PROJECT CHINA STONE

Aquatic Ecology and Stygofauna Report

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Aquatic Ecology and Stygofauna Impact Assessment

For:

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Final

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Report No. Q12001RP4

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Date:	*20 March, 2015*

CUMBERLAND ECOLOGY

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Glossary of Terms

ANZECC	Australia New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AusRivAS	*Queensland Australian River Assessment System (AusRivAS) Sampling and Processing Manual* (DNRM 2001)
BoM	Bureau of Meteorology
CCM&RP	Carmichael Coal Mine and Rail Project
CHPP	Coal Handling and Preparation Plants
DAFF	Department of Agriculture, Fisheries and Forestry
DNRM	Queensland Department of Natural Resources and Mine
DO	Dissolved oxygen
DotE	Commonwealth Department of the Environment
EA	Environmental Authority
EC	Electrical conductivity
EHP	Queensland Department of Environment and Heritage Protection
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority (Western Australia)
EO Act	Queensland *Environmental Offsets Act 2014*
EO Regulation	Queensland *Environmental Offsets Regulation 2014*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPT Macroivertebrates	Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies)
Fisheries Act	Queensland *Fisheries Act 1994*
GES	General Ecological Significance
HES	High Environmental Significance (wetland)
LOR	Limits of reporting
MNES	Matters of National Environmental Significance.
MSES	Matters of State Environmental Significance
Mtpa	Million tonnes per annum
NC Act	Queensland *Nature Conservation Act 1992*
NC[W]R	*Nature Conservation (Wildlife) Regulation 2006*
O/E	Observed/Expected

QEOP	Queensland Environmental Offsets Policy
SEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (former)
SIGNAL	Stream Invertebrate Grade Number – Average Level
SP Act	Queensland *Sustainable Planning Act 2009*
the project	Project China Stone
Threatened species	Flora and fauna species that are listed under the NC Act, EPBC Act and Fisheries Act
TSF	Tailings Storage Facility
VM Act	Queensland *Vegetation Management Act 1999*
Water Act	Queensland *Water Act 2000*
WPA	Wetland Protection Area

Chapter **1**

Introduction

1.1 Project Overview

Cumberland Ecology was commissioned by Hansen Bailey on behalf of MacMines Austasia Pty Ltd (the proponent) to complete an Aquatic Ecology and Stygofauna Impact Assessment as part of the Environmental Impact Statement (EIS) for Project China Stone (the project).

The project involves the construction and operation of a large-scale coal mine on a greenfield site in Central Queensland. The project site (the area that will ultimately form the mining leases for the project) is remote, being located approximately 270 km south of Townsville and 300 km west of Mackay at the northern end of the Galilee Basin (**Figure 1**). The closest townships are Charters Towers, approximately 285 km by road to the north, and Clermont, approximately 260 km by road to the south-east. The project site comprises approximately 20,000 ha of well vegetated land, with low-lying scrub in the south and east and a densely vegetated ridgeline, known as 'Darkies Range', running north to south through the western portion of the site.

The mine will produce up to approximately 55 million tonnes per annum (Mtpa) of Run of Mine thermal coal. Coal will be mined using both open cut and underground mining methods (**Figure 2**). Open cut mining operations will involve multiple draglines and truck and shovel pre-stripping. Underground mining will involve up to three operating longwalls. Coal will be washed and processed on site and product coal will be transported from site by rail. It is anticipated that mine construction will commence in 2016 and the mine life will be in the order of 50 years.

The majority of the mine infrastructure will be located in the eastern portion of the project site (**Figure 2**). Infrastructure will include coal handling and preparation plants (CHPPs), stockpiles, conveyors, rail loop and train loading facilities, workshops, dams, tailings storage facility (TSF) and a power station. A workforce accommodation village and private airstrip will also be located in the eastern part of the project site.

The scope of this Aquatic Ecology and Stygofauna Impact Assessment is restricted to assessing activities that are proposed to be undertaken within the project site and no off-lease activities are considered in this assessment.

1.2 Report Terminology

The study area for the purposes of this Aquatic Ecology and Stygofauna Impact Assessment is the same as the project site (i.e. the area that will form the mining leases for the project).

The term “drainage line” has been used in this report to describe any natural feature that conveys surface water during rainfall events. Drainage lines may therefore include watercourses and drainage features (defined under the *Water Act 2000* [Water Act]); waterways (defined under the *Fisheries Act 1994* [Fisheries Act]); and watercourses (defined under the *Vegetation Management Act 1999* [VM Act]).

1.3 Overview of Study Area

The study area is located within the Belyando Basin, a sub-basin of the Burdekin Basin (**Figure 3**). The Burdekin Basin has a total catchment area to the coastline of approximately 135,000 km^2. The Belyando Basin is in the upper catchment of the larger Burdekin Basin. The Belyando Basin, together with the Cape Campaspe, Upper Burdekin and Suttor Basins, form the catchment of the Burdekin Falls Dam (**Figure 3**). The Burdekin Falls Dam is located approximately 255 km downstream of the study area and is a defining feature of the Burdekin Basin. Both the Belyando Basin and the wider catchment of the Burdekin Falls Dam are characterised by high soil erosion rates which result in naturally elevated sediment loads in watercourses. The Burdekin Falls Dam acts to partially attenuate natural sediment loads prior to discharge into the Lower Burdekin Basin and ultimately into the Pacific Ocean.

The study area is located at the head of the catchment and site drainage is therefore highly ephemeral. There are no major watercourses traversing the site. The majority of the study area drains towards the east from Darkies Range at the western boundary of the site through a network of steep rock gullies. These gullies coalesce on the flatter areas east of Darkies Range and form a network of minor drainage lines that comprise the headwaters of several downstream watercourses (**Figure 4**).

The north of the study area is drained by the headwaters of Tomahawk Creek, and its tributary Pigeonhole Creek (**Figure 4**). Drainage from two gully sub-catchments coalesce to form Pigeonhole Creek 10 km downstream of the study area. Pigeonhole Creek flows south-east for 12 km before dissipating into overland flowpaths that drain parallel to Tomahawk Creek as the topography flattens. A further four unnamed gully sub-catchments drain from Darkies Range to the south-east. These gullies transition to overland flow paths that traverse the north-east of the study area and continue to drain south-east, parallel to Tomahawk Creek. These overland flowpaths that drain the study area coalesce with the main Tomahawk Creek channel at least 25 km downstream of the study area. Tomahawk Creek then flows a further 20 km into the main channel of the Belyando River 40 km east of the study area (**Figure 4**).

The south of the study area is drained by the headwaters of North Creek and its tributary, Laguna Creek (**Figure 4**). These headwaters are characterised by overland flowpaths that coalesce and dissipate over the flat topography before forming the defined flow channel of the North Creek watercourse approximately 20 km downstream of the study area. The overland

flowpaths and downstream channel bed and banks of the North Creek catchment are significantly degraded by cattle grazing. North Creek flows 14 km before receiving flows from its tributary Eight Mile Creek. North Creek then flows a further 25 km into the Moray Anabranch of the Belyando River south-east of the study area (**Figure 4**). North Creek enters the Belyando River 32 km upstream of Tomahawk Creek-Belyando River confluence.

The Belyando River is an ephemeral, regionally significant watercourse that enters the Suttor River upstream of the Burdekin Falls Dam. The Belyando River is a braided river system comprising several anabranchs occupying a broad floodplain.

The Carmichael River is located 27 km south of the study area (**Figure 4**) and flows generally eastward for over 40 km into the Belyando River, 28 km upstream of the North Creek-Belyando River confluence. A small area in the south-west of the study area drains to the Carmichael River catchment. This area comprises a negligible proportion of the Carmichael River catchment.

The study area itself is relatively dry and areas of potential aquatic habitat are restricted to ephemeral drainage lines, two seasonal wetlands and artificial farm dams.

Chapter 2

Regulatory Framework

2.1 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Commonwealth government's principal piece of environmental legislation, and is administered by the Commonwealth Department of the Environment (DotE). It is designed to protect national environmental assets, known as Matters of National Environmental Significance (MNES), which include threatened species of flora and fauna, endangered ecological communities, and migratory species as well as other protected matters. Among other things, it defines the categories of threat for threatened species, identifies key threatening processes and provides for the preparation of recovery plans for threatened species and communities.

Any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES is termed a Controlled Action and is subject to assessment under the EPBC Act.

The project has been declared a Controlled Action and requires approval under the EPBC Act before it can proceed. The Controlling Provisions include listed threatened species and communities; listed migratory species; and a water resource in relation to coal seam gas development and large coal mining development.

2.2 Queensland *Nature Conservation Act 1992*

The Queensland *Nature Conservation Act 1992* (NC Act) is the key piece of legislation in Queensland relating to the protection and management of biodiversity and threatened species. It establishes a framework for the identification, gazettal and management of protected areas (such as National Parks) and the protection of native flora and fauna (protected wildlife) listed under the *Nature Conservation (Wildlife) Regulation 2006* (NC[W]R). The NC Act is administered by the Queensland Department of Environment and Heritage Protection (EHP).

The NC Act classifies native flora and fauna species into categories of conservation significance including Extinct in the Wild, Endangered, Vulnerable, Near Threatened, Special Least Concern and Least Concern in recognition of how threatened they are and what action needs to be taken to protect them.

2.3 Queensland *Water Act 2000*

The Queensland Water Act provides for the sustainable management of water resources. The Water Act governs the construction, control and management of works with respect to water conservation and protection, irrigation, drainage, water supply and flood control and prevention. The Water Act is administered by the Queensland Department of Natural Resources and Mines (DNRM).

Section 5 of the Water Act defines a watercourse as a river, creek or other stream, including a stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events. Watercourses do not include drainage features and must have flow that persists after rain has ceased. A watercourse determination was undertaken by DNRM for the project in order to identify any watercourses in the study area. It determined that there are no watercourses in the study area.

Under the Water Act, any potential works that destroy vegetation, excavate, or place fill within a watercourse, lake or spring require a riverine protection permit, unless the works can be undertaken in accordance with DNRM's (2014a) *Riverine Protection Permit Exemption Requirements*. Given that there are no watercourses in the study area, and there are no lakes or springs, no riverine protection permits will be required for the project.

The Water Act also regulates the taking of overland flow and groundwater. These issues are discussed further in the EIS Regulatory Framework Section. Watercourse diversions also require assessment under the Water Act. However, none are proposed for this project.

2.4 Queensland *Fisheries Act 1994*

The Fisheries Act, amongst other purposes, provides for the management, use, development and protection of fisheries resources and fish habitats. This Act is administered by the Department of Agriculture, Fisheries and Forestry (DAFF).

Under Division 8 of the Fisheries Act, a development permit under the *Sustainable Planning Act 2009* (SP Act) is required prior to constructing any waterway barrier works (i.e. structures such as culverts, road crossings, dams, etc.) that may inhibit fish passage. This provision aims to reduce the potential impacts that constructed structures pose to fish migration. The DAFF has published a number of guidelines related to minimising impacts from waterway barrier works. The activities being assessed in this EIS are restricted to activities to be undertaken within the proposed mining lease boundaries, and the activities will be undertaken in accordance with the mining leases and Environmental Authority (EA) that will be obtained for the project. The SP Act does not apply to activities undertaken within a mining lease, and there is consequently no need to obtain separate approvals for waterway barrier works. This Aquatic and Stygofauna Ecology Impact Assessment does, however, assess potential impacts of the project on fish passage and makes reference to the DAFF's guidelines on waterway barrier works, where relevant. According to the Queensland Environmental Offsets Framework (**Section 2.9**), it is necessary to provide offsets if the construction of waterway barrier works, beyond an urban area, will limit the passage of fish along a waterway. Further detail on offsets is provided in **Section 2.8**

The DAFF has prepared mapping which classifies all waterways in Queensland in relation to the level of risk that waterway barrier works could pose to fish movement and fish communities (DAFF, 2014). The mapping is based on stream order, stream slope, flow regime, number of fish species present and fish swimming ability. The maps were prepared from desktop information, with ground-truthing of the classification system undertaken to confirm that it represented an accurate representation of risk. The streams are coloured according to the level of risk – waterways with the highest degree of risk are coloured purple, with the risk decreasing progressively for red, amber and green waterways.

This mapping is used for projects that require approvals under the SP Act to assist proponents in determining the level of assessment that is required. For example, works within green waterways are "low impact" and are self-assessable, whereas works in purple waterways have a major risk of impact and require further assessment. The DAFF's waterway mapping is therefore not directly relevant to the project, given that approvals under the SP Act are not required. Nevertheless, the DAFF's map of waterways is discussed in **Section 4.1,** and a copy of the DAFF waterway map for the study area is provided. It should be noted that the waterways shown on the DAFF's waterway map are not considered to be watercourses under the Water Act because they do not have flow that persists after rain has ceased.

The Fisheries Act also contains provisions for the declaration of fish habitat. Significant residual impacts to areas of declared fish habitat are required to be offset in accordance with the Queensland Environmental Offsets Framework (**Section 2.8**). **Section 4.1** explains that there is no declared fish habitat within the study area.

2.5 Ramsar Wetlands and Nationally Important Wetlands

The Convention on Wetlands of International Importance (i.e. the Ramsar Convention), is an international cooperative designed to conserve wetlands. Ramsar wetlands are those that are representative, rare or unique wetlands, or are important for conserving biological diversity. Ramsar wetlands are recognised as a MNES under the EPBC Act. The Project will not affect any Ramsar wetlands. In addition, the DotE have determined that Ramsar wetlands are not a controlling provision for this project under the EPBC Act.

The Directory of Important Wetlands is managed by the DotE and is an online database that lists Nationally Important Wetlands. Nationally Important Wetlands, although listed on a database managed by the DotE, are not MNES and are not protected under the EPBC Act.

Section 4.1 describes the nearest Ramsar wetlands and Nationally Important Wetlands to the study area.

2.6 Government Mapping of Wetlands and Watercourses

2.6.1 Map of Referrable Wetlands

The EHP has a range of policies and programs to manage wetlands. As part of a broader policy of wetland protection, and in accordance with schedule 12, part 2 of the *Environmental Protection Regulation 2008*, the EHP has prepared a map of referable wetlands. The map of referable wetlands includes:

- Wetland protection areas (WPAs), which comprise:
  - Wetlands of high ecological significance (HES) located within Great Barrier Reef catchments (termed HES wetlands); and
  - Trigger areas that represent the area of hydrological influence of HES wetlands. Outside urban areas, the trigger area is 500 m from the edge of a HES wetland.
- Wetlands of General Ecological Significance (GES wetlands).

WPAs and HES wetlands contain wetland environmental values as listed under section 81A of the Queensland *Environmental Protection Regulation 2008*. WPAs are derived using a mapping method developed by the EHP called the Aquatic Biodiversity Assessment and Mapping Method.

Significant residual impacts on WPAs are required to be offset in accordance with the Queensland Environmental Offsets Framework (**Section 2.8**).

2.6.2 Vegetation Management Watercourse Map

The Queensland government has produced a vegetation management watercourse map under Section 20AB of the VM Act. This map shows watercourses, as defined under the VM Act. It is used primarily to regulate vegetation clearing in proximity of watercourses. The map is produced based on desktop information and include stream order mapping under the Strahler method (DNRM 2014b). It should be noted that the definition of watercourse under the VM Act is different to the definition under the Water Act. None of the watercourses shown on the vegetation management watercourses map are considered to be watercourses under the Water Act.

Significant residual impacts on regional ecosystems located within a defined distance of watercourses shown on the vegetation management watercourse map are required to be offset (**Section 2.8**). This issue is considered further in the EIS Terrestrial Ecology Report.

2.6.3 High Ecological Value Waters

Schedule 2 of the *Environmental Protection (Water) Policy 2009* defines high ecological value waters as waters in which the biological integrity of the water is effectively unmodified or highly valued. The DNRM has produced draft mapping of high ecological waters. Significant residual impacts on wetlands or watercourses in high ecological value waters are required to be offset in accordance with the Queensland Environmental Offsets Framework (**Section 2.8**).

Section 4.1.5 explains that the study area is not located within high ecological value waters.

2.7 Commonwealth Offsets Policy

Environmental offsets are actions taken to counterbalance significant residual impacts on matters of environmental significance (e.g. matters of national or state significance). Offsets are used as a last resort in instances where an action will give rise to residual impacts, even after the application of management measures.

The *EPBC Act Environmental Offsets Policy* came into force in October 2012 (Commonwealth Department of Sustainability, Environment, Water, Population and Communities [SEWPaC] 2012) and provides guidance on the role of offsets in environmental impact assessments and how the DotE considers the suitability of a proposed offset package.

According to the policy, an offsets package is a "*suite of actions that a proponent undertakes in order to compensate for the residual significant impact of a project"* (SEWPaC 2012). It can comprise a combination of direct offsets and other compensatory measures.

Direct offsets are those actions that provide a measurable conservation gain for an impacted protected matter. Direct offsets are an essential component of a suitable offsets package. A minimum of 90% of the offset requirements for any given impact must be met through direct offsets. Other compensatory measures are those actions that do not directly offset the impacts on the protected matter, but are anticipated to lead to benefits for the impacted protected matter, for example funding for research or educational programs (SEWPaC 2012).

2.8 Queensland Environmental Offsets Framework

Queensland recently passed the *Environmental Offsets Act 2014* (EO Act) along with the *Environmental Offsets Regulation 2014* (EO Regulation). The *Queensland Environmental Offsets Policy (Version 1.1)* (QEOP) (EHP 2014a) came into force on 19 December 2014. The EO Act, EO Regulation and QEOP comprise the Queensland Environmental Offsets Framework. According to this framework, it is necessary to provide offsets for any significant, residual impacts on Matters of State Environmental Significance (MSES).

The EO Regulation prescribes a number of MSES that are potentially relevant to freshwater aquatic ecology. These include:

- Aquatic habitat that is shown as essential habitat, in accordance with the VM Act, for protected wildlife;
- Wetlands that are located within a WPA or a HES wetland shown on the map of referrable wetlands;
- A wetland or watercourse in high ecological value waters;
- Habitat for aquatic flora and fauna species that are listed as Special Least Concern, Vulnerable or Endangered under the NC Act;
- A part of a wild river area described as a high preservation area;
- Fish habitat areas; and
- Waterways providing for fish passage, if the activity will limit the passage of fish along the waterway.

The EHP released guidelines *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (EHP 2014b) in December 2014, which have been used where relevant and have been used to determine if offsets are required.

The QEOP has identified Strategic Offset Investment Corridors which are areas where land may be suitable for management activities that provide a benefit to environmental matters likely to be impacted by development (EHP 2014a). The Galilee Basin is the first Strategic Offset Investment Corridor to be mapped.

Chapter **3**

Methodology

The methodology utilised in the aquatic ecology assessment included a desktop study (**Section 3.1**), comprising database analysis (**Section 3.1.1**) and literature review of environmental assessments prepared for nearby coal projects in the Galilee Basin (**Section 3.1.2**); field surveys and data analysis (**Section 3.2**). Methodology limitations are outlined in **Section 3.3**.

3.1 Desktop Study

3.1.1 Database Analysis

Prior to the fieldwork and during the preparation of the report, database searches were conducted, and government mapping was consulted. Database searches and mapping review included the following:

- EPBC Act Protected Matters Search Tool (DotE 2015), accessed on 2 March 2015 (10 km search from the boundary of the study area);
- Queensland Wildlife Online threatened species database (EHP 2015), accessed on 2 March 2015 (25 km search radius from three central points in the centre of the study area);
- Queensland Museum Database (Queensland Museum 2015) (accessed on 5 March 2015);
- HERBRECS data from the Queensland Herbarium (accessed on 4 March 2015);
- DAFF's map of Queensland waterways for waterway barrier works;
- Declarations of fish habitat under the Fisheries Act;
- Searches for Nationally important wetlands using the DotE website;
- Map of referrable wetlands; and
- Draft mapping of high ecological waters.

3.1.2 Literature Review

Several aquatic surveys have been undertaken within and surrounding the study area in the past five years. The study area adjoins the recently approved Carmichael Coal Mine and Rail Project (CCM&RP), which is shown on **Figure 4**. Flora and fauna surveys undertaken for this project were reviewed as part of the desktop assessment. This study is, however, of limited relevance because the study area is located within the headwaters of the catchment and has no permanent watercourses. In contrast, a significant watercourse traverses the site for the CCM&RP.

3.1.3 Aerial Photography review

The most recent aerial photographs (flown October 2012 and October 2013) were utilised for the assessment. These were used to identify features for ground-truthing during the field survey, to identify appropriate survey locations and for determining and characterising potential aquatic habitats.

3.2 Aquatic Ecology Field Surveys

Aquatic surveys were conducted in accordance with the *Queensland Australian River Assessment System (AusRivAS) Sampling and Processing Manual* (herein referred to as AusRivAS) (DNRM 2001). This approach involves undertaking habitat assessments, water quality measurements *in-situ* and macroinvertebrate samples to provide an indication of the current condition of the aquatic survey locations. The aquatic survey also included sampling for fish and turtles. GPS coordinates were taken at each aquatic survey location and observations and water quality measurements were recorded to assess habitat potential.

3.2.1 Survey Timing

Aquatic field surveys were conducted in the study area in two survey periods; between 16 May and 25 May 2012 and between 22 October and 9 November 2012. Although all survey sites were inspected during both survey periods, not all survey sites could be sampled in the October 2012 survey due to a lack of water.

A further terrestrial ecology field survey was undertaken between 14 October and 20 October 2013, and although no targeted aquatic surveys were undertaken, the general amount of water remaining in the study area, both in dams and in remnant pools in ephemeral drainage lines, was noted in order to compare with previous surveys. Information noted during the October 2013 terrestrial ecological field survey, where relevant to aquatic ecology, has been included in this report.

The purpose of the field surveys was to undertake a baseline aquatic ecology assessment of existing aquatic conditions in the study area.

3.2.2 Survey Site Selection

Aquatic survey sites were selected based on different habitat types present (e.g. seasonal wetlands, ephemeral drainage lines and/or dams), relative size and accessibility for

sampling. Potential survey sites within were determined through an initial site inspection combined with an assessment of aerial photographs, available site infrastructure information and site boundaries. Detailed review of the aerial photographs resulted in the identification of key habitat types that were then assessed (ground-truthed) during the field assessment. Survey sites were surveyed in May 2012 and any survey site that still contained water in October 2012 were surveyed again.

A total of 22 survey sites were assessed for aquatic ecology in accordance with the AusRivAS methodology (DNRM 2001), consisting of the following (**Figure 5**):

- **Drainage lines in headwaters of Pigeonhole Creek catchment** (four sites): Ephemeral drainage lines within rocky escarpments in the northern portion of the study area;
- **Drainage lines in tributaries of Tomahawk Creek catchment** (nine sites): Ephemeral drainage lines in the central portion of the study area;
- **Drainage lines in headwaters of North Creek catchment** (two sites): Ephemeral drainage line in the southern portion of the study area;
- **Northern seasonal wetland** (one site): Large seasonal wetland in the northern portion of the study area;
- **Southern seasonal wetland** (two sites): Small seasonal wetland located in the southern portion of the study area;
- **Red Dog Dam** (one site): Artificial dam constructed within a large seasonal wetland in the northern portion of the study area; and
- **Southern farm dam** (three sites): Artificial farm dam located in the southern portion of the study area.

Aquatic survey locations are shown on **Figure 5** and listed in **Table 3.1**.

Table 3.1 Location of Survey Sites Surveyed During the Current Surveys

Survey Site	Latitude	Longitude
Drainage lines in headwaters of Pigeonhole Creek catchment		
A13	21.659	146.124
A14	21.658	146.126
A21	21.658	146.132
A22	21.633	146.105
Drainage lines in tributaries of Tomahawk Creek catchment		
A3	21.788	146.151
A4	21.787	146.151
A5	21.752	146.117

Survey Site	Latitude	Longitude
A10	21.787	146.236
A11	21.787	146.236
A15	21.799	146.161
A17	21.787	146.151
A18	21.798	146.159
A20	21.721	146.121
Drainage lines in headwaters of North Creek catchment		
A1	21.850	146.195
A2	21.850	146.197
Northern seasonal wetland		
A12	21.678	146.115
Southern seasonal wetland		
A8	21.775	146.184
A9	21.776	146.183
Red Dog Dam		
A19	21.679	146.115
Southern farm dam		
A6	21.781	146.202
A7	21.780	146.202
A16	21.780	146.201

3.2.3 Meteorological Conditions

The closest meteorological station to the study area is the Bureau of Meteorology's (BoM's) Carmichael Weather Station (Station Number 036122), located to the south-west of the study area (**Figure 4**). The Carmichael weather station does not measure temperature and this data was obtained from BoM's Clermont Airport Weather Station (Station Number 035124), located approximately 170 km to the south-east of the study area. Observed meteorological conditions during the two survey periods are presented below in **Table 3.2**.

Table 3.2 Meteorological Conditions During the Field Surveys

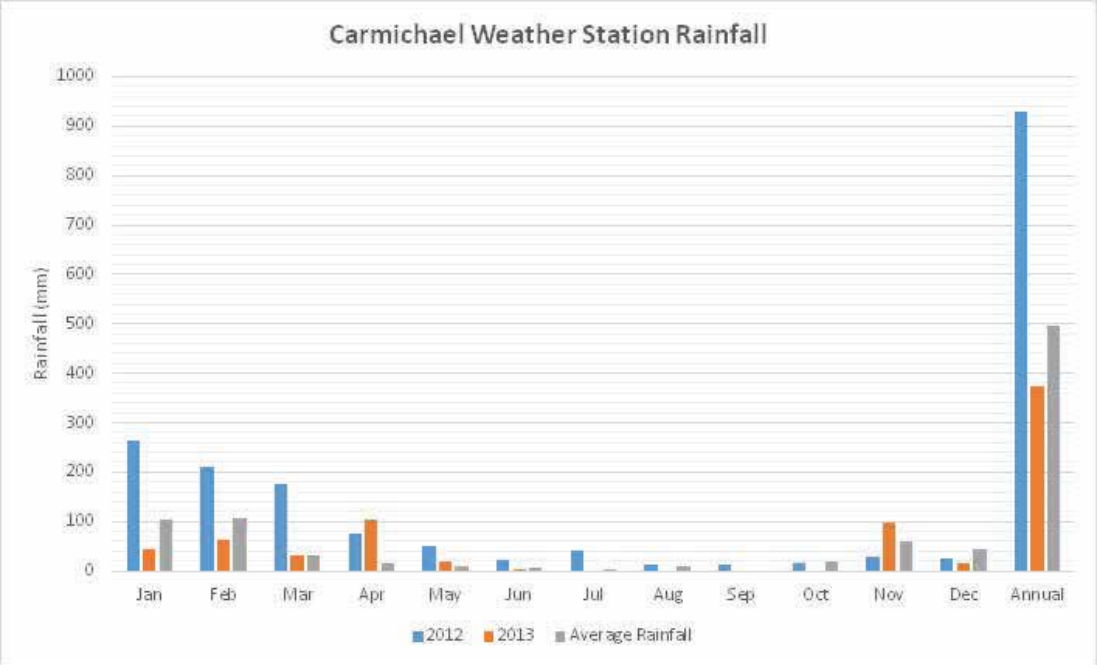
Date	Clermont Airport (035124) Weather Station		Carmichael (036122) Weather Station
	Minimum Temperature	Maximum Temperature	Rainfall (mm)
Survey 1			
16/05/2012	0.8	24.3	0
17/05/2012	7.3	25.2	0
18/05/2012	9	25.6	0
19/05/2012	7.4	24.8	0
20/05/2012	5.5	25.2	0
21/05/2012	7	25.4	0
22/05/2012	9.1	25.1	0
23/05/2012	15.7	23.8	0
24/05/2012	17.4	20.2	0.2
25/05/2012	15.1	15.7	45.2
Survey 2			
22/10/2012	16.5	36.9	0
23/10/2012	17.1	32.6	0
24/10/2012	14.7	30.3	0
25/10/2012	12.9	30.9	0
26/10/2012	12	34.5	0
27/10/2012	15.7	33	0
28/10/2012	15.3	22.6	0
29/10/2012	16.8	24.8	0
30/10/2012	17.2	27.4	15.4
31/10/2012	18.2	31.1	0
1/11/2012	14	34.1	0
2/11/2012	19.4	37.6	0
3/11/2012	20.5	37.1	0
4/11/2012	17.4	32.9	0
5/11/2012	20.6	33.3	0
6/11/2012	15	33.3	0
7/11/2012	14.8	32.7	0
8/11/2012	16.8	33.8	0
9/11/2012	20.2	31.5	2

Source: BoM (2014).

Temperatures within the study area are typical of the sub-tropical Queensland climate, with warmer summer months during December, January and February and cooler winter months in June, July and August. The first and second survey periods experienced maximum and minimum temperatures ranging between 25.6ºC and 0.8ºC; and 37.6ºC and 12ºC,

respectively (**Table 3.1**). Rainfall occurred on two days during both the first and second survey periods (**Table 3.1**).

Graph 1 shows 2012 and 2013 rainfall vs median rainfall at the Carmichael Weather Station. As can be seen from **Graph 1**, above average rainfall levels were experienced in 2012, while 2013 showed below average rainfall levels for the entire year. The May 2012 survey was preceded by several months of well above average rainfall. May 2012 was the first opportunity in 2012 to access the study area, given that extremely wet conditions prevented access during January to April 2012.



Graph 1 Rainfall Recorded at the Carmichael Weather Station in 2012 and 2013

3.2.4 Aquatic Habitat Assessments

Aquatic habitat assessments were conducted at each of the 22 aquatic sampling locations in accordance with the AusRivAS methodology (Turak and Waddell 2002). Visual assessments were generally conducted for a 100 m reach, where present, or a subset that included bed and banks. The assessment considered all the habitats within this area in terms of habitat diversity and extent, suitability for aquatic fauna groups, sensitivity to change, existing disturbances/modifications or barriers, riparian condition and flow characteristics.

The key features noted for each survey site included:

- Variety of habitat: shallow, deep, pool, run, riffle, undercut bank, woody debris and macrophytes habitats;
- Current land use;

- Riparian vegetation;
- Visual assessment of disturbance;
- Substrate composition and cover (bedrock, boulder, cobble, pebble, gravel, sand or silt/clay);
- Embeddedness of rocks, gravel and boulders;
- Velocity/depth category;
- Channel alteration;
- Bottom scouring and deposition;
- Pool/riffle and run/bend ratio;
- Presence/percentage cover of snags and woody debris;
- Habitat attributes such as filamentous algae, macrophytes, bank overhang vegetation, trailing bank vegetation, blanketing silt and substrate anoxia;
- Bank stability;
- Bank vegetative stability; and
- Streamside cover.

During the field surveys, edge habitat was not present at many survey sites and therefore edge and bed samples were pooled to create composite samples of both edge and pool habitat. This is a recognised approach that allows the overall condition of each sampling location to be compared based on macroinvertebrate species composition and diversity (Barmuta *et al*. 2002, Turak and Waddell 2002). The data were compared to the AusRivAS models for both edge and pool, and where these differed, the lowest score was taken for that survey site.

3.2.5 Aquatic Flora

An aquatic flora assessment was undertaken along a 100 m reach in conjunction with aquatic habitat assessments, noting any aquatic flora species present and their relative abundance. This assessment targeted aquatic macrophytes and water dependant species only.

Aquatic flora can have many different forms, including:

- Submerged macrophytes: Growth is predominantly beneath the water surface although flowers and/or leaves of some species protrude the surface of the water;
- Floating macrophytes: Can be either attached or free floating (Sainty and Jacobs 2003). For example, the introduced water hyacinth floats freely around waterways

being moved across the surface by wind or currents, while the waterlilies are rooted to the substrate but the mature leaves float on the surface;

- Emergent macrophytes: Generally grow in the shallower waters and are rooted to the substrate with the majority of the plant (stems, flowers and leaves) protruding above the surface of the water (Sainty and Jacobs 2003); and
- Algae: Generally need to be fully submerged to survive.

Aquatic flora surveys were conducted at each survey site along a 100m reach. This assessment recorded the presence of all aquatic flora and their form (from the four categories listed above) in accordance with AusRivAS requirements. Surveys could not be effectively conducted in highly turbid and/or deep habitats, therefore aquatic flora surveys were conducted only within the accessible shallower waters.

Details of the riparian vegetation community present at each survey site were recorded as part of the standard AusRivAS habitat assessment of each survey site. Further assessment of riparian vegetation was conducted for the terrestrial flora ecology assessment as part of the EIS.

3.2.6 Aquatic Macroinvertebrate Communities

i. Quantitative Samples

At each of the 22 survey locations, macroinvertebrate samples were collected from bed habitat and edge habitat where both habitats occurred. Where only one kind of habitat was present, then macroinvertebrate samples were only taken from that habitat. Where possible, 10 m of habitat was surveyed along a 100 m stretch at each location. Bed samples were collected by disturbing the sediment with the feet within the 10 m section and the sample was then collected by sweeping a standard macroinvertebrate sampling net, with a 250 micron mesh, through the water. Edge samples were collected by vigorously sweeping the net in short upward movements at right angles to the bank to ensure the substrate is disturbed and to sweep through any suspended material. This sampling was consistent with the AusRivAS methodology (Turak and Waddell 2002).

Sediment samples were live-sorted for a minimum of 30 minutes to maximise the diversity of macroinvertebrates collected. This involved tipping the contents of the sampling net into white plastic trays which were square in shape and approximately 50 cm X 50 cm in size. Forceps and pipettes were used to extract all macroinvertebrate species observed. Active, common taxa were picked first, followed by searches for cryptic and/or small taxa. Specimens were placed in vials containing 70% ethanol and labelled for further analysis.

Macroinvertebrate analysis was undertaken by Dr Mirella Verhoeven, a recognised specialist in invertebrate taxonomy, who is also accredited to conduct AusRivAS assessments. Macroinvertebrate analysis involved identification using taxonomic keys and aquatic invertebrate guides. While most taxa were identified to family level, a few groups that are more difficult to take to family level such as mites (Acarina) and roundworms (Nematoda) and were subsequently left at order-class-phylum level.

The macroinvertebrate data collected from each survey site was further analysed using AusRivAS and Stream Invertebrate Grade Number – Average Level (SIGNAL) Analysis, which are two macroinvertebrate scoring methods that can provide an indication of the water quality and therefore aquatic health at the sample collection sites. These scoring methods are described in the following sections. The SIGNAL scoring was conducted in accordance with Version 2 of the scoring system (SIGNAL 2) which allows for identification at family level as well as order-class-phylum level. The SIGNAL 2 scoring was conducted at the family level for most taxa. However, for taxa such as mites and roundworms, the order-class-phylum grades were used consistently across the samples (Chessman 2003).

ii. AusRivAS Analysis

The macroinvertebrate data from each survey site were assessed using the AusRivAS modelling programme (*AUSRIVAS Macroinvertebrate Bioassessment Predictive Modelling Software V3.2.0*), to enable comparison to other AUSRIVAS data sets from the region. The AusRivAS models compare the abundance and identity of macroinvertebrates collected from a sample site with a database from a large number of reference sites throughout Australia. The AusRivAS models match the sample site to reference sites for similar types of streams in the same State or region. Reference sites are those believed to be least altered by human activity. If the test site is lacking the macroinvertebrate families that are expected to occur, according to the reference site database, it is likely that the test site is more affected by human influences than the reference sites (Turak and Waddell 2002).

Data for the AusRivAS samples were run through the *AUSRIVAS Macroinvertebrate Bioassessment Predictive Modelling Software V3.2.0* to determine the AusRivAS bandings for each survey site. This model is used to predict the condition of a site based on the invertebrate community present within the sample. The results from the model provide an indication of the level of biological impairment experienced at the targeted sites. The Observed/Expected (O/E) score (50%) provides a measure of biological impairment for each habitat within a site. The O/E score (50%) indicates the number of collected taxa that were predicted (expected) to occur with equal to or greater than 50% probability. Each O/E score (50%) occurs within the range of one of five Bands (X, A, B, C or D). The Band provides the description of biological impairment. The habitat that provides the lowest O/E score (50%) (e.g. the most biologically impaired) for a site provides the level of biological impairment for that particular site. This provides a conservative approach to management.

The AusRivAS levels of biological impairment at a site (i.e. 'Bands') can be categorised and are defined in **Table 3.3**.

Table 3.3 AusRivAS Ecological Integrity Bands

AusRivAS Band	Description	Macroinvertebrate Biodiversity Status	Interpretation Guide
X	More biologically diverse than reference sites	Over 112% more biodiversity than reference sites	More macroinvertebrate families found than expected. Potential biodiversity 'hot spot'. Possible mild nutrient enrichment.
R	Reference Site	Natural or near-natural levels of biodiversity	Presumed to be in a reference condition.
A	Reference condition	Similar levels of biodiversity to reference sites	Most or all of the expected families were found at the sample site. Water quality and/or habitat condition roughly equivalent to reference sites.
B	Significantly impaired	Approximately 16-45% of macroinvertebrate biodiversity has been lost	Several expected families not found. Water quality and/or habitat condition significantly impaired. Significant loss of macroinvertebrate biodiversity.
C	Severely impaired	Approximately 46-75% of macroinvertebrate biodiversity has been lost	Many expected families not found. Water quality and/or habitat condition severely impaired. Severe loss of macroinvertebrate biodiversity.
D	Extremely impaired	Approximately 66-100% of macroinvertebrate biodiversity has been lost	Extremely few of the expected families found. Extremely poor water quality and/or habitat condition. Extreme loss of macroinvertebrate biodiversity. Highly degraded.

Source: Gray (2004).

Stream Invertebrate Grade Number – Average Level (SIGNAL) Analysis

The SIGNAL index was developed by Chessman (1995) to assist in the bioassessment of water quality in Australia. Chessmen (1995) determined sensitivity grade numbers (between 1 and 10) for most freshwater macroinvertebrate families in Australia based on how sensitive each was to various pollutants and other physical and chemical factors. In 2003 Chessman (2003) devised a weighted system for analysing SIGNAL indices to provide an overall SIGNAL 2 score for the site. This weighted system of analysis takes into consideration relative family abundance and therefore community composition. The overall SIGNAL 2 score is calculated using the following steps:

- Determine SIGNAL grade for each different taxa present;
- Determine weighting of each taxa present based on the number of individuals collected using the categories outlined in Chessman (2003);
- Multiply the weight value by the SIGNAL grade for each taxa; and
- Divide the total weight determined for a site (add up all the weights) by the total SIGNAL grade x weight determined (add up all the values determined in the previous step) to provide an overall SIGNAL 2 score for the site.

SIGNAL 2 scores are then interpreted using bi-plots and compared against the number of families recorded at each site. The bi-plots can then be divided into quadrants with each separate quadrant identifying the particular conditions occurring within a site (**Figure 6**). The boundaries that determine the quadrants are generally based on background assessments from the regional area. However, stream specific boundaries can be identified if sufficient reliable data are available. To date, all previous monitoring undertaken within the region has applied the boundaries for each quadrant based on a whole of Australia assessment undertaken by Chessman (2003) (designated interim boundaries). These boundary values will be adopted for the current study to aid in ease on comparison with past assessments. Use of the interim boundaries is an accepted approach.

iii. EPT Taxa Richness

The EPT group of macroinvertebrates are three orders of insects that are especially sensitive to disturbance and are generally present in very low numbers in degraded water bodies. The three orders are; Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). These macroinvertebrate orders are considered sensitive to changes within their environment. Therefore, a low number of families collected from these orders (compared to the guidelines values) may suggest habitat degradation.

iv. Macrocrustacean Samples

Four collapsible box traps were set at five survey sites to target crustaceans over three nights. Due to the difficulties associated with accessing some of the survey sites (i.e. distance, etc.), it was not feasible to return to many of the survey sites to check traps, and therefore box traps were only set in locations that allowed for daily checking (i.e. survey sites

A1, A6, A8, A16 and A19) (**Table 3.4**). These box traps were approximately 45 cm long and 25 cm high and wide, covered with 3 mm mesh. The box traps were baited with raw meat and left for three days at each location. The traps were checked daily, and all animals captured were identified, their abundances recorded, and then released back into the water. A total of 60 trap nights were conducted in the study area.

Table 3.4 Fish and Macrocrustacean Survey Effort Employed at Each Survey Site

Survey Site	Date	Average Depth (m)	Method	Total Effort (hours)
Drainage lines in headwaters of Pigeonhole Creek catchment				
A13	23/05/14	0.5	Dip net	0.25
A14	23/05/14	1.0	Dip net	0.25
A21	30/10/12	0.75	Dip net	0.25
A22	30/10/12	0.65	Dip net	0.25
Drainage lines in tributaries of Tomahawk Creek catchment				
A3	18/05/12	0.75	Seine net	0.25
A4	18/05/12	1.2	Seine net	0.25
A5	18/05/12	0.2	Dip net	0.25
A10	22/05/12	1.0	Seine net	0.5
A11	22/05/12	1.5	Seine net	0.5
A15	23/05/12	0.5	Dip net	0.25
A17	24/10/12	0.2	Dip net	0.25
A18	25/10/12	0.5	Dip net	0.25
A20	26/10/12	1.2	Seine net	0.25
Drainage lines in headwaters of North Creek catchment				
A1	17/05/12	0.5	Seine net	0.5
		0.5	Box trap	72
A2	17/05/12	0.5	Seine net	0.25
Northern seasonal wetland				
A12	23/05/12	0.3	Dip net	0.25
Southern seasonal wetland				
A8	19/05/12	0.8	Seine net	0.5
		0.8	Box trap	72
A9	19/05/12	1.0	Seine net	0.5
Red Dog Dam				
A19	26/10/12	1.2	Seine net	0.5
		1.2	Box trap	72

Survey Site	Date	Average Depth (m)	Method	Total Effort (hours)
Southern farm dam				
A6	19/05/12	1.0	Seine net	0.5
		1.2	Box trap	72
A7	19/05/12	0.6	Seine net	0.5
A16	24/10/12	1.2	Seine net	0.5
		1.2	Box trap	72

3.2.7 Aquatic Vertebrates

i. Fish

Fish communities were surveyed using a combination of seine netting and dip nets, depending on habitat type. A seine net with 1 cm mesh was used at large pools, dams and the seasonal wetland areas, in which the net was dragged through the water by two people at each survey location where sufficient water was present. The seine net was approximately 4 m long, and the bottom edge was weighted with lead to maximise the depth sampled. The length of the seine transects was determined by the habitat characteristics (i.e. depth, length and presence of woody debris) of the water body and generally did not exceed 10 m for each trawl.

A hand-held dip net was used to survey the smaller remnant pools. The dip net had approximately 1 cm mesh and was dragged through the water by one person. This is a standard technique that has also been used at the proposed Carmichael Coal Mine (GHD 2012).

After each trawl, if fish were caught, they were placed in a bucket of water for recovery and processing, and then returned to the water body after identification. Processing involved counting, identifying, measuring (to determine life history stage) and photographing the fish.

Table 3.4 outlines the fishing techniques that were employed at each survey site during the surveys.

ii. Turtles

Observations of each of the 22 survey sites were undertaken prior to fish surveys to determine turtle presence. The majority of the survey sites consisted of remnant pools in ephemeral drainage lines, and were small in size and therefore if turtles were present they would have been readily recorded. No snorkelling surveys were undertaken in larger water bodies (i.e. the dams) due to the high degree of turbidity (i.e. low visibility) of the water.

3.2.8 Water and Sediment Quality

i. In-situ Water Quality Measurements

At each of the 22 survey locations, a range of water quality measurements were sampled *in situ* during both the May 2012 survey and the October 2012 survey using a 90 FLT Multi-parameter water quality meter. The following *in-situ* parameters were recorded:

- Alkalinity (as mg/L of $CaCO^3$): Measure of the buffering capacity of the water;
- Electrical conductivity (EC) (µS/cm): Measure of the total concentration of inorganic ions (salts) in the water;
- Dissolved oxygen (DO) (ppm): Reflects the equilibrium between oxygen consuming processes (e.g. respiration) and oxygen releasing processes (e.g. photosynthesis);
- Temperature (°C): Temperature of the water at the time of sampling;
- pH: Measure of the acidity or alkalinity of the water; and
- Turbidity (NTU): Measures the presence of suspended particulate and colloidal matter such as suspended clay, silt, phytoplankton and detritus.

ii. Laboratory Water and Sediment Quality Measurements

In addition to the *in-situ* water quality parameters listed above, laboratory water quality analysis for nitrogen and phosphorus (nutrients) was undertaken on all water samples collected in May 2012 and October 2012. Water for nutrient samples was collected in appropriate acidified collection bottles.

Additional water samples for the analysis of metals, major cations and anions were collected during the second survey period in October 2012. Water and sediment for laboratory analysis of metals, major cations and anions was collected from a total of eight survey sites (A15 to A22) during the October 2012 surveys. A total of three water samples were collected for laboratory water analysis from each of these survey sites (a total of 24 samples). Collection was made using the appropriate bottles for each parameter and water samples for metals were passed through a filter prior to bottling.

The water parameters tested are as follows: hydroxide alkalinity as $CaCO_3$ (mg/L), including carbonate alkalinity, bicarbonate alkalinity and total alkalinity; sulfate as SO_4 - turbidimetric (mg/L); chloride (mg/L); calcium (mg/L); magnesium (mg/L); sodium (mg/L); potassium (mg/L); aluminium (mg/L); antimony (mg/L); arsenic (mg/L); beryllium (mg/L); barium (mg/L); bismuth (mg/L); cadmium (mg/L); chromium (mg/L); copper (mg/L); cobalt (mg/L); nickel (mg/L); lead (mg/L); zinc (mg/L); lithium (mg/L); manganese (mg/L); molybdenum (mg/L); selenium (mg/L); silver (mg/L); strontium (mg/L); thallium (mg/L); thorium (mg/L); tin (mg/L); titanium (mg/L); uranium (mg/L); vanadium (mg/L); boron (mg/L); iron (mg/L); nitrite + nitrate as N (mg/L); total kjeldahl nitrogen as N (mg/L); total nitrogen as N (mg/L); total phosphorus as P (mg/L); total anions (meq/L); and total cations (meq/L).

Sediment samples were collected during the second survey period in October 2012 from survey sites A15 to A22 and were analysed for metals and particle size. A single sediment sample was taken from each of these survey sites and placed in a clean glass jar. The sediment parameters tested were as follows: moisture content (dried @ 103°C); aluminium (mg/kg); antimony (mg/kg); cobalt (mg/kg); iron (mg/kg); manganese (mg/kg); selenium (mg/kg); silver (mg/kg); vanadium (mg/kg); arsenic (mg/kg); cadmium (mg/kg); chromium (mg/kg); copper (mg/kg); lead (mg/kg); nickel (mg/kg); and zinc (mg/kg).

Water and sediment samples were refrigerated at the end of each survey day, and were submitted to ALS laboratories in Townsville for analysis.

iii. Data Analysis

Water quality and sediment data were analysed, tabulated and compared to the relevant guideline values, including the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council [ANZECC] and Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ] 2000), focussing on:

- Volume 2 *Water Quality Guidelines for Aquatic Ecosystems*; and
- Volume 3 *Water Quality Guidelines for Primary Industries*, specifically stock drinking water guidelines.

3.3 Limitations

The study area is largely dry and has limited freshwater habitats. The aquatic habitats present in the study area consist largely of ephemeral drainage lines. The first round of field survey in May 2012 was conducted as close as practicable to the end of the wet season, and many ephemeral drainage lines still contained water, although none were flowing at the time of that survey. These consisted mainly of non-flowing pools, dams and seasonal wetlands. The largest ephemeral drainage lines in the study area were sampled during the May 2012 field survey; however it is likely that macroinvertebrate assemblages recorded may be different to those that are present during peak flows during the wet season. However, it was not feasible to sample at that time due to the difficulties of access.

The second round of field survey was conducted towards the end of the dry season in northern Queensland (October 2012) and the majority of the pools were dry, and the seasonal wetland areas had retracted to pools of water in the bases of excavated farm dams.

Water samples were analysed for an additional suite of water quality parameters during the second round of sampling in October 2012, including dissolved metals, anions and cations. The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000) were used to provide a benchmark comparison, however the ephemeral drainage lines in the study area were not typical of upland waterways and were

not flowing at the time that water samples were taken. Nevertheless, these results provide an indication of the water quality of the survey sites at the time of the field survey.

It should be noted that AusRivAS is designed to assess bed (riffles, rocky beds, sandy beds) and edge habitats within rivers as these can easily be accessed by land based surveyors. It is therefore not an ideal bioassessment method for dams and wetlands as no comparable reference sites are available in the model and the habitat predictor variables fall outside the values of the model. Nevertheless, it provides a broad indication of the habitat quality in dams and wetlands in the study area.

Temperature was not recorded for survey sites A1, A2, A3, A4 A5 and A20 due to equipment malfunction. Turbidity was also not recorded from survey site A19; the meter did not read the value of turbidity at this survey site due to the excessive degree of turbidity of the water. DO was recorded in the field as ppm, and converted to percent saturation to allow for comparison with the water quality guidelines.

3.4 Stygofauna

"Stygofauna" is a collective term for microscopic, aquatic animals that live in groundwater. They are characteristically "stygobites", meaning animals that have evolved to live in interstitial groundwater. Stygofaunal species are generally restricted to subterranean groundwater habitats and characterized morphologically by loss or severe reduction of eyes and pigment, often accompanied by attenuation of the body and/or appendages (especially the antennae).

Stygofaunal communities are often dominated by crustacean invertebrates, but also contain oligochaetes, insects, other invertebrate groups and occasionally fish. Stygofauna are known from limestone, calcrete, and fractured rock aquifers, but are most abundant in alluvial aquifers (Hancock *et al.* 2005).

3.4.1 Overview of Groundwater Setting

The relevant geology within the study area comprises (with increasing depth):

- A veneer of highly weathered Tertiary sediments and localised fluvial Quaternary sediments;
- Triassic sediments of the Clematis Sandstone;
- Triassic sediments of the Rewan Formation; and
- Permian Betts Creek Beds including coal seams.

The hydrogeology of each stratigraphic unit is described in the following sections. The groundwater distribution within each geological unit is discussed in **Section 4.8**.

i. Quaternary Sediments

As discussed above, stygofauna are most abundant in aquifers hosted by alluvial deposits laid down by river (fluvial) systems.

Published regional geological mapping indicates the presence of Quaternary sediments associated with present day drainage features within the study area and surrounding area. The distribution of these sediments in the vicinity of the study area was further investigated through targeted groundwater drilling and stream geomorphology assessments. These assessments are discussed in the EIS Groundwater Report and the EIS Surface Water Section, respectively.

These studies confirmed that the ephemeral drainage lines and overland flowpaths present within the study area and downstream catchment are characterised by rock channels or exposed Tertiary materials. Extensive, deep alluvial deposits and associated shallow groundwater are therefore absent from the study area and surrounding area. Quaternary sediments present in the vicinity of the study area are limited to thin (less than 1 m) patches of mud and gravel that dry quickly following flow events.

The absence of shallow groundwater is further evidenced by the documented history of difficulties in finding water for cattle in the grazing properties that make up the study area. There are no confirmed alluvial bores in the vicinity of the study area.

This contrasts with the extensive alluvial deposits associated with the regionally significant Belyando and Carmichael River systems. These alluvial deposits are recharged by direct rainfall to large catchments and seepage from major rivers during periods of surface flow. These alluvial deposits are known to support a perennial water table and exhibit high yields and permeability. The Belyando River alluvium is located over 40 km downstream of the study area and Carmichael River alluvium is located in a separate catchment from the study area.

ii. Tertiary Sediments

The Tertiary sediments comprise claystone and weakly indurated sandstone and siltstone. This unit is a highly weathered, low to moderate permeability detrital deposit that covers much of the low-lying areas either side of the Darkies Range ridgeline. These sediments typically increase in thickness with distance from Darkies Range and within the project site range from zero to 60 m. The Tertiary sediments are thin or absent on the elevated ridge known as Darkies Range.

In elevated areas, recharge is diffuse and limited to sporadic rainfall events over small catchment areas. As a result of the limited recharge, the localised Tertiary sediments along Darkies Range are dry and unsaturated. In the lower lying areas beyond Darkies Range, recharge is expected to be enhanced as the topography transitions from the sloping ridge to flatter plains, and the diffuse rainfall catchment area increase.

A water table forms within these sediments in the south-east of the project site and extends east towards the Belyando River. The hydraulic gradient of this groundwater body is also to

the east, reflecting the regional topography and surface water catchment setting. Where present within the project site the water table is generally deep (25 to 55 m below ground level) and entirely disconnected from local drainage features. Further east, the water table is typically 15 to 20 m below North Creek and 20 to 25 m below Tomahawk Creek. Groundwater from this unit is likely to discharge to the Belyando River.

iii. Clematis Sandstone

The Clematis Sandstone is a massive sandstone unit, with minor interbeds of siltstone and claystone. This unit outcrops to form the western slopes of Darkies Range where it is up to 200 m thick along the ridgeline. In this area, the formation is deeply weathered resulting in clay-bound, low to moderately permeability unit.

Due to the prominence of the outcropping relative to the surrounding area, the Clematis Sandstone is generally dry within the study area. Where present in this area, a water table is present at depths in excess of 100 m.

In the north of the project site, a normal fault is present in this unit and the underlying Betts Creek Beds. To the east of the fault, a thin wedge of Clematis Sandstone has been downthrown by approximately 100 m and is now truncated against the Rewan Formation on the west of the fault. In this area, the deeper Clematis Sandstone lies below the water table. The saturated thickness of this unit reaches 50 m close to the fault and gradually reduces to the east as the base of the unit rises above the water table.

The generally dry nature of the Clematis Sandstone and relatively deep water table within the vicinity of Darkies Range indicate a low rate of groundwater recharge in this area. Groundwater flow reflects surface topography and catchment boundaries, with limited discharge into overlying formations. Lake Buchanan is an inferred discharge zone for the Clematis Sandstone groundwater. The salt pans that surround Lake Buchanan and the saline water quality indicate that volumes of groundwater discharging to the lake are low and readily removed by evaporation.

iv. Rewan Formation

The Rewan Formation is a thinly interbedded sequence of siltstone, claystone and minor fine grained sandstone. This unit outcrops along the eastern margin of Darkies Range where the Clematis Sandstone has been removed by erosion. This unit has also been subject to erosion and disconformably overlies the Betts Creek Beds. The potentiometric groundwater surface is relatively deep under Darkies Range where groundwater levels within the Rewan Formation can be more than 100 m below the surface.

The Rewan Formation is a recognised regional aquitard and acts as a basal confining unit to the overlying Clematis Sandstone aquifer. This unit is characterised by low primary porosity and as a result, groundwater movement is controlled by local fracture sets. Where fractures are intersected this unit shows slightly higher permeability, and conversely, where limited fractures are intersected this unit shows lower permeability associated with the primary porosity. Bulk permeability of this unit is therefore constrained by the degree of connection between any localised fractures. This means that at the regional scale the representative

average hydraulic conductivity is expected to be towards the lower end of the values measured by field testing and private bores.

Rainfall recharge to the Rewan Formation is very low due to limited diffuse rainfall infiltrating Darkies Range and the overlying Tertiary sediments. Runoff from the eastern slopes of Darkies Range may concentrate at the break of slope and act to locally enhance recharge into this unit. However, recharge is further limited by the layered low permeability of this unit. The generally very low rates of recharge are confirmed by the typically dry and unsaturated nature of these sediments along Darkies Range. Where present in this unit, the potentiometric groundwater surface is typically deep (i.e. 100 m below ground level).

Groundwater movement is a subdued reflection of the typography and surface water catchments. Limited discharge into overlying formations is the main discharge mechanism. However, discharge volumes similarly very low due to the very low rates of groundwater recharge.

This unit is typically dry and unsaturated at the project site.

v. Betts Creek Beds

The Betts Creek Beds sub-crop under the Tertiary sediments immediately east of Darkies Range and dip gently towards the west. The sub-cropping Betts Creek Beds are deeply weathered and the coal seams are typically absent within this weathered profile. As this unit dips under Darkies Range, the depth increases to between approximately 200 m and 450 m at the western extent of the project site.

Groundwater storage and movement occurs within the cleats that intersect the coal seams. Other sediments in the coal overburden and interburden sequence exhibit very low permeability and form discrete confining units between the seams. The Betts Creek Beds may therefore be categorised into the following hydrogeological units:

- Hydraulically "tight" and hence very low yielding to essentially dry sandstone and siltstone that comprise the majority of the Betts Creek Beds inter-burden/overburden; and

- Low to moderately permeable coal seams which are the primary water bearing strata within the Betts Creek Beds.

Data shows that limited recharge occurs through the elevated topography of Darkies Range into the underlying Betts Creek Beds. However, this recharge is limited by the layered, low permeability interburden and overlying Rewan Formation that retard downward flow. Slightly more recharge is expected where the coal seams subcrop against the weathered Betts Creek Beds, although the clayey nature of this weathered material will also limit recharge. Ephemeral runoff from Darkies Range that collects in drainage lines and the break of slope are also considered areas where recharge to the Betts Creek Beds could occur, although the recharge volumes will be limited by the small size of these recharge zones and the thickness of overlying Tertiary sediments. Overall, the Betts Creek Beds recharge rate will be low. The relatively deep water levels support this conclusion.

Groundwater movement is a subdued reflection of the typography and surface water catchments (i.e. from topographically elevated areas to lower lying parts of the landscape). Darkies Range acts as a groundwater divide, with groundwater flowing west towards Lake Buchanan, and east to south-east following the surface water catchments generally towards the Belyando River.

Limited discharge into overlying formations is the main discharge mechanism. However, discharge volumes are similarly very low due to the very low rates of groundwater recharge.

3.4.2 Stygofauna Investigation

A stygofauna study was undertaken in accordance with the Western Australian Environmental Protection Authority's (EPA's) guidelines for assessing groundwater systems, *Guidance for the Assessment of Environmental Factors – Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia No. 54a 2007* (Western Australia EPA 2007), which are currently viewed as the best practice methods for assessing stygofauna throughout Australia.

A desktop review of regional and local groundwater studies, stygofauna studies and other relevant technical reports was undertaken. This included publicly available reports prepared in relation to the Carmichael Coal Mine Project (GHD 2012). This information indicated a low potential for the presence of significant stygofauna assemblages within the study area.

A site investigation was developed to confirm this initial assessment. The site investigation included collection of groundwater samples for stygofauna testing and collection of field data on groundwater quality. Samples were obtained from groundwater monitoring bores installed in the relevant geological strata found within the study area. Samples were collected from bores where groundwater was available. The Tertiary sediments, Clematis Sansdstone, Rewan Formation and Betts Creek Beds yielded sufficient groundwater to allow stygofauna sampling. Details of the groundwater monitoring bores are provided in the EIS Groundwater Report.

Groundwater samples were collected in accordance with the EPA's guidelines for assessing groundwater systems, *Guidance for the Assessment of Environmental Factors – Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia No. 54a 2007* (Western Australia EPA 2007) between 31 March 2014 and 3 April 2014, and analysed for stygofauna. The samples were collected from the bores shown on **Figure 7** and summarised in **Table 3.5**.

Stygofauna sampling for the project was conducted by Northern Resource Consultants within existing groundwater bores that had been established for at least 6 months prior to sampling, as required by the Western Australia EPA's guidelines. A stygofauna net trawl was placed at 15 groundwater bores within the study area and one 100 mL water sample was taken from each bore prior to stygofauna sampling. The following steps were undertaken to collect each stygofauna sample within the bores:

- A plankton net (63 µm mesh net) (that contained a small lead weight) was lowered gently into the bore;

- The net was lowered to the bottom of the bore and oscillated a few times vertically over the lower 50 cm of the bore before it was pulled back up to the surface; and
- The contents of the plankton net were rinsed with methanol or ethanol and placed into a labelled 250 mL vial (of which the contents of the vial were topped up with alcohol to preserve the sample).

This process was repeated six times at each bore. Electrical conductivity of the water within each bore was also recorded.

The stygofauna sampling conducted was consistent with the Western Australian EPA's (2007) *Guidance Statement No. 54a, Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia*. In accordance with guidelines, bores were not purged prior to sampling.

Table 3.5 summarises the monitoring bores sampled, the targeted strata and the depth of the groundwater bore response zone.

Table 3.5 Stygofauna Sampling

Bore	Easting	Northing	Sample Collection Date	Bore Response Zone Depth (m)	Strata Sampled
MB03	414830	7589056	2/04/2014	81.75	Betts Creek Beds including coal seams
MB06	413874	7590369	1/04/2014	105.0	Betts Creek Beds including coal seams
MB07	415547	7590584	3/04/2014	44.0	Tertiary Sediments
MB08	415553	7590570	3/04/2014	79.0	Betts Creek Beds including coal seams
MB10	414439	7592830	2/04/2014	50.53	Betts Creek Beds including coal seams
MB13	408638	7594223	2/04/2014	92.3	Rewan Formation
MB14	407589	7598323	2/04/2014	138.0	Rewan Formation
MB15	409522	7602328	1/04/2014	103.4	Rewan Formation
MB17	417118	7585137	3/04/2014	66.65	Tertiary Sediments
MB21	407809	7592771	2/04/2014	120.5	Clematis Sandstone
MB22	409254	7588046	2/04/2014	89.5	Clematis Sandstone
MB24	408081	7596736	1/04/2014	118.5	Rewan Formation
MB26	407115	7601043	1/04/2014	109.6	Rewan Formation
MB28	409796	7599783	1/04/2014	126.0	Rewan Formation
MB33	407079	7604221	31/03/2014	137.0	Clematis Sandstone / Rewan Formation

Stygofauna samples taken by Northern Resource Consultants were sent to the laboratory for further analysis. The resultant samples collected using the above methods were placed in separate sample jars containing at least 70% ethanol for transportation prior to sorting and identification.

3.4.3 Taxonomy Identification

All stygofauna samples collected via the bore monitoring were sent to a specialist taxonomist (Associate Professor Grant Hose from Macquarie University) for analysis and identification of stygofauna (**Appendix E**). A total of 24 samples were sent to analysis and identification.

Rose Bengal stain was added to each sample to assist in the identification of fauna in the sample. The stain dyes organic material pink/red, making it easy to find against the aquifer sediments, which are typically white and brown.

All samples were processed by first sieving the sample through a 63-um mesh sieve. The sieve contents were placed into a petri dish and were progressively examined under a dissection microscope at >60 x magnification. The entire contents of each sample were processed. All animals found were removed and preserved in 100% ethanol. Animals were identified using morphological characters to the lowest practical level, which for the taxa found, was Class or Order.

As part of quality assurance, approximately 20% of the samples were processed a second time by a different operator. No animals were recovered during the second processing.

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Chapter **4**

Results

This section provides a description of the aquatic biodiversity values present in the study area. The following results are discussed in this section:

- Desktop study results (**Section 4.1**);
- Aquatic habitat assessment of the study area (**Section 4.2**);
- Aquatic flora survey results (**Section 4.3**);
- Macroinvertebrate results (**Section 4.4**);
- Vertebrate fauna survey results (**Section 4.5**);
- Water quality results, including results of sediment testing (**Sections 4.6** and **4.7**); and
- Stygofauna survey results (**Section 4.8**).

4.1 Desktop Study Results

4.1.1 Threatened Aquatic Species

No threatened aquatic species listed under the EPBC Act or the NC Act were found from the EPBC Act Protected Matters Search Tool (**Appendix A**), the Wildlife Online database search (**Appendix B**) or within the Queensland Museum Database search. No threatened aquatic species listed under the EPBC Act or NC Act were recorded from surveys undertaken at the proposed Carmichael Coal Mine (GHD 2012).

4.1.2 Queensland Fisheries Act

Figure 8 provides the DAFF's Queensland waterways for waterway barrier works mapping. It shows that the majority of waterways in the study area are mapped as being green (low risk of impact) or amber (moderate risk of impact). The upper reach of an ephemeral drainage line in the Tomahawk Creek catchment is mapped as purple (major risk of impact), and there are two waterways mapped as red (high risk of impact).

No declaration of fish habitat has been made for the study area.

4.1.3 Queensland Wild Rivers Act

A small section (14 ha) of the western area of the study area sits within the Coopers Creek wild river area, under the *Coopers Creek Basin Wild Rivers Declaration Area* (EHP 2011). The small section of the Coopers Creek wild river area that is within the study area is not classified as a high preservation area. Further detail on wild rivers is provided in the EIS Regulatory Framework Section.

The EHP is currently proposing to revoke this declaration area, to be replaced with alternative protection measures for Queensland's western river systems.

4.1.4 RAMSAR Wetlands and Nationally Important Wetlands

The study area is not located within an area designated as a RAMSAR wetland and there are no such places located near to the study area. The nearest RAMSAR wetland to the study area is the Bowling Green Bay RAMSAR site, located approximately 250 km by direct line from the study area (**Figure 3**). RAMSAR wetlands are not a controlling provision for this project under the EPBC Act.

The closest Nationally Important Wetlands to the study area are Lake Buchanan, Bingeringo Aggregation and Lake Galilee. Lake Buchanan is located 17 km via direct line to the west of the study area, Bingeringo Aggregation is located 30 km via direct line to the north east of the study area and Lake Galilee is located 45 km via direct line to the south-west of the study area (**Figure 3**).

As indicated in the EIS Surface Water Section, both Lake Buchanan and Lake Galilee lie within closed, internally draining sub-basins located in the Thomson Basin. The Thomson Basin is a sub-catchment of the Cooper Creek Basin. The catchment of Lake Buchanan is bounded to the east by Darkies Range (**Figure 4**). The catchment of the Bingeringo Aggregation lies to the north of the Study Area and is within the Bully Creek catchment. The study area does not lie within the catchments of Lake Buchanan, Bingeringo Aggregation or Lake Galilee and will not impact surface water drainage to these Nationally Important Wetlands.

The process of open cut and underground mining reduces groundwater pressures in surrounding rock beyond the zone directly mined or cracked by subsidence. This depressurisation can reduce groundwater levels in the surrounding hydrogeological units. A detailed 3D numerical groundwater model has been developed to assess the potential zone of groundwater depressurisation associated with the project. Modelling predictions presented in the EIS Groundwater Report confirm that depressurisation is unlikely to significantly impact water levels in these lakes, or the associated wetlands. Further detail is provided in the EIS Groundwater Report. These wetlands are consequently not discussed further in this Aquatic Ecology and Stygofauna Impact Assessment.

4.1.5 Map of Referable Wetlands

The map of referable wetlands shows that there is one HES wetland (with an associated 500 m trigger area) and one GES wetland located within the north of the study area

(**Figure 9**). The HES wetland is described in more detail below in **Section 4.2.2** and is assessed in more detail in **Section 5.2.3**.

4.1.6 High Ecological Value Waters

Draft mapping prepared by the DNRM indicates that the closest high ecological value waters to the study area are located approximately 17 km from the study area at Lake Buchannan. In addition, NQ Dry Tropics Land & Water Solutions (2009) has also mapped high ecological value waters in the Upper Burdekin Basin. Based on NQ Dry Tropics Land & Water Solutions (2009) mapping no high ecological value waters are present within the study area.

4.2 Aquatic Habitat Assessment

The study area comprises three different aquatic habitat types, namely naturally occurring ephemeral drainage lines; seasonal wetlands; and artificial farm dams (**Figure 5**). No permanently flowing waterway occurs in the study area, and all of the drainage lines that occur are ephemeral and dependent on seasonal rainfall. These originate in the higher altitude areas to the west of the study area and flow eastwards towards lower, flatter land (**Figure 5**).

No groundwater fed waterways are present in the study area, and the only sources of water in the dry season are remnant pools in some ephemeral drainage lines, and farm dams that are deep enough to retain water. No artesian springs or bores are present in the study area.

The aquatic habitats present in the study area are discussed in more detail below. **Photograph 4.1** shows the upstream and downstream view from each survey site. Note that survey site A12 does not have an upstream and a downstream photograph as survey site was located at the northern seasonal wetland, which is discussed in **Section 4.2.2**.

Drainage lines in headwaters of Pigeonhole Creek catchment

Site A13 - upstream

Site A13 - downstream

Site A14 - upstream

Site A14 - downstream

Site A21 - upstream

Site A21 - downstream

Drainage lines in headwaters of Pigeonhole Creek catchment (continued)

Site A22 - upstream

Site A22 - downstream

Drainage lines in tributaries of Tomahawk Creek catchment

Site A3 - upstream

Site A3 - downstream

Drainage lines in tributaries of Tomahawk Creek catchment (continued)

Site A4 - upstream

Site A4 - downstream

Site A5 - upstream

Site A5 - downstream

Site A10 - upstream

Site A10 - downstream

Site A11 - upstream

Site A11 - downstream

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Drainage lines in tributaries of Tomahawk Creek catchment (continued)

Site A15 - upstream

Site A15 - downstream

Site A17 - upstream

Site A17 - downstream

Site A18 - upstream

Site A18 - downstream

Site A20 - upstream

Site A20 - downstream

Drainage lines in headwaters of North Creek catchment

Site A1 - upstream

Site A1 - downstream

Site A2 - upstream

Site A2 - downstream

Northern seasonal wetland

Site A12

Site A12

Southern seasonal wetland

Site A8 – upstream

Site A8 – downstream

Site A9 – upstream

Site A9 – downstream

Red Dog Dam

Site A19 – upstream

Site A19 – downstream

Southern farm dam

Site A6 - upstream

Site A6 - downstream

Site A7 - upstream

Site A7 - downstream

Site A16 - upstream

Site A16 - downstream

Photograph 4.1 Upstream and Downstream Photographs of Aquatic Survey Sites

4.2.1 Ephemeral Drainage Lines

Numerous ephemeral drainage lines occur in the study area that only flow for short durations when sufficient rain has fallen. Remnant pools form along these ephemeral drainage lines during the wet season and generally dry out during the dry season. Accordingly, these ephemeral drainage lines have very different aquatic communities to permanent, flowing water bodies.

Water pools were present in several of the ephemeral drainage lines during the May 2012 field surveys, however no areas of flowing water were present and the ephemeral drainage lines consisted only of isolated remnant pools (e.g. survey sites A5 and A13; see

Photograph 4.1). During the October 2012 and October 2013 field surveys, the vast majority of these had dried out, and the only ones left were the deeper pools or those on clay or rock substrate (e.g. survey site A21; see **Photograph 4.1**). The ephemeral drainage lines usually had no distinct riparian zone, and the surrounding land types extended up to the banks. Depending on the location, some areas had a very wide channel (i.e. 2 to 10 m) which indicated high water levels during the wet season.

The width of the remnant pools (where present) ranged from approximately 1 m to 4 m and the depth was between 30 cm and 1 m deep. The substrate comprised clay, rock or sand, and there was typically a high degree of silt. Rocks were present in some locations where flow velocities had been high during the wet season, but mostly the pools had a substrate of clay or sand, overlain with fine silt. Woody debris and snags were rare.

A remnant pool occurs in a drop hole in the upper tributaries of Tomahawk Creek (survey site A20). This remnant pool is situated at the head of a gorge approximately 85 m wide at its maximum width and is located at the termination of the gorge. It contained water in May 2012 and still provided a large pool in October 2012 (see survey site A20; **Photograph 4.1**). This was revisited in October 2013, and only an extremely small puddle of water was remaining that would likely have dried up completely before the advent of the next wet season.

The study area is currently used for cattle grazing, and in the majority of the ephemeral drainage lines, stock access had degraded the ephemeral drainage lines to varying degrees. This was mainly through bank erosion and nutrient enrichment through wastes.

The amount of aquatic habitat for aquatic macroinvertebrates such as in-stream vegetation, rocks and snags was variable between survey sites; however this is likely to be due to random variation and natural processes rather than as a result of human intervention. Some survey sites were particularly devoid of habitat structure, and few macroinvertebrates can colonise and survive on bare substrates, even if water quality is suitable (Chessman 2003).

The majority of the ephemeral drainage lines are unlikely to support significant freshwater fish communities due to a lack of both woody debris and macrophyte coverage for shelter and spawning; generally low levels and flow; and the intermittently dry nature of the ephemeral drainage lines. The ephemeral drainage lines are likely to be used by birds and amphibians, and several waterbirds were recorded adjacent to these areas, as well as frogs and tadpoles of several species in the water.

4.2.2 Seasonal Wetlands

Seasonal wetlands are areas that contain water after significant rainfall during the wet season and dry up during the dry season. Two seasonal wetlands occur in the study area (**Figure 5**).

In the north of the study area there is a natural seasonal palustrine wetland, namely the northern seasonal wetland (survey site A12; see **Photographs 4.1** and **4.2**, and **Figure 5**). Palustrine wetlands are non-tidal wetlands that have a cover of trees, shrubs or emergent

plants. These wetlands are typically shallower than lacustrine (lake) wetlands and include marshes, fens and seasonally inundated forests.

This seasonal wetland is approximately 127 ha in size (including the area mapped outside of the study area boundary), and has been mapped as a HES wetland by the EHP (**Section 4.1**). This seasonal wetland has been created by rainfall pooling and accumulating during the wet season, however it has been enhanced by the construction of a farm dam that helps retain water in this area. The substrate is clay in this area, and due to the low permeability of this soil type, the water accumulates, forming a wetland. This area is not dependent on groundwater recharge due to its relatively high elevation and the deep groundwater table in this area, and although it contained water during the May 2012 field survey after a significant and prolonged wet season, it was dry during the October 2012 and October 2013 surveys (**Photograph 4.2**). Drilling undertaken in the area of the northern seasonal wetland has determined that the watertable in this area of Darkies Range is very deep, being some 100 m below the land surface. This means the wetland does not interact with the underlying groundwater systems, and the source of the water is runoff from the local catchment. Further detail on the groundwater setting is provided in the EIS Groundwater Report.

The northern seasonal wetland is dominated by a canopy of River Reid Box (*Eucalyptus browneii*) and contains an understorey of sedges (**Photograph 4.2**). When it contains water (as observed in May 2012), this seasonal wetland provides good habitat for macroinvertebrates such as leaf litter, woody debris, macrophytes and fringing vegetation such as reeds and rushes. In May 2012 it contained macrophytes such as Native Willow Primrose (*Ludwigia octovalvis*) and Hansen's Nardoo (*Marsilea hirsuta*). When it contains water it also provides high quality habitat for amphibians and waterbirds, and numerous waterbirds were recorded utilising this area including the Intermediate Egret (*Ardea intermedia*) and the White-necked Heron (*Ardea pacifica*). That notwithstanding, its importance to waterbirds is likely to be reduced due to its drying out over summer.

May 2012 Survey

October 2013 Survey

Photograph 4.2 Northern Seasonal Wetland

One more seasonal wetland is located in the southern section of the study area, the southern seasonal wetland (**Figure 5**). The southern seasonal wetland only contained water during the May 2012 surveys (see survey sites A8 and A9; **Photographs 4.1** and **4.3**) and was dry in the October 2012 and October 2013 surveys (no photograph available). Typical canopy tree species of low lying areas were present such as River Red Gum (*Eucalyptus camaldulensis*) and a range of aquatic habitat features were present including emergent rushes and reeds as well as large woody debris. As this seasonal wetland dries out in the dry season, it is only able to offer habitat in the wet season.

Photograph 4.3 Southern Seasonal Wetland – May 2012 Survey

The EHP wetland mapping has identified a GES wetland along an ephemeral drainage line in the headwaters of Pigeonhole Creek catchment in the northern portion of the study area (**Figure 9**). This drainage line is highly ephemeral and was not flowing during any of the surveys. Three survey sites (A3, A14 and A21) were located along this ephemeral drainage line and data collected from these survey sites indicate that it does not constitute a wetland. Although some remnant pools were present and were sampled, there was no indication that this area conforms more to the description of a wetland than other ephemeral drainage lines in the study area. No macrophytes were present, and although some rushes such as Sticky Sedge (*Cyperus fulvus*) and Common Fringe-sedge (*Fimbristylis dichotoma*) were present, these species commonly occur in the study area on the fringes of remnant pools, and in any areas where water may remain longer after the wet season, and they are not considered to be an indicator of wetland habitat.

4.2.3 Farm Dams

Two farm dams are present within the study area. One of the farm dams, termed Red Dog Dam, has been developed by excavating a section of the seasonal wetland in the north of the study area. The other farm dam is located in the southern portion of the study area (**Figure 5**).

During the May 2012 surveys, Red Dog Dam was full, and due to its location adjacent to the seasonal wetland, it supported a high diversity of aquatic bird life (**Photograph 4.4**). However, in October 2012 (see survey site A19, **Photograph 4.1**) and October 2013 (**Photograph 4.4**), the water level in this dam had dropped significantly and it consisted of an excavated hole surrounded by bare soil. It was highly turbid, there was no fringing vegetation or woody debris and habitat values were very low.

The dam in the southern portion of the study area (i.e. the southern farm dam) is an artificial dam that is approximately 2 ha in size and approximately 2 m deep at the deepest point (see survey sites A6, A7 and A16; **Photograph 4.1**). Its condition varied substantially depending on the season. In the wet season (i.e. May 2012 surveys) it was full of water and overflowed, creating a large area of seasonal wetland habitat (survey sites A6 and A7; **Photographs 4.1** and **4.5**). In the October 2012 dry season however, the water had retracted significantly (survey site A16; **Photograph 4.1**). In October 2013, the water had retracted still further to just the excavated dam area (**Photograph 4.5**). During the October 2012 surveys this farm dam did not contain any fringing vegetation or aquatic macrophytes and it was surrounded by bare clay. No woody debris was present. Large numbers of waterbirds were observed in this area during the May 2012 field survey, however very few were observed in October 2012 and October 2013. This is likely due to the water quality of the dam which had deteriorated markedly by October and was highly turbid. The margins of the dam were very boggy and pugged by stock hooves and in October 2012 and 2013 and it provided low quality aquatic habitat.

May 2012 Survey

October 2013 Survey

Photograph 4.4 Red Dog Dam

May 2012 Survey

October 2013 Survey

Photograph 4.5 Southern Farm Dam

4.3 Aquatic Flora

No macrophytes were recorded at any of the ephemeral drainage line survey locations. The absence of aquatic flora communities within watercourses in northern Queensland is typical due to the fast flowing nature of the watercourses during the wet season. This shifts large volumes of sediment down the bed of the watercourses which reduces substrate stability and impacts macrophyte species ability to establish and grow.

Although no macrophytes were observed in the ephemeral drainage lines, sedges and rushes were present along the edges of the ephemeral drainage lines in locations with poor drainage. These included, for example, various sedges and rushes: Lax Flat-sedge (*Cyperus flaccidus*), Sticky Sedge, Saw Sedge (*Gahnia aspera*), Common Fringe-sedge and a rush (*Juncus continuus*).

Some macrophytes were observed in the northern seasonal wetland, including Native Willow Primrose and Hansen's Nardoo. These were not abundant, and they were not a significant component of the wetland. No macrophytes were recorded in the farm dams.

4.4 Macroinvertebrates

Aquatic macroinvertebrates are used as biological indicators of freshwater ecosystem health due to their sensitivity to changes in water quality, flow regime and general habitat condition (von der Ohe and Liess 2004). The presence or absence of particular species, diversity, composition and abundance of communities provide general measures of health which can be used to assess impacts on aquatic systems (Maher and Norris 1990). The condition and degree of ecological integrity of the aquatic survey sites was determined by inputting survey data into the AusRivAS macroinvertebrate predictive model (Turak and Waddell 2002) (**Section 4.4.2**).

4.4.1 Species Diversity

i. Macroinvertebrates

A total of 1,511 individual macroinvertebrates were recorded from 47 families in the study area (**Appendix C**), with an average diversity of macroinvertebrates per survey site of approximately 13 families. This level of diversity is very similar to that reported for the proposed Carmichael Coal Mine, in which 41 families of macroinvertebrates were recorded (GHD 2012). This relatively low macroinvertebrate diversity is likely to be due to the limited aquatic habitat in the study area and ephemeral nature of the habitat.

The families recorded consisted mostly of Veliidae (small water striders) (200 individuals), the truebugs Notonectidae (backswimmers) (199 individuals), Dysticidae (diving beetles) (174 individuals), Acarina (mites and ticks) and Corixidae (water boatmen) (92 individuals per family) (**Appendix C**). Other common taxa include the true-fly Chironominae (a subfamily of the Chironomidae) (84 individuals), Tanypodinae (subfamily of the true-fly Chironomidae [78 individuals]) and microcrustaceans (such as Cladocera [85 individuals] and Copepoda [84 individuals]) (**Appendix C**). These families were also commonly recorded

at the proposed Carmichael Coal Mine (GHD 2012). Taxa observed in fewer samples and/or lower abundances within the study area included Nematoda (roundworms) (2 individual), Lymnaeidae (freshwater snails) (3 individuals), and Hydrometridae (water measurers) (3 individuals) (**Appendix C**).

Notably absent or in very low numbers in all samples were the three orders that make up the EPT group, namely the Ephemeroptera (mayflies) (5 individuals), Plecoptera (stoneflies) (1 individual) and Trichoptera (caddisflies) (absent) (**Appendix C**). Studies conducted for the proposed Carmichael Coal Mine have similarly recorded only three individuals from the EPT group (GHD 2012).

Taxa that were predicted to occur in high numbers based on AusRivAS models (Turak and Waddell 2002), given their tolerance to disturbed conditions, but which were not observed at the survey sites included the gastropod Thiaridae, the crustaceans Atyidae (Shrimp) and Palaemonidae (shrimp) (**Appendix C**). As both the adult and larval stages of these families are fully aquatic (i.e. are not able to breathe air), the low numbers of these species may be due to the highly ephemeral nature of the water bodies within the study area.

The macroinvertebrate community at most survey sites were similar in abundance and diversity, with the exception of some survey sites (e.g. A4 and A5) where diversity was reduced but the abundance of some taxa were very high (**Appendix C**). Survey sites A1, A2, A11 and A15 had the greatest diversity (over 20 families) and highest abundance (over 100 individuals) (**Appendix C**). The lowest abundance was observed at survey sites A16 and A17, with 52 individuals recorded at each survey site (**Appendix C**).

The study area appears to lack taxa sensitive to disturbance/pollution. This may be due to a range of factors including the ephemeral nature of the aquatic habitat and the lack of in-stream and fringing vegetation. This is likely to be exacerbated by the presence of cattle and their associated impacts in the area such as fouling the ephemeral drainage lines and pugging of stream beds.

No threatened macroinvertebrates are known to occur in the locality or are considered likely to occur in the study area.

ii. Macrocrustaceans

Two macrocrustaceans were recorded from the study area:

- Redclaw (*Cherax quadricarinatus*); and
- Inland Freshwater Crab (*Austrothelphusa tranversa*).

The most conspicuous macrocrustacean recorded was the large predatory Redclaw. This species was not captured; however it was frequently recorded by analysing fragments of shell and claws that were regularly recorded along ephemeral drainage lines, particularly at feeding stations of the Water Rat. Given the available habitat, this species is expected to occur in aquatic habitat throughout the study area. This species is tolerant of a wide variety

of habitats and conditions and is also likely to be present at the dams and seasonal wetlands within the study area.

Numerous Inland Freshwater Crab shells were also observed in the study area, typically along dry beds of ephemeral drainage lines. This species makes burrows into the banks of freshwater rivers and creeks, drainage channels, pools, swamps and farm dams (Esser and Cumberlidge 2008). During the dry season, or in extended drought conditions, they plug their burrows with earth and go into a dormant state. This species can survive long periods of drought in these burrows, and emerge from their burrows in large numbers when the rains start (Esser and Cumberlidge 2008). Given the numerous shells of this species observed along the ephemeral drainage lines, it is likely that this taxon is common in the study area.

4.4.2 AusRivAS Analysis

Based on the diversity and abundance of invertebrates, the majority of aquatic survey locations (13 survey sites) were classified as Band B (significantly impaired), while five survey sites were classified as Band A (equal to reference site) and four were classified as Band C (severely impaired) **(Table 4.1**). Survey sites were surveyed at the end of the wet season (i.e. during optimum conditions).

This analysis shows that some of the survey sites are in relatively good condition. However as the AusRivAS model is not an ideal bioassessment method for ephemeral drainage lines, dams and seasonal wetlands and the survey sites show some degree of degradation, these results should only be taken as a general guide. Given the ephemeral nature of the majority of the drainage lines sampled, they are likely to conform to the good conditions of the AusRivAS model for a limited period during the wet season only.

Table 4.1 AusRivAS Bands for Each Sampling Location

Survey Site	AusRivAS Band
Drainage lines in headwaters of Pigeonhole Creek catchment	
A13	C
A14	C
A21	B
A22	B
Drainage lines in tributaries of Tomahawk Creek catchment	
A3	B
A4	B
A5	A
A10	B
A11	B
A15	A
A17	B

Survey Site	AusRivAS Band
A18	C
A20	B
Drainage lines in headwaters of North Creek catchment	
A1	A
A2	B
Northern seasonal wetland	
A12	B
Southern seasonal wetland	
A8	A
A9	B
Red Dog Dam	
A19	C
Southern farm dam	
A6	B
A7	A
A16	B

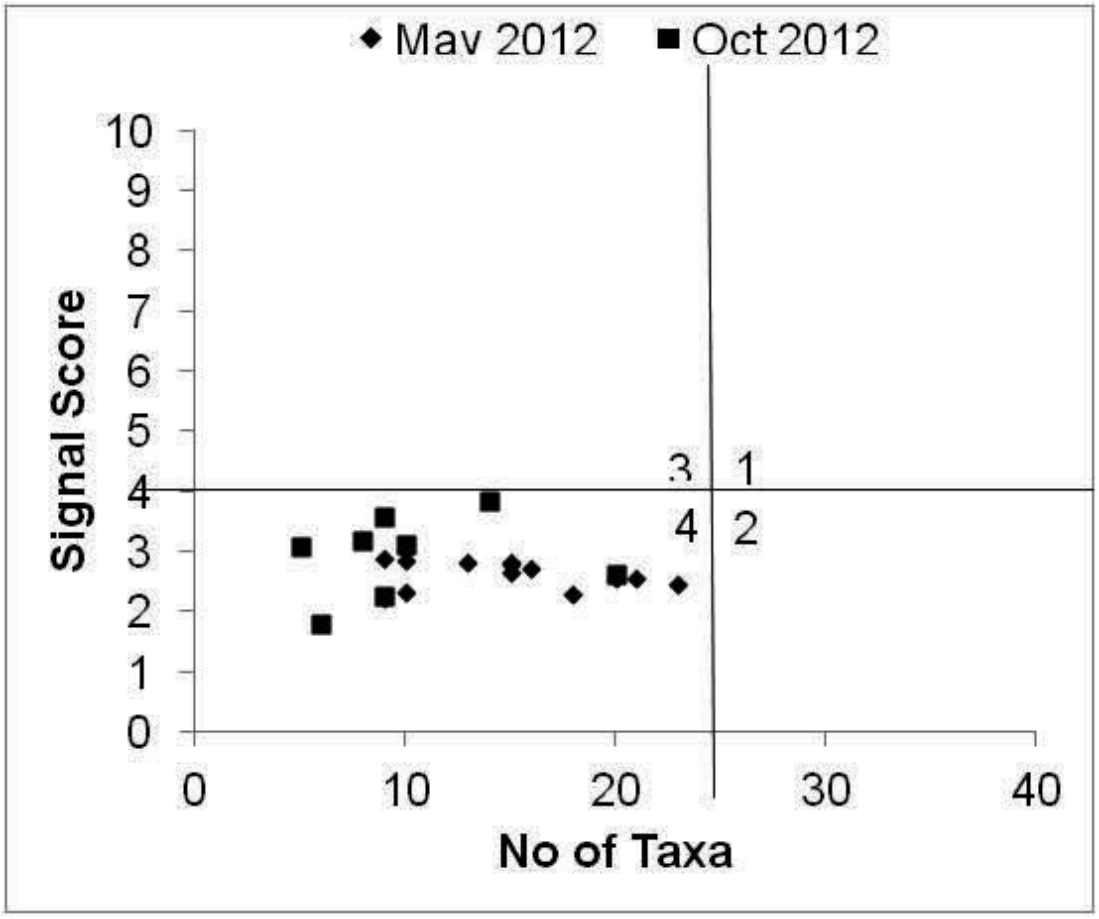
4.4.3 SIGNAL 2 Analysis

SIGNAL 2 analysis involves categorising the aquatic health of waterways on a scale of 1- 10 based on the environmental tolerance of the macroinvertebrates recorded. Relatively pristine sites would be expected to have high macroinvertebrate diversity, including taxa that are sensitive to pollution. These sites would have a high SIGNAL 2 score. Sites that are highly degraded are expected to support a lower diversity of macroinvertebrate species, and these are expected to be pollution tolerant species. These sites would have a low SIGNAL 2 score. It should be noted that although scores range from 1 to 10 (with site SIGNAL 2 score > 6 being healthy habitat and scores <4 indicating severe pollution), SIGNAL was originally developed for 'normal' streams with typical freshwater habitats. Streams with unusual water chemistry, wetlands and/or ephemeral streams can produce SIGNAL 2 scores which may not be representative.

SIGNAL 2 analysis has been conducted on the macroinvertebrates recorded from both survey periods (i.e. May 2012 and October 2012). The most common taxa recorded in the survey sites were true-flies, true bugs and beetles; generally those with low SIGNAL 2 grades indicating their tolerance to a range of environmental conditions, including poor water quality and common forms of water pollution, such as toxic chemicals, turbidity, salinity, and nutrient concentrations. Although Redclaw was excluded from SIGNAL 2 scoring due to the non-standardised method of capturing them (i.e. captures were not timed for the live-picking method when dip-netting) the species has a SIGNAL 2 score of 4 which indicates that the species is tolerant to poor water conditions.

SIGNAL 2 scores of the macroinvertebrates recorded from the study area have been plotted in a basic quadrant diagram, displayed in **Graph 2.** The scores represent general environmental conditions based on the abundance and diversity of taxa collected at each survey site, where survey sites that fall within Quadrant 1 are considered to have the highest ecological condition and survey sites in Quadrant 4 are considered to have the lowest ecological condition.

Scores observed from the study area are very low but this is a result of the relatively low abundances of the taxa observed, even where richness was high. Signal score plotted against total taxonomic richness in a bi-plot (**Graph 2**) provides an indication of the type of environment the samples were collected from based on their location on the plot. The division between quadrants is arbitrarily determined depending on (1) where sites fall on the bi-plot and (2) existing knowledge about site conditions. In this case, sites were similar with respect to water quality parameters (e.g. low pH and high turbidity) and adjacent land use (primarily grazing). Therefore the survey sites were grouped together on the bi-plot and subsequently all survey sites were placed into Quadrant 4 (**Graph 2**). Quadrant 4 is associated with urban, industrial or agricultural pollution, or the downstream effects of dams. These results are expected, as stock had access to all survey sites and there was evidence of habitat degradation by stock at several survey sites.



Graph 2: SIGNAL/Family BiPlot for each Survey Site

4.5 Vertebrate Fauna

4.5.1 Fish

Three species of fish were recorded from the study area, the Spangled Perch (*Leiopotherapon unicolor*), the Desert Rainbowfish (*Melanotaenia splendida*) and Agazziz's Glassfish (*Ambassis agassizii*) (**Table 4.2**). None of these fish species are listed under the NC Act or the EPBC Act. A total of 11 fish species were recorded from the proposed Carmichael Coal Mine (GHD 2012), which may be due to the fact that this survey site contains larger more permanent areas of water, unlike the project study area that only contains ephemeral drainage lines, seasonal wetlands and artificial farm dams.

No threatened fish have been recorded from the EPBC Act Protected Matters Search Tool or the Wildlife Online database (**Appendices A** and **B**) and none are considered likely to occur in the study area.

No pest fish species were detected during field surveys and no records of pest fish were identified within the locality. A number of introduced species are known to occur in the wider Burdekin Basin, although these species were not recorded from the study area.

Surveys for the proposed Carmichael Coal Mine also recorded these three species of fish, and did not record any threatened fish species listed under the NC Act or the EPBC Act (GHD 2012).

Table 4.2 Fish Species Recorded from the Study Area

Survey Sites	Spangled Perch (*Leiopotherapon unicolor*)	Desert Rainbowfish (*Melanotaenia splendida*)	Agazziz's Glassfish (*Ambassis agassizii*)
Drainage lines in headwaters of Pigeonhole Creek catchment			
A13		1	
Drainage lines in tributaries of Tomahawk Creek catchment			
A10		1	
Southern farm dam			
A6	2		
A16	1		1

The Spangled Perch (**Photograph 4.6**) was only recorded from the southern farm dam in May 2012 (survey site A6) and October 2012 (survey site A16) (**Table 4.2**). The Spangled Perch is one of Australia's most ubiquitous tropical freshwater fish, occupying a wide range of environments. It is often found in lagoons and dams (as in the study area) where it is often found to stunt (Herbert and Peeters 1995). The size of each fish was relatively uniform at approximately 10 cm long.

Photograph 4.6 Spangled Perch Recorded from the Study Area

The Desert Rainbowfish (**Photograph 4.7**) was recorded from two locations in remnant pools along the ephemeral drainage lines containing substrates comprised of silt and sand (survey sites A10 and A13) (**Table 4.2**). The Desert Rainbowfish is a common fish species found across central and northern Australia in fresh water. It is an arid-adapted species, found in a variety of slow-flowing and still habitats, including ephemeral rivers, waterholes, lakes, flowing bores and stock dams. These habitats are often quite turbid and highly variable in terms of permanence (Murray-Darling Basin Commission 2007).

Photograph 4.7 Desert Rainbow Fish Recorded from the Study Area

Agaziz's Glassfish (**Photograph 4.8**) is also a common species found throughout the Burdekin Basin in Northern Queensland. Individuals are usually collected in close proximity to shelter in water bodies with low water velocity (Pusey and Kennard 2004). This species was recorded from the southern farm dam in October 2012 (survey site A16) (**Table 4.2**).

Photograph 4.8 Agaziz's Glassfish Recorded from the Study Area

Although there is potential for additional fish species to occur in the study area, these are likely to be restricted to common, widespread species. The diversity of fish species in the study area is relatively low. This may be a result of a number of factors including hydrologic characteristics of the study area, and a relatively low diversity of aquatic habitats. In the study area, high flows are generally short in duration and interspersed by long dry periods. This is likely to have reduced the ability of specialist species to colonise the area. Furthermore, prolonged dry conditions (as evident within the study area) are likely to result in an absence of species with low tolerances to changing environmental conditions (Pusey and Kennard 2004).

The study area has a low diversity of aquatic habitats and microhabitats with the system primarily characterised by open shallow water with a sandy/gravel substrate and limited in-stream debris and macrophytes. The drainage lines in the study area are all ephemeral, and with the exception of small remnant pools and artificially excavated dams, little aquatic habitat was recorded in the dry season during the October survey periods. This environment provides habitat for generalist, hardy species and low species diversity is to be expected in such environments.

4.5.2 Turtles

No threatened turtle species were recorded from the EPBC Act Protected Matters Search Tool or the Wildlife Online database (**Appendices A** and **B**) and none were recorded during the field surveys. No threatened turtles have been recorded from the proposed Carmichael Coal Mine (GHD 2012).

Freshwater turtle species known to occur within the Burdekin Basin include: Cann's Long-necked Turtle (*Chelodina canni*); Eastern Snake-necked Turtle (*Chelodina longicollis*); Irwin's Turtle (*Elseya irwini*); Sawshelled Turtle (*Wollumbinia latisternum*) and Krefft's Turtle (*Emydura macquarii krefftii*) (Cann 2008). None of these are listed under the EPBC Act or the NC Act.

Limited habitat for some of these turtles is present in the study area. The Cann's Long-necked turtle and the Eastern Snake-necked Turtle are primarily encountered in off-stream habitats such as lagoons, billabongs and swamps (Cann, 2008). Remnant ephemeral pools along drainage lines and farm dams in the study area may provide temporary habitat for these two species, however none were recorded from the study area.

The Irwin's Turtle generally prefers sandy riverine habitats with an abundance of macrophytes and instream debris (Cann, 2008). No riverine habitat for this species is present in the study area.

The Saw-shelled Turtle is commonly observed in upstream water courses as well as lagoons and billabongs that support abundant in-stream habitat (Cann 2008). In-stream habitat features were absent in most survey sites in the study area and highly limited habitat for this species is present.

Krefft's Turtle is a generalist species that occurs in large permanent rivers and swamps (Australian Museum 2014). Some seasonal wetlands occur in the study area, however no

permanent rivers or swamps are present and accordingly, no habitat for this species is present in the study area.

Although no turtles were recorded from the study area, several deceased juvenile Krefftts Turtles and the Eastern Snake-necked Turtle were recorded from the proposed Carmichael Coal Mine (GHD 2012). The aquatic habitats present in the Carmichael Coal Mine project area are substantially different to the study area however; and a large perennial watercourse (the Carmichael River) flows through the site.

The vast majority of the study area does not provide suitable habitat for turtles, as most of the remnant pools dry up in the dry season, and only the larger pools and artificial farm dams still had water in October 2012 and October 2013. Due to the small size of the remnant water pools surveyed in October 2012, if turtles had been present it is nearly certain that they would have been recorded by observation or by being captured in the fish net.

4.6 Water Quality

Water parameters were measured *in-situ* during both rounds of aquatic field surveys including alkalinity, EC, DO, temperature, pH and turbidity. Temperature was not recorded for survey sites A1, A2, A3, A4 A5 and A20 due to equipment malfunction. Turbidity was also not recorded from survey site A19 as the meter did not read the value of turbidity at this survey site due to the excessive degree of turbidity of the water. DO was recorded in the field as ppm, and converted to percent saturation to allow for comparison with the water quality guidelines.

In addition, laboratory water quality analysis for nitrogen and phosphorus (nutrients) was undertaken on all water samples collected in May 2012 and October 2012. Additional laboratory analyses were conducted on water samples collected in October 2012 to determine the concentrations of major cations, anions and dissolved metals in the water samples.

In situ water quality parameters and nutrients were compared to the water quality guidelines (ANZECC and ARMCANZ 2000) for upland rivers in tropical Australia to provide an indication of the relative water quality of the survey sites. Guideline trigger values are concentrations (or loads) of the key performance indicators, below which there is a low risk that adverse biological effects will occur (von der Ohe and Liess 2004). **Table 4.3** shows the *in-situ* water quality and nutrient data collected, and a brief explanation of the impact of these stressors in relation to ANZECC trigger values (ANZECC and ARMCANZ 2000; Turak and Waddell 2002). These parameters are the most ecologically relevant ones to this study and are considered individually below in subsequent subheadings in more detail.

The results of the laboratory analysis of water and sediment samples is provided in **Appendix D**.

Table 4.3 Water Quality Results from the Study Area

Survey Site	Water Temperature (°C)	Electrical Conductivity (µS/cm)	pH	Dissolved Oxygen (%)	Turbidity (NTU)	Total Alkalinity (mg/L)	Phosphorus Total (mg/L)	Nitrogen Total (mg/L)
EPHEMERAL DRAINAGE LINES								
ANZECC and ARMCANZ (2000) Trigger Values[1]	**N/A**	**20 - 250**	**6 - 7.5**	**90 - 120**	**2 - 15**	**N/A**	**0.01**	**0.15**
Drainage lines in headwaters of Pigeonhole Creek catchment								
May 2012								
A13	18	48.1	6.25	77	97.8	25	<0.02	0.24
A14	18	54.2	6.17	72	58.5	20	<0.02	0.17
October 2012								
A21	23.6	185.8	5.9	75	93.5	16	0.05	0.9
A22	24	100.9	5.8	75	132.1	24	0.02	0.8
Drainage lines in tributaries of Tomahawk Creek catchment								
May 2012								
A3	-	115.3	5.6	30	21.2	80	<0.02	0.15
A4	-	110	6.09	61	17.3	35	<0.02	0.1
A5	-	149	6.29	75	427	20	0.10	
A10	21	61.8	7.3	70	585	50	0.11	0.52
A11	23	50.5	6.45	92	539	50	0.09	0.57

Survey Site	Water Temperature (°C)	Electrical Conductivity (µS/cm)	pH	Dissolved Oxygen (%)	Turbidity (NTU)	Total Alkalinity (mg/L)	Phosphorus Total (mg/L)	Nitrogen Total (mg/L)
October 2012								
A15	19.8	177.2	6.4	70	19.8	25	0.28	1.7
A17	28.6	20	6.5	145	395	45	0.41	6.6
A18	20	30	5.8	35	32	25	0.11	1.7
A20	-	68.1	5.6	104	54.3	24	0.02	2.4
Drainage lines in headwaters of North Creek catchment								
May 2012								
A1	-	176.5	6.54	75	284.5	60	<0.02	0.46
A2	-	165	6.64	75	137.9	60	<0.02	0.12
SEASONAL WETLANDS AND FARM DAMS								
ANZECC and ARMCANZ (2000) Trigger Values[2]	**N/A**	**90 - 900**	**6 - 8**	**90 - 120**	**2 - 200**	**N/A**	**0.01 – 0.05**	**0.35 – 1.2**
Northern seasonal wetland								
May 2012								
A12	17	75.2	6.6	44	610	55	0.1	1.5
Southern seasonal wetland								
May 2012								
A8	19.4	169	6.78	42	213.4	70	0.067	0.71
A9	20.7	158.4	6.92	65	90.9	70	0.091	0.74

Survey Site	Water Temperature (°C)	Electrical Conductivity (µS/cm)	pH	Dissolved Oxygen (%)	Turbidity (NTU)	Total Alkalinity (mg/L)	Phosphorus Total (mg/L)	Nitrogen Total (mg/L)
Red Dog Dam								
October 2012								
A19	23.8	12.3	6.4	91	-	55	0.54	2.2
Southern farm dam								
May 2012								
A6	18.7	57.2	6.68	26	28.7	35	0.04	0.53
A7	20.4	66.8	6.69	79	50.8	40	0.1	1.2
October 2012								
A16	26.5	124.2	6.3	105	807	40	0.18	2.2

[1] ANZECC and ARMCANZ (2000) trigger value for upland rivers in tropical Australia.

[2] ANZECC and ARMCANZ (2000) trigger values for wetlands in tropical Australia.

The water quality parameters within the project site were generally in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council [ANZECC] and Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ] 2000), however where stock had access to the ephemeral drainage lines, seasonal wetlands and dams, the water was more turbid and had elevated levels of nitrogen and phosphorus. No industrial development is present in the catchment and therefore, aside from elevated nutrient runoff due to cattle grazing, pollutants are expected to be very low to non-existent.

4.6.1 Temperature (°C)

The water temperature in the survey sites varied between 17°C and 23°C in the study area during the May 2012 survey period and reached 29°C in the October 2012 survey period. As none of the ephemeral drainage lines, seasonal wetlands or farm dams are fed from groundwater, and none of the ephemeral drainage lines were experiencing any flow during both survey periods, the variation in temperature between survey sites is likely to be a function of the size and depth of each pool. Higher temperatures are expected from smaller or shallower pools. The main difference in temperature is likely attributable to the timing of the field surveys, and water temperatures were generally higher in October than in May. Water temperature at survey sites within ephemeral drainage lines were relatively consistent with the water temperature at survey sites within the seasonal wetlands and farm dams (**Table 4.3**).

4.6.2 EC (µS/cm)

EC levels in the survey sites were variable, ranging between 12.3 µS/cm (at survey site A19 within the northern seasonal wetland) to 185.8 µS/cm (at survey site A21, along an ephemeral drainage line in the headwaters of Pigeonhole Creek catchment), however most were relatively low (<100 µS/cm) (**Table 4.3; Figure 5**). ANZECC and ARMCANZ (2000) Guideline ranges are from 20 – 250 µS/cm for ephemeral drainage lines and all survey sites were within these limits.

EC levels at survey sites within the seasonal wetlands and farm dams were generally lower than the ANZECC and ARMCANZ (2000) Guideline ranges (i.e. 90 – 900 µS/cm), with only three survey sites recorded EC levels within the ANZECC and ARMCANZ (2000) Guideline trigger value range (survey sites A8, A9 and A16) (**Table 4.3**).

Variability of inorganic ions (salts) in the water at the survey sites is likely to be the result of a combination of factors such as flow regime, evaporation, runoff and the minerals within underlying geology and soil. It is likely that levels of salinity are higher in the dry season due to increased evaporation, and this is likely to be the cause of the increased level of salinity in the southern farm dam in October 2012 compared to May 2012. A similar pattern is present in the headwaters of the Pigeonhole Creek catchment.

4.6.3 pH

The pH levels were relatively similar across all survey sites (**Table 4.3**) and the majority of survey sites were within the ANZECC and ARMCANZ (2000) Guideline trigger values for

ephemeral drainage lines (6 – 7.5). Five survey sites at ephemeral drainage lines recorded lower pH levels when compared to the ANZECC and ARMCANZ (2000) Guideline trigger values, namely: survey sites A3 (pH 5.6), A18 (pH 5.8) and A20 (pH 5.6) located in drainage lines in the tributaries of Tomahawk Creek catchment; and survey sites A21 (pH 5.9) and A22 (pH 5.8) located in ephemeral drainage lines in the headwaters of Pigeonhole Creek catchment. All survey sites within the seasonal wetlands and farm dams were within the ANZECC and ARMCANZ (2000) Guideline trigger values (**Table 4.3; Figure 5**).

No significant difference in pH was noted between seasons, except for the ephemeral drainage lines in the headwaters of the Pigeonhole Creek catchment, where the October 2012 surveys had a slightly lower pH than the May 2012 surveys.

4.6.4 DO (%)

DO levels varied, with the majority of survey sites recording values below the ANZECC and ARMCANZ (2000) Guideline minimum criteria values (90 – 120%) for ephemeral drainage lines, seasonal wetlands and farm dams (**Table 4.3**), indicating levels of oxygen unsuitable for many aquatic organisms. Four survey sites were within the ANZECC and ARMCANZ (2000) Guideline level (A11, A16, A19 and A20), and one was above the guideline level (A17) (**Table 4.3**).

In general, the ephemeral drainage lines recorded similar levels of DO to the farm dams (average of approximately 75%), however this was higher than the average of the seasonal wetlands (average of approximately 50%).

However, DO levels can fluctuate depending on factors such as time of day, temperature, photosynthetic activity, amount of decaying organic matter, aeration and ephemeral drainage line flow and impacts from stock which may account for variances in survey results.

4.6.5 Turbidity (NTU)

The survey sites all have high levels of suspended particulate matter and turbidity which were both well over the range specified in the ANZECC and ARMCANZ (2000) Guideline (2-15 NTU) for ephemeral drainage lines, indicating that they are highly turbid (**Table 4.3**). The highest levels of turbidity in ephemeral drainage lines were recorded in survey sites A10 and A11. This may be due to the fact that the ephemeral drainage lines consisted of isolated pools at the time of sampling. The lack of flow allows fine clay and silt sediment to accumulate in the bottom of each pool. The sediment was observed to be easily disturbed and remained suspended in the water column for a long time before settling to the substrate. The ephemeral drainage lines in the study area are in a relatively natural state, and it is unlikely that these levels are the result of human disturbance. The ANZECC and ARMCANZ (2000) Guideline state that Queensland turbidity values are known to be highly variable depending on catchment modification and seasonal rainfall runoff.

Three of the survey sites sampled within the southern farm dam (i.e. survey sites A6, A7 and A9) were within the ANZECC and ARMCANZ (2000) Guideline trigger values for lakes, reservoirs and wetlands, with the remaining survey sites above the trigger values. The most highly turbid environments in the study area were the southern farm dam and northern

seasonal wetland, sampled in October 2012 (survey sites A16 and A12, respectively). The southern farm dam (survey site A16) had a turbidity level of 807 NTU in October 2012 and the northern seasonal wetland (survey site A12) had a turbidity level of 610 NTU in May 2012 (**Table 4.3**). Survey site A19, located at Red Dog Dam, was so turbid the meter could not provide a reading. In October 2012, the two dams were significantly reduced in area compared to May 2012 and were extensively utilised by cattle for watering, and the edges of the dams were heavily pugged from stock.

The very high turbidity results (807 NTU) recorded from the southern farm dam in October 2012 contrast significantly with the relatively low turbidity results recorded in May 2012 (28.7 NTU at survey site A6 and 50.8 NTU at survey site A7) (**Table 4.3**). Due to the significantly reduced size, the area sampled in October 2012 was much more heavily utilised by stock, and it is likely that this is the main reason for the observed dramatic increase in turbidity.

4.6.6 Alkalinity (ppm)

Alkalinity levels at all survey sites were relatively low, ranging from 16 ppm at survey site A21 located in an ephemeral drainage line in the headwaters of Pigeonhole Creek catchment to 80 ppm at survey site A3, located in an ephemeral drainage line in the tributaries of Tomahawk Creek catchment (**Table 4.3; Figure 5**). Alkalinity levels were generally consistent between survey sites within ephemeral drainage lines and survey sites within the seasonal wetlands and farm dams. There are no ANZECC and ARMCANZ (2000) Guideline trigger values for alkalinity.

4.6.7 Phosphorus (mg/L)

Levels of phosphorus in the study area were variable with six survey sites within ephemeral drainage lines recording levels below the detection level of the laboratory (<0.02 mg/L) and the other survey sites above the maximum level of phosphorus specified in the ANZECC and ARMCANZ (2000) Guideline of 0.01 mg/L (**Table 4.3**). As ephemeral drainage lines in the study area are in a relatively natural state however, it is unlikely that these levels are the result of human disturbance. Stock may contribute towards high levels in some ephemeral drainage lines due to phosphorus input from wastes.

The majority of survey sites within the seasonal wetlands and farm dams were also above the ANZECC and ARMCANZ (2000) Guideline trigger values (**Table 4.3**).

In general, there is a slight trend towards higher values of phosphorus in the October 2012 field surveys across the ephemeral drainage lines, seasonal wetlands and farm dams. This may be due to the increased concentration of stock around remnant pools of water in the dry season, compared to just following the wet season when water is abundant in the landscape and there are far more water sources for stock to utilise.

4.6.8 Nitrogen (Mg/L)

Levels of nitrogen in the study area were variable, with some survey sites below and the majority of survey sites within ephemeral drainage lines above the maximum level of

nitrogen specified in the ANZECC and ARMCANZ (2000) Guideline of 0.15 mg/L (**Table 4.3**). This may relate to the impacts of stock access to the ephemeral drainage lines and subsequent fouling with nitrogen-rich wastes. The highest level of nitrogen was recorded in October 2012 from survey site A17, with a value of 6.6 mg/L. This is a very small ephemeral pool and it is likely that it has been extensively utilised by stock.

The majority of survey sites within the seasonal wetlands and farm dams were within the ANZECC and ARMCANZ (2000) Guideline trigger values (0.35 to 1.2 mg/L) for these areas (**Table 4.3**). The highest nitrogen values in this group of survey sites were recorded in October 2012 from the southern farm dam and Red Dog Dam. This is likely to be due to the same reasons for the high turbidity recorded at these two survey sites (i.e. reduction in water levels). These two survey sites were heavily utilised by stock, which may have subsequently caused nutrient enrichment.

4.6.9 Metals

In October 2012, water samples collected from each survey location were analysed for the following metals: calcium (mg/L); magnesium (mg/L); sodium (mg/L); potassium (mg/L); aluminium (mg/L); antimony (mg/L); arsenic (mg/L); beryllium (mg/L); barium (mg/L); bismuth (mg/L); cadmium (mg/L); chromium (mg/L); copper (mg/L); cobalt (mg/L); nickel (mg/L); lead (mg/L); zinc (mg/L); lithium (mg/L); manganese (mg/L); molybdenum (mg/L); selenium (mg/L); silver (mg/L); strontium (mg/L); thallium (mg/L); thorium (mg/L); tin (mg/L); titanium (mg/L); uranium (mg/L); vanadium (mg/L); boron (mg/L); iron (mg/L).

The results were compared with the trigger values for the protection of 95% of species for freshwater, contained in the ANZECC and ARMCANZ (2000) Guidelines (**Tables D.1** and **D.2** in **Appendix D**). The level of metals in the majority of the samples were below the limits of reporting (LOR) (**Tables D.2** and **D.1** in **Appendix D**), and where they were able to be detected, they were without exception well below the trigger values for the protection of 95% of freshwater species. These results are to be expected in the study area given the very low level of human disturbance. No industrial development is located in the vicinity, and no major roadways are nearby that could contribute contaminants. Some metals sampled for in this survey have no corresponding trigger value in the guidelines; these include Barium, Lithium, Strontium, Thorium and Titanium (**Tables D.2** and **D.1** in **Appendix D**). For several parameters, there was insufficient data to derive a reliable trigger value. The full results of the laboratory analyses are presented in **Tables D.2** and **D.1** in **Appendix D**.

4.7 Sediment Quality

Sediment samples were collected during the second survey period in October 2012 from survey sites A15 to A22 and were analysed for metals and particle size. These were compared to the recommended sediment quality guideline values (ANZECC and ARMCANZ 2000) for aquatic ecosystems to provide an indication of the relative sediment quality of the survey sites (**Table D.2** in **Appendix D**). The sediment guidelines have been derived on the basis of the toxicity of contaminants in sediments and associated pore waters to benthic biota (ANZECC and ARMCANZ 2000).

No levels of any metal were above the sediment quality guidelines (**Table D.2** in **Appendix D**). These results are expected from the study area, given the low levels of human disturbance and the lack of development or industry in the locality.

The levels of metals were variable between the survey sites, sometimes quite significantly. For example, the levels of Aluminium at survey site A21 were 490 mg/kg, compared to 14,200 mg/kg at survey site A18 (**Table D.2** in **Appendix D**). Similarly, levels of Iron varied from 4,370 mg/kg at survey site A21, to 18,400mg/kg at survey site A15 (**Table D.2** in **Appendix D**). Survey site A21 recorded the lowest levels of all metals analysed; for all the metals analysed, levels at survey site A21 were either below the limit of reporting, or were the lowest of all the survey sites (**Table D.2** in **Appendix D**).

4.8 Stygofauna Communities

This section presents the results of the stygofauna sampling that has been conducted in the study area. The results of stygofauna sampling undertaken are presented in **Table 4.4**.

No definite stygofauna taxa were found during the investigation. The majority of sample locations (13 of 15 monitoring bores) returned no invertebrate fauna at all and several of the geological strata sampled had no invertebrate fauna. Within the two samples where invertebrates were detected, two broad faunal groups were represented by three specimens.

The taxa found comprised springtails (Collembola) and mites (Acarina) rather than the crustaceans that are more commonly found in stygofaunal communities. The springtails are not stygofauna and are likely to have been introduced to the bores via contamination with surface litter (Hose 2014). The single mite found was potentially a stygofauna species, though such mites also occur naturally in decoposing leaf litter and surface waters.

No stygofauna listed under the EPBC Act or NC Act were recorded from the EPBC Act Protected Matters Search Tool or Wildlife Online database search (**Appendices A** and **B**).

A discussion of the results relative to each groundwater system is provided in the following sections.

Table 4.4 Results of Stygofauna Sample Sorting and Identification

Aquifer	Survey Site	Collembola (springtails)	Acarina (mites)
Tertiary Sediments	MB07	0	0
	MB17	0	0
Clematis Sandstone	MB21	0	0
	MB22	0	0
Clematis Sandstone/Rewan Formation interface	MB33	0	0
Rewan Formation	MB13	0	0

Aquifer	Survey Site	Collembola (springtails)	Acarina (mites)
	MB14	0	0
	MB15	0	0
	MB24	0	0
	MB26	2	0
	MB28	0	0
Betts Creek Beds including coal seams	MB03	0	0
	MB06	0	0
	MB08	0	1
	MB10	0	0

4.8.1 Tertiary Sediments

The Tertiary Sediments are typically dry and unsaturated within the study area. Where present beneath the low lying south-eastern areas of the study area, the groundwater table is up to 55 m below ground level and disconnected from ephemeral surface water drainage lines. The depth and generally weathered nature and low permeability of this unit are not conducive to the presence of stygofauna. No fauna were detected within the samples analysed.

4.8.2 Clematis Sandstone

The Clematis Sandstone is typically dry and unsaturated within the study area. Where present beneath the elevated ridgeline of Darkies Range, groundwater is in excess of 100 m below ground level. This depth is not conducive to the presence of stygofauna. No fauna were detected within the samples analysed.

4.8.3 Rewan Formation

Groundwater samples were analysed from six monitoring bores within this unit. With the exception of one sample from MB26, all results showed no stygofauna or other fauna present.

The sample collected from Bore MB26 contained two specimens of springtail (Collembola) (**Table 4.4; Appendix E; Figure 7**). Springtails (Collembola) are not an obligate groundwater taxon and are typically found in surface waters and within rotting vegetation.

However, Collembola species are also commonly collected during sampling of groundwater monitoring bores, where they live on the water surface. The presence of Collembola species at the water surface in groundwater monitoring bores is normally attributed to entrainment of surrounding soil and vegetation within the bore during drilling and construction (**Appendix E**). Given that this bore was drilled through highly weathered surface materials on the ridgeline of Darkies Range, some entrainment of this type of material is not unexpected. The

presence of a typically surface-dwelling species at the significant depth from which this was sample collected (i.e. in excess of 110 m below ground level) is therefore considered to be a result of entrainment of surface detritus during bore construction. More broadly, the Rewan Formation is a regionally recognised aquitard exhibiting low permeability and thinly interbedded sediments. Within the study area, the groundwater generally is typically deep (in excess of 100 m below ground level) and not conducive to stygofauna presence.

No stygofauna were detected within the samples analysed.

4.8.4 Betts Creek Beds

Groundwater samples were analysed from four monitoring bores within this unit. With the exception of one sample from MB08, all results showed no stygofauna or other fauna present.

The sample collected from MB08 returned a single specimen of a mite (Acarina) (**Table 4.4; Appendix E; Figure 7**). This specimen lacked pigment and obvious eye spots which is consistent with the expected morphology of subterranean adapted fauna. However, such traits are also common among mites, including those from surface/soil environments.

This sample was collected from the weathered upper sediments of the Betts Creek Beds, at a depth in excess of 80 m below ground level which is typically not conducive to stygofauna development, except in the presence of limestone caves and subterranean voids. The Betts Creek Beds are known to be laterally consistent as they dip to the west across the study area, with no faulting detected in the vicinity of MB08. Furthermore, this is a low permeability unit with no cavities or other geomorphic features that would typically support deep-dwelling stygofauna or encourage endemism.

It should be noted that there is no shallow groundwater present in the study area and the monitoring network therefore required the development of deep monitoring bores in order to intersect groundwater. It should be noted that development of deep monitoring bores through fine sediments carries a high potential for the entrainment of shallower soils into the base of the bore installation. It is noted that stygofauna are typically concentrated in the hyporheic zone associated with alluvial systems. As explained in **Section 3.4.1**, no such alluvial systems occur within the study area.

Consideration of the taxonomy results together with the groundwater setting suggest that this specimen is most likely to represent a common surface species rather than an obligate groundwater species (**Appendix E**).

CUMBERLAND ECOLOGY

Chapter **5**

Impact Assessment

The following activities have the potential to impact aquatic ecology within the study area:

- Vegetation clearing and earthworks associated with open cut mining and the construction of infrastructure (**Section 5.1**);
- Disturbance of aquatic habitat due to the impacts of mine subsidence (**Section 5.2**);
- The potential to impact the water quality of ephemeral drainage lines and watercourses downstream of the study area due to the release of mine-affected water (**Section 5.3**);
- The potential for project activities to spread weeds and thereby impact vegetation and aquatic habitat (**Section 5.4**);

As a result of the activities listed above, the project may have the potential to impact on threatened species and stygofauna. These potential impacts are assessed in **Sections 5.5** and **5.6**, respectively.

No creek diversions are proposed as part of the project. There are also no proposed creek crossings as a result of the project.

5.1 Construction of Open Cut Mine and Mine Infrastructure

The key impact of the project on the aquatic environment will be the construction of the open cut mining area and mine infrastructure area. Approximately 11,000 ha will be disturbed as a result of the construction of the open cut mining area and mine infrastructure area (**Figure 10**). The open cut mining area and mine infrastructure area have been designed to avoid disturbance to the upper reach of an ephemeral drainage line in the Tomahawk Creek catchment (shown as a major waterway on the DAFF's waterway map – **Figure 8**). This is the only "major waterway" under the DAFF's mapping system on the study area. It will however, be necessary to remove the southern farm dam and the southern seasonal wetland, as well as some ephemeral drainage lines, as a result of open cut mining and infrastructure development (**Figure 10**). The HES wetland in the northern section of the study area is well beyond the clearing footprint of the project and would not be disturbed by open cut mining or infrastructure development.

5.1.1 Removal of Habitat

Excavation and construction associated with open cut mining in the south of the study area will remove areas of habitat for aquatic species; however no aquatic species listed under the EPBC Act or NC Act have been recorded in the study area and none are expected to occur. No turtles were recorded during the field survey, and no threatened turtles are considered likely to occur as the study area is beyond the known distribution limit of any threatened turtle species. Similarly, no threatened fish species were recorded or considered likely to occur, and the fish species recorded are common, widespread species in these kinds of environments. No threatened invertebrate species were recorded from the study area.

The southern seasonal wetland and southern farm dam will be removed as a result of the project. These areas provide habitat for a range of bird and amphibian species during the wet season when these features contain water and the impact of the project to these species has been considered in the EIS Terrestrial Ecology Report.

5.1.2 Erosion and Sedimentation

The project has the potential to increase the amount of erosion occurring in the study area through the construction of the open cut mine and infrastructure. The study area is located in a tropical climate, and during the wet season heavy rainfall can wash away any disturbed earth relatively easily. This has the potential to increase sedimentation and turbidity of waterways. Effects of erosion, caused by stock, can be seen within parts of the study area along ephemeral drainage lines.

The project will result in a significant amount of soil disturbance, with an associated increase in the potential for erosion and sedimentation of waterways. Erosion may also be exacerbated by any kind of vegetation clearance, given the role that vegetation plays in stabilising soils.

Suspended particulates can influence the aquatic ecosystem when:

- In suspension – when in the water column particulates reduce light penetration and thus primary production as well as affecting gill function of fish; and
- Settling out – when settled sediments can smother organisms and their habitats (ANZECC and ARMCANZ 2000).

Turbidity in streams in disturbed catchments is closely connected with rainfall and surface runoff, with spikes in turbidity typically occurring after rain events. Turbidity levels then reduce as flows return to normal. Although aquatic ecosystems in highly ephemeral systems, such as those found in the study area, are likely to be adapted to peaks in high turbidity during some periods, an increase in the magnitude or the frequency of these peaks of turbidity has the potential to have a detrimental effect on aquatic ecosystems.

Sediment movement can also mobilise nutrients and pollutants to aquatic habitats. Soils from the exposed areas, and potential pollutants, will be readily mobilised into local drainage lines and water bodies via erosion processes. The potential for mobilisation of soils and

potential pollutants will be maximised after rain events and during high winds. Nutrient pollution has the potential to impact upon a system via the stimulation of growth of nuisance plants and cyanobacteria (ANZECC and ARMCANZ 2000). Growth of these plants can lead to changes in the biological community composition as well as flow on effects to habitat suitability and aspects of water quality such as DO concentration which can impact upon aquatic fauna communities.

Although erosion and sedimentation can potentially give rise to significant impacts on aquatic ecosystems, the impacts on the ecological values of the study area are expected to be minor. This is because no significant, permanent streams occur that could be impacted by sedimentation, and the ephemeral drainage lines that are present are accustomed to heavy rainfall and associated erosion during the wet season. In addition, a range of mitigation measures will be established to avoid any potential impacts due to erosion and sedimentation. These are discussed in **Section 5.1.4**. These measures will be described in detail in the Erosion and Sediment Control Plan that will be prepared for the project. It is concluded that with the implementation of appropriate measures, it is unlikely that erosion or sedimentation will significantly affect the aquatic ecology of the study area.

5.1.3 Barriers to Fish Movement

The construction of the open cut mining area and mine infrastructure area has the potential to impact on the aquatic environment through the creation of barriers to fish movement. Barriers to fish passage can effectively stop many fish species from breeding and re-populating waterways by restricting their ability to access breeding partners and spawning grounds (Fairfull and Witheridge 2003).

In the context of aquatic habitat values within the study area and surrounds, the aquatic habitat to be removed within the open cut mining area and mine infrastructure area is considered to be low value fish habitat due to the ephemeral nature of the drainage lines and seasonal wetland.

As shown on **Figure 8**, the majority of drainage lines that will be removed are classified as yellow or green waterways under the DAFF's mapping system (i.e. waterway barrier works would pose a low or moderate risk to fish passage). As noted in **Section 5.1**, the project has been designed to avoid impacts on the only waterway classified as purple (major risk) under the DAFF's mapping system. In addition, the study area is not located within an area of declared fish habitat under the Fisheries Act, and only common, widespread fish species were recorded from the field survey. Consequently, loss of aquatic habitat, and any associated impact on fish passage, due to the construction of the open cut mining and mine infrastructure area is not considered to be significant.

5.1.4 Mitigation

A number of controls will be placed on construction activities to limit potential impacts on aquatic habitat. Clearing will be undertaken in accordance with a clearing procedure that restricts the area of remnant vegetation to be cleared to that required for the safe construction and operation of facilities. The clearing procedure is described in the EIS

Terrestrial Ecology Report. Particular care will be taken in relation to any work in or adjacent to drainage lines, with mitigation measures including:

- Construction adjacent to drainage lines will only be undertaken when flows have ceased within the drainage lines.
- Any necessary sediment control works will be implemented, particularly if remnant pools are located adjacent to construction activities.
- Work will be undertaken in accordance with the requirements of an Erosion and Sediment Control Plan.
- The proponent will consult with the DAFF, as necessary, in relation to construction in drainage lines that could impact fish habitat or fish passage. **Figure 8** shows the location of waterways, as mapped by the DAFF.

The following available guidelines and codes will be reviewed, where relevant, as part of the detailed design of any works in waterways:

- *Guide for the Determination of Waterways using the Spatial Data Layer Queensland Waterways for Waterway Barrier Works* (DAFF 2013); and
- *Fisheries Guidelines for Fish Habitat Buffer Zones* (Bavins *et al.* 2000).

As detailed in the EIS Terrestrial Ecology Report, offsets will be provided for the loss of riparian vegetation in accordance with the Queensland Environmental Offsets Framework. Although riparian vegetation is addressed in the EIS Terrestrial Ecology Report, rather than in this Aquatic and Stygofauna Impact Assessment, this offset will have a range of benefits for aquatic habitat. Riparian vegetation reduces the risk of erosion and subsequent sedimentation of waterways by reinforcing and increasing cohesion of the soil, and by providing a protective surface matting (Water and Rivers Commission 2000). Riparian vegetation also supplies energy in the form of leaf litter and other organic debris, which supports diverse aquatic food webs. This is particularly the case in narrow upland streams where the riparian vegetation has a significant influence on the waterway as a whole, because it often shades the entire waterway (Water and Rivers Commission 2000).

The remainder of the study area, beyond the clearing footprint of the project, will be managed to retain and enhance ecological values as far as possible. This will include managing grazing pressure and provision of additional fauna watering points. As detailed in the EIS Terrestrial Ecology Report, the fauna watering points will mitigate for the loss of water sources (i.e. the southern seasonal wetland, southern farm dam and a number of remnant pools). The watering points will comprise a combination of water troughs and areas of aquatic habitat. Although these watering points are primarily intended to mitigate for the loss of water for terrestrial species, a number of the watering points will be designed in a manner that will also provide aquatic habitat. Such watering points will be designed to have:

- A deep section that provides a suitable reservoir of water that will persist into the dry season;

- A large, shallow area that is inundated during the wet season;
- Presence of a diversity of fringing vegetation such as sedges, rushes and reeds; and
- Canopy tree species nearby.

Creating watering points with these habitat features is considered to be achievable, given that these values are all present in the southern farm dam, an artificial structure. The construction and management of these watering points will be in accordance with a Biodiversity Management Plan.

5.2 Subsidence

Longwall mining is a method of underground coal mining whereby large, rectangular panels of coal are progressively mined. As the coal is extracted, the roof immediately above the mined seam collapses, leading to fracturing and settling of material in the overlying strata. This can result in the progressive formation of gentle trough-like depressions on the surface relative to natural topography (called subsidence). The area that will be subject to subsidence is shown on **Figure 10**, and is defined as the area within the limit of measureable subsidence.

The differential lowering of the ground surface due to subsidence leads to areas of residual tensile strain. Tensile strains can lead to the formation of tension cracks ("subsidence cracks") on the ground surface. After longwall mining has been completed, permanent subsidence cracks can potentially develop in limited areas around the perimeter of the subsidence troughs, in the areas of residual tensile strain. Although the zone of residual tensile strain (i.e. the zone where subsidence cracking can occur) is located around the perimeter of the longwall panels (and consequently around the perimeter of the subsidence troughs), the exact location and extent of the zone for a particular longwall panel varies depending on the depth of cover, panel and pillar width, and the geology.

The majority of the subsided surface area will be unaffected by cracking and there may also be no subsidence cracking above some of the longwall panels because of their significant depth. A monitoring program will be undertaken to identify subsidence cracks and initiate remediation.

Residual subsidence cracks occur within a few weeks of an area being mined. It is predicted that subsidence cracks will have a maximum width of up to 0.3 m, and larger cracks may occur in isolated locations. Subsidence cracking can extend to depths in the order of 5 to 10 m. The extent and magnitude of subsidence cracks is dependent on the thickness of the near surface strata layers, the soil type, the mining depth, and the level of residual strain.

Transient subsidence cracks may also form in areas of transient tensile strain above the retreating longwall, however transient cracks typically close again after a short period (within days) as the longwall retreats and the transient subsidence wave and associated transient tensile strain passes.

Subsidence will also give rise to sub-surface cracking in the strata that overlie the area from which the coal has been extracted (i.e. the goaf).

Please refer to the EIS Subsidence Report for the details of predicted cracking and a detailed assessment of sub-surface cracking.

As shown on **Figure 10**, a number of ephemeral drainage lines, as well as the northern seasonal wetland and Red Dog Dam will be subject to subsidence. Potential impacts of subsidence on aquatic ecology are discussed in the following sections.

5.2.1 Ephemeral Drainage Lines

Ephemeral drainage lines within the limit of measureable subsidence (**Figure 10**) will be subject to subsidence. The EIS Surface Water Section discusses predicted impacts on ephemeral drainage lines, including an assessment of potential geomorphological impacts due to subsidence.

Subsidence above the northern underground (**Figure 2**) will intersect minor rock gullies and will result in localised changes to bed gradients. The localised change in bed gradients and flow velocities are mitigated by the rocky nature of the drainage lines. These steep rocky gullies are subject to naturally high flow velocities due to the steep terrain characteristic of the Darkies Range area. Consequently, the potential for subsidence induced channel instability in these areas is considered to be low. Subsidence above the southern underground mine (**Figure 2**) could potentially result in localised erosion. The EIS Surface Water Section explains that monitoring of these areas will be undertaken to ensure that no long-term impacts arise, and to identify any necessary mitigation measures.

Subsidence cracking may occur within the bed and banks of the ephemeral drainage lines located within the limit of measureable subsidence. These cracks are likely to be shallow and a rehabilitation program for subsidence cracking will be implemented for the project to ensure that all cracks are remediated. This will involve monitoring areas potentially subject to subsidence cracking and repairing any individual cracks that develop. This non-intrusive, targeted method of subsidence crack rehabilitation has been proposed in order to minimise disturbance to vegetation. This approach does not involve any routine clearing of vegetation. Erosion control measures will be implemented as part of this approach.

Overall, subsidence is not predicted to give rise to any long-term, significant impacts on ephemeral drainage lines or their ecological values. This conclusion is supported by monitoring work undertaken at other Queensland coal mines, where watercourses have been subsided a number of times, without any significant impact on channel stability. Nevertheless, the mitigation measures described in **Section 5.2.5** will be adopted in relation to any subsidence of ephemeral drainage lines.

5.2.2 Subsidence Ponding

Subsidence troughs can result in localised alteration of surface drainage paths and create ponding areas. Subsidence ponding will be mitigated by the installation of minor remedial drainage earthworks to re-establish free drainage. With the installation of the minor remedial

drainage earthworks and the re-instatement of free drainage, there will be no significant changes in the existing ponding regime within the study area due to subsidence.

Repair of subsidence cracks on the study area will be undertaken in accordance with the proponent's rehabilitation program for subsidence cracking, which has been designed to limit impacts on vegetation and prevent erosion and associated sedimentation. These measures are further described in the EIS Terrestrial Ecology Report.

5.2.3 Northern Seasonal Wetland

The northern seasonal wetland is located above the northern underground and is located within the limit of measureable subsidence (**Figure 10**). This wetland has been mapped by the EHP as a HES wetland. As described in **Section 4.2.2**, this wetland is not fed by groundwater and is a natural depression that collects surface water during the wet season. The water collected during the wet season in this wetland evaporates during the dry season. Groundwater drilling in the area of the wetland has determined that the water table in this area of Darkies Range is very deep being some 100 m below the land surface. This means the wetland does not interact with the underlying groundwater systems, and the source of the water is purely runoff from the local catchment. Changes to the groundwater regime induced by longwall mining will therefore not impact upon the wetland.

As noted above, the wetland will be subject to subsidence and will potentially experience impacts due to surface cracking and changes in drainage.

Subsidence cracks that form within the ponded area of the wetland are likely to be shallow, and will have no connection to underground workings. If cracks form at a time when the wetland contains water, the cracks would fill with water and the cracks would ultimately fill with the sediment contained in the water. Monitoring of cracks will be undertaken and individual cracks will be repaired as necessary. Cracks that form when the wetland is dry would be repaired in accordance with the subsidence crack remediation program outlined in the Subsidence Management Plan for the project.

Figure 11 shows the location of the northern seasonal wetland within the study area, and **Figure 12** shows the pre and post-mining topography in the vicinity of the wetland.

The northern seasonal wetland is a depression where surface water ponds and it does not overflow, given its small isolated catchment. Changes in the surface topography due to subsidence may change the area and depth of the wetland pond. In order to ensure that the wetland pond continues to retain water following subsidence, a small bund will be constructed along the eastern margin of the northern seasonal wetland. The bund will be small scale structure – approximately 1 m in height, 3 m wide along the crest, and 460 m long.

In addition, as shown on Figure 12, subsidence will also have the effect of increasing the surface area and storage capacity of the wetland pond. The wetland's pond area before mining is approximately 127 ha and it will increase to approximately 199 ha as a result of subsidence.

The wetland pond catchment will also be potentially affected by subsidence and it is anticipated that the catchment will change in size from 2,711 ha pre-mining to 2,399 ha post-mining, resulting in a 12% reduction in the size of the catchment.

These changes to the pond storage and catchment area of the wetland will result in changes to ponding characteristics of the seasonal wetland. For a particular rainfall event, the water level of the seasonal wetland will be reduced following subsidence, compared to the wetland pre-subsidence. This will also mean that the wetland will dry out more rapidly and more frequently. This will impact on the flora and fauna that depend on aquatic habitat by reducing the length of time that aquatic habitat is available in each season. However; as explained previously, the northern wetland is highly seasonal and only contains water during the wet season, and for a variable time following the wet season, depending on the amount and duration of rainfall. The aquatic species that utilise the wetland are accustomed to it providing habitat for a limited period of time every year and for a varying period of time, and it is likely that the species that currently utilise this area will be able to continue to do so.

The northern seasonal wetland is a HES wetland and consequently it will be necessary to provide offsets under the EO Regulation in the event of the project giving rise to significant, residual impacts on the wetland. The need for offsets will be determined prior to any subsidence of the wetland and based on detailed mine planning and subsidence predictions for the area. **Figure 12** is based on the mine layout, but detailed design supported by further exploration work is still to be undertaken. Even minor changes in the mine plan could significantly alter the nature and extent of impacts on the wetland. It is therefore proposed to:

- Undertake detailed ground survey of the wetland prior to subsidence;
- Undertake a detailed review of potential impacts on the wetland, making use of subsidence predictions based on the detailed mine plan;
- Design any necessary drainage works, such as drains or levees, in order to reduce potential impacts on the wetland; and
- Determine the need for offsets if significant, residual impacts on the wetland are predicted.

This work will be described in the Subsidence Management Plan.

5.2.4 Red Dog Dam

Red Dog Dam, which is located within the northern seasonal wetland, will be subsided. This dam is used for stock watering and there are signs of recent cattle activity at the dam. The potential impact of subsidence on the dam will depend on the relative location of the dam embankment and pond area in relation to the surface subsidence profile. Potential effects may include cracking of the earth embankment and changes in the lateral extent and depth of the pond area. The EIS Subsidence Report has concluded that there will be no connection between the dam and the underground workings due to sub-surface cracking. Consequently, sub-surface cracking would not lead to the loss of any water from the dam.

Based on experiences at other longwall mines in Queensland and New South Wales, any subsidence effects on small earth dams can be easily remedied with minor civil earthworks and subsidence does not generally give rise to any lasting adverse impacts on the use and functioning of the dams, including any ecological values.

5.2.5 Mitigation

A Subsidence Management Plan will be a requirement of the project's EA to be developed over the life of the project. The Subsidence Management Plan will include:

- Methods for remediating subsidence cracking (including cracking in the beds and banks of ephemeral drainage lines and cracking in the northern seasonal wetland).
- Survey of the pre-subsidence and post-subsidence condition of ephemeral drainage lines, and prescriptions for management measures to prevent erosion due to localised changes in gradient within the bed and banks of an ephemeral drainage line within the limit of measurable subsidence.
- The installation of remedial drainage works to prevent ponding of water in subsidence depressions.
- Management measures for the northern seasonal wetland. As noted in **Section 5.2.3**, this will include accurate ground survey of the wetland; a detailed assessment of the potential impacts of subsidence on the wetland (based on the mine plan developed as part of detailed mine planning) and prescriptions for the installation of remedial works to limit any impacts on the wetland.
- Monitoring of Red Dog Dam to confirm any subsidence effects, and installation of remedial works to ensure the ongoing functioning of this dam.

A copy of the draft EIS Subsidence Management Plan is included as part of the EIS.

5.3 Release of Mine-affected Water

As discussed in the EIS Surface Water Section, modelling of the proposed mine water management system indicates that there will be no uncontrolled discharges of mine-affected water. This means that the probability that an uncontrolled discharge will occur is less than once in 124 years (i.e. the average recurrence interval of a discharge event is greater than 124 years).

However, during extended wet periods, significant volumes of rainfall runoff will accumulate in the open cut pit. To ensure that the mine can continue to operate following periods of extended rainfall periods, controlled discharge mine-affected water will be required. The water management system has therefore been designed to allow for the controlled release of stored water from the Mine Water Dam to the Belyando River catchment.

The quality and quantity of the water being discharged, as well as the quality and quantity of the receiving environment will need to comply with the EHP model discharge conditions.

The EHP model discharge conditions are designed to ensure that the health and quality of downstream water values, including aquatic ecology, are protected. Therefore, there are unlikely to be any significant changes to habitat values for fish and other aquatic biota within or downstream of the study area, due to controlled discharges of mine-affected water.

5.4 Spread of Weeds

During the construction and operations phases of the project, environmental management measures will be required to prevent the transportation of pest plants; prevent the introduction of additional pest species; and manage and reduce the area of occupancy of pest plants on the site. A Pest Animal and Weed Management Plan will be developed and implemented for the site and has been described in the EIS Terrestrial Ecology Report.

5.5 Potential Impacts to Threatened Species

No threatened aquatic species, habitats, populations or communities listed under the EPBC Act or NC Act have been recorded in the study area. No turtles were recorded during the field survey, and no threatened turtles are considered likely to occur as the study area is beyond the known distribution limit of any threatened turtle species. Similarly, no threatened fish species were recorded or considered likely to occur, and the fish species recorded are common, widespread species in these kinds of environments. Based on the data available from the study area, it is considered that the project would not adversely impact any populations of Commonwealth or State listed aquatic species.

5.6 Potential Impacts to Stygofaunal Assemblages

No stygofauna were detected within the samples analysed and the potential for significant stygofaunal assemblages to be present is considered low due to the hydrogeological setting. The project is therefore unlikely to have significant impacts upon stygofaunal assemblages. No threatened invertebrate species, either surface dwelling or stygofauna, were recorded from the study area.

The process of open cut and underground mining reduces groundwater pressures in surrounding rock beyond the zone directly mined or cracked by subsidence. This groundwater depressurisation can reduce groundwater levels in the surrounding hydrogeological units. However, depressurisation due to the project is predicted to be generally localised to the study area and immediate surrounds. Further detail on potential groundwater impacts is provided in the EIS Groundwater Report.

Based upon the results presented in **Section 4.8**, the three specimens detected in samples from bores within the deep groundwater at the study area are considered likely to be surface dwelling organisms. The absence of optimal hydrogeology and the lack of any unambiguous fauna specimens within the remaining deep groundwater samples strongly indicates that the geological units within the study area do not support any significant stygofauna

assemblages. This is consistent with the results of previous stygofauna studies completed in the locality (**Section 4.8.6**).

The Belyando River alluvium is located over 40 km downstream of the study area and the Carmichael River alluvium is located in a separate catchment from the study area. While these alluvial deposits are known to support a perennial water table and represent the more likely candidate sites for stygofauna assemblage, the project is not predicted to result in any significant impacts to these groundwater bodies and any associated stygofauna assemblages.

The Doongmabulla Spring Complex is located 20 km south of the southern boundary of the study area. Groundwater depressurisation due to the project is not likely to result in significant impacts to these springs and any associated assemblage of stygofauna.

In summary, the project is unlikely to result in significant stygofauna impacts due to the nature of the existing groundwater setting, the localised effects of groundwater depressurisation, and the lack of any confirmed stygofauna assemblage within the vicinity of the project.

Chapter **6**

Biodiversity Offset Strategy

In order to compensate for any significant residual impacts of the project on flora and fauna that remain once the avoidance and mitigation measures outlined in **Section 5** have been implemented, a Biodiversity Offset Strategy will be developed. The Biodiversity Offset Strategy will address the residual impacts of the project in a strategic and meaningful way that will deliver a real biodiversity outcome, and will ensure that the project does not result in a net loss of biodiversity values.

No offsets for impacts on aquatic ecology are required under the EPBC Act, given that no aquatic MNES are predicted to be impacted by the project.

A summary of the Queensland MSES in the study area for which offsets are required is presented in **Table 6.1**.

As shown in **Table 6.1**, subsidence impacts on the northern seasonal wetland may cause a significant, residual impact on the northern seasonal wetland. The northern seasonal wetland is a HES wetland and consequently it will be necessary to provide offsets under the Queensland EO Regulation in the event of the project giving rise to significant, residual impacts on the wetland. As detailed in **Section 5.2.3**, the need for offsets will be determined once detailed mine planning has been conducted for this area given that even minor changes in the mine plan could significantly alter the nature and extent of any impacts on the wetland.

Table 6.1 Matters of State Environmental Significance in the Study Area Relevant to the Project

Matters of State Environmental Significance	Details	Presence on Study area	Potential Project Impact (ha)	Offsets
Regulated Vegetation				
A prescribed regional ecosystem is a MSES if it is— • an area of essential habitat on the essential habitat map for an animal that is endangered wildlife or vulnerable wildlife or a plant that is endangered wildlife or vulnerable wildlife.	The **essential habitat map** is a map certified by the chief executive as the essential habitat map for the State and showing, for the State, areas the chief executive reasonably believes are areas of essential habitat for protected wildlife under section 20AC(1) of the VM Act.	No aquatic habitat shown as essential habitat as per the EHP's essential habitat map has been mapped within the study area.	Not applicable.	Not applicable.
Wetlands and watercourses				
Each of the following matters is a MSES— • a wetland— o in a wetland protection area; or • of high ecological significance shown on the Map of referable wetlands;	**Wetland** means an area shown as a wetland on the Map of referable wetlands. **Wetland protection area** means an area shown as a wetland protection area on the Map of referable wetlands. **Map of referable wetlands** means the 'Map of referable wetlands', a document approved by the chief executive on 4 November 2011 and published	The Map of Referable Wetlands shows that there is one HES wetland (the northern seasonal wetland) (with an associated 500 m trigger area) located to the north of the study area (**Figure 9**).	The northern seasonal wetland will not be cleared as a result of the project. However, the area will be impacted as a result of subsidence. The potential impacts of the project on the northern seasonal wetland are described in detail in **Section 5.2.3**. As noted in **Section 5.2.3**, further survey and assessment work will be	Subsidence impacts on the northern seasonal wetland may cause a significant, residual impact to this HES wetland. This is discussed further in the Biodiversity Offset Strategy.

Matters of State Environmental Significance	Details	Presence on Study area	Potential Project Impact (ha)	Offsets
	by the department, as amended from time to time by the chief executive under section 144D of the *Environmental Protection Regulation 2008*.		undertaken based on the detailed mine plan. This future work will determine whether the project will give rise to a residual significant impact and hence whether offsets are required.	
• a wetland or watercourse in high ecological value waters.	**Wetland** means an area shown as a wetland on the Map of referable wetlands. **Watercourse** is defined in schedule 12, part 1, section 8 of the *Environmental Protection Regulation 2008* and is: • a river, creek or stream in which water flows permanently or intermittently— o in a natural channel, whether artificially improved or not; or o in an artificial channel that has changed	No wetlands or watercourses in high ecological value waters have been recorded within the study area.	Not applicable.	Not applicable.

Matters of State Environmental Significance	Details	Presence on Study area	Potential Project Impact (ha)	Offsets
	the course of the watercourse. • A ***watercourse*** includes the bed and banks and any other element of a river, creek or stream confining or containing water. **High ecological value waters** means waters in which the biological integrity of the water is effectively unmodified or highly valued under schedule 2 of the *Environmental Protection (Water) Policy 2009*.			
High preservation areas of wild river areas				
A part of a wild river area described as a high preservation area in the wild river declaration for the area is a MSES. However, to the extent a wild river area described as a high preservation area is in an urban area, it is not a MSES.	**Wild river area**s see the *Wild Rivers Act 2005*. **Wild river declaration** see the *Wild Rivers Act 2005*.	As explained in **Section 4.1**, no parts of the Coopers Creek wild river area that occurs within the study area are classified as a high preservation area in the wild river declaration for the area.	Not applicable.	Not applicable.

Matters of State Environmental Significance	Details	Presence on Study area	Potential Project Impact (ha)	Offsets
Protected Wildlife Habitat				
An area that is shown as a high risk area on the flora survey trigger map and that contains plants that are endangered wildlife or vulnerable wildlife is a MSES.	**Flora survey trigger map** means the map held by EHP under section 247 of the *Nature Conservation (Wildlife Management) Regulation 2006*.	The flora survey trigger map has not identified any high risk areas that contains aquatic plants that are endangered wildlife or vulnerable wildlife within the study area.	Not applicable.	Not applicable.
An area that is not shown as a high risk area on the flora survey trigger map, to the extent that the area contains plants that are endangered wildlife or vulnerable wildlife is a MSES.	**Flora survey trigger map** means the map held by EHP under section 247 of the *Nature Conservation (Wildlife Management) Regulation 2006*.	No threatened aquatic flora species listed as Endangered or Vulnerable under the NC Act have been recorded or are likely to occur within the study area (**Section 4.3**).	Not applicable.	Not applicable.
A habitat for an animal that is endangered wildlife or vulnerable wildlife or a special least concern animal is a MSES.	Examples of habitat include an area of land used by an animal for foraging, roosting, nesting or breeding **Special least concern animal** means the following animals that are least concern wildlife under the NC Act: • a koala (*Phascolarctos cinereus*); • an echidna (*Tachyglossus*	No habitat for threatened or Special Least Concern aquatic flora or fauna species has been recorded and habitat is not considered likely to occur within the study area.	Not applicable.	Not applicable.

Matters of State Environmental Significance	Details	Presence on Study area	Potential Project Impact (ha)	Offsets
	aculeatus); • a platypus (*Ornithorhynchus anatinus*).			
Protected Areas				
A protected area is a MSES.	A coordinated conservation area under the *Nature Conservation Act 1992* is excluded by the *Environmental Offsets Act 2014*, definition protected area.	No protected aquatic areas are within the study area.	Not applicable.	Not applicable.
Highly protected zones of State marine parks				
A highly protected area of a relevant Queensland marine park is a MSES.	**Highly protected area** means: • a zone classified, under the *Marine Parks Act 2004*, as a conservation park zone, marine national park zone or preservation zone; or • another area prescribed under a regulation or zoning plan, under the *Marine Parks Act 2004*, as a highly protected area. **Relevant Queensland marine**	No highly protected areas of a relevant Queensland marine park are within the study area. The study area is located approximately 280 km from the Queensland coast.	Not applicable.	Not applicable.

Matters of State Environmental Significance	Details	Presence on Study area	Potential Project Impact (ha)	Offsets
	park means any of the following marine parks declared under the *Marine Parks Act 2004:* • the Great Barrier Reef Coast Marine Park; • the Moreton Bay Marine Park; • the Great Sandy Marine Park. **Zone**, for a marine park, see the *Marine Parks Act 2004*, schedule.			
Fish habitat areas				
An area declared under the *Fisheries Act 1994* to be a fish habitat area is a MSES.	The *Fisheries Act 1994* details areas to be declared as a fish habitat area.	No declaration of fish habitat has been made for the study area.	Not applicable.	Not applicable.
Waterway providing for fish passage				
Any part of a waterway providing for passage of fish and not located within an urban area is a MSES only if the construction, installation or modification of waterway barrier works carried out under an authority will limit the passage of fish along the	**Fish** means fish regulated under the *Fisheries Act 1994*. **Passage**, for fish, means the natural movement patterns of fish species required to maintain the biological integrity of the species. **Waterway** includes a river, creek, stream, watercourse or	The majority of waterways in the study area are mapped as being green (low risk of impact) or amber (moderate risk of impact). As noted in **Section 5.1**, the project has been designed to avoid impacts on the only waterway classified as purple (major risk) under the DAFF's	Not applicable.	Not applicable.

Matters of State Environmental Significance	Details	Presence on Study area	Potential Project Impact (ha)	Offsets
waterway.	inlet of the sea. **Waterway barrier works** means a dam, weir or other barrier across a waterway.	mapping system. **Section 5.1.3** concludes that the project is not predicted to give rise to any significant impacts on fish passage.		
Marine plants				
A marine plant within the meaning of the *Fisheries Act 1994* is a MSES. However, a marine plant is not a MSES if the plant is in an urban area.	Section 8 of the *Fisheries Act 1994* defines a marine plant as: • plant (a "tidal plant") that usually grows on, or adjacent to, tidal land, whether it is living, dead, standing or fallen; • material of a tidal plant, or other plant material on tidal land; • a plant, or material of a plant, prescribed under a regulation or management plan to be a marine plant.	No marine plants were recorded within the study area.	Not applicable.	Not applicable.
Legally secured offset areas				
A legally secured offset area is a MSES.	A legally secured offset area is an area of land the subject of a covenant under the *Land Act*	There are no offset areas present on the study area.	Not applicable.	Not applicable.

Matters of State Environmental Significance	Details	Presence on Study area	Potential Project Impact (ha)	Offsets
	1994.			

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Figures

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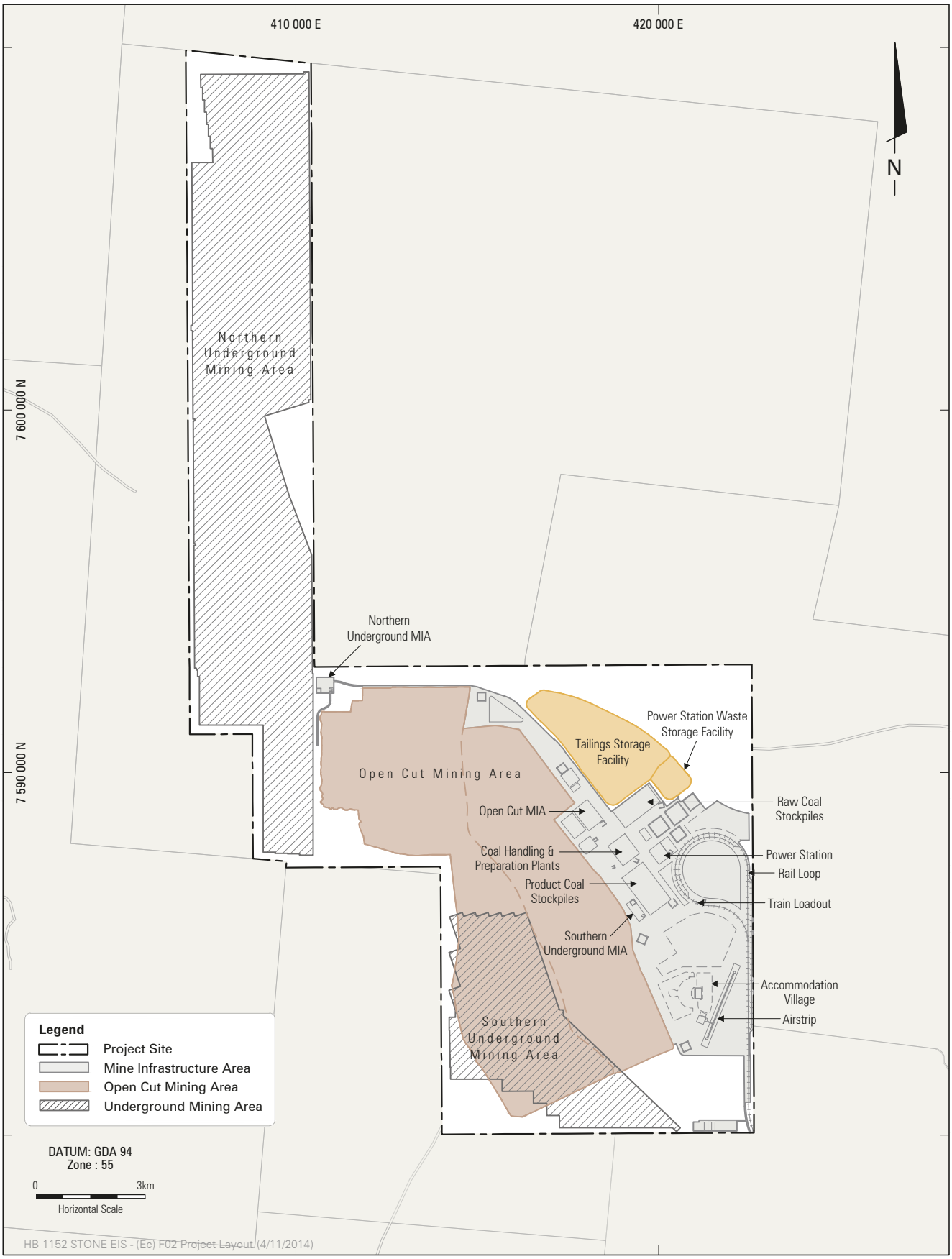
- Figure 2: Project Layout
- Figure 3: Regional Catchment Setting
- Figure 4: Local Catchment Setting
- Figure 5: Aquatic Survey Sites within the Study Area
- Figure 6: Habitat Condition Represented by Each Quadrant of the SIGNAL 2/Family Bi-plot (extracted from Chessman 2003)
- Figure 7: Location of Stygofauna Sampling Groundwater Bores within the Study Area
- Figure 8: DAFF Queensland Waterways for Waterway Barrier Works
- Figure 9: EHP Map of Referrable Wetlands
- Figure 10: Aquatic Habitat within Disturbance Boundary and Predicted Limit of Measurable Subsidence
- Figure 11: Northern Seasonal Wetland Location
- Figure 12: Northern Seasonal Wetland – Pre and Post-Mining

PROJECT CHINA STONE

MACMINES AUSTASIA | Hansen Bailey ENVIRONMENTAL CONSULTANTS

Project Location

FIGURE 1



PROJECT CHINA STONE

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Project Layout

FIGURE 2

PROJECT CHINA STONE

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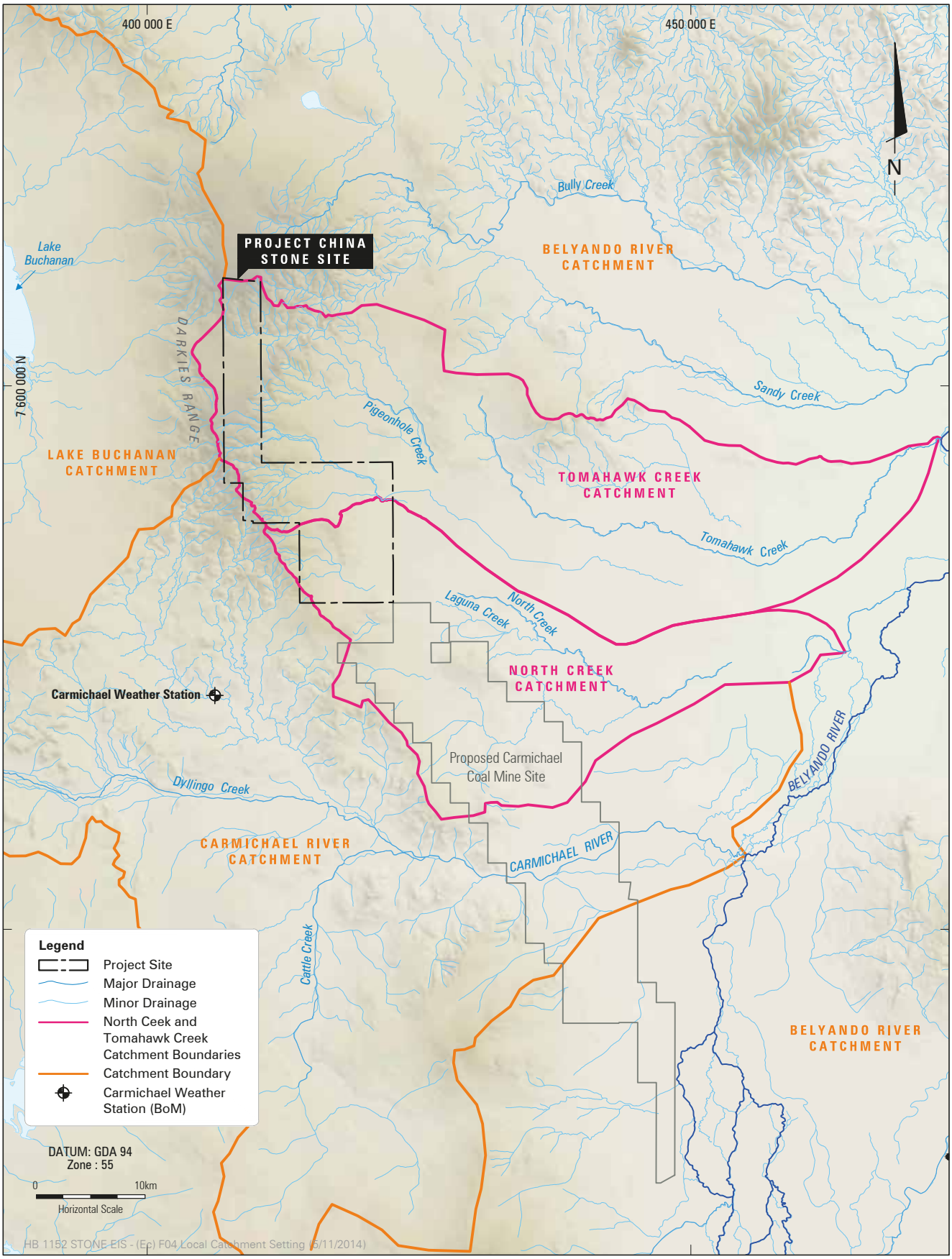
Regional Catchment Setting

FIGURE 3



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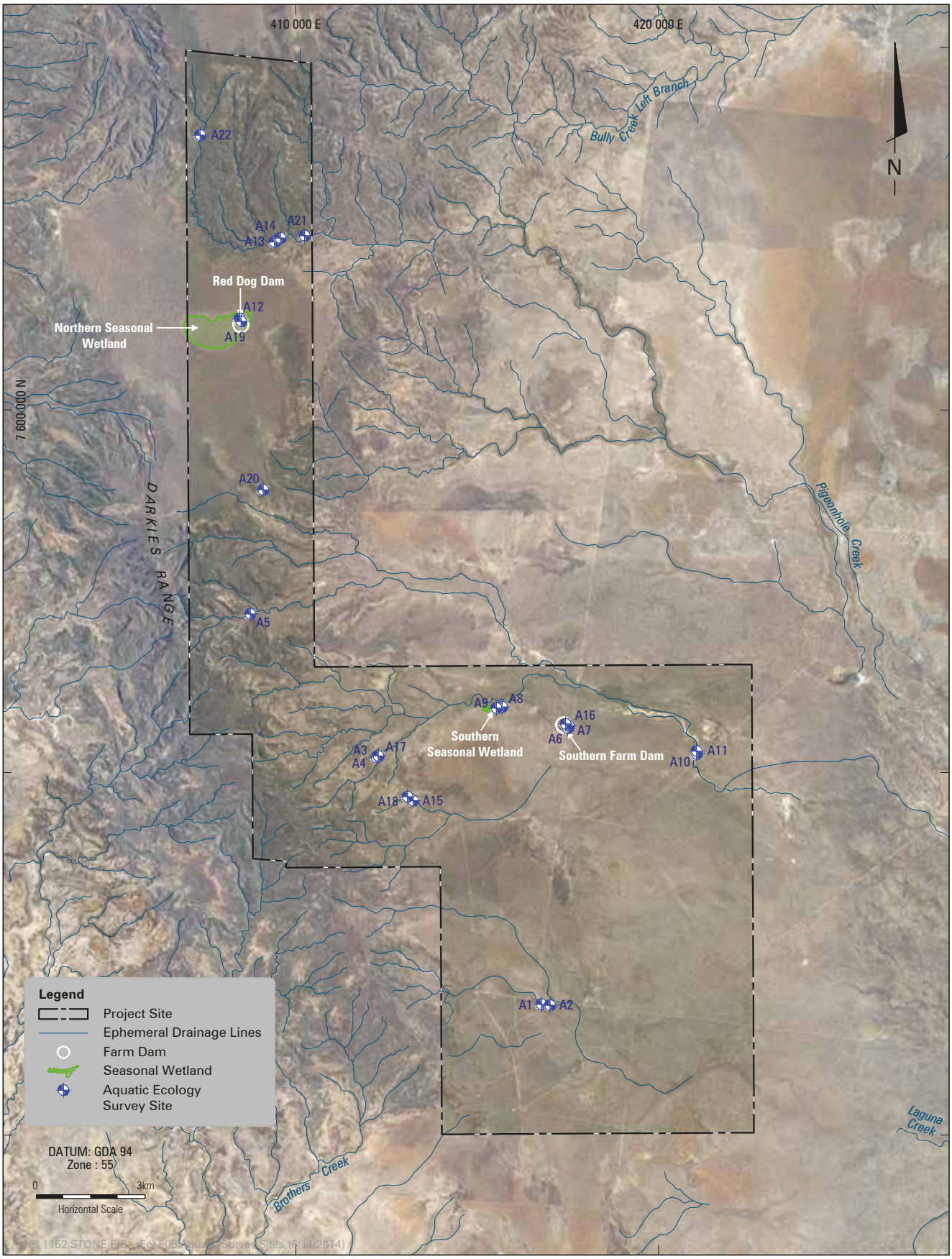
Local Catchment Setting

FIGURE 4



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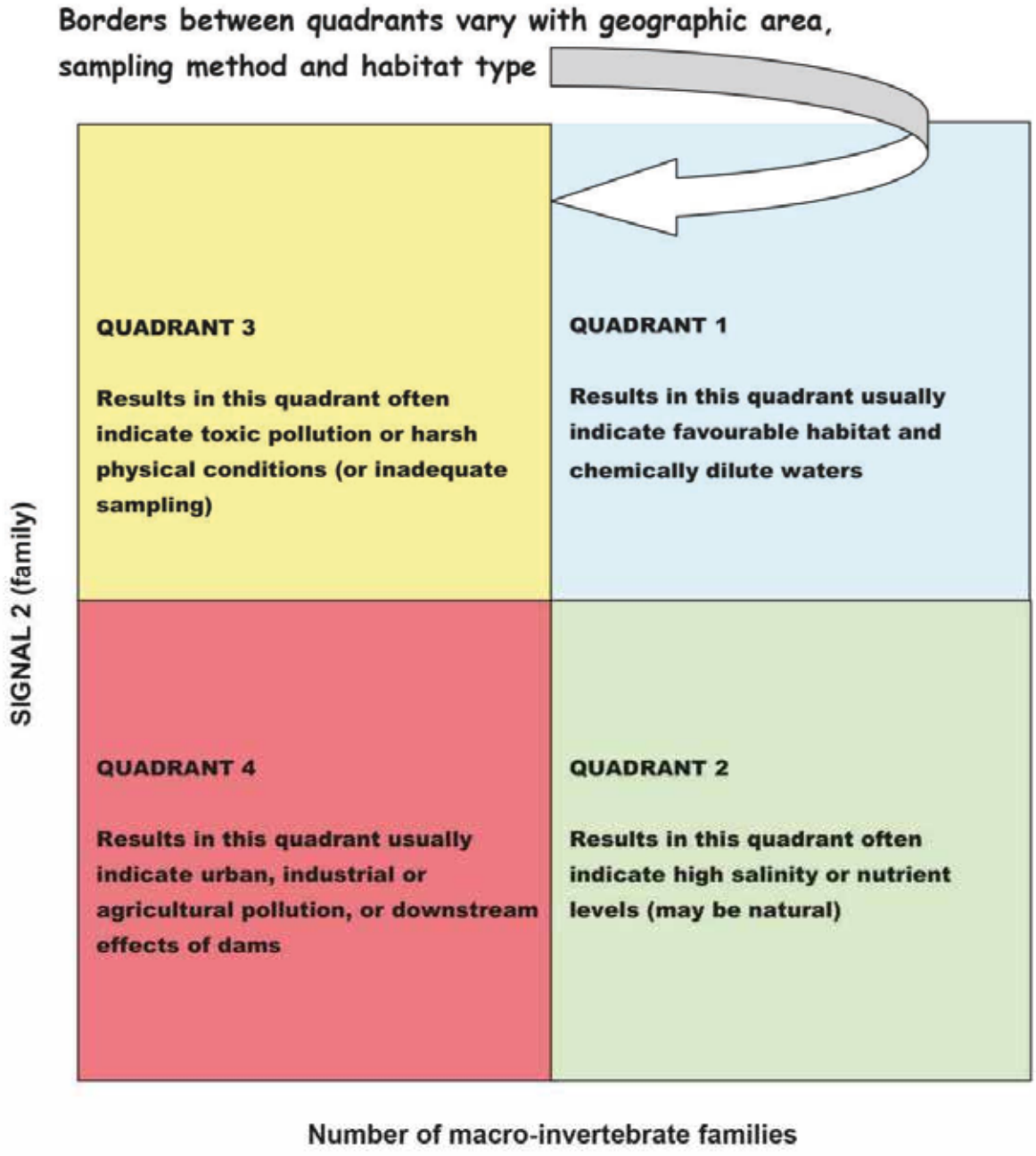
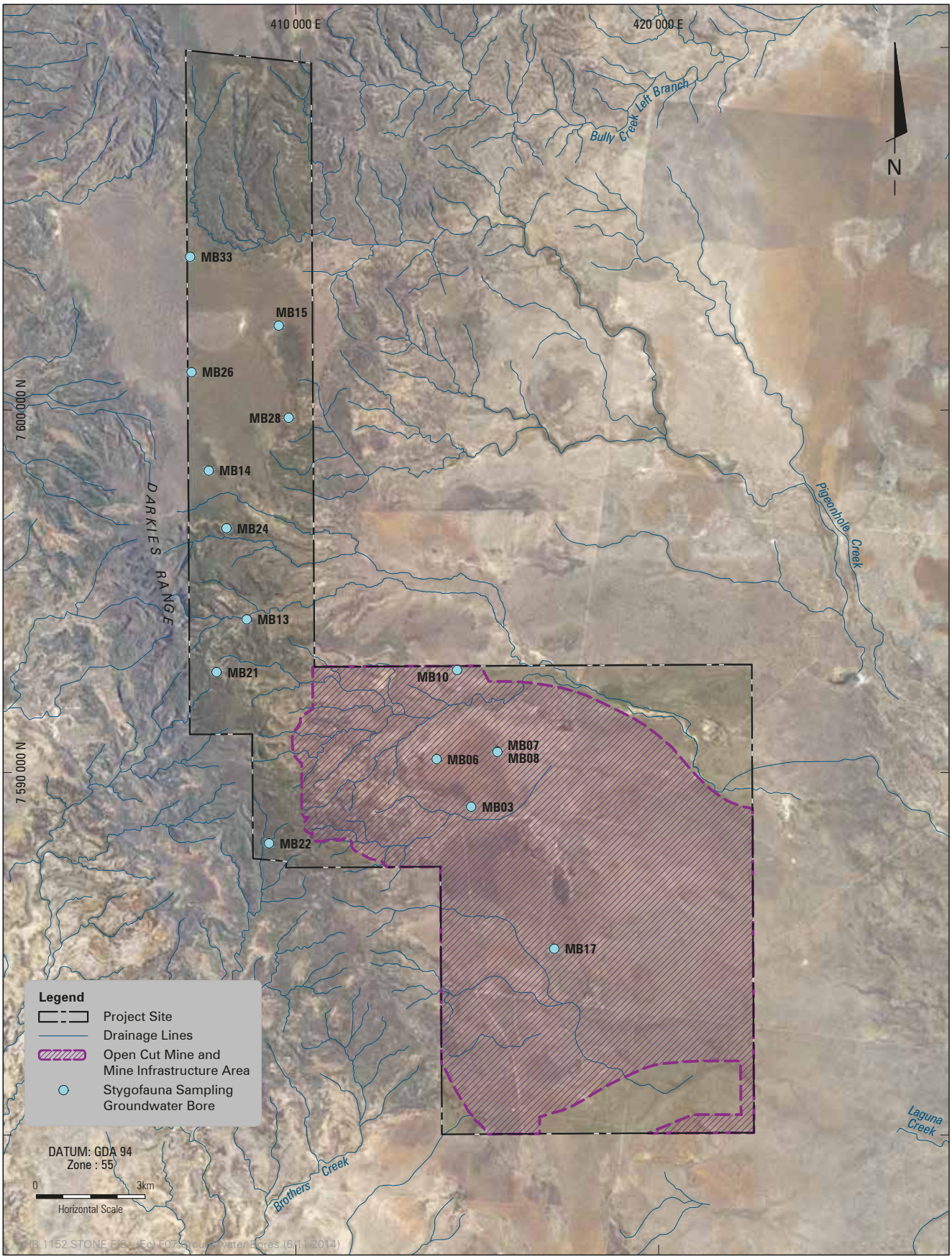
Aquatic Survey Sites within the Study Area

FIGURE 5

Figure 6 **Habitat Condition Represented by Each Quadrant of the SIGNAL 2/Family Bi-plot (extracted from Chessman 2003)**





PROJECT CHINA STONE

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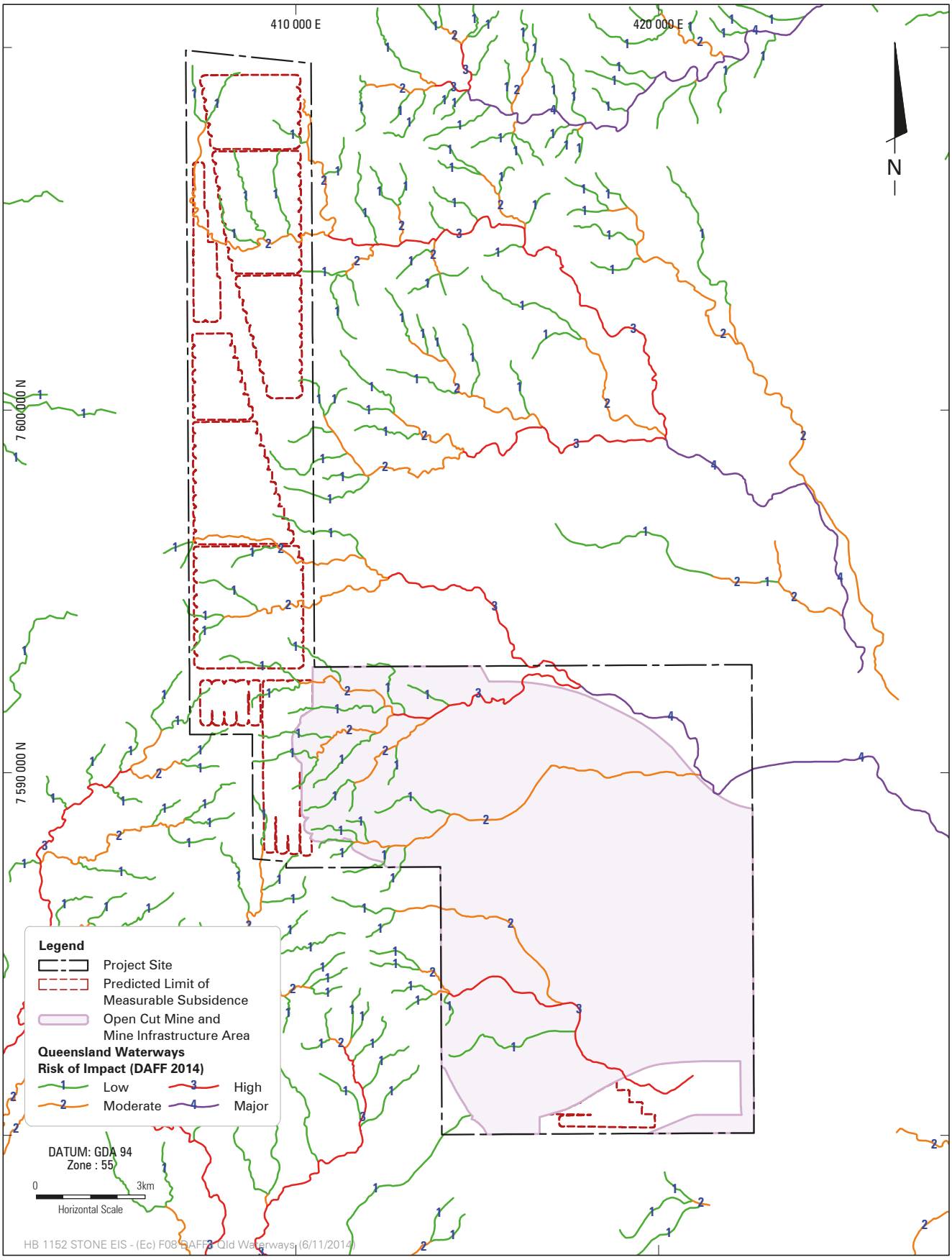
Location of Stygofauna Sampling Groundwater Bores within the Study Area

FIGURE 7



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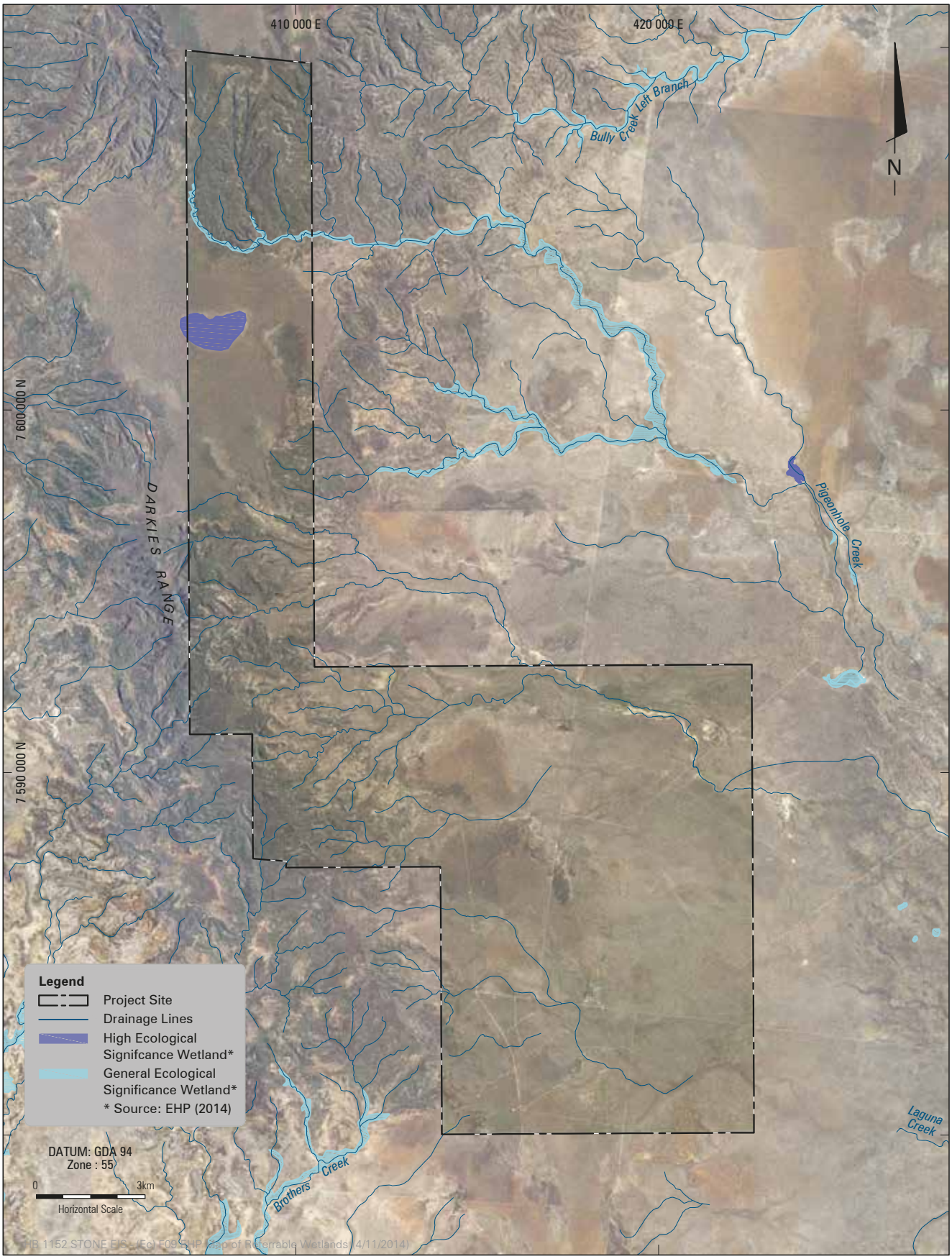
DAFF Queensland Waterways for Waterway Barrier Works

FIGURE 8



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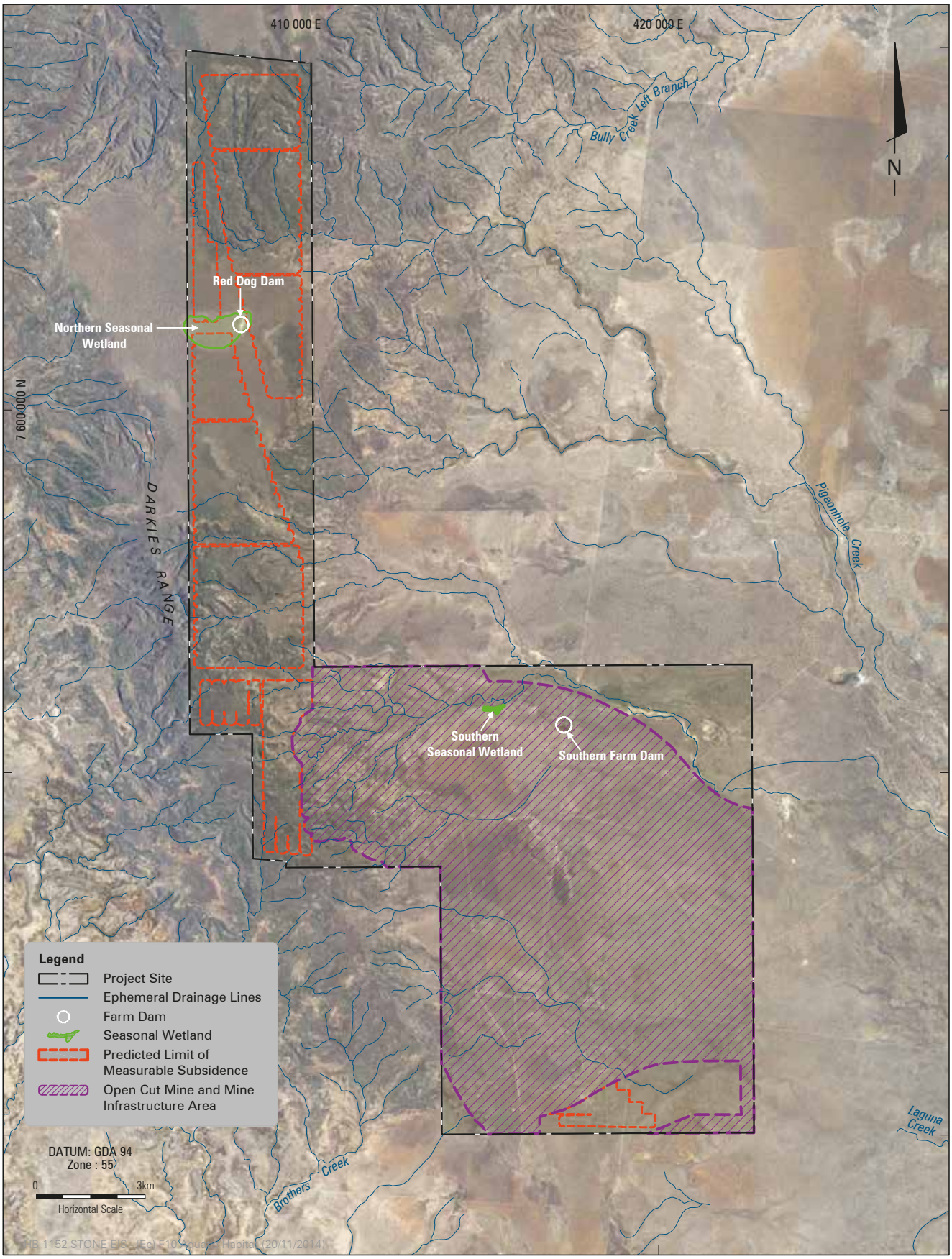
EHP Map of Referrable Wetlands

FIGURE 9



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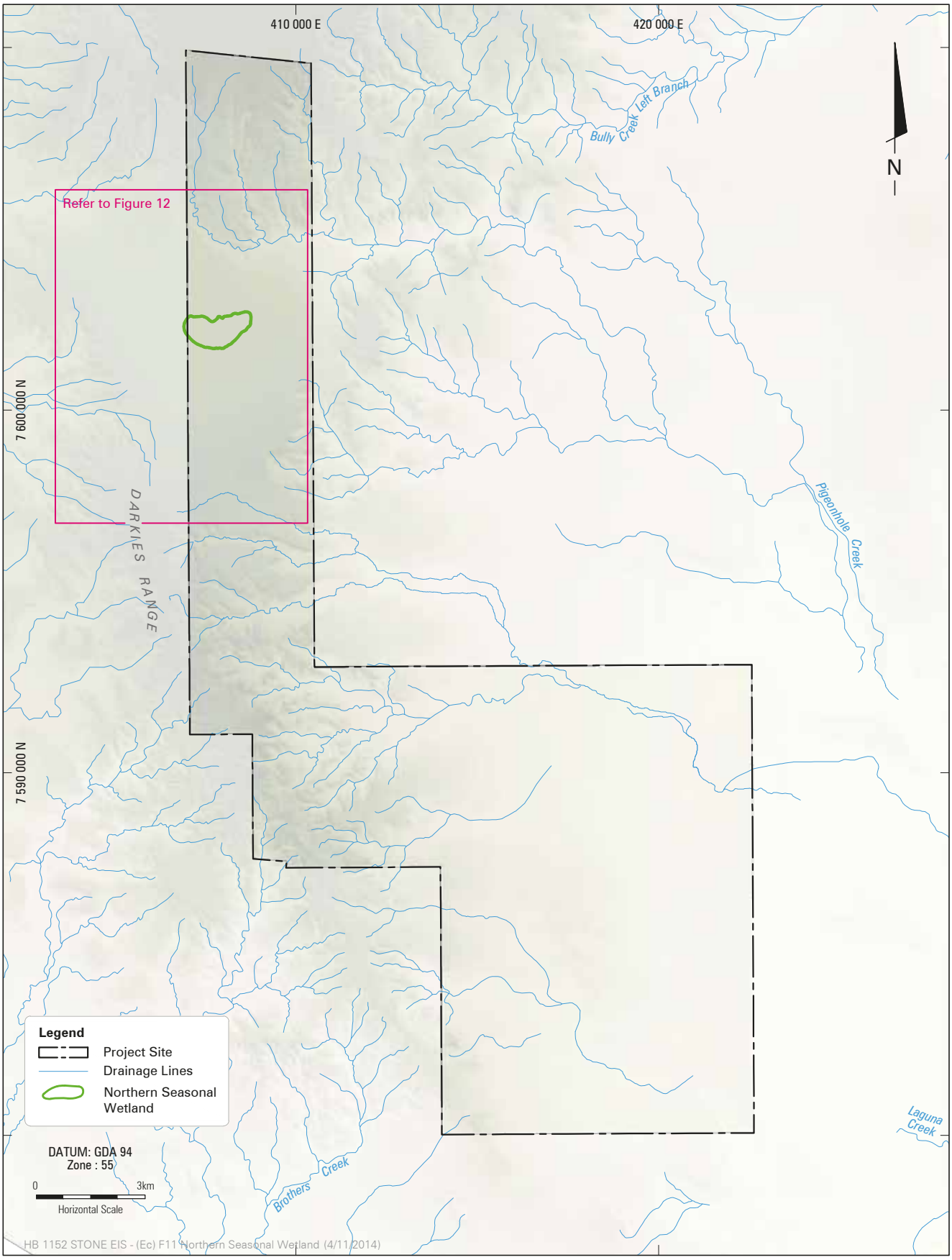
Aquatic Habitat within Disturbance Boundary and Predicted Limit of Measurable Subsidence

FIGURE 10



PROJECT CHINA STONE

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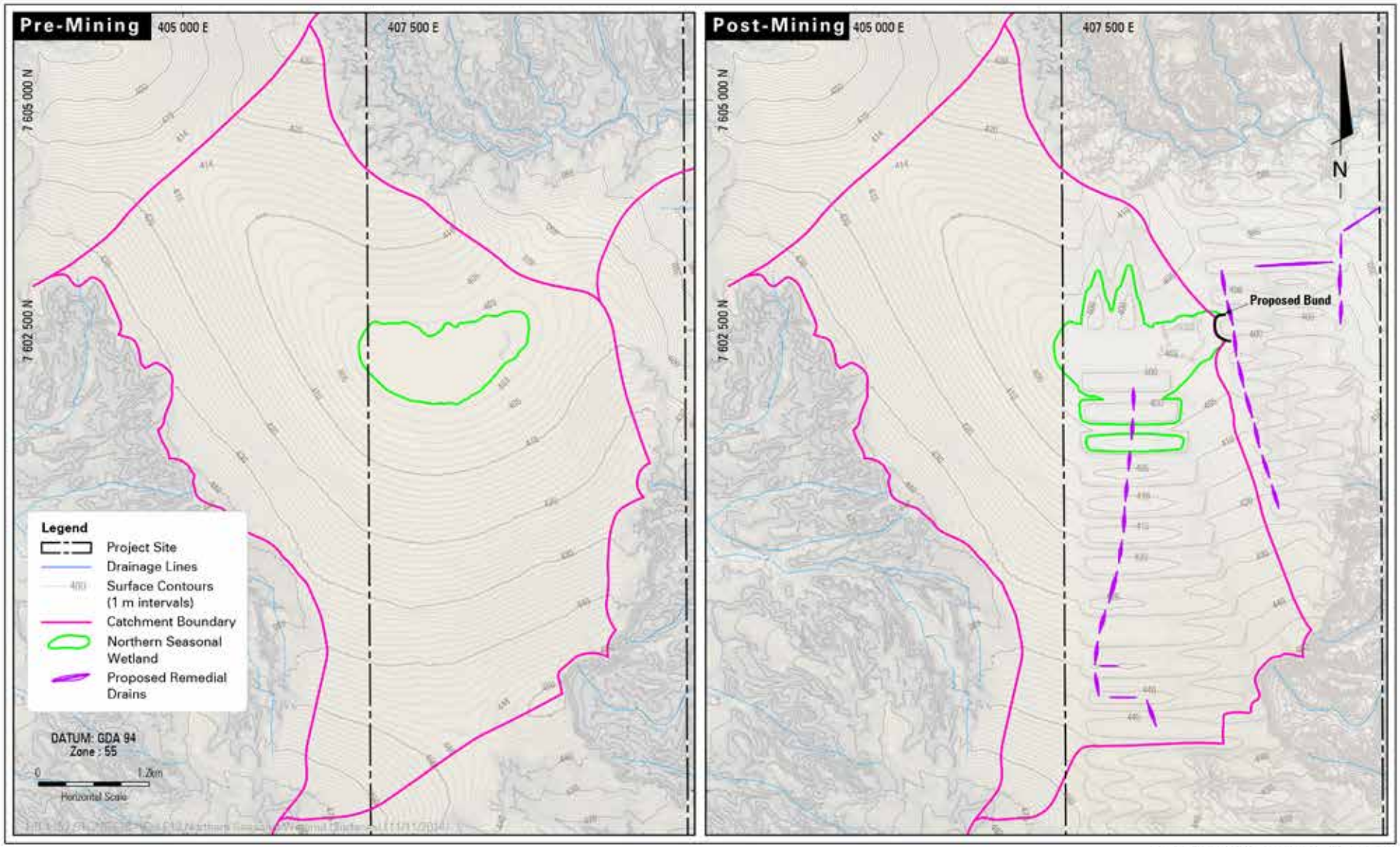
Northern Seasonal Wetland Location

FIGURE 11



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Northern Seasonal Wetland - Pre and Post-Mining

FIGURE 12

Appendix A

EPBC Act Protected Matters Search

Australian Government
Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 02/03/15 12:32:09

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Coordinates
Buffer: 10.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	9
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	8
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	1
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	8
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Erythrotriorchis radiatus		
Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Geophaps scripta scripta		
Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Neochmia ruficauda ruficauda		
Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Poephila cincta cincta		
Black-throated Finch (southern) [64447]	Endangered	Species or species habitat known to occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Macrotis lagotis		
Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Denisonia maculata		
Ornamental Snake [1193]	Vulnerable	Species or species habitat may occur within area
Egernia rugosa		
Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Lake Buchanan and Catchment	QLD	Registered

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Frogs		
Rhinella marina		
Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Jatropha gossypifolia		
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus		
Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur

Name	Status	Type of Presence within area

Coordinates

-21.765 146.25111,-21.88167 146.25111,-21.88167 146.16778,-21.815 146.16778,-21.815 146.12639,-21.81333 146.12667,-21.81278 146.11778,-21.78167 146.11778,-21.78167 146.10111,-21.61111 146.10111,-21.61472 146.13444,-21.765 146.13444,-21.765 146.25111

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B

Queensland Wildlife Online Database Search Results

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: All
Latitude: -21.8818
Longitude: 146.2094
Distance: 25
Email: katrina.wolf@cumberlandecology.com.au
Date submitted: Monday 02 Mar 2015 13:01:57
Date extracted: Monday 02 Mar 2015 13:10:36

The number of records retrieved = 557

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			4
animals	amphibians	Hylidae	*Litoria rubella*	ruddy treefrog		C		4
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		5
animals	amphibians	Hylidae	*Cyclorana brevipes*	superb collared frog		C		2
animals	amphibians	Hylidae	*Litoria rothii*	northern laughing treefrog		C		3
animals	amphibians	Hylidae	*Litoria inermis*	bumpy rocketfrog		C		5/1
animals	amphibians	Hylidae	*Cyclorana novaehollandiae*	eastern snapping frog		C		6/3
animals	amphibians	Hylidae	*Litoria nasuta*	striped rocketfrog		C		1/1
animals	amphibians	Limnodynastidae	*Platyplectrum ornatum*	ornate burrowing frog		C		3/1
animals	amphibians	Myobatrachidae	*Crinia deserticola*	chirping froglet		C		1
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		21
animals	birds	Acanthizidae	*Acanthiza nana*	yellow thornbill		C		1
animals	birds	Acanthizidae	*Gerygone fusca*	western gerygone		C		3
animals	birds	Acanthizidae	*Acanthiza reguloides*	buff-rumped thornbill		C		2
animals	birds	Acanthizidae	*Gerygone albogularis*	white-throated gerygone		C		9
animals	birds	Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill		C		12
animals	birds	Acanthizidae	*Acanthiza uropygialis*	chestnut-rumped thornbill		C		2
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		5
animals	birds	Accipitridae	*Lophoictinia isura*	square-tailed kite		C		2
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		1
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		1
animals	birds	Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler		SL		1
animals	birds	Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar		C		38
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		1
animals	birds	Anatidae	*Malacorhynchus membranaceus*	pink-eared duck		C		2
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		1
animals	birds	Anatidae	*Aythya australis*	hardhead		C		3
animals	birds	Anatidae	*Anas gracilis*	grey teal		C		3
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		3
animals	birds	Ardeidae	*Ardea intermedia*	intermediate egret		C		2
animals	birds	Ardeidae	*Egretta garzetta*	little egret		C		2
animals	birds	Ardeidae	*Nycticorax caledonicus*	Nankeen night-heron		C		1
animals	birds	Ardeidae	*Ardea pacifica*	white-necked heron		C		4
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		1
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		20
animals	birds	Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		C		1
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		40
animals	birds	Artamidae	*Artamus minor*	little woodswallow		C		2
animals	birds	Artamidae	*Artamus cinereus*	black-faced woodswallow		C		7
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		28
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		2
animals	birds	Burhinidae	*Burhinus grallarius*	bush stone-curlew		C		2
animals	birds	Cacatuidae	*Eolophus roseicapillus*	galah		C		1
animals	birds	Cacatuidae	*Calyptorhynchus banksii*	red-tailed black-cockatoo		C		4
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		1
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		14

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Campephagidae	*Lalage sueurii*	white-winged triller		C		8
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		25
animals	birds	Campephagidae	*Coracina maxima*	ground cuckoo-shrike		C		2
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		4
animals	birds	Charadriidae	*Vanellus miles miles*	masked lapwing (northern subspecies)		C		1
animals	birds	Charadriidae	*Vanellus miles novaehollandiae*	masked lapwing (southern subspecies)		C		2
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		1
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		6
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		8
animals	birds	Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)		V	V	13
animals	birds	Columbidae	*Phaps chalcoptera*	common bronzewing		C		1
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		10
animals	birds	Columbidae	*Geopelia cuneata*	diamond dove		C		1
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		11
animals	birds	Coraciidae	*Eurystomus orientalis*	dollarbird		C		1
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		20
animals	birds	Corvidae	*Corvus bennetti*	little crow		C		1
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		17
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		18
animals	birds	Cuculidae	*Chalcites basalis*	Horsfield's bronze-cuckoo		C		6
animals	birds	Cuculidae	*Cacomantis pallidus*	pallid cuckoo		C		3
animals	birds	Cuculidae	*Cacomantis variolosus*	brush cuckoo		C		2
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		3
animals	birds	Estrildidae	*Neochmia modesta*	plum-headed finch		C		2
animals	birds	Estrildidae	*Taeniopygia guttata*	zebra finch		C		4
animals	birds	Estrildidae	*Poephila cincta cincta*	black-throated finch (white-rumped subspecies)		E	E	25
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		7
animals	birds	Eurostopodidae	*Eurostopodus argus*	spotted nightjar		C		14
animals	birds	Falconidae	*Falco cenchroides*	Nankeen kestrel		C		7
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		9
animals	birds	Gruidae	*Grus rubicunda*	brolga		C		4
animals	birds	Halcyonidae	*Dacelo leachii*	blue-winged kookaburra		C		12
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		8
animals	birds	Halcyonidae	*Todiramphus sanctus*	sacred kingfisher		C		13
animals	birds	Hirundinidae	*Petrochelidon nigricans*	tree martin		C		3
animals	birds	Maluridae	*Malurus lamberti*	variegated fairy-wren		C		21
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		5
animals	birds	Megaluridae	*Cincloramphus mathewsi*	rufous songlark		C		6
animals	birds	Megaluridae	*Eremiornis carteri*	spinifexbird		C		4
animals	birds	Meliphagidae	*Ptilotula plumulus*	grey-fronted honeyeater		C		11
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		18
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		2
animals	birds	Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater		C		20
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		7
animals	birds	Meliphagidae	*Manorina flavigula*	yellow-throated miner		C		22

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Meliphagidae	*Gavicalis virescens*	singing honeyeater		C		19
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		13
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		47
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		1
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		18
animals	birds	Meliphagidae	*Ptilotula penicillatus*	white-plumed honeyeater		C		8
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		SL		11
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		10
animals	birds	Monarchidae	*Myiagra inquieta*	restless flycatcher		C		11
animals	birds	Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		C		1
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		15
animals	birds	Neosittidae	*Daphoenositta chrysoptera*	varied sittella		C		6
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		8
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		20
animals	birds	Pachycephalidae	*Oreoica gutturalis*	crested bellbird		C		21
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		24
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		22
animals	birds	Pelecanidae	*Pelecanus conspicillatus*	Australian pelican		C		1
animals	birds	Petroicidae	*Microeca fascinans*	jacky winter		C		30
animals	birds	Petroicidae	*Melanodryas cucullata*	hooded robin		C		4
animals	birds	Phasianidae	*Coturnix ypsilophora*	brown quail		C		2
animals	birds	Podargidae	*Podargus strigoides*	tawny frogmouth		C		19
animals	birds	Podicipedidae	*Poliocephalus poliocephalus*	hoary-headed grebe		C		1
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		2
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		14
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		12
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		7
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		14
animals	birds	Psittacidae	*Melopsittacus undulatus*	budgerigar		C		3
animals	birds	Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird		C		4
animals	birds	Rallidae	*Gallinula tenebrosa*	dusky moorhen		C		1
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		27
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		6
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		17
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		2
animals	birds	Threskiornithidae	*Threskiornis molucca*	Australian white ibis		C		2
animals	birds	Threskiornithidae	*Platalea regia*	royal spoonbill		C		1
animals	birds	Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill		C		1
animals	mammals	Canidae	*Canis lupus dingo*	dingo				1
animals	mammals	Dasyuridae	*Sminthopsis macroura*	stripe-faced dunnart		C		10
animals	mammals	Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail bat		C		1
animals	mammals	Felidae	*Felis catus*	cat	Y			3
animals	mammals	Leporidae	*Oryctolagus cuniculus*	rabbit	Y			2
animals	mammals	Macropodidae	*Macropus rufus*	red kangaroo		C		12
animals	mammals	Macropodidae	*Wallabia bicolor*	swamp wallaby		C		1
animals	mammals	Macropodidae	*Macropus robustus*	common wallaroo		C		6

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	mammals	Macropodidae	*Macropus giganteus*	eastern grey kangaroo		C		12
animals	mammals	Macropodidae	*Lagorchestes conspicillatus*	spectacled hare-wallaby		C		1
animals	mammals	Molossidae	*Chaerephon jobensis*	northern freetail bat		C		1
animals	mammals	Muridae	*Leggadina lakedownensis*	Lakeland Downs mouse		C		1
animals	mammals	Muridae	*Pseudomys delicatulus*	delicate mouse		C		3
animals	mammals	Muridae	*Pseudomys desertor*	desert mouse		C		11
animals	mammals	Muridae	*Pseudomys patrius*	eastern pebble-mound mouse		C		1
animals	mammals	Muridae	*Mus musculus*	house mouse	Y			1
animals	mammals	Petauridae	*Petaurus breviceps*	sugar glider		C		2
animals	mammals	Petauridae	*Petaurus norfolcensis*	squirrel glider		C		1
animals	mammals	Phalangeridae	*Trichosurus vulpecula*	common brushtail possum		C		4
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		SL	V	3
animals	mammals	Potoroidae	*Aepyprymnus rufescens*	rufous bettong		C		1
animals	mammals	Pteropodidae	*Pteropus scapulatus*	little red flying-fox		C		2
animals	mammals	Suidae	*Sus scrofa*	pig	Y			1
animals	mammals	Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna		SL		2
animals	mammals	Vespertilionidae	*Vespadelus finlaysoni*	Finlayson's cave bat		C		1
animals	mammals	Vespertilionidae	*Nyctophilus geoffroyi*	lesser long-eared bat		C		3
animals	mammals	Vespertilionidae	*Chalinolobus picatus*	little pied bat		C		1
animals	mammals	Vespertilionidae	*Vespadelus baverstocki*	inland forest bat		C		1
animals	mammals	Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat		C		3
animals	mammals	Vespertilionidae	*Scotorepens greyii*	little broad-nosed bat		C		5
animals	mammals	Vespertilionidae	*Vespadelus troughtoni*	eastern cave bat		C		1
animals	mammals	Vespertilionidae	*Chalinolobus morio*	chocolate wattled bat		C		1
animals	reptiles	Agamidae	*Amphibolurus gilberti*	Gilbert's dragon		C		1
animals	reptiles	Agamidae	*Diporiphora australis*			C		3
animals	reptiles	Agamidae	*Ctenophorus nuchalis*	central netted dragon		C		6
animals	reptiles	Agamidae	*Amphibolurus burnsi*			C		1
animals	reptiles	Agamidae	*Pogona barbata*	bearded dragon		C		11
animals	reptiles	Boidae	*Aspidites melanocephalus*	black-headed python		C		3
animals	reptiles	Carphodactylidae	*Nephrurus asper*	spiny knob-tailed gecko		C		2
animals	reptiles	Colubridae	*Tropidonophis mairii*	freshwater snake		C		1
animals	reptiles	Colubridae	*Boiga irregularis*	brown tree snake		C		1
animals	reptiles	Diplodactylidae	*Rhynchoedura ornata sensu lato*	beaked gecko		C		2
animals	reptiles	Diplodactylidae	*Diplodactylus conspicillatus*	fat-tailed diplodactylus		C		4
animals	reptiles	Diplodactylidae	*Lucasium steindachneri*	Steindachner's gecko		C		7
animals	reptiles	Diplodactylidae	*Strophurus williamsi*	soft-spined gecko		C		4
animals	reptiles	Diplodactylidae	*Amalosia rhombifer*	zig-zag gecko		C		1
animals	reptiles	Diplodactylidae	*Oedura marmorata*	marbled velvet gecko		C		1
animals	reptiles	Elapidae	*Cryptophis boschmai*	Carpentaria whip snake		C		1
animals	reptiles	Elapidae	*Demansia psammophis*	yellow-faced whipsnake		C		1
animals	reptiles	Elapidae	*Furina diadema*	red-naped snake		C		1
animals	reptiles	Elapidae	*Acanthophis praelongus*	northern death adder		C		1
animals	reptiles	Gekkonidae	*Heteronotia binoei*	Bynoe's gecko		C		10
animals	reptiles	Gekkonidae	*Gehyra catenata*			C		2
animals	reptiles	Pygopodidae	*Lialis burtonis*	Burton's legless lizard		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	reptiles	Scincidae	*Morethia taeniopleura*	fire-tailed skink		C		1
animals	reptiles	Scincidae	*Cryptoblepharus plagiocephalus sensu lato*			C		5
animals	reptiles	Scincidae	*Proablepharus tenuis*			C		1
animals	reptiles	Scincidae	*Ctenotus pantherinus*			C		5
animals	reptiles	Scincidae	*Morethia boulengeri*			C		3
animals	reptiles	Scincidae	*Ctenotus strauchii*			C		5
animals	reptiles	Scincidae	*Ctenotus spaldingi*			C		3
animals	reptiles	Scincidae	*Concinnia sokosoma*	stout bar-sided skink		C		1
animals	reptiles	Scincidae	*Ctenotus hebetior*			C		3
animals	reptiles	Scincidae	*Egernia striolata*	tree skink		C		2
animals	reptiles	Scincidae	*Carlia munda*			C		7
animals	reptiles	Scincidae	*Carlia schmeltzii*			C		1
animals	reptiles	Scincidae	*Ctenotus ingrami*			C		4
animals	reptiles	Scincidae	*Menetia greyii*	common dwarf skink		C		4
animals	reptiles	Scincidae	*Menetia maini*	northern dwarf skink		C		2
animals	reptiles	Typhlopidae	*Ramphotyphlops ligatus*			C		1
animals	reptiles	Varanidae	*Varanus tristis*	black-tailed monitor		C		3
plants	ferns	Azollaceae	*Azolla pinnata*	ferny azolla		C		1
plants	ferns	Marsileaceae	*Marsilea hirsuta*	hairy nardoo		C		1
plants	higher dicots	Acanthaceae	*Dipteracanthus australasicus subsp. australasicus*			C		1/1
plants	higher dicots	Acanthaceae	*Rostellularia adscendens*			C		1/1
plants	higher dicots	Acanthaceae	*Nelsonia campestris*			C		1/1
plants	higher dicots	Aizoaceae	*Trianthema triquetra*	red spinach		C		2/2
plants	higher dicots	Aizoaceae	*Zaleya galericulata*			C		1/1
plants	higher dicots	Aizoaceae	*Trianthema sp. (Coorabulka R.W.Purdie 1404)*			C		2/2
plants	higher dicots	Amaranthaceae	*Alternanthera pungens*	khaki weed	Y			1/1
plants	higher dicots	Amaranthaceae	*Gomphrena sp. (Doongmabulla E.J.Thompson+ GAL137)*			C		1/1
plants	higher dicots	Amaranthaceae	*Ptilotus nobilis subsp. semilanatus*			C		1/1
plants	higher dicots	Amaranthaceae	*Gomphrena lanata*			C		1/1
plants	higher dicots	Amaranthaceae	*Alternanthera angustifolia*			C		1/1
plants	higher dicots	Apiaceae	*Eryngium plantagineum*	long eryngium		C		1/1
plants	higher dicots	Apiaceae	*Platysace valida*			C		1/1
plants	higher dicots	Apiaceae	*Centella asiatica*			C		1
plants	higher dicots	Apiaceae	*Eryngium fontanum*			E	E	5/3
plants	higher dicots	Araliaceae	*Hydrocotyle dipleura*			V		3/2
plants	higher dicots	Asteraceae	*Streptoglossa odora*			C		1/1
plants	higher dicots	Asteraceae	*Pluchea baccharoides*	narrow-leaved plains bush		C		3/3
plants	higher dicots	Asteraceae	*Pluchea rubelliflora*			C		2/2
plants	higher dicots	Asteraceae	*Calotis xanthosioidea*			C		1/1
plants	higher dicots	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			4/4
plants	higher dicots	Asteraceae	*Chrysocephalum apiculatum*	yellow buttons		C		1/1
plants	higher dicots	Asteraceae	*Olearia arguta var. lanata*			C		1/1
plants	higher dicots	Asteraceae	*Apowollastonia spilanthoides*			C		1/1
plants	higher dicots	Asteraceae	*Emilia sonchifolia var. sonchifolia*		Y			1/1
plants	higher dicots	Asteraceae	*Acmella grandiflora var. brachyglossa*			C		2/1
plants	higher dicots	Asteraceae	*Pterocaulon serrulatum var. serrulatum*			C		1/1

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plants	higher dicots	Asteraceae	*Pluchea dentex*	bowl daisy		C		1/1
plants	higher dicots	Asteraceae	*Rutidosis leucantha*			C		1/1
plants	higher dicots	Asteraceae	*Emilia sonchifolia*		Y			1
plants	higher dicots	Asteraceae	*Epaltes australis*	spreading nutheads		C		1
plants	higher dicots	Asteraceae	*Camptacra barbata*			C		2/2
plants	higher dicots	Asteraceae	*Aster subulatus*	wild aster	Y			2
plants	higher dicots	Asteraceae	*Pluchea xanthina*			C		1/1
plants	higher dicots	Byttneriaceae	*Keraudrenia nephrosperma*			C		1/1
plants	higher dicots	Byttneriaceae	*Keraudrenia hookeriana*			C		2/2
plants	higher dicots	Byttneriaceae	*Keraudrenia collina*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Labichea rupestris*			C		1/1
plants	higher dicots	Campanulaceae	*Isotoma sp. (Myross R.J.Fensham 3883)*			C		3/1
plants	higher dicots	Capparaceae	*Capparis lasiantha*	nipan		C		1/1
plants	higher dicots	Caryophyllaceae	*Polycarpaea spirostylis subsp. compacta*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena lanicuspis*			C		2/2
plants	higher dicots	Chenopodiaceae	*Dysphania plantaginella*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena everistiana*			C		2/2
plants	higher dicots	Chenopodiaceae	*Sclerolaena anisacanthoides*	yellow burr		C		2/2
plants	higher dicots	Chenopodiaceae	*Einadia trigonos subsp. stellulata*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena bicornis var. bicornis*			C		1/1
plants	higher dicots	Chenopodiaceae	*Dysphania melanocarpa forma melanocarpa*			C		1/1
plants	higher dicots	Chenopodiaceae	*Dissocarpus sp. (Doongmabulla E.J.Thompson+ GAL21)*			C		3/3
plants	higher dicots	Chenopodiaceae	*Atriplex sp. (Doongmabulla Homestead E.J.Thompson+ GAL20)*			C		1/1
plants	higher dicots	Chenopodiaceae	*Atriplex*			C		1/1
plants	higher dicots	Chenopodiaceae	*Maireana georgei*			C		2/2
plants	higher dicots	Chenopodiaceae	*Maireana villosa*			C		1/1
plants	higher dicots	Chenopodiaceae	*Atriplex lindleyi*			C		1/1
plants	higher dicots	Chenopodiaceae	*Maireana coronata*			C		2/2
plants	higher dicots	Chenopodiaceae	*Salsola australis*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena glabra*			C		6/6
plants	higher dicots	Chenopodiaceae	*Tecticornia indica*			C		1/1
plants	higher dicots	Chenopodiaceae	*Maireana dichoptera*			C		1/1
plants	higher dicots	Chenopodiaceae	*Rhagodia spinescens*	thorny saltbush		C		2/2
plants	higher dicots	Chenopodiaceae	*Sclerolaena bicornis*			C		2/2
plants	higher dicots	Chenopodiaceae	*Sclerolaena ramulosa*			C		5/5
plants	higher dicots	Chenopodiaceae	*Dissocarpus paradoxus*	cannonball burr		C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena calcarata*	red burr		C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena convexula*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena diacantha*	grey copper burr		C		5/5
plants	higher dicots	Chenopodiaceae	*Sclerolaena tricuspis*	giant red burr		C		1/1
plants	higher dicots	Clusiaceae	*Hypericum gramineum*			C		1/1
plants	higher dicots	Convolvulaceae	*Jacquemontia sp. (Fairview R.W.Johnson 4026)*			C		1/1
plants	higher dicots	Convolvulaceae	*Bonamia media var. media*			C		1/1
plants	higher dicots	Convolvulaceae	*Evolvulus alsinoides*			C		2/2
plants	higher dicots	Convolvulaceae	*Polymeria marginata*			C		1/1

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plants	higher dicots	Convolvulaceae	*Polymeria calycina*	pink bindweed		C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia papillata var. laevicaulis*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia coghlanii*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia petala*			C		1/1
plants	higher dicots	Euphorbiaceae	*Beyeria viscosa*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia thelephora var. thelephora*			C		1/1
plants	higher dicots	Fabaceae	*Vigna luteola*	dalrymple vigna	Y			3/1
plants	higher dicots	Fabaceae	*Cullen cinereum*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia juncea*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia supina*			C		1/1
plants	higher dicots	Fabaceae	*Zornia adenophora*			C		1/1
plants	higher dicots	Fabaceae	*Glycine tomentella*	woolly glycine		C		1/1
plants	higher dicots	Fabaceae	*Indigofera colutea*	sticky indigo		C		1/1
plants	higher dicots	Fabaceae	*Indigofera linnaei*	Birdsville indigo		C		1/1
plants	higher dicots	Fabaceae	*Sesbania cannabina*			C		1
plants	higher dicots	Fabaceae	*Aeschynomene indica*	budda pea		C		2/2
plants	higher dicots	Fabaceae	*Indigofera linifolia*			C		1/1
plants	higher dicots	Fabaceae	*Indigofera pratensis*			C		1/1
plants	higher dicots	Fabaceae	*Jacksonia ramosissima*			C		1/1
plants	higher dicots	Fabaceae	*Jacksonia rhadinoclona*	Miles dogwood		C		2/2
plants	higher dicots	Fabaceae	*Leptosema oxylobioides*			C		1/1
plants	higher dicots	Fabaceae	*Vigna vexillata var. angustifolia*			C		2/1
plants	higher dicots	Fabaceae	*Cajanus scarabaeoides var. scarabaeoides*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia sp. (Lake Buchanan E.J.Thompson+ BUC2128)*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia expansa*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia grandiflora*			C		1/1
plants	higher dicots	Goodeniaceae	*Velleia macrocalyx*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia rosulata*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia gracilis*			C		1/1
plants	higher dicots	Haloragaceae	*Myriophyllum artesium*			E		4/1
plants	higher dicots	Lamiaceae	*Plectranthus intraterraneus*			C		1/1
plants	higher dicots	Lamiaceae	*Prostanthera parvifolia*			C		1/1
plants	higher dicots	Lamiaceae	*Teucrium integrifolium*			C		1/1
plants	higher dicots	Lamiaceae	*Ocimum x africanum*		Y			1/1
plants	higher dicots	Lentibulariaceae	*Utricularia dichotoma*	fairy aprons		C		1
plants	higher dicots	Lentibulariaceae	*Utricularia fenshamii*			C		3/3
plants	higher dicots	Lentibulariaceae	*Utricularia gibba*	floating bladderwort		C		3/2
plants	higher dicots	Lentibulariaceae	*Utricularia caerulea*	blue bladderwort		C		5/2
plants	higher dicots	Loranthaceae	*Lysiana subfalcata*			C		1/1
plants	higher dicots	Loranthaceae	*Amyema bifurcata*			C		1/1
plants	higher dicots	Loranthaceae	*Amyema quandang var. quandang*			C		1/1
plants	higher dicots	Loranthaceae	*Dendrophthoe glabrescens*			C		2/1
plants	higher dicots	Lythraceae	*Ammannia multiflora*	jerry-jerry		C		1/1
plants	higher dicots	Malvaceae	*Sida spinosa*	spiny sida	Y			2/2
plants	higher dicots	Malvaceae	*Sida brachypoda*			C		2/2
plants	higher dicots	Malvaceae	*Sida goniocarpa*			C		1/1

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plants	higher dicots	Malvaceae	*Sida trichopoda*			C		1/1
plants	higher dicots	Malvaceae	*Sida atherophora*			C		1/1
plants	higher dicots	Malvaceae	*Sida sp. (Charters Towers E.J.THompson+ CHA456)*			C		1/1
plants	higher dicots	Malvaceae	*Abutilon calliphyllum*	velvet lanternflower		C		1/1
plants	higher dicots	Malvaceae	*Sida aprica var. solanacea*			C		1/1
plants	higher dicots	Malvaceae	*Abutilon fraseri subsp. fraseri*			C		1/1
plants	higher dicots	Malvaceae	*Sida sp. (Laglan Station L.S.Smith 10325)*			C		1/1
plants	higher dicots	Malvaceae	*Sida sp. (Musselbrook M.B.Thomas+ MRS437)*			C		1/1
plants	higher dicots	Malvaceae	*Hibiscus verdcourtii*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia sericophylla*			C		1/1
plants	higher dicots	Mimosaceae	*Neptunia dimorphantha*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia leptostachya*	Townsville wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia stipuligera*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia holosericea*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia tenuissima*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia platycarpa*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia hyaloneura*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia flavescens*	toothed wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia galioides*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia salicina*	doolan		C		2/2
plants	higher dicots	Mimosaceae	*Acacia oswaldii*	miljee		C		1/1
plants	higher dicots	Mimosaceae	*Acacia cambagei*	gidgee		C		2/2
plants	higher dicots	Mimosaceae	*Acacia decora*	pretty wattle		C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca leucadendra*	broad-leaved tea-tree		C		4/1
plants	higher dicots	Myrtaceae	*Corymbia plena*			C		2/2
plants	higher dicots	Myrtaceae	*Thryptomene parviflora*			C		2/2
plants	higher dicots	Myrtaceae	*Leptospermum lamellatum*			C		1/1
plants	higher dicots	Myrtaceae	*Lithomyrtus microphylla*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus camaldulensis*			C		2
plants	higher dicots	Myrtaceae	*Eucalyptus drepanophylla*			C		7/7
plants	higher dicots	Myrtaceae	*Eucalyptus melanophloia - E.whitei*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia setosa subsp. pedicellaris*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus camaldulensis subsp. acuta*			C		2/2
plants	higher dicots	Myrtaceae	*Corymbia aparrerinja - C.dallachiana (Benth.)*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca fluviatilis*			C		2/1
plants	higher dicots	Myrtaceae	*Eucalyptus thozetiana*			C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus persistens*			C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus cambageana*	Dawson gum		C		2/2
plants	higher dicots	Myrtaceae	*Corymbia leichhardtii*	rustyjacket		C		1/1
plants	higher dicots	Myrtaceae	*Corymbia lamprophylla*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia clarksoniana*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus coolabah*	coolabah		C		1/1
plants	higher dicots	Myrtaceae	*Corymbia terminalis*			C		2/2
plants	higher dicots	Myrtaceae	*Melaleuca uncinata*			C		2/2
plants	higher dicots	Myrtaceae	*Calytrix microcoma*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca nervosa*			C		1/1

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plants	higher dicots	Myrtaceae	*Eucalyptus whitei*	White's ironbark		C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca tamariscina*			C		1/1
plants	higher dicots	Nyctaginaceae	*Boerhavia dominii*			C		1/1
plants	higher dicots	Nyctaginaceae	*Boerhavia pubescens*			C		1/1
plants	higher dicots	Nyctaginaceae	*Boerhavia paludosa*			C		1/1
plants	higher dicots	Onagraceae	*Ludwigia peploides*		Y			1
plants	higher dicots	Onagraceae	*Ludwigia octovalvis*	willow primrose		C		2
plants	higher dicots	Orobanchaceae	*Buchnera linearis*			C		1/1
plants	higher dicots	Orobanchaceae	*Buchnera ramosissima*			C		2/2
plants	higher dicots	Pentapetaceae	*Melhania oblongifolia*			C		2/2
plants	higher dicots	Phyllanthaceae	*Poranthera microphylla*	small poranthera		C		1/1
plants	higher dicots	Phyllanthaceae	*Phyllanthus sp. (Pentland R.J.Cumming 9742)*			C		1/1
plants	higher dicots	Phyllanthaceae	*Phyllanthus virgatus*			C		2/2
plants	higher dicots	Plantaginaceae	*Scoparia dulcis*	Scoparia	Y			2/2
plants	higher dicots	Polygalaceae	*Polygala difficilis*			C		1/1
plants	higher dicots	Polygalaceae	*Polygala triflora*			C		1/1
plants	higher dicots	Polygalaceae	*Polygala crassitesta*			C		1/1
plants	higher dicots	Polygonaceae	*Persicaria decipiens*	slender knotweed		C		3/1
plants	higher dicots	Portulacaceae	*Calandrinia ptychosperma*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea parallela*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea sessilis*			C		1/1
plants	higher dicots	Proteaceae	*Persoonia falcata*			C		1/1
plants	higher dicots	Proteaceae	*Hakea leucoptera*			C		3/3
plants	higher dicots	Proteaceae	*Grevillea pteridifolia*	golden parrot tree		C		1/1
plants	higher dicots	Rhamnaceae	*Alphitonia excelsa*	soap tree		C		1/1
plants	higher dicots	Rubiaceae	*Psydrax forsteri*			C		1/1
plants	higher dicots	Rubiaceae	*Spermacoce brachystema*			C		3/3
plants	higher dicots	Rubiaceae	*Psydrax saligna forma saligna*			C		1/1
plants	higher dicots	Rubiaceae	*Psydrax attenuata forma megalantha*			C		1/1
plants	higher dicots	Rutaceae	*Geijera salicifolia*	brush wilga		C		1/1
plants	higher dicots	Santalaceae	*Santalum lanceolatum*			C		2/2
plants	higher dicots	Sapindaceae	*Atalaya hemiglauca*			C		1/1
plants	higher dicots	Sapindaceae	*Dodonaea lanceolata var. subsessilifolia*			C		1/1
plants	higher dicots	Sapindaceae	*Dodonaea tenuifolia*			C		1/1
plants	higher dicots	Solanaceae	*Solanum esuriale*	quena		C		1/1
plants	higher dicots	Solanaceae	*Solanum crebrispinum*			C		1/1
plants	higher dicots	Solanaceae	*Solanum cleistogamum*			C		1/1
plants	higher dicots	Solanaceae	*Solanum nodiflorum*		Y			1/1
plants	higher dicots	Stackhousiaceae	*Stackhousia intermedia*			C		1/1
plants	higher dicots	Stylidiaceae	*Stylidium velleioides*			C		1
plants	higher dicots	Violaceae	*Hybanthus enneaspermus*			C		1/1
plants	lower dicots	Nymphaeaceae	*Nymphaea gigantea*			C		3/1
plants	monocots	Amaryllidaceae	*Calostemma luteum*			C		1/1
plants	monocots	Arecaceae	*Livistona lanuginosa*			V	V	2/2
plants	monocots	Cyperaceae	*Cyperus flavidus*			C		3/1
plants	monocots	Cyperaceae	*Eleocharis plana*	ribbed spikerush		C		2/1

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plants	monocots	Cyperaceae	*Fuirena ciliaris*			C		2/1
plants	monocots	Cyperaceae	*Baumea rubiginosa*	soft twigrush		C		4/2
plants	monocots	Cyperaceae	*Cyperus concinnus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus difformis*	rice sedge		C		7/3
plants	monocots	Cyperaceae	*Cyperus exaltatus*	tall flatsedge		C		1
plants	monocots	Cyperaceae	*Fimbristylis rara*			C		2/2
plants	monocots	Cyperaceae	*Fuirena umbellata*			C		2
plants	monocots	Cyperaceae	*Cyperus dactylotes*			C		3/3
plants	monocots	Cyperaceae	*Cyperus laevigatus*			C		5/2
plants	monocots	Cyperaceae	*Scleria sphacelata*			C		1/1
plants	monocots	Cyperaceae	*Cyperus polystachyos*			C		4
plants	monocots	Cyperaceae	*Cyperus victoriensis*			C		3/1
plants	monocots	Cyperaceae	*Cyperus alterniflorus*			C		1/1
plants	monocots	Cyperaceae	*Eleocharis equisetina*			C		5/2
plants	monocots	Cyperaceae	*Cyperus sanguinolentus*			C		6/1
plants	monocots	Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C		10/5
plants	monocots	Cyperaceae	*Schoenoplectus validus*			C		1
plants	monocots	Cyperaceae	*Fimbristylis littoralis*			C		3/2
plants	monocots	Cyperaceae	*Fimbristylis squarrulosa*			C		2/2
plants	monocots	Cyperaceae	*Schoenoplectiella erecta*		Y			1/1
plants	monocots	Cyperaceae	*Schoenoplectiella laevis*			C		1/1
plants	monocots	Cyperaceae	*Schoenoplectus mucronatus*			C		2
plants	monocots	Cyperaceae	*Eleocharis cylindrostachys*			C		1
plants	monocots	Cyperaceae	*Cyperus betchei subsp. betchei*			C		3/3
plants	monocots	Cyperaceae	*Schoenoplectiella dissachantha*			C		1/1
plants	monocots	Cyperaceae	*Schoenoplectus tabernaemontani*			C		2/2
plants	monocots	Cyperaceae	*Cyperus haspan*			C		1
plants	monocots	Cyperaceae	*Cyperus conicus*			C		1/1
plants	monocots	Cyperaceae	*Schoenus kennyi*			C		1/1
plants	monocots	Cyperaceae	*Cyperus iria*			C		1/1
plants	monocots	Eriocaulaceae	*Eriocaulon carsonii subsp. orientale*			E	E	3/3
plants	monocots	Eriocaulaceae	*Eriocaulon carsonii*			E	E	3
plants	monocots	Johnsoniaceae	*Tricoryne elatior*	yellow autumn lily		C		1/1
plants	monocots	Juncaceae	*Juncus usitatus*			C		1/1
plants	monocots	Juncaceae	*Juncus polyanthemus*			C		4/1
plants	monocots	Juncaginaceae	*Cycnogeton multifructus*			C		1/1
plants	monocots	Orchidaceae	*Cymbidium canaliculatum*			C		1/1
plants	monocots	Philydraceae	*Philydrum lanuginosum*	frogsmouth		C		1
plants	monocots	Poaceae	*Paspalidium constrictum*			C		1/1
plants	monocots	Poaceae	*Pseudoraphis spinescens*	spiny mudgrass		C		1/1
plants	monocots	Poaceae	*Sporobolus actinocladus*	katoora grass		C		3/3
plants	monocots	Poaceae	*Sporobolus partimpatens*			C		1/1
plants	monocots	Poaceae	*Enneapogon robustissimus*			C		1/1
plants	monocots	Poaceae	*Perotis rara*	comet grass		C		1/1
plants	monocots	Poaceae	*Eulalia aurea*	silky browntop		C		1/1
plants	monocots	Poaceae	*Melinis repens*	red natal grass	Y			1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Chloris inflata*	purpletop chloris	Y			3/3
plants	monocots	Poaceae	*Chloris virgata*	feathertop rhodes grass	Y			1/1
plants	monocots	Poaceae	*Diplachne fusca*		Y			5
plants	monocots	Poaceae	*Eriachne obtusa*			C		1/1
plants	monocots	Poaceae	*Isachne globosa*	swamp millet		C		4/3
plants	monocots	Poaceae	*Sehima nervosum*			C		1/1
plants	monocots	Poaceae	*Setaria surgens*			C		1/1
plants	monocots	Poaceae	*Triodia pungens*			C		1/1
plants	monocots	Poaceae	*Cynodon dactylon*		Y			3
plants	monocots	Poaceae	*Leersia hexandra*	swamp rice grass		C		5/2
plants	monocots	Poaceae	*Themeda avenacea*			C		1/1
plants	monocots	Poaceae	*Digitaria ciliaris*	summer grass	Y			1/1
plants	monocots	Poaceae	*Echinochloa colona*	awnless barnyard grass	Y			2/1
plants	monocots	Poaceae	*Eragrostis falcata*	sickle lovegrass		C		1/1
plants	monocots	Poaceae	*Eragrostis sororia*			C		3/2
plants	monocots	Poaceae	*Ischaemum australe*			C		2
plants	monocots	Poaceae	*Paspalum dilatatum*	paspalum	Y			2
plants	monocots	Poaceae	*Paspalum distichum*	water couch		C		1
plants	monocots	Poaceae	*Paspalum vaginatum*	saltwater couch		C		2/1
plants	monocots	Poaceae	*Sacciolepis indica*	Indian cupscale grass		C		7/2
plants	monocots	Poaceae	*Sporobolus pamelae*			E		5/1
plants	monocots	Poaceae	*Amphipogon sericeus*			C		1/1
plants	monocots	Poaceae	*Brachyachne tenella*			C		2/2
plants	monocots	Poaceae	*Chrysopogon filipes*			C		1/1
plants	monocots	Poaceae	*Cymbopogon ambiguus*	lemon grass		C		1/1
plants	monocots	Poaceae	*Enneapogon gracilis*	slender nineawn		C		3/3
plants	monocots	Poaceae	*Enteropogon ramosus*			C		1/1
plants	monocots	Poaceae	*Eragrostis elongata*			C		3/3
plants	monocots	Poaceae	*Imperata cylindrica*	blady grass		C		1
plants	monocots	Poaceae	*Paspalidium distans*	shotgrass		C		1/1
plants	monocots	Poaceae	*Paspalidium gracile*	slender panic		C		2/2
plants	monocots	Poaceae	*Echinochloa inundata*	marsh millet		C		1/1
plants	monocots	Poaceae	*Enneapogon avenaceus*			C		2/2
plants	monocots	Poaceae	*Enneapogon truncatus*			C		1/1
plants	monocots	Poaceae	*Eragrostis lacunaria*	purple lovegrass		C		1/1
plants	monocots	Poaceae	*Sporobolus scabridus*			C		3/3
plants	monocots	Poaceae	*Triodia microstachya*			C		1/1
plants	monocots	Poaceae	*Tripogon loliiformis*	five minute grass		C		1/1
plants	monocots	Poaceae	*Alloteropsis cimicina*			C		1/1
plants	monocots	Poaceae	*Aristida helicophylla*			C		1/1
plants	monocots	Poaceae	*Cenchrus purpurascens*			C		4/3
plants	monocots	Poaceae	*Cymbopogon bombycinus*	silky oilgrass		C		1/1
plants	monocots	Poaceae	*Dichanthium annulatum*	sheda grass	Y			1/1
plants	monocots	Poaceae	*Digitaria breviglumis*			C		1/1
plants	monocots	Poaceae	*Eragrostis leptocarpa*	drooping lovegrass		C		1/1
plants	monocots	Poaceae	*Eragrostis parviflora*	weeping lovegrass		C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Iseilema vaginiflorum*	red flinders grass		C		1/1
plants	monocots	Poaceae	*Sporobolus disjunctus*			C		4/4
plants	monocots	Poaceae	*Sporobolus virginicus*	sand couch		C		3/1
plants	monocots	Poaceae	*Alloteropsis semialata*	cockatoo grass		C		1/1
plants	monocots	Poaceae	*Echinochloa crus-galli*	barnyard grass	Y			4/1
plants	monocots	Poaceae	*Enneapogon lindleyanus*			C		1/1
plants	monocots	Poaceae	*Enneapogon polyphyllus*	leafy nineawn		C		1/1
plants	monocots	Poaceae	*Enteropogon acicularis*	curly windmill grass		C		1/1
plants	monocots	Poaceae	*Urochloa mosambicensis*	sabi grass	Y			1/1
plants	monocots	Poaceae	*Eragrostis spartinoides*			C		1/1
plants	monocots	Poaceae	*Aristida calycina*			C		1/1
plants	monocots	Poaceae	*Aristida pruinosa*			C		3/3
plants	monocots	Poaceae	*Chloris pectinata*	comb chloris		C		2/2
plants	monocots	Poaceae	*Digitaria brownii*			C		1/1
plants	monocots	Poaceae	*Eragrostis pilosa*	soft lovegrass	Y			1/1
plants	monocots	Poaceae	*Panicum laevinode*	pepper grass		C		1/1
plants	monocots	Poaceae	*Paspalidium rarum*			C		1/1
plants	monocots	Poaceae	*Sporobolus caroli*	fairy grass		C		1/1
plants	monocots	Poaceae	*Triodia longiceps*	giant grey spinifex		C		2/2
plants	monocots	Poaceae	*Aristida latifolia*	feathertop wiregrass		C		1/1
plants	monocots	Poaceae	*Astrebla elymoides*	hoop mitchell grass		C		1/1
plants	monocots	Poaceae	*Astrebla pectinata*	barley mitchell grass		C		1/1
plants	monocots	Poaceae	*Astrebla squarrosa*	bull mitchell grass		C		1/1
plants	monocots	Poaceae	*Hymenachne amplexicaulis*	hymenachne	Y			1
plants	monocots	Poaceae	*Cenchrus setigerus*		Y			1/1
plants	monocots	Poaceae	*Chrysopogon fallax*			C		1/1
plants	monocots	Poaceae	*Digitaria bicornis*			C		1/1
plants	monocots	Poaceae	*Paspalidium albovillosum*			C		1/1
plants	monocots	Poaceae	*Sporobolus australasicus*			C		1/1
plants	monocots	Poaceae	*Digitaria divaricatissima*	spreading umbrella grass		C		2/2
plants	monocots	Poaceae	*Diplachne fusca var. fusca*			C		4/4
plants	monocots	Poaceae	*Eriochloa pseudoacrotricha*			C		4/4
plants	monocots	Poaceae	*Cynodon dactylon var. dactylon*		Y			1/1
plants	monocots	Poaceae	*Aristida calycina var. calycina*			C		1/1
plants	monocots	Poaceae	*Aristida calycina var. praealta*			C		1/1
plants	monocots	Poaceae	*Dinebra decipiens var. decipiens*			C		1/1
plants	monocots	Poaceae	*Ischaemum australe var. australe*			C		1/1
plants	monocots	Poaceae	*Ischaemum australe var. villosum*			C		1/1
plants	monocots	Poaceae	*Aristida benthamii var. benthamii*			C		1/1
plants	monocots	Poaceae	*Aristida holathera var. holathera*			C		1/1
plants	monocots	Poaceae	*Chloris divaricata var. divaricata*	slender chloris		C		2/2
plants	monocots	Poaceae	*Hymenachne amplexicaulis cv. Olive*		Y			1/1
plants	monocots	Poaceae	*Amphipogon caricinus var. caricinus*			C		1/1
plants	monocots	Poaceae	*Bothriochloa bladhii subsp. bladhii*			C		1/1
plants	monocots	Poaceae	*Dichanthium sericeum subsp. sericeum*			C		1/1
plants	monocots	Poaceae	*Chloris sp. (Edgbaston R.J.Fensham 5694)*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Bothriochloa decipiens var. cloncurrensis*			C		1/1
plants	monocots	Poaceae	*Eriachne mucronata forma (Burnham R.W.Purdie 1370)*			C		1/1
plants	monocots	Potamogetonaceae	*Potamogeton tricarinatus*	floating pondweed		C		2/1
plants	monocots	Typhaceae	*Typha domingensis*			C		1/1
plants	monocots	Typhaceae	*Typha orientalis*	broad-leaved cumbungi		C		1
plants		Phrymaceae	*Peplidium foecundum*			C		2/1
plants		Phrymaceae	*Peplidium*			C		1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.* The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: All
Latitude: -21.6130
Longitude: 146.1178
Distance: 25
Email: katrina.wolf@cumberlandecology.com.au
Date submitted: Monday 02 Mar 2015 13:03:06
Date extracted: Monday 02 Mar 2015 13:10:49

The number of records retrieved = 518

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			5
animals	amphibians	Hylidae	*Litoria inermis*	bumpy rocketfrog		C		3
animals	amphibians	Hylidae	*Litoria rubella*	ruddy treefrog		C		3
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		3
animals	amphibians	Hylidae	*Cyclorana brevipes*	superb collared frog		C		1
animals	amphibians	Hylidae	*Litoria rothii*	northern laughing treefrog		C		3
animals	amphibians	Hylidae	*Cyclorana novaehollandiae*	eastern snapping frog		C		3
animals	amphibians	Limnodynastidae	*Platyplectrum ornatum*	ornate burrowing frog		C		3
animals	amphibians	Limnodynastidae	*Limnodynastes convexiusculus*	marbled frog		C		1
animals	amphibians	Myobatrachidae	*Crinia deserticola*	chirping froglet		C		1
animals	amphibians	Myobatrachidae	*Uperoleia littlejohni*	Einasleigh gungan		C		1
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		14
animals	birds	Acanthizidae	*Acanthiza reguloides*	buff-rumped thornbill		C		2
animals	birds	Acanthizidae	*Gerygone albogularis*	white-throated gerygone		C		2
animals	birds	Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill		C		12
animals	birds	Acanthizidae	*Acanthiza uropygialis*	chestnut-rumped thornbill		C		2
animals	birds	Acanthizidae	*Gerygone fusca*	western gerygone		C		2
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		7
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		4
animals	birds	Accipitridae	*Accipiter fasciatus*	brown goshawk		C		4
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		5
animals	birds	Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar		C		46
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		5
animals	birds	Anatidae	*Anas gracilis*	grey teal		C		9
animals	birds	Anatidae	*Anas rhynchotis*	Australasian shoveler		C		1
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		3
animals	birds	Anatidae	*Dendrocygna eytoni*	plumed whistling-duck		C		3
animals	birds	Anatidae	*Stictonetta naevosa*	freckled duck		C		2
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		2
animals	birds	Ardeidae	*Ardea intermedia*	intermediate egret		C		3
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		5
animals	birds	Ardeidae	*Ardea pacifica*	white-necked heron		C		9
animals	birds	Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		C		4
animals	birds	Artamidae	*Artamus cinereus*	black-faced woodswallow		C		11
animals	birds	Artamidae	*Artamus minor*	little woodswallow		C		7
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		30
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		2
animals	birds	Artamidae	*Artamus personatus*	masked woodswallow		C		2
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		50
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		59
animals	birds	Burhinidae	*Burhinus grallarius*	bush stone-curlew		C		5
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		25
animals	birds	Cacatuidae	*Calyptorhynchus banksii*	red-tailed black-cockatoo		C		6
animals	birds	Cacatuidae	*Eolophus roseicapillus*	galah		C		20
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		11
animals	birds	Campephagidae	*Coracina maxima*	ground cuckoo-shrike		C		5

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		18
animals	birds	Casuariidae	*Dromaius novaehollandiae*	emu		C		7
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		5
animals	birds	Charadriidae	*Vanellus miles novaehollandiae*	masked lapwing (southern subspecies)		C		3
animals	birds	Charadriidae	*Charadrius ruficapillus*	red-capped plover		C		2
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		4
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		11
animals	birds	Columbidae	*Geopelia cuneata*	diamond dove		C		5
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		7
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		22
animals	birds	Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)		V	V	17
animals	birds	Columbidae	*Phaps chalcoptera*	common bronzewing		C		7
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		17
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		23
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		17
animals	birds	Cuculidae	*Cacomantis pallidus*	pallid cuckoo		C		2
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		6
animals	birds	Cuculidae	*Chalcites basalis*	Horsfield's bronze-cuckoo		C		2
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		2
animals	birds	Estrildidae	*Taeniopygia guttata*	zebra finch		C		9
animals	birds	Estrildidae	*Poephila cincta cincta*	black-throated finch (white-rumped subspecies)		E	E	6
animals	birds	Eurostopodidae	*Eurostopodus argus*	spotted nightjar		C		20
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		17
animals	birds	Falconidae	*Falco cenchroides*	Nankeen kestrel		C		12
animals	birds	Falconidae	*Falco longipennis*	Australian hobby		C		2
animals	birds	Gruidae	*Grus rubicunda*	brolga		C		4
animals	birds	Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher		C		5
animals	birds	Halcyonidae	*Todiramphus macleayii*	forest kingfisher		C		2
animals	birds	Halcyonidae	*Dacelo leachii*	blue-winged kookaburra		C		5
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		4
animals	birds	Halcyonidae	*Todiramphus sanctus*	sacred kingfisher		C		6
animals	birds	Hirundinidae	*Petrochelidon nigricans*	tree martin		C		5
animals	birds	Hirundinidae	*Petrochelidon ariel*	fairy martin		C		1
animals	birds	Laridae	*Chlidonias hybrida*	whiskered tern		C		3
animals	birds	Laridae	*Hydroprogne caspia*	Caspian tern		SL		2
animals	birds	Laridae	*Gelochelidon nilotica*	gull-billed tern		C		4
animals	birds	Laridae	*Chroicocephalus novaehollandiae*	silver gull		C		4
animals	birds	Maluridae	*Malurus lamberti*	variegated fairy-wren		C		16
animals	birds	Megaluridae	*Cincloramphus mathewsi*	rufous songlark		C		7
animals	birds	Meliphagidae	*Ptilotula penicillatus*	white-plumed honeyeater		C		12
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		11
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		28
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		8
animals	birds	Meliphagidae	*Manorina flavigula*	yellow-throated miner		C		47
animals	birds	Meliphagidae	*Ptilotula plumulus*	grey-fronted honeyeater		C		11

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Meliphagidae	*Gavicalis virescens*	singing honeyeater		C		22
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		6
animals	birds	Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater		C		6
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		2
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		SL		8
animals	birds	Monarchidae	*Myiagra inquieta*	restless flycatcher		C		4
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		29
animals	birds	Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		C		3
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		13
animals	birds	Neosittidae	*Daphoenositta chrysoptera*	varied sittella		C		2
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		2
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		6
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		27
animals	birds	Pachycephalidae	*Oreoica gutturalis*	crested bellbird		C		30
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		20
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		38
animals	birds	Pelecanidae	*Pelecanus conspicillatus*	Australian pelican		C		4
animals	birds	Petroicidae	*Melanodryas cucullata*	hooded robin		C		4
animals	birds	Petroicidae	*Microeca fascinans*	jacky winter		C		30
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		2
animals	birds	Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant		C		1
animals	birds	Phasianidae	*Coturnix ypsilophora*	brown quail		C		2
animals	birds	Podargidae	*Podargus strigoides*	tawny frogmouth		C		17
animals	birds	Podicipedidae	*Podiceps cristatus*	great crested grebe		C		1
animals	birds	Podicipedidae	*Poliocephalus poliocephalus*	hoary-headed grebe		C		2
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		23
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		9
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		21
animals	birds	Psittacidae	*Melopsittacus undulatus*	budgerigar		C		2
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		16
animals	birds	Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird		C		2
animals	birds	Rallidae	*Fulica atra*	Eurasian coot		C		1
animals	birds	Recurvirostridae	*Recurvirostra novaehollandiae*	red-necked avocet		C		2
animals	birds	Recurvirostridae	*Himantopus himantopus*	black-winged stilt		C		4
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		35
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		5
animals	birds	Scolopacidae	*Tringa stagnatilis*	marsh sandpiper		SL		3
animals	birds	Scolopacidae	*Tringa nebularia*	common greenshank		SL		2
animals	birds	Scolopacidae	*Actitis hypoleucos*	common sandpiper		SL		1
animals	birds	Scolopacidae	*Calidris acuminata*	sharp-tailed sandpiper		SL		2
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		10
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		2
animals	birds	Threskiornithidae	*Plegadis falcinellus*	glossy ibis		SL		3
animals	birds	Threskiornithidae	*Threskiornis molucca*	Australian white ibis		C		2
animals	birds	Turnicidae	*Turnix varius*	painted button-quail		C		7
animals	birds	Tytonidae	*Tyto javanica*	eastern barn owl		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	mammals	Dasyuridae	*Sminthopsis macroura*	stripe-faced dunnart		C		9
animals	mammals	Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail bat		C		2
animals	mammals	Felidae	*Felis catus*	cat	Y			2
animals	mammals	Macropodidae	*Lagorchestes conspicillatus*	spectacled hare-wallaby		C		1
animals	mammals	Macropodidae	*Macropus giganteus*	eastern grey kangaroo		C		10
animals	mammals	Macropodidae	*Macropus robustus*	common wallaroo		C		6
animals	mammals	Macropodidae	*Macropus rufus*	red kangaroo		C		18
animals	mammals	Molossidae	*Chaerephon jobensis*	northern freetail bat		C		2
animals	mammals	Muridae	*Pseudomys delicatulus*	delicate mouse		C		4
animals	mammals	Muridae	*Pseudomys desertor*	desert mouse		C		7
animals	mammals	Muridae	*Pseudomys patrius*	eastern pebble-mound mouse		C		1
animals	mammals	Petauridae	*Petaurus breviceps*	sugar glider		C		2
animals	mammals	Phalangeridae	*Trichosurus vulpecula*	common brushtail possum		C		1
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		SL	V	1
animals	mammals	Potoroidae	*Aepyprymnus rufescens*	rufous bettong		C		1
animals	mammals	Pteropodidae	*Pteropus scapulatus*	little red flying-fox		C		2
animals	mammals	Suidae	*Sus scrofa*	pig	Y			3
animals	mammals	Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna		SL		3
animals	mammals	Vespertilionidae	*Chalinolobus morio*	chocolate wattled bat		C		1
animals	mammals	Vespertilionidae	*Scotorepens greyii*	little broad-nosed bat		C		4
animals	mammals	Vespertilionidae	*Vespadelus troughtoni*	eastern cave bat		C		1
animals	mammals	Vespertilionidae	*Chalinolobus picatus*	little pied bat		C		1
animals	mammals	Vespertilionidae	*Nyctophilus geoffroyi*	lesser long-eared bat		C		3
animals	mammals	Vespertilionidae	*Vespadelus finlaysoni*	Finlayson's cave bat		C		1
animals	mammals	Vespertilionidae	*Vespadelus baverstocki*	inland forest bat		C		1
animals	mammals	Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat		C		2
animals	reptiles	Agamidae	*Pogona barbata*	bearded dragon		C		13
animals	reptiles	Agamidae	*Diporiphora nobbi*	nobbi		C		4
animals	reptiles	Agamidae	*Ctenophorus nuchalis*	central netted dragon		C		8
animals	reptiles	Agamidae	*Chlamydosaurus kingii*	frilled lizard		C		1
animals	reptiles	Agamidae	*Diporiphora australis*			C		4
animals	reptiles	Boidae	*Aspidites melanocephalus*	black-headed python		C		3
animals	reptiles	Carphodactylidae	*Nephrurus asper*	spiny knob-tailed gecko		C		2
animals	reptiles	Chelidae	*Chelodina longicollis*	eastern snake-necked turtle		C		1
animals	reptiles	Diplodactylidae	*Diplodactylus conspicillatus*	fat-tailed diplodactylus		C		3
animals	reptiles	Diplodactylidae	*Strophurus williamsi*	soft-spined gecko		C		4
animals	reptiles	Diplodactylidae	*Lucasium steindachneri*	Steindachner's gecko		C		3
animals	reptiles	Diplodactylidae	*Amalosia rhombifer*	zig-zag gecko		C		1
animals	reptiles	Diplodactylidae	*Oedura marmorata*	marbled velvet gecko		C		2
animals	reptiles	Elapidae	*Acanthophis praelongus*	northern death adder		C		1
animals	reptiles	Elapidae	*Pseudonaja nuchalis sensu lato*	western brown snake		C		1
animals	reptiles	Elapidae	*Pseudonaja guttata*	speckled brown snake		C		1
animals	reptiles	Elapidae	*Demansia psammophis*	yellow-faced whipsnake		C		1
animals	reptiles	Gekkonidae	*Gehyra dubia*			C		4
animals	reptiles	Gekkonidae	*Gehyra versicolor*			C		2
animals	reptiles	Gekkonidae	*Heteronotia binoei*	Bynoe's gecko		C		13

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	reptiles	Gekkonidae	*Gehyra catenata*			C		3
animals	reptiles	Pygopodidae	*Pygopus schraderi*	eastern hooded scaly-foot		C		1
animals	reptiles	Scincidae	*Tiliqua scincoides*	eastern blue-tongued lizard		C		2
animals	reptiles	Scincidae	*Ctenotus pantherinus*			C		4
animals	reptiles	Scincidae	*Proablepharus tenuis*			C		1
animals	reptiles	Scincidae	*Morethia taeniopleura*	fire-tailed skink		C		1
animals	reptiles	Scincidae	*Lerista punctatovittata*			C		4
animals	reptiles	Scincidae	*Cryptoblepharus pannosus*	ragged snake-eyed skink		C		1
animals	reptiles	Scincidae	*Cryptoblepharus plagiocephalus sensu lato*			C		6
animals	reptiles	Scincidae	*Ctenotus strauchii*			C		1
animals	reptiles	Scincidae	*Ctenotus spaldingi*			C		4
animals	reptiles	Scincidae	*Concinnia sokosoma*	stout bar-sided skink		C		1
animals	reptiles	Scincidae	*Egernia striolata*	tree skink		C		3
animals	reptiles	Scincidae	*Ctenotus hebetior*			C		12
animals	reptiles	Scincidae	*Carlia schmeltzii*			C		1
animals	reptiles	Scincidae	*Ctenotus ingrami*			C		3
animals	reptiles	Scincidae	*Menetia greyii*	common dwarf skink		C		12
animals	reptiles	Scincidae	*Carlia munda*			C		6
animals	reptiles	Scincidae	*Menetia maini*	northern dwarf skink		C		2
animals	reptiles	Typhlopidae	*Ramphotyphlops ligatus*			C		1
animals	reptiles	Varanidae	*Varanus tristis*	black-tailed monitor		C		7
animals	reptiles	Varanidae	*Varanus gouldii*	sand monitor		C		3
plants	ferns	Marsileaceae	*Marsilea mutica*	shiny nardoo		C		1/1
plants	higher dicots	Acanthaceae	*Rostellularia adscendens*			C		1/1
plants	higher dicots	Acanthaceae	*Dipteracanthus australasicus subsp. australasicus*			C		2/2
plants	higher dicots	Aizoaceae	*Trianthema triquetra*	red spinach		C		1/1
plants	higher dicots	Amaranthaceae	*Amaranthus interruptus*			C		1/1
plants	higher dicots	Amaranthaceae	*Alternanthera pungens*	khaki weed	Y			1/1
plants	higher dicots	Amaranthaceae	*Alternanthera angustifolia*			C		1/1
plants	higher dicots	Amaranthaceae	*Nyssanthes erecta*			C		1/1
plants	higher dicots	Apiaceae	*Eryngium plantagineum*	long eryngium		C		1/1
plants	higher dicots	Apocynaceae	*Marsdenia microlepis*			C		1/1
plants	higher dicots	Apocynaceae	*Marsdenia viridiflora subsp. viridiflora*			C		1/1
plants	higher dicots	Apocynaceae	*Carissa ovata*	currantbush		C		1
plants	higher dicots	Asteraceae	*Chrysocephalum apiculatum*	yellow buttons		C		1/1
plants	higher dicots	Asteraceae	*Apowollastonia spilanthoides*			C		1/1
plants	higher dicots	Asteraceae	*Calotis sp. (Lake Buchanan J.Kemp+ 3384H)*			C		1/1
plants	higher dicots	Asteraceae	*Streptoglossa adscendens*	desert daisy		C		2/2
plants	higher dicots	Asteraceae	*Pterocaulon intermedium*			C		1/1
plants	higher dicots	Asteraceae	*Vittadinia pterochaeta*	rough fuzzweed		C		1/1
plants	higher dicots	Asteraceae	*Pterocaulon redolens*			C		1/1
plants	higher dicots	Asteraceae	*Pluchea rubelliflora*			C		1/1
plants	higher dicots	Asteraceae	*Minuria integerrima*	smooth minuria		C		1/1
plants	higher dicots	Asteraceae	*Peripleura diffusa*			C		1/1
plants	higher dicots	Asteraceae	*Peripleura scabra*			C		1/1
plants	higher dicots	Asteraceae	*Camptacra barbata*			C		1/1

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plants	higher dicots	Asteraceae	*Pluchea xanthina*			C		1/1
plants	higher dicots	Asteraceae	*Pluchea dentex*	bowl daisy		C		1/1
plants	higher dicots	Asteraceae	*Blumea diffusa*			C		1/1
plants	higher dicots	Asteraceae	*Calotis xanthosioidea*			C		1/1
plants	higher dicots	Boraginaceae	*Ehretia membranifolia*	weeping koda		C		1/1
plants	higher dicots	Boraginaceae	*Heliotropium ovalifolium*			C		2/2
plants	higher dicots	Boraginaceae	*Heliotropium peninsulare*			C		1/1
plants	higher dicots	Byttneriaceae	*Keraudrenia hookeriana*			C		1/1
plants	higher dicots	Byttneriaceae	*Keraudrenia collina*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Senna artemisioides subsp. zygophylla*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Labichea rupestris*			C		2/2
plants	higher dicots	Caesalpiniaceae	*Senna artemisioides subsp. sturtii*			C		1/1
plants	higher dicots	Campanulaceae	*Wahlenbergia tumidifructa*			C		1/1
plants	higher dicots	Campanulaceae	*Wahlenbergia gracilis*	sprawling bluebell		C		1/1
plants	higher dicots	Capparaceae	*Capparis lasiantha*	nipan		C		1/1
plants	higher dicots	Caryophyllaceae	*Polycarpaea corymbosa*			C		2/2
plants	higher dicots	Chenopodiaceae	*Sclerolaena ramulosa*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena convexula*			C		2/2
plants	higher dicots	Chenopodiaceae	*Sclerolaena diacantha*	grey copper burr		C		2/2
plants	higher dicots	Chenopodiaceae	*Dysphania plantaginella*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena anisacanthoides*	yellow burr		C		2/2
plants	higher dicots	Chenopodiaceae	*Sclerolaena bicornis var. horrida*			C		1/1
plants	higher dicots	Chenopodiaceae	*Dysphania melanocarpa forma melanocarpa*			C		1/1
plants	higher dicots	Chenopodiaceae	*Maireana villosa*			C		1/1
plants	higher dicots	Clusiaceae	*Hypericum gramineum*			C		1/1
plants	higher dicots	Convolvulaceae	*Bonamia media*			C		1/1
plants	higher dicots	Convolvulaceae	*Ipomoea brassii*			C		2/2
plants	higher dicots	Convolvulaceae	*Evolvulus alsinoides*			C		4/3
plants	higher dicots	Convolvulaceae	*Bonamia media var. media*			C		1/1
plants	higher dicots	Convolvulaceae	*Evolvulus alsinoides var. decumbens*			C		1/1
plants	higher dicots	Dilleniaceae	*Hibbertia exutiacies*			C		1/1
plants	higher dicots	Erythroxylaceae	*Erythroxylum australe*	cocaine tree		C		1
plants	higher dicots	Euphorbiaceae	*Euphorbia tannensis subsp. eremophila*			C		3/3
plants	higher dicots	Euphorbiaceae	*Euphorbia mitchelliana var. mitchelliana*			C		2/2
plants	higher dicots	Euphorbiaceae	*Microstachys chamaelea*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia stevenii*	bottle tree spurge		C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia petala*			C		1/1
plants	higher dicots	Euphorbiaceae	*Beyeria viscosa*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia leptoclada*			C		3/3
plants	higher dicots	Fabaceae	*Zornia adenophora*			C		2/2
plants	higher dicots	Fabaceae	*Indigofera haplophylla*			C		2/2
plants	higher dicots	Fabaceae	*Jacksonia rhadinoclona*	Miles dogwood		C		1/1
plants	higher dicots	Fabaceae	*Swainsona swainsonioides*	downy swainsona		C		1/1
plants	higher dicots	Fabaceae	*Gastrolobium grandiflorum*			C		1/1
plants	higher dicots	Fabaceae	*Crotalaria medicaginea var. neglecta*			C		1/1

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plants	higher dicots	Fabaceae	*Tephrosia brachyodon var. longifolia*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia sp. (Lake Buchanan E.J.Thompson+ BUC2128)*			C		2/2
plants	higher dicots	Fabaceae	*Lotus cruentus*	red-flowered lotus		C		1/1
plants	higher dicots	Fabaceae	*Tephrosia*			C		1/1
plants	higher dicots	Fabaceae	*Indigofera linifolia*			C		3/3
plants	higher dicots	Fabaceae	*Desmodium filiforme*			C		3/3
plants	higher dicots	Fabaceae	*Indigofera linnaei*	Birdsville indigo		C		1/1
plants	higher dicots	Fabaceae	*Indigofera colutea*	sticky indigo		C		3/3
plants	higher dicots	Fabaceae	*Glycine tomentella*	woolly glycine		C		3/3
plants	higher dicots	Fabaceae	*Cajanus marmoratus*			C		2/2
plants	higher dicots	Fabaceae	*Jacksonia ramosissima*			C		2/2
plants	higher dicots	Goodeniaceae	*Goodenia hirsuta*			C		1/1
plants	higher dicots	Goodeniaceae	*Dampiera adpressa*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia splendida*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia grandiflora*			C		1/1
plants	higher dicots	Lamiaceae	*Prostanthera parvifolia*			C		1/1
plants	higher dicots	Loganiaceae	*Mitrasacme sp. (Warang M.B.Thomas 1571)*			C		2/2
plants	higher dicots	Loranthaceae	*Lysiana spathulata subsp. parvifolia*			C		1/1
plants	higher dicots	Lythraceae	*Ammannia robertsii*			E		1/1
plants	higher dicots	Malvaceae	*Sida everistiana*			C		1/1
plants	higher dicots	Malvaceae	*Sida atherophora*			C		1/1
plants	higher dicots	Malvaceae	*Lawrencia buchananensis*			V	V	1/1
plants	higher dicots	Malvaceae	*Sida rohlenae subsp. rohlenae*			C		2/2
plants	higher dicots	Malvaceae	*Sida goniocarpa*			C		1/1
plants	higher dicots	Malvaceae	*Hibiscus leptocladus*			C		1/1
plants	higher dicots	Malvaceae	*Sida brachypoda*			C		1/1
plants	higher dicots	Malvaceae	*Sida macropoda*			C		1/1
plants	higher dicots	Malvaceae	*Sida*			C		1
plants	higher dicots	Malvaceae	*Sida sp. (Laglan Station L.S.Smith 10325)*			C		1/1
plants	higher dicots	Malvaceae	*Sida sp. (Musselbrook M.B.Thomas+ MRS437)*			C		1/1
plants	higher dicots	Malvaceae	*Sida fibulifera*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia sp. (Urandangi L.Pedley 2025)*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia aneura var. aneura*			C		1/1
plants	higher dicots	Mimosaceae	*Vachellia bidwillii*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia sericophylla*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia leptostachya*	Townsville wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia stipuligera*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia holosericea*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia tenuissima*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia platycarpa*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia ixiophylla*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia hyaloneura*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia flavescens*	toothed wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia lazaridis*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia galioides*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia torulosa*			C		2/2

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plants	higher dicots	Mimosaceae	*Acacia salicina*	doolan		C		3/3
plants	higher dicots	Mimosaceae	*Acacia cambagei*	gidgee		C		1/1
plants	higher dicots	Mimosaceae	*Acacia decora*	pretty wattle		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus sp. (Mt Hope Homestead E.J.Thompson+ BUC175)*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia plena*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca nervosa*			C		1/1
plants	higher dicots	Myrtaceae	*Calytrix microcoma*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus similis*	Queensland yellowjacket		C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca uncinata*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus coolabah*	coolabah		C		1/1
plants	higher dicots	Myrtaceae	*Corymbia dallachiana*			C		1
plants	higher dicots	Myrtaceae	*Corymbia clarksoniana*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia lamprophylla*			C		2/1
plants	higher dicots	Myrtaceae	*Corymbia leichhardtii*	rustyjacket		C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus cambageana*	Dawson gum		C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus persistens*			C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus thozetiana*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca tamariscina*			C		2/2
plants	higher dicots	Myrtaceae	*Ochrosperma adpressum*			C		1/1
plants	higher dicots	Myrtaceae	*Thryptomene parviflora*			C		1/1
plants	higher dicots	Myrtaceae	*Leptospermum lamellatum*			C		1/1
plants	higher dicots	Myrtaceae	*Lithomyrtus microphylla*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus drepanophylla*			C		5/5
plants	higher dicots	Myrtaceae	*Corymbia brachycarpa x C.plena*			C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus melanophloia - E.whitei*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus camaldulensis subsp. acuta*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus melanophloia subsp. melanophloia*			C		1/1
plants	higher dicots	Onagraceae	*Ludwigia perennis*			C		1/1
plants	higher dicots	Orobanchaceae	*Buchnera linearis*			C		2/2
plants	higher dicots	Phyllanthaceae	*Sauropus elachophyllus var. elachophyllus*			C		1/1
plants	higher dicots	Phyllanthaceae	*Phyllanthus virgatus*			C		3/3
plants	higher dicots	Picrodendraceae	*Petalostigma pubescens*	quinine tree		C		1
plants	higher dicots	Picrodendraceae	*Petalostigma banksii*			C		2/2
plants	higher dicots	Pittosporaceae	*Bursaria incana*			C		1
plants	higher dicots	Plantaginaceae	*Scoparia dulcis*	Scoparia	Y			2/2
plants	higher dicots	Polygalaceae	*Polygala pycnantha*			C		2/2
plants	higher dicots	Portulacaceae	*Portulaca tuberosa*			C		1/1
plants	higher dicots	Portulacaceae	*Portulaca oleracea*	pigweed	Y			1
plants	higher dicots	Portulacaceae	*Portulaca oligosperma*			C		1/1
plants	higher dicots	Portulacaceae	*Calandrinia ptychosperma*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea decora subsp. decora*			C		3/3
plants	higher dicots	Proteaceae	*Grevillea sessilis*			C		1/1
plants	higher dicots	Proteaceae	*Persoonia falcata*			C		1/1
plants	higher dicots	Proteaceae	*Hakea lorea*			C		1
plants	higher dicots	Proteaceae	*Grevillea parallela*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Rhamnaceae	*Alphitonia excelsa*	soap tree		C		1/1
plants	higher dicots	Rubiaceae	*Oldenlandia mitrasacmoides subsp. nigricans*			C		2/2
plants	higher dicots	Rubiaceae	*Synaptantha tillaeacea var. tillaeacea*			C		1/1
plants	higher dicots	Rubiaceae	*Everistia vacciniifolia forma crassa*			C		1/1
plants	higher dicots	Rubiaceae	*Psydrax saligna forma saligna*			C		2/2
plants	higher dicots	Rubiaceae	*Spermacoce brachystema*			C		2/2
plants	higher dicots	Rubiaceae	*Oldenlandia mitrasacmoides*			C		1/1
plants	higher dicots	Rutaceae	*Flindersia maculosa*	leopardwood		C		1/1
plants	higher dicots	Santalaceae	*Santalum lanceolatum*			C		2/2
plants	higher dicots	Sapindaceae	*Dodonaea tenuifolia*			C		1/1
plants	higher dicots	Sapindaceae	*Dodonaea filifolia*			C		1/1
plants	higher dicots	Sapindaceae	*Atalaya hemiglauca*			C		2/2
plants	higher dicots	Scrophulariaceae	*Eremophila maculata subsp. maculata*			C		2/2
plants	higher dicots	Scrophulariaceae	*Eremophila mitchellii*			C		1/1
plants	higher dicots	Solanaceae	*Solanum parvifolium subsp. parvifolium*			C		1/1
plants	higher dicots	Solanaceae	*Solanum crebrispinum*			C		1/1
plants	higher dicots	Solanaceae	*Solanum cleistogamum*			C		1/1
plants	higher dicots	Solanaceae	*Solanum nodiflorum*		Y			1/1
plants	higher dicots	Solanaceae	*Solanum esuriale*	quena		C		1/1
plants	higher dicots	Sparrmanniaceae	*Corchorus sidoides subsp. vermicularis*			C		1/1
plants	higher dicots	Sparrmanniaceae	*Grewia retusifolia*			C		1/1
plants	higher dicots	Sparrmanniaceae	*Grewia latifolia*	dysentery plant		C		1
plants	higher dicots	Stackhousiaceae	*Stackhousia intermedia*			C		2/2
plants	higher dicots	Stylidiaceae	*Stylidium eglandulosum*			C		1/1
plants	higher dicots	Stylidiaceae	*Stylidium eriorhizum*			C		1/1
plants	higher dicots	Violaceae	*Hybanthus stellarioides*			C		1/1
plants	higher dicots	Violaceae	*Hybanthus enneaspermus*			C		1/1
plants	higher dicots	Violaceae	*Hybanthus monopetalus*			C		1
plants	higher dicots	Zygophyllaceae	*Tribulopis angustifolia*			C		1/1
plants	lower dicots	Aristolochiaceae	*Aristolochia*			C		1
plants	lower dicots	Lauraceae	*Cassytha rufa*			C		1/1
plants	monocots	Commelinaceae	*Cyanotis axillaris*			C		1/1
plants	monocots	Cyperaceae	*Cyperus iria*			C		2/2
plants	monocots	Cyperaceae	*Fimbristylis*			C		1/1
plants	monocots	Cyperaceae	*Cyperus bifax*	western nutgrass		C		2/2
plants	monocots	Cyperaceae	*Cyperus conicus*			C		1/1
plants	monocots	Cyperaceae	*Schoenus kennyi*			C		1/1
plants	monocots	Cyperaceae	*Cyperus bulbosus*			C		2/2
plants	monocots	Cyperaceae	*Cyperus gracilis*			C		1
plants	monocots	Cyperaceae	*Cyperus concinnus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus difformis*	rice sedge		C		1/1
plants	monocots	Cyperaceae	*Cyperus flaccidus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus pulchellus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus squarrosus*	bearded flatsedge		C		1/1
plants	monocots	Cyperaceae	*Bulbostylis barbata*			C		1/1
plants	monocots	Cyperaceae	*Cyperus holoschoenus*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Cyperaceae	*Cyperus orgadophilus*			C		1/1
plants	monocots	Cyperaceae	*Scleria tricuspidata*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C		4/4
plants	monocots	Cyperaceae	*Fimbristylis macrantha*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis neilsonii*			C		1/1
plants	monocots	Cyperaceae	*Eleocharis atropurpurea*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis caespitosa*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis littoralis*			C		2/2
plants	monocots	Cyperaceae	*Fimbristylis microcarya*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis squarrulosa*			C		1/1
plants	monocots	Cyperaceae	*Schoenoplectiella erecta*		Y			2/2
plants	monocots	Cyperaceae	*Schoenoplectiella laevis*			C		1/1
plants	monocots	Cyperaceae	*Cyperus conicus var. conicus*			C		1/1
plants	monocots	Cyperaceae	*Schoenoplectiella lateriflora*			C		1/1
plants	monocots	Cyperaceae	*Cyperus betchei subsp. betchei*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis sp. (Lake Buchanan V.J.Neldner+ 3362)*			C		2/2
plants	monocots	Eriocaulaceae	*Eriocaulon cinereum*			C		1/1
plants	monocots	Johnsoniaceae	*Tricoryne elatior*	yellow autumn lily		C		1/1
plants	monocots	Juncaginaceae	*Cycnogeton dubius*			C		1/1
plants	monocots	Laxmanniaceae	*Laxmannia gracilis*	slender wire lily		C		2/2
plants	monocots	Laxmanniaceae	*Lomandra leucocephala subsp. leucocephala*			C		3/3
plants	monocots	Laxmanniaceae	*Lomandra multiflora subsp. multiflora*			C		1/1
plants	monocots	Laxmanniaceae	*Thysanotus chinensis*			C		1/1
plants	monocots	Poaceae	*Iseilema membranaceum*	small flinders grass		C		1/1
plants	monocots	Poaceae	*Schizachyrium fragile*	firegrass		C		1/1
plants	monocots	Poaceae	*Sporobolus disjunctus*			C		2/2
plants	monocots	Poaceae	*Alloteropsis semialata*	cockatoo grass		C		2/2
plants	monocots	Poaceae	*Enneapogon lindleyanus*			C		1/1
plants	monocots	Poaceae	*Eragrostis pergracilis*			C		2/2
plants	monocots	Poaceae	*Urochloa subquadripara*		Y			1/1
plants	monocots	Poaceae	*Dactyloctenium radulans*	button grass		C		2/2
plants	monocots	Poaceae	*Digitaria hystrichoides*	umbrella grass		C		1/1
plants	monocots	Poaceae	*Eragrostis leptostachya*			C		1/1
plants	monocots	Poaceae	*Eragrostis spartinoides*			C		2/2
plants	monocots	Poaceae	*Sporobolus actinocladus*	katoora grass		C		4/4
plants	monocots	Poaceae	*Dactyloctenium aegyptium*	coast button grass	Y			1/1
plants	monocots	Poaceae	*Enneapogon robustissimus*			C		2/2
plants	monocots	Poaceae	*Sporobolus australasicus*			C		1/1
plants	monocots	Poaceae	*Sporobolus coromandelianus*		Y			2/2
plants	monocots	Poaceae	*Austrochloris dichanthioides*			C		3/3
plants	monocots	Poaceae	*Dactyloctenium buchananensis*			C		4/4
plants	monocots	Poaceae	*Cynodon dactylon var. dactylon*		Y			2/2
plants	monocots	Poaceae	*Aristida calycina var. calycina*			C		1/1
plants	monocots	Poaceae	*Aristida calycina var. praealta*			C		1/1
plants	monocots	Poaceae	*Dinebra decipiens var. decipiens*			C		1/1
plants	monocots	Poaceae	*Aristida holathera var. holathera*			C		4/4

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Chloris divaricata var. divaricata*	slender chloris		C		1/1
plants	monocots	Poaceae	*Urochloa holosericea subsp. velutina*			C		1/1
plants	monocots	Poaceae	*Eragrostis sp. (Lakefield NP J.R.Clarkson+ 7010)*			C		1/1
plants	monocots	Poaceae	*Eriachne mucronata forma (Alpha C.E.Hubbard 7882)*			C		2/2
plants	monocots	Poaceae	*Eriachne mucronata forma (Burnham R.W.Purdie 1370)*			C		1/1
plants	monocots	Poaceae	*Aristida*			C		1
plants	monocots	Poaceae	*Eriachne*			C		1
plants	monocots	Poaceae	*Enneapogon*			C		1
plants	monocots	Poaceae	*Eragrostis*			C		1
plants	monocots	Poaceae	*Perotis rara*	comet grass		C		1/1
plants	monocots	Poaceae	*Melinis repens*	red natal grass	Y			1/1
plants	monocots	Poaceae	*Panicum simile*			C		1/1
plants	monocots	Poaceae	*Sarga plumosum*			C		2/2
plants	monocots	Poaceae	*Eriachne obtusa*			C		1/1
plants	monocots	Poaceae	*Panicum effusum*			C		2/2
plants	monocots	Poaceae	*Setaria surgens*			C		1/1
plants	monocots	Poaceae	*Triodia pungens*			C		1/1
plants	monocots	Poaceae	*Aristida ingrata*			C		2/2
plants	monocots	Poaceae	*Eriachne ciliata*			C		1/1
plants	monocots	Poaceae	*Aristida contorta*	bunched kerosene grass		C		1/1
plants	monocots	Poaceae	*Chloris pectinata*	comb chloris		C		2/2
plants	monocots	Poaceae	*Digitaria brownii*			C		2/2
plants	monocots	Poaceae	*Elionurus citreus*	lemon-scented grass		C		1/1
plants	monocots	Poaceae	*Mnesithea formosa*			C		1/1
plants	monocots	Poaceae	*Panicum laevinode*	pepper grass		C		1/1
plants	monocots	Poaceae	*Paspalidium rarum*			C		3/2
plants	monocots	Poaceae	*Urochloa piligera*			C		1/1
plants	monocots	Poaceae	*Chrysopogon fallax*			C		1
plants	monocots	Poaceae	*Digitaria bicornis*			C		2/2
plants	monocots	Poaceae	*Digitaria ciliaris*	summer grass	Y			1/1
plants	monocots	Poaceae	*Eragrostis sororia*			C		2/2
plants	monocots	Poaceae	*Eriachne aristidea*			C		1/1
plants	monocots	Poaceae	*Amphipogon sericeus*			C		2/2
plants	monocots	Poaceae	*Aristida sciuroides*			C		2/2
plants	monocots	Poaceae	*Brachyachne tenella*			C		2/2
plants	monocots	Poaceae	*Cymbopogon ambiguus*	lemon grass		C		1/1
plants	monocots	Poaceae	*Cymbopogon obtectus*			C		1/1
plants	monocots	Poaceae	*Enneapogon gracilis*	slender nineawn		C		1/1
plants	monocots	Poaceae	*Eragrostis cumingii*			C		2/2
plants	monocots	Poaceae	*Eragrostis elongata*			C		2/2
plants	monocots	Poaceae	*Eragrostis speciosa*			C		1/1
plants	monocots	Poaceae	*Paspalidium distans*	shotgrass		C		1/1
plants	monocots	Poaceae	*Digitaria longiflora*			C		2/2
plants	monocots	Poaceae	*Eragrostis basedowii*			C		2/2
plants	monocots	Poaceae	*Eragrostis lacunaria*	purple lovegrass		C		1/1
plants	monocots	Poaceae	*Sporobolus scabridus*			C		3/3

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Thaumastochloa major*			C		1/1
plants	monocots	Poaceae	*Whiteochloa airoides*			C		1/1
plants	monocots	Poaceae	*Alloteropsis cimicina*			C		1/1
plants	monocots	Poaceae	*Aristida helicophylla*			C		1/1
plants	monocots	Poaceae	*Aristida hygrometrica*			C		3/3
plants	monocots	Poaceae	*Digitaria breviglumis*			C		2/2
plants	monocots	Poaceae	*Eragrostis filicaulis*			C		1/1
plants	monocots	Poaceae	*Eragrostis lanicaulis*			C		2/2
plants	monocots	Poaceae	*Eragrostis microcarpa*			C		3/3
plants	monocots	Ruppiaceae	*Ruppia maritima*	sea tassel		C		2/2
plants	monocots	Ruppiaceae	*Ruppia*			C		1/1
plants	monocots	Xanthorrhoeaceae	*Xanthorrhoea johnsonii*			C		1/1
plants		Streptophyceae	*Lamprothamnium papulosum*			C		1/1
plants		Streptophyceae	*Chara*			C		1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.* The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: All
Latitude: -21.7466
Longitude: 146.176
Distance: 25
Email: katrina.wolf@cumberlandecology.com.au
Date submitted: Monday 02 Mar 2015 13:03:49
Date extracted: Monday 02 Mar 2015 13:10:43

The number of records retrieved = 478

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			5
animals	amphibians	Hylidae	*Litoria inermis*	bumpy rocketfrog		C		3
animals	amphibians	Hylidae	*Litoria rubella*	ruddy treefrog		C		4
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		5
animals	amphibians	Hylidae	*Cyclorana novaehollandiae*	eastern snapping frog		C		4
animals	amphibians	Hylidae	*Litoria rothii*	northern laughing treefrog		C		3
animals	amphibians	Hylidae	*Cyclorana brevipes*	superb collared frog		C		2
animals	amphibians	Limnodynastidae	*Platyplectrum ornatum*	ornate burrowing frog		C		2
animals	amphibians	Myobatrachidae	*Crinia deserticola*	chirping froglet		C		1
animals	birds	Acanthizidae	*Gerygone fusca*	western gerygone		C		2
animals	birds	Acanthizidae	*Acanthiza reguloides*	buff-rumped thornbill		C		2
animals	birds	Acanthizidae	*Gerygone albogularis*	white-throated gerygone		C		8
animals	birds	Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill		C		12
animals	birds	Acanthizidae	*Acanthiza uropygialis*	chestnut-rumped thornbill		C		2
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		22
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		2
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		1
animals	birds	Accipitridae	*Lophoictinia isura*	square-tailed kite		C		2
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		2
animals	birds	Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar		C		48
animals	birds	Anatidae	*Aythya australis*	hardhead		C		2
animals	birds	Anatidae	*Malacorhynchus membranaceus*	pink-eared duck		C		2
animals	birds	Anatidae	*Anas gracilis*	grey teal		C		2
animals	birds	Ardeidae	*Ardea pacifica*	white-necked heron		C		4
animals	birds	Ardeidae	*Ardea intermedia*	intermediate egret		C		2
animals	birds	Artamidae	*Artamus personatus*	masked woodswallow		C		2
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		37
animals	birds	Artamidae	*Artamus minor*	little woodswallow		C		5
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		2
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		22
animals	birds	Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		C		2
animals	birds	Artamidae	*Artamus cinereus*	black-faced woodswallow		C		8
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		49
animals	birds	Burhinidae	*Burhinus grallarius*	bush stone-curlew		C		2
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		2
animals	birds	Cacatuidae	*Eolophus roseicapillus*	galah		C		2
animals	birds	Cacatuidae	*Calyptorhynchus banksii*	red-tailed black-cockatoo		C		6
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		18
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		28
animals	birds	Campephagidae	*Coracina maxima*	ground cuckoo-shrike		C		2
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		4
animals	birds	Campephagidae	*Lalage sueurii*	white-winged triller		C		8
animals	birds	Casuariidae	*Dromaius novaehollandiae*	emu		C		3
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		2
animals	birds	Charadriidae	*Vanellus miles novaehollandiae*	masked lapwing (southern subspecies)		C		2
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		13
animals	birds	Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)		V	V	17
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		12
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		13
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		23
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		20
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		16
animals	birds	Cuculidae	*Cacomantis variolosus*	brush cuckoo		C		2
animals	birds	Cuculidae	*Chalcites basalis*	Horsfield's bronze-cuckoo		C		6
animals	birds	Cuculidae	*Cacomantis pallidus*	pallid cuckoo		C		2
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		4
animals	birds	Estrildidae	*Poephila cincta cincta*	black-throated finch (white-rumped subspecies)		E	E	25
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		5
animals	birds	Estrildidae	*Taeniopygia guttata*	zebra finch		C		6
animals	birds	Eurostopodidae	*Eurostopodus argus*	spotted nightjar		C		14
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		14
animals	birds	Falconidae	*Falco cenchroides*	Nankeen kestrel		C		6
animals	birds	Gruidae	*Grus rubicunda*	brolga		C		2
animals	birds	Halcyonidae	*Todiramphus macleayii*	forest kingfisher		C		2
animals	birds	Halcyonidae	*Todiramphus sanctus*	sacred kingfisher		C		10
animals	birds	Halcyonidae	*Dacelo leachii*	blue-winged kookaburra		C		12
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		7
animals	birds	Hirundinidae	*Petrochelidon nigricans*	tree martin		C		2
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		4
animals	birds	Maluridae	*Malurus lamberti*	variegated fairy-wren		C		22
animals	birds	Megaluridae	*Eremiornis carteri*	spinifexbird		C		4
animals	birds	Megaluridae	*Cincloramphus mathewsi*	rufous songlark		C		4
animals	birds	Meliphagidae	*Gavicalis virescens*	singing honeyeater		C		19
animals	birds	Meliphagidae	*Manorina flavigula*	yellow-throated miner		C		29
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		47
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		15
animals	birds	Meliphagidae	*Ptilotula penicillatus*	white-plumed honeyeater		C		11
animals	birds	Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater		C		19
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		2
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		18
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		12
animals	birds	Meliphagidae	*Ptilotula plumulus*	grey-fronted honeyeater		C		10
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		7
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		SL		10
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		14
animals	birds	Monarchidae	*Myiagra inquieta*	restless flycatcher		C		10
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		16
animals	birds	Neosittidae	*Daphoenositta chrysoptera*	varied sittella		C		6
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		8
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Pachycephalidae	*Oreoica gutturalis*	crested bellbird		C		29
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		24
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		30
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		30
animals	birds	Petroicidae	*Microeca fascinans*	jacky winter		C		38
animals	birds	Petroicidae	*Melanodryas cucullata*	hooded robin		C		4
animals	birds	Phasianidae	*Coturnix ypsilophora*	brown quail		C		2
animals	birds	Podargidae	*Podargus strigoides*	tawny frogmouth		C		19
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		2
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		16
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		14
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		10
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		14
animals	birds	Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird		C		4
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		29
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		6
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		20
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		1
animals	birds	Threskiornithidae	*Threskiornis molucca*	Australian white ibis		C		1
animals	birds	Threskiornithidae	*Platalea regia*	royal spoonbill		C		1
animals	birds	Turnicidae	*Turnix varius*	painted button-quail		C		4
animals	mammals	Canidae	*Canis lupus dingo*	dingo				1
animals	mammals	Dasyuridae	*Sminthopsis macroura*	stripe-faced dunnart		C		11
animals	mammals	Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail bat		C		1
animals	mammals	Felidae	*Felis catus*	cat	Y			3
animals	mammals	Leporidae	*Oryctolagus cuniculus*	rabbit	Y			2
animals	mammals	Macropodidae	*Macropus giganteus*	eastern grey kangaroo		C		14
animals	mammals	Macropodidae	*Macropus rufus*	red kangaroo		C		15
animals	mammals	Macropodidae	*Macropus robustus*	common wallaroo		C		6
animals	mammals	Macropodidae	*Lagorchestes conspicillatus*	spectacled hare-wallaby		C		1
animals	mammals	Molossidae	*Chaerephon jobensis*	northern freetail bat		C		1
animals	mammals	Muridae	*Leggadina lakedownensis*	Lakeland Downs mouse		C		1
animals	mammals	Muridae	*Pseudomys delicatulus*	delicate mouse		C		4
animals	mammals	Muridae	*Pseudomys patrius*	eastern pebble-mound mouse		C		1
animals	mammals	Muridae	*Mus musculus*	house mouse	Y			1
animals	mammals	Muridae	*Pseudomys desertor*	desert mouse		C		11
animals	mammals	Petauridae	*Petaurus breviceps*	sugar glider		C		2
animals	mammals	Petauridae	*Petaurus norfolcensis*	squirrel glider		C		1
animals	mammals	Phalangeridae	*Trichosurus vulpecula*	common brushtail possum		C		4
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		SL	V	2
animals	mammals	Potoroidae	*Aepyprymnus rufescens*	rufous bettong		C		1
animals	mammals	Pteropodidae	*Pteropus scapulatus*	little red flying-fox		C		1
animals	mammals	Suidae	*Sus scrofa*	pig	Y			1
animals	mammals	Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna		SL		3
animals	mammals	Vespertilionidae	*Chalinolobus morio*	chocolate wattled bat		C		1
animals	mammals	Vespertilionidae	*Vespadelus baverstocki*	inland forest bat		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	mammals	Vespertilionidae	*Vespadelus troughtoni*	eastern cave bat		C		1
animals	mammals	Vespertilionidae	*Vespadelus finlaysoni*	Finlayson's cave bat		C		1
animals	mammals	Vespertilionidae	*Nyctophilus geoffroyi*	lesser long-eared bat		C		3
animals	mammals	Vespertilionidae	*Scotorepens greyii*	little broad-nosed bat		C		5
animals	mammals	Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat		C		3
animals	mammals	Vespertilionidae	*Chalinolobus picatus*	little pied bat		C		1
animals	reptiles	Agamidae	*Amphibolurus gilberti*	Gilbert's dragon		C		1
animals	reptiles	Agamidae	*Diporiphora australis*			C		3
animals	reptiles	Agamidae	*Chlamydosaurus kingii*	frilled lizard		C		1
animals	reptiles	Agamidae	*Pogona barbata*	bearded dragon		C		12
animals	reptiles	Agamidae	*Diporiphora nobbi*	nobbi		C		2
animals	reptiles	Agamidae	*Ctenophorus nuchalis*	central netted dragon		C		7
animals	reptiles	Boidae	*Aspidites melanocephalus*	black-headed python		C		3
animals	reptiles	Carphodactylidae	*Nephrurus asper*	spiny knob-tailed gecko		C		2
animals	reptiles	Colubridae	*Boiga irregularis*	brown tree snake		C		1
animals	reptiles	Diplodactylidae	*Rhynchoedura ornata sensu lato*	beaked gecko		C		2
animals	reptiles	Diplodactylidae	*Diplodactylus conspicillatus*	fat-tailed diplodactylus		C		4
animals	reptiles	Diplodactylidae	*Lucasium steindachneri*	Steindachner's gecko		C		8
animals	reptiles	Diplodactylidae	*Strophurus williamsi*	soft-spined gecko		C		4
animals	reptiles	Diplodactylidae	*Amalosia rhombifer*	zig-zag gecko		C		1
animals	reptiles	Diplodactylidae	*Oedura marmorata*	marbled velvet gecko		C		1
animals	reptiles	Elapidae	*Pseudonaja guttata*	speckled brown snake		C		1
animals	reptiles	Elapidae	*Acanthophis praelongus*	northern death adder		C		1
animals	reptiles	Elapidae	*Cryptophis boschmai*	Carpentaria whip snake		C		1
animals	reptiles	Elapidae	*Furina diadema*	red-naped snake		C		1
animals	reptiles	Elapidae	*Demansia psammophis*	yellow-faced whipsnake		C		1
animals	reptiles	Gekkonidae	*Gehyra dubia*			C		2
animals	reptiles	Gekkonidae	*Gehyra versicolor*			C		1
animals	reptiles	Gekkonidae	*Heteronotia binoei*	Bynoe's gecko		C		15
animals	reptiles	Gekkonidae	*Gehyra catenata*			C		2
animals	reptiles	Pygopodidae	*Pygopus schraderi*	eastern hooded scaly-foot		C		1
animals	reptiles	Pygopodidae	*Lialis burtonis*	Burton's legless lizard		C		1
animals	reptiles	Scincidae	*Lerista punctatovittata*			C		3
animals	reptiles	Scincidae	*Cryptoblepharus plagiocephalus sensu lato*			C		7
animals	reptiles	Scincidae	*Morethia taeniopleura*	fire-tailed skink		C		2
animals	reptiles	Scincidae	*Proablepharus tenuis*			C		1
animals	reptiles	Scincidae	*Ctenotus pantherinus*			C		5
animals	reptiles	Scincidae	*Morethia boulengeri*			C		3
animals	reptiles	Scincidae	*Tiliqua scincoides*	eastern blue-tongued lizard		C		1
animals	reptiles	Scincidae	*Ctenotus strauchii*			C		5
animals	reptiles	Scincidae	*Ctenotus spaldingi*			C		5
animals	reptiles	Scincidae	*Concinnia sokosoma*	stout bar-sided skink		C		1
animals	reptiles	Scincidae	*Egernia striolata*	tree skink		C		5
animals	reptiles	Scincidae	*Ctenotus hebetior*			C		7
animals	reptiles	Scincidae	*Ctenotus ingrami*			C		4
animals	reptiles	Scincidae	*Carlia schmeltzii*			C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	reptiles	Scincidae	*Carlia munda*			C		10
animals	reptiles	Scincidae	*Menetia maini*	northern dwarf skink		C		2
animals	reptiles	Scincidae	*Menetia greyii*	common dwarf skink		C		8
animals	reptiles	Typhlopidae	*Ramphotyphlops ligatus*			C		1
animals	reptiles	Varanidae	*Varanus tristis*	black-tailed monitor		C		5
animals	reptiles	Varanidae	*Varanus gouldii*	sand monitor		C		1
plants	higher dicots	Acanthaceae	*Dipteracanthus australasicus subsp. australasicus*			C		2/2
plants	higher dicots	Acanthaceae	*Rostellularia adscendens*			C		1/1
plants	higher dicots	Amaranthaceae	*Ptilotus nobilis subsp. semilanatus*			C		1/1
plants	higher dicots	Apiaceae	*Eryngium plantagineum*	long eryngium		C		1/1
plants	higher dicots	Apocynaceae	*Carissa ovata*	currantbush		C		1
plants	higher dicots	Asteraceae	*Pluchea dentex*	bowl daisy		C		1/1
plants	higher dicots	Asteraceae	*Pluchea xanthina*			C		1/1
plants	higher dicots	Asteraceae	*Camptacra barbata*			C		2/2
plants	higher dicots	Asteraceae	*Minuria integerrima*	smooth minuria		C		1/1
plants	higher dicots	Asteraceae	*Streptoglossa odora*			C		1/1
plants	higher dicots	Asteraceae	*Pterocaulon redolens*			C		1/1
plants	higher dicots	Asteraceae	*Calotis xanthosioidea*			C		1/1
plants	higher dicots	Asteraceae	*Vittadinia pterochaeta*	rough fuzzweed		C		1/1
plants	higher dicots	Asteraceae	*Pterocaulon intermedium*			C		1/1
plants	higher dicots	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			1/1
plants	higher dicots	Asteraceae	*Streptoglossa adscendens*	desert daisy		C		2/2
plants	higher dicots	Asteraceae	*Chrysocephalum apiculatum*	yellow buttons		C		2/2
plants	higher dicots	Asteraceae	*Olearia arguta var. lanata*			C		1/1
plants	higher dicots	Asteraceae	*Apowollastonia spilanthoides*			C		1/1
plants	higher dicots	Boraginaceae	*Heliotropium peninsulare*			C		1/1
plants	higher dicots	Byttneriaceae	*Keraudrenia hookeriana*			C		1/1
plants	higher dicots	Byttneriaceae	*Keraudrenia nephrosperma*			C		1/1
plants	higher dicots	Byttneriaceae	*Keraudrenia collina*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Senna artemisioides subsp. zygophylla*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Senna artemisioides subsp. sturtii*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Labichea rupestris*			C		2/2
plants	higher dicots	Campanulaceae	*Wahlenbergia gracilis*	sprawling bluebell		C		1/1
plants	higher dicots	Capparaceae	*Capparis lasiantha*	nipan		C		1/1
plants	higher dicots	Caryophyllaceae	*Polycarpaea corymbosa*			C		1/1
plants	higher dicots	Chenopodiaceae	*Maireana dichoptera*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena glabra*			C		1/1
plants	higher dicots	Chenopodiaceae	*Salsola australis*			C		1/1
plants	higher dicots	Chenopodiaceae	*Maireana coronata*			C		1/1
plants	higher dicots	Chenopodiaceae	*Maireana villosa*			C		1/1
plants	higher dicots	Chenopodiaceae	*Maireana georgei*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena ramulosa*			C		2/2
plants	higher dicots	Chenopodiaceae	*Dysphania melanocarpa forma melanocarpa*			C		1/1
plants	higher dicots	Chenopodiaceae	*Einadia trigonos subsp. stellulata*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena anisacanthoides*	yellow burr		C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena everistiana*			C		1/1

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plants	higher dicots	Chenopodiaceae	*Sclerolaena convexula*			C		2/2
plants	higher dicots	Chenopodiaceae	*Sclerolaena diacantha*	grey copper burr		C		4/4
plants	higher dicots	Chenopodiaceae	*Sclerolaena lanicuspis*			C		2/2
plants	higher dicots	Clusiaceae	*Hypericum gramineum*			C		1/1
plants	higher dicots	Convolvulaceae	*Polymeria marginata*			C		1/1
plants	higher dicots	Convolvulaceae	*Evolvulus alsinoides var. decumbens*			C		1/1
plants	higher dicots	Convolvulaceae	*Bonamia media var. media*			C		1/1
plants	higher dicots	Convolvulaceae	*Evolvulus alsinoides*			C		3/2
plants	higher dicots	Dilleniaceae	*Hibbertia exutiacies*			C		1/1
plants	higher dicots	Erythroxylaceae	*Erythroxylum australe*	cocaine tree		C		1
plants	higher dicots	Euphorbiaceae	*Beyeria viscosa*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia petala*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia stevenii*	bottle tree spurge		C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia mitchelliana var. mitchelliana*			C		2/2
plants	higher dicots	Euphorbiaceae	*Microstachys chamaelea*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia papillata var. laevicaulis*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia thelephora var. thelephora*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia tannensis subsp. eremophila*			C		3/3
plants	higher dicots	Euphorbiaceae	*Euphorbia*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia coghlanii*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia*			C		1/1
plants	higher dicots	Fabaceae	*Zornia adenophora*			C		2/2
plants	higher dicots	Fabaceae	*Cajanus marmoratus*			C		2/2
plants	higher dicots	Fabaceae	*Glycine tomentella*	woolly glycine		C		3/3
plants	higher dicots	Fabaceae	*Indigofera colutea*	sticky indigo		C		2/2
plants	higher dicots	Fabaceae	*Aeschynomene indica*	budda pea		C		1/1
plants	higher dicots	Fabaceae	*Tephrosia sp. (Lake Buchanan E.J.Thompson+ BUC2128)*			C		2/2
plants	higher dicots	Fabaceae	*Indigofera linifolia*			C		2/2
plants	higher dicots	Fabaceae	*Tephrosia leptoclada*			C		3/3
plants	higher dicots	Fabaceae	*Jacksonia rhadinoclona*	Miles dogwood		C		3/3
plants	higher dicots	Fabaceae	*Leptosema oxylobioides*			C		1/1
plants	higher dicots	Fabaceae	*Swainsona swainsonioides*	downy swainsona		C		1/1
plants	higher dicots	Fabaceae	*Gastrolobium grandiflorum*			C		1/1
plants	higher dicots	Fabaceae	*Desmodium filiforme*			C		2/2
plants	higher dicots	Goodeniaceae	*Dampiera adpressa*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia gracilis*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia grandiflora*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia splendida*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia rosulata*			C		1/1
plants	higher dicots	Lamiaceae	*Ocimum x africanum*		Y			1/1
plants	higher dicots	Lamiaceae	*Prostanthera parvifolia*			C		1/1
plants	higher dicots	Loganiaceae	*Mitrasacme sp. (Warang M.B.Thomas 1571)*			C		1/1
plants	higher dicots	Loranthaceae	*Amyema quandang var. quandang*			C		1/1
plants	higher dicots	Loranthaceae	*Lysiana subfalcata*			C		1/1
plants	higher dicots	Loranthaceae	*Lysiana spathulata subsp. parvifolia*			C		1/1
plants	higher dicots	Lythraceae	*Ammannia robertsii*			E		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Lythraceae	*Ammannia multiflora*	jerry-jerry		C		1/1
plants	higher dicots	Malvaceae	*Hibiscus leptocladus*			C		1/1
plants	higher dicots	Malvaceae	*Sida atherophora*			C		1/1
plants	higher dicots	Malvaceae	*Sida rohlenae subsp. rohlenae*			C		2/2
plants	higher dicots	Malvaceae	*Sida sp. (Laglan Station L.S.Smith 10325)*			C		2/2
plants	higher dicots	Malvaceae	*Sida sp. (Musselbrook M.B.Thomas+ MRS437)*			C		1/1
plants	higher dicots	Malvaceae	*Sida sp. (Charters Towers E.J.THompson+ CHA456)*			C		1/1
plants	higher dicots	Malvaceae	*Abutilon calliphyllum*	velvet lanternflower		C		1/1
plants	higher dicots	Malvaceae	*Sida trichopoda*			C		1/1
plants	higher dicots	Malvaceae	*Sida goniocarpa*			C		1/1
plants	higher dicots	Malvaceae	*Sida brachypoda*			C		1/1
plants	higher dicots	Malvaceae	*Sida spinosa*	spiny sida	Y			1/1
plants	higher dicots	Malvaceae	*Sida*			C		1
plants	higher dicots	Mimosaceae	*Acacia torulosa*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia galioides*			C		3/3
plants	higher dicots	Mimosaceae	*Acacia oswaldii*	miljee		C		1/1
plants	higher dicots	Mimosaceae	*Acacia cambagei*	gidgee		C		2/2
plants	higher dicots	Mimosaceae	*Acacia decora*	pretty wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia sp. (Urandangi L.Pedley 2025)*			C		1/1
plants	higher dicots	Mimosaceae	*Neptunia dimorphantha*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia sericophylla*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia leptostachya*	Townsville wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia stipuligera*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia holosericea*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia tenuissima*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia platycarpa*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia hyaloneura*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia flavescens*	toothed wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia salicina*	doolan		C		1/1
plants	higher dicots	Myrtaceae	*Corymbia dallachiana*			C		1
plants	higher dicots	Myrtaceae	*Melaleuca uncinata*			C		2/2
plants	higher dicots	Myrtaceae	*Calytrix microcoma*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca nervosa*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus whitei*	White's ironbark		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus camaldulensis subsp. acuta*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia setosa subsp. pedicellaris*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus melanophloia - E.whitei*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus drepanophylla*			C		6/6
plants	higher dicots	Myrtaceae	*Lithomyrtus microphylla*			C		1/1
plants	higher dicots	Myrtaceae	*Leptospermum lamellatum*			C		1/1
plants	higher dicots	Myrtaceae	*Thryptomene parviflora*			C		2/2
plants	higher dicots	Myrtaceae	*Ochrosperma adpressum*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca tamariscina*			C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus thozetiana*			C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus persistens*			C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus cambageana*	Dawson gum		C		2/2

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plants	higher dicots	Myrtaceae	*Corymbia leichhardtii*	rustyjacket		C		1/1
plants	higher dicots	Myrtaceae	*Corymbia lamprophylla*			C		2/1
plants	higher dicots	Myrtaceae	*Corymbia plena*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca pallescens*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia clarksoniana*			C		1/1
plants	higher dicots	Nyctaginaceae	*Boerhavia pubescens*			C		1/1
plants	higher dicots	Nyctaginaceae	*Boerhavia paludosa*			C		1/1
plants	higher dicots	Onagraceae	*Ludwigia perennis*			C		1/1
plants	higher dicots	Orobanchaceae	*Buchnera linearis*			C		1/1
plants	higher dicots	Orobanchaceae	*Buchnera ramosissima*			C		2/2
plants	higher dicots	Phyllanthaceae	*Phyllanthus virgatus*			C		4/4
plants	higher dicots	Phyllanthaceae	*Poranthera microphylla*	small poranthera		C		1/1
plants	higher dicots	Picrodendraceae	*Petalostigma pubescens*	quinine tree		C		1
plants	higher dicots	Pittosporaceae	*Bursaria incana*			C		1
plants	higher dicots	Plantaginaceae	*Scoparia dulcis*	Scoparia	Y			1/1
plants	higher dicots	Polygalaceae	*Polygala crassitesta*			C		1/1
plants	higher dicots	Polygalaceae	*Polygala difficilis*			C		1/1
plants	higher dicots	Polygalaceae	*Polygala pycnantha*			C		1/1
plants	higher dicots	Portulacaceae	*Calandrinia ptychosperma*			C		1/1
plants	higher dicots	Portulacaceae	*Portulaca oleracea*	pigweed	Y			1
plants	higher dicots	Proteaceae	*Grevillea parallela*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea pteridifolia*	golden parrot tree		C		1/1
plants	higher dicots	Proteaceae	*Grevillea sessilis*			C		1/1
plants	higher dicots	Proteaceae	*Persoonia falcata*			C		1/1
plants	higher dicots	Proteaceae	*Hakea leucoptera*			C		3/3
plants	higher dicots	Proteaceae	*Hakea lorea*			C		1
plants	higher dicots	Rubiaceae	*Synaptantha tillaeacea var. tillaeacea*			C		1/1
plants	higher dicots	Rubiaceae	*Spermacoce brachystema*			C		2/2
plants	higher dicots	Rubiaceae	*Psydrax forsteri*			C		1/1
plants	higher dicots	Rubiaceae	*Oldenlandia mitrasacmoides subsp. nigricans*			C		2/2
plants	higher dicots	Rubiaceae	*Oldenlandia mitrasacmoides*			C		1/1
plants	higher dicots	Rubiaceae	*Psydrax attenuata forma megalantha*			C		1/1
plants	higher dicots	Rubiaceae	*Psydrax saligna forma saligna*			C		1/1
plants	higher dicots	Santalaceae	*Santalum lanceolatum*			C		2/2
plants	higher dicots	Sapindaceae	*Atalaya hemiglauca*			C		2/2
plants	higher dicots	Sapindaceae	*Dodonaea tenuifolia*			C		1/1
plants	higher dicots	Scrophulariaceae	*Eremophila maculata subsp. maculata*			C		2/2
plants	higher dicots	Solanaceae	*Solanum cleistogamum*			C		1/1
plants	higher dicots	Solanaceae	*Solanum crebrispinum*			C		1/1
plants	higher dicots	Solanaceae	*Solanum nodiflorum*		Y			1/1
plants	higher dicots	Solanaceae	*Solanum esuriale*	quena		C		1/1
plants	higher dicots	Sparrmanniaceae	*Grewia retusifolia*			C		1/1
plants	higher dicots	Sparrmanniaceae	*Grewia latifolia*	dysentery plant		C		1
plants	higher dicots	Stackhousiaceae	*Stackhousia intermedia*			C		2/2
plants	higher dicots	Stylidiaceae	*Stylidium eglandulosum*			C		1/1
plants	higher dicots	Violaceae	*Hybanthus enneaspermus*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Violaceae	*Hybanthus monopetalus*			C		1
plants	higher dicots	Violaceae	*Hybanthus stellarioides*			C		1/1
plants	higher dicots	Zygophyllaceae	*Tribulopis angustifolia*			C		1/1
plants	lower dicots	Aristolochiaceae	*Aristolochia*			C		1
plants	monocots	Commelinaceae	*Cyanotis axillaris*			C		1/1
plants	monocots	Cyperaceae	*Cyperus bifax*	western nutgrass		C		1/1
plants	monocots	Cyperaceae	*Cyperus conicus*			C		1/1
plants	monocots	Cyperaceae	*Schoenus kennyi*			C		1/1
plants	monocots	Cyperaceae	*Cyperus gracilis*			C		1
plants	monocots	Cyperaceae	*Cyperus concinnus*			C		2/2
plants	monocots	Cyperaceae	*Cyperus difformis*	rice sedge		C		1/1
plants	monocots	Cyperaceae	*Cyperus flaccidus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus dactylotes*			C		2/2
plants	monocots	Cyperaceae	*Cyperus pulchellus*			C		1/1
plants	monocots	Cyperaceae	*Scleria sphacelata*			C		1/1
plants	monocots	Cyperaceae	*Bulbostylis barbata*			C		1/1
plants	monocots	Cyperaceae	*Cyperus orgadophilus*			C		1/1
plants	monocots	Cyperaceae	*Scleria tricuspidata*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C		2/2
plants	monocots	Cyperaceae	*Fimbristylis macrantha*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis neilsonii*			C		1/1
plants	monocots	Cyperaceae	*Eleocharis atropurpurea*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis caespitosa*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis littoralis*			C		2/2
plants	monocots	Cyperaceae	*Fimbristylis microcarya*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis squarrulosa*			C		1/1
plants	monocots	Cyperaceae	*Schoenoplectiella erecta*		Y			2/2
plants	monocots	Cyperaceae	*Schoenoplectiella laevis*			C		2/2
plants	monocots	Cyperaceae	*Schoenoplectiella lateriflora*			C		1/1
plants	monocots	Cyperaceae	*Cyperus betchei subsp. betchei*			C		1/1
plants	monocots	Cyperaceae	*Schoenoplectiella dissachantha*			C		1/1
plants	monocots	Cyperaceae	*Cyperus iria*			C		3/3
plants	monocots	Cyperaceae	*Fimbristylis*			C		1/1
plants	monocots	Juncaginaceae	*Cycnogeton dubius*			C		1/1
plants	monocots	Laxmanniaceae	*Laxmannia gracilis*	slender wire lily		C		2/2
plants	monocots	Laxmanniaceae	*Thysanotus chinensis*			C		1/1
plants	monocots	Laxmanniaceae	*Lomandra leucocephala subsp. leucocephala*			C		3/3
plants	monocots	Poaceae	*Chrysopogon fallax*			C		1
plants	monocots	Poaceae	*Digitaria ciliaris*	summer grass	Y			1/1
plants	monocots	Poaceae	*Eriachne aristidea*			C		1/1
plants	monocots	Poaceae	*Amphipogon sericeus*			C		2/2
plants	monocots	Poaceae	*Aristida sciuroides*			C		2/2
plants	monocots	Poaceae	*Brachyachne tenella*			C		3/3
plants	monocots	Poaceae	*Cymbopogon ambiguus*	lemon grass		C		1/1
plants	monocots	Poaceae	*Enneapogon gracilis*	slender nineawn		C		2/2
plants	monocots	Poaceae	*Eragrostis cumingii*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Eragrostis elongata*			C		2/2
plants	monocots	Poaceae	*Paspalidium distans*	shotgrass		C		1/1
plants	monocots	Poaceae	*Digitaria longiflora*			C		1/1
plants	monocots	Poaceae	*Enneapogon avenaceus*			C		2/2
plants	monocots	Poaceae	*Enneapogon truncatus*			C		1/1
plants	monocots	Poaceae	*Eragrostis lacunaria*	purple lovegrass		C		1/1
plants	monocots	Poaceae	*Sporobolus scabridus*			C		2/2
plants	monocots	Poaceae	*Triodia microstachya*			C		1/1
plants	monocots	Poaceae	*Whiteochloa airoides*			C		1/1
plants	monocots	Poaceae	*Alloteropsis cimicina*			C		1/1
plants	monocots	Poaceae	*Aristida helicophylla*			C		2/2
plants	monocots	Poaceae	*Aristida hygrometrica*			C		3/3
plants	monocots	Poaceae	*Digitaria breviglumis*			C		2/2
plants	monocots	Poaceae	*Eragrostis filicaulis*			C		1/1
plants	monocots	Poaceae	*Eragrostis lanicaulis*			C		1/1
plants	monocots	Poaceae	*Eragrostis leptocarpa*	drooping lovegrass		C		1/1
plants	monocots	Poaceae	*Eragrostis parviflora*	weeping lovegrass		C		1/1
plants	monocots	Poaceae	*Iseilema membranaceum*	small flinders grass		C		1/1
plants	monocots	Poaceae	*Schizachyrium fragile*	firegrass		C		1/1
plants	monocots	Poaceae	*Sporobolus disjunctus*			C		1/1
plants	monocots	Poaceae	*Alloteropsis semialata*	cockatoo grass		C		2/2
plants	monocots	Poaceae	*Enneapogon lindleyanus*			C		1/1
plants	monocots	Poaceae	*Enneapogon polyphyllus*	leafy nineawn		C		1/1
plants	monocots	Poaceae	*Urochloa mosambicensis*	sabi grass	Y			1/1
plants	monocots	Poaceae	*Urochloa subquadripara*		Y			1/1
plants	monocots	Poaceae	*Eragrostis spartinoides*			C		1/1
plants	monocots	Poaceae	*Sporobolus actinocladus*	katoora grass		C		3/3
plants	monocots	Poaceae	*Enneapogon robustissimus*			C		3/3
plants	monocots	Poaceae	*Paspalidium albovillosum*			C		1/1
plants	monocots	Poaceae	*Digitaria divaricatissima*	spreading umbrella grass		C		1/1
plants	monocots	Poaceae	*Eriochloa pseudoacrotricha*			C		1/1
plants	monocots	Poaceae	*Dactyloctenium buchananensis*			C		1/1
plants	monocots	Poaceae	*Aristida calycina var. praealta*			C		1/1
plants	monocots	Poaceae	*Dinebra decipiens var. decipiens*			C		1/1
plants	monocots	Poaceae	*Aristida holathera var. holathera*			C		4/4
plants	monocots	Poaceae	*Chloris divaricata var. divaricata*	slender chloris		C		1/1
plants	monocots	Poaceae	*Amphipogon caricinus var. caricinus*			C		1/1
plants	monocots	Poaceae	*Urochloa holosericea subsp. velutina*			C		1/1
plants	monocots	Poaceae	*Eragrostis sp. (Lakefield NP J.R.Clarkson+ 7010)*			C		1/1
plants	monocots	Poaceae	*Aristida*			C		1
plants	monocots	Poaceae	*Eriachne*			C		1
plants	monocots	Poaceae	*Enneapogon*			C		1
plants	monocots	Poaceae	*Eragrostis*			C		1
plants	monocots	Poaceae	*Perotis rara*	comet grass		C		1/1
plants	monocots	Poaceae	*Melinis repens*	red natal grass	Y			1/1
plants	monocots	Poaceae	*Sarga plumosum*			C		2/2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Chloris virgata*	feathertop rhodes grass	Y			1/1
plants	monocots	Poaceae	*Eriachne obtusa*			C		1/1
plants	monocots	Poaceae	*Panicum effusum*			C		2/2
plants	monocots	Poaceae	*Setaria surgens*			C		1/1
plants	monocots	Poaceae	*Triodia pungens*			C		1/1
plants	monocots	Poaceae	*Aristida ingrata*			C		2/2
plants	monocots	Poaceae	*Eriachne ciliata*			C		1/1
plants	monocots	Poaceae	*Chloris pectinata*	comb chloris		C		1/1
plants	monocots	Poaceae	*Digitaria brownii*			C		1/1
plants	monocots	Poaceae	*Elionurus citreus*	lemon-scented grass		C		1/1
plants	monocots	Poaceae	*Eragrostis pilosa*	soft lovegrass	Y			1/1
plants	monocots	Poaceae	*Panicum laevinode*	pepper grass		C		1/1
plants	monocots	Poaceae	*Paspalidium rarum*			C		3/2
plants	monocots	Poaceae	*Urochloa piligera*			C		1/1
plants	monocots	Poaceae	*Aristida latifolia*	feathertop wiregrass		C		1/1
plants	monocots	Poaceae	*Astrebla pectinata*	barley mitchell grass		C		1/1
plants	monocots	Xanthorrhoeaceae	*Xanthorrhoea johnsonii*			C		1/1
plants		Phrymaceae	*Peplidium foecundum*			C		1/1
plants		Streptophyceae	*Lamprothamnium papulosum*			C		1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.* The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Appendix C

Macroinvertebrate Data

Table C.1 Macroinvertebrate Data

Taxon Name	SIGNAL Grade	Survey Sites												
		Drainage lines in headwaters of Pigeonhole Creek catchment				Drainage lines in tributaries of Tomahawk Creek catchment								
		A13	A14	A21	A22	A3	A4	A5	A10	A11	A15	A17	A18	A20
Acarina	6			6				25	1					7
Aeshnidae	4									1				
Ancylidae	4									1				
Baetidae	5									9	1			
Belostomatidae											1			
Caenidae	4													1
Calocidae	9													
Ceratopogonidae	4					1				4		3		1
Chaoboridae	2							1						
Chironominae	3	1	2		3	7	3	9	2	9	2	1		3
Cladocera			1	5		13		1	3		10		6	
Coenagrionidae	2										5	2		
Coleoptera														
Copepoda				1		1		13	3	5	15		11	
Corixidae	2	2	4					8		27	18	1	2	
Culicidae	1			1						5				
Dytiscidae	2	2	18	18	10	15	7	4	1	1	15	10	13	17

Taxon Name	SIGNAL Grade	Survey Sites												
		Drainage lines in headwaters of Pigeonhole Creek catchment				Drainage lines in tributaries of Tomahawk Creek catchment								
		A13	A14	A21	A22	A3	A4	A5	A10	A11	A15	A17	A18	A20
Elmidae	7		9	2			3			5				
Ephemeroptera							2							
Gerridae	4	7	2						4	1				
Gomphidae	5			2				1						
Gyrinidae	4	7			4									
Haliplidae	2							2						
Hydridae	2							1						
Hydrochidae	4	1	2			1	1							1
Hydropsychidae				1	4						1	2		
Hydrometridae	3		2											
Hydrophilidae	2					1			4	1				
Leptoceridae	6										7			
Lestidae	1		2				2			9				
Libellulidae	4				4		4	2		3	1			
Lymnaeidae	1									2	1			
Nematoda	3									1				
Mesoveliidae											4	3		
Nepidae	3		2	2	2				1	2	1			

Taxon Name	SIGNAL Grade	Survey Sites												
		Drainage lines in headwaters of Pigeonhole Creek catchment				Drainage lines in tributaries of Tomahawk Creek catchment								
		A13	A14	A21	A22	A3	A4	A5	A10	A11	A15	A17	A18	A20
Notonectidae	1	14	14		12		15	2	2	32	20	11	12	
Oligochaeta	2													
Ostracoda								2		11	7			
Physidae	1							13		4	1	1		
Planorbidae											1			
Plecoptera				1										
Pleidae	2		1					3		2				1
Staphylinidae	3		1	29										1
Sundathelphusidae	3													
Tanypodinae	4	1	1	4	3	4	3	8		6	6		1	3
Temnocephalidae	5							1						
Veliidae	3	12	18	10		1	9	1	21	9				

Family Name	SIGNAL Grade	Survey Sites								
		Drainage lines in headwaters of North Creek catchment		Northern seasonal wetland	Southern seasonal wetland		Red Dog Dam	Southern farm dam		
		A1	A2	A12	A8	A9	A19	A6	A7	A16
Acarina	6			5	13	3	1	21	5	5
Aeshnidae	4	11	2							
Ancylidae	4									
Baetidae	5									
Belostomatidae										
Caenidae	4	2							2	2
Calocidae	9								1	
Ceratopogonidae	4		2	1						
Chaoboridae	2					6				
Chironominae	3	4	12	4	7	3		2	8	2
Cladocera			3	4	2	25		7	5	
Coenagrionidae	2					1				
Coleoptera		1		1						
Copepoda		14	5		5	3		3	5	
Corixidae	2	2	2	4			13	3	4	2
Culicidae	1	2		1	6					
Dytiscidae	2	11	8	5	2	2		1	7	7

Family Name	SIGNAL Grade	Survey Sites								
		Drainage lines in headwaters of North Creek catchment		Northern seasonal wetland	Southern seasonal wetland		Red Dog Dam	Southern farm dam		
		A1	A2	A12	A8	A9	A19	A6	A7	A16
Elmidae	7	7	1			6		1		1
Ephemeroptera		3								
Gerridae	4	1	2	7		2				
Gomphidae	5									
Gyrinidae	4		8	4						
Haliplidae	2							8		
Hydridae	2							9	1	
Hydrochidae	4	3	6	3	2			1		
Hydropsychidae							4			1
Hydrometridae	3					1				
Hydrophilidae	2	4		2				1		
Leptoceridae	6	2			1			2	2	
Lestidae	1	2								
Libellulidae	4	1	5					1		
Lymnaeidae	1									
Nematoda	3									
Mesoveliidae										

Family Name	SIGNAL Grade	Survey Sites								
		Drainage lines in headwaters of North Creek catchment		Northern seasonal wetland	Southern seasonal wetland		Red Dog Dam	Southern farm dam		
		A1	A2	A12	A8	A9	A19	A6	A7	A16
Nepidae	3		1							
Notonectidae	1	2	23	11		1	20			8
Oligochaeta	2		1							
Ostracoda		7	4		1	1		1	4	
Physidae	1							1		1
Planorbidae										
Plecoptera										
Pleidae	2	3	1	1		1			2	
Staphylinidae	3									
Sundathelphusidae	3		1							
Tanypodinae	4	2	1	5	8	4			18	
Temnocephalidae	5									
Veliidae	3	24	25	24		27	14			5

Appendix D

Water and Sediment Quality Data

Table D.1 Results of Water Quality Analysis for Metals, showing the 95% Trigger Values for the Protection of Freshwater Species

Analyte			Survey Sites							
			Drainage lines in headwaters of Pigeonhole Creek catchment		Drainage lines in tributaries of Tomahawk Creek catchment				Red Dog Dam	Southern farm dam
WATER	LOR	95% trigger value *	A21	A22	A15	A17	A18	A20	A19	A16
Aluminium (mg/L)	0.01	55	3.13	0.14	0.16	0.82	3.02	5.13	1.36	0.31
Antimony (mg/L)	0.001	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic (mg/L)	0.001	13	0.001	<0.001	0.002	<0.001	0.001	<0.001	0.001	0.001
Beryllium (mg/L)	0.001	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	0.001	N/A	0.026	0.001	0.032	0.156	0.022	0.009	0.027	0.041
Bismuth (mg/L)	0.001	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/L)	0.0001	0.2	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium (mg/L)	0.001	1	0.003	<0.001	<0.001	<0.001	0.002	0.004	0.001	<0.001
Copper (mg/L)	0.001	1.4	0.002	<0.001	0.002	0.002	0.002	0.002	0.001	0.004
Cobalt (mg/L)	0.001	ID	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.006

Analyte			Survey Sites							
			Drainage lines in headwaters of Pigeonhole Creek catchment		Drainage lines in tributaries of Tomahawk Creek catchment				Red Dog Dam	Southern farm dam
			A21	A22	A15	A17	A18	A20	A19	A16
Nickel (mg/L)	0.001	ID	0.001	<0.001	0.001	0.003	0.002	0.002	<0.001	0.005
Lead (mg/L)	0.001	3.4	0.002	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001
Zinc (mg/L)	0.005	8	0.016	<0.005	<0.005	0.009	<0.005	<0.005	0.007	<0.005
Lithium (mg/L)	0.001	N/A	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Manganese (mg/L)	0.001	1900	0.019	0.004	0.076	0.406	0.004	0.018	0.007	0.462
Molybdenum (mg/L)	0.001	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (mg/L)	0.01	11	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver (mg/L)	0.001	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium (mg/L)	0.001	N/A	0.022	0.004	0.074	0.015	0.029	0.01	0.008	0.02
Thallium (mg/L)	0.001	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (mg/L)	0.001	N/A	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Tin (mg/L)	0.001	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium (mg/L)	0.01	N/A	0.06	<0.01	<0.01	0.02	0.05	0.08	0.02	0.01

Analyte			Survey Sites							
			Drainage lines in headwaters of Pigeonhole Creek catchment		Drainage lines in tributaries of Tomahawk Creek catchment				Red Dog Dam	Southern farm dam
			A21	A22	A15	A17	A18	A20	A19	A16
Uranium (mg/L)	0.001	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (mg/L)	0.01	ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Boron (mg/L)	0.05	370	<0.05	<0.05	0.07	<0.05	0.17	<0.05	<0.05	0.08
Iron (mg/L)	0.05	ID	2.7	0.36	0.39	1.22	1.47	2.75	0.55	0.53

* ANZECC and ARMCANZ (2000)

N/A = Not applicable – this metal is not included in the ANZECC and ARMCANZ (2000) Water Quality Guidelines

Table D.2 Water and Sediment Quality Results at Sites A15 to A22

Analyte		Survey Sites							
		Drainage lines in headwaters of Pigeonhole Creek catchment		Drainage lines in tributaries of Tomahawk Creek catchment				Red Dog Dam	Southern farm dam
WATER	Limit of Recording	A21	A22	A15	A17	A18	A20	A19	A16
Hydroxide Alkalinity as CaCO3 (mg/L)	1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3 (mg/L)	1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3 (mg/L)	1	20	5	39	22	49	9	3	46
Total Alkalinity as CaCO3 (mg/L)	1	20	5	39	22	49	9	3	46
Sulfate as SO4 - Turbidimetric (mg/L)	1	2	<1	<1	2	21	2	5	<1
Chloride (mg/L)	1	29	7	15	28	13	26	15	50
Calcium (mg/L)	1	1	<1	6	<1	2	<1	<1	1
Magnesium (mg/L)	1	5	<1	4	4	2	2	1	6
Sodium (mg/L)	1	16	5	10	17	34	16	11	38
Potassium (mg/L)	1	4	2	11	3	3	3	3	6
Aluminium (mg/L)	0.01	3.13	0.14	0.16	0.82	3.02	5.13	1.36	0.31
Antimony (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Analyte		Survey Sites							
		Drainage lines in headwaters of Pigeonhole Creek catchment		Drainage lines in tributaries of Tomahawk Creek catchment				Red Dog Dam	Southern farm dam
		A21	A22	A15	A17	A18	A20	A19	A16
Arsenic (mg/L)	0.001	0.001	<0.001	0.002	<0.001	0.001	<0.001	0.001	0.001
Beryllium (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	0.001	0.026	0.001	0.032	0.156	0.022	0.009	0.027	0.041
Bismuth (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/L)	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium (mg/L)	0.001	0.003	<0.001	<0.001	<0.001	0.002	0.004	0.001	<0.001
Copper (mg/L)	0.001	0.002	<0.001	0.002	0.002	0.002	0.002	0.001	0.004
Cobalt (mg/L)	0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.006
Nickel (mg/L)	0.001	0.001	<0.001	0.001	0.003	0.002	0.002	<0.001	0.005
Lead (mg/L)	0.001	0.002	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001
Zinc (mg/L)	0.005	0.016	<0.005	<0.005	0.009	<0.005	<0.005	0.007	<0.005
Lithium (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Manganese (mg/L)	0.001	0.019	0.004	0.076	0.406	0.004	0.018	0.007	0.462
Molybdenum (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (mg/L)	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Analyte		Survey Sites							
		Drainage lines in headwaters of Pigeonhole Creek catchment		Drainage lines in tributaries of Tomahawk Creek catchment				Red Dog Dam	Southern farm dam
		A21	A22	A15	A17	A18	A20	A19	A16
Strontium (mg/L)	0.001	0.022	0.004	0.074	0.015	0.029	0.010	0.008	0.020
Thallium (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Tin (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium (mg/L)	0.01	0.06	<0.01	<0.01	0.02	0.05	0.08	0.02	0.01
Uranium (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (mg/L)	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Boron (mg/L)	0.05	<0.05	<0.05	0.07	<0.05	0.17	<0.05	<0.05	0.08
Iron (mg/L)	0.05	2.70	0.36	0.39	1.22	1.47	2.75	0.55	0.53
Nitrite + Nitrate as N (mg/L)	0.01	0.02	<0.01	<0.01	0.11	0.51	<0.01	<0.01	<0.01
Total Kjeldahl Nitrogen as N (mg/L)	0.1	0.8	0.7	2.2	1.6	1.7	0.9	2.4	6.6
Total Nitrogen as N (mg/L)	0.1	0.8	0.7	2.2	1.7	2.2	0.9	2.4	6.6
Total Phosphorus as P (mg/L)	0.01	0.02	0.22	0.18	0.11	0.54	0.05	0.02	0.41
Total Anions (meq/L)	0.01	1.26	0.30	1.20	1.27	1.78	0.95	0.59	2.33
Total Cations (meq/L)	0.01	1.26	0.27	1.34	1.15	1.82	0.94	0.64	2.35
SOIL									

Analyte		Survey Sites							
		Drainage lines in headwaters of Pigeonhole Creek catchment		Drainage lines in tributaries of Tomahawk Creek catchment				Red Dog Dam	Southern farm dam
		A21	A22	A15	A17	A18	A20	A19	A16
Moisture Content (dried @ 103°C)		21.8	23.2	34.2	26.2	32.5	25.1	22.8	36.6
Aluminium (mg/kg)		490	860	4710	800	14200	780	820	4110
Antimony (mg/kg)		<5	<5	<5	<5	<5	<5	<5	<5
Cobalt (mg/kg)		<2	<2	4	4	13	<2	<2	13
Iron (mg/kg)		4370	10400	18400	7280	14400	6100	5210	16400
Manganese (mg/kg)		<5	<5	184	237	391	<5	5	1200
Selenium (mg/kg)		<5	<5	<5	<5	<5	<5	<5	<5
Silver (mg/kg)		<2	<2	<2	<2	<2	<2	<2	<2
Vanadium (mg/kg)		9	18	46	12	42	11	12	28
Arsenic (mg/kg)		<5	<5	<5	<5	<5	<5	<5	<5
Cadmium (mg/kg)		<1	<1	<1	<1	<1	<1	<1	<1
Chromium (mg/kg)		5	15	19	6	17	6	5	12
Copper (mg/kg)		<5	<5	12	<5	9	<5	<5	8
Lead (mg/kg)		<5	<5	10	<5	21	<5	<5	6
Nickel (mg/kg)		<2	<2	5	4	12	<2	<2	8
Zinc (mg/kg)		<5	<5	12	8	8	<5	<5	9

Appendix E

Stygofauna Sampling Results

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Hansen Bailey
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25 June 2014

ATTN: Craig Brown, Project Manager

Dear Craig,

Processing of groundwater samples and identification of stygofauna

Thank you for the opportunity to process your groundwater samples and identify any stygofauna.

We received 24 groundwater samples from Gemma Kenny, Northern Resource Consultants. On receipt of those samples, we added rose bengal stain to each to assist in the identification of fauna in the sample. The stain dyes organic material pink/red, making it easy to find against the white and brown of the aquifer sediments.

All 24 samples were processed by first sieving the sample through a 63-um mesh sieve. The sieve contents were placed into a petri dish and were examined progressively examined under a dissection microscope at >60 x magnification. The entire contents of each sample was processed. All animals found were in the samples were removed and preserved in 100% ethanol. Animals were identified using morphological characters to the lowest practical level, which for the taxa found, was Class or Order.

Animals were only found in two samples. Those samples were MB08 (Jar 2) and MB26. A list of taxa and counts is appended to this letter. Sample MB08 (Jar 2) contained a single specimen of a mite (Acarina). This specimen lacks pigment and obvious eye spots which is consistent with the expected morphology of obligate, groundwater adapted fauna, but such traits are common among mites, including those from surface/soil environments so it is uncertain whether this taxon represents an obligate groundwater species. A photo of the specimen is appended to this letter. The pink colour of the specimen in the image is a result of our addition of the Rose Bengal stain.

Sample MB26 contained two specimens of Springtail (Collembola). This insect taxon is often found associated with groundwater samples where it lives on the surface of water within bore holes or associated with soil and vegetation around the collection site. It is not an obligate groundwater taxon. A photo of the specimen is appended to this letter.

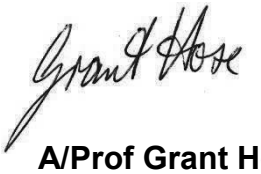
The pink colour of the specimen in the image is a result of our addition of the Rose Bengal stain.

The low frequency with which stygofauna were found in these samples is not unusual. Indeed, multiple sampling events are usually needed in order to have confidence of concluding the presence (or not) of stygofauna in an aquifer. As I have not been party to the sample collection and I am unaware of the sampling location or setting, I cannot comment further on these samples or the results obtained.

As part of quality assurance, samples MB06, MB08 (Jars 1 & 2), MB10 and MB21 (i.e. 20% of samples) were processed twice (second time by a different operator). No animals were recovered during the second processing.

Please contact me should you wish to discuss these details or require clarity on any information provided.

Yours sincerely



A/Prof Grant Hose

Appendix 1. Raw data

Northern Resource Consultants QLD Stygofauna				
Jun-14				
Sample	Collection date	Jar	Collembola	Acarina
MB03	2/04/2014	1	0	0
MB03	2/04/2014	2	0	0
MB06	1/04/2014	1	0	0
MB07	3/04/2014	1	0	0
MB07	3/04/2014	2	0	0
MB08	3/04/2014	1	0	0
MB08	3/04/2014	2	0	1
MB10	2/04/2014	1	0	0
MB10	2/04/2014	2	0	0
MB13	2/04/2014	1	0	0
MB13	2/04/2014	2	0	0
MB14	2/04/2014	1	0	0
MB14	2/04/2014	2	0	0
MB15	1/04/2014	1	0	0
MB15	1/04/2014	2	0	0
MB17	3/04/2014	1	0	0
MB17	3/04/2014	2	0	0
MB21	2/04/2014	1	0	0
MB22	2/04/2014	1	0	0
MB22	2/04/2014	2	0	0
MB24	1/04/2014	1	0	0
MB26	1/04/2014	1	2	0
MB28	1/04/2014	1	0	0
MB33	31/03/2014	1	0	0

Appendix 2. Images of specimens collected

Image 1. Mite (Acarina) - Dorsal view

Image 2. Springtail (Collembola) - Side view