

### Memo

- To: Mr M. Brooks (Strategen)
- From: Dr E. Mattiske
- Date: 7<sup>Th</sup> December 2016

Re: Review of Flora and Vegetation Reports for the Mineralogy project at Cape Preston

#### 1. INTRODUCTION

The following review is based on the documents supplied by Mr M. Brooks from Strategen in November 2016 for the Mineralogy project at Cape Preston.

- Maunsell (2003), *Cape Preston Iron Ore Development. Seasonal Biological Survey Threatened Flora.* Prepared for Austeel Pty Ltd, November 2003.
- Astron Environmental Services (2007), *General Purpose Leases G08/52 and G08/53 Additional Vegetation Survey and Mapping.* Prepared for CP Mining Management Pty Ltd, June 2007.
- Mattiske Consulting Pty Ltd (2007a), *Flora and Vegetation Survey of Cape Preston Potential Campsites and Airstrips*. Unpublished Report for CITIC Pacific Mining Management Pty Ltd, April 2007.
- Mattiske Consulting Pty Ltd (2007b), *Comparison of Flora and Vegetation Values on Preferred and Original Campsites Cape Preston.* Unpublished Report for CITIC Pacific Mining Management Pty Ltd, April 2007.
- Maunsell and AECOM (2008), *Cape Preston Mining Estate Consolidated Vegetation, Flora and Fauna Assessment.* Prepared for International Minerals, 25<sup>th</sup> September 2008.
- Astron Environmental Services (2008), Sino Iron Project Cape Preston. Mapping and Surveying of Groundwater Dependent Ecosystems. Prepared for CITIC Pacific Mining Management Pty Ltd, September/October 2008.
- AECOM (2009), *Balmoral North and Balmoral South Stage 2. Flora and Vegetation Assessment*. Report prepared for Mineralogy, 18 June 2009.
- Astron Environmental Services (2009a), *Mineralogy Expansion Proposal Desktop Flora and Vegetation Study*. Prepared for Mineralogy Pty Ltd, June 2009.
- Astron Environmental Services (2009b), Waste Rock Dump and Tailings Expansion Areas Vegetation, Flora and Fauna Survey. Prepared for CITIC Pacific Mining Management Pty Ltd, May 2009.

#### 2. REVIEW

The variety of work covers detailed Level 1 studies, targeted work on species, targeted work on communities, targeted work on groundwater dependent ecosystems and Level 2 studies for some areas on the Cape Preston area. The effort is variable due to the different types of work and also different coverage in the Cape Preston area (see Table 1).

The methodologies have been relatively consistent and most authors have tried to align mapping with previous investigations (Table 2). Several of the reports are more comprehensive and the merged interpretation in the more recent documents provides a comprehensive summary; and in particular the Maunsell (2008), Astron 2009 AECOM (2009) reports appear to address many of the issues and provide the most comprehensive summaries on the wider project areas.

Despite some variations in scope and coverage by the different specialists it is apparent that a substantial amount of flora and vegetation studies have been undertaken over a range of seasons (both following the rainfall cyclonic months and the drier months). The specialists involved with the work have had many years of experience in botanical and ecological studies in the Pilbara and therefore this has not been a limitation on the efforts at various times in this project area. The unreliability of seasonal rains in the Pilbara region is an ongoing issue. In this instance any concerns related to the timing are minimized by a few favorable rainfall events prior to several of the assessments (Maunsell 2008; Astron 2009b) and through the experience level of the specialists undertaking the studies at Cape Preston. The data collection for the flora and vegetation studies was based mainly on the accepted standard of 50m x 50m quadrats. The consistency in interpretation also extended to the data analyses for the more extensive studies in the project area and used either PATN or PRIMER with underlying similarities in some of the analytical techniques.

Although not all areas were assessed in multiple seasons, the broad nature of the plant communities and consistency in mapping approaches enabled the correlation and interpretation of data between survey areas. The consistency of mapping units was used by the different specialists and consequently this improved the alignment of mapping units.

There is a need to update the information on the flora lists as there have been some taxonomic changes to recorded species, some changes to the conservation status of the flora species and some changes to the weed species in the Pilbara. The summary supplied in Table 3 illustrates the type of review and amendments that should be undertaken through cross-checking against data on flora with the current Department of Parks and Wildlife Florabase. Such changes may lead to a few minor changes in the interpretation of the impacts of the proposed operations on these values. To assist in these matters the threatened and priority species extracted from the respective reports is summarized below in Table 3. Based on the extent of the surveys, the multiple seasons in which surveys were conducted and the highly experienced personnel conducting the surveys it is unlikely that any additional species of Threatened or Priority Flora would be recorded by additional survey.

AECOM (2009) noted two declared plant species (introduced species) that occur in the project area (see Table 7 in AECOM 2009), namely the \**Prosopis pallida* (Mesquite) and \**Datura leichhardtii* (Native Thornapple). In addition a range of environmental weed species were highlighted in AECOM 2009. In Astron 2008 \**Prosopis glandulosa x velutina* (Mesquite) was also highlighted. Hence the apparent need to rationalize the information on the declared and other weed species in the impact assessment.

There have been several references to the potential Priority and Threatened Ecological Communities (PEC/TEC) in the Cape Preston area. Whilst these were suggested in several of the reviewed documents there appears to be little justification that these values exist in the Cape Preston area (see AECOM 2009 - section 5.3). The interpretation of the latter was based on Kendrick & McKenzie (2001) and Kendrick and Stanley (2001) and information supplied by J Pryde in 2009. Consequently, the grassland communities that have been previously mapped in the Cape Preston Mining Precinct are no longer considered to be equivalent to the Priority 1 Ecological Community "Roebourne Plains Gilgai Grassland). Astron 2008, Astron 2009 and AECOM 2009 address other communities of conservation significance. The justification for highlighting some vegetation mapping units and associated plant communities requires some attention and should include the localized wetlands, the cracking clay communities and some of the areas that are either restricted in the regional context or that have the potential to support particular flora or fauna species that are of conservation significance. Examples of other communities with potential conservation significance include the spring, some of the gullies and some rockpiles (see Astron 2008 and Astron 2009b). Astron 2008, highlighted a range of groundwater dependent ecosystems on the Fortescue and Du Boulay Rivers and associated with the River and Yamerina land systems. Hence there is a need to collate and integrate the other significant communities in the impact report.

There has been some variation in the uses of Trudgen (see Table 8, Astron 2009b) and Keighery (see Table 3, AECOM 2009) condition scales. Whilst there are differences in the condition scales, these do not justify further investigations on the assessment of the condition ratings.

In relation to the need to meet the requirements of the Environment Protection Authority Guidance Statement 51 (Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia) and Position Statement 3 (Terrestrial Biological Surveys as an Element of Biodiversity Protection) currently a substantial amount of work has been undertaken on the various lease areas and the reports by Astron 2009 and AECOM in 2009 which built on the earlier Maunsell (2003 and 2008) studies in particular bring the majority of the work to date in summaries. As such the suggested refinements in relation to the flora species will improve the clarity and currency of information for the impact assessment. To date the survey effort fulfils the Level 1 needs and in view of the depth of experience of the specialists, the extent of the coverage and with some desktop integration and alignment of the known values on the flora and vegetation into the impact assessment report the coverage should then be accepted as addressing the Level 2 needs of the EPA process for the Cape Preston area.

Dr E M Mattiske

Report	Flora	T & P Flora	Weeds	Range Extensions	Vegetation	PEC and TEC Values	Vegetation Condition	Other Potentially Significant Communities	Representation of Vegetation Mapping units
Maunsell 2003	No	Yes	No	No	No	No	No	No	No
Astron Environmental Services 2007	No	No	No	No	Yes	Yes	No	No	No
Mattiske Consulting Pty Ltd 2007a and 2007b	Yes	Yes	Yes	No	Yes	No	No	No	No
Maunsell/AECOM 2008 (including integration of 2000 to 2006 studies)	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Astron Environmental Services (2008)	Yes	Yes (although none located)	Yes	No	Yes (although concentrate on GDEs)	Yes	Yes	No	Yes
AECOM 2009	Yes	Yes (although none located)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Astron Environmental Services (2009a)	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Astron Environmental Services (2009b)	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes

#### Table 1: Summary of Current Coverage of the Different Key Components associated with Flora and Vegetation Assessments

Report/Date	Methodology – Flora and vegetation	Timing	Comments	Limitations
Maunsell 2003	Foot traverses targeting threatened and priority species	June 2003 and July 2003	Recent rains enabled better coverage of flora in July 2003 trip. Cracking clays, creeklines, minor flowlines and rockpiles and rocky outcrops were targeted after desktop studies on potential species	Seasonal conditions led to some limitations in assessment of flora. Also some areas supported degraded vegetation. In part overcome by July assessment in targeted areas.
Astron Environmental Services 2007	50m x 50m quadrats and aerial photograph interpretation.	June 2007	Drier site conditions, used previous HGM et al. (2005) mapping codes and Van Vreeswyk et al. (2004) land system codes.	Some limitations on flora coverage due to drier seasonal rainfall conditions prior to the June 2007 assessment.
Mattiske (2007a and 2007b)	Foot traverses and quadrats and aerial photograph interpretation.	February 2007	Drier site conditions and a reliance on previous studies by Maunsell (2003).	Some limitations due to seasonal conditions. Coverage of localized areas only (as requested).
Maunsell and AECOM 2008	155 quadrats. 50m x 50m quadrats and aerial photograph interpretation. Integration with previous studies. Creekline vegetation in 2m wide transects due to linear nature. Targeted work also on cracking clay areas.	2000 and 2006	Desktop and expansion and consolidation of earlier 2000 to 2006 studies. PATN analysis of 2006 datasets. Lack of clarity on timing of flora and vegetation work in 2000, 2006 and 2007. Analyses appear to have concentrated on 2000 and 2006 data.	Potential seasonal limitations. Positives related to the integration of previous studies in the period 2000 to 2006.
Astron Environmental Services 2008	GDE assessment, targeted work along major and minor creeklines. 27 releves (200 to 500m long as along creeklines and watercourses) and aerial photograph interpretation.	August and September 2008	Desktop on T & P flora species, weeds and GDE communities, targeted GDE work and some integration with previous 2000 to 2006 studies. Condition of vegetation based on Keighery (1994). Some alignment of vegetation mapping unit with previous studies 2000 to 2008 by Maunsell 2001, Maunsell/AECOM 2006 and Astron 2008)	Limitations due to drier seasonal conditions prior to assessment.
AECOM 2009	53 quadrats. 50m x 50m quadrats and aerial photograph interpretation. In creekline areas 10m x 50m quadrats. Foot traverses also to target additional species.	August and September 2008	Desktop, reconnaissance and detailed field survey. Flora and vegetation on Balmoral North and South. Some re- assessment of selected 2000 and 2006 quadrats. Condition assessment based on Keighery 1994 and the Braun-Blanquet Scale of Cover Abundance (from Mueller-Dombois and Ellenberg 1974). Detailed wide review of flora and vegetation values beyond the T&P and TEC and PEC.	Limitations due to timing of assessments in drier months.
Astron Environmental Services 2009a	Extrapolation from previous studies and aerial photograph interpretation, results tentative due to lack of field studies.		Report was based on desktop review and also extrapolation and therefore findings tentative in view of lack of field studies.	Some limitations associated with no field studies and difficulty of covering flora and vegetation values without ground-truthing.
Astron Environmental Services 2009b	5 quadrats in each vegetation type. 50m x 50m quadrats. Foot traverses also to target additional species and aerial photograph interpretation.	May 2009	Shift to Clarke and Green (1988) with Bray-Curtis Similarity Index. Ordination analysis (MDS) also used to examine relationships using Primer 6.1.5 (Clarke and Gorley 2006). This report highlighted a small permanent wetland in a local area (Roc7).	Some limitations associated with seasonal conditions; although good rains in January and early February 2009 the months leading up to the assessment in May 2009 were drier.

### Table 2: Summary of Methodologies and Timing associated with Flora and Vegetation Assessments

Threatened and Priority Flora	Maunsell 2003	Background	Comments – Based on Data and Florabase (DPaW 2016)
Abutilon uncinatum P1	See potential in Appendix D in Astron Environmental Services (2008)	Recorded at 21^39'17.0";115^43'33.0"	Now known as Abutilon sp. Onslow (F.Smith s.n. 10/9/61) based on Florabase (DPaW 2016)
Goodenia omearana ms P1	Only recorded once in tussock grassland on clay soils (M027) – Maunsell (2003). Noted in Mattiske (2007a) as a potential Priority 1 and in AECOM (2009a and 2009b) that it had been recorded in the 2000 assessment.	Typically on calcareous soils and known from a few locations in eastern Pilbara near Weeli Wolli Springs and Marillana Creek areas	In Maunsell/AECOM 2008 and Mattiske 2007 some queries over the taxonomy of this species; this is now synonymous with <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP727) (Florabase, DPaW 2016). Also suggested as potential priority species in AECOM 2009 (using name change as above). In AECOM (2009) noted that this was recorded in 2000.
Goodenia pallida P1	See potential in Mattiske (2007a), and in Appendix D in Astron Environmental Services (2008) and Astron Environmental Services (2009b).	Recorded at 21^01'55.0";116^15'26.0"	Remains as P1, near Karratha on Florabase (DPaW 2016). Also <i>Goodenia pallida</i> raised in the audit table (Mattiske 2007).
<i>Gunniopsis</i> sp. Fortescue (M.E. Trudgen 11019) P1	Potential suggested in Mattiske (2007a) and AECOM 2009 report.	Is an error and should not be used (Florabase, DPaW 2016).	Name should not be used according to Florabase (DPaW 2016). AECOM (2009) included this taxon as likely to occur.
<i>Ischaemum albovillosum</i> P2	Potential suggested as a Priority 2 species in Mattiske (2007a)	Occurs in central and eastern Pilbara and Ashburton.	Not currently a Priority species, based on Florabase (DPaW 2016).
<i>Mukia</i> sp. Barrow Island (DW Goodall 1264) P2	Potential P2 species in Astron Environmental Services (2008)	Recorded from Barrow Island.	Not recorded on assessment areas. Now known as <i>Cucumis s</i> p. Barrow Island (DW Goodall 1264), based on Florabase (DPaW 2016).
<i>Abutilon trudgenii</i> ms P3	Low shrub recorded from six locations within survey area. Recorded in minor flowlines through stony hills of the Rocklea or Newman land systems (Maunsell 2003). In Mattiske 2007a, noted as a potential Priority 2 species.	Possibly poorly known rather than rare as recorded from Warralong, Woodstock, Point Samson and Pannowonica (Atkins 1999).	Now known as <i>Abutilon</i> sp. Pilbara (W.R. Barker 2025) based on Florabase (DPaW 2016)
<i>Acacia glaucocaesia</i> P3	Potential P3 species in Mattiske (2007a), Astron Environmental Services (2008) and AECOM (2009) and Astron Environmental Services (2009b).	Recorded previously near Karratha, Port Hedland, Mardie, Roebourne and De Grey.	Not recorded on assessment areas, remains as a P3 on Florabase (DPaW 2016). AECOM (2009) included this taxon as likely to occur.
Eriachne tenuiculmis P3	Clumps of this grass species were recorded in 2 locations within creekline habitat in the Paraburdoo Land System (Maunsell 2003 and Mattiske 2007a).	Possibly poorly known rather than rare as recorded from Serpentine Creek, Yandi and Millstream in larger creeklines and on the Burrup Peninsula (Trudgen and Casson 1998).	No longer listed as a Priority species on Florabase (DPaW 2016).

#### Table 3: Summary of Results presented on Potential and Recorded Threatened and Priority Flora Species during Flora and Vegetation Assessments

# Table 3: Summary of Results presented on Potential and Recorded Threatened and Priority Flora Species during Flora and Vegetation Assessments (continued)

Threatened and Priority Flora	Maunsell 2003	Background	Comments – Based on Data and Florabase (DPaW 2016)
<i>Gymnanthera cunninghamii</i> P3	Potential P3 species in Astron Environmental Services (2009b)	Recorded in Ashburton, Broome, Carnarvon, East Pilbara, Karratha and Port Hedland areas (Florabase, DPaW 2016).	Not recorded, listed as potential species by Astron Environmental Services (2009b).
<i>Goodenia nuda</i> P3	Potential P3 species in in Astron Environmental Services (2008), AECOM (2009) and Astron Environmental Services (2009b).	Habitat, Plains, dry red sands, in Mesquite Scrub.	AECOM (2009) included this taxon as "may occur".
<i>Goodenia pascua</i> P3	Potential P3 species in in Astron Environmental Services (2008), (2009a).	Recorded previously on Hamersley Station, Sandy Creek, Port Hedland, Onslow, Mardie, Roebourne and Little Sandy Desert.	Not recorded on assessment areas. No longer listed as a Priority species on Florabase (DPaW 2016).
<i>Hibiscus brachysiphonius</i> P3	Low spreading herb occurred as scattered individuals on clay soils of clayey or stony plains at 5 locations (Maunsell 2003). Noted as potential in Mattiske (2007a). Most sites within Horseflats or Paraburdoo land systems and 1 collection from the Boolgeeda land system.	This species appears restricted to cracking clays and has been recorded previously near Minilya River, Tom Price, Karratha, Millstream, Balga Mission, Christmas Creek, Wandagee, Warrawagine and Hamersley Range.	Delisted in November 2008. Only recorded in Maunsell in 2003.
<i>Owenia acidula</i> P3	Potential P3 species in in Astron Environmental Services (2008) and AECOM (2009).	Recorded previously on Mardie Station, Millstream, Collier Range, Winning Station, Minilya Station, Boolathana Station, Qld and NSW	Not recorded on assessment areas. Still listed as a Priority 3 species and near coastal species on Florabase (DPaW 2016). AECOM (2009) included this taxon as "may occur".
<i>Phyllanthus aridus</i> P3	Small perennial shrub recorded a 1 location within creekline habitat of Paraburdoo land system (Maunsell 2003). Noted as potential in Mattiske (2007a), noted previous record in 2000 studies (AECOM 2009a, 2009b).	This species is known from several Kimberley populations; but has also been recorded from 12 populations on the southern slopes of the Chichester Ranges and at the time was described as uncommon along creeks in the area (Trudgen and Casson 1998).	Only known from Kimberley region and no longer listed as a Priority species on Florabase (DPaW 2016). In AECOM (2009) noted that this was recorded in 2000.
Rhynchosia bungarensis P3	Potential P3 species in in Astron Environmental Services (2008) and Astron Environmental Services (2009a, 2009b).	Recorded previously on Hamersley Ranges, Chichester Ranges, Yardie Creek, Robe River, Tom Price, Ashburton, East Lewis Island, Burrup Peninsula, Dampier Archipelago	Not recorded on assessment areas. Now a Priority 4 species on Florabase (DPaW 2016).

# Table 3: Summary of Results presented on Potential and Recorded Threatened and Priority Flora Species during Flora and Vegetation Assessments (continued)

Threatened and Priority Flora	Maunsell 2003	Background	Comments – Based on Data and Florabase (DPaW 2016)
<i>Sida</i> sp. Wittenoom (W.R. Barker 1962) P3	Perennial shrub was recorded from 1 location within a creek line (Maunsell 2003), noted as potential in Mattiske (2007a).	This species known from several locations including Warralong Station, Nickol Bay, near Onslow, Roy Hill and east of Pannawonica and Fortescue Roadhouse (Atkins 1999).	Now known as <i>Sida arsiniata</i> , no longer a Priority species, Florabase (DPaW 2016).
<i>Stackhousia clementii</i> P3	Potential P3 species in Astron Environmental Services (2009b)	Recorded previously in Ashburton, Carnarvon, Karratha, Murchison, Ngaanyatjarraku, Wiluna (Florabase, DPaW 2016).	Not recorded, listed as potential species by Astron Environmental Services (2009b).
<i>Stylidium costulatum</i> P3	Potential P3 species in Astron Environmental Services (2009b)	Recorded previously from Kimberley only (Florabase, DPaW 2016).	Should be excluded as not in Pilbara area.
<i>Tephrosia</i> sp. Cathedral Gorge P3	Noted as potential in Mattiske (2007a).	Occurs through southern and eastern Pilbara and northern section of Ashburton.	Now known as <i>Tephrosia oxalidea</i> based on Florabase (DPaW 2016).
<i>Themeda</i> sp. Hamersley station (MR Trudgen 11431) P3	Potential P3 species in Mattiske (2007a) and in Astron Environmental Services (2008)	Recorded previously from Karratha, Millstream, Hamersley Station, West Angelas, Coondewanna Flat	Not recorded on assessment areas. Remains a Priority 3 species on Florabase (DPaW 2016).
<i>Terminalia supranitifolia</i> P3	Potential P3 species in Astron Environmental Services (2009b)	Recorded previously from Ashburton, East Pilbara, Karratha and Port Hedland (Florabase, DPaW 2016).	Not recorded, listed as potential species by Astron Environmental Services (2009b).