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**FLORA AND VEGETATION OF THE  
CS2 – TUBRIDGI – WHEATSTONE  
GAS PIPELINE PROJECT AREA**

Prepared for

**DBP**

Prepared by

**Mattiske Consulting Pty Ltd**

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**Mattiske** Consulting Pty Ltd

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## 1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned in March 2013 by DBP to undertake a Level 1 flora and vegetation survey of the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area. Primary aim of this survey was to assist planning regarding a proposed expansion to the existing CS2 – Tubridgi – Wheatstone easement. A total of 116 sites were surveyed along the 109.6 km long survey area.

A total of 139 vascular plant taxa which are representative of 80 plant genera and 28 plant families were recorded within the survey area. The majority of the taxa recorded were representative of the Poaceae (30 taxa), Fabaceae (26 taxa), Amaranthaceae (10 taxa), Chenopodiaceae (9 taxa) and Malvaceae (9 taxa) families.

No Declared Threatened Flora species were recorded within the survey area. Two Priority 3 Flora species (*Eremophila forrestii* subsp. *viridis* and *Grevillea ?subterlineata*) were recorded within the survey area.

No threatened or Priority Ecological Communities were inferred to occur within the survey area.

Eight taxa recorded within the survey represent range extensions from current known locations, these being *Streptoglossa tenuiflora*, *Maireana ?lanosa*, *Rhagodia baccata*, *Cassytha capillaris*, *Marsilea hirsuta*, *Melaleuca glomerata*, *Grevillea striata* and *Grevillea ?subterlineata* (P3).

A total of seven introduced (exotic) taxa were recorded within the survey area. Of these, one taxon, *\*Parkinsonia aculeata* is a Declared Plant species pursuant to section 37 of the *Agriculture and Related Resources Protection Act (1976)*. Three recorded species *\*Aerva javanica*, *\*Cenchrus ciliaris* and *\*Vachellia farnesiana* have high environmental weed ratings.

Thirty vegetation communities were delineated and mapped across the survey area. Eight of which were inferred from previous mapping of the area due to access restrictions north of Wheatstone Road. Comparable sample, statistical and descriptive methodologies with previous work maintained mapping reliability and continuity.

The survey area largely traversed *Acacia* dominated inland sand and clayey plain communities interspersed with *Eucalyptus victrix* dominated inland floodplains and depressions to the south, with a transition to coastal sand and clayey plain and inland sand dune communities further north. A large number of claypans and clayey plains create a distinct mosaic with fringing inland sand dune communities north of Twitchin Road. Tidal mudflat and tidal creek communities dominate areas north of Wheatstone Road.

Vegetation was generally in very good to excellent condition, with factors such as weed density (particularly *\*Cenchrus ciliaris*), clearing and vehicle movement and cattle movement and grazing observed as primary causes of decreasing vegetation condition. Coastal sand dune communities north of Wheatstone Road were in particularly poor condition due to the dominance of *\*Cenchrus ciliaris* to the exclusion of native tussock grasses.

Tree densities across the survey area were generally low, with the exception of inland floodplains and depressions and riverine environments. Individual tree sizes in areas of high density were generally small, with tree size increasing outside an approximate +/- 30 m buffer from the centre of the current easement, a result of historic clearing. The two pipeline crossings of the Ashburton River contained larger trees at high densities, particularly the southern crossing near CS2.

For the purposes of a Level 1 Flora and Vegetation survey, more than adequate data was collected to define and assess the presence, extent and significance of vegetation communities within the survey area. The majority of recorded taxa are widespread throughout the region and the percentage impact to pre-European vegetation associations and Rangeland Land Systems was low.

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## 2. INTRODUCTION

Mattiske Consulting Pty Ltd was commissioned in March 2013 by DBP to undertake a Level 1 flora and vegetation survey of the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area. The aim of the broader project is to assess the feasibility and obtain approval to widen the existing corridor and accommodate an additional pipeline and campsite area, with the following report to assess the botanical values associated with the project area.

### 2.1 Location and Scope of Proposal

The survey area is located along the existing CS2 – Tubridgi – Wheatstone Gas Pipeline (Figure 1). Compressor Station 2 (CS2) is located approximately 27 km west-northwest of the Nanutarra Roadhouse. The pipeline extends north from CS2 to the Tubridgi Gas Processing Plant then traverses east to Wheatstone Road then north to the Wheatstone terminus approximately 10 km west-southwest of Onslow.

The survey area lies in the Carnarvon Botanical District region of the Eremaean Botanical Province (Beard, 1990). More recently, the vegetation of Western Australia has been assigned to bioregions and subregions under the Interim Biogeographic Regionalisation for Australia (IBRA), with the project area situated within the Carnarvon Bioregion and Cape Range subregion (Department of Sustainability, Environment, Water, Population and Communities, 2013c).

The aim of the current survey was to define and quantify botanical values present within the survey area, the survey area being defined as a boundary +/- 100 m from the centre of the existing corridor. It is therefore recognised that the survey area bounds far exceed what would actually be impacted by clearing associated with any easement expansion.

### 2.2 Climate

Climate of the survey area ranges from sub-tropical to semi-desert with summer rainfall (250 mm – 300 mm per annum) along the coastal plain, to arid with variable summer and winter rainfall extending further inland. Rainfall is highly variable, although there is a pronounced summer peak associated with north-west monsoons. Tropical cyclones typically occur between January and March which can result in the average annual rainfall being exceeded in one event (Payne and Tille, 1992).

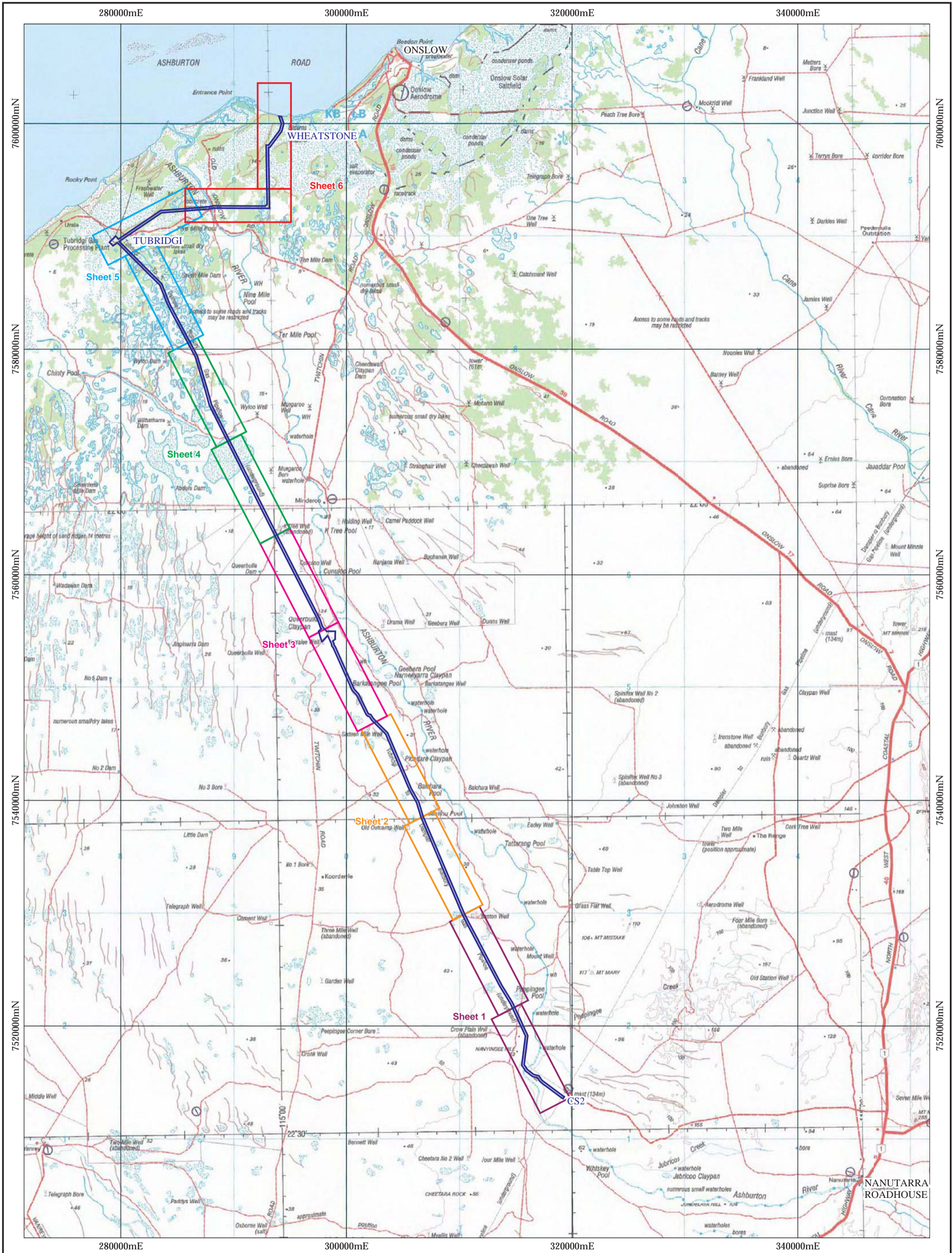
Onslow airport provides the nearest and most representative climatic data for the survey area. Rainfall figures for January and February 2013 were in excess of the long-term average for those months, such ample rainfall six to eight weeks preceding the current survey (April 1<sup>ST</sup> to April 5<sup>th</sup>) was expected to make favourable survey conditions for annual and cryptic perennial species (Figure 2). A completely dry (0 mm) and hot (average maxima 36.6 °C) March however, may have contributed to the poor condition of many annual species occurring within the survey area.

### 2.3 Western Australia's Flora – A Legislative Perspective

Western Australia has a unique and diverse flora, and is recognised as one of the world's 34 biodiversity hotspots (Myers *et al.* 2000). In this context, Western Australia possesses a high degree of species richness and endemism. This is particularly pronounced in the south-west region of the state. There are currently over 12,000 plant species known to occur within Western Australia (Department of Environment and Conservation 2013a), and scientific knowledge of many of these species is limited.

The legislative protection of flora within Western Australia is principally governed by three Acts. These are:

- The *Wildlife Conservation Act 1950*;
- The *Environmental Protection Act 1986*; and
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.



Notes:

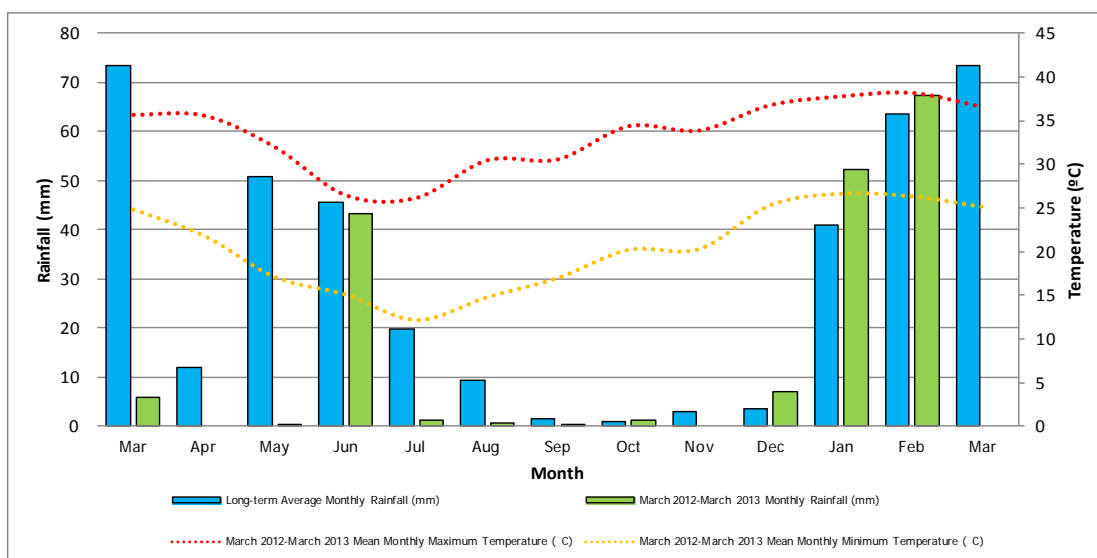


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**CS2 - Tubridgi - Wheatstone Project**  
**Locality**  
 Showing Vegetation Sheet Layout

Figure:  
**1**



**Figure 2: Rainfall and temperature data for the Onslow Airport recording station**

Long-term average rainfall (1940 - 2013) and monthly rainfall and average maximum and minimum temperature data for the year preceding the current field survey (Bureau of Meteorology, 2013).

The unique flora of Western Australia is potentially under threat due to historical clearing practices associated with agricultural, mining and human habitation activities. As a consequence of these historical clearing practices a number of flora species have become threatened or have the potential to become threatened as their habitat is impacted by human activity. In addition, some areas of the State have been affected by past clearing practices such that entire ecological communities are under threat. The following sections describe these threatened and priority flora and ecological communities, and outline the legislative protection afforded to them.

At the State level, the *Wildlife Conservation Act 1950* provides for taxa of native flora (and fauna) to be specially protected because they are subject to identifiable threats. Protection of these taxa has been identified as being warranted because they may become extinct, are threatened, or are otherwise in need of special protection. Ecological communities that are deemed to be threatened are afforded protection under the *Environmental Protection Act 1986*. Listings of threatened species and communities are reviewed annually by the Western Australian Threatened Species Scientific Committee (TSSC), which is a body appointed by the Minister for the Environment and supported by the Department of Environment and Conservation. The TSSC reviews threatened and specially protected flora (and fauna) listings on an annual basis. Recommendation for additions or deletions to the listings of specially protected flora (and fauna) is made to the Minister for the Environment by the TSSC, via the Director General of the Department of Environment and Conservation, and the WA Conservation Commission. Under Schedule 1 of the *Wildlife Conservation Act 1950*, the Minister for the Environment may declare that a class or description of flora to be threatened flora throughout the State, by notice published in the *Government Gazette* (Department of Environment and Conservation 2013b).

At the Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999*, a nomination process exists, to list a threatened species or ecological community. Additions or deletions to the lists of Threatened species and communities are made by the Minister for Sustainability, Environment, Water, Populations and Communities, on advice from the Federal Threatened Species Scientific Committee. *Environment Protection and Biodiversity Conservation Act 1999* lists of Threatened flora and ecological communities are published on the Department of Sustainability, Environment, Water, Populations and Communities website (2013a, 2013b).

### 2.3.1 Threatened and Priority Flora

Flora within Western Australia that is considered to be under threat may be classed as either threatened flora or priority flora. Where flora has been gazetted as threatened flora under the *Wildlife Conservation Act 1950*, it is an offence "to take" such flora without the written consent of the Minister. The *Wildlife*



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*Conservation Act 1950* states that “to take” flora includes to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority flora constitute species which are considered to be under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. Such species are considered to potentially be under threat, but do not have legislative protection afforded under the *Wildlife Conservation Act 1950*. The Department of Environment and Conservation categorises priority flora according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such species, with P1 listed species being the most threatened, and P5 the least. Priority flora species are regularly reviewed, and may have their priority status changed when more information on the species becomes available. Appendix A1 sets out definitions of both threatened and priority flora (Department of Environment and Conservation 2013c).

At the Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999*, threatened species can be listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent, by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities. Refer to Appendix A2 for a description of each of these categories of threatened species. Under the *Environment Protection and Biodiversity Conservation Act 1999*, a person must not take an action that has or will have a significant impact on a listed threatened species without approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities, unless those actions are not prohibited under the Act.

The current *Environment Protection and Biodiversity Conservation Act 1999* list of Threatened flora may be found on the Department of Sustainability, Environment, Water, Population and Communities (2013a) website.

### 2.3.2 Threatened and Priority Ecological Communities

An ecological community is defined as a naturally occurring biological assemblage that occurs in a particular type of habitat composed of specific abiotic and biotic factors. At the State level, ecological communities may be considered as threatened once they have been identified as such by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. A threatened ecological community is defined, under the *Environmental Protection Act 1986*, as an ecological community listed, designated or declared under a written law or a law of the Commonwealth as threatened, endangered or vulnerable. There are four State categories of threatened ecological communities, or TECs: presumed totally destroyed (PD); critically endangered (CR); endangered (EN); and vulnerable (VU) (Department of Environment and Conservation 2013d). A description of each of these categories of TECs is presented in Appendix A3. Threatened ecological communities are gazetted as such (Department of Environment and Conservation 2013e).

At the Commonwealth level, some Western Australian TECs are listed as threatened, under the *Environment Protection and Biodiversity Conservation Act 1999*. Under the *Environment Protection and Biodiversity Conservation Act 1999*, a person must not take an action that has or will have a significant impact on a listed threatened ecological community without approval from the Commonwealth Minister for the Sustainability, Environment, Water, Population and Communities, unless those actions are not prohibited under the Act. A description of each of these categories of TECs is presented in Appendix A4. The current *Environment Protection and Biodiversity Conservation Act 1999* list of threatened ecological communities can be located on the Department of Sustainability, Environment, Water, Population and Communities (2013b) website.

Ecological communities identified as threatened, but not listed as threatened ecological communities, can be classified as priority ecological communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. The Department of Environment and Conservation categorises priority ecological communities according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such ecological communities, with P1 communities being the most threatened and P5 the least. Appendix A5 sets out definitions of priority ecological communities (Department of Environment and Conservation 2013d). A list of current priority ecological communities can be viewed at the Department of Environment and Conservation (2013f) website.

### 2.3.3 Clearing of Native Vegetation

Under the *Environmental Protection Act 1986*, the clearing of native vegetation requires a permit to do so, from the Department of Environment and Conservation or the Department of Mines and Petroleum, unless that clearing is exempted under specific provisions listed in Schedule 6 of the Act, or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Under the *Environmental Protection Act (1986)*, "native vegetation" means indigenous aquatic or terrestrial vegetation, and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation. Under the *Environmental Protection Act 1986*, Section 51A, "clearing" means the killing or destruction of, the removal of, the severing or ringbarking of trunks or stems of, or the doing of any other substantial damage to, some or all of the native vegetation in an area, and includes the draining or flooding of land, the burning of vegetation, the grazing of stock, or any other act or activity, that causes any of the aforementioned consequences or results.

Under the *Environmental Protection Act 1986*, ten principles are set out, under which native vegetation should not be cleared. These principles state that native vegetation should not be cleared, if:

- a. it comprises a high level of biological diversity;
- b. it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;
- c. it includes, or is necessary for the continued existence of, threatened flora;
- d. it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community;
- e. it is significant as a remnant of native vegetation in an area that has been extensively cleared;
- f. it is growing in, or in association with, an environment associated with a watercourse or wetland;
- g. the clearing of the vegetation is likely to cause appreciable land degradation;
- h. the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;
- i. the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or
- j. the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 5, sets out prescribed clearing actions that do not require a clearing permit, as defined in Section 51C of the *Environmental Protection Act 1986*.

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 6 – "Environmentally sensitive areas" are defined as "the area covered by vegetation within 50 m of threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the threatened flora is located".

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* - Regulation 6 (Environmentally sensitive areas), the area covered by a threatened ecological community, is similarly considered an Environmentally sensitive area and therefore non-permitted, unless Ministerial approval is granted.

## 2.4 Declared Plant Species

The *Agriculture and Related Resources Protection Act 1976*, Section 35, makes provision for classes of plants to be listed as declared in respect of parts of, or the entire State. According to the *Agriculture and Related Resources Protection Act 1976*, a declared plant is defined as a plant belonging to a class of plants declared under section 35 of the Act to be declared plants and includes any part of such a plant and/or the product of such a plant.

The *Agriculture and Related Resources Protection Act 1976* provides for declared plants to be assigned to specific categories, P1 to P5, which determines the form of control which applies to the declared plant. Appendix A6 lists the categories of control codes for declared plants and the associated management requirements.

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The current listing of declared plant species is available at the Department of Agriculture and Food website (Department of Agriculture and Food 2013).

## 2.5 Local and Regional Significance

Flora or vegetation may be locally or regionally significant in addition to statutory listings by the State or Federal Government.

In regards to flora; species, subspecies, varieties, hybrids and ecotypes may be significant other than as threatened flora or priority flora, for a variety of reasons, including:

- a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status
- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution; and
- being poorly reserved (Environmental Protection Authority 2004).

Vegetation may be significant because the extent is below a threshold level and a range of other reasons, including:

- scarcity;
- unusual species;
- novel combinations of species;
- a role as a refuge;
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- being representative of the range of a unit (particularly, a good local and/or regional example of a unit in "prime" habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- a restricted distribution (Environmental Protection Authority 2004).

Vegetation communities are locally significant if they contain Priority Flora species or contain a range extension of a particular taxon outside of the normal distribution. They may also be locally significant if they are very restricted to one or two locations or occur as small isolated communities. In addition, vegetation communities that exhibit unusually high structural and species diversity are also locally significant.

Vegetation communities are regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of threatened Flora.

Determining the significance of flora and vegetation may be applied at various scales, for example, a vegetation community may be nationally significant and governed by statutory protection as well as being locally and regionally significant.

### 3. OBJECTIVES

The aim of the current survey was to undertake a Level 1 flora and vegetation assessment of the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area. Specifically:

- Collect and identify vascular plant species present in the Survey Area;
- Collect and identify Declared Threatened and Priority vascular plant species ;
- Review the conservation status of vascular plant species recorded by reference to current literature and current listings by the Department of Environment and Conservation (2013b) and plant collections held at the Western Australian State Herbarium (Department of Environment and Conservation 2013h), and listed by the Department of Sustainability, Environment, Water, Population and Communities (2013a) under the *Environmental Protection and Biodiversity Conservation Act 1999*;
- Record information regarding the GPS co-ordinates and number of plants for any known or potential Declared Threatened Flora and Priority Flora located during the survey;
- Undertake the flora survey to standards outlined in Guidance Statement 51 (Environmental Protection Authority 2004);
- Lodge Threatened and Priority Flora Report Forms with the Department of Environment and Conservation for all recorded localities of Declared Threatened Flora and Priority Flora species;
- Define and map the native vegetation communities;
- Provide details pertaining to the condition of vegetation communities;
- Provide details on the type and extent of weed species;
- Define and map tree densities;
- Review and detail the local and regional significance of vegetation, with specific reference to Rangeland Land Systems and Pre-European mapping; and
- Prepare a report summarising the findings.

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## 4. METHODS

Prior to the field survey, a desktop search for Declared Threatened and Priority flora and Threatened and Priority Ecological Communities that have the potential to occur within the survey area was undertaken using Florabase and NatureMap (Department of Environment and Conservation 2013c; 2013g).

Assessment of flora and vegetation of the survey area was undertaken by four experienced Botanists from Mattiske Consulting Pty Ltd from the 2<sup>nd</sup> April to the 5<sup>th</sup> April 2013. A total of 116 sampling sites were selected using high resolution aerial photographic maps of the survey area as supplied by CAD Resources and opportunistic field selection (Appendix B). Survey sites consisted of 50 m x 50 m quadrats. All geographical coordinates cited in this report are based on the GDA94 datum. The survey was undertaken in accordance with the recommendations made in Guidance Statement 51 (Environmental Protection Authority 2004).

The flora and vegetation was described and sampled systematically at each survey site, and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site the following floristic and environmental parameters were recorded:

- GPS location;
- topography;
- percentage and type of litter cover;
- soil type and colour;
- percentage of bare ground;
- outcropping rocks and their type;
- notes on disturbance, vegetation condition and tree density;
- site photograph;
- time since fire; and
- number, height and percentage cover of species.

All plant specimens collected during the field surveys were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. Plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the Department of Environment and Conservation (2013c; 2013g).

### 4.1 Statistical Analysis of Data and Vegetation Mapping

PRIMER v6 (Plymouth Routines in Multivariate Ecological Research) statistical analysis software was used to analyse species-by-site data and discriminate survey sites on the basis of their species composition (Clarke and Gorley, 2006). To down weight the relative contributions of quantitatively dominant species a presence/absence transformation was applied to the data set. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Hierarchical Clustering (CLUSTER), Similarity Percentages (SIMPER) and SIMPROF analysis. Results were used to inform and support interpretation of aerial photography and delineation of individual plant communities. Eight vegetation communities described north of Wheatstone Road were inferred from previous mapping of the area by Biota (2010). Comparable sample, statistical and descriptive methodologies to the current survey were used, maintaining mapping reliability and continuity. As such vegetation communities T1, T2, C4, CD1, CP3, CP4, CP5 and ID3 do not appear in the species by community appendix or in the hierarchical clustering dendrogram.

### 4.2 Vegetation Descriptions

Vegetation descriptions were based on Alpin's (1979) modification of the vegetation classification system of Specht (1970), to align with the National Vegetation Information System. Vegetation communities were described at the association level of the NVIS classification framework, as defined by the Executive

Steering Committee for Australian Vegetation Information (ESCAVI, 2003). Vegetation community descriptions and representative photos are shown in Appendix F.

#### 4.3 Survey Limitations and Constraints

An assessment of the survey against a range of factors which may have had an impact on the outcomes of the present survey was made (Table 1). Based on this assessment, the present survey has not been subject to constraints which would affect the thoroughness of the survey, and the conclusions which have been formed.

**Table 1: Potential Flora and Vegetation Survey Limitations for Survey Area**

Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	<b>Not a constraint:</b> Adequate background information was sourced to provide detailed contextual information for the current project. Adequate supplementary material was utilised to compare and contrast current data with that of previous work in the Onslow locality including but not limited to Rangeland Land System surveys, Beard (1975) mapping and previous work undertaken by botanical consultancies.
Scope (i.e. what life forms, etc., were sampled).	<b>Not a constraint:</b> Vascular flora was the focus of the survey. These were thoroughly sampled.
Proportion of flora collected and identified (based on sampling, timing and intensity).	<b>Not a constraint:</b> The proportion of flora collected and identified was adequate for a level 1 flora and vegetation survey. It was estimated that approximately 97% of the flora potentially present within the survey area were sampled.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	<b>Not a constraint:</b> Sites were pre-selected using high resolution aerial photography to ensure all vegetation communities subjectively identified were sampled, with multiple replications. Where necessary, additional sites were chosen in the field. Site selection and replication was considered more than adequate to accurately analyse and discriminate sites based on species composition and subsequently delineate vegetation community boundaries.
Mapping reliability.	<b>Not a constraint:</b> Adequate coverage of the area was made during the present survey. High quality aerial maps (Scale: 1:10, 000) were used for both the survey work and subsequent vegetation community mapping. Extensive earthworks in the Wheatstone area and tidal inflows made sections of the current survey, to the north of Wheatstone Road, completely inaccessible. As a result the vegetation described and mapped in this area was inferred from data presented in Biota (2010). Comparable sample, statistical and descriptive methodologies to the current survey were used, maintaining mapping reliability and continuity.
Timing, weather, season, cycle.	<b>Potential constraint:</b> Above average rainfall was recorded in the months of December 2012 and January and February 2013 proving favourable conditions for and early April survey. March however, recorded zero rainfall and high daily maximum temperatures. As a result, annual species and perennial grasses were in poor health. Despite this, adequate species information (via multiple collections) was gathered to define vegetation communities present in the survey area. There were no interruptions to field work due to weather or timing issues.
Disturbances (fire flood, accidental human intervention, etc.).	<b>Not a constraint:</b> Much of the survey area (south of the Twitchin Road – Ashburton River Bridge) traverses areas managed by the Minderoo Station. Extensive cattle grazing and soil compaction via herd movement was observed. Grazing tended to be focussed on perennial grasses and as such though grazing was widespread it did not adversely affect species richness.
Intensity (in retrospect, was the intensity adequate).	<b>Not a constraint:</b> Survey intensity was considered to have been thorough. More than adequate replication was achieved both via pre-planned sites and opportunistic field selection.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	<b>Not a constraint:</b> Resources, in terms of time, equipment, support and personnel were adequate to undertake and complete the survey.

**Table 1: Potential Flora and Vegetation Survey Limitations for Survey Area (continued)**

Potential Survey Limitation	Impact on Survey
Access problems (i.e. ability to access survey area).	<b>Not a constraint:</b> With the exception of areas to the north of Wheatstone Road, the survey area was accessible via the existing lateral right-of-way. As previously discussed areas to the north of Wheatstone Road were inaccessible due to earthworks and tidal inflows. Detailed flora and vegetation surveys have previously been undertaken to define the vegetation communities in this area and as such the inability to access this area was not viewed as a constraint.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	<b>Not a constraint:</b> Botanists have undertaken previous surveys in the wider area and were familiar with the flora and vegetation. Specimens that were unable to be identified in the Mattiske herbarium were taken to the Western Australian Herbarium for positive identification.

## 5. RESULTS

### 5.1 Desktop Survey

#### 5.1.1 Geology and Soils

The survey area is situated within Coastal Plains Geomorphic Province which covers some 15, 370 km<sup>2</sup> (Payne *et al.*, 1988). Quarternary alluvium, colluvium and aeolian sands dominate the province, with small outcroppings of lower Cretaceous sedimentary rocks, Proterozoic granite and metamorphic rocks occurring further to the east. The province is characterised by extensive sandy plains with north-west or north trending longitudinal dunes, broad claypans and circular grassy depressions. Natural relief across the province rarely exceeds 40 m above the surrounding plains and occurs in the form of dune crests and isolated hills (Payne *et al.*, 1988).

The Coastal Plains Soil Region dominates the Coastal Plains Geomorphic Province and consists of eight broad units (Payne *et al.*, 1988). These being skeletal soils, stony plains, sandy plains, sand dunes, drainage floors, claypans, swamps and depressions, and coastal mud flats.

#### 5.1.2 Rangeland Land Systems

Rangeland Land Systems mapping prepared by the Western Australian Department of Agriculture and Food (formerly Western Australian Department of Agriculture), provides and inventory and condition survey of lands in the Ashburton River Catchment (Payne *et al.*, 1988) and Pilbara (Van Vreeswyk *et al.*, 2004) at a 1: 50 000 scale. These surveys describe the biophysical characteristics of each region and subsequently divide each region into land systems; land systems being defined as repeating patterns of topography, soils and vegetation (Heddl *et al.*, 1980).

**Table 2: Rangeland Land Systems Traversed by the CS2 – Tubridgi – Wheatstone Gas Pipeline Survey Area: Total Extent, Area Traversed and Percentage Impact**

Land System	Total Extent of Land System (ha)	Extent of Land System Traversed by the Survey Area (ha)	% Impact
Cheetara	43156.5	100.0	0.23
Dune	44421.0	93.0	0.21
Globe	126658.6	516.5	0.41
Littoral	387589.9	104.7	0.03
Mideroo	144436.2	511.9	0.35
Nanyarra	38627.2	438.7	1.14
Onslow	86704.8	364.2	0.42
Yankagee	110474.6	189.2	0.17

The survey area traverses eight land systems as described by Payne *et al.* (1988) and Van Vreeswyk *et al.* (2004). Extent of Land Systems mapped in the Western Australia, area traversed by the survey area and percentage impact data is presented in Table 2. A description of each land system is provided below:

### **Cheetara Land System**

The Cheetara land system comprises two land units:

1. Alluvial plains with gilgais: Open tussock grasslands of *Eragrostis xerophila*, *Eragrostis setifolia*, *Eriachne benthamii* and *Chrysopogon fallax* with sparse shrubs; degraded in parts to forby herb fields. Some patches of *Acacia victoriae* and low shrubs and sparse perennial grasses.
2. Alluvial plains without gilgais: Tall shrublands or open shrublands of *Acacia victoriae* and *Acacia tetragonophylla* with low shrubs, sparse perennial grasses and forbs

### **Dune Land System**

The Dune land system comprises four land units:

1. Linear and reticulated dunes: Hummock grasslands of *Triodia schinzii* or *Triodia pungens* with numerous low and mid height shrubs. Occasionally \**Cenchrus ciliaris* is dominant.
2. Swales and sandplains: Hummock grasslands of *Triodia pungens* and some *Triodia lanigera* with sparse low shrubs such as *Acacia stellaticeps*.
3. Swamps and depressions: Scattered low woodlands of *Eucalyptus victrix* with *Muehlenbeckia florulenta* and tussock grasses such as *Sporobolus mitchellii* and *Eriachne benthamii*.
4. Claypans: Typically no vegetation.

### **Globe Land System**

The Globe land system comprises six land units:

1. Sandy tracts: Hummock grasslands of hard spinifex *Triodia wiseana*, and soft *Triodia pungens* with an overstorey of *Acacia trachycarpa* and *Acacia victoriae*.
2. Levees: Open woodland of *Eucalyptus camaldulensis* and *Eucalyptus victrix* with an understorey of *Acacia trachycarpa*, *Acacia coriacea*, *Acacia victoriae* and \**Cenchrus ciliaris*.
3. Alluvial Plains: Patchy tall shrubland of snakewood *Acacia xiphophylla* with *Acacia victoriae*, *Senna artemisioides* subsp. *x sturtii*, *Rhagodia eremaea* and *Enchylaena tomentosa*, frequent bare areas.
4. Gilgai plains: Open tussock grassland of *Eragrostis xerophila* with invading overstorey of *Acacia victoriae*.
5. Low lying back plains and depressions: Tall shrubland or open woodland of *Acacia tetragonophylla*, *Acacia victoriae* or *Eucalyptus* spp. with a dense tussock grass understorey of *Chrysopogon fallax* or *Eragrostis xerophila* or *Eriachne benthamii*.
6. Channels and banks: Tall fringing woodland of *Eucalyptus victrix*, *Melaleuca glomerata* and *Sesbania formosa* with a sparse understorey of tussock grasses.

### **Littoral Land System**

The Littoral land system comprises nine land units:

1. Beaches: Typically no vegetation.
2. Coastal Dunes: Hummock grasslands with *Triodia pungens* or *Triodia epactia* and scattered shrubs such as *Acacia coriacea*, \**Aerva javanica* and *Threlkeldia diffusa*.
3. Limestone ridges: Grasslands often mixed *Triodia pungens* and \**Cenchrus ciliaris* with isolated shrubs.
4. Tidal flats: Mostly no vegetation, occasional patches of samphire.
5. Mangrove outer margins: Closed mangrove woodlands with *Avicennia marina* and *Rhizophora stylosa*.
6. Tidal channels: Narrow fringing communities of mangroves and samphire.



7. Samphire flats: Scattered to moderately closed low shrublands or grassy shrublands of *Tecticornia* spp. and *Sporobolus virginicus*.
8. Alluvial Plains: Tussock grasslands of \**Cenchrus ciliaris* or mixed perennial grasses such as *Chrysopogon fallax*, *Eragrostis xerophila* and *Sporobolus virginicus*; also *Triodia pungens*.
9. Hummock grasslands of *Triodia pungens*, *Triodia epactia*, *Triodia* spp. with isolated shrubs.

### **Minderoo Land System**

The Minderoo land system comprises seven land units:

1. Sand Dunes: Hummock grasslands of *Triodia schinzii* with an overstorey of *Acacia murrayana*, *Acacia stellaticeps*, *Corchorus walcottii* and *Grevillea gordoniana* and \**Cenchrus ciliaris*, and annual grasses.
2. Sand plains: Hummock grasslands of *Triodia schinzii* and *Triodia pungens* with an overstorey of *Acacia sclerosperma*, *Acacia tetragonophylla*, *Acacia victoriae*, *Eremophila forrestii*, *Eucalyptus victrix* and *Rhagodia eremaea*.
3. Hummocky plains: Tall shrublands of *Acacia xiphophylla* with a mixed understorey of low shrubs *Atriplex bunburyana*, *Senna artemisioides* subsp. x *sturtii* and the grass *Eragrostis xerophila*.
4. Plains with through drainage: Tall shrubland of *Acacia tetragonophylla*, *Acacia victoriae* and rarely understorey of \**Cenchrus ciliaris* and *Chrysopogon fallax*; occasionally *Triodia pungens*.
5. Gilgal plains: Variable open tussock grassland of *Astrelba elymoides*, *Chrysopogon fallax* or *Eragrostis xerophila* or *Eriachne benthamii* or *Sporobolus virginicus* with an open tall shrub overstorey of *Acacia tetragonophylla* and *Acacia victoriae*.
6. Swamps and depressions: Low open woodland of *Eucalyptus victrix* with a low shrub understorey of *Muehlenbeckia florulenta* with *Sporobolus virginicus* and other tussock grasses.
7. Claypans: Mostly no vegetation occasionally supports *Eriachne gardneri*.

### **Nanyarra Land System**

The Nanyarra land system comprises five land units:

1. Alluvial plains: Tall open shrubland of *Acacia victoriae*, *Acacia sclerosperma* and *Acacia tetragonophylla* with scattered *Eucalyptus victrix*, tussock grass ground storey including \**Cenchrus ciliaris*.
2. Sand dunes: Open tussock grassland of \**Cenchrus ciliaris* and *Eragrostis eriopoda* with and overstorey of *Acacia sclerosperma* and *Acacia translucens*.
3. Swamps and low back plains: Low open woodland of *Eucalyptus victrix* with sparse shrubs *Acacia victoriae*, *Scaevola spinescens* and tussock grasses *Eriachne benthamii* and *Chrysopogon fallax*.
4. River margins with restricted drainage: Low woodland of *Eucalyptus victrix* with a sparse understorey of tussock grasses or shrubs such as *Rhagodia eremaea*.
5. Channels and banks: Tall fringing woodland of *Eucalyptus victrix*, *Melaleuca glomerata* and *Sesbania formosa* with a sparse understorey of tussock grasses.

### **Onslow Land System**

The Onslow land system comprises seven land units:

1. Sandplains: Hummock grasslands of *Triodia pungens* with isolated *Acacia* spp. shrubs, also patches of \**Cenchrus ciliaris*.
2. Dunes: Hummock grasslands of *Triodia pungens* with isolated to scattered shrubs such as *Crotalaria cunninghamii* and patches of \**Cenchrus ciliaris*.
3. Clay plains: Hummock grasslands of *Triodia longiceps*, patchy tussock grasslands with *Eragrostis xerophila* and sparse chenopod shrubs including *Atriplex* spp. Patchy *Sporobolus virginicus* grasslands with *Tecticornia* spp. low shrubs.
4. Saline flats: Scattered low shrublands of *Tecticornia* spp. and/or *Frankenia* spp. with variable amounts of *Sporobolus virginicus*. Highly saline parts usually contain no vegetation.
5. Narrow drainage floors: Tussock grasslands or grassy woodlands with *Sporobolus virginicus*, *Eragrostis xerophila*, *Chrysopogon fallax*, *Eulalia aurea* and *Eucalyptus victrix*.

6. Depressions: Variable tussock grasslands, mostly *Sporobolus virginicus* and *Eriachne benthamii* with fringing margins of *Eucalyptus victrix*.
7. Claypans: No vegetation.

### ***Yankagee Land System***

The Yankagee land system comprises seven land units:

1. Dunes: Soft spinifex *Triodia pungens* hummock grasslands with sparse shrubs such as *Acacia translucens*.
2. Swales and sandplain: Soft spinifex *Triodia pungens* grasslands with sparse shrubs, forbs and annual grasses.
3. Hummocky plains: Snakewood *Acacia xiphophylla* shrublands with sparse undershrubs *Enchylaena tomentosa*, *Atriplex bunburyana*, *Maireana* spp., *Rhagodia eremaea*, forbs and annual grasses.
4. Claypans: No vegetation or occasionally sparse perennial grasses *Eriachne benthamii* and *Eriachne gardneri*.
5. Plains receiving concentrated flow: Tall shrublands with *Acacia tetragonophylla*, *Acacia xiphophylla*, *Acacia victoriae* and sparse low shrubs and perennial grasses *Eriachne benthamii*, *Eulalia aurea* and *Chrysopogon fallax*.
6. Swamps and depressions: Low woodlands of *Eucalyptus victrix* with sparse undershrubs such as *Scaevola spinescens*, *Muehlenbeckia florulenta* and perennial grass *Sporobolus mitchellii*.
7. Gilgai plains: Open tussock grasslands of *Astrebla elymoides*, *Eragrostis xerophila* and *Eragrostis setifolia*.

### **5.1.3 Interim Biogeographic Regionalisation of Australia (IBRA)**

The Interim Biogeographic Regionalisation for Australia (IBRA) currently recognises 89 bioregions and 419 subregions (Environment Australia, 2013). The survey area is located within the Carnarvon (CAR) Bioregion, specifically within the Cape Range subregion (CAR1).

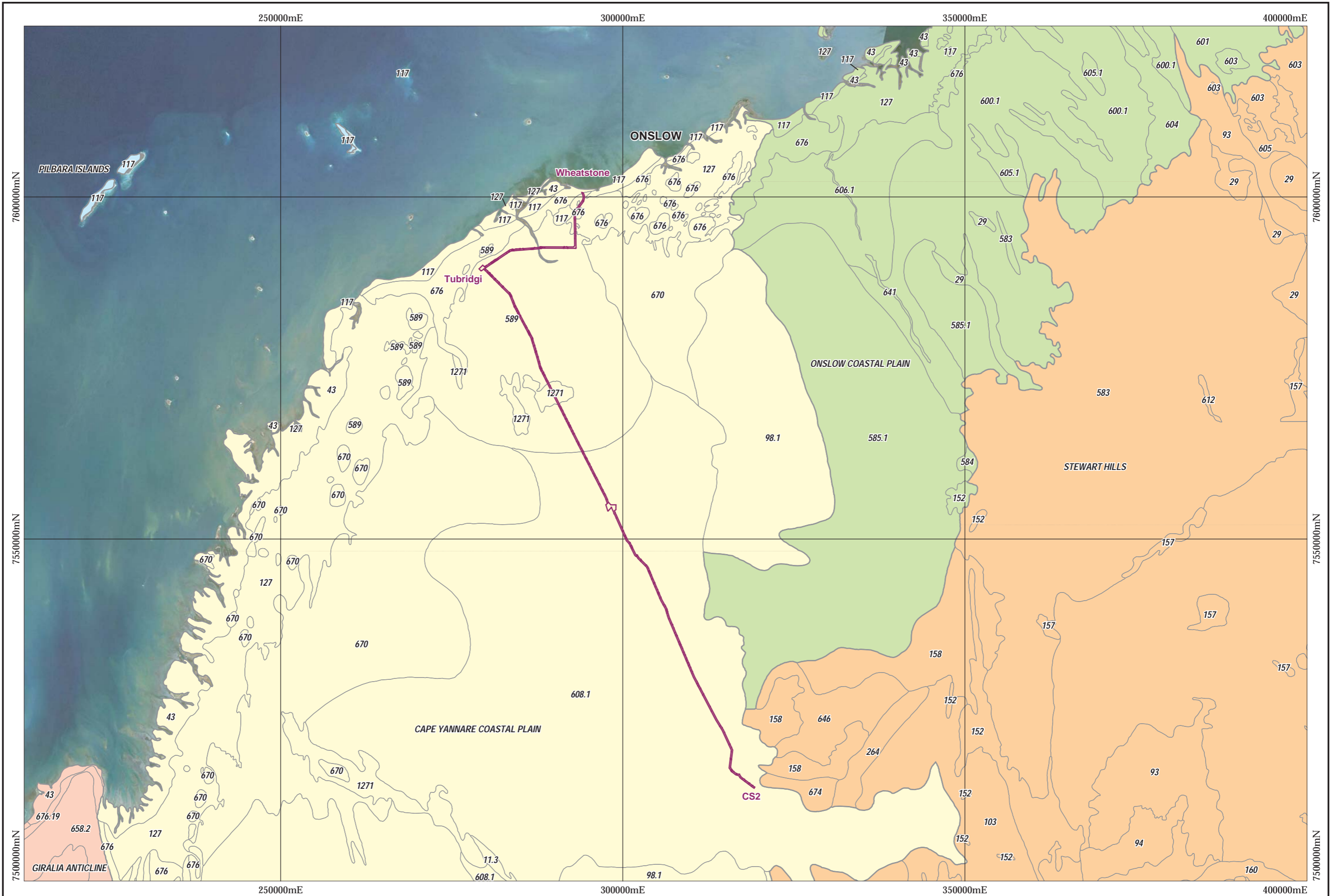
#### ***Carnarvon (CAR) Bioregion***

Cape Range subregion (CAR1): Rugged tertiary limestone ranges and extensive red Aeolian dunefields, quaternary coastal beach dunes and mud flats. *Acacia* shrublands (e.g. *Acacia bivenosa*) over *Triodia* spp. occur on limestone and red dunefields, *Triodia* hummock grasslands with sparse *Eucalyptus* trees and shrubs on the Cape Range. Tidal mudflats of the Exmouth Gulf support extensive mangroves while the eastern hinterlands comprise a mosaic of saline alluvial plains with samphire and saltbush low shrublands (Kendrick and Mau, 2002).

### **5.1.4 Historical Mapping of Beard**

Beard (1975) broadly mapped vegetation of the Pilbara at a scale of 1: 1, 000, 000. The survey area traverses the Carnarvon Botanical District region of the Eremaean Botanical Province, as defined by Beard (1975, 1990; Figure 3).

The Carnarvon Botanical District is divided into nine physiographic units with the survey area traversing the Cape Yannerie Coastal Plain Unit (Beard, 1975; Figure 3). The Cape Yannerie Coastal Plain consists of three recognised topographic/soil units namely pediplains and hills on siltstones and other marine rocks with predominately hard alkaline red soils; extensive plains with occasional rocky hills inland with acid, neutral and alkaline red earths, coastal claypans with non-cracking clays and shoreline-parallel dunes with red sands.



Notes:  
Pre-European System Association numbers shown



0 8km  
Scale 1:500,000  
MGA94 (Zone 50)  
CAD Ref: g2088\_DBP\_f04.dgn  
Date: Apr 2013 | Rev: A | A3

**Mattiske** Consulting Pty Ltd  
28 Central Road, Kalamunda WA 6076 - Tel: 9257 1825 - Fax: 9257 1840  
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**CS2 - Tubridgi - Wheatstone Project**  
**Pre-European Vegetation**

Beard (1975) broadly described the vegetation of the Cape Yinnarie Coastal Plain as being bordered by mangrove (primarily *Avicennia marina*) vegetation on the coastline and intertidal zones; hinterlands of predominately bare hypersaline mudflats, though samphire (*Tecticornia* spp.) communities occasionally occur and; shrub steppe on sandhills dominated by *Triodia* spp. and *Acacia* spp. interspersed with small claypans.

Beard (1975) mapped 5 more detailed units within the study area; Table 3 provides a brief description, area figures and priority status for each association. Note: Area figures are based on a survey area +/- 100 m from the centre of the easement, as such percentage impact figure exceed what would actually be impacted by clearing.

**Table 3: Beard (1975) Vegetation Associations Traversed by the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area: Pre-European Extent, Current Extent, Area Traversed, Percentage Impact and Priority Status**

Beard Vegetation Association	Vegetation Description*	Total Pre-Euro Extent (ha)	Total Current Extent (ha)	Area Traversed (ha)	%Impact	Priority*
127	Bare areas; mudflats	100898.9	99719.9	100.0	0.1	H
589	Mosaic: Short bunch grassland – savannah/grass plain (Pilbara)/hummock grasslands, grass steppe; soft spinifex.	78100.8	77834.9	909.9	1.2	H
608	Mosaic: Shrublands; <i>A. victoriae</i> and snakewood scrub patches/short bunch grassland – savannah/grass plain (Pilbara).	312836.4	312836.4	1211.7	0.4	L
676	Succulent Steppe; samphire.	29189.9	28441.5	25.4	0.1	H
1271	Bare areas; claypans	18353.6	18353.6	68.8	0.4	H

\*Kendrick and Mau, 2002.

### 5.1.5 Previous Flora and Vegetation Studies in the Locality

Two relevant botanical surveys have been conducted adjacent to sections of the current survey area by Astron (2009) and Biota (2010).

Astron (2009) described and mapped vegetation of the Macedon Gas Development. A small section of the Macedon Gas Pipeline survey area lies adjacent to the current survey area running for approximately 4 km – east of the Ashburton River Causeway. No GPS locations for survey sites established in this area were presented, and as such the number of comparable survey sites is unknown.

Biota (2010) described and mapped vegetation of the Wheatstone Study Area. Twenty-five standard floristic quadrats (50 m x 50 m) were assessed adjacent to the current survey area – from the Ashburton River causeway east to Wheatstone.

Extensive earthworks in the Wheatstone area and tidal inflows made sections of the current survey, to the north of Wheatstone Road, completely inaccessible. As a result the vegetation described and mapped in this area was inferred from data presented in both Astron (2009) and Biota (2010). Comparable sample, statistical and descriptive methodologies to the current survey were used, maintaining mapping reliability and continuity.

### 5.1.6 Threatened and Priority Ecological Communities

The Pilbara and Carnarvon bioregions both contain two Threatened Ecological Communities namely Carnarvon: Camerons Cave Troglobitic Community - P1 and Cape Range Remipede Community - P; Pilbara: Themeda Grasslands - VU and Ethel Gorge aquifer stygobiont community- VU. None of these however, are known to occur in close proximity and are thus highly unlikely to occur within the survey area

There are thirty known Priority Ecological Communities in the Pilbara bioregion; however none of these are known to occur in close proximity to the survey area. The closest of which, Peedamulla Marsh vegetation complex (P1) and Tanpool land system (P1) occur approximately 40 km and 55 km to the east of Wheatstone. The restricted nature of these two communities makes their occurrence within the survey area highly unlikely.

### 5.1.7 Declared Threatened and Priority Flora

No Threatened Flora species pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* and as listed by the Department of Environment and Conservation (2013b) were recorded within the bounds of the desktop search (within 40 km of the survey area; Table 4).

A total of seven Priority Flora species as listed by the Department of Environment and Conservation (2013h) were identified by the desktop search as having potential to occur within the survey area. This included two Priority 1, one Priority 2 and four Priority 4 flora species (Table 4). One of these species, *Eleocharis papillosa*, is also listed under the *Environment Protection Biodiversity Conservation Act 1999* (Department of Sustainability, Environment, Water, Population and Communities 2013a).

*Eleocharis papillosa* (P3) (dwarf desert spike-rush) is listed as a Priority 3 (poorly known) taxa in Western Australia (DEC 2013a) and as Vulnerable under the *Environment Protection Biodiversity Conservation Act 1999* (Department of Sustainability, Environment, Water, Population and Communities 2013a). It is a small erect perennial sedge, typically less than 10 cm high (TSSC 2010). The above-ground parts grow in response to inundation or flooding, and subsequently die back to tubers (TSSC 2010). It flowers brown in November, and is found in ephemeral (temporary) wetlands, predominantly freshwater and semi-saline swamps, red clay over granite, open clay flats, and Claypans (TSSC 2010; DEC 2013a).

**Table 4: Threatened and Priority Flora Species with Potential to Occur within the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area**

SCC = State Conservation Code (Appendix A1); FCC = Federal Conservation Code (Appendix A1)

SPECIES	FAMILY	SCC	FCC	DESCRIPTION
<i>Abutilon uncinatum</i>	Malvaceae	P1		Prostrate perennial herb, 0.2- 1m high, occurring on flat red sand plains.
<i>Helichrysum oligochaetum</i>	Asteraceae	P1		Erect annual herb, to 0.25 m high, yellow flowers from August to November, occurring on red clay alluvial plains.
<i>Vigna</i> sp. central (M.E. Trudgen 1626)	Fabaceae	P2		Prostrate herb/shrub, yellow flowers, occurring on sandy plains and red-brown cracking clay loam.
<i>Atriplex flabelliformis</i> *	Chenopodiaceae	P3		Monoecious erect perennial herb, to 0.35 m high, occurring on clay loam saline flats and marshes.
<i>Eleocharis papillosa</i> *	Cyperaceae	P3	VU	Annual herb, brown flowers in November, occurring on red clay flats and claypans.
<i>Eremophila forrestii</i> subsp. <i>viridis</i>	Scrophulariaceae	P3		Multi-branched shrub, to 1 m high, pink-cream flowers in August, occurring on red sands.
<i>Triumfetta echinata</i>	Malvaceae	P3		Prostrate shrub, to 0.3 m high, occurring on red sandy soils.

\* Recorded adjacent to the current survey area by Biota (2010).

### 5.1.8 Conservation Significant Wetlands

The Wheatstone to Tubridgi section of the proposed expansion crosses the Ashburton River approximately 8 km upstream from the rivermouth (50K; 287978, 7592619). The Tubridgi to CS2 section of the proposed alignment crosses the Ashburton River just south of Nanyingee Hill (50K; 315793, 7516084). The Ashburton River Catchment covers approximately 75, 718 ha, of which 14% is deemed woodland, 1% woody pasture, 47% shrubby pasture and 38% pasture (Bureau of Rural Sciences, 2013). Regionally significant arid zone mangrove vegetation occurs at the mouth of the Ashburton River (Department of Environment, 2006).

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Three wetlands of national importance occur within the Ashburton River Catchment (Drainage Basin No. 6), none of which occur in close proximity to the survey area. No Ramsar listed wetlands occur in close proximity to the survey area (DIWHA, 2013).

#### **5.1.9 Conservation Reserves**

Approximately 8.3% of the Carnarvon Bioregion is vested in various forms of conservation tenure, with approximately 2.2% of the Cape Range subregion being reserved (Kendrick and Mau, 2002).

Of particular note within the Cape Range subregion is the Cape Range National Park, Bundegi and Jurabi Conservation Parks, Ningaloo Marine Park and Barrow Island nature Reserve. The aforementioned conservation vested lands occur in the broader Cape Range subregion and as such bear no direct relevance to the current survey.

The Cane River Conservation Park is the closest gazetted conservation reserve to the survey area. At its closest point the Cane River Conservation Park is approximately 8 km east of the survey area (point approx. 5.5 km north-west of CS2). The survey area does not traverse nor run adjacent to the Cane River Conservation Park, as a result this area is not considered to be of direct relevance to current survey.

## **5.2 Field Survey**

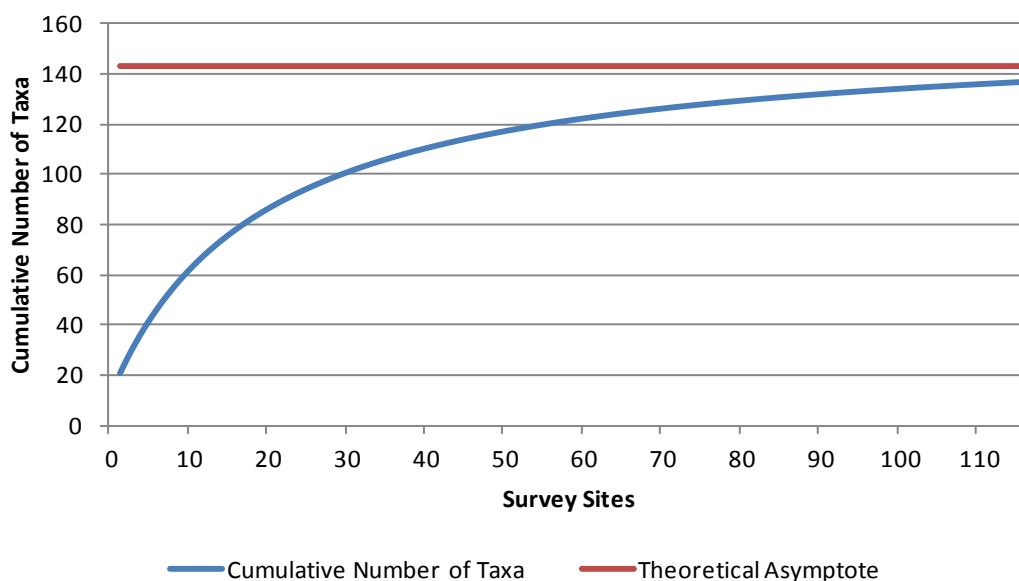
A total of 116 survey sites, both pre-selected and opportunistic, were used in the Level 1 flora and vegetation assessment of the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area. Refer to Appendix B for a list of the geographic locations for each survey site.

### **5.2.1 Flora**

A total of 139 vascular plant taxa which are representative of 80 plant genera and 28 plant families were recorded within the survey area. The majority of the taxa recorded were representative of the Poaceae (30 taxa), Fabaceae (26 taxa), Amaranthaceae (10 taxa), Chenopodiaceae (9 taxa) and Malvaceae (9 taxa) families (Appendix C). Of the 139 taxa recorded 98 (71.0%) were perennial, 21 (15.2%) were annual and 19 taxa (13.8%) were both annual and perennial with phenology dependent on local conditions.

### **5.2.2 Accumulated Species – Sites Surveyed (Species-Area Curve)**

A species accumulation plot, based on accumulated species versus sites surveyed was prepared to provide an indication as to the level of adequacy of the survey effort. As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.



**Figure 4: Averaged randomised species accumulation curve**

Field survey data was used to calculate both a species accumulation curve and a theoretical maximum number of species (asymptotic value) within the survey area.

The species accumulation curve (Figure 4), based on the species accumulation analysis of Colwell (2006) was used to evaluate the adequacy of sampling. The asymptotic value was determined using Michaelis-Menten modelling. Using this analysis, the incidence based coverage estimator of species richness (Chao, 2004) was calculated to be 143.4. Based on this value, and the total of 139 species recorded during the survey, approximately 97% of the flora species potentially present within the survey area were recorded. Though seemingly high, a figure of 97% is reflective of the survey as vegetation communities comprised similar dominant species, the assemblage and structure of these species however differed substantially.

### 5.2.3 Threatened and Priority Flora

No Declared Threatened Flora species pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* [WA] and as listed by the Department of Environment and Conservation (2013a) were recorded within the survey area.

Two Priority Flora species pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* [WA] and as listed by the Department of Environment and Conservation (2013a) were recorded within the survey area. *Eremophila forrestii* subsp. *viridis* and *Grevillea ?subterlineata* are both Priority 3 species recorded within the survey area; a brief description of these taxa and a table of locations are listed below (Table 5).

#### ***Eremophila forrestii* subsp. *viridis* (Priority 3) – SCROPHULARIACEAE**

This species is described as much-branched shrub, 0.5 m to 1.5 m high, producing pale pink flowers from June to August. It is known to occur on dunes with red sands (Brown and Burchell, 2011). There are three records of this taxon in the database of the Western Australian Herbarium, two of which occur in the Onslow locality (Department of Environment and Conservation 2013a).

#### ***Grevillea ?subterlineata* (Priority 3) – PROTEACEAE**

This species is described as a 2 to 2.5 m high shrub, producing irregular, white to pink flowers in August. It is known to occur amongst medium or low trees in sand, loam, or clay, often occupying islands in salt lakes (Department of Environment and Conservation 2013g). The 11 records of this taxon in the database of the Western Australian Herbarium are from two populations, both of which are located over 230 km south of this collection (See Section 5.2.5) (Department of Environment and Conservation 2013a).

**Table 5: GPS Locations of Priority Flora Recorded within the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area**

Family	Species	Site	Geographic Location (GDA94_Z50K)		Pop No.
			Easting	Northing	
PROTEACEAE	<i>Grevillea ?subterlineata</i> (P3)	1	318415	7514260	1
SCROPHULARIACEAE	<i>Eremophila forrestii</i> subsp. <i>viridis</i> (P3)	39	302096	7547469	3

#### 5.2.4 Threatened and Priority Ecological Communities

No Threatened or Priority Ecological Communities as defined by the Department of Environment and Conservation (2013e) and the *Environment Protection and Biodiversity Conservation Act 1999* were recorded or inferred to occur within the survey area.

#### 5.2.5 Taxa with Extensions to their Range

Eight species recorded during the survey represented extensions to the currently known range for that species; a brief description of these taxa and a table of locations are listed below (Table 6).

##### ***Streptoglossa tenuiflora* – ASTERACEAE**

This herb is up to 0.35 m high, producing a pink to purple flower between April and October. It is known to occur on claypans and mudflats, in accord with the observations of the soil type at the collection site.

There are only 13 - albeit widespread - records of this taxon in the database of the Western Australian Herbarium (Department of Environment and Conservation 2013g), all occurring over 200 km from the collections within the survey area.

##### ***Maireana ?lanosa* – CHENOPODIACEAE**

This divaricately branched shrub is between 0.25-0.6 m high, and is known to occur on red sand and loam in saline flats and floodplains (Department of Environment and Conservation 2013g). This species has previously been recorded in a survey of the area (Biota 2010). However; none of the 27 records of this species in the database of the Western Australian Herbarium occur within the survey area (Department of Environment and Conservation 2013g). This collection therefore represents a range extension of over 100 km for this species.

##### ***Rhagodia baccata* – CHENOPODIACEAE**

*Rhagodia baccata* is a spreading shrub between 0.3-2 m high. It inhabits white-grey sand, limestone and granite through sand dunes, coastal rocky areas and hills. This species is well collected along the south-western coast (Department of Environment and Conservation 2013g). The two northern records of the species are approximately 100 km west of the survey area (Department of Environment and Conservation 2013g). This collection therefore represents a range extension for this species.

##### ***Cassytha capillaris* – LAURACEAE**

This perennial parasite is found on grassy undergrowth as a climber or herb (Department of Environment and Conservation 2013g). It has previously been recorded in a survey of the area (Biota 2010), however this is not recorded in the database of the Western Australian herbarium. This species has been well collected to the east of the survey area (Department of Environment and Conservation); thus this collection represents a range extension of over 100 km for this species.

##### ***Marsilea hirsuta* – MARSILEACEAE**

This amphibious fern is up to 0.15 m tall, occurring on red clay or loamy sand in creeks, riverbeds, swamps, salt flats and claypans. The nearest record of this widespread yet poorly collected species in the database of the Western Australian Herbarium is over 100 km away; this collection therefore represents a range extension for this species.



***Melaleuca glomerata* – MYRTACEAE**

*Melaleuca glomerata* is a spreading shrub or tree between 1 and 8 m high, which occurs on red clay and sandy loam in rocky river beds, shallow depressions and sandy flats (Department of Environment and Conservation 2013g). This well collected and widespread species has not been collected within 100 km of the survey area (Department of Environment and Conservation 2013g), however; this species has been observed in a previous survey of the survey area (Biota 2010).

***Grevillea striata* – PROTEACEAE**

*Grevillea striata* is a tree up to 15 m high which occurs in red loam, sand or clay near watercourses and in plains. These collections in the survey area represent a range extension of over 100 km.

**Table 6: GPS Locations of Taxa Recorded within the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area Representing Range Extensions**

Family	Species	Site	Geographic Location (GDA94_Z50K)		Pop No.
			Easting	Northing	
ASTERACEAE	<i>Streptoglossa tenuiflora</i>	108	313208	7524489	1
	<i>Streptoglossa tenuiflora</i>	61	293234	7564365	200+
CHENOPODIACEAE	<i>Maireana ?lanosa</i>	94	284764	7592240	1
CHENOPODIACEAE	<i>Rhagodia baccata</i>	71	287362	7577145	1
LAURACEAE	<i>Cassytha capillaris</i>	92	282589	7591512	10
MARSILEACEAE	<i>Marsilea hirsuta</i>	61	293234	7564365	200+
MYRTACEAE	<i>Melaleuca glomerata</i>	9	315853	7516250	4
PROTEACEAE	<i>Grevillea striata</i>	5	316928	7515411	1
	<i>Grevillea striata</i>	19	309595	7531732	1
	<i>Grevillea striata</i>	30	305507	7541395	1
PROTEACEAE	<i>Grevillea ?subterlineata</i> (P3)	1	318415	7514260	1

***Grevillea ?subterlineata* (Priority 3) – PROTEACEAE**

The database of the Western Australian Herbarium has only 11 records of this taxon (Department of Environment and Conservation 2013g). These records comprise two populations south of the survey area; one approximately 200 km north of Kalgoorlie and the other in Upper Gascoyne. This collection within the survey area is over 230 km from the Upper Gascoyne population and approximately 1000 km north of the Kalgoorlie population.

**5.2.6 Introduced (Exotic) Plant Species**

A total of seven introduced (exotic) taxa were recorded within the survey area (Appendix C). Of these, one taxon, *\*Parkinsonia aculeata* is a Declared Plant species pursuant to section 37 of the *Agriculture and Related Resources Protection Act (1976)* according to the Western Australian Department of Agriculture and Food (2013a; Table 7).

*\*Parkinsonia aculeata* has a Declared Plant status of P1 and P2 across the state of Western Australia (Department of Agriculture and Food 2013a; Table 7). Definitions for Categories of Standard Control Codes for Declared Plant species in Western Australia are detailed in Appendix A5 (Department of Agriculture and Food, 2013a). *\*Parkinsonia aculeata* was recorded at one location adjacent to the Ashburton River Causeway, location listed below:

**Table 7: Geographic Locations and Status of Declared Plant Species Recorded within the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area**

Species	Declared Plant Status	Site	Geographic Location (GDA94)		
			Zone	Easting (mE)	Northing (mN)
<i>Parkinsonia aculeata</i>	P1, P2	116	50K	287918	7592522

Table 8 identifies weed management priorities for weed species identified within the survey area. With a view to provide information for prioritising the control of spread, prevent introductions and control existing weeds. Weed locations are shown on Figure series 6. Note that these are physical locations recorded at survey sites to show the geographic extent of each weed species across the survey area, not to highlight actual distribution and/or densities. Physical mapping of all weed locations and densities across the survey area was unfeasible for a 110 km long area that covers approximately 2 318 ha.

The *Environmental Weed Strategy for WA* (DEC, 2012) assesses and rates weeds in terms of their environmental impact on biodiversity using the same criteria as those used in the *National Weed Strategy* (ARMCANZ, 1997). These ratings have been applied to weed species identified within the survey area to determine weed management priorities. The environmental weed rating system is outlined as follows:

- High – These weeds should have priority for control and/or research.
- Moderate – Control and/or research funds should be directed toward these weeds.
- Mild – These weeds should be monitored and controlled where appropriate.
- Low – Low level of monitoring required for these weeds.

\**Cenchrus ciliaris* has a high environmental weed rating and occurs in high densities throughout the survey area. Regarding \**Cenchrus* species it should be noted that as outlined by (DEC, 2012) “Control of some widespread weeds may not be practicable, particularly if they are plants valued by the pastoral industry. Chemical control of these species would be a very costly and probably futile exercise”.

In addition to \**Cenchrus ciliaris*, \**Aerva javanica* and \**Vachellia farnesiana* also have high environmental weed ratings. *Aerva javanica* was recorded at one survey site (Site 9, ten individuals) near the southern Ashburton River crossing. Caution should be applied for all soil movement and storage associated with proposed works near the Ashburton River southern crossing to limit further spread.

\**Vachellia farnesiana* was recorded throughout the survey area, with densities increasing in areas of high cattle movement. Larger individuals (> 2.5 m high) were observed on clay flats between Tubridgi and Wheatstone. This species occurs throughout the Pilbara and has a low feasibility of control (Table 8).

**Table 8: Summary Management Details of Weed Species Recorded within the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area**

Weed Species	Environmental Weed Rating <sup>1</sup>	Permitted & Quarantine Plant Species <sup>2</sup>	Current Distribution in Pilbara <sup>1</sup>	Feasibility of Control <sup>1</sup>	Comments <sup>3</sup>
<i>Aerva javanica</i> (Kapok bush)	High	Conditional	Medium	High-Medium	Widespread in many types of vegetation from the Kimberly to Carnarvon, preferring calcareous soils.
<i>Cenchrus ciliaris</i> (Buffel grass)	High	Conditional	High	Low	Widespread weed of roadsides, creek lines, river edges and most vegetation types in the Pilbara.
<i>Cynodon dactylon</i> (Couch)	Moderate	Conditional	High	Low	Widespread across the entire State.
<i>Malvastrum americanum</i> (Spiked Malvastrum)	Moderate	Conditional	High	Low	Weed of river and creek margins, wasteland and many arid zone habitats throughout the Pilbara.
<i>Parkinsonia aculeata</i> (Jerusalem thorn)	Moderate	Declared	Medium	Low	A serious weed along riparian areas in the Pilbara and Kimberley. Parkinsonia is classified as a Weed of National Significance (WONS) and as a Declared Plant in the Shire of Ashburton.

<sup>1</sup> DEC (2012); <sup>2</sup> DAFWA (2013b); <sup>3</sup> Hussey *et al.*, (1997).

**Table 8: Summary Management Details of Weed Species Recorded within the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area (continued)**

Weed Species	Environmental Weed Rating <sup>1</sup>	Permitted & Quarantine Plant Species <sup>2</sup>	Current Distribution in Pilbara <sup>1</sup>	Feasibility of Control <sup>1</sup>	Comments <sup>3</sup>
<i>Portulaca oleracea</i> (Pigweed)	Not Listed	Conditional	n/a	n/a	A widespread succulent herb, which occurs from the Kimberley to the South-west of WA.
<i>Vachellia farnesiana</i> (Mimosa bush)	High	Conditional	High	Low	A widespread weed of roadsides, creeks, rivers, and disturbed floodplains from the Kimberley to Carnarvon. This species tends to be restricted to silty flats, but may spread under more favourable moisture conditions.

<sup>1</sup> DEC (2012); <sup>2</sup> DAFWA (2013b); <sup>3</sup> Hussey *et al.*, (1997).

### 5.2.7 Statistical Analysis

Hierarchical cluster analyses derived from a species-by-site resemblance matrix (Bray-Curtis similarity) grouped survey sites into discrete clusters based on species composition (dissimilarity/distance increased) (Clarke and Gorley, 2006). Singletons and introduced (exotic) species were excluded from final analysis. Hierarchical Clustering was used in conjunction with Analysis of Similarities (ANOSIM), Similarity Percentages (SIMPER), site descriptions, site photos and aerial photographs; combining these methods increased the understanding of site inter-relations and thus the ability to accurately delineate those sites based on species composition.

A number of vegetation communities were defined and mapped using aerial photography (C1), subjective ground assessments (River, Cleared and C3) and inferred mapping using previous mapping (T1, T2, C4, CD1, CP3, CP4, CP5 and ID3). As a result these communities do not contain associated survey sites, do not appear on the vegetation community dendrogram (Appendix G) or in associated analyses and are not discussed in the following section. Cluster analysis separated the sites into ten main groupings; these ten main groupings were further separated into twenty statistically dissimilar vegetation communities (Global R = 0.84; Significance level of sample statistic = 0.1%).

Site 116 represented a distinct vegetation community (R1) defined by remnant vegetation bordering the Ashburton River Causeway. Site 116 comprised *Eucalyptus victrix*, \**Parkinsonia aculeata* low woodland over *Acacia tetragonophylla*, *Acacia coriacea* subsp. *coriacea* tall open shrubland over *Eulalia aurea*, *Leptochloa digitata* low tussock grassland.

One claypan community was sampled (C2; Appendix G). C1 comprised a distinct chenopod low shrubland with low isolated tussock grasses.

Two distinct coastal sand and clayey plain communities were identified (CP1 and CP2; Appendix G). Both communities comprised a similar *Eucalyptus victrix* overstorey structure but significantly ( $p < 0.05$ ) differed in understorey composition, particularly with the absence of a pronounced *Acacia* spp. mid-storey in CP2.

Two inland sand dune communities were identified (ID1 and ID2; Appendix G). Delineation of these two communities was based equally on differences in both species and landform. ID1 tended to occur on gently undulating dunes and limestone areas closer to the coast, whereas ID2 tended to occur as fringing vegetation to bare claypans further inland. Both communities comprised *Acacia stellaticeps* and *Triodia epactia* and key dominant species, however ID2 noticeably lacked the presence of *Grevillea stenobotrya*.

Eight inland sand and clayey plain communities were identified (IP1 – IP8; Appendix G). Delineation of these communities was based on changes in the abundance and structure of co-dominant upper and mid-storey species, understorey composition and site descriptions. For the most part sand and clayey plain communities comprised a dominant *Acacia* spp. tall mid-storey with sparse to isolated emergent *Eucalyptus victrix*. *Acacia* species were similar across the eight communities, however distinct changes in height and dominance allowed for clear differentiation. The presence and composition of tussock and hummock grass species was also highly variable across the inland plain communities.

Five inland floodplain and depression communities were identified (IF1 – IF5; Appendix G). Two distinct *Acacia* dominated communities in these areas both comprise a mixed chenopod shrubland over mixed tussock grasses. Differentiation of these two *Acacia* communities was primarily based on differences in the dominance of *Acacia* species and differences in tussock grass species. Delineation of *Eucalyptus victrix* dominated communities was based on changes to the abundance and structure of co-dominant mid-storey species, understorey composition and site descriptions.

Two distinct riverine and drainage channel communities were identified (R1 and R2; Appendix G). Community R1 was confined to riverine environments adjacent to the Ashburton River Causeway and R2 was confined to riverine and drainage areas adjacent to the southern lateral crossing of the Ashburton River. R2 comprised a more intact mid- and ground storey, whereas R1 was in poor condition comprising a narrow sparse band of fringing vegetation.

A summary of the twenty PRIMER groupings, species by vegetation community, is detailed in Appendix E. A photographic record and further details of vegetation communities delineated within the survey area is detailed in Appendix F. A dendrogram of the 116 survey sites with assigned vegetation communities is depicted in Appendix G.

### 5.2.8 Vegetation

Thirty vegetation communities were defined and mapped within the survey area (see Appendix F and Figure Series 5). Of these, eight vegetation communities (denoted by 'B' after community descriptions) were inferred from previous mapping of the area (see sections 4.4, 4.6 and 5.1.5 for details) and two claypan communities (C1 and C3) were inferred from relevé data; as such these communities do not appear in the species by community dataset (Appendix E) or in the hierarchical clustering dendrogram (Appendix G). Further vegetation community descriptions, condition, soils and landform and representative photographs are detailed in Appendix F.

Vegetation communities are summarised below.

#### Tidal Mudflats and Tidal Creeks:

T1: *Tecticornia* spp. low scattered shrubs (B).

T2: *Avicennia marina* mid open scrubland (B).

#### Claypans and Clayey Plains:

C1: Bare Claypan.

C2: *Tecticornia* spp. low sparse chenopod shrubland with *Sporobolus mitchellii*, *Eriachne helmsii* low isolated tussock grasses.

C3: *Acacia tetragonophylla*, *Acacia synchronicia*, \**Vachellia farnesiana* mid isolated shrubs over *Urochloa occidentalis* var. *occidentalis*, *Chrysopogon fallax*, *Sporobolus mitchellii*, \**Cenchrus ciliaris* low open tussock grasses.

C4: *Tecticornia* spp. low shrubland (B).

#### Coastal Sand Dunes:

CD1: *Acacia coriacea* subsp. *coriacea* tall shrubland over *Crotalaria cunninghamii*, *Trichodesma zeylanicum* var. *grandiflorum* mid open shrubland over *Triodia epactia* mid open hummock grassland with \**Cenchrus ciliaris* low open tussock grassland (B).

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**Coastal Sand and Clayey Plains:**

- CP1: *Eucalyptus victrix* low open woodland over *Acacia tetragonophylla*, *Acacia sclerosperma* subsp. *sclerosperma*, *Scaevola spinescens* tall sparse shrubland over *Triodia epactia* mid open hummock grassland with *Sporobolus mitchellii*, *Chrysopogon fallax*, \**Cenchrus ciliaris* low sparse tussock grassland.
- CP2: *Eucalyptus victrix* low open woodland over *Abutilon oxycarpum*, *Ipomoea muelleri*, *Panicum decompositum* mid sparse forbland over *Enteropogon ramosus*, *Eriachne helmsii*, *Sporobolus mitchellii* low open tussock grassland.
- CP3: *Acacia tetragonophylla* low scattered shrubs over *Triodia epactia* low hummock grassland with \**Cenchrus ciliaris* low open tussock grassland (B).
- CP4: \**Prosopis pallida*, *Acacia tetragonophylla*, *Acacia synchronicia* tall scattered shrubs over *Triodia epactia* mid sparse hummock grassland with \**Cenchrus ciliaris* low open tussock grassland (B).
- CP5: *Sporobolus mitchellii*, *Eriachne* aff. *benthamii*, *Eriachne benthamii*, *Eulalia aurea* mid tussock grassland (B).

**Inland Sand Dunes:**

- ID1: *Grevillea stenobotrya* low sparse shrubland over *Acacia stellaticeps* mid open shrubland over *Triodia epactia* hummock grassland.
- ID2: *Acacia stellaticeps*, *Acacia sclerosperma* subsp. *sclerosperma* mid sparse shrubland with *Bonamia erecta*, *Hibiscus brachychlaenus*, *Scaevola sericophylla* low sparse shrubland over *Triodia epactia* mid hummock grassland with \**Cenchrus ciliaris*, *Eragrostis eriopoda* low sparse tussock grassland.
- ID3: *Grevillea stenobotrya* tall open shrubland over *Crotalaria cunninghamii*, *Trichodesma zeylanicum* var. *grandiflorum* mid open shrubland over *Triodia epactia* mid open hummock grassland (B).

**Inland Sand and Clayey Plains:**

- IP1: *Eucalyptus victrix* low scattered trees over *Acacia synchronicia*, *Acacia xiphophylla*, *Acacia sclerosperma* subsp. *sclerosperma* tall open shrubland over *Triodia lanigera* mid hummock grassland with \**Cenchrus ciliaris* low sparse tussock grassland.
- IP2: *Eucalyptus victrix* low isolated trees over *Acacia synchronicia*, *Acacia tetragonophylla*, *Acacia xiphophylla* tall sparse shrubland with *Senna artemisioides* subsp. *oligophylla*, *Scaevola spinescens* low sparse shrubland over *Triodia epactia* mid hummock grassland with *Eriachne helmsii*, \**Cenchrus ciliaris* low open tussock grassland.
- IP3: *Eucalyptus victrix*, *Grevillea striata* low isolated trees over *Hakea chordophylla*, *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia trachycarpa* tall open shrubland with *Acacia synchronicia*, *Acacia tetragonophylla* low sparse shrubland over *Triodia epactia* mid isolated hummock grasses with \**Cenchrus ciliaris* low sparse tussock grassland.
- IP4: *Acacia xiphophylla*, *Acacia synchronicia* low open shrubland over *Senna artemisioides* subsp. *oligophylla*, *Solanum lasiophyllum* low sparse shrubland over *Eragrostis xerophila*, \**Cenchrus ciliaris* low sparse tussock grassland.
- IP5: *Acacia synchronicia*, *Acacia tetragonophylla*, *Acacia sclerosperma* subsp. *sclerosperma* low sparse shrubland over *Chrysopogon fallax*, *Eriachne helmsii*, *Urochloa occidentalis* var. *occidentalis* low open tussock grassland.
- IP6: *Acacia synchronicia*, *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia xiphophylla* low sparse shrubland over *Eragrostis eriopoda*, *Eriachne aristidea*, \**Cenchrus ciliaris* low open tussock grassland.
- IP7: *Eucalyptus victrix* low open woodland over *Acacia tetragonophylla*, *Acacia synchronicia*, *Cullen leucanthum* mid sparse shrubland over *Eriachne helmsii*, *Eulalia aurea*, \**Cenchrus ciliaris* low sparse tussock grassland.
- IP8: *Eucalyptus victrix* low isolated trees over *Acacia tetragonophylla*, *Acacia synchronicia* tall isolated shrubs with *Acacia stellaticeps*, *Acacia coriacea* subsp. *coriacea*, *Senna artemisioides* subsp. *oligophylla* low sparse shrubland over *Triodia epactia* mid hummock grassland with *Eulalia aurea*, *Eragrostis eriopoda*, \**Cenchrus ciliaris* low sparse tussock grassland.

### Inland Floodplains and Depressions:

- IF1: *Eucalyptus victrix* low open woodland over *Acacia synchronicia*, *Acacia tetragonophylla*, *Scaevola spinescens* tall sparse shrubland with *Rhynchosia minima*, *Senna artemisioides* subsp. *oligophylla*, *Eremophila longifolia* mid sparse shrubland over *Triodia epactia* low isolated hummock grasses with *Eriachne helmsii*, *Chrysopogon fallax*, *Urochloa occidentalis* var. *occidentalis* low sparse tussock grassland.
- IF2: *Acacia xiphophylla*, *Acacia synchronicia* mid open shrubland over *Salsola australis*, *Rhagodia eremaea*, *Maireana* spp. mid sparse chenopod shrubland over *Eriachne benthamii*, *Sporobolus australasicus*, \**Cenchrus ciliaris* low open tussock grassland.
- IF3: *Acacia synchronicia*, *Acacia xiphophylla*, *Acacia trachycarpa* low sparse shrubland over *Salsola australis*, *Threlkeldia diffusa*, *Rhagodia eremaea* mid sparse chenopod shrubland with *Chrysopogon fallax*, *Enteropogon ramosus*, \**Cenchrus ciliaris* low open tussock grassland.
- IF4: *Eucalyptus victrix* low open woodland over *Acacia synchronicia*, *Acacia tetragonophylla*, *Scaevola spinescens* tall sparse shrubland over *Sporobolus mitchellii*, *Eriachne helmsii*, *Eulalia aurea* low open tussock grassland.
- IF5: *Eucalyptus victrix* low open woodland over *Acacia synchronicia*, *Acacia tetragonophylla*, *Senna artemisioides* subsp. *oligophylla* mid sparse shrubland over *Panicum decompositum*, *Rhynchosia minima*, *Neptunia dimorphantha* mid sparse forbland with *Eriachne helmsii*, *Eragrostis xerophila*, *Iseilema membranaceum* low open tussock grassland.

### River Zones and Drainage Channels:

- R1: *Eucalyptus victrix*, \**Parkinsonia aculeata* low woodland over *Acacia tetragonophylla*, *Acacia coriacea* subsp. *coriacea* tall open shrubland over *Eulalia aurea*, *Leptochloa digitata* low tussock grassland.
- R2: *Eucalyptus victrix*, *Eucalyptus camaldulensis* low woodland over *Scaevola spinescens*, *Acacia coriacea* subsp. *coriacea*, *Melaleuca glomerata* mid sparse shrubland over *Ipomoea muelleri*, *Euphorbia boophthona*, \**Portulaca oleracea* low sparse forbland with \**Cenchrus ciliaris* low sparse tussock grassland.

## 5.2.9 Area Coverage of Vegetation Communities

The total area mapped and percentage cover for each delineated vegetation community (Figure Series 5) is shown in Table 9.

Area figures highlight the subtle vegetation mosaic existing across the survey with eleven communities recording a percentage under one, and sixteen communities recording a percentage between 1 and 5 (Table 9). Dominant vegetation communities included clayey plain community C3 (7.42%); inland dune community ID2 (5.09%); inland sand and clayey plain communities IP2 (6.84%) and IP8 (12.17%) and; inland floodplain and depression communities IF1 (15.72%) and IF3 (8.61%).

Communities assigned to inland sand and clayey plains and inland floodplains and depressions account for 33.6% and 32.7% of the total area mapped, respectively.

**LEGEND**

- Tidal Mudflats and Tidal Creeks:**
- T1: *Tecticornia* spp. low scattered shrubs (B).
  - T2: *Avicennia marina* mid open scrubland (B).
- Claypans and Clayey Plains:**
- C1: Bare Claypan.
  - C2: *Tecticornia* spp. low sparse chenopod shrubland with *Sporobolus mitchellii*, *Eriachne helmsii* low isolated tussock grasses.
  - C3: *Acacia tetragonophylla*, *Acacia synchronicia*, *\*Vachellia farnesiana* mid isolated shrubs over *Urochloa occidentalis* var. *occidentalis*, *Chrysopogon fallax*, *Sporobolus mitchellii*, *\*Cenchrus ciliaris* low open tussock grasses.
  - C4: *Tecticornia* spp. low shrubland (B).
- Coastal Sand Dunes:**
- CD1: *Acacia coriacea* subsp. *coriacea* tall shrubland over *Crotalaria cunninghamii*, *Trichodesma zeylanicum* var. *grandiflorum* mid open shrubland over *Triodia epactia* mid open hummock grassland with *\*Cenchrus ciliaris* low open tussock grassland (B).
- Coastal Sand and Clayey Plains:**
- CP1: *Eucalyptus victrix* low open woodland over *Acacia tetragonophylla*, *Acacia sclerosperma* subsp. *sclerosperma*, *Scaevola spinescens* tall sparse shrubland over *Triodia epactia* mid open hummock grassland with *Sporobolus mitchellii*, *Chrysopogon fallax*, *\*Cenchrus ciliaris* low sparse tussock grassland.
  - CP2: *Eucalyptus victrix* low open woodland over *Abutilon oxycarpum*, *Ipomoea muelleri*, *Panicum decompositum* mid sparse forbland over *Enteropogon ramosus*, *Eriachne helmsii*, *Sporobolus mitchellii* low open tussock grassland.
  - CP3: *Acacia tetragonophylla* low scattered shrubs over *Triodia epactia* low hummock grassland with *\*Cenchrus ciliaris* low open tussock grassland (B).
  - CP4: *\*Prosopis pallida*, *Acacia tetragonophylla*, *Acacia synchronicia* tall scattered shrubs over *Triodia epactia* mid sparse hummock grassland with *\*Cenchrus ciliaris* low open tussock grassland (B).
  - CP5: *Sporobolus mitchellii*, *Eriachne aff. benthamii*, *Eriachne benthamii*, *Eulalia aurea* mid tussock grassland (B).
- Inland Sand Dunes:**
- ID1: *Grevillea stenobotrya* low sparse shrubland over *Acacia stellaticeps* mid open shrubland over *Triodia epactia* hummock grassland.
  - ID2: *Acacia stellaticeps*, *Acacia sclerosperma* subsp. *sclerosperma* mid sparse shrubland with *Bonamia erecta*, *Hibiscus brachychaenus*, *Scaevola sericophylla* low sparse shrubland over *Triodia epactia* mid hummock grassland with *\*Cenchrus ciliaris*, *Eragrostis eriopoda* low sparse tussock grassland.
  - ID3: *Grevillea stenobotrya* tall open shrubland over *Crotalaria cunninghamii*, *Trichodesma zeylanicum* var. *grandiflorum* mid open shrubland over *Triodia epactia* mid open hummock grassland (B).
- Inland Sand and Clayey Plains:**
- IP1: *Eucalyptus victrix* low scattered trees over *Acacia synchronicia*, *Acacia xiphophylla*, *Acacia sclerosperma* subsp. *sclerosperma* tall open shrubland over *Triodia lanigera* mid hummock grassland with *\*Cenchrus ciliaris* low sparse tussock grassland.
  - IP2: *Eucalyptus victrix* low isolated trees over *Acacia synchronicia*, *Acacia tetragonophylla*, *Acacia xiphophylla* tall sparse shrubland with *Senna artemisioides* subsp. *oligophylla*, *Scaevola spinescens* low sparse shrubland over *Triodia epactia* mid hummock grassland with *Eriachne helmsii*, *\*Cenchrus ciliaris* low open tussock grassland.
  - IP3: *Eucalyptus victrix*, *Grevillea striata* low isolated trees over *Hakea chordophylla*, *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia trachycarpa* tall open shrubland with *Acacia synchronicia*, *Acacia tetragonophylla* low sparse shrubland over *Triodia epactia* mid isolated hummock grasses with *\*Cenchrus ciliaris* low sparse tussock grassland.
  - IP4: *Acacia xiphophylla*, *Acacia synchronicia* low open shrubland over *Senna artemisioides* subsp. *oligophylla*, *Solanum lasiophyllum* low sparse shrubland over *Eragrostis xerophila*, *\*Cenchrus ciliaris* low sparse tussock grassland.
  - IP5: *Acacia synchronicia*, *Acacia tetragonophylla*, *Acacia sclerosperma* subsp. *sclerosperma* low sparse shrubland over *Chrysopogon fallax*, *Eriachne helmsii*, *Urochloa occidentalis* var. *occidentalis* low open tussock grassland.
  - IP6: *Acacia synchronicia*, *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia xiphophylla* low sparse shrubland over *Eragrostis eriopoda*, *Eriachne aristidea*, *\*Cenchrus ciliaris* low open tussock grassland.
  - IP7: *Eucalyptus victrix* low open woodland over *Acacia tetragonophylla*, *Acacia synchronicia*, *Cullen leucanthum* mid sparse shrubland over *Eriachne helmsii*, *Eulalia aurea*, *\*Cenchrus ciliaris* low sparse tussock grassland.
  - IP8: *Eucalyptus victrix* low isolated trees over *Acacia tetragonophylla*, *Acacia synchronicia* tall isolated shrubs with *Acacia stellaticeps*, *Acacia coriacea* subsp. *coriacea*, *Senna artemisioides* subsp. *oligophylla* low sparse shrubland over *Triodia epactia* mid hummock grassland with *Eulalia aurea*, *Eragrostis eriopoda*, *\*Cenchrus ciliaris* low sparse tussock grassland.

- Inland Floodplains and Depressions:**
- IF1: *Eucalyptus victrix* low open woodland over *Acacia synchronicia*, *Acacia tetragonophylla*, *Scaevola spinescens* tall sparse shrubland with *Rhynchosia minima*, *Senna artemisioides* subsp. *oligophylla*, *Eremophila longifolia* mid sparse shrubland over *Triodia epactia* low isolated hummock grasses with *Eriachne helmsii*, *Chrysopogon fallax*, *Urochloa occidentalis* var. *occidentalis* low sparse tussock grassland.
  - IF2: *Acacia xiphophylla*, *Acacia synchronicia* mid open shrubland over *Salsola australis*, *Rhagodia eremaea*, *Maireana* spp. mid sparse chenopod shrubland over *Eriachne benthamii*, *Sporobolus australasicus*, *\*Cenchrus ciliaris* low open tussock grassland.
  - IF3: *Acacia synchronicia*, *Acacia xiphophylla*, *Acacia trachycarpa* low sparse shrubland over *Salsola australis*, *Threlkeldia diffusa*, *Rhagodia eremaea* mid sparse chenopod shrubland with *Chrysopogon fallax*, *Enteropogon ramosus*, *\*Cenchrus ciliaris* low open tussock grassland.
  - IF4: *Eucalyptus victrix* low open woodland over *Acacia synchronicia*, *Acacia tetragonophylla*, *Scaevola spinescens* tall sparse shrubland over *Sporobolus mitchellii*, *Eriachne helmsii*, *Eulalia aurea* low open tussock grassland.
  - IF5: *Eucalyptus victrix* low open woodland over *Acacia synchronicia*, *Acacia tetragonophylla*, *Senna artemisioides* subsp. *oligophylla* mid sparse shrubland over *Panicum decompositum*, *Rhynchosia minima*, *Neptunia dimorphantha* mid sparse forbland with *Eriachne helmsii*, *Eragrostis xerophila*, *Iseilema membranaceum* low open tussock grassland.
- River Zones and Drainage Channels:**
- R1: *Eucalyptus victrix*, *\*Parkinsonia aculeata* low woodland over *Acacia tetragonophylla*, *Acacia coriacea* subsp. *coriacea* tall open shrubland over *Eulalia aurea*, *Leptochloa digitata* low tussock grassland.
  - R2: *Eucalyptus victrix*, *Eucalyptus camaldulensis* low woodland over *Scaevola spinescens*, *Acacia coriacea* subsp. *coriacea*, *Melaleuca glomerata* mid sparse shrubland over *Ipomoea muelleri*, *Euphorbia boophthona*, *\*Portulaca oleracea* low sparse forbland with *\*Cenchrus ciliaris* low sparse tussock grassland.
  - CL: Cleared Land

**Note:** (B) denotes vegetation communities defined and described by Biota (2010)

**Threatened and Priority Species**

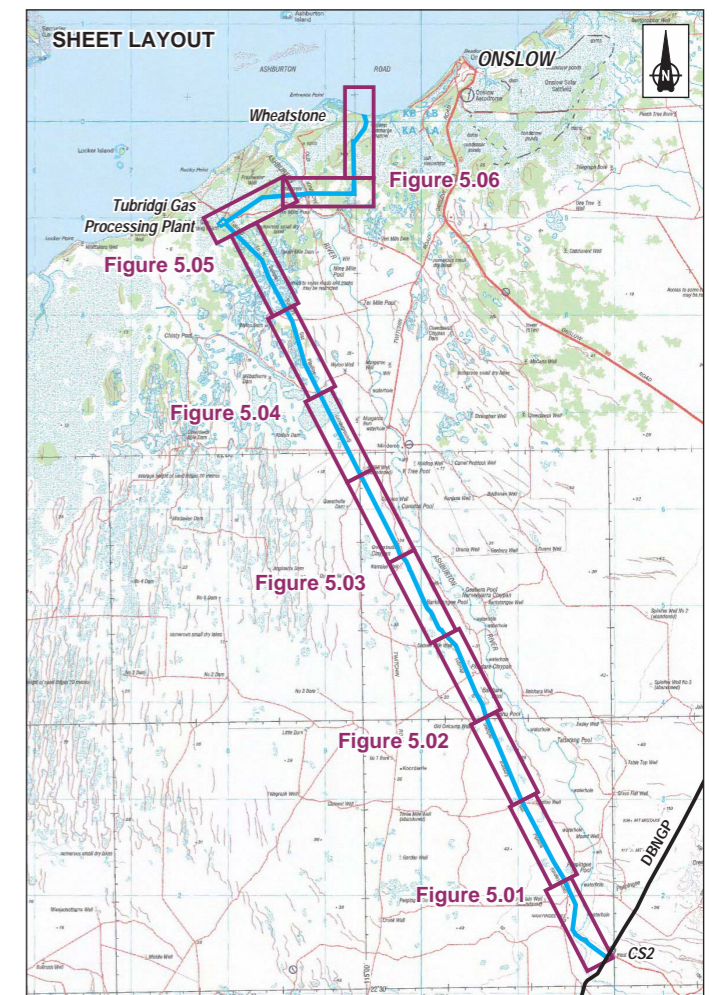
Abbrev	Species	Priority
Efv	<i>Eremophila forrestii</i> subsp. <i>viridis</i>	P3
Gs	<i>Grevillea ?subterlineata</i>	P3
Vice	<i>Vigna</i> sp. central (M.E. Trudgen 1626)	P2

**Declared Plants**

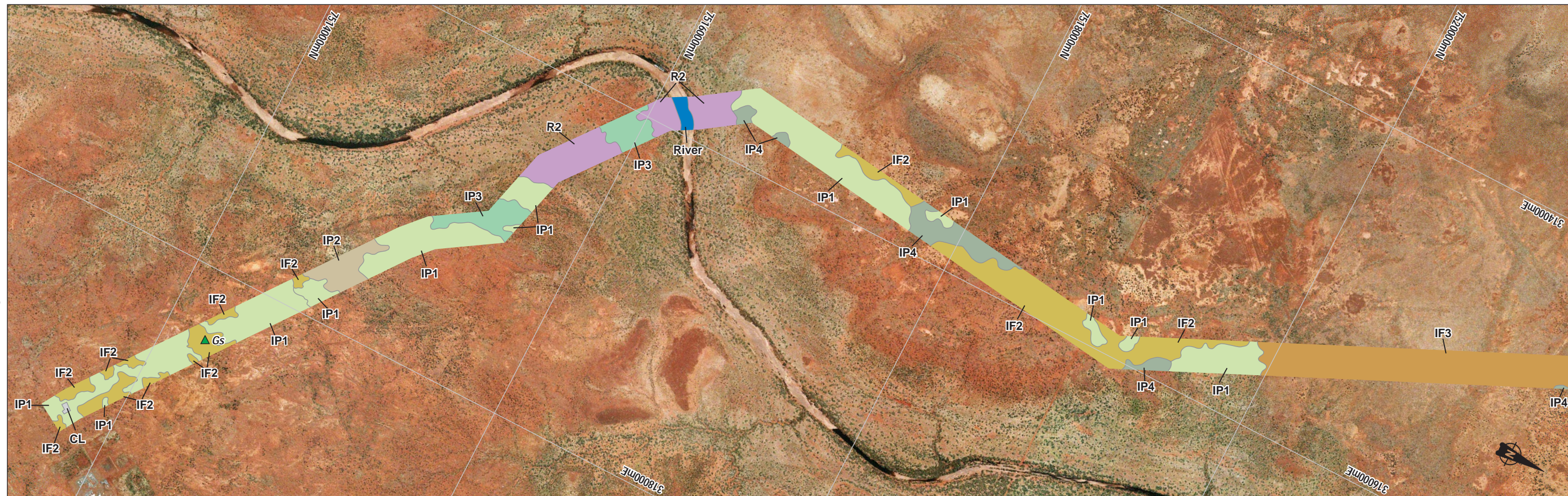
Abbrev	Species	Priority
★ Pa	<i>Parkinsonia aculeata</i>	P1, P2

**THREATENED AND PRIORITY SPECIES**

Priority	Herbarium	MCPL
Threatened	■	▲
1	■	▲
2	■	▲
3	■	▲
4	■	▲



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For Continuation Refer Figure 3.02

Notes:  
For legend - refer to figure 5.00

Sheet Layout:



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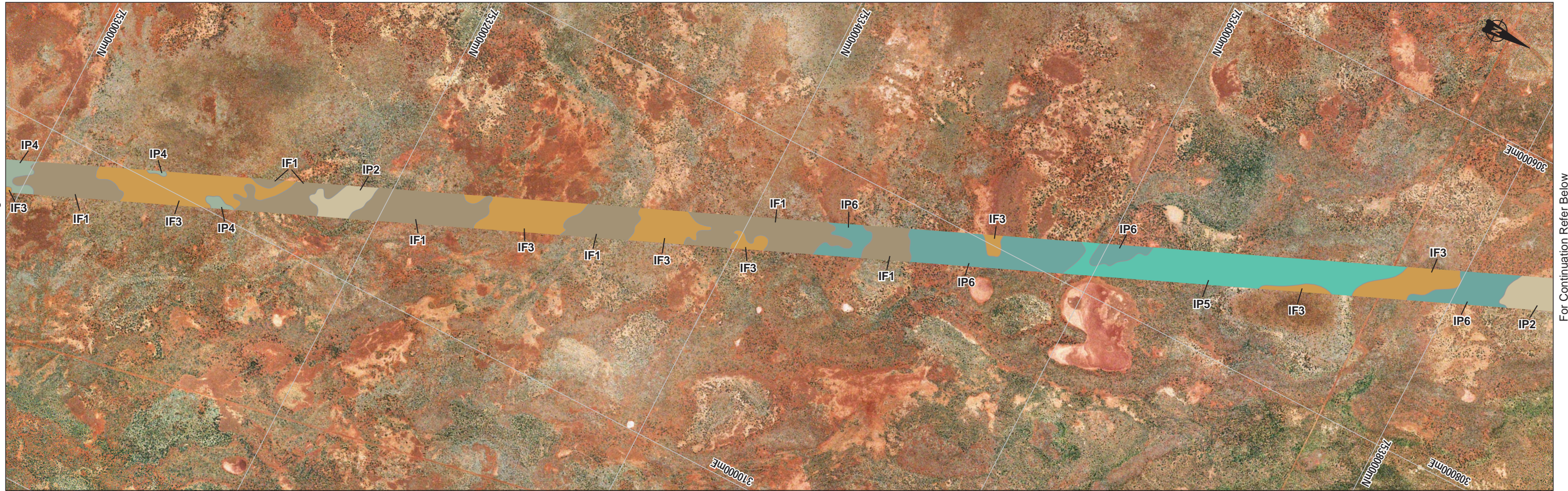
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**CS2 - Tubridgi - Wheatstone Project**  
**Vegetation**  
Sheet 1 of 6

Figure:  
**5.01**



For Continuation Refer Figure 3.01



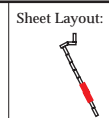
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For Continuation Refer Figure 3.03

Notes:  
For legend - refer to figure 3.00



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**CS2 - Tubridgi - Wheatstone Project**  
**Vegetation**  
Sheet 2 of 6

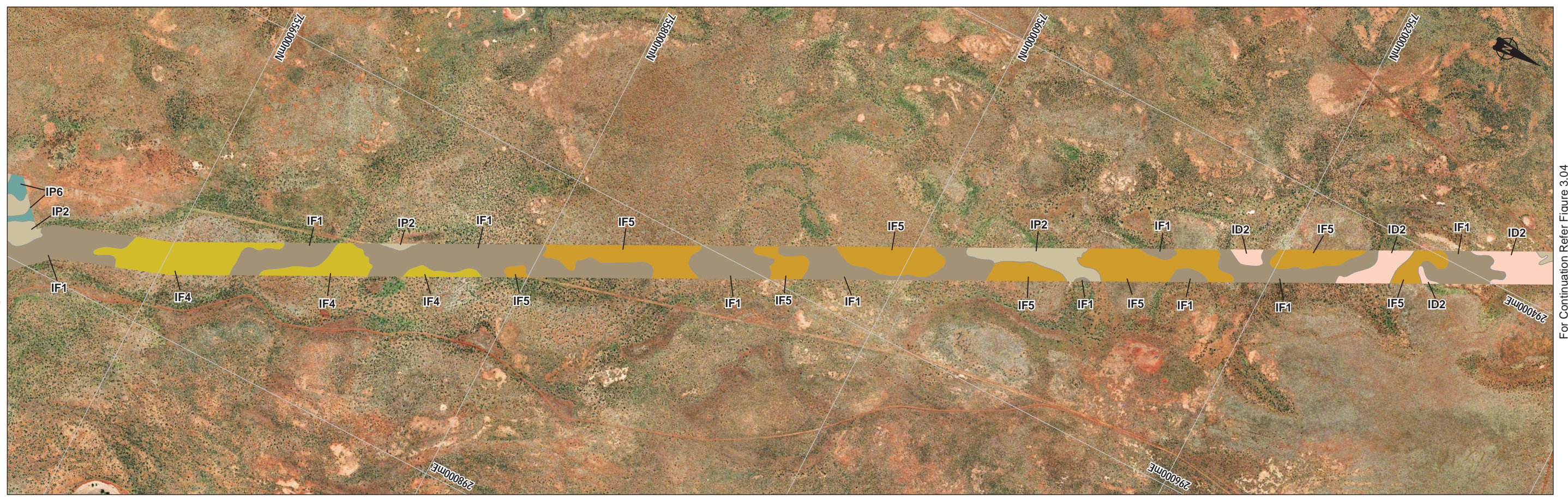
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**5.02**

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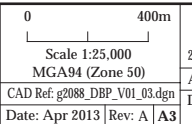
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For Continuation Refer Figure 3.04

Notes:  
For legend - refer to figure 3.00

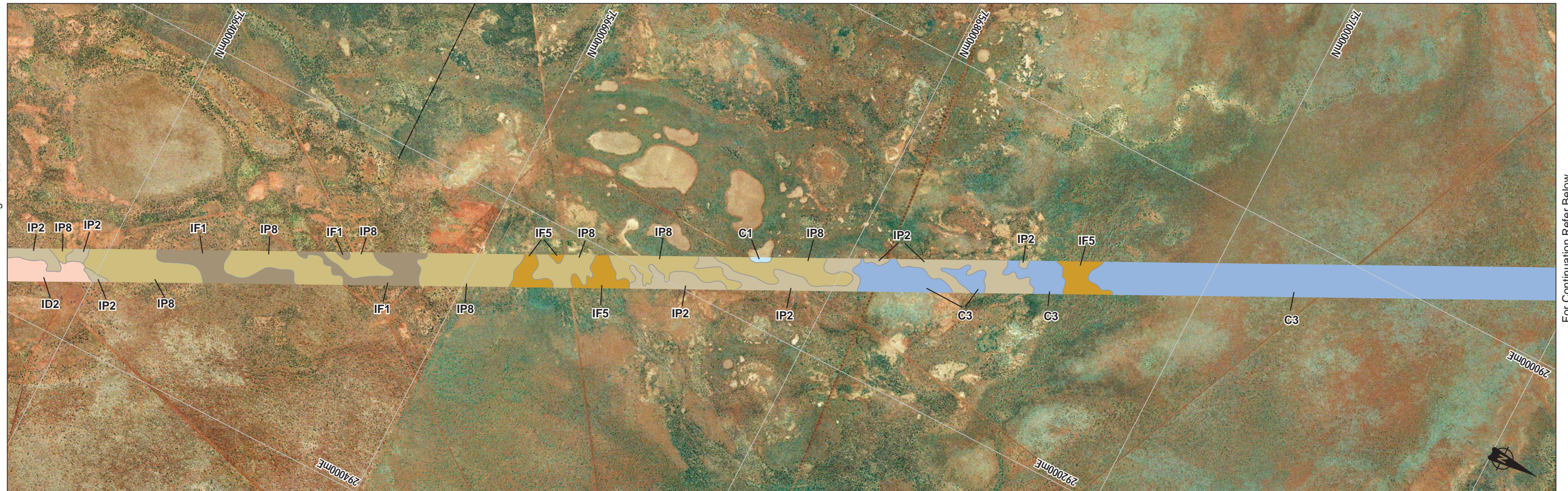


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**CS2 - Tubridgi - Wheatstone Project**  
**Vegetation**  
 Sheet 3 of 6

Figure:  
**5.03**

For Continuation Refer Figure 3.03



For Continuation Refer Below

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For Continuation Refer Figure 3.05

Notes:  
For legend - refer to figure 3.00

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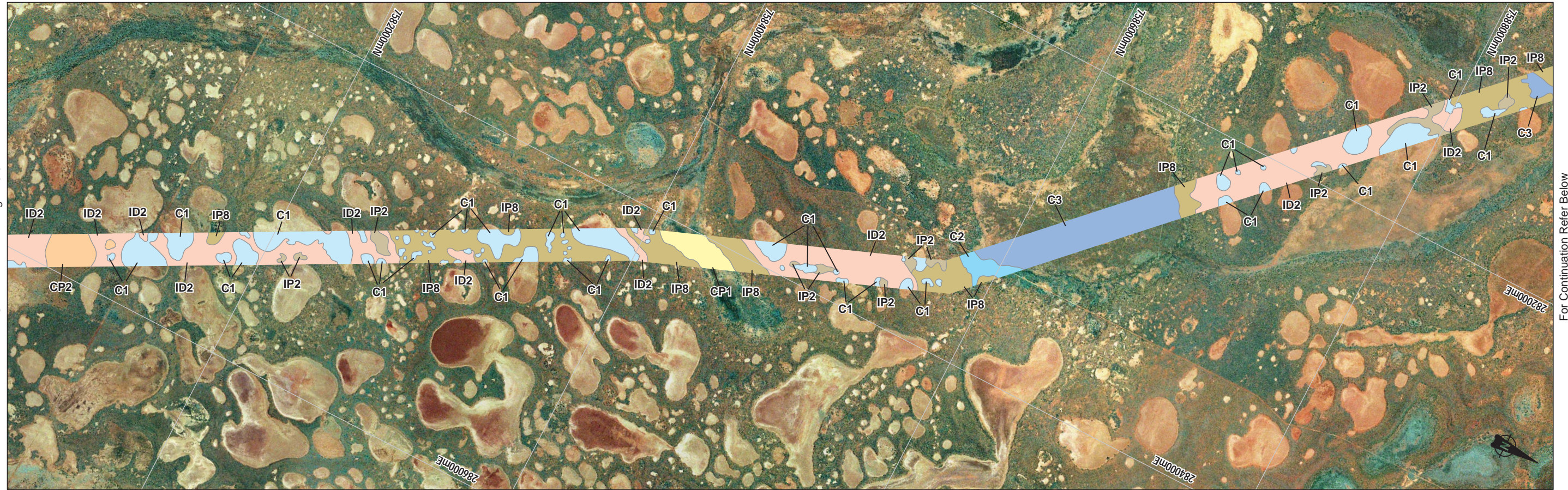
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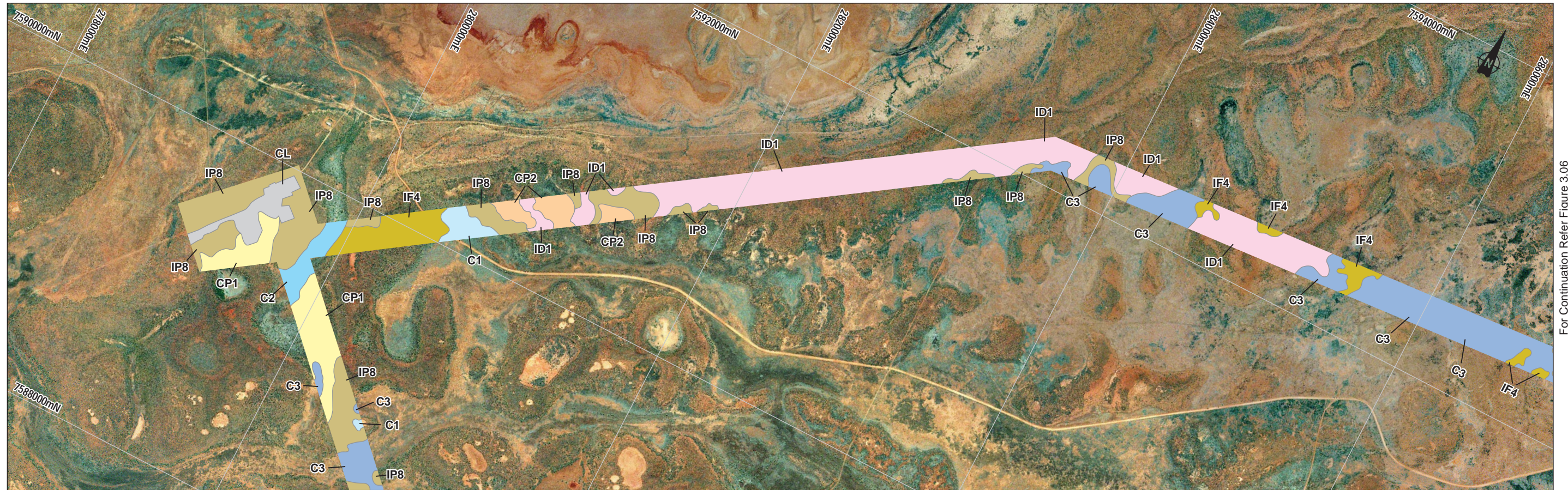
**CS2 - Tubridgi - Wheatstone Project**  
**Vegetation**  
Sheet 4 of 6

Figure:  
**5.04**

For Continuation Refer Figure 3.04



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For Continuation Refer Figure 3.06

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Notes:  
For legend - refer to figure 3.00

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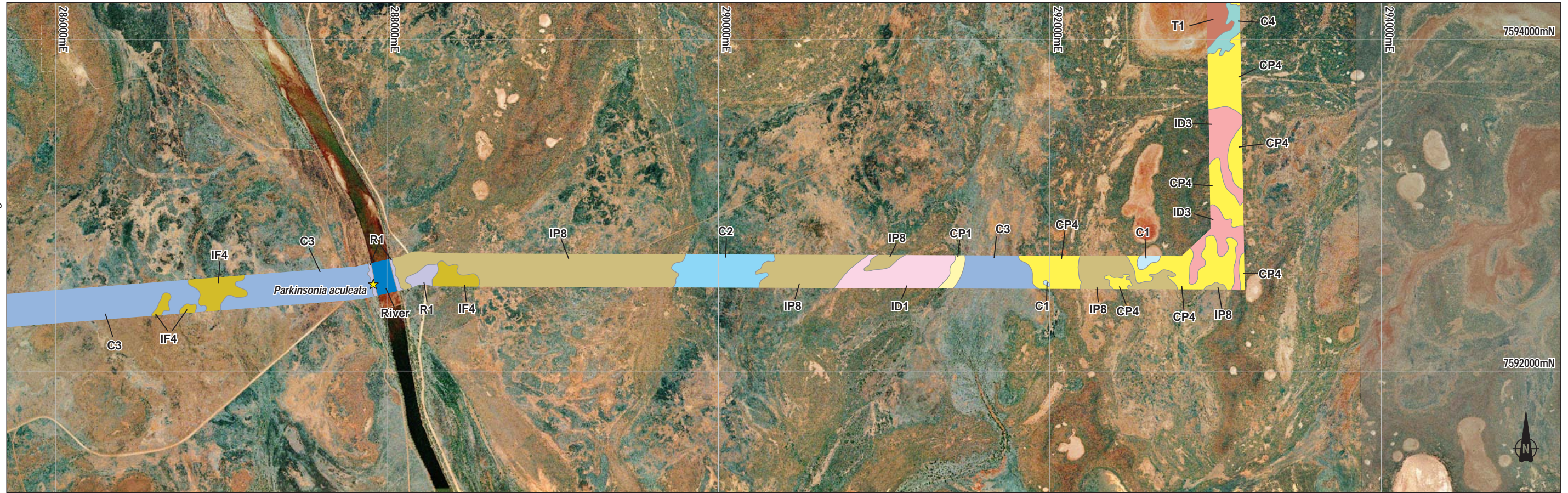
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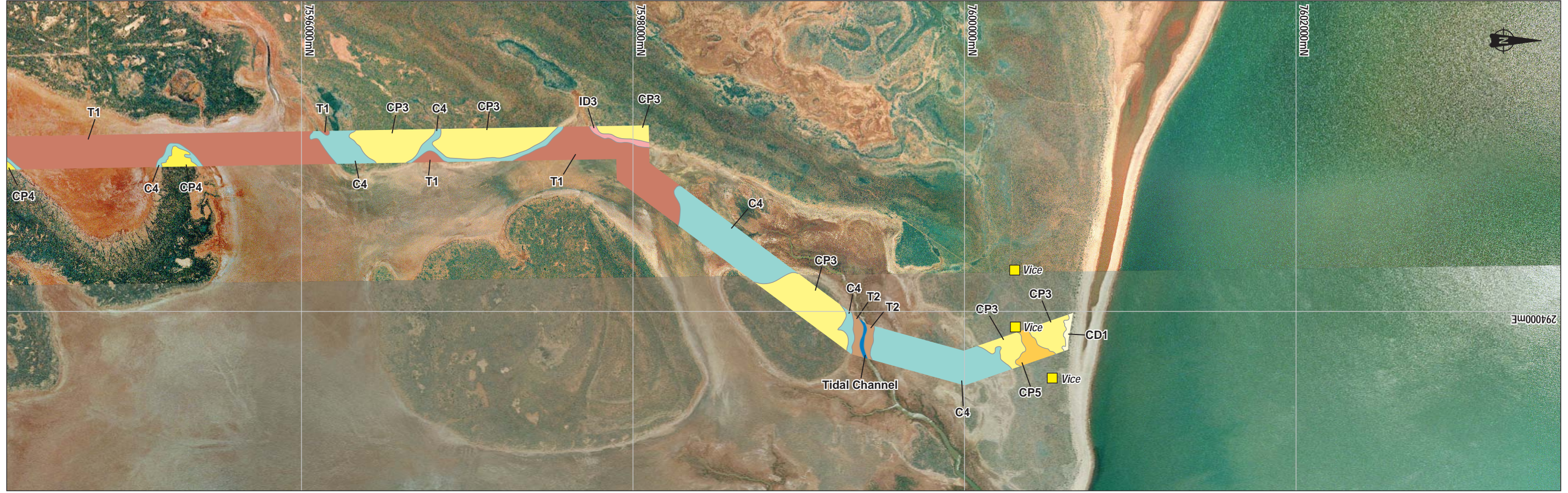
**CS2 - Tubridgi - Wheatstone Project**  
**Vegetation**  
Sheet 5 of 6

Figure:  
**5.05**

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Notes:  
For legend - refer to figure 5.00

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**Vegetation**  
Sheet 6 of 6

Figure:  
**5.06**

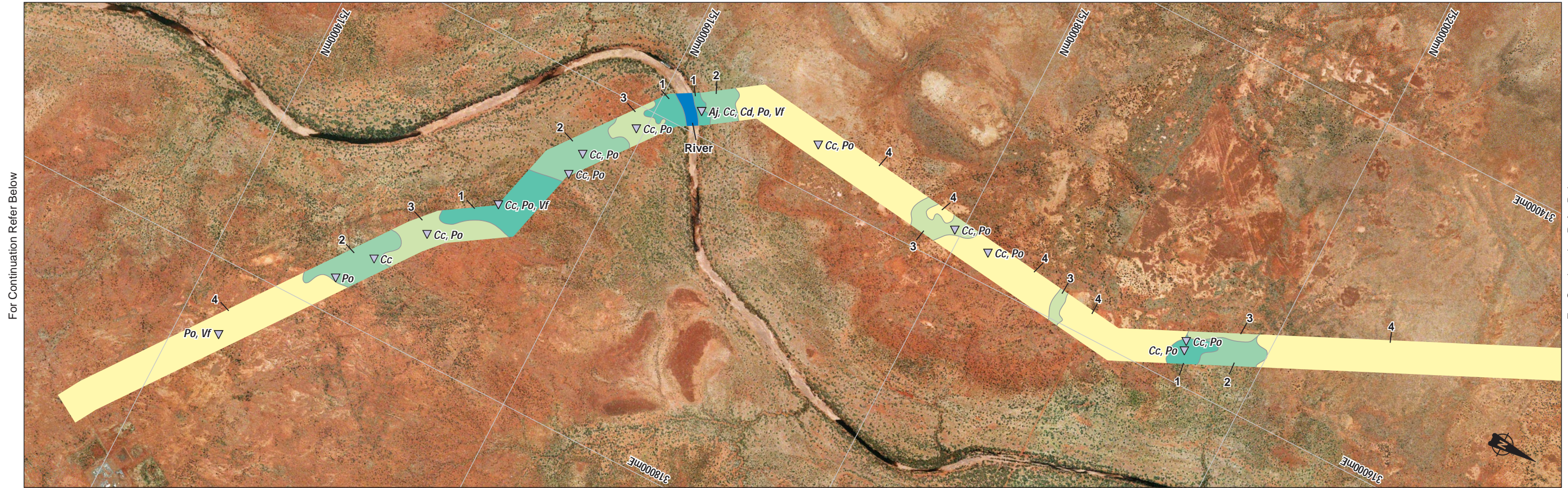
**Table 9: Area Coverage of each Vegetation Community Type within the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area**

Vegetation Community	Area (ha)	Percentage of Survey Area
T1	56.64	2.44
T2	2.04	0.09
C1	70.39	3.04
C2	20.03	0.86
C3	172.07	7.42
C4	43.26	1.87
CD1	0.64	0.03
CP1	25.88	1.12
CP2	67.35	2.91
CP3	36.92	1.59
CP4	33.28	1.44
CP5	2.32	0.10
ID1	83.17	3.59
ID2	118.07	5.09
ID3	13.47	0.58
IP1	74.33	3.21
IP2	158.49	6.84
IP3	22.47	0.97
IP4	55.09	2.30
IP5	43.81	1.89
IP6	62.66	2.70
IP7	80.43	3.47
IP8	282.20	12.17
IF1	364.42	15.72
IF2	50.13	2.16
IF3	199.66	8.61
IF4	78.16	3.37
IF5	65.51	2.83
R1	2.49	0.11
R2	19.47	0.84
Cleared	8.54	0.37
River	3.97	0.17
Tidal Channel	0.53	0.02
<b>Totals</b>	<b>2317.87</b>	<b>100</b>

#### 5.2.10 Vegetation Condition

Vegetation was generally in very good to excellent condition, with factors such as weed density (particularly density of *\*Cenchrus ciliaris*), clearing and vehicle movement and cattle movement and grazing observed as primary causes of decreasing vegetation condition.

Communities in good to poor conditions included coastal sand communities CP3 and CP4 and the riverine community R1. These two coastal sand communities comprised a dominant *\*Cenchrus ciliaris* understorey to the exclusion of native tussock grasses, while heavy cattle movement and vehicle tracks have resulted in the poor condition of community R1.



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For Continuation Refer Figure 3.02

**Tree Density Legend**

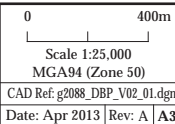
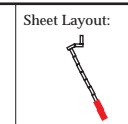
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**Weed Species**

Abbrev	Species
▽ Aj	* <i>Aerva javanica</i>
▽ Cc	* <i>Cenchrus ciliaris</i>
▽ Cd	* <i>Cynodon dactylon</i>

**Abbrev Species**

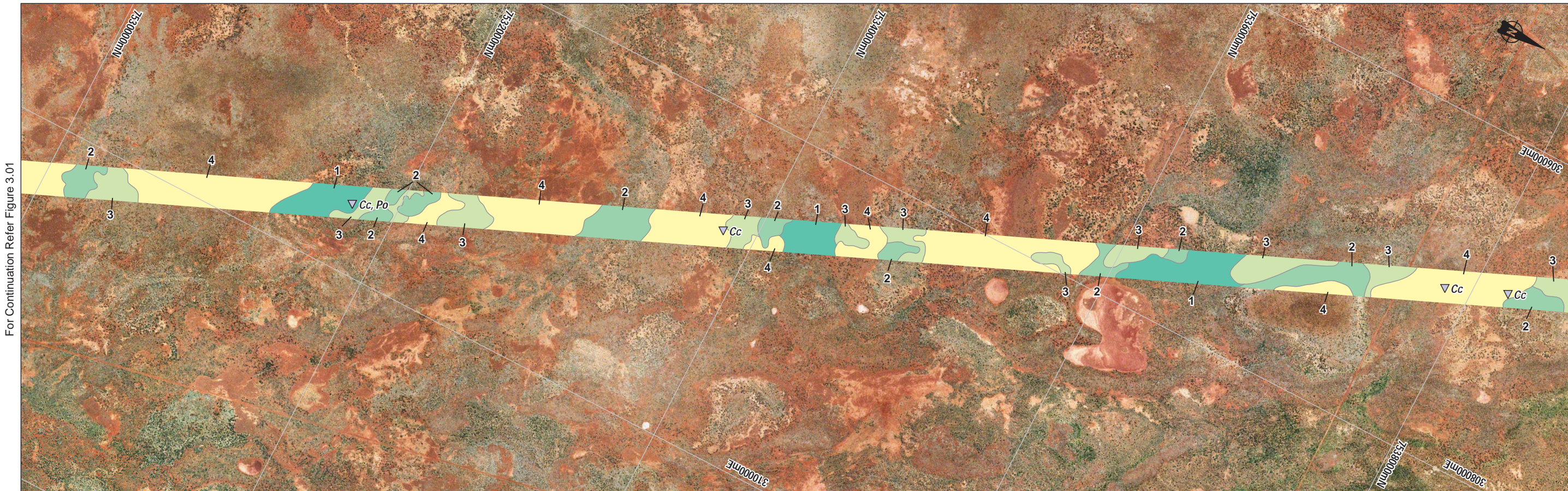
▽ Ma	* <i>Malvastrum americanum</i>
▽ Pa	* <i>Parkinsonia aculeate</i>
▽ Po	* <i>Portulaca oleracea</i>
▽ Vf	* <i>Vachellia farnesiana</i>



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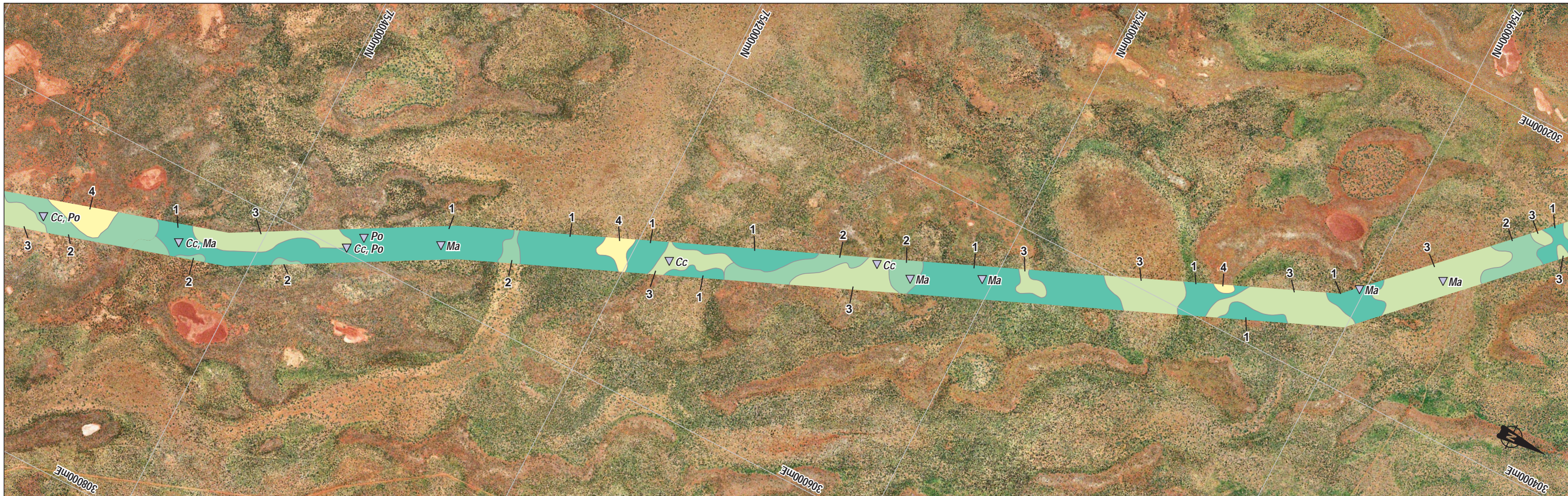
**CS2 - Tubridgi - Wheatstone Project**  
**Tree Density**  
 Sheet 1 of 6

Figure:  
**6.01**



For Continuation Refer Figure 3.01

For Continuation Refer Below



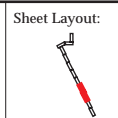
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Weed Species	
Abbrev	Species
▽ Aj	* <i>Aerva javanica</i>
▽ Cc	* <i>Cenchrus ciliaris</i>
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Abbrev	Species
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▽ Pa	* <i>Parkinsonia aculeate</i>
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▽ Vf	* <i>Vachellia farnesiana</i>



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**CS2 - Tubridgi - Wheatstone Project**  
**Tree Density**  
Sheet 2 of 6

Figure:  
**6.02**

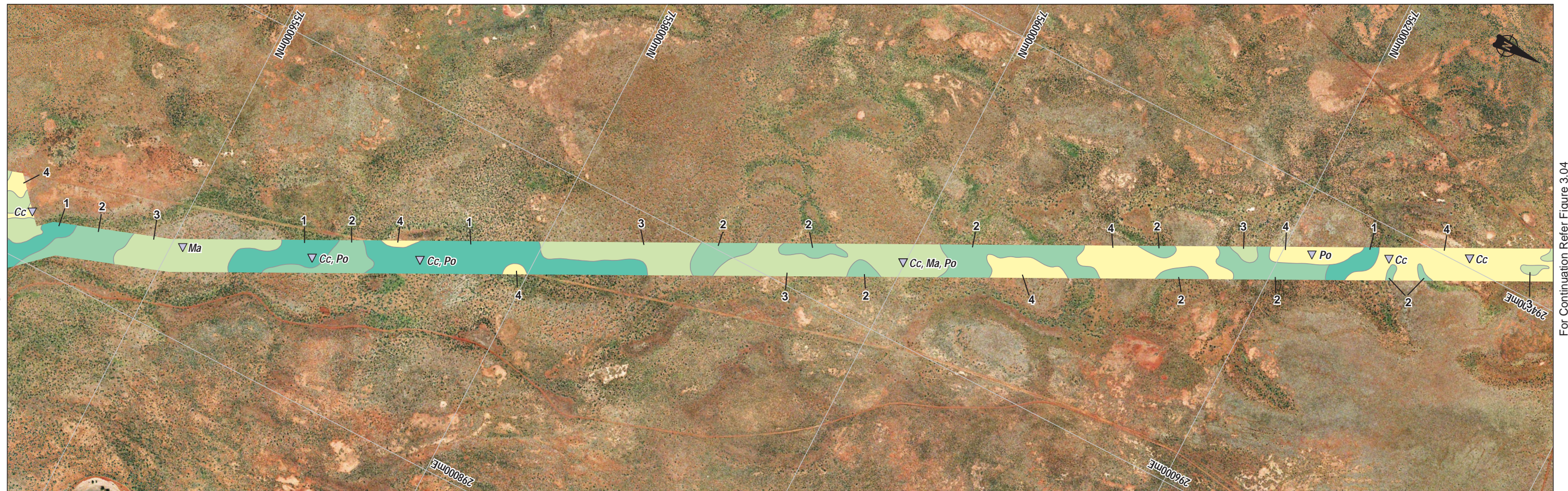


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For Continuation Refer Figure 3.04

**Tree Density Legend**

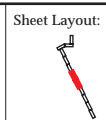
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	4 - Isolated Trees to No Trees

**Weed Species**

Abbrev	Species
▽ Aj	*Aerva javanica
▽ Cc	*Cenchrus ciliaris
▽ Cd	*Cynodon dactylon

**Abbrev Species**

▽ Ma	*Malvastrum americanum
▽ Pa	*Parkinsonia aculeate
▽ Po	*Portulaca oleracea
▽ Vf	*Vachellia farnesiana



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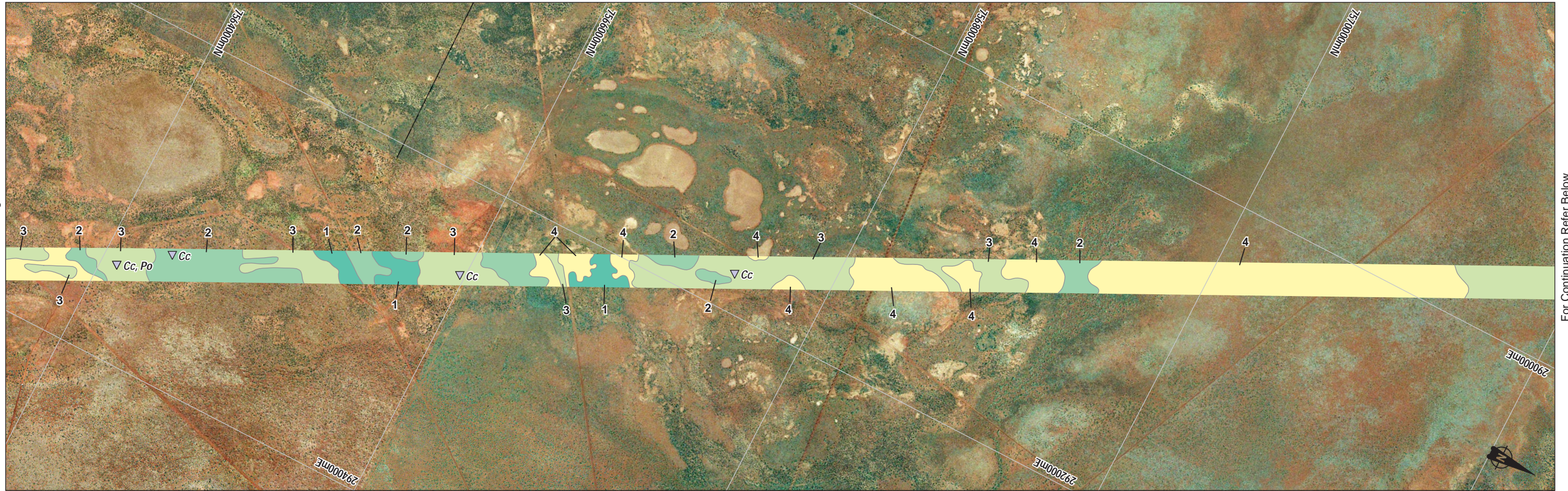
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**CS2 - Tubridgi - Wheatstone Project**  
**Tree Density**  
Sheet 3 of 6

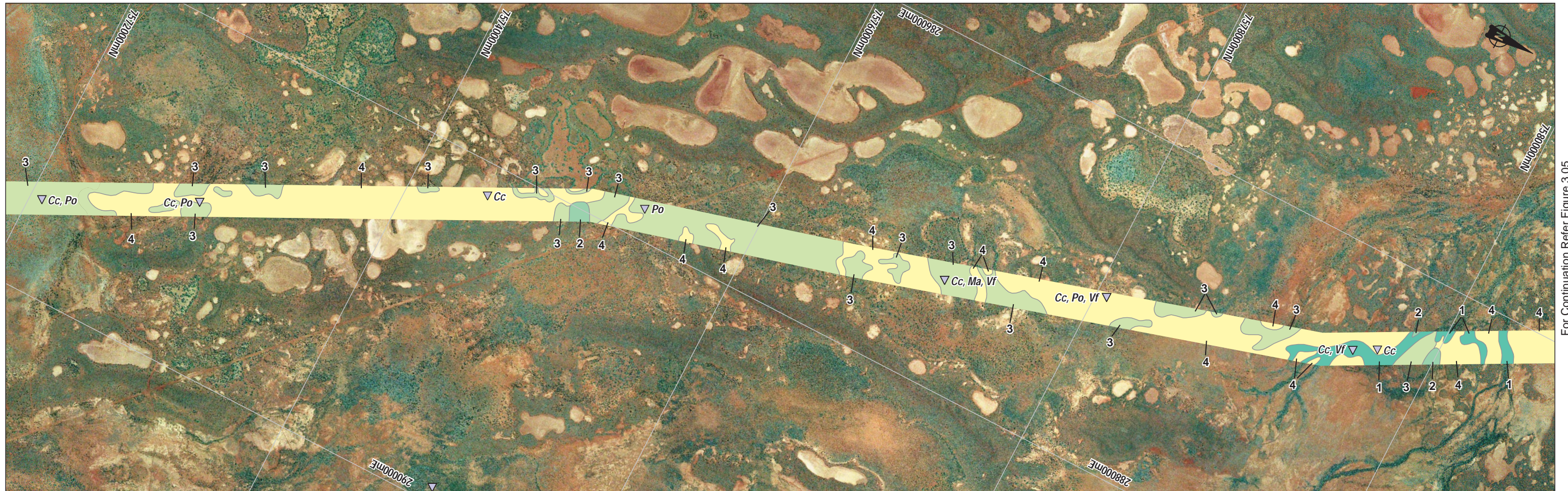
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**Tree Density Legend**

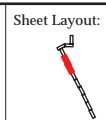
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**Weed Species**

Abbrev	Species
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▽ Cd	*Cynodon dactylon

**Abbrev Species**

▽ Ma	*Malvastrum americanum
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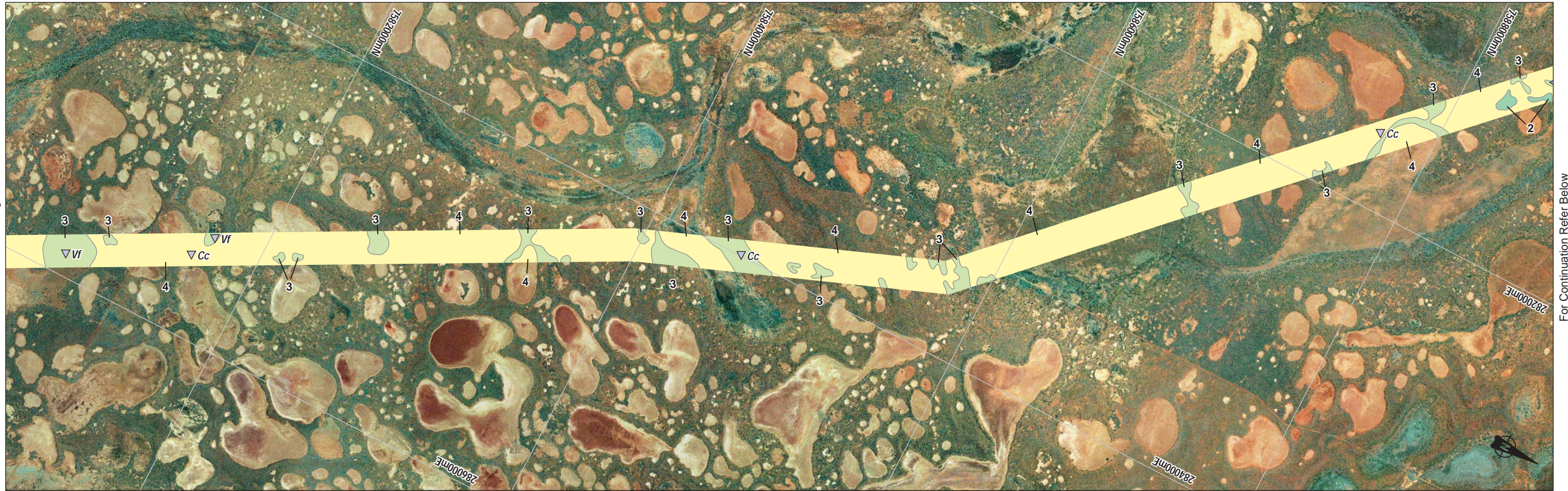
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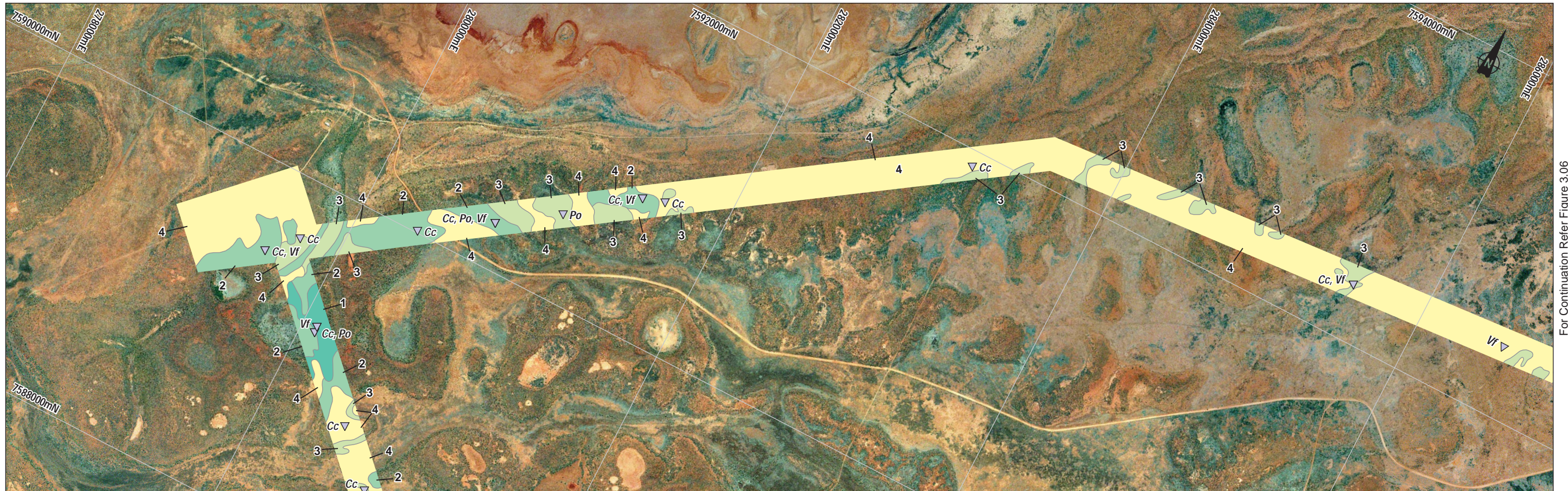
**CS2 - Tubridgi - Wheatstone Project**  
**Tree Density**  
Sheet 4 of 6

Figure:  
**6.04**

For Continuation Refer Figure 3.04



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**Tree Density Legend**

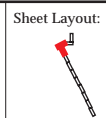
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**Weed Species**

Abbrev	Species
▽ Aj	* <i>Aerva javanica</i>
▽ Cc	* <i>Cenchrus ciliaris</i>
▽ Cd	* <i>Cynodon dactylon</i>

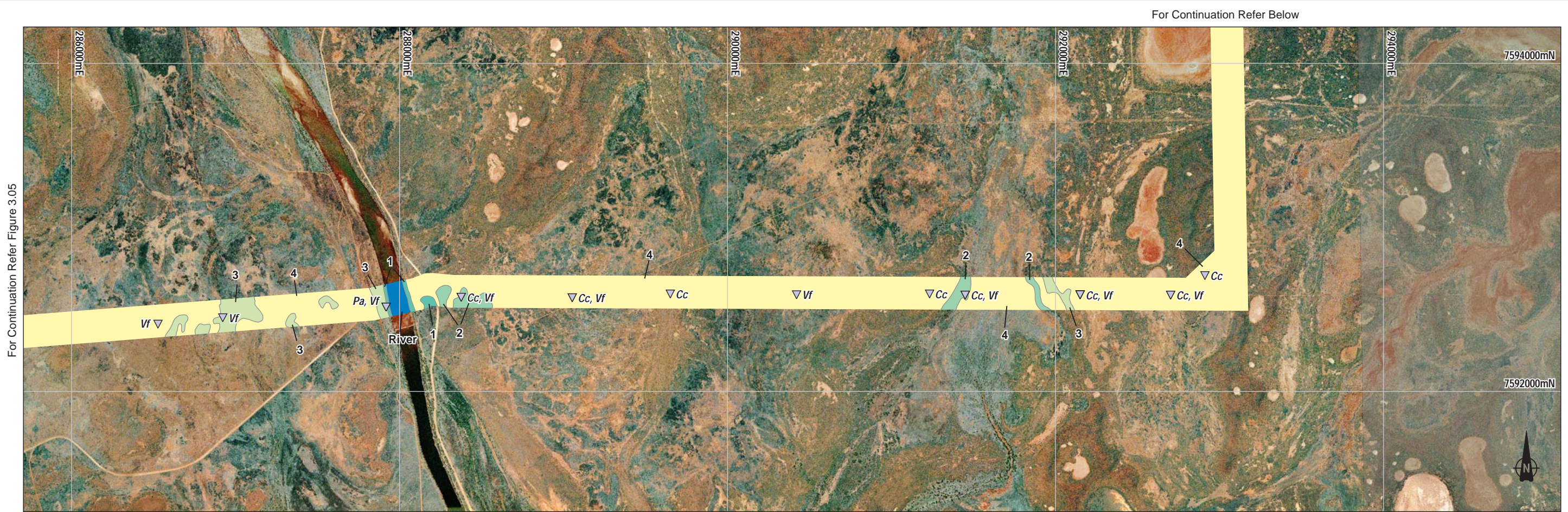
**Abbrev Species**

▽ Ma	* <i>Malvastrum americanum</i>
▽ Pa	* <i>Parkinsonia aculeate</i>
▽ Po	* <i>Portulaca oleracea</i>
▽ Vf	* <i>Vachellia farnesiana</i>



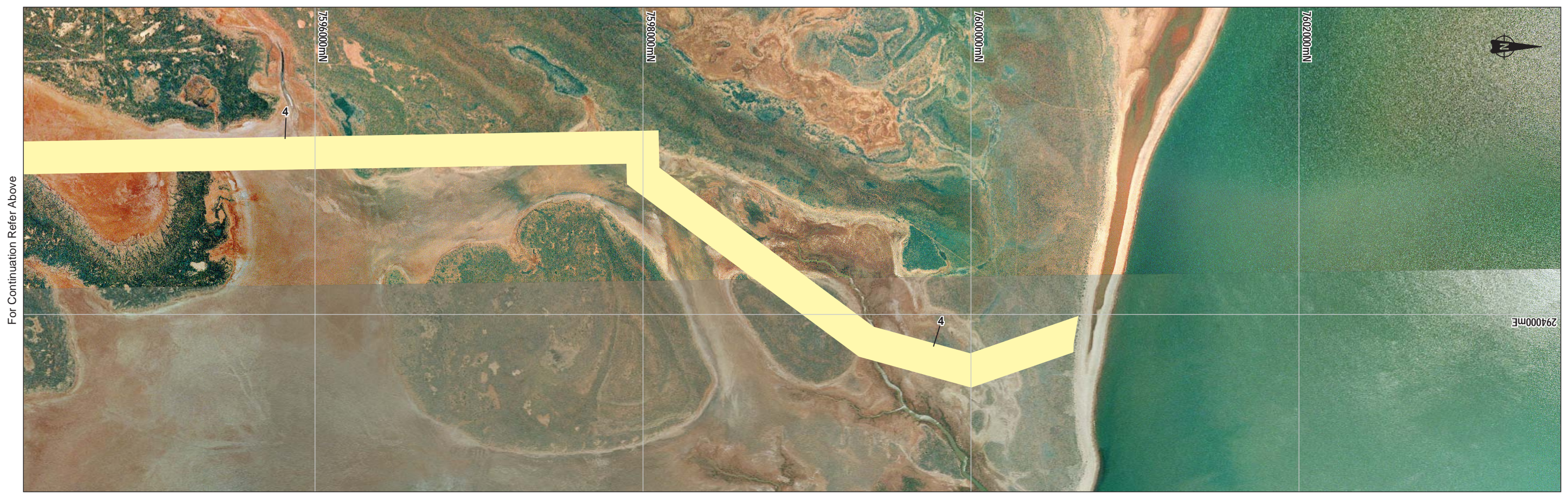
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Date: Apr 2013   Rev: A   A3	Tel: (08) 9246 3242 - Fax: (08) 9246 3202

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For Continuation Refer Figure 3.05

For Continuation Refer Below



For Continuation Refer Above

**Tree Density Legend**

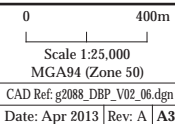
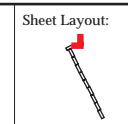
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<span style="display:inline-block; width:10px; height:10px; background-color: #90EE90; border: 1px solid black;"></span>	3 - Low Density
<span style="display:inline-block; width:10px; height:10px; background-color: #FFFF00; border: 1px solid black;"></span>	4 - Isolated Trees to No Trees

**Weed Species**

Abbrev	Species
▽ Aj	* <i>Aerva javanica</i>
▽ Cc	* <i>Cenchrus ciliaris</i>
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**Abbrev Species**

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**CS2 - Tubridgi - Wheatstone Project**  
**Tree Density**  
 Sheet 6 of 6

Figure:  
**6.06**

---

Communities in good to very good condition included claypan and clayey plain communities C2 and C3, coastal sand communities CP1 and CP2 and the inland sand and clayey plain community IP7. Heavy cattle movements, weed species and vehicle tracks were observed in many vegetated claypans and clayey plains. Such factors were not sufficient to substantially alter the natural structure of the vegetation but did result in a slightly decreased condition rating. High density of \**Cenchrus ciliaris* resulted in decreased condition ratings in communities CP1, CP2 and IP7. Condition of vegetation communities are detailed in Appendix F.

#### 5.2.11 Tree Density

Tree densities were mapped within the survey area to inform and assist in decisions regarding proposed alignments and associated clearing. Areas of high, medium, low and very low tree densities were mapped using high resolution aerial photographs and field observations (Figure Series 6). Tree densities being delineated and defined from subjective assessments of the spatial orientation of tree crowns to one another on a decreasing scale.

Tree densities were highest across inland floodplain and depressions, and riverine environments. Coastal and inland sand and clayey plains generally were absent of trees or contained isolated to scattered trees. Areas of isolated trees to no trees accounted for 53.7% of the survey area, while areas of high density only accounted for 12.3% of the survey area.

*Eucalyptus victrix* was the dominant tree species recorded across the survey area. With the expectation of larger individuals fringing the two Ashburton River crossings, tree heights rarely exceeded 6 m. As a result, caution should be applied to proposed earthworks near the two river crossings (particularly the southern crossing west of CS2) as a number of large trees (heights > 6 m and basal diameters > 50 cm) may need to be removed.

Historic clearing has removed the majority of large trees (basal diameter > 20 cm) from an approximate 30 m buffer either side of the easement centre line, with only saplings and small trees remaining. Larger trees (basal diameter > 20 cm) tended to occur outside this approximate 30 m buffer zone. As a result areas mapped high and medium densities generally comprise smaller trees and as such pose little difficulty with proposed earthworks.

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## 6. DISCUSSION

The CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area comprises eight broad vegetation associations, each consisting of further subdivisions in the form of more detailed vegetation communities. The survey area traverses *Acacia* dominated inland sand and clayey plain communities interspersed with *Eucalyptus victrix* dominated inland floodplains and depressions to the south, with a gradual transition to coastal sand and clayey plain and inland sand dune communities further north. A large number of claypans and clayey plains create a distinct mosaic with fringing inland sand dune communities north of Twitchin Road. Tidal mudflat and tidal creek communities dominate areas north of Wheatstone Road. Transitions between communities, though occasionally abrupt as a result of topographic and/or soil profile changes, were generally discontinuous with margins resembling admixtures of two or more vegetation communities. This was particularly the case with inland sand and clayey plain communities, where subtle changes in species dominance and structure rather than clear changes in species composition delineated individual communities.

A total of 139 vascular plant taxa which are representative of 80 plant genera and 28 plant families were recorded within the survey area. Of the 139 taxa recorded 71.0% were perennial, 15.2% were annual and 13.8% were both annual and perennial with phenology dependent on local conditions. Despite a hot dry March period the proportion of annuals present (though in poor condition) during the survey is regarded as adequate.

No Declared Threatened Flora species were recorded within the survey area. Two Priority 3 Flora species *Eremophila forrestii* subsp. *viridis* and *Grevillea ?subterlineata* were recorded within the survey area. *Grevillea ?subterlineata* was a sterile specimen and as such positive identification was not possible, however this specimen did match WAH vault specimens vegetatively. The recording of *Grevillea ?subterlineata* also represents a range extension of 200 km from previously known locations. *Eremophila forrestii* subsp. *viridis* has been previously recorded in the locality by Biota (2010).

Although not recorded in the current survey, the Priority Three (DEC 2013a) and Vulnerable (DSEWPC 2013a) listed *Eleocharis papillosa* (P3) (dwarf desert spike-rush) was previously recorded approximately 12.5 km to the southeast of the closest point of the survey area by Biota (2010), from a tidal creek 800 m southwest of the Peedamulla station turnoff along the Onslow road. The recorded location of this species by Biota (2010) represented a considerable range extension, with the nearest other known population found over 450 km to the east south east from the Fortescue Marsh. There are only four scattered records of this species in Western Australia, from the Goldfields, Wheatbelt, and Pilbara regions (DEC 2013a).

The recorded occurrence of *Eleocharis papillosa* (P3) in the vegetation and flora survey of the Wheatstone Project Area by Biota (2010) was at a single location in their C3 Claypan community 'C3:TECspp: *Tecticornia* species in low shrubland', within a tidally influenced creek along the Onslow road. While this particular creek does not appear to flow through the current survey area this vegetation community, denoted C4 in the current survey, is found in the northern tidal section, as inferred from Biota (2010) mapping. The presence of this vegetation community signifies the potential for *Eleocharis papillosa* (P3) to occur in the survey area to the north of Wheatstone road. Although this area was unable to be accessed in the current survey due to construction works at Wheatstone, the Biota (2010) survey of this area did not record the presence of *Eleocharis papillosa* (P3). Given this, and the sporadic occurrence of this species, it is highly unlikely that it would occur in the relatively narrow corridor of the survey area.

No Threatened or Priority Ecological Communities were inferred to occur within the survey area.

Reservation priorities of ecosystems as identified by Kendrick and Mau (2002) assign each Beard vegetation association an appropriate management scenario, these being High, Medium or Low. Reservation priorities are primarily determined by CAR principles, these broadly being to effectively and efficiently develop and integrate regional conservation strategies which provide for the establishment and management of conservation reserves and complementary management of adjoining areas. Assignments of management scenarios highlight reservation priorities for each sub-region, in this case the Cape Range sub-region. The level of reservation priority for each vegetation association is determined by factors including: comprehensiveness, communities recognised by an agreed national scientific classification system; adequacy, maintenance of ecological viability and integrity of populations, species and communities and; representativeness, inclusion of vegetation in reserves should reasonably reflect the biotic diversity of the communities.

The survey area traverses five Beard (1975) vegetation associations, four of which are considered to be of high priority status (Kendrick and Mau, 2002). A significant bias for these vegetation associations being assigned a high priority status is lack of representation in DEC managed estate. Over fifty percent of the survey area traverses low priority vegetation associated with Mosaic shrublands of *A. victoriae* and snakewood scrub patches/short bunch grassland – savannah/grass plain; representing a 0.4% impact on the total current extent. With the exception of Beard association 589, percentage impact of high priority vegetation associations 127, 676 and 1271 is equal to or less than half a percent of their total current extent. Association 589 (Mosaic: short bunch grassland– savannah/grass plain (Pilbara)/hummock grasslands, grass steppe; soft spinifex) occurs throughout northern sections of the survey area, with just over one percent of the total current extent impacted by the survey area. It should be reiterated that the survey area and thus percentage impact figures exceed what would actually be impacted by the proposed easement expansion. As a result, the impact of proposed earthworks on each of the four high priority vegetation associations would be well under one percent. The broad nature of Beard vegetation associations makes it unlikely that these associations are locally restricted or indeed are restricted to the Cape Range sub-region. This coupled with very low percentage impact figures make it unlikely that proposed works will reduce the adequacy and/or representativeness of these vegetation associations across the landscape.

A total of thirty vegetation communities were defined and mapped in the survey area. Vegetation communities were assigned to eight broad vegetation complex associations including tidal mudflats and tidal creeks, claypans and clayey plains, coastal sand dunes, coastal sand and clayey plains, inland sand dunes, inland sand and clayey plains, inland floodplains and depressions, and river zones and drainage channels. The majority of the survey area comprised *Acacia* dominated inland sand and clayey plain communities interspersed with *Eucalyptus victrix* dominated inland floodplains and depressions. Closer to the coast a gradual transition to coastal sand and clayey plain and inland sand dune communities occurs, with large number of claypans creating a distinct mosaic with fringing inland dune communities. Tidal mudflat and tidal creek communities dominate areas north of Wheatstone Road.

The survey area was for the most part in very good to excellent condition. Factors such as weed density, clearing and vehicle movement and cattle movement and grazing were observed as primary causes of decreasing vegetation condition. Cattle movement and grazing and clearing via vehicle movement were mostly sporadic and although leading to decreased condition ratings did not alter the natural structure and composition of native vegetation; weed densities however did. The dominance of *\*Cenchrus ciliaris* to the exclusion of native tussock grasses lead to poor condition ratings, particularly in coastal sand and clayey plain vegetation communities.

A total of seven introduced (exotic) taxa were recorded within the survey area. Of these, one taxon, *\*Parkinsonia aculeata* is a Declared Plant species pursuant to section 37 of the *Agriculture and Related Resources Protection Act (1976)*. Though a small number of weed species were recorded species such as *\*Cenchrus ciliaris*, *\*Vachellia farnesiana* and *\*Portulaca oleracea* were observed in high densities throughout the entire survey area. Both *\*Cenchrus ciliaris* and *\*Vachellia farnesiana* have a high environmental weed rating (i.e. have a high priority for control and/or research). It is noted however, that both these species occur in high densities throughout the Pilbara region; this coupled with a rapid invasiveness rating have lead to a low feasibility of control (DEC, 2012).

Large sections of the survey area comprise open Eucalypt woodlands and Acacia shrublands with scattered or isolated trees; as such tree densities were generally low. Inland floodplains and depressions and riverine environments frequently contained areas of high tree densities, though individual trees within these areas were generally small (< 6 m in height; < 20 cm basal diameter). Tree size tended to increase outside an approximate 30 m buffer either side of the easement. The two crossings of the Ashburton River contained larger trees at high densities (particularly the southern crossing near CS2). Potential earthworks in these areas will require removal of large amounts of standing coarse woody debris.

Two extended areas adjacent to the crossing of the gas pipeline and Twitchin Road were mapped to aid in the planning of a proposed campsite. Polygon boundaries of both areas were dictated by the location of major and minor roads. Both areas contain similar vegetation communities and tree densities, with low natural relief in the form of small dunes. Both areas contain cracking clays and as such managing surface water flows would be of a high priority. With the aforementioned results in mind, location of a potential campsite should be determined by ease of access in order to reduce unnecessary clearing as a result of track creations and expansions.

An assessment of the proposal against the Department of Environment and Conservation 10 Clearing Principles (*Environmental Protection Act 1986*) is included in Table 10.

**Table 10. Assessment of clearing for the CS2 – Tubridgi – Wheatstone Gas Pipeline proposal against the 10 clearing principles**

No.	Principle / Assessment
1	<p><b>Clearing principle</b> Native vegetation should not be cleared if it comprises a high level of biological diversity.</p> <p><b>Assessment:</b> Proposal is not at variance to this principle.</p> <p>A total of 139 vascular plant taxa which are representative of 80 plant genera and 28 plant families were recorded within the survey area. The majority of the taxa recorded were representative of the Poaceae (30 taxa), Fabaceae (26 taxa), Amaranthaceae (10 taxa), Chenopodiaceae (9 taxa) and Malvaceae (9 taxa) families (Appendix C). Of the 139 taxa recorded 98 (71.0%) were perennial, 21 (15.2%) were annual and 19 taxa (13.8%) were both annual and perennial with phenology dependent on local conditions. The species accumulation curve indicated that approximately 97% of the flora species potentially present within the survey area were recorded.</p> <p>The average number of taxa per site (50m x 50m) was 10.3. With on average 15% being annual this is an average of approximately 8.8 perennial species per site. This compares to an average of 16 perennial species per site (radius of 50m) for the greater Pilbara area as found by Van Vreeswyk <i>et al.</i> (2004). This indicates that the survey area, on the whole, has a relatively low plant species diversity in a regional context.</p>
2	<p><b>Clearing principle</b> 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.</p> <p><b>Assessment:</b> Refer to Vertebrate Fauna Assessment (Ninox 2013).</p>
3	<p><b>Clearing principle</b> Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, threatened flora.</p> <p><b>Assessment</b> Proposal is not at variance to this principle</p> <p>No Declared Threatened Flora species pursuant to subsection (2) of section 23F of the Wildlife Conservation Act 1950 [WA] and as listed by the Department of Environment and Conservation (2013a) were recorded within the survey area.</p> <p>Two Priority 3 Flora species <i>Eremophila forrestii</i> subsp. <i>viridis</i> and <i>Grevillea ?subterlineata</i> were recorded within the survey area. Three individuals of <i>Eremophila forrestii</i> subsp. <i>viridis</i> were found at one site within the survey area. There are three records of this taxon in the database of the Western Australian Herbarium, two of which occur in the Onslow locality (Department of Environment and Conservation 2013a).</p> <p>One individual of <i>Grevillea ?subterlineata</i> was found in the survey area. It was unable to be confirmed to species level due to a lack of flowering/fruitlet material. The 11 records of <i>Grevillea subterlineata</i> in the database of the Western Australian Herbarium are from populations in the Gascoyne and Goldfield regions, the closest of which is located over 230 km south of this collection (See Section 5.2.5) (Department of Environment and Conservation 2013a). The current record of this species therefore, if confirmed, represents a range extension.</p>



**Table 10. Assessment of clearing for the CS2 – Tubridgi – Wheatstone Gas Pipeline proposal against the 10 clearing principles**

No.	Principle / Assessment
4	<p><b>Clearing principle</b> (d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community.</p> <p><b>Assessment</b> Proposal is not at variance to this principle</p> <p>No Threatened or Priority Ecological Communities as defined by the Department of Environment and Conservation (2013e) and the <i>Environment Protection and Biodiversity Conservation Act 1999</i> were recorded or inferred to occur within the survey area.</p>
5	<p><b>Clearing principle</b> (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</p> <p><b>Assessment</b> Proposal is not at variance to this principle</p> <p>The Pilbara region remains largely uncleared, however there has been a long history of active introduction of Buffel grass (<i>*Cenchrus ciliaris</i>) for grazing (Fisher <i>et al.</i> 2004). The survey area is affected by grazing and Buffel grass.</p>
6	<p><b>Clearing principle</b> (f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.</p> <p><b>Assessment</b> Proposal may be at variance to this principle</p> <p>The Wheatstone to Tubridgi section of the proposed expansion crosses the Ashburton River approximately 8 km upstream from the rivermouth (50K; 287978mE, 7592619mN). The Tubridgi to CS2 section of the proposed alignment crosses the Ashburton River just south of Nanyingee Hill (50K; 315793mE, 7516084mN)</p> <p>The vegetation at these points includes some large <i>Eucalyptus victrix</i> trees. The vegetation at the crossings is also modified to some extent, with the introduced weed species <i>*Aerva javanica</i> present nearby the southern crossing near CS2 and the declared weed, <i>*Parkinsonia aculeata</i>, present at the northern concrete vehicle crossing.</p> <p>The northern section of the survey area around Wheatstone contains tidal mudflats and tidal creeks, and their associated Samphire (<i>Tecticornia</i> spp.) and Mangrove (<i>Avicennia marina</i>) vegetation. This arid zone mangrove vegetation at the mouth of the Ashburton River is regionally significant (Department of Environment, 2006).</p> <p>Three wetlands of national importance occur within the Ashburton River Catchment (Drainage Basin No. 6), none of which occur in close proximity to the survey area. No Ramsar listed wetlands occur in close proximity to the survey area (DIWHA, 2013).</p>

**Table 10. Assessment of clearing for the CS2 – Tubridgi – Wheatstone Gas Pipeline proposal against the 10 clearing principles**

No.	Principle / Assessment
7	<p><b>Clearing principle</b> (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.</p> <p><b>Assessment</b> Proposal is not at variance to this principle</p> <p>The survey area consists of a pipeline corridor, the width of which is greater than that required to be cleared. The narrow width of clearing and the generally flat landscape mean that land degradation is unlikely to be appreciable.</p>
8	<p><b>Clearing principle</b> (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.</p> <p><b>Assessment</b> Proposal is not at variance to this principle</p> <p>The Cape Range National Park, Bundegi and Jurabi Conservation Parks, Ningaloo Marine Park and Barrow Island Nature Reserve lie within the Cape Range subregion. These conservation vested lands occur in the broader Cape Range subregion and as such bear no direct relevance to the project survey area.</p> <p>The Cane River Conservation Park is the closest gazetted conservation reserve to the survey area. At its closest point the Cane River Conservation Park is approximately 8 km east of the survey area (point approx. 5.5 km north-west of CS2). The survey area does not traverse nor run adjacent to the Cane River Conservation Park, and therefore should not have an impact on the Conservation Park.</p>
9	<p><b>Clearing principle</b> (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface and underground water.</p> <p><b>Assessment</b> Proposal is not at variance to this principle</p> <p>The area to be cleared is a relatively narrow corridor on generally flat topography.</p>
10	<p><b>Clearing principle</b> (j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.</p> <p><b>Assessment</b> Proposal is not at variance to this principle</p> <p>The area to be cleared is a relatively narrow corridor on generally flat topography.</p>

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## 7. CONCLUSION

For the purposes of a Level 1 flora and vegetation survey, more than adequate data has been collected to define and assess the presence, extent and significance of vegetation communities within the survey area. The majority of recorded taxa are widespread throughout the region and the percentage impact to vegetation associations as defined by both Beard (1975) and Rangeland Land Systems mapping (Payne *et al.*, 1988; Van Vreeswyk *et al.*, 2004) is low.

Specific remarks regarding alignment are as follows:

- Two weed species with high environmental weed ratings were recorded in high densities throughout the survey area, namely *\*Cenchrus ciliaris* and *\*Vachellia farnesiana*. Efforts should be made to reduce the spread of these species, however direct management may be unfeasible.
- Caution with regard to weed species should be applied for all earthworks in the vicinity of river crossings. One declared weed *\*Parkinsonia aculeata* and one weed with a high environmental weed rating *\*Aerva javanica* were recorded in these riverine areas.
- Vegetation throughout the survey area is generally in very good to excellent condition, efforts should be made maintain this by means of:
  - Ground disturbance and clearing of vegetation should be limited to that which is essential;
  - Maintain standard vehicle hygiene practices to minimise the risk of spreading introduced (exotic) weeds;
  - Retain and stockpile topsoil for use in the later rehabilitation of roads and other areas cleared in the process of expansion;
  - Maintain existing drainage systems, i.e. do not allow access tracks etc. to disrupt or divert historic water flow patterns. Where drainage systems are interrupted by earthworks, the use of culverts to assist in maintaining natural water flow patterns should be implemented;
  - Avoid driving vehicles across undisturbed ground;
  - The creation of new tracks should be restricted to that which is absolutely necessary, ensuring equipment blades are set above ground level to minimize disturbance to topsoil, rootstock and to reduce soil erosion.
- A number of large trees were recorded near both pipeline crossings of the Ashburton River (particularly the southern crossing near CS2). Given the large amount of standing woody debris in these areas, caution with regard to earthworks should be observed.
- Tree density was predominately low, with areas mapped as high and medium density generally comprising a large number of smaller trees. As a result, tree density should not significantly influence the proposed location of the additional pipeline. Historic clearing of the easement has resulted in only saplings being recorded within 30 m +/- of the centre corridor.
- Regarding the location of a potential campsite, the two areas of extended mapping near the gas pipeline and Twitchin Road crossing comprise similar vegetation communities and tree densities. Both areas contain areas of low natural relief, with topographic changes less abrupt in the area mapped to the east of Twitchin Road.

## 8. ACKNOWLEDGEMENTS

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## 9. LIST OF PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were involved in this project:

Name	Position	Project Involvement	Flora Permit	Collection
Dr E.M. Mattiske	Managing Director & Principal Ecologist	Planning, Management & Reporting		
Mrs B. Koch	Senior Botanist	Plant identification		
Mr J. Cargill	Senior Ecologist	Planning, fieldwork, data interpretation, mapping and report preparation	407960	
Mr M. Gannaway	Experienced Botanist	Fieldwork	373006	
Mr A. MacGillivray	Experienced Botanist	Fieldwork	388350	
Ms C. Reynolds	Botanist	Fieldwork	407949	
Mr B. Ellery	Botanist	Plant identification	n/a	
Ms J. Ellery	Botanist	Plant identification	n/a	
Ms L. Joyce	Botanist	Report preparation	n/a	
Ms K. Tippur	Botanist	Plant identification	n/a	

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**APPENDIX A1: DEFINITION OF THREATENED AND PRIORITY FLORA SPECIES (Department of Environment and Conservation 2013a)**

Conservation Code	Category
T	<p><b>Threatened Flora (Declared Rare Flora – Extant)</b></p> <p>“Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the <i>Wildlife Conservation Act 1950</i>).</p> <p>Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:</p> <ul style="list-style-type: none"> <li>• <b>CR:</b> Critically Endangered – considered to be facing an extremely high risk of extinction in the wild</li> <li>• <b>EN:</b> Endangered – considered to be facing a very high risk of extinction in the wild</li> <li>• <b>VU:</b> Vulnerable – considered to be facing a high risk of extinction in the wild.”</li> </ul>
P1	<p><b>Priority One – Poorly Known Species</b></p> <p>“Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.”</p>
P2	<p><b>Priority Two – Poorly Known Species</b></p> <p>“Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.”</p>
P3	<p><b>Priority Three – Poorly Known Species</b></p> <p>“Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities 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 localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.”</p>
P4	<p><b>Priority Four – Rare Threatened and other species in need of monitoring</b></p> <p>“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.</p> <p>b. Near Threatened - Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>c. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.”</p>
P5	<p><b>Priority Five – Conservation Dependent Species</b></p> <p>“Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.”</p>



**APPENDIX A2: DEFINITION OF THREATENED FLORA SPECIES (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*)**

Category Code	Category
Ex	<p><b>Extinct</b></p> <p>Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.</p>
ExW	<p><b>Extinct in the Wild</b></p> <p>Taxa which 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.</p>
CE	<p><b>Critically Endangered</b></p> <p>Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.</p>
E	<p><b>Endangered</b></p> <p>Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.</p>
V	<p><b>Vulnerable</b></p> <p>Taxa which is 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.</p>
CD	<p><b>Conservation Dependent</b></p> <p>Taxa which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.</p>

**APPENDIX A3: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Department of Environment and Conservation 2013d)**

Category Code	Category
PTD	<p><b>Presumed Totally Destroyed</b></p> <p>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:</p> <ul style="list-style-type: none"> <li>(i) records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or;</li> <li>(ii) all occurrences recorded within the last 50 years have since been destroyed.</li> </ul>
CE	<p><b>Critically Endangered</b></p> <p>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:</p> <ul style="list-style-type: none"> <li>(i) 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;</li> <li>(ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area;</li> <li>(iii) The ecological community is highly modified with potential of being rehabilitated in the immediate future.</li> </ul>
E	<p><b>Endangered</b></p> <p>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:</p> <ul style="list-style-type: none"> <li>(i) 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;</li> <li>(ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area;</li> <li>(iii) The ecological community is highly modified with potential of being rehabilitated in the short term future.</li> </ul>
V	<p><b>Vulnerable</b></p> <p>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:</p> <ul style="list-style-type: none"> <li>(i) The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated;</li> <li>(ii) The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution;</li> <li>(iii) The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.</li> </ul>

**APPENDIX A4: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Department of Sustainability, Environment, Water, Population and Communities 2013b)**

Three categories exist for listing threatened ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Listing Category	Explanation of Category
<b>Critically endangered</b>	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
<b>Endangered</b>	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
<b>Vulnerable</b>	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

**APPENDIX A5: DEFINITION OF PRIORITY ECOLOGICAL COMMUNITIES (Department of Environment and Conservation 2013d)**

Category Code	Category
P1	<p><b>Poorly-known ecological communities</b></p> <p>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.</p>
P2	<p><b>Poorly-known ecological communities</b></p> <p>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.</p>
P3	<p><b>Poorly known ecological communities</b></p> <p>(i) 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:</p> <p>(ii) 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;</p> <p>(iii) 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.</p>
P4	<p>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.</p>
P5	<p><b>Conservation Dependent ecological communities</b></p> <p>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.</p>

**APPENDIX A6: DEFINITION OF STANDARD CONTROL CODES FOR DECLARED PLANT SPECIES IN WESTERN AUSTRALIA (Department of Agriculture and Food 2013a)**

Control Code Requirement	Conditions
<p><b>P1</b> Prohibits movement</p>	<p>The movement of plants or their seeds is prohibited within the State.</p> <p>This prohibits the movement of contaminated machinery and produce including livestock and fodder.</p>
<p><b>P2</b> Aim is to eradicate infestation</p>	<p>Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.</p>
<p><b>P3</b> Aims to control infestation by reducing area and/or density of infestation</p>	<p>The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.</p> <p>Treat to destroy and prevent seed set all plants:-</p> <ul style="list-style-type: none"> <li>• within 100 metres inside of the boundaries of the infestation</li> <li>• within 50 metres of roads and highwater mark on waterways</li> <li>• within 50 metres of sheds, stock yards and houses</li> </ul> <p>Treatment must be done prior to seed set each year.</p> <p>Of the remaining infested area:-</p> <p>Where plant density is 1-10 per hectare treat 100% of infestation.  Where plant density is 11-100 per hectare treat 50% of infestation.  Where plant density is 101-1000 per hectare treat 10% of infestation.  Properties with less than 2 hectares of infestation must treat the entire infestation.  Additional areas may be ordered to be treated.</p>
<p><b>P4</b> Aims to prevent infestation spreading beyond existing boundaries of infestation.</p>	<p>The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.</p> <p>Treat to destroy and prevent seed set all plants:-</p> <ul style="list-style-type: none"> <li>• within 100 metres inside of the boundaries of the infested property</li> <li>• within 50 metres of roads and highwater mark on waterways</li> <li>• within 50 metres of sheds, stock yards and houses</li> </ul> <p>Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation.</p> <p>Additional areas may be ordered to be treated.</p>
<p><b>Special considerations</b></p>	<p>In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.</p>

**APPENDIX A7: DEFINITION OF VEGETATION CONDITION SCALE (Keighery, 1994)**

Condition Rating	Description
<b>Pristine (1)</b>	Pristine or nearly so, no obvious sign of disturbance.
<b>Excellent (2)</b>	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
<b>Very Good (3)</b>	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
<b>Good (4)</b>	Vegetation structure significantly altered by obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback, grazing.
<b>Degraded (5)</b>	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
<b>Completely Degraded (6)</b>	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.

**APPENDIX B: GPS LOCATION OF SITES FOR THE CS2 - TUBRIDGI - WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**

SURVEY SITE	DATUM	GDA 94	
		EASTING	NORTHING
1	50K	318415	7514260
2	50K	317780	7514735
3	50K	317570	7514890
4	50K	317288	7515108
5	50K	316928	7515411
6	50K	316566	7515707
7	50K	316418	7515726
8	50K	316130	7515945
9	50K	315853	7516250
10	50K	315707	7516975
11	50K	315784	7517953
12	50K	315816	7518197
13	50K	315737	7519518
14	50K	313999	7522996
15	50K	313619	7523581
16	50K	311617	7527386
17	50K	310951	7528796
18	50K	310107	7530531
19	50K	309595	7531732
20	50K	308928	7533305
21	50K	308704	7533801
22	50K	307205	7537355
23	50K	307002	7537843
24	50K	306858	7538199
25	50K	306637	7538763
26	50K	306402	7539555
27	50K	305968	7540463
28	50K	305868	7540528
29	50K	305695	7540958
30	50K	305507	7541395
31	50K	305205	7541909
32	50K	305149	7542216
33	50K	304593	7543330
34	50K	304580	7543547
35	50K	304383	7543931
36	50K	304109	7544857
37	50K	303396	7545966
38	50K	303122	7546388
39	50K	302096	7547469
40	50K	301590	7548184
41	50K	301382	7548607
42	50K	301211	7548953
43	50K	300592	7549626
44	50K	300254	7550590
45	50K	299770	7551673
46	50K	299383	7552382
47	50K	299078	7553213
48	50K	298953	7553369
49	50K	298634	7554350
50	50K	298434	7554446
51	50K	297473	7556065
52	50K	297169	7556791
53	50K	296880	7557378

**APPENDIX B: GPS LOCATION OF SITES FOR THE CS2 - TUBRIDGI - WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**

SURVEY SITE	DATUM	GDA 94	
		EASTING	NORTHING
54	50K	296593	7557756
55	50K	295545	7559986
56	50K	295205	7560489
57	50K	294362	7562165
58	50K	294394	7562313
59	50K	294170	7562592
60	50K	293943	7563025
61	50K	293234	7564365
62	50K	292678	7565657
63	50K	292121	7566738
64	50K	291770	7567439
65	50K	290846	7569271
66	50K	289442	7572070
67	50K	289017	7572925
68	50K	288181	7574454
69	50K	289902	7574969
70	50K	287815	7575336
71	50K	287362	7577145
72	50K	287003	7578063
73	50K	286602	7579533
74	50K	285864	7580938
75	50K	285520	7581617
76	50K	285366	7581698
77	50K	284383	7593735
78	50K	284135	7584341
79	50K	283990	7584575
80	50K	281552	7587673
81	50K	280798	7588474
82	50K	280514	7588765
83	50K	280090	7589185
84	50K	280087	7589221
85	50K	279595	7589488
86	50K	279751	7589650
87	50K	280361	7590017
88	50K	280757	7590276
89	50K	281098	7590512
90	50K	281481	7590819
91	50K	281613	7590860
92	50K	282589	7591512
93	50K	283166	7591909
94	50K	284764	7592240
95	50K	285544	7592337
96	50K	286527	7592418
97	50K	286922	7592457
98	50K	288376	7592582
99	50K	289053	7592579
100	50K	289651	7592602
101	50K	290421	7592597
102	50K	291232	7592602
103	50K	291449	7592595
104	50K	292150	7592597
105	50K	292702	7592595
106	50K	292911	7592714



**APPENDIX B: GPS LOCATION OF SITES FOR THE CS2 - TUBRIDGI - WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**

SURVEY SITE	DATUM	GDA 94	
		EASTING	NORTHING
107	50K	315793	7519534
108	50K	313208	7524489
109	50K	293442	7564094
110	50K	298270	7554858
111	50K	298170	7554854
112	50K	297701	7555156
113	50K	292542	7565966
114	50K	286531	7579664
115	50K	279830	7589462
116	50K	287918	7592522

**APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE CS2 - TUBRIDG  
WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**

**Note:** \* denotes introduced species;

T denotes Threatened Flora and P1-P5 denote Priority Flora Species (DEC 2013c).

FAMILY	SPECIES
AIZOACEAE	<i>Trianthema oxycalyptra</i> var. <i>oxycalyptra</i> <i>Trianthema triquetra</i>
AMARANTHACEAE	* <i>Aerva javanica</i> <i>Alternanthera nodiflora</i> <i>Amaranthus cuspidifolius</i> <i>Amaranthus mitchellii</i> <i>Gomphrena affinis</i> subsp. <i>affinis</i> <i>Ptilotus macrocephalus</i> <i>Ptilotus murrayi</i> <i>Ptilotus obovatus</i> <i>Ptilotus polystachyus</i> <i>Ptilotus</i> sp.
ASTERACEAE	<i>Olearia</i> sp. Kennedy Range (G. Byrne 66) <i>Pluchea rubelliflora</i> <i>Pterocaulon sphaeranthoides</i> <i>Streptoglossa tenuiflora</i>
BORAGINACEAE	<i>Ehretia saligna</i> var. <i>saligna</i> <i>Trichodesma zeylanicum</i>
CHENOPODIACEAE	<i>Atriplex ?codonocarpa</i> <i>Enchylaena</i> sp. <i>Maireana ?lanosa</i> <i>Maireana</i> sp. <i>Rhagodia baccata</i> <i>Rhagodia eremaea</i> <i>Salsola australis</i> <i>Tecticornia</i> sp. <i>Threlkeldia diffusa</i>
CLEOMACEAE	<i>Cleome viscosa</i>
CONVOLVULACEAE	<i>Bonamia erecta</i> <i>Cressa australis</i> <i>Evolvulus alsinoides</i> <i>Ipomoea ?pes-caprae</i> <i>Ipomoea lonchophylla</i> <i>Ipomoea muelleri</i>
CUCURBITACEAE	<i>Cucumis maderaspatanus</i>
CYPERACEAE	<i>Bulbostylis barbata</i> <i>Cyperus bifax</i> <i>Cyperus squarrosus</i>
EUPHORBIACEAE	<i>Euphorbia boophthona</i> <i>Euphorbia drummondii</i>

**APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE CS2 - TUBRIDGE WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**

**Note:** \* denotes introduced species;

T denotes Threatened Flora and P1-P5 denote Priority Flora Species (DEC 2013c).

FAMILY	SPECIES
FABACEAE	<p><i>Acacia ancistrocarpa</i>  <i>Acacia bivenosa</i>  <i>Acacia citrinoviridis</i>  <i>Acacia coriacea</i> subsp. <i>coriacea</i>  <i>Acacia gregorii</i>  <i>Acacia ligulata</i>  <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>  <i>Acacia stellaticeps</i>  <i>Acacia synchronicia</i>  <i>Acacia tetragonophylla</i>  <i>Acacia trachycarpa</i>  <i>Acacia xiphophylla</i>  <i>Crotalaria ?cunninghamii</i> subsp. <i>sturtii</i>  <i>Cullen cinereum</i>  <i>Cullen lachnostachys</i>  <i>Cullen leucanthum</i>  <i>Indigofera boviparda</i> subsp. <i>boviparda</i>  <i>Indigofera colutea</i>  <i>Indigofera linifolia</i>  <i>Neptunia dimorphantha</i>  * <i>Parkinsonia aculeata</i>  <i>Rhynchosia minima</i>  <i>Senna artemisioides</i> subsp. <i>helmsii</i>  <i>Senna artemisioides</i> subsp. <i>oligophylla</i>  <i>Senna glutinosa</i> subsp. x <i>luerssenii</i>  * <i>Vachellia farnesiana</i></p>
GOODENIACEAE	<p><i>Goodenia forrestii</i>  <i>Scaevola ?sericophylla</i>  <i>Scaevola spinescens</i></p>
GYROSTEMONACEAE	<p><i>Gyrostemon ramulosus</i></p>
LAMIACEAE	<p><i>Quoya loxocarpa</i></p>
LAURACEAE	<p><i>Cassytha capillaris</i>  <i>Cassytha</i> sp.</p>
MALVACEAE	<p><i>Abutilon ?cunninghamii</i>  <i>Abutilon fraseri</i>  <i>Abutilon oxycarpum</i>  <i>Corchorus laniflorus</i>  <i>Hibiscus brachychlaenus</i>  <i>Hibiscus</i> sp.  * <i>Malvastrum americanum</i>  <i>Sida fibulifera</i>  <i>Sida</i> sp.</p>

**APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE CS2 - TUBRIDGE WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**

**Note:** \* denotes introduced species;

T denotes Threatened Flora and P1-P5 denote Priority Flora Species (DEC 2013c).

FAMILY	SPECIES
MARSILEACEAE	<i>Marsilea ?drummondii</i> <i>Marsilea hirsuta</i>
MYRTACEAE	<i>Corymbia zygophylla</i> <i>Eucalyptus</i> sp. <i>Eucalyptus camaldulensis</i> <i>Eucalyptus victrix</i> <i>Melaleuca glomerata</i>
NYCTAGINACEAE	<i>Boerhavia coccinea</i> <i>Boerhavia</i> sp.
PHYLLANTHACEAE	<i>Phyllanthus maderaspatensis</i>
PITTOSPORACEAE	<i>Pittosporum ?phillyreoides</i>
PLANTAGINACEAE	<i>Stemodia</i> sp. Onslow (A.A. Mitchell 76/148)
POACEAE	* <i>Cenchrus ciliaris</i> * <i>Cynodon dactylon</i> <i>Aristida ?contorta</i> <i>Aristida holathera</i> <i>Aristida inaequiglumis</i> <i>Astrebula elymoides</i> <i>Chloris</i> sp. <i>Chrysopogon fallax</i> <i>Dactyloctenium radulans</i> <i>Enteropogon ramosus</i> <i>Eragrostis eriopoda</i> <i>Eragrostis falcata</i> <i>Eragrostis setifolia</i> <i>Eragrostis tenellula</i> <i>Eragrostis xerophila</i> <i>Eriachne aristidea</i> <i>Eriachne benthamii</i> <i>Eriachne helmsii</i> <i>Eulalia aurea</i> <i>Iseilema eremaeum</i> <i>Iseilema membranaceum</i> <i>Leptochloa digitata</i> <i>Panicum decompositum</i> <i>Panicum laevinode</i> <i>Setaria dielsii</i> <i>Sporobolus australasicus</i> <i>Sporobolus mitchellii</i> <i>Triodia epactia</i> <i>Triodia lanigera</i> <i>Urochloa occidentalis</i> var. <i>occidentalis</i>

**APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE CS2 - TUBRIDGE WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**

**Note:** \* denotes introduced species;

T denotes Threatened Flora and P1-P5 denote Priority Flora Species (DEC 2013c).

FAMILY	SPECIES
PORTULACACEAE	* <i>Portulaca oleracea</i>
PROTEACEAE	<i>Grevillea ?eristachya</i> <i>Grevillea stenobotrya</i> <i>Grevillea striata</i> <i>Grevillea ?subterlineata</i> (P3) <i>Hakea chordophylla</i>
SCROPHULARIACEAE	<i>Eremophila forrestii</i> <i>Eremophila forrestii</i> subsp. <i>viridis</i> (P3) <i>Eremophila longifolia</i> <i>Eremophila</i> sp.
SOLANACEAE	<i>Solanum ?sturtianum</i> <i>Solanum diversiflorum</i> <i>Solanum lasiophyllum</i>
SURIANACEAE	<i>Stylobasium spathulatum</i>
ZYGOPHYLLACEAE	<i>Tribulus ?cistoides</i>































**APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY SITE WITHIN THE CS2 - TUBRIDGI - WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**

Note: \* denotes introduced species; R denotes Rare Flora Species; P1, P2, P3 and P4 denote Priority Flora Species (DEC, 2013g)

SPECIES	Site							
	109	110	111	112	113	114	115	116
<i>Corymbia zygophylla</i>					x			
<i>Cressa australis</i>							x	
<i>Crotalaria ?cunninghamii</i> subsp. <i>sturtii</i>								
<i>Cucumis maderaspatanus</i>								
<i>Cullen cinereum</i>								
<i>Cullen lachnostachys</i>								
<i>Cullen leucanthum</i>								
* <i>Cynodon dactylon</i>								
<i>Cyperus bifax</i>								
<i>Cyperus squarrosus</i>								
<i>Dactyloctenium radulans</i>	x		x				x	
<i>Ehretia saligna</i> var. <i>saligna</i>								
<i>Enchylaena</i> sp.								
<i>Enteropogon ramosus</i>								
<i>Eragrostis eriopoda</i>		x		x	x			
<i>Eragrostis falcata</i>								
<i>Eragrostis setifolia</i>			x	x				
<i>Eragrostis tenellula</i>								
<i>Eragrostis xerophila</i>								
<i>Eremophila forrestii</i>								
<i>Eremophila forrestii</i> subsp. <i>viridis</i> (P3)								
<i>Eremophila longifolia</i>								
<i>Eremophila</i> sp.								
<i>Eriachne aristidea</i>								
<i>Eriachne benthamii</i>								
<i>Eriachne helmsii</i>								
<i>Eucalyptus camaldulensis</i>								
<i>Eucalyptus</i> sp.								
<i>Eucalyptus victrix</i>	x		x		x	x		x
<i>Eulalia aurea</i>								x
<i>Euphorbia boophthona</i>								
<i>Euphorbia drummondii</i>								
<i>Evolvulus alsinoides</i>								
<i>Gomphrena affinis</i> subsp. <i>affinis</i>								
<i>Goodenia forrestii</i>		x						

**APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY SITE WITHIN THE CS2 - TUBRIDGI - WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**

Note: \* denotes introduced species; R denotes Rare Flora Species; P1, P2, P3 and P4 denote Priority Flora Species (DEC, 2013g)

SPECIES	Site						
	109	110	111	112	113	114	115
<i>Grevillea ?eristachya</i>							
<i>Grevillea stenobotrya</i>							
<i>Grevillea striata</i>							
<i>Grevillea subterlineata</i> (P3)							
<i>Gyrostemon ramulosus</i>							
<i>Hakea chordophylla</i>							
<i>Hibiscus brachychlaenus</i>							
<i>Hibiscus</i> sp.							
<i>Indigofera boviparda</i> subsp. <i>boviparda</i>							
<i>Indigofera colutea</i>							
<i>Indigofera linifolia</i>							
<i>Ipomoea ?pes-caprae</i>							
<i>Ipomoea lonchophylla</i>							
<i>Ipomoea muelleri</i>							
<i>Iseilema eremaeum</i>							
<i>Iseilema membranaceum</i>							
<i>Leptochloa digitata</i>							x
<i>Maireana ?lanosa</i>							
<i>Maireana</i> sp.							
* <i>Malvastrum americanum</i>							
<i>Marsilea ?drummondii</i>							
<i>Marsilea hirsuta</i>							
<i>Melaleuca glomerata</i>							
<i>Neptunia dimorphantha</i>							
<i>Olearia</i> sp. Kennedy Range (G. Byrne 66)							
<i>Panicum decompositum</i>							
<i>Panicum laevinode</i>							
* <i>Parkinsonia aculeata</i>							x
<i>Phyllanthus maderaspatensis</i>							
<i>Pittosporum ?phillyreoides</i>							
<i>Pluchea rubelliflora</i>							
* <i>Portulaca oleracea</i>	x		x				
<i>Pterocaulon sphaeranthoides</i>							
<i>Ptilotus macrocephalus</i>							
<i>Ptilotus murrayi</i>							



APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY FOR THE CS2 - TUBRIDGI - WHEATSTONE GAS PIPELINE PROJECT AREA, 2013

Note: \* denotes introduced species, P1, P2, P3, P4, P5 denote priority flora species (DEC 2013c)

Species	Vegetation Community																			
	C2	CP1	CP2	ID1	ID2	IF1	IF2	IF3	IF4	IF5	IP1	IP2	IP3	IP4	IP5	IP6	IP7	IP8	R1	R2
<i>Abutilon ?cunninghamii</i>				X																
<i>Abutilon fraseri</i>														X						
<i>Abutilon oxycarpum</i>		X	X															X		
<i>Acacia ancistrocarpa</i>		X			X															
<i>Acacia bivenosa</i>																			X	
<i>Acacia citrinoviridis</i>													X							
<i>Acacia coriacea</i> subsp. <i>coriacea</i>		X			X				X									X	X	X
<i>Acacia gregorii</i>																			X	
<i>Acacia ligulata</i>					X															
<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>		X			X	X					X	X	X		X	X		X		
<i>Acacia stellaticeps</i>				X	X											X		X		
<i>Acacia synchronicia</i>			X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	
<i>Acacia tetragonophylla</i>		X		X		X			X	X		X	X	X	X		X	X	X	
<i>Acacia trachycarpa</i>								X					X			X				
<i>Acacia xiphophylla</i>						X	X	X		X	X			X		X				
* <i>Aerva javanica</i>																				X
<i>Alternanthera nodiflora</i>							X													
<i>Amaranthus cuspidifolius</i>													X							
<i>Amaranthus mitchellii</i>													X		X		X			
<i>Aristida ?contorta</i>													X	X						
<i>Aristida holathera</i>						X														
<i>Aristida inaequiglumis</i>																		X		
<i>Astrelba elymoides</i>						X				X										
<i>Atriplex ?codonocarpa</i>																		X		
<i>Boerhavia coccinea</i>					X	X					X	X	X	X	X	X		X		X
<i>Boerhavia</i> sp.							X													
<i>Bonamia erecta</i>				X	X														X	
<i>Bulbostylis barbata</i>															X				X	
<i>Cassyltha capillaris</i>																			X	
<i>Cassyltha</i> sp.				X	X														X	
* <i>Cenchrus ciliaris</i>		X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X
<i>Chloris</i> sp.						X	X							X					X	
<i>Chrysopogon fallax</i>		X				X		X	X			X			X				X	
<i>Cleome viscosa</i>							X	X			X		X	X				X		
<i>Corchorus laniflorus</i>											X		X	X	X			X		
<i>Corymbia zygophylla</i>																			X	
<i>Cressa australis</i>		X																		
<i>Crotalaria ?cunninghamii</i> subsp. <i>sturtii</i>				X																
<i>Cucumis maderaspatanus</i>						X							X				X			



APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY FOR THE CS2 - TUBRIDGI - WHEATSTONE GAS PIPELINE PROJECT AREA, 2013

Note: \* denotes introduced species, P1, P2, P3, P4, P5 denote priority flora species (DEC 2013c)

Species	Vegetation Community																				
	C2	CP1	CP2	ID1	ID2	IF1	IF2	IF3	IF4	IF5	IP1	IP2	IP3	IP4	IP5	IP6	IP7	IP8	R1	R2	
<i>Indigofera bovipерda</i> subsp. <i>bovipерda</i>																				X	
<i>Indigofera colutea</i>					X															X	
<i>Indigofera linifolia</i>						X						X		X							
<i>Ipomoea ?pes-caprae</i>								X													
<i>Ipomoea lonchophylla</i>										X											
<i>Ipomoea muelleri</i>				X		X	X		X		X	X			X						X
<i>Iseilema eremaeum</i>						X															
<i>Iseilema membranaceum</i>										X									X		
<i>Leptochloa digitata</i>																				X	
<i>Maireana ?lanosa</i>					X																
<i>Maireana</i> sp.						X	X														
* <i>Malvastrum americanum</i>				X		X			X								X	X			
<i>Marsilea ?drummondii</i>										X											
<i>Marsilea hirsuta</i>						X															
<i>Melaleuca glomerata</i>																					X
<i>Neptunia dimorphantha</i>						X		X		X				X	X						
<i>Olearia</i> sp. Kennedy Range (G. Byrne 66)				X																	
<i>Panicum decompositum</i>				X		X				X										X	
<i>Panicum laevinode</i>						X															
* <i>Parkinsonia aculeata</i>																			X		
<i>Phyllanthus maderaspatensis</i>						X															
<i>Pittosporum ?phillyreoides</i>						X			X												
<i>Pluchea rubelliflora</i>	X																				
* <i>Portulaca oleracea</i>		X	X			X	X	1		X	X	X	X	X	X					X	X
<i>Pterocaulon sphaeranthoides</i>	X					X															X
<i>Ptilotus macrocephalus</i>															X						
<i>Ptilotus murrayi</i>				X		X								X							
<i>Ptilotus obovatus</i>																X					
<i>Ptilotus polystachyus</i>						X										X	X				
<i>Ptilotus</i> sp.					X		X														
<i>Quoya loxocarpa</i>				X																	
<i>Rhagodia baccata</i>																					
<i>Rhagodia eremaea</i>						X	X	X	X		X		X								
<i>Rhynchosia minima</i>		X				X			X	X									X	X	
<i>Salsola australis</i>				X		X	X	X			X									X	
<i>Scaevola ?sericophylla</i>					X															X	
<i>Scaevola spinescens</i>		X				X			X		X	X	X		X	X	X	X			X
<i>Senna artemisioides</i> subsp. <i>helmsii</i>															X	X	X				
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>						X		X	X	X	X	X		X	X	X	X				





**APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY FOR THE CS2 - TUBRIDGI - WHEATSTONE GAS PIPELINE PROJECT AREA, 2013**



Note: \* denotes introduced species, P1, P2, P3, P4, P5 denote priority flora species (DEC 2013c)

Species	Vegetation Community																			
	C2	CP1	CP2	ID1	ID2	IF1	IF2	IF3	IF4	IF5	IP1	IP2	IP3	IP4	IP5	IP6	IP7	IP8	R1	R2
<i>Senna glutinosa</i> subsp. <i>x luerssenii</i>								x										x		
<i>Setaria dielsii</i>						x		x		x				x						
<i>Sida fibulifera</i>									x		x				x					
<i>Sida</i> sp.				x														x		
<i>Solanum ?sturtianum</i>																				x
<i>Solanum diversiflorum</i>																				x
<i>Solanum lasiophyllum</i>				x		x		x	x	x		x	x	x			x	x		
<i>Sporobolus australasicus</i>							x													
<i>Sporobolus mitchellii</i>	x	x	x			x			x	x										
<i>Stemodia</i> sp. Onslow (A.A. Mitchell 76/148)																			x	
<i>Streptoglossa tenuiflora</i>						x		x												x
<i>Stylobasium spathulatum</i>																				x
<i>Tecticornia</i> sp.	x																			
<i>Threlkeldia diffusa</i>								x												x
<i>Trianthema oxycalyptra</i> var. <i>oxycalyptra</i>							x													
<i>Trianthema triquetra</i>			x				x				x	x	x	x	x					
<i>Tribulus ?cistoides</i>					x															
<i>Trichodesma zeylanicum</i>																		x		
<i>Triodia epactia</i>		x		x	x	x				x		x	x			x		x		
<i>Triodia lanigera</i>											x			x		x				
<i>Urochloa occidentalis</i> var. <i>occidentalis</i>						x		x	x						x			x		
* <i>Vachellia farnesiana</i>	x	x	x			x	x		x					x	x			x	x	x


**APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA**

Mapping Code	Vegetation Community Description	Representative Plate of Community
<b>T1</b>	<p><i>Tecticornia</i> spp. low scattered shrubs (B).</p> <p><b>Other Associated Species:</b> <i>Avicennia marina</i>.</p> <p><b>Soils and Landform:</b> Coastal mudflats.</p> <p><b>Condition:</b> Excellent.</p> <p><b>Plate Details:</b> Opportunistic photograph in representative community outside the survey area.</p> <p><b>No. of Quadrats:</b> Inferred                      <b>Similarity Percentage:</b> n/a</p>	 <p>A wide-angle photograph of a coastal mudflat. The ground is reddish-brown and sparsely covered with low, scattered green shrubs. The horizon is flat and distant under a clear, bright blue sky.</p>
<b>T2</b>	<p><i>Avicennia marina</i> mid open scrubland (B).</p> <p><b>Other Associated Species:</b> <i>Ceriops tagal</i>, <i>Muellerolimon salicorniaceum</i> and <i>Tecticornia halocnemoides</i> subsp. <i>tenuis</i>.</p> <p><b>Soils and Landform:</b> Coastal mudflat and tidal creeks.</p> <p><b>Condition:</b> Excellent.</p> <p><b>Plate Details:</b> Opportunistic photograph in representative community outside the survey area.</p> <p><b>No. of Quadrats:</b> Inferred                      <b>Similarity Percentage:</b> n/a</p>	 <p>A photograph showing a coastal mudflat with reddish-brown soil. In the foreground, there is a dense cluster of green, bushy vegetation. In the background, there are scattered trees and a clear blue sky with a few wispy clouds near the horizon.</p>


APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA

Mapping Code	Vegetation Community Description	Representative Plate of Community
<p><b>C1</b></p>	<p>Bare claypan.</p> <p><b>Other Associated Species:</b> Isolated mixed tussock grasses.</p> <p><b>Soils and Landform:</b> Depressions and flats with red cracking clays.</p> <p><b>Condition:</b> Excellent.</p> <p><b>Plate Details:</b> Opportunistic photograph in representative community within the survey area.</p> <p><b>No. of Quadrats:</b> Inferred                                <b>Similarity Percentage:</b> n/a</p>	
<p><b>C2</b></p>	<p><i>Tecticornia</i> spp. low sparse chenopod shrubland with <i>Sporobolus mitchellii</i>, <i>Eriachne helmsii</i> low isolated tussock grasses.</p> <p><b>Other Associated Species:</b> <i>Cressa australis</i>, <i>Dactyloctenium radulans</i>, <i>Pluchea rubelliflora</i>, <i>Pterocaulon sphaeranthoides</i> and *<i>Vachellia farnesiana</i>.</p> <p><b>Soils and Landform:</b> Depressions and plains with deep red/brown cracking clays.</p> <p><b>Condition:</b> Very Good to Good.</p> <p><b>Plate Details:</b> Survey Site 101.</p> <p><b>No. of Quadrats:</b> 2    <b>Similarity Percentage:</b> 57 %</p>	


**APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA**

Mapping Code	Vegetation Community Description	Representative Plate of Community
<p><b>C3</b></p>	<p><i>Acacia tetragonophylla</i>, <i>Acacia synchronicia</i>, *<i>Vachellia farnesiana</i> mid isolated shrubs over <i>Urochloa occidentalis</i> var. <i>occidentalis</i>, <i>Chrysopogon fallax</i>, <i>Sporobolus mitchellii</i>, *<i>Cenchrus ciliaris</i> low open tussock grasses.</p> <p><b>Other Associated Species:</b> Mixed tussock grasses.</p> <p><b>Soils and Landform:</b> Depressions and flats with red/brown clayey sands.</p> <p><b>Condition:</b> Very Good to Good.</p> <p><b>Plate Details:</b> Opportunistic photograph in representative community within the survey area.</p> <p><b>No. of Quadrats:</b> Inferred <span style="margin-left: 150px;"><b>Similarity Percentage:</b> n/a</span></p>	
<p><b>C4</b></p>	<p><i>Tecticornia</i> spp. low shrubland (B).</p> <p><b>Other Associated Species:</b> <i>Frankenia ambita</i>, <i>Sporobolus virginicus</i>, <i>Lawrenca viridigrisea</i>, <i>Neobassia astrocarpa</i> and <i>Trianthema turgidifolia</i>.</p> <p><b>Soils and Landform:</b> Fringing saline claypans.</p> <p><b>Condition:</b> Excellent.</p> <p><b>Plate Details:</b> Not available.</p> <p><b>No. of Quadrats:</b> Inferred <span style="margin-left: 150px;"><b>Similarity Percentage:</b> n/a</span></p>	<p style="text-align: center;"><b>Not Available</b></p>

APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA

Mapping Code	Vegetation Community Description	Representative Plate of Community
CD1	<p><i>Acacia coriacea</i> subsp. <i>coriacea</i> tall shrubland over <i>Crotalaria cunninghamii</i>, <i>Trichodesma zeylanicum</i> var. <i>grandiflorum</i> mid open shrubland over <i>Triodia epactia</i> mid open hummock grassland with *<i>Cenchrus ciliaris</i> low open tussock grassland (B).</p> <p><b>Other Associated Species:</b> <i>Adriana tomentosa</i> var. <i>tomentosa</i>, <i>Cassya capillaris</i>, <i>Corynotheca pungens</i>, <i>Euphorbia myrtilodes</i>, <i>Indigofera colutea</i>, <i>Rhagodia eremaea</i>, <i>Scaevola sericophylla</i> and <i>Solanum lasiophyllum</i>.</p> <p><b>Soils and Landform:</b> Coastal sand dunes.</p> <p><b>Condition:</b> Good to Poor.</p> <p><b>Plate Details:</b> Not available.</p> <p><b>No. of Quadrats:</b> Inferred <span style="float: right;"><b>Similarity Percentage:</b> n/a</span></p>	<p><b>Not Available</b></p>
CP1	<p><i>Eucalyptus victrix</i> low open woodland over <i>Acacia tetragonophylla</i>, <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>, <i>Scaevola spinescens</i> tall sparse shrubland over <i>Triodia epactia</i> mid open hummock grassland with <i>Sporobolus mitchellii</i>, <i>Chrysopogon fallax</i>, *<i>Cenchrus ciliaris</i> low sparse tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Abutilon oxycarpum</i>, <i>Acacia ancistrocarpa</i>, <i>Cullen cinereum</i>, <i>Eriachne helmsii</i>, <i>Eulalia aurea</i>, *<i>Portulaca oleracea</i>, <i>Rhynchosia minima</i> and *<i>Vachellia farnesiana</i>.</p> <p><b>Soils and Landform:</b> Flats with red brown clayey sands and occasional red/brown cracking clays.</p> <p><b>Condition:</b> Very Good to Good.</p> <p><b>Plate Details:</b> Survey Site 85.</p> <p><b>No. of Quadrats:</b> 5 <span style="float: right;"><b>Similarity Percentage:</b> 54 %</span></p>	



APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA

Mapping Code	Vegetation Community Description	Representative Plate of Community
CP2	<p><i>Eucalyptus victrix</i> low open woodland over <i>Abutilon oxycarpum</i>, <i>Ipomoea muelleri</i>, <i>Panicum decompositum</i> mid sparse forbland over <i>Enteropogon ramosus</i>, <i>Eriachne helmsii</i>, <i>Sporobolus mitchellii</i> low open tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Acacia synchronicia</i>, <i>Cullen cinereum</i>, <i>Dactyloctenium radulans</i>, <i>Eulalia aurea</i>, *<i>Malvastrum americanum</i>, <i>Ptilotus murrayi</i>, *<i>Portulaca oleracea</i>, <i>Trianthema triquetra</i> and *<i>Vachellia farnesiana</i>.</p> <p><b>Soils and Landform:</b> Flats with red/brown clays.</p> <p><b>Condition:</b> Very Good to Good.</p> <p><b>Plate Details:</b> Survey Site 71</p> <p><b>No. of Quadrats:</b> 3                                  <b>Similarity Percentage:</b> 52 %</p>	
CP3	<p><i>Acacia tetragonophylla</i> low scattered shrubs over <i>Triodia epactia</i> low hummock grassland with *<i>Cenchrus ciliaris</i> low open tussock grassland (B).</p> <p><b>Other Associated Species:</b> <i>Acacia synchronicia</i>, <i>Atriplex bunburyana</i>, <i>Cassytha capillaris</i>, <i>Chrysopogon fallax</i>, <i>Dactyloctenium radulans</i>, <i>Eulalia aurea</i>, <i>Indigofera colutea</i>, <i>Lawrenxia viridigrisea</i>, *<i>Prosopis pallida</i>, <i>Rhynchosia minima</i> and *<i>Vachellia farnesiana</i>.</p> <p><b>Soils and Landform:</b> Coastal sand plains.</p> <p><b>Condition:</b> Poor.</p> <p><b>Plate Details:</b> Not Available.</p> <p><b>No. of Quadrats:</b> Inferred                                  <b>Similarity Percentage:</b> n/a</p>	<p style="text-align: center;"><b>Not Available</b></p>

APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA


Mapping Code	Vegetation Community Description	Representative Plate of Community
<p>CP4</p>	<p><i>*Prosopis pallida</i>, <i>Acacia tetragonophylla</i>, <i>Acacia synchronicia</i> tall scattered shrubs over <i>Triodia epactia</i> mid sparse hummock grassland with <i>*Cenchrus ciliaris</i> low open tussock grassland (B).</p> <p><b>Other Associated Species:</b> <i>Atriplex codonocarpa</i>, <i>Chrysopogon fallax</i>, <i>Cullen cinereum</i>, <i>Dactyloctenium radulans</i>, <i>Eragrostis xerophila</i> and <i>Rhynchosia minima</i>.</p> <p><b>Soils and Landform:</b> Orange-brown loamy sands fringing claypans.</p> <p><b>Condition:</b> Poor.</p> <p><b>Plate Details:</b> Not Available.</p> <p><b>No. of Quadrats:</b> Inferred                                  <b>Similarity Percentage:</b> n/a</p>	<p>Not Available</p>
<p>CP5</p>	<p><i>Sporobolus mitchellii</i>, <i>Eriachne</i> aff. <i>benthamii</i>, <i>Eriachne benthamii</i>, <i>Eulalia aurea</i> mid tussock grassland (B).</p> <p><b>Other Associated Species:</b> <i>Acacia synchronicia</i>, <i>Acacia tetragonophylla</i>, <i>Cucumis maderaspatanus</i>, <i>Cullen cinereum</i>, <i>Cyperus</i> spp., <i>Eragrostis xerophila</i>, <i>Eucalyptus victrix</i>, <i>Marsilea hirsuta</i>, <i>*Prosopis pallida</i>, <i>Sesbania cannabina</i> and <i>Sporobolus virginicus</i>.</p> <p><b>Soils and Landform:</b> Depressions with heavy clay.</p> <p><b>Condition:</b> Very Good.</p> <p><b>Plate Details:</b> Not Available.</p> <p><b>No. of Quadrats:</b> Inferred                                  <b>Similarity Percentage:</b> n/a</p>	<p>Not Available</p>

APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA



Mapping Code	Vegetation Community Description	Representative Plate of Community
<p><b>ID1</b></p>	<p><i>Grevillea stenobotrya</i> low sparse shrubland over <i>Acacia stellaticeps</i> mid open shrubland over <i>Triodia epactia</i> hummock grassland.</p> <p><b>Other Associated Species:</b> <i>Acacia tetragonophylla</i>, <i>Bonamia erecta</i>, *<i>Cenchrus ciliaris</i>, <i>Eragrostis eriopoda</i>, <i>Evolvulus alsinoides</i>, <i>Grevillea eriostachya</i>, <i>Ipomoea muelleri</i>, <i>Salsola australis</i> and <i>Solanum lasiophyllum</i>.</p> <p><b>Soils and Landform:</b> Dune crests and slopes with red/brown sandy loams and occasional limestone outcropping.</p> <p><b>Condition:</b> Excellent.</p> <p><b>Plate Details:</b> Survey Site 91.</p> <p><b>No. of Quadrats:</b> 2 <span style="float: right;"><b>Similarity Percentage:</b> 50 %</span></p>	
<p><b>ID2</b></p>	<p><i>Acacia stellaticeps</i>, <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> mid sparse shrubland with <i>Bonamia erecta</i>, <i>Hibiscus brachychlaenus</i>, <i>Scaevola sericophylla</i> low sparse shrubland over <i>Triodia epactia</i> mid hummock grassland with *<i>Cenchrus ciliaris</i>, <i>Eragrostis eriopoda</i> low sparse tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Acacia ancistrocarpa</i>, <i>Acacia ligulata</i>, <i>Boerhavia coccinea</i>, *<i>Cenchrus ciliaris</i>, <i>Eragrostis eriopoda</i>, <i>Evolvulus alsinoides</i>, <i>Indigofera colutea</i> and <i>Scaevola sericophylla</i>.</p> <p><b>Soils and Landform:</b> Dune crests, slopes and swales with red/orange sandy loams.</p> <p><b>Condition:</b> Excellent.</p> <p><b>Plate Details:</b> Survey Site 59.</p> <p><b>No. of Quadrats:</b> 6 <span style="float: right;"><b>Similarity Percentage:</b> 50 %</span></p>	





APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA

Mapping Code	Vegetation Community Description	Representative Plate of Community
ID3	<p><i>Grevillea stenobotrya</i> tall open shrubland over <i>Crotalaria cunninghamii</i>, <i>Trichodesma zeylanicum</i> var. <i>grandiflorum</i> mid open shrubland over <i>Triodia epactia</i> mid open hummock grassland <sup>(B)</sup>.</p> <p><b>Other Associated Species:</b> <i>Acacia coriacea</i> subsp. <i>coriacea</i>, <i>Acacia tetragonophylla</i>, <i>Bonamia rosea</i>, <i>Cassytha capillaris</i>, <i>Diplopeltis eriocarpa</i>, <i>Grevillea eriostachya</i>, <i>Indigofera bovipерda</i> subsp. <i>bovipерda</i>, <i>Icolutea</i>, <i>Petalostylis cassioides</i>, <i>Pityrodia loxocarpa</i>, <i>Solanum lasiophyllum</i> and <i>Verticordia forrestii</i>.</p> <p><b>Soils and Landform:</b> Swales between dunes and sloping sand sheets adjacent to large dunes.</p> <p><b>Condition:</b> Very Good.</p> <p><b>Plate Details:</b> Not Available.</p> <p><b>No. of Quadrats:</b> Not Available.                      <b>Similarity Percentage:</b> n/a</p>	<p style="text-align: center;"><b>Not Available</b></p>
IP1	<p><i>Eucalyptus victrix</i> low scattered trees over <i>Acacia synchronicia</i>, <i>Acacia xiphophylla</i>, <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> tall open shrubland over <i>Triodia lanigera</i> mid hummock grassland with *<i>Cenchrus ciliaris</i> low sparse tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Boerhavia coccinea</i>, <i>Corchorus laniflorus</i>, <i>Cleome viscosa</i>, <i>Dactyloctenium radulans</i>, <i>Ipomoea muelleri</i>, *<i>Portulaca oleracea</i>, <i>Salsola australis</i>, <i>Senna artemisioides</i> subsp. <i>oligophylla</i>, <i>Trianthema triquetra</i> and <i>Triodia epactia</i></p> <p><b>Soils and Landform:</b> Flats of red cracking clay or red/brown clay loam.</p> <p><b>Condition:</b> Very Good to Excellent.</p> <p><b>Plate Details:</b> Survey Site 107.</p> <p><b>No. of Quadrats:</b> 5    <b>Similarity Percentage:</b> 58 %</p>	



APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA

Mapping Code	Vegetation Community Description	Representative Plate of Community
<p>IP2</p>	<p><i>Eucalyptus victrix</i> low isolated trees over <i>Acacia synchronicia</i>, <i>Acacia tetragonophylla</i>, <i>Acacia xiphophylla</i> tall sparse shrubland with <i>Senna artemisioides</i> subsp. <i>oligophylla</i>, <i>Scaevola spinescens</i> low sparse shrubland over <i>Triodia epactia</i> mid hummock grassland with <i>Eriachne helmsii</i> , *<i>Cenchrus ciliaris</i> low open tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Boerhavia coccinea</i>, <i>Dactyloctenium radulans</i>, <i>Gomphrena affinis</i> subsp. <i>affinis</i>, <i>Indigofera linifolia</i>, <i>Solanum lasiophyllum</i> and <i>Triodia pungens</i>.</p> <p><b>Soils and Landform:</b> Flats with red clay loams and upper slopes of red sand with pebbles.</p> <p><b>Condition:</b> Very Good to Excellent.</p> <p><b>Plate Details:</b> Survey Site 25.</p> <p><b>No. of Quadrats:</b> 9 <span style="float: right;"><b>Similarity Percentage:</b> 56 %</span></p>	
<p>IP3</p>	<p><i>Eucalyptus victrix</i>, <i>Grevillea striata</i> low isolated trees over <i>Hakea chordophylla</i>, <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>, <i>Acacia trachycarpa</i> tall open shrubland with <i>Acacia synchronicia</i>, <i>Acacia tetragonophylla</i> low sparse shrubland over <i>Triodia epactia</i> mid isolated hummock grasses with *<i>Cenchrus ciliaris</i> low sparse tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Amaranthus mitchellii</i>, <i>Boerhavia coccinea</i>, <i>Cleome viscosa</i>, *<i>Portulaca oleracea</i>, <i>Rhagodia eremaea</i>, <i>Scaevola spinescens</i> and <i>Solanum lasiophyllum</i>.</p> <p><b>Soils and Landform:</b> Red/brown clay loam to sandy loam flats, occasionally with pebbles.</p> <p><b>Condition:</b> Very Good to Excellent.</p> <p><b>Plate Details:</b> Survey Site 44.</p> <p><b>No. of Quadrats:</b> 3 <span style="float: right;"><b>Similarity Percentage:</b> 54 %</span></p>	



APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA

Mapping Code	Vegetation Community Description	Representative Plate of Community
IP4	<p><i>Acacia xiphophylla</i>, <i>Acacia synchronicia</i> low open shrubland over <i>Senna artemisioides</i> subsp. <i>oligophylla</i>, <i>Solanum lasiophyllum</i> low sparse shrubland over <i>Eragrostis xerophila</i>, *<i>Cenchrus ciliaris</i> low sparse tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Aristida ?contorta</i>, <i>Boerhavia coccinea</i>, <i>Cleome viscosa</i> and <i>Gomphrena affinis</i> subsp. <i>affinis</i>.</p> <p><b>Soils and Landform:</b> Flats with red clay loam and pebbles or cracking clay.</p> <p><b>Condition:</b> Very Good to Excellent.</p> <p><b>Plate Details:</b> Survey Site 14.</p> <p><b>No. of Quadrats:</b> 3                                      <b>Similarity Percentage:</b> 70 %</p>	
IP5	<p><i>Acacia synchronicia</i>, <i>Acacia tetragonophylla</i>, <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> low sparse shrubland over <i>Chrysopogon fallax</i>, <i>Eriachne helmsii</i>, <i>Urochloa occidentalis</i> var. <i>occidentalis</i> low open tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Boerhavia coccinea</i>, <i>Corchorus laniflorus</i>, <i>Dactyloctenium radulans</i>, <i>Gomphrena affinis</i> subsp. <i>affinis</i>, <i>Ptilotus murrayi</i> and <i>Senna artemisioides</i> subsp. <i>oligophylla</i></p> <p><b>Soils and Landform:</b> Red cracking clay flats, occasionally with pebbles.</p> <p><b>Condition:</b> Very Good to Excellent.</p> <p><b>Plate Details:</b> Survey Site 22.</p> <p><b>No. of Quadrats:</b> 3                                      <b>Similarity Percentage:</b> 56 %</p>	



APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA

Mapping Code	Vegetation Community Description	Representative Plate of Community
IP6	<p><i>Acacia synchronicia</i>, <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>, <i>Acacia xiphophylla</i> low sparse shrubland over <i>Eragrostis eriopoda</i>, <i>Eriachne aristidea</i>, *<i>Cenchrus ciliaris</i> low open tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Boerhavia coccinea</i>, <i>Bulbostylis barbata</i>, <i>Corchorus laniflorus</i>, <i>Goodenia forrestii</i> and <i>Triodia epactia</i>.</p> <p><b>Soils and Landform:</b> Flats with red clay loam to sandy loam and hillslopes with red sands.</p> <p><b>Condition:</b> Very Good to Excellent.</p> <p><b>Plate Details:</b> Survey Site 110.</p> <p><b>No. of Quadrats:</b> 4 <span style="float: right;"><b>Similarity Percentage:</b> 59 %</span></p>	
IP7	<p><i>Eucalyptus victrix</i> low open woodland over <i>Acacia tetragonophylla</i>, <i>Acacia synchronicia</i>, <i>Cullen leucanthum</i> mid sparse shrubland over <i>Eriachne helmsii</i>, <i>Eulalia aurea</i>, *<i>Cenchrus ciliaris</i> low sparse tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Amaranthus mitchellii</i>, <i>Cleome viscosa</i>, <i>Cucumis maderaspatanus</i>, <i>Ipomoea muelleri</i>, <i>Gomphrena affinis</i> subsp. <i>affinis</i> and <i>Trichodesma zeylanicum</i>.</p> <p><b>Soils and Landform:</b> Flats with red/brown clay loam.</p> <p><b>Condition:</b> Good to Very Good.</p> <p><b>Plate Details:</b> Survey Site 29.</p> <p><b>No. of Quadrats:</b> 3 <span style="float: right;"><b>Similarity Percentage:</b> 53 %</span></p>	



APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA

Mapping Code	Vegetation Community Description	Representative Plate of Community
<p><b>IP8</b></p>	<p><i>Eucalyptus victrix</i> low isolated trees over <i>Acacia tetragonophylla</i>, <i>Acacia synchronicia</i> tall isolated shrubs with <i>Acacia stellaticeps</i>, <i>Acacia coriacea</i> subsp. <i>coriacea</i>, <i>Senna artemisioides</i> subsp. <i>oligophylla</i> low sparse shrubland over <i>Triodia epactia</i> mid hummock grassland with <i>Eulalia aurea</i>, <i>Eragrostis eriopoda</i>, *<i>Cenchrus ciliaris</i> low sparse tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>, <i>Atriplex ?codonocarpa</i>, <i>Bonamia erecta</i>, <i>Corchorus laniflorus</i>, <i>Dactyloctenium radulans</i>, <i>Setaria dielsii</i>, <i>Solanum lasiophyllum</i>, <i>Stemodia</i> sp. Onslow (A.A. Mitchell 76/148) and <i>Threlkeldia diffusa</i>.</p> <p><b>Soils and Landform:</b> Dune slopes, ridges and swales of red sand, and flats of sand over clay or cracking clay.</p> <p><b>Condition:</b> Very Good.</p> <p><b>Plate Details:</b> Survey Site 113.</p> <p><b>No. of Quadrats:</b> 23 <span style="float: right;"><b>Similarity Percentage:</b> 49 %</span></p>	
<p><b>IF1</b></p>	<p><i>Eucalyptus victrix</i> low open woodland over <i>Acacia synchronicia</i>, <i>Acacia tetragonophylla</i>, <i>Scaevola spinescens</i> tall sparse shrubland with <i>Rhynchosia minima</i>, <i>Senna artemisioides</i> subsp. <i>oligophylla</i>, <i>Eremophila longifolia</i> mid sparse shrubland over <i>Triodia epactia</i> low isolated hummock grasses with <i>Eriachne helmsii</i>, <i>Chrysopogon fallax</i>, <i>Urochloa occidentalis</i> var. <i>occidentalis</i> low sparse tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Boerhavia coccinea</i>, <i>Dactyloctenium radulans</i>, <i>Enteropogon ramosus</i>, <i>Ipomoea muelleri</i>, <i>Iseilema eremaeum</i>, <i>Pittosporum ?phillyreoides</i> and <i>Sida fibulifera</i>.</p> <p><b>Soils and Landform:</b> Flats with red/brown sands over clays and occasional cracking clays.</p> <p><b>Condition:</b> Very Good to Excellent.</p> <p><b>Plate Details:</b> Survey Site .</p> <p><b>No. of Quadrats:</b> 25 <span style="float: right;"><b>Similarity Percentage:</b> 60 %</span></p>	

APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA

Mapping Code	Vegetation Community Description	Representative Plate of Community
IF2	<p><i>Acacia xiphophylla</i>, <i>Acacia synchronicia</i> mid open shrubland over <i>Salsola australis</i>, <i>Rhagodia eremaea</i>, <i>Maireana</i> spp. mid sparse chenopod shrubland over <i>Eriachne benthamii</i>, <i>Sporobolus australasicus</i>, *<i>Cenchrus ciliaris</i> low open tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Dactyloctenium radulans</i>, <i>Grevillea subterlineata</i> (P3), <i>Ipomoea muelleri</i> and <i>Trianthema triquetra</i>.</p> <p><b>Soils and Landform:</b> Flats with red/brown clay loams or red cracking clays with pebbles.</p> <p><b>Condition:</b> Very Good.</p> <p><b>Plate Details:</b> Survey Site 13.</p> <p><b>No. of Quadrats:</b> 2   <b>Similarity Percentage:</b> 63 %</p>	
IF3	<p><i>Acacia synchronicia</i>, <i>Acacia xiphophylla</i>, <i>Acacia trachycarpa</i> low sparse shrubland over <i>Salsola australis</i>, <i>Threlkeldia diffusa</i>, <i>Rhagodia eremaea</i> mid sparse chenopod shrubland with <i>Chrysopogon fallax</i>, <i>Enteropogon ramosus</i>, *<i>Cenchrus ciliaris</i> low open tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Eragrostis setitida</i>, <i>Gomphrena affinis</i> subsp. <i>affinis</i>, <i>Neptunia dimorphantha</i>, <i>Senna artemisioides</i> subsp. <i>oligophylla</i>, <i>Sida fibulifera</i> and <i>Urochloa occidentalis</i> var. <i>occidentalis</i>.</p> <p><b>Soils and Landform:</b> Flats with red sandy clays and occasional cracking clays.</p> <p><b>Condition:</b> Very Good.</p> <p><b>Plate Details:</b> Survey Site 21.</p> <p><b>No. of Quadrats:</b> 3   <b>Similarity Percentage:</b> 60 %</p>	

**APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA**

Mapping Code	Vegetation Community Description	Representative Plate of Community
<p><b>IF4</b></p>	<p><i>Eucalyptus victrix</i> low open woodland over <i>Acacia synchronicia</i>, <i>Acacia tetragonophylla</i>, <i>Scaevola spinescens</i> tall sparse shrubland over <i>Sporobolus mitchellii</i>, <i>Eriachne helmsii</i>, <i>Eulalia aurea</i> low open tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Chrysopogon fallax</i>, <i>Ipomoea muelleri</i>, <i>Urochloa occidentalis</i> var. <i>occidentalis</i> and *<i>Vachellia farnesiana</i>.</p> <p><b>Soils and Landform:</b> Flats with red/brown clay loams, sandy clays or brown sand.</p> <p><b>Condition:</b> Very Good to Excellent.</p> <p><b>Plate Details:</b> Survey Site 88.</p> <p><b>No. of Quadrats:</b> 8 <span style="float:right"><b>Similarity Percentage:</b> 57 %</span></p>	
<p><b>IF5</b></p>	<p><i>Eucalyptus victrix</i> low open woodland over <i>Acacia synchronicia</i>, <i>Acacia tetragonophylla</i>, <i>Senna artemisioides</i> subsp. <i>oligophylla</i> mid sparse shrubland over <i>Panicum decompositum</i>, <i>Rhynchosia minima</i>, <i>Neptunia dimorphantha</i> mid sparse forbland with <i>Eriachne helmsii</i>, <i>Eragrostis xerophila</i>, <i>Iseilema membranaceum</i> low open tussock grassland.</p> <p><b>Other Associated Species:</b> <i>Astrebla elymoides</i>, <i>Cyperus bifax</i>, <i>Enteropogon ramosus</i> and <i>Sida fibulifera</i>.</p> <p><b>Soils and Landform:</b> Red-brown clay-loam flats.</p> <p><b>Condition:</b> Very Good to Excellent.</p> <p><b>Plate Details:</b> Survey Site 63.</p> <p><b>No. of Quadrats:</b> 3 <span style="float:right"><b>Similarity Percentage:</b> 64 %</span></p>	





**APPENDIX G: CLUSTER DENDROGRAM OF SITES SURVEYED WITHIN THE CS2 – TUBRIDGI – WHEATSTONE GAS PIPELINE PROJECT AREA**

