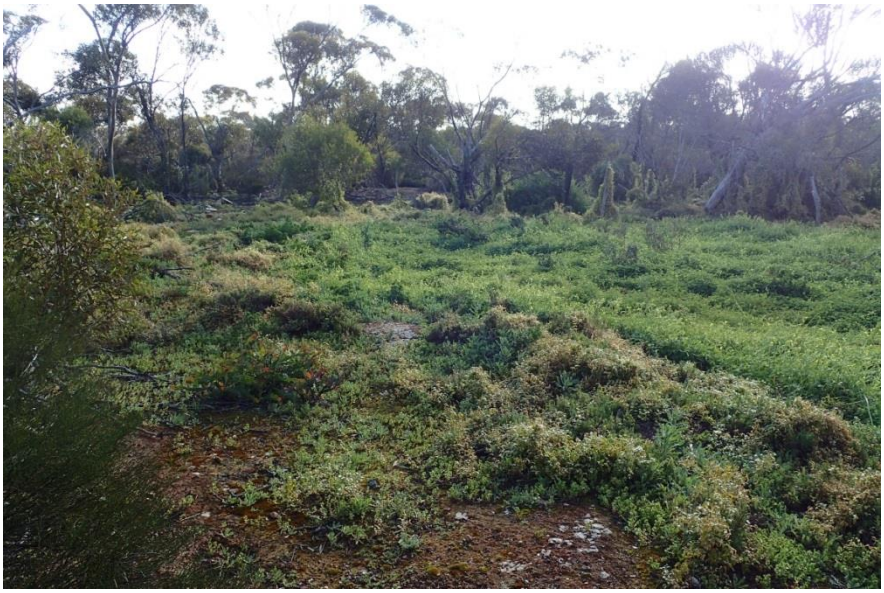

Plate 2: A zonal weed patch (APM, 2016)