Port Augusta Renewable Energy Park

Stage 2

Figure V3.06.13

Project Site Entry/ Exit Locations and Delivery Methodology

West Site Secondary Entry/Exit (North Only, Light Vehicles Only)

West Site Main Entry/Exit (North/South)

East Site Secondary Entry/Exit (North)

East Site Main Entry/Exit (North/South)

West Site Secondary Entry/Exit (North Only, Light Vehicles Only)

Stage 1 West Site Entry/Exit

Stage 1 West Site Main Exit

Stage 1 West Site Main Entry

N

0 0.75 1.5 3 km

The base mapping used herein was sourced from the South Australian 1:50000 Topographic Series. These maps were produced on Australian Geodetic Datums AGD66 and AGD84, now superseded by the Geodetic Datum of Australia GDA94. The maps have been reprojected into GDA94 according to the procedure recommended by the copyright owner, specifically the addition of 5 seconds to longitudes and the subtraction of 5 seconds from latitudes. Base map gridlines therefore do not represent standard GDA94 gridlines.

Legend

- East Site
- Stage 1
- West Site
- Consented
- Existing
- Proposed

Ver	Date	Drawn by	Checked	Approved
V1	08/12/2017	AM	LM	DB

Coordinate System
UTM Zone 53 Southern Hemisphere

Size
A3

Printed @ A3

Filename:
3_Fig_V3_06_13_TrffcMeth

Photography/Cadastral/Mapping Data supplied/copyright by Mapland Department of Environment, Water and Natural Resources

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Port Augusta Renewable Energy Park Stage 2

Development Application

Volume 4: Technical Appendices

December 2017

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Technical Appendices

Number	Title
3.1	Development Plan Assessment
5.1	Geotechnical Investigation
7.1.1	Flora and Fauna Survey
7.2.1	Archaeological Risk Assessment
7.2.2	Cultural Heritage Site Assessment (Stage 1)
7.3.1	Photomontages
7.4.1	Traffic Impact Assessment
7.4.2	Route Feasibility Assessment (Stage 1)
7.5.1	Hydrological Assessment
7.5.2	Hydrological Assessment (Stage 1)
7.5.3	Physical Description (Stage 1)
7.6.1	Solar Farm Aviation Impact Statement (Stage 1)
7.8.1	Environmental Noise Assessment
7.9.1	Telecommunications and EMI (Stage 1)

Appendix 3.1
Development Plan Assessment

Port Augusta Renewable Energy Park Stage 2

Development Application Volume 4: Technical Appendices

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URPS

DP Energy Australia Pty Ltd
17ADL-0166
15 December 2017

PORT AUGUSTA RENEWABLE ENERGY PARK

STAGE 2 DEVELOPMENT APPLICATION

Development Plan Assessment

Port Augusta Renewable Energy Park – Stage 2

Development Plan Assessment

15 December 2017

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Prepared for	DP Energy Australia
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Contents

1.0 Introduction and Background

DP Australia Pty Ltd (DPEA) proposes a second Stage to its Renewable Energy Park on the fringe of Port Augusta. This development application proposes a solar farm and associated infrastructure including battery storage and one or more synchronous condensers to provide stability to the network.

DPEA has prepared this development application for Stage 2 for submission under section 49 of the *Development Act 1993.*

URPS has been engaged by DPEA to undertake an assessment of the proposed development against the provisions of the Port Augusta Development Plan. This Development Plan assessment will be incorporated into DPEA's Development Application Report in order to have its findings considered by the relevant authority when assessing this development application.

In preparing this report, we have undertaken an inspection of the site and locality, reviewed the Development Application Report, and made further enquiries of DPEA and its sub-consultants. We have also:

- reviewed the provisions of the City of Port Augusta Development Plan (consolidated 7 July 2016), and
- considered the relevant legislation including the Development Act 1993, the Development Regulations 2008 and the Environment Protection (Noise) Policy 2007.

Following our review of all supporting documentation and our assessment against the relevant planning provisions we consider that the proposed development satisfies those provisions and therefore warrants Development Plan Consent.

2.0 Proposal

2.1 Project Summary

The proposed development comprises a solar farm consisting of up to 5,000,000 solar PV modules, 400MW of battery storage, up to 3000MW.s of synchronous condenser capacity and associated infrastructure including grid connection elements.

This development application seeks approval for a number of design and location options for the proposed infrastructure. This is required due to the nature of the proposal and the potential for a number of solutions to be suitable for the proposed development. These options will be refined and ultimately determined during the detailed design and procurement stages of the development. The same approach was applied for Stage 1 of the project.

Detail of the construction, operation and decommissioning methodologies is provided in the DPEA Project Description.

The proposed development is summarised in the following table with each component further described below:

Table 1 - Summary of Proposed Development

Component Group	Component	Design Options	Location Options
Power Generation	Solar arrays	Building envelope proposed	
Power Collection	Inverter/transformer stations (up to 500)	Final design not resolved – image of "typical skid mounted inverter/station" in PD	Final locations to be confirmed dependent on design solution
	Interconnector stations (up to 10)	Final design not resolved – image of "typical solar PV interconnector substation" in PD	Final locations to be confirmed dependent on design solution
Power Distribution	Sub/switching station	Final design not resolved – image of "typical substation/switchyard" in PD <u>Substation Envelope</u> 200m x 200m	1 – East site 2 – West site 3 – Both sites
	Battery storage	<u>Storage Type</u> 1 – Containerised battery module 2 – Cabinet based battery storage module 3 – building based system	1 – East site 2 – West site 3 – Both sites

		Storage Facility Envelope 200m x 200m x 20m	
	Synchronous condenser	System Type 1 – Outdoor based system 2 – Indoor based system Sync. Cond. Envelope 200m x 200m x 20m	1 – East site 2 – West site 3 – Both sites
	Network Connection	1 – underground 2 – aboveground	Dependent on location of other distribution equipment. 1 – directly into the 275kV lines traversing the site 2 – via the west site and stage 1 substation and utilising one of the consented stage 1 underground cables to Davenport substation 3 – via the west site and utilising a new overhead connection to Davenport substation 4 – via a new overhead route to Davenport substation
Associated/Ancillary Component	Access tracks	Dependent on final design	
	Site access		
	Site fencing		
	Water supply		
	Public viewing area		
	Site office		

2.2 Power Generation

2.2.1 Solar Arrays

The proposed solar arrays will comprise photovoltaic (PV) modules mounted on steel frames. The solar arrays will be mounted in a single-axis tracking configuration with the frames oriented in a north-south direction.

The PV module and the mounting and racking system is still to be selected. Therefore, the applicant seeks approval for a design envelope such that the PV modules will have a minimum height above ground level of 0.5 metres and a maximum height of 6 metres.

Solar PV farms at their most basic level are comprised of individual PV cells that are connected in a specific configuration to produce useful amounts of power as follows:

Table 2 Solar PV Power Production Hierarchy

Component	Dimension	Power (DC Approx.)
Single PV Cell	0.15 m^2	5 W
72 Cell Module	2 m^2	360 W
28 Module String	150 m^2	10 kW
282 String Array	4 ha	2.8 MW
25 Array Field	100 ha	70 MW

Each string of modules is connected by a PV string combiner which will comprise a small cabinet that is then connected to the inverter/transformer stations.

2.3 Power Collection

2.3.1 Inverter/Transformer Stations

Inverters are required to convert direct current (DC) to alternating current (AC). A series of inverter/transformer stations are required across the site and as outlined in Table 1 there could be up to 500 of these stations across the site connected each string combiner.

As **outlined in Table 1, the design** of the inverter/transformer stations is not yet fully resolved but could have a similar form to that identified in Figure 6.2 of the DPEA Project Description.

The location of the proposed inverter/transformer stations will be dependent on the technology chosen as this will influence the number of inverter/transformer stations required. In any event, the transformer/inverter stations will be sited amongst the solar arrays on the east site of the project.

2.3.2 Interconnector Stations

The inverter/transformer stations are connected to interconnector stations prior to the connection of the network to the sub/switching station. There will be up to 10 interconnector stations required across the east site with the design of the interconnector stations still to be resolved.

A typical interconnector station is illustrated in Plate 6.3 of the DPEA Project Description.

The location of the proposed interconnector stations will be dependent on the technology chosen as this will influence the number of interconnector stations required. In any event, the interconnector stations will be sited amongst the solar arrays on the east site of the project.

2.4 Power Distribution

2.4.1 Sub/Switching Station

The sub/switching station is the last component of the site infrastructure prior to the connection to the electricity grid.

The design of the sub/switching station is not yet fully resolved at this stage of the project. A design envelope has been selected comprising an area of approximately 200 metres by 200 metres.

The sub/switching yard could be sited in one of two or in both locations and will be sited with the proposed battery storage facility(s) and the proposed synchronous condenser facility(s). The two sites are at the western edge of the west site and the western edge of the east sites. As illustrated on development application figure V3.06.01, an area of 800 metres by 200 metres have been set aside for the battery storage, synchronous condenser and substation elements as well as an area for temporary construction (the temporary construction compound is discussed further below under the heading Associated/Ancillary Components).

2.4.2 Battery Storage

Energy storage is proposed with a capacity of up to 400 MW.

At this stage, there are a number of technologies that could be used for power storage and these would dictate the type of housing/building within which these are stored.

The design could comprise containerised battery modules, cabinet based modules or a building-based system with batteries within a building.

The energy storage is proposed within a defined building envelope of 200 metres (l) by 200 metres (w) by 20 metres (h).

The proposed energy storage area could be sited in one of two or in both locations and will be sited with the proposed sub/switching station(s) and the proposed synchronous condenser(s). The sites are at the western edge of the west site and the western edge of the east sites (as identified earlier).

2.4.3 Synchronous Condenser Facilities

One or more synchronous condensers are proposed to provide stability to the grid network. A synchronous condenser stores energy in the form of inertia and is able to absorb or deliver real and reactive power to the grid to maintain stability.

The choice of synchronous condenser technology is yet to be determined. It could comprise one or more machines to achieve the same result.

The synchronous condenser is proposed within a defined building envelope of 200 metres (l) by 200 metres (w) by 20 metres (h).

The proposed synchronous condenser could be sited in one of two or in both locations and will be sited with the proposed sub/switching station and the battery storage. The sites are at the western edge of the west site and the western edge of the east sites (as identified earlier).

2.4.4 Network Connection

Transmission lines between the sub/switching station and the electricity grid will comprise either underground or overhead lines. This will be dependent on the design and location of other distribution equipment.

It will most likely occur through one of the following:

1 directly into the 275kV lines traversing the site
2 via the west site and stage 1 substation and utilising one of the consented stage 1 underground cables to Davenport substation
3 via the west site and utilising a new overhead connection to Davenport substation
4 via a new overhead route to Davenport substation

2.5 Associated/Ancillary Components

2.5.1 Access Tracks

Access tracks will be required between strings/arrays of solar panels. These access tracks will be used for maintenance and construction vehicles. They may run around the perimeter of the site and/or between site infrastructure.

2.5.2 Site Access

Two access points are proposed to the eastern site. The first makes use of an existing access point from the Augusta Highway and the second from Spear Creek Road.

Three access points are proposed to the western site. Two make use of Stage 1 (approved solar and wind farm) access points; one located off Port Paterson Road, the other located off the Augusta Highway (south of the west site). The third (and intended main) access point makes use of the existing Sundrop Farms access to the Augusta Highway.

2.5.3 Site Fencing

Fencing is proposed around the perimeter of the east site. This will be nominally 2.4 metres high and likely constructed of mesh with appropriate barbed wire or similar on top.

2.5.4 Water Supply

Water will be delivered to the site by a new supply from the Morgan-Whyalla Pipeline. This will be used for:

- concrete dust suppression
- wheel washing
- concrete mixer wash down
- welfare facilities
- fire fighting

The final location of the abstraction point will be subject to detailed design and consultation with SA Water and Australian Rail Track Corporation following approval of this application.

2.5.5 Public Viewing Area

A viewing platform and visitor information facility is proposed. This will be located in an area used as a temporary site construction compound. The viewing area will likely be limited to a car parking area and

ground level area with information displays. Signage will be installed to discourage parking elsewhere along the Augusta Highway and direct drivers to the public viewing area.

2.5.6 Site Office

A site office is proposed to be part of the sub/switching station. Generic designs and layouts of this kind of facility are provided in DPEA Figure V3.06.09 in conjunction with the sub/switching station and control room details.

2.6 Environmental Management Plans and Ongoing Commitments

In addition to the physical components of the development application outlined above, the applicant has committed to the preparation and adoption of a number of environmental management plans. These are detailed in Chapter 8 of the DPEA Development Application.

These plans will ensure that the applicant meets its commitments made as part of this Development Application and ensure compliance with all relevant legislation.

3.0 Subject Land and Locality

3.1 Subject Land

The subject land comprises

- sections 726, 1191 and 1192 of Hundred Plan 330600 in Certificate of Title 6077/672
- sections 696, 697, 698, 699, 700 and 708 of Hundred Plan 330600 in Certificate of Title 6191/916
- allotment 1 of Deposited Plan 114916 and sections 693, 701 and 720 of Hundred Plan 330600 in Certificate of Title 6192/71, and
- allotment 2 in Deposited Plan 114916 in Certificate of Title 6192/72.

The subject land is bisected by the Augusta Highway creating a similarly sized east and west site.

3.1.1 West Site

The west site occupies the same land parcels as the Stage 1 Renewable Energy Park application. This land is bordered by the Augusta Highway to the east and Port Paterson Road to the west. The land is generally flat and clear of mature vegetation.

There is an existing dwelling located on one part of the subject land. This is on section 696 and the dwelling is referred to as H01 (Beneficiary) in other reports associated with this application. Section 696 is also the potential location of infrastructure associated with this development.

As part of the Stage 1 Renewable Energy Park, (already approved) the west site is proposed to also accommodate both wind turbines and solar arrays.

There are existing transmission lines on the west site.

3.1.2 East Site

The east site occupies land not forming part of the Stage 1 Renewable Energy Park application. The land is bordered by the Augusta Highway to the west (and the associated rail line and landholdings) and Spear Creek Road to the east (and, in part, north). It is also located directly to the south of the Stirling North Airfield.

The east site is also generally flat although it has a gentle slope down toward the west. There are some scattered trees on this site and low level vegetation. There some existing drainage channels that cross the site, some of which extend through to the Augusta Highway and others which naturally cease on the east site.

The site is also crossed by existing 275 kV transmission lines.

Image 1 Panoramic view of the east site from the north east along Speak Creek Road

Image 2 Panoramic view of the East Site from the intersection of Speak Creek Road and Catninga Road

3.2 Locality

The subject site lies to the south and south-east of Port Augusta and Stirling North where it will be some 3 kilometres from Stirling North and 9 kilometres from Port Augusta.

Given the relatively constrained visual impact of the proposed development, the locality of this proposal does not have the same extent as that defined for the Stage 1 Renewable Energy Park (which included tall wind turbines).

Generally in the lower lying areas to the north, west and south, the locality is considered somewhat smaller, extending approximately 1-2 kilometres from the perimeter of the subject land. Land within this locality is generally used for low intensity grazing.

The Sundrop Farms glasshouse facility is a notable element in this landscape. This development comprises approximately 20 hectares of glasshouses and a solar thermal farm consisting of a series of low level mirrors and a central solar tower of 115 metres in height.

The eastern edge of the locality extends toward the Flinders Ranges from where there are expansive views toward and across the Spencer Gulf. Land to the east at the lower edge of the Flinders Ranges is also typically put to pastoral use.

The hills and ridges to the east of the site varies in height with the escapement itself largely devoid of vegetation. Native vegetation is generally confined to the valleys and watercourses. There is little built

form development across the escarpment except for some scattered agricultural buildings and a small number of dwellings.

Image 3 View of the site and locality near the intersection of Spear Creek Road and Horrocks Pass Road

Image 4 View of the northern extent of the locality from Flinders Ranges Highway (note the Sundrop Farms tower and glasshouses near the centre of the image)

4.0 Procedural Considerations

4.1 Section 49 of the Development Act 1993.

The application will be assessed in accordance with section 49 of the Development Act 1993. Pursuant to section 49(2), the proposed development has been supported and sponsored by the Department of Premier and Cabinet for the purposes of the provision of the public infrastructure. The Department of Premier and Cabinet will lodge the application for approval with the State Planning Commission (SPC)

At the conclusion of the assessment process, the SPC will prepare a report to the Minister for Planning, who will then determine whether to approve or refuse the application.

4.2 Notification Requirements

Under section 49(7d) of the Act, where the cost of a development exceeds $4,000,000, the application is publicly notified with interested parties given at least 15 days to make written submission on the proposal. Any person who has made a written submission and has indicated they wish to be heard will be given an opportunity to appear before the State Commission Assessment Panel (SCAP) to be heard in support of their submission. All submissions must be given due consideration in the assessment of the application.

4.3 Referrals

Pursuant to sub-sections (4a) and 7(a) of section 49, the application will be referred to the City of Port Augusta (being the Council area the subject land is located within). The City of Port Augusta may respond on any matters within a two month timeframe. If no comment is made, it is presumed that the Council does not intend to comment on the application.

Other statutory referrals are prescribed within Schedule 8 of the *Development Regulations 2008*. In this case referrals may be required to:

- the Coast Protection Board pursuant to Schedule 8, Part 2, 1 as the proposed electricity distribution components and the export line will be constructed on land adjacent the Coastal Conservation Zone, and
- the Commissioner of Highways pursuant to Schedule 8, Part 2, 3, as the proposed development is adjacent an arterial road (Augusta Highway) and will alter an existing access/create a new access along this roads

4.4 Development Plan

The subject land is located within the Primary Industry Zone of the Port Augusta Development Plan (consolidated 7 July 2016).

The land is not located in any Policy Areas or Precincts, however, a small portion of the west site is located within the “Stirling North Flood Plain Area” as delineated within the Primary Industry Zone.

5.0 Development Plan Assessment

Having considered the application documentation prepared by DPEA and its consultants outlining and in support of the proposed development, we consider that the most relevant assessment considerations in this application are:

- land use and efficient energy generation
- visual appearance
- potential noise impact
- flora and fauna impact
- heritage impact
- transportation and access
- glare
- electromagnetic interference, and
- hydrological impacts.

5.1 Land Use and Energy Efficient Energy Generation

The subject land is located within the Primary Industry Zone of the Port Augusta Development Plan. The Primary Industry Zone generally seeks sustainable primary production activities and it is recognised that the zone covers a semi-arid landscape.

Solar farms are not an expressly envisaged form of development within the Zone.

They are not, however, expressly anticipated in any zone, yet that are a clearly contemplated land use in the Council Wide section of the Port Augusta Development Plan. We consider that the use of the land for a solar farm and with its associated infrastructure to be appropriate on the basis that the siting of renewable energy facilities should take place where they can maximise efficient generation and supply of electricity in accordance with the following provisions:

Council Wide Renewable Energy Facilities

Objective 120 **The development of renewable energy facilities, such as wind farms and ancillary development, in areas that provide opportunity to harvest natural resources for the efficient generation of electricity.**

Principle 392 **Renewable energy facilities, including wind farms and ancillary development, should be:**

(a) located in areas that maximize efficient generation and supply of electricity; and

(b) designed and sited so as not to impact on the safety of water or air transport and the operation of ports, airfields and designated landing strips.

(underlining added)

We consider the site suitable on the basis that:

- Port Augusta has an excellent solar resource with some of the highest solar yields in Australia adjacent the 275 kV transmission network

- the site is located within 2-4 kilometres of the Davenport Substation and which features multiple 132 kV/275 kV circuits (including which cross the subject site)
- only the west site is used for primary production purposes (stock grazing), and the Stage 1 development approval affects much of that site
- there is a low population density surrounding the subject site and the electricity distribution activities and therefore no detrimental impact to adjoining landowners
- there are no significant impacts to areas of native vegetation or heritage/conservation value, and
- the site has suitable access for construction without disruption to local traffic networks.

We also note that much of the supporting infrastructure associated with the proposed solar farm is contemplated within wind farms in the Primary Industry Zone.

5.2 Visual Appearance

The Development Plan's General Section includes a series of provisions under the heading of "Renewable Energy Facilities". Objective 121 is particularly relevant with respect to the proposed development and the management of the potential visual impact of the development:

Council Wide – Renewable Energy Facilities

Objective 121 **Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts on the natural environment and other land uses.**

In considering the nature of Objective 121, we note that the location, siting and design of the solar PV farm should "avoid or minimise" impacts on the natural environment and other land uses. While not explicit, we consider this includes the need to avoid or minimise the visual impact.

With respect to wind farms, it is acknowledged by the Development Plan that the scale of a wind farm means that a visual impact is unavoidable and therefore its visual impact should be "managed".

In respect of the proposed development the horizontal spread (and low vertical profile) of the development means that it is difficult, if not impossible, to "avoid" a visual impact. Council Wide Objective 121 must be read in the context that it address all impacts rather than just the visual impact.

We contend that, while the built form nature of a solar PV farm is substantially different to a wind farm there will always be a degree of visual impact. In our view, and considering the nature of the provisions quoted above, the visual impact of a solar PV farm is one which should be minimised rather than avoided.

It is also noted that the Development Plan contains some general provisions relating to the protection of views. For instance, Primary Industry Zone Principle 6 states that buildings should be limited to those associated with primary industry and that they should be setback from allotment boundaries to minimise the visual impact on the landscape as viewed from public roads.

We do not interpret this provision or other similar provisions at the Council Wide level so narrowly as to prevent development that is otherwise anticipated.

In considering the visual impact of the proposed development, we note that the biggest components are likely to be the sub/switching station, battery storage and the synchronous condenser which could

comprise large buildings in one or two locations as described within the proposal section of this report and as described by DPEA.

The visual impact of the proposed solar arrays and the associated infrastructure is considered to be sufficiently minimised and appropriate given:

- the nominated building envelopes for the associated infrastructure are located substantial distances from the nearest dwellings (in the order of 2.5 kilometres in the case of the west site and an even greater distance from the east site)
- the nominated building envelopes for the associated infrastructure are located at least 300 metres from the Augusta Highway (in the case of the east site) and up to 2.5 kilometres for the west site
- the nominated building envelopes for west site is located in relative close proximity to Port Paterson Road, a local road only that services only one dwelling that is a project beneficiary
- views from nearby dwellings are generally expansive in all directions and the location of, and distance to, the nominated building envelopes means that the viewshed from nearby dwellings would not be unreasonably compromised, and
- the solar arrays could have a maximum building height of 6 metres which, as identified on the photomontages, would not be so visually prominent from nearby residential areas or the Flinders Ranges so as to have a detrimental impact from these locations.

As part of our Stage 1 assessment, we considered the broader provisions in the Development Plan that seek more generally the minimisation of adverse impacts and that development should not impair the amenity of a locality and preserve areas of high scenic value. This included an assessment against provisions such as Objective 18 and 21 and their following commentary:

Objective 18 The amenity of localities not impaired by the appearance of land, buildings and objects.

In areas of high scenic value, electric supply and telecommunications structures should be so sited and designed to preserve the attractiveness of such areas.

Objective 21 The conservation, preservation and enhancement, of scenically attractive areas, including land adjoining water or scenic routes.

The landscape of the Flinders Ranges and the shores of Spencer Gulf are examples of areas of visual significance worthy of protection against unsightly development and mismanagement.

(underlining added)

Having reconsidered our earlier assessment we maintain that the proposed development will not have an unreasonable visual impact in the broader context of the Development Plan as:

- there are no tourist roads designated in the Development Plan
- the solar farm is neither inherently “urban” or “rural” in character/nature and it is very common for development of this nature to be located in rural/non-urban areas, and
- the subject site and the Primary Industry Zone is not identified as an area of “high scenic value” in the Development Plan, and
- it will be sited in relatively close proximity to other large scale infrastructure.

5.3 Potential Noise Impact

The applicant has engaged Sonus to prepare an Environmental Noise Assessment (ENA) for the project. The ENA has been undertaken against the relevant criteria of the *Environment Protection (Noise) Policy 2007* as applicable under the Environment Protection Act 1999 and referred to in Council Wide Principle 338 of the Port Augusta Development Plan.

The ENA considers the location of dwellings nearby the project (i.e. neighbours) and dwellings where those owners are beneficiaries of the project. The noise goal levels were determined to be:

- an average noise level (Leq,15min) of 52dB(A) during the day (7am to 10pm), and
- an average noise level (Leq,15min) of 45dB(A) during the night (10pm to 7am).

The ENA has been undertaken with noise sources including the solar inverters, interconnector substations, air-conditioning units for the battery storage, the synchronous condenser and the main substation.

The predicted noise level at all neighbours is less than 40dB(A), a level significantly below the noise goal levels. Noise at one project beneficiary dwelling may be up to 53dB(A), however mitigation measures suggested by Sonus in their report will enable the Project to achieve compliance with the Noise Policy.

The following provisions of the Port Augusta Development Plan are relevant with respect to the potential noise impact:

Council Wide

Principle 331 **Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following: …**

(b) noise; …

Principle 337 **Development should be sited, designed and constructed to minimise negative impacts of noise and to avoid unreasonable interference.**

Principle 338 **Development should be consistent with the relevant provisions in the current Environment Protection (Noise) Policy.**

(Underlining added)

Council Wide Principle 14 is also relevant and is effectively a duplicate of Council Wide Principle 331.

The *Environment Protection (Noise) Policy 2007* (as outlined in Principle 338), provides a quantitative standard that can be applied. In our view, it is appropriate to consider that if the Noise Policy is satisfied, then a proposed development will not detrimentally impact the amenity of a locality. This is because the noise goals are based on the nature of the locality.

Given the proposed development will be designed and sited so as to achieve compliance with the Noise Policy, we contend that the proposed development satisfies the provisions quoted above.

5.4 Flora and Fauna Impact

The applicant engaged EBS Ecology to undertake an ecological assessment of the Project.

The assessment by EBS Ecology found:

- that there were 3 vegetation associations across the site, with *Maireana pyramidata* (Black Bluebush) Low Open Shrubland covering some 99.6% of the subject land
- the vegetation condition varied from 0:1 (very poor) to 4:1 (poor)
- the desktop assessment did not highlight any potential for threatened mammal, reptile or amphibian species to occur in the project area, and therefore the fauna survey focussed on birds
- no threatened fauna during was found during the survey, but notes that the Elegant Parrot (*Neophema elegans*), which is state listed as Rare has been observed in the same vegetation associations across the site and are therefore likely to occur
- there are no flora species that are anticipated to be possibly impacted
- there are no migratory birds that are anticipated to be possibly impacted
- there are some birds that may be possible impacted as a result of a loss of habitat, although none of these species were recorded during the site surveys, and
- none of the bird species would be significantly impacted by the project.

EBS also proposed a series of recommendations including

- avoiding one vegetation association during construction
- utilising existing watering points where the environment is most degraded
- implementing a Construction Environmental Management Plan to avoid environmental and ecological damage during construction, and
- employing best practice environmental management measured during and following construction.

With respect to the relevant Development Plan provisions, we consider the following to be most relevant in the assessment of the impact on native vegetation and biodiversity:

Council Wide – Natural Resources

Objective 38 **Native flora, fauna and ecosystems protected, retained, conserved and restored.**

Principle 80 **Development should be undertaken with minimum impact on the natural environment, including air and water quality, land, soil, biodiversity, and scenically attractive areas.**

Principle 81 **Development should ensure that South Australia's natural assets, such as biodiversity, water and soil, are protected and enhanced.**

Principle 106 **Development should be designed and sited to minimise the loss and disturbance of native flora and fauna, including marine animals and plants, and their breeding grounds and habitats.**

(Underlining added)

As assessed by EBS, the proposed development will have a very limited environmental impact. This is principally due to the nature of the site and its previous land uses that have degraded significant areas of the subject site.

While the proposed development involves installing solar arrays over a significant portion of land, it will not significantly impact any rare, threatened or vulnerable bird species or indeed any other animal species.

An application for native vegetation clearance has been lodged by the applicant separate to this development application. This process will ensure that there is a significant environmental benefit which offsets the loss of native vegetation on the subject site.

On this basis it is contended that the proposed development will have minimal impact on native flora and fauna, and complies with the relevant provisions identified above.

5.5 Heritage Impact

The applicant engaged Integrated Heritage Services Pty Ltd (IHS) to undertake a preliminary archaeological risk assessment of the areas within the subject site in addition to the areas surveyed as part of the Stage 1 application by Australian Cultural Heritage Services (ACHM).

IHS found:

- the site of Stages 1 and 2 are the subject of three separate native title claims:
  - the Barngarla native title claim determined in June 2016 does intersect the Stage 2 project area and it was, therefore, considered unlikely that the Barngarla have traditional owner interests in the site of this application
  - the Kokatha were consulted in 2014 at which point it was identified that their area of interest did not extend to the area that is the subject of this application and it was, therefore, considered unlikely that the Kokatha have traditional owner interests in the site of this application. Additionally, the (2 August 2016) registration test decision for Kokatha No. 3 native title claim (including project site areas) has been rejected, and
  - the Nukunu claim intersects with the entirety off of the Stage 2 area.
- the archaeological inspection of the site of the proposed development found artefact scatters and eight isolated artefacts – these have been recorded, and
- no sites of European heritage were identified.

IHS has made a series of recommendations which are consistent with those as part of the Stage 1 development application.

The Port Augusta Development Plan contains an Objective and supporting Principles that relate to the conservation of heritage. Council Wide Objective 54 states that:

Objective 54 **The conservation of land, buildings and structures and their settings, which are of aesthetic, architectural, historical, cultural, archaeological, geological, palaeontological, technological or scientific significance.**

(underlining added)

The applicant is committed to ensuring that the development is sited such that it avoids impacting areas of aboriginal significance and understands its obligations under the *Aboriginal Heritage Act 1988.* Further surveys are to take place, including Traditional Owner participation, prior to the commencement of ground disturbing works.

On this basis, we consider that the proposed development appropriately satisfies the intent of the Port Augusta Development Plan Objective 54.

5.6 Transportation and Access

The potential transportation and traffic related impacts of the proposed development relate principally to its construction as it will generate little traffic during normal operation.

GTA prepared a Traffic Impact Assessment which assessed traffic and access during construction and operation. GTA concluded that:

Site Access

- *The locations of the proposed site access and egress points are considered appropriate, with good sight distance available in accordance with relevant design standards and guidelines.*
- *The access points will be constructed to accommodate the largest design vehicles expected to enter and exit the site.*
- *The primary east site access will be designed with a full channelised right turn treatment and a short auxiliary left turn treatment in accordance with the warrant assessment and anticipated traffic volumes.*
- *Any requirements from ARTC to cross rail infrastructure will need to be adhered to.*

Traffic Impact

- *When comparing the additional traffic volume generated by the site during the construction and operational Stages against current traffic volumes on the road network, it is not expected the site traffic will impact on the safety or function of the surrounding road network.*
- *There is sufficient capacity on the adjacent road network to accommodate the cumulative traffic generation of any potential future developments proposed within the vicinity of the site, whilst maintaining an appropriate level of service.*

In respect of the assessment of the potential traffic impact, the following provisions are considered relevant:

Port Augusta – Council Wide – Transportation

Objective 101 **A road network of a standard that enables safe and comfortable travel between major centres and gives access to popular resorts.**

Objective 103 **The free flow of traffic on roads by minimising interference from adjoining development.**

Principle 350 **Vehicular access points to and from each allotment and the layout of car parking spaces should provide for safe vehicular movement which will not detrimentally affect traffic safety and vehicular movement on adjoining streets, or the safety of pedestrians.**

Principle 351 **The number of vehicle crossings should be kept to a minimum and all development should have a solid immovable barrier along road boundaries to restrict access onto and off an allotment other than by way of approved crossovers.**

(underlining added)

We consider that the most relevant provisions relating to transport and access numbered above to be met and that the adjoining road network can accommodate the traffic generated in the construction of the project on the basis that:

- the proposed routes to the site are appropriate
- access to and exit from the site is considered safe
- car parking for staff and construction workers will be provided within the site construction compounds
- all roads leading to the site can safely accommodate the increase in traffic, and
- the preparation of the Traffic and Transportation Management Plan is prepared in accordance with that recommended by GTA Consultants.

5.7 Glare and Aviation

A glare assessment has been undertaken by DPEA. In the absence of any specific Civil Aviation Safety Authority guide, the assessment followed the recommendations of the United States Federal Aviation Authority and guidance issued by specialist consultancy "Pager Power".

The glare assessment has assessed the potential impact at the nearby airfields (including the adjoining Stirling North Authorised Landing Area (ALA), dwellings, roads and railways.

The assessment has determined that there would be a negligible glare impact. There would be no glare impact to road or rail users, rail operators or residents and there would be no glare impact during take-off and landing at either the Stirling North ALA or the Port Augusta Aerodrome. There may be some minor glare occurrences when flying over the solar farm, however, such glare would not present a safety risk to aviation.

On this basis, it is considered that the proposed development meets the following provision:

Council Wide – Interface between Land Uses

Principle 331 **Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following…**

(f) glare…

(underlining added)

DPEA has also confirmed that the Stage 1 Aviation Impact Assessment is otherwise applicable to this stage and that there will be no non-glare impacts on aviation stakeholders.

5.8 Electromagnetic Interference

DPEA has advised that solar inverters, battery storage inverters, synchronous condensers and transformers may cause interference to radio signals over relatively short distances i.e. within tens of metres. All infrastructure proposed to be installed will be compliant with the relevant electromagnetic emissions standards and therefore any impacts by this equipment are expected to be negligible.

In addition to the above, DPEA has advised that there will be no passive electromagnetic interference impacts on any other telecommunication networks.

On this basis, it is considered that the proposed development meets the following provision:

Council Wide - Interface between Land Uses

Principle 331 **Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following:…**

(d) electrical interference…

(underlining added)

5.9 Hydrological Impacts

The applicant engaged Southfront to undertake a hydrological assessment of the subject site. This is additional to its investigations as part of Stage 1.

The findings from the assessment is that:

- the Stage 2 area intersects 4 of the 8 watercourse catchments identified as draining from the western side of the southern Flinders Ranges through to the Stage 1 development area
- some of these watercourses may retain a channel form within the eastern portion of Stage 2, but tend to have a reduced channel form on the flatter portions of the site which could suggest some inundation on occasion
- there are no additional issues with respect to the catchments, watercourses and existing water infrastructure above those identified in the Stage 1 assessment
- some mitigation measures are required for the design and siting of the battery storage facility and the synchronous condenser such that they are located outside of land inundated in a 1 in 100 year flood event (potentially requiring floor levels elevated above the flood level), and
- the Stage 1 and 2 developments are not assessed to result in any specific surface water management impacts as a result of the development.

There are several Development Provisions at the Council Wide/General Section level relating to natural resource management. The following provisions are considered most relevant, however, it is noted that additional provisions are relevant to a lesser extent:

Council Wide – Natural Resources

Objective 32 **Protection of the quality and quantity of South Australia's surface waters, including inland, marine and estuarine and underground waters.**

Objective 33 **The ecologically sustainable use of natural resources including water resources, including marine waters, ground water, surface water and watercourses.**

Objective 36 **Development sited and designed to:**

(a) protect natural ecological systems;

(b) achieve the sustainable use of water;

(c) protect water quality, including receiving waters;

(d) reduce runoff and peak flows and prevent the risk of downstream flooding;

(e) minimise demand on reticulated water supplies;

(f) maximise the harvest and use of stormwater;

(g) protect stormwater from pollution sources.

Principle 80 **Development should be undertaken with minimum impact on the natural environment, including air and water quality, land, soil, biodiversity, and scenically attractive areas.**

Principle 82 **Development should not significantly obstruct or adversely affect sensitive ecological areas such as creeks, wetlands, estuaries and significant seagrass and mangrove communities.**

Principle 96 **Development should ensure watercourses and their beds, banks, wetlands and floodplains are not damaged or modified and are retained in their natural state, except where modification is required for essential access or maintenance purposes.**

(underlining added)

Like many other aspects of the proposed development, the potential impacts on watercourses are largely limited to the construction period.

Subject to the implementation commitments outlined Chapter 8 of Volume 2 of the Development Application, and the adherence to the recommendations of Southfront (as addressed in its Stage 1 and Stage 2 advice), we consider that the proposed development has been appropriately designed to minimise hydrological impacts within the site and the locality satisfying the provisions quoted above.

6.0 Summary and Conclusion

The proposed development comprises a solar farm and associated collection and distribution infrastructure, including battery storage and a synchronous condenser. The proposed development:

- is an appropriate land use within the Primary Industry Zone
- has an appropriate visual appearance given the location and size of that development in the context of the nearest adjoining dwellings and public roads
- will achieve the requirements of the *Environment Protection (Noise) Policy 2007* at all adjoining and nearby dwellings
- will achieve the requirements of the *Environment Protection (Noise) Policy 2007* at a project beneficiary dwelling with the implementation of appropriate mitigation measures
- will have minimal and acceptable impacts on native flora and fauna
- has been designed and will be further refined in to avoid areas of archaeological significance in consultation with Traditional Owners
- has safe and convenient access and will generate traffic volumes that are capable of being accommodated on the subject road network
- will not cause any detrimental impacts by way of glare to aviation activities, road or rail users or to any dwellings
- will not have any other operational impacts on any aviation stakeholders
- is designed to minimise the potential for electromagnetic interference, and
- is designed to minimise impact on the natural environment and the flow of water across the site.

In addition to the above, the applicant has committed to all recommendations of its external consultants and will prepare a range of management plans that outline its commitments and obligations. This will ensure that, during construction and on-going site management, that the proposed development achieves compliance with all relevant legislation and standards.

For all of the reasons outlined above, we consider the proposed development satisfies the relevant provisions of the Port Augusta Development Plan to warrant approval.

Appendix 5.1
Geotechnical Investigation

Port Augusta Renewable Energy Park Stage 2

Development Application Volume 4: Technical Appendices

December 2017

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21 April 2017

STAGE 1 GEOTECHNICAL INVESTIGATION

Renewable Energy Park, Port Augusta

Submitted to:
DP Energy
4 Marshall Road
LAKE BARRINE QLD 4884

Report Number. 1776468-001-R-Rev1

Distribution:

1 electronic copy - DP Energy
1 electronic copy - Golder Associates

REPORT

Golder Associates

EXECUTIVE SUMMARY

Background

Golder Associates Pty Ltd (Golder) was engaged by DP Energy to carry out a preliminary geotechnical investigation (Stage 1) for the proposed Port Augusta Renewable Energy Park (PAREP) located near Port Augusta in South Australia. The site covers an area of approximately 5400 ha, predominantly covered in salt bush and currently used for sheep and cattle grazing. The proposed development will consist of three solar farms, 67 wind turbines, one substation, access roads and associated infrastructure.

Objectives

The aim of the Stage 1 investigation was to carry out a "light" or preliminary geotechnical investigation that provided broad coverage of the site and provide information that could be used to develop a preliminary geological model for the site, preliminary geotechnical design parameters and footing types.

Scope of Works

The scope of works undertaken by Golder included the following:

- Five boreholes to approximately 5 m depth within solar array areas and six boreholes to approximately 12 m depth within wind turbine areas.
- Carrying out standard penetration tests (SPTs) at approximately 1.5 m intervals during advancement of the boreholes.
- Carrying out hand (or "pocket") penetrometer tests (PP tests) on samples of cohesive materials (i.e. clays and sandy clays) from the boreholes.
- Collecting soil samples for geotechnical laboratory testing (for the purpose of soil classification) and chemical testing (to assess the aggressivity of the soils to steel and concrete).

Summary of Findings

The subsurface materials encountered in the boreholes were in general agreement with published information and our previous experience in this area, and are summarised below:

- In the solar farm areas in the northern portion of the site, the subsurface conditions generally comprised orange brown clayey sand and sandy clay soils extending to 5 m bgl (limit of investigation).
- The subsurface conditions encountered in the deeper boreholes put down within the wind turbine areas on the west side of the Augusta Highway generally comprised interbedded orange brown sands and clays overlying mottled red-brown and grey clay extending to the maximum depth investigated (about 12 m bgl).
- The subsurface conditions encountered in the deeper boreholes put down within the wind turbine areas in the southeast quadrant of the site generally comprised interbedded sands, clays and gravels to the depth of investigation (about 12m bgl).

For wind turbines founded on mass gravity footings typically founded at a depth of at least 2 m bgl, it is likely that the turbine footings will be founded on either very stiff clay or medium dense silty/clayey sand, we recommend adopting a maximum allowable bearing pressure of 200 kPa under permanent and semi-permanent (dead or live) loads or 240 kPa under very short term loads (wind or earthquake).

For solar arrays if is likely that piled footings will be required, it is also possible that piled footings could be considered for wind turbine bases (the adoption of piled footings will largely be dependent on imposed loads). We recommend that all piles are designed in accordance with the Australian Standard for Piling – Design and installation (AS 2159 – 2009). AS 2159 – 2009 requires a pile to be proportioned such that the pile design geotechnical strength ($R_{d,g}$) is not less than the pile design action effect (E_d). The design geotechnical strength is calculated as the design ultimate geotechnical strength ($R_{d,ug}$) multiplied by a geotechnical strength reduction factor (ϕ_g).

Values of ultimate end bearing resistance and ultimate skin friction for design piles will vary according to the depth of pile and material type.

Table of Contents

TABLES

FIGURES

APPENDICES

FIGURES

1.0 INTRODUCTION

This report presents a summary of preliminary geotechnical investigations, Stage 1, undertaken between 27 and 31 March 2017 by Golder Associates Pty Ltd (Golder) for the proposed Port Augusta Renewable Energy Park (PAREP) located near Port Augusta, South Australia (the Site).

Golder's services were commissioned by DP Energy and were carried out in general accordance with the Stage 1 Investigation scope presented in our proposal (Golder Proposal No. P1776468-001-L-Rev1) dated 22 March 2017.

The following information was provided to us by DP Energy for the proposed development:

- GPS coordinates for proposed borehole locations – *'170323 Port Augusta REP_Additional boreholes.xlsx'*, received by email (Way/Arnott) on 23 March 2017.
- DP Energy Project Design Layout – '*Port Augusta Renewable Energy Park, Project Design Layout*', Figure V3.06.01, Ver. V1.1, dated 4 November 2015.
- Geotechnical Materials Search report – '*Geotechnical Materials Search, Port Augusta Renewable Energy Park, Port Augusta'*, prepared by FMG Engineering for DP Energy, job number S24887 – 236847, Rev. 2, dated 15 September 2015.

2.0 PROPOSED DEVELOPMENT AND INVESTIGATION OBJECTIVES

We understand, based on the provided plans and discussions, that the Renewable Energy Park will comprise the following:

- three solar farms;
- 67 wind turbines;
- one substation;
- access roads and associated site infrastructure; and
- PA2, an extension to the consented PA1 solar farms, featuring an east site solar farm with associated substation.

DP Energy requested a staged geotechnical investigation including a 'light' geotechnical investigation (Stage 1) followed by a 'full' geotechnical survey (Stage 2).

The objectives of the Stage 1 geotechnical investigation are to provide preliminary geotechnical information over a broad coverage of the site, including a preliminary geological model for the site and preliminary comment on geotechnical risks for the proposed development. We understand that the Stage 2 investigation will be carried out at a later date to further inform detailed design and construction of the proposed development.

3.0 FIELDWORK

Prior to carrying out the fieldwork, a site-specific Health, Safety and Environment Plan (HSEP) was prepared for the works and a review of available underground service plans for the site (via a Dial-Before-You-Dig (DBYD) search) was undertaken.

Fieldwork for this portion of the investigation was carried out between 27 and 31 March 2017, in the presence of a geotechnical engineer from Golder.

The fieldwork included the following scope of works:

- Advancing five boreholes to approximately 5 m depth within solar array areas and six boreholes to approximately 12 m depth near to selected wind turbines within wind turbine areas.

- Carrying out standard penetration tests (SPTs) at approximately 1.5 m intervals during advancement of the boreholes.
- Carrying out hand (or "pocket") penetrometer tests (PP tests) on samples of cohesive materials (i.e. clays and sandy clays) from the boreholes.
- Collecting soil samples for geotechnical laboratory testing (for the purpose of soil classification) and chemical testing (to assess the aggressivity of the soils to steel and concrete).

Proposed borehole locations were provided to us by DP Energy. The locations of some boreholes were adjusted on site for ease of access.

A summary of the boreholes carried out is presented in Table 1. A site plan showing the approximate investigation locations is included as Figure 1 (Borehole Location Plan). Table 2 presents a list of borehole locations that were adjusted on site to accessible locations with details of proposed versus actual locations.

Table 1: Summary of borehole investigation

Borehole ID	Approximate Termination Depth (m bgl)	General Location	Coordinates (UTM Zone 53, GDA 94)	
			Easting (m)	Northing (m)
BH100	5	Solar Farm 1	765914	6394284
BH101	5	Solar Farm 3	768901	6393538
BH102	12	Wind Turbine 12	768293	6391890
BH103	12	Wind Turbine 34 (southwest sector)	771147	6386263
BH104	12	West end of wind turbines 40 to 49 (1)	774358	6389835
BH105	12	Wind Turbine 53	776026	6389459
BH106	12	Wind Turbine 62	776719	6387330
BH107	12	Vicinity of wind turbines 63 to 67 (2)	777095	6386255
BH108	5	PA2 Substation	769490	6394466
BH109	5	PA2 Solar Farm 1 (3) (typical location north)	770301	6395486
BH110	5	PA2 Solar Farm 2 (3) (typical location south)	771207	6393192

Notes: (1) DPE proposed borehole location at wind turbine T42; borehole location moved to an accessible location for Stage 1
(2) DPE proposed borehole location at wind turbine T65; borehole location moved to an accessible location for Stage 1
(3) actual borehole location moved from proposed location to an accessible location for Stage 1.

Table 2: Actual borehole locations versus proposed locations

Borehole ID	General Location		Coordinates (UTM Zone 53, GDA 94)				Difference in Location
	Proposed	Actual	Proposed		Actual		
			Easting (m)	Northing (m)	Easting (m)	Northing (m)	
BH104	T42 (represent west end of wind turbines 40 to 49)	West end of wind turbines 40 to 49 (vicinity of T43)	773591	6389748	774358	6389835	770 m east-northeast of proposed location
BH107	T65	Vicinity of wind turbines 63 to 67 (closer to T64)	777439	6386200	777095	6386255	350 m west-northwest of proposed location
BH109	PA2 Solar Farm 1 (typical location north)		770088	6395726	770301	6395486	320 m southeast of proposed location
BH110	PA2 Solar Farm 2 (typical location south)		771051	6393091	771207	6393192	180 m northeast of proposed location

Boreholes were advanced by Drilling Solutions with a truck-mounted drilling rig (Investigator MK5/2) using hollow auger techniques.

The fieldwork was carried out in the presence of a geotechnical engineer from Golder, who located the boreholes, logged the materials encountered, recorded SPTs, and recovered samples for subsequent geotechnical and chemical laboratory testing and analysis. Investigation locations were recorded using a handheld GPS accurate to approximately ±5 m horizontally.

4.0 REGIONAL GEOLOGY

The Cultana 1:100,000 scale geological mapsheet[1] indicates that the general site area is underlain by the following quaternary aged geological formations:

- Q_{e1} – *'Sand sheets and sief dunes (red-brown FULHAM SAND and pale-yellow MOLINEAUX SAND equivalents)'*.
- Qpap – *'POORAKA FORMATION: Gravels, sands and clayey sands with clay lenses. Overlies lower Pleistocene HINDMARSH CLAY in many places'.*

The Australian Stratigraphic Units Database[2] further describes the sand sheets and sief dunes as:

> *'Orange siliceous aeolian sand' (Fulham Sand) and 'Unconsolidated locally mobile yellow-grey pale orange well-sorted medium to fine frosted quartz sand. Aeolian dunes' (Molineaux Sand);*

[1] Geological Survey of SA (2009). CULTANA Geological Mapsheet, 1:100,000 scale (sheet: Cultana 6432 / Port Augusta Si5304), Department of Primary Industry and Resources SA

[2] Australian Stratigraphic Units Database, http://dbforms.ga.gov.au/pls/www/geodx.strat_units.int, Accessed: 17 March 2017, Geoscience Australia, Australian Government

and the Pooraka Formation as:

> *'Unconsolidated red-brown poorly-sorted clayey sand, gravel, conglomerate, breccia; as colluvial sheet wash, alluvial fan and residual lag; forms extensive, coalesced, low-angle fans, high-angle talus cones and scree slopes'.*

The mapsheet indicates that most areas of the site are likely to be underlain by the Q_{e1} sand formation (i.e. west of the Augusta Highway, and the north portion of the site). However, the eastern portion of the site is likely to be underlain, at least in some areas, by Pooraka Formation, associated with slope wash and alluvial fan deposition from the mountain ranges immediately east of the site (i.e. the wind turbine areas nearer to Spear Creek/Wilmington Road and close to Horrocks Pass Road). These areas are also likely to be punctuated by eroded creeks and watercourses, preferential water pathways from the upslope areas.

5.0 RESULTS OF THE INVESTIGATION

5.1 General Site Description and Observations

The Site, covering an area of around 5400 ha, is located on both sides of the Augusta Highway approximately 6 km south of Port Augusta. The site is roughly bounded to the east by the Wilmington Road (also referred to as Spear Creek Road) and to the west by Port Paterson Road and the Spencer Gulf; it covers an area that extends from from about 1 km south of the existing Davenport Substation to about 2 km south of the Horrocks Pass Road.

The site encompasses areas of fenced off farm land that generally appears to be used for sheep and cattle grazing. Vegetation across the site includes saltbush (varying in size and density) and some trees. The site slopes downwards in a westerly direction from the mountain range to the Spencer Gulf although the topography of the site is relatively flat. Some incised creek channels were observed across areas of the site, extending from the east. Two sets of electrical transmission wires are aligned approximately northwest-to-southeast across the site extending from the Davenport Substation to the east side of the Augusta Highway. Where possible, access to investigation locations was obtained via existing access tracks across the paddocks.

Selected photographs taken during the fieldwork are provided below.

Figure A: Selected Site Photographs

5.2 Subsurface Conditions

5.2.1 General Commentary

Descriptions of the materials encountered in the boreholes are presented in the Report of Boreholes (Appendix A) with photographs of the material encountered. Our explanatory sheets on Terms and Abbreviations and the Method of Soil Classification used in preparing the Report of Boreholes are also included. Where consistencies or densities are stated in the Report of Boreholes, they have been estimated from SPTs, hand penetrometer testing, drilling resistance and visual-tactile assessments.

5.2.2 Solar Farm Areas in Northern Portion of the Site

The subsurface materials encountered in the boreholes put down within the solar farm areas in the northern portion of the site (i.e. BH100, BH101 and BH108 to BH110) generally comprised orange brown clayey sand and sandy clay soils extending to 5 m bgl. These materials can generally be summarised by the following geological units:

- Clayey/Silty Sand: fine to medium grained, orange brown with some pale brown/white mottling (inferred calcareous), medium dense to very dense; interbedded with
- Sandy Clay/ Clay: low plasticity, orange brown with some pale brown/white mottling (inferred calcareous), very stiff to hard consistency with some dry and friable materials.

One exception to this was a layer of sandy gravel encountered in BH109 from 3.0 m to 3.5 m bgl.

5.2.3 Wind Turbine Areas West of the Augusta Highway

The subsurface conditions encountered in the deeper boreholes put down within the wind turbine areas on the west side of the Augusta Highway (i.e. BH102 and BH103) generally comprised interbedded orange brown sands and clays extending to 4.25 m in BH102 and 7.3 m in BH103; overlying mottled red-brown and grey clay extending to the maximum depth investigated (about 12 m bgl). These materials can generally be summarised by the following geological units:

- Clayey Sand: fine to medium grained, orange brown with some pale brown/white mottling (inferred calcareous), medium dense to very dense; interbedded with
- Sandy/Silty Clay: low plasticity, orange brown with some pale brown/white mottling (inferred calcareous), stiff to hard consistency with some dry and friable materials; overlying
- Clay: medium to high plasticity, mottled red brown and grey, hard.

5.2.4 Wind Turbine Areas East of the Augusta Highway

The subsurface conditions encountered in the deeper boreholes put down within the wind turbine areas in the southeast quadrant of the site (i.e. BH104 to BH107) generally comprised interbedded sands, clays and gravels. These materials can generally be summarised by the following geological units:

- Silty/Clayey Sand: fine to medium grained, orange brown with some pale brown/white mottling (inferred calcareous), loose to very dense; interbedded with
- Sandy/Silty Clay and Clay: low plasticity, orange brown with some pale brown/white mottling (inferred calcareous), stiff to hard consistency, with some dry and friable materials; overlying
- Clayey/Sandy Gravel and Gravelly Clayey Sand: fine to coarse grained, grey gravel in orange brown sandy clay matrix, dense to very dense, with interbedded layers of sandy clay and clayey sand; overlying
- Sandy/Silty Clay, low plasticity, orange brown with some pale brown/white mottling, hard, with some dry and friable materials; interbedded with
- Silty/Clayey Sand: fine to medium grained, orange brown with some pale brown/white mottling (inferred calcareous), dense to very dense.

One exception to this was BH107 where two distinct gravelly layers were encountered from 2.75 m to 3.4 m bgl and from 9.1 m to 11.95 m bgl.

5.2.5 Groundwater

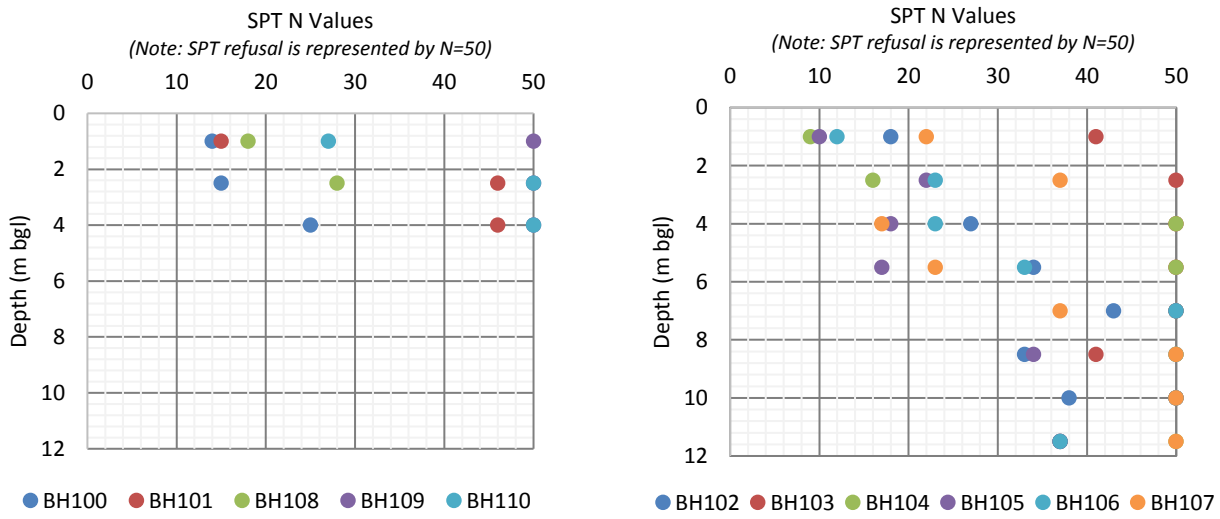
Groundwater was not encountered in any of the boreholes at the time of the investigation. However, groundwater levels can vary subject to seasonal and climatic variations; and the boreholes extended to a maximum depth of 5 m within the solar array areas and 11.95 m within the wind turbine areas.

5.3 Geotechnical Field Testing

5.3.1 Standard Penetration Testing

The Standard Penetration Test (SPT) involves dropping (free-fall) a 63.5 kg hammer a distance of 760 mm to strike an anvil assembly connected via drill rods to a 51 mm diameter split tube sampler; the sampler is driven into undisturbed stratum as part of advancing the borehole. The number of blows of the drop-hammer is recorded for each 150 mm interval of penetration over a maximum penetration of 450 mm; and SPT blow numbers greater than 30 per 150 mm interval or hammer bouncing is considered to be refusal.

A numerical result, 'N' value, is calculated based on the number of blows required to drive the last 300 mm of the 450 mm penetration (or part thereof, i.e. refusal). Summary graphs of the SPT 'N' values is presented below (Figure B), where SPT refusal is represented on the plot by N=50. SPTs undertaken during advancement of the boreholes resulted in 'N' values ranging between 9 and greater than 50.



(a) Boreholes within solar array areas

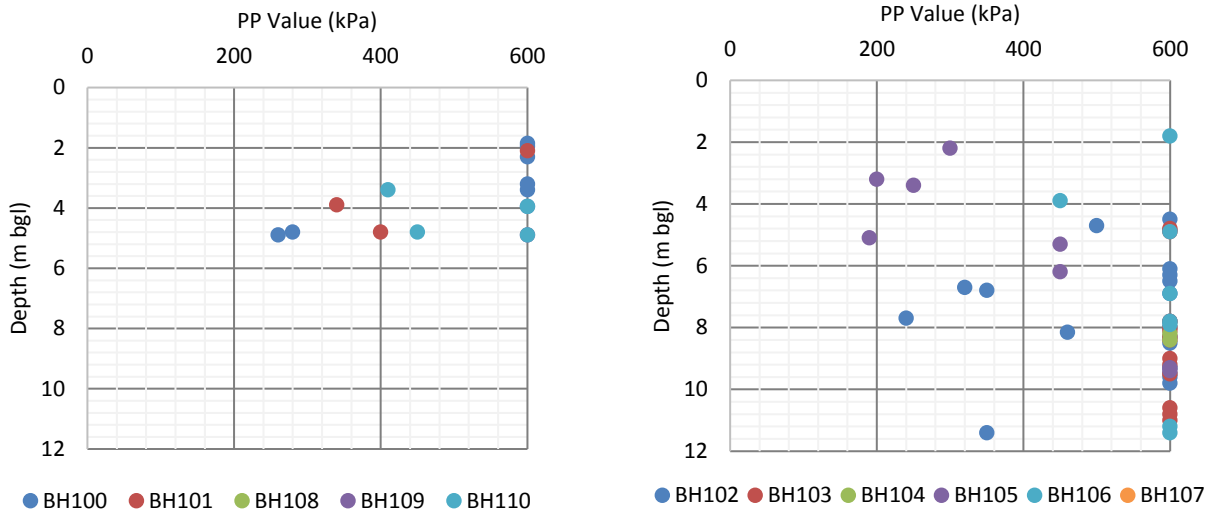
(b) Boreholes within wind turbine areas

Figure B: Summary of SPT Results

5.3.2 Hand Penetrometer Testing

Hand (or "pocket") penetrometer tests (PP tests) were carried out in the field on samples of cohesive materials (i.e. clays and sandy clays) from the boreholes. The results of hand penetrometer testing can be used to assess the undrained shear strength and consistency of the material.

The results of the PP tests are included on the borehole logs in Appendix A. The PP test readings ranged between 190 kPa (BH105, 5.1 m depth) and greater than 600 kPa, indicating that the fine grained cohesive materials encountered in these boreholes at the time of the investigation were generally of stiff to hard consistency. Some of the fine grained materials encountered were dry and somewhat friable, and the samples crumbled during PP testing; and other samples (also dry) were disturbed during the sampling process such that it was not possible to carry out a PP test on that material. Summary graphs of the PP values are presented below (Figure C).



(a) Boreholes within solar array areas

(b) Boreholes within wind turbine areas

Figure C: Summary of Pocket Penetrometer Readings

5.4 Laboratory Testing

5.4.1 Geotechnical Laboratory Testing

Samples collected from the boreholes were selected for geotechnical laboratory testing. Geotechnical laboratory testing was performed in Golder's National Association of Testing Authorities (NATA) accredited laboratory in Adelaide. A summary of the geotechnical laboratory testing carried out is presented below in Table 3.

Table 3: Summary of Geotechnical Laboratory Testing Undertaken

Laboratory Test	Number of Tests
Moisture Content (AS1289 2.1.1)	4
Consistency Limits* (AS1289 3.1.2, 3.2.1, 3.3.1, 3.4.1)	4
Particle Size Distribution (AS1289.3.6.1)	4

Note: * Consistency limits testing comprised determination of one point liquid limit, plastic limit, plasticity index and linear shrinkage.

A summary of the geotechnical laboratory test results is presented in Table 4. The laboratory test certificates are presented in Appendix B. References to the testing procedures adopted are also shown on the laboratory test reports.

Table 4: Results of geotechnical laboratory classification testing

Borehole ID	Sample Depth (m bgs)	USC Symbol	Soil Description	Moisture Content (%)	Particle Size Distribution (% passing)			Consistency Limits			
					19 mm	2.36 mm	0.075 mm	LL (%)	PL (%)	PI (%)	LS (%)
BH102	1.50 – 1.95	CI	Sandy Clay	8.9	100	100	52	35	13	22	9.0
BH104	6.70 – 7.00	CL	Gravelly Clay	6.1	100	67	55	28	16	12	6.0
BH105	3.00 – 3.50	CL	Clay	7.4	100	100	93	30	16	14	7.0
BH109	1.75 – 2.00	CL	Sandy Clay	7.3	100	99	60	29	12	17	7.5

Note: 'USC' = Unified Soil Classification; 'm bgs' = metres below ground surface; 'LL' = Liquid Limit; 'PL' = Plastic Limit; 'PI' = Plasticity Index; 'LS' = Linear Shrinkage

5.4.2 Chemical Laboratory Testing

Chemical laboratory testing was carried out on four samples recovered from the boreholes to provide a preliminary assessment of the exposure classification for steel and concrete in accordance with Australian Standard AS 2159 – 2009 *'Piling – Design and Installation'*.

The chemical laboratory testing was carried out at ALS NATA accredited laboratory in Melbourne and included pH, sulfate, chloride and electrical resistivity tests on each of the four samples. A summary of the results of chemical laboratory testing, for assessment of the durability requirements for concrete and steel components is presented in Table 5.

Table 5: Chemical laboratory test results for exposure classification

Borehole ID	Sample Depth (m bgl)	Material Type [soil conditions][(1)]	pH (pH unit)	Sulfate as SO_4^{2-} (mg/kg)	Chloride (mg/kg)	Resistivity (Ω.cm)	Exposure Classification	
							Concrete	Steel
BH100	2.50 – 2.95	Clayey Sand [B]	9.0	560	2,630	562	Non-aggressive	
BH103	7.50 – 8.00	Clay [B]	8.9	1,300	4,140	427	Non-aggressive	
BH105	8.25 – 8.70	Clayey Sand [B]	9.0	160	930	1,540	Non-aggressive	
BH108	2.20 – 2.60	Clayey Sand [B]	8.8	2,420	1,530	613	Non-aggressive	

Notes: (1) Soil conditions A – high permeability soils (e.g. sands and gravels) which are below the water table.
Soil conditions B – low permeability soils (e.g. silts and clays) or all soils above the water table (as per AS 2159, Table 6.2).
(2) Concentration of SO_4 is approximately equivalent to 80% of SO_3 concentration.
(3) Refer AS 2159, Table 6.3

6.0 GEOTECHNICAL ASSESSMENT

Comments and recommendations relating to geotechnical aspects of the development are presented in the following sections. The information provided herein is preliminary and based on information known to Golder at the time of preparing this report and will likely require to be refined as design develops and items such as site levels and loads on structures are taken into consideration. A more detailed investigation (i.e. Stage 2 investigation) should be carried out prior to detailed design and construction of the proposed development.

6.1 Expected Subsurface Conditions and Geotechnical Parameters

The tables below present geotechnical parameters for the various sub-surface materials encountered across the site. These were generally encountered as interbedded layers and reference should be made to the borehole logs provided in Appendix A for the vertical extents of the various units at borehole locations.

Table 6: Preliminary Geotechnical Design Parameters – Solar Farm Areas, Northern Portion of Site

Material	Depth range to top of layer (m bgl)	γ (kN/m^3)	s_u (kPa)	ϕ' (°)	E_u (MPa)	E' (MPa)	ν
Clayey/Silty Sand (medium to very dense)	0.0	18	-	35	-	30	0.3
Sandy Clay / Clay (very stiff to hard)	1.75 to 3.95	18	150	-	45	35	0.45

Note: – = neglect; γ = unit weight; s_u = undrained shear strength;
ϕ' = friction angle; E = Young's modulus; ν = Poisson's ratio

Boreholes were terminated at a maximum depth of 5 m bgl within the solar farm areas in the northern portion of the site, and therefore we have not provided parameters for the subsurface conditions below this depth.

Table 7: Geotechnical Design Parameters – Wind Turbine Areas, West of Augusta Highway

Material	Depth range to top of layer (m bgl)	γ (kN/m³)	s_u (kPa)	ϕ' (°)	E_u (MPa)	E' (MPa)	ν
Clayey Sand (medium to very dense), or	0.0	18	-	35	-	30	0.3
Sandy/Silty Clay (very stiff to hard)		18	150	-	45	35	0.45
Clay (hard)	4.25 to 7.30	18	200	-	60	45	0.45

Note: – = neglect; γ = unit weight; s_u = undrained shear strength; ϕ' = friction angle; E = Young's modulus; ν = Poisson's ratio

Table 8: Geotechnical Design Parameters – Wind Turbine Areas, East of Augusta Highway

Material	Depth range to top of layer (m bgl)	γ (kN/m³)	s_u (kPa)	ϕ' (°)	E_u (MPa)	E' (MPa)	ν
Silty/Clayey Sand (loose to medium dense), or	0.0	18	-	30	-	10	0.3
Sandy/Silty Clay or Clay (stiff)		18	75	-	22	17	0.45
Silty/Clayey Sand (dense to very dense), or	1.75 to 8.15	18	-	35	-	30	0.3
Sandy/Silty Clay or Clay (very stiff to hard), or		18	150	-	45	35	0.45
Clayey/Sandy Gravel and Gravelly Sand (dense to very dense)		19	-	35	-	50	0.3

Note: – = neglect; γ = unit weight; s_u = undrained shear strength; ϕ' = friction angle; E = Young's modulus; ν = Poisson's ratio

6.2 Site Classification

The soil profile is expected to shrink and swell with changes in the soil moisture regime. We have performed calculations to estimate the soil surface movement (y_s) on the site, using the methods described in AS2870 – 2011 '*Residential Slabs and Footings*'. The soil parameters used in the calculations were chosen on the basis of previous experience, the results of previous testing of similar soils and published data. The calculations indicate surface movements for the site of up to about 35 mm.

On the basis of the assessment, the site classification for the site in its existing condition is Class 'M-D' to AS2870 – 2011 *('moderately reactive clay or silt sites, which may experience moderate ground movement from [deep] moisture changes').*

We note that this site classification does not account for the effect of moisture change due to tree effects. We therefore recommend that all footings be located away from any trees by a distance equal to at least the height of the tree.

6.3 Shallow Footings

6.3.1 Wind Turbines

Based on our experience, shallow footings for wind turbines (i.e. mass gravity) are typically founded at a depth of at least 2 m bgl. Based on the boreholes advanced within the wind turbine areas (i.e. BH102 to BH107), it is likely that the turbine footings will be founded on either very stiff clay or medium dense silty/clayey sand.

On the basis of the above, for a turbine footing founded at a minimum depth of 2 m bgl on very stiff clay or medium dense silty/clayey sand, we recommend adopting a maximum allowable bearing pressure of 200 kPa under permanent and semi-permanent (dead or live) loads or 240 kPa under very short term loads (wind or earthquake). This recommendation for bearing pressure assumes that any loose, disturbed or softened materials will be stripped from the excavations prior to footing construction.

6.3.2 Miscellaneous Structures

Proposed development at the site includes a substation and will likely include other miscellaneous site structures (relatively lightly loaded) where shallow footings are likely to be considered appropriate. Based on the materials encountered in the boreholes, shallow footings for these types of structures, if founded at a minimum depth of 0.3 m below current ground surface, would likely be founded on loose to medium dense silty/clayey sand or stiff sandy clay.

On the basis of the above, for shallow footings founded at a minimum depth of 0.3 m bgl on loose to medium dense silty/clayey sand or stiff sandy clay, we recommend adopting a maximum allowable bearing pressure of 75 kPa for strip footings or pad footings of minimum width 0.5 m.

6.4 Piled Footings

6.4.1 General Commentary

Piled footings could be considered for the wind turbines and dependent on imposed loads, these could be adopted as an alternative to gravity footings. Piled footings are also likely to be the preferred option for solar arrays. We have provided parameters in the following sections for preliminary design of piled footings.

We recommend that all piles are designed in accordance with the Australian Standard for Piling – Design and installation (AS 2159 – 2009).

AS 2159 – 2009 requires a pile to be proportioned such that the pile design geotechnical strength ($R_{d,g}$) is not less than the pile design action effect (E_d). The design geotechnical strength is calculated as the design ultimate geotechnical strength ($R_{d,ug}$) multiplied by a geotechnical strength reduction factor (ϕ_g).

The value of the geotechnical strength reduction factor is influenced by the following factors:

- ϕ_{gb} – basic geotechnical strength reduction factor, which is in turn influenced by an assessment of various risk factors relating to the site, design methodology and the method of pile installation.
- ϕ_{tf} – intrinsic test factor based on the type of pile testing to be undertaken.
- K – the testing benefit factor which is dependent on the percentage of piles to be tested.

The assessment of individual risk ratings for risk factors as set out in Table 4.3.2 (A) of AS 2159 – 2009 will need to be undertaken by the designer of the piled footings. However, to assist in preliminary design of piled footings we have made an assessment of the average risk rating and recommend a geotechnical strength reduction factor of 0.4 for the site. It should be noted that this strength reduction is based on no pile testing being undertaken for the site. If pile testing is undertaken a higher strength reduction factor could be adopted.

The followings sections provide parameters to allow for preliminary design of piles.

6.4.2 Solar Farm Areas

Based on our experience of similar developments driven steel piles are typically adopted for solar panels. On the basis of the penetration resistance and subsurface materials encountered in the boreholes we consider that conventional pile driving methods using truck or tractor mounted jacking, hammering, or vibration would be suitable to install piles across the solar farm areas. Parameters for preliminary design of piled footings (by static methods) are provided in the table below. Design of driven piles could also be undertaken by dynamic formulae when details of pile types, sizes and driving equipment are known.

Table 9: Pile Design Parameters for Solar Farm Areas

Material Type	Depth Range to Top of Layer * (m bgl)	Average Ultimate Skin Friction, f_{ms} (kPa)	Ultimate End Bearing Resistance, f_b (kPa)
Clayey/Silty Sand (medium to very dense)	0.0	5	360
Sandy Clay / Clay (very stiff to hard)	1.75 to 3.95	90	360

* Note: Reports of boreholes in Appendix A should be referred to for the vertical extents of the various units.
For piles in uplift, skin friction should be reduced by a factor of 0.8

6.4.3 Wind Turbines

Preliminary pile design parameters have been provided according to ground conditions encountered in the wind turbine areas during the investigation, and have been summarised in Table 10 and Table 11 below for locations either side of the Augusta Highway. At this stage, information on the structures and loads are unknown, however, pile design parameters are provided for use in preliminary design of bored or driven piles. The values of end bearing resistance given assume that there are no weak strata below the pile toe and are based on a minimum pile length to diameter ratio of 5.

Table 10: Pile Design Parameters for Wind Turbines – West of Augusta Highway

Material Type	Depth Range to Top of Layer * (m bgl)	Average Ultimate Skin Friction, f_{ms} (kPa)	Ultimate end bearing resistance, f_b (kPa)
Clayey Sand (medium to very dense), or	0.0	15	1,250
Sandy/Silty Clay (very stiff to hard)		90	1,350
Clay (hard)	4.25 to 7.30	70	1,800

* Note: Reports of boreholes in Appendix A should be referred to for the vertical extents of the various units.
For piles in uplift, skin friction should be reduced by a factor of 0.8

Table 11: Pile Design Parameters for Wind Turbines – East of Augusta Highway

Unit	Depth Range to Top of Layer * (m bgl)	Average Ultimate Skin Friction, f_{ms} (kPa)	Ultimate end bearing resistance, f_b (kPa)
Silty/Clayey Sand (loose to medium dense), or Sandy/Silty Clay or Clay (stiff)	0.0	neglect	-
Silty/Clayey Sand (dense to very dense), or	1.75 to 8.15	15	1,250
Sandy/Silty Clay or Clay (very stiff to hard), or		90	1,350
Clayey/Sandy Gravel and Gravelly Sand (dense to very dense)		15	1,250

* Note: Reports of boreholes in Appendix A should be referred to for the vertical extents of the various units.
For piles in uplift, skin friction should be reduced by a factor of 0.8

6.5 Exposure Classification for Steel and Concrete

Soils that exhibit low pH values or high concentrations of sulfate and chloride have the capacity to affect durability of in-ground structures and services. Section 6 of AS 2159-2009 provides information on exposure classification for concrete and steel piles. On the basis of the pH values and sulfate/chloride concentrations obtained from the laboratory testing, exposure classifications for concrete and steel piles are provided below. These classifications have been based on the information contained in Table 6.4.2(C) and Table 6.5.2(C) of AS2159.

- **For concrete piles:** non-aggressive
- **For steel piles:** non-aggressive.

It should be noted that these exposure classifications have been based on Soil conditions B – low permeability soils (e.g. silts and clays) or all soils above the water table (as per AS 2159, Table 6.4.2(C) and Table 6.5.2(C)).

While groundwater was not encountered at the time of the investigation, we cannot rule out groundwater being encountered at any location across the site. Based on the information contained in Table 6.4.2(C) and Table 6.5.2(C), soils of Soil condition A (i.e. high permeability soils (e.g. sands and gravels) that are in groundwater), are generally more aggressive than soils of Soil condition B for the same exposure conditions.

6.6 Other Considerations

6.6.1 Site Preparation and Fill Placement

Site preparation in areas where structures are proposed and/or where engineered fill is to be placed (e.g. the substation location, hardstand areas, access tracks, etc.), should include:

- The removal of rubbish, surface vegetation and soils containing significant amounts of organics (i.e. greater than 5%).
- Following this the upper 200 mm of exposed natural soil should then be moisture conditioned and compacted to achieve a minimum dry density ratio of 95% relative to standard compaction (AS1289 5.1.1).
- Prior to placing fill a proof roll should be carried out using at least two passes of a vibratory roller of at least 12 tonne mass (static tonne). Any areas displaying signs of excessive deflection (i.e. soft zones) during proof rolling should be excavated and replaced with engineered fill compacted to achieve a minimum dry density ratio of 95% relative to standard compaction (AS 1289 5.1.1).

Where fill is required we recommend it is moisture conditioned and compacted to achieve a minimum dry density ratio of 95% compared with standard compaction (AS1289.5.1.1). It is recommended that earthworks, including subgrade preparation and bulk fill placement be supervised by suitably experienced geotechnical personnel, in accordance with AS 3798 *(Guidelines on Earthworks for Commercial and Residential Developments).*

Excavated natural clays and sands are considered suitable for re-use as engineered/structural fill, provided any deleterious or organic materials are removed, oversized particles (≥ 75 mm maximum particle size that do not break down during compaction) are excluded and materials are appropriately moisture-conditioned on placement.

Note that silt was encountered in some of the boreholes and these soils are not considered suitable for re-use as engineered or structural fill. Particular care should be taken to ensure sufficient drainage in excavations that may expose these silty materials, as they can be significantly weakened by the presence of water.

6.6.2 Material Excavatability

Soils encountered in the boreholes generally comprised interlayered sand and clay in the northern portion of the site and on the west side of the Augusta Highway, and interlayered sand, clay and gravel in the southeast quadrant. Drilling resistance was generally within the range of low to medium using a truck-mounted drill rig and hollow augers; however, higher resistance was encountered at some locations, generally on gravelly materials. According to these observations, it is expected that excavation of materials at the site will be achievable using conventional earthmoving equipment.

6.6.3 Excavation Stability

All excavations where personnel entry is required should be battered or fully supported to reduce the risk to personnel safety. For excavations required for construction of foundations or installation of services, temporary short-term excavations to a depth of 3 m that remain un-surcharged (i.e. no loads at or behind crest) may be profiled as per the following:

- Excavations in natural sands: maximum batter angle of 1V:3H.
- Excavations in natural clays: maximum batter angle of 1V:1H for short term, and 1V:2H for long term.

Batter stability should be confirmed by a geotechnical engineer at the time of excavation and prior to entry of personnel. No surcharge (including temporary stockpiling of construction materials or excavated material) should be placed within a set back from the crest of the excavation equal to at least the depth of the excavation. At these temporary slope gradients nominated above, some minor face slumping and movements behind the batter crests could occur.

In the presence of groundwater, it may be necessary to lessen batter gradients mentioned above, or fully support the excavation (e.g. with the use of shoring). Suitable methods for control of groundwater are expected to consist of grading excavations to sumps and large capacity pumps. Sizing of pumps would depend on the actual inflows, the dimensions of the excavation and groundwater levels at the time of construction.

6.6.4 Surface Water Management

Surface water management is expected to be critical at the site depending on the time of construction. Large rainfall events are known to have occurred in the area which may affect stability of excavations or soil strength. Care should be undertaken during construction to prevent water from ponding in the base of any open excavation. The ponding of water could result in softening of the soils, collapse and additional post construction settlement or reactive soil movements.

6.6.5 Site Trafficability

During the site investigation, the site was generally trafficable by a 4WD car and 4WD truck-mounted drill rig. However, access was more difficult at some locations due to the density and height of the vegetation present across the site (i.e. salt bush), areas of loose surficial sandy soils, fences, incised water courses and erosion and deterioration of existing access tracks. Furthermore, we note that investigations were undertaken during autumn and it is reasonable to expect that conditions could vary seasonally; large rainfall events are known to have occurred in the area and the incised water courses observed at some locations across the site are evidence of this. During, or subsequent to, periods of wet weather it is anticipated that the natural surface could become un-trafficable due to softening of the surficial soils and it would be prudent to allow for provision of access tracks and working platforms during the construction phase.

7.0 REQUIREMENTS FOR FURTHER INVESTIGATION

The investigation undertaken to date is preliminary in nature and provides broad coverage of the site and ground conditions. Further investigation will be required (referred to as Stage 2 in our proposal P1776468-001-L-Rev1 dated 22 March 2017). It is suggested that allowance is made for the following, the number of boreholes might require to be amended, depending on the size of solar farm, size of substation and number of turbines:

- Three boreholes per solar farm (to a maximum depth of 5 m or shallower refusal).
- Five boreholes within the proposed site of the substation.
- 61 boreholes within the proposed wind turbine areas to a maximum depth of 12 m or shallower refusal. This equates to one borehole per turbine location.
- Approximately 30 boreholes along the proposed access track alignments to a maximum depth of 2 m or shallower refusal.
- Electrical resistivity testing at the substation site (using the Wenner Array method).
- Geotechnical laboratory testing.
- Geotechnical reporting.

8.0 IMPORTANT INFORMATION

Your attention is drawn to the document – “Important Information” (LEG04, RL2), which is provided in Appendix D of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Report Signature Page

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FIGURES

Figure 1 – Investigation Location Plan
Figure 2 – Regional Geology

PORT PATERSON ROAD
AUGUSTA HIGHWAY
WOOLUNDUNGA ROAD
PORT PATERSON
CATNINGA ROAD
BH109
BH108
BH100
BH101
BH110
BH102
BOULLY ROAD
GADE ROAD
SPEAR CREEK ROAD
BH104
BH105
BH106
WINNINOWIE
BH103
HORROCKS PASS ROAD
BH107

LEGEND

- Borehole
- Cadastre

REFERENCE

IMAGERY & BASEMAP SOURCED FROM ESRI ONLINE BASEMAPS.
ROAD & PROPERTY (C) THE STATE OF SOUTH AUSTRALIA, DEPARTMENT OF PLANNING, TRANSPORT AND INFRASTRUCTURE, 2017.
LOCALITIES (C) STREETPRO, 2004.

DRAFT

KEY MAP

CLIENT
DP ENERGY

TITLE
BOREHOLE LOCATION PLAN

PROJECT
STAGE 1 GEOTECHNICAL INVESTIGATION
RENEWABLE ENERGY PLANT, PORT AUGUSTA

0 1,000 2,000 3,000
METRES

REFERENCE SCALE: 1:45,000 (at A3)
PROJECTION: GDA 1994 MGA Zone 53

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-06
PREPARED	AFE
DESIGN	-
REVIEW	AMH
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
1776468	001-R	A	1

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PORT PATERSON ROAD
AUGUSTA HIGHWAY
WOOLUNDUNGA ROAD
CATNINGA ROAD
PORT PATERSON
BH109
BH108
BH100
BH101
BH110
BH102
Qe1
Qpap
BOULLY ROAD
SPEAR CREEK ROAD
GADE ROAD
BH104
BH105
Qhck
Qhl1
WINNINOWIE
BH106
BH103
HORROCKS PASS ROAD
BH107

LEGEND

Borehole

Surface Geology

- Qe1
- Qhck
- Qhl1
- Qpap

REFERENCE

IMAGERY & BASEMAP SOURCED FROM ESRI ONLINE BASEMAPS.
ROAD & PROPERTY (C) THE STATE OF SOUTH AUSTRALIA, DEPARTMENT OF PLANNING, TRANSPORT AND INFRASTRUCTURE, 2017.
LOCALITIES (C) STREETPRO, 2004.
SURFACE GEOLOGY (C) THE STATE OF SOUTH AUSTRALIA, DEPARTMENT OF PRIMARY INDUSTRIES & REGIONS, 2008.

KEY MAP

CLIENT
DP ENERGY

TITLE
BOREHOLE LOCATIONS AND SURFACE GEOLOGY

PROJECT
STAGE 1 GEOTECHNICAL INVESTIGATION
RENEWABLE ENERGY PLANT, PORT AUGUSTA

0 1,000 2,000 3,000
METRES

REFERENCE SCALE: 1:45,000 (at A3)
PROJECTION: GDA 1994 MGA Zone 53

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-06
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REVIEW	AMH
APPROVED	####

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PROJECT No.	CONTROL	Rev.	FIGURE
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APPENDIX A

Reports of Boreholes and Core Photographs

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	JET	Jetting	EE	Existing Excavation
WB	Washbore or Bailer	NDD	Non-destructive digging	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration possible with little effort from the equipment used.

M **Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.

H **High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.

R **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

▽	Water level at date shown	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (s_v = peak value, s_r = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \text{Axial lengths of core} > 100 \text{ mm}}{\text{Length of core run}} \times 100$$

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS

 FILL

 GRAVEL (GP or GW)

 SAND (SP or SW)

 SILT (ML or MH)

 CLAY (CL, CI or CH)

 ORGANIC SOILS (OL or OH or Pt)

 COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

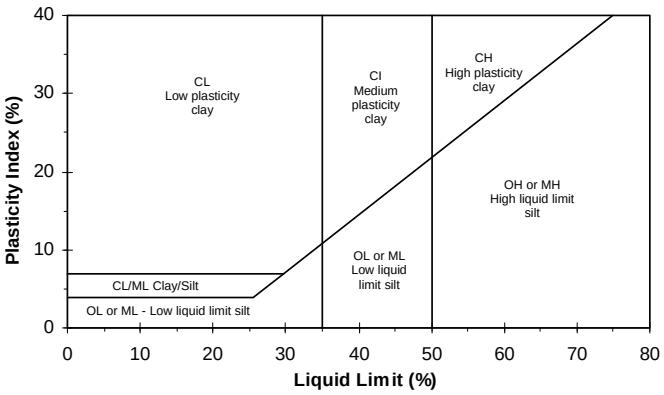
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

REPORT OF BOREHOLE: BH100

SHEET: 1 OF 1

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 765914 m E 6394284 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 5.00 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 30/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					SC	Clayey SAND orange brown, low plasticity clay	D	MD	Salt bush at surface
			1		SPT 1.00-1.45 m 4, 5, 9 N=14							
				1.75				CL	Silty CLAY low plasticity, pale brown and white			weakly cemented
ADH	L-M		2	1.90	PP 1.85 m >600 kPa BH100-G-1 DS 1.90-2.05 m PP 1.95 m >600 kPa			CI	CLAY low to medium plasticity, dark orange brown, mottled pale brown, with some fine to coarse grained sand	M (<<PL)	H	
				2.10					2.1-2.2 m, layer of Clayey SAND			
				2.20	BH100-G-2 DS 2.20-2.50 m PP 2.30 m >600 kPa							
				2.50				SC	Clayey SAND fine to coarse grained, dark orange brown, mottled pale brown, low plasticity clay	D - M	MD	
			3		BH100-G-3 DS 2.50-2.95 m SPT 2.50-2.95 m 5, 7, 8 N=15							
				3.15				CL	CLAY low plasticity, dark orange brown, with some fine to coarse grained sand			Interbedded layers of clay, with some sand, to clayey sand
					PP 3.20 m >600 kPa PP 3.40 m >600 kPa							
				3.65					3.65-3.90 m, layer of Clayey SAND			
				3.90						M (<PL)	VSt	
			4	4.00	PP 3.95 m >600 kPa SPT 4.00-4.45 m 9, 12, 13 N=25				4.00-4.25 m, layer of Clayey SAND			
				4.25								
				4.50					4.50-4.65 m, layer of Clayey SAND			
				4.65								
			5		BH100-G-4 DS 4.70-5.00 m PP 4.80 m =280 kPa PP 4.90 m =260 kPa					M (>PL)		
									END OF BOREHOLE @ 5.00 m GROUNDWATER NOT ENCOUNTERED			
			6									

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REPORT OF BOREHOLE: BH101

SHEET: 1 OF 1

CLIENT: DP Energy
DRILL RIG: Investigator MK5/2

PROJECT: Renewable Energy Park
COORDS: 768901 m E 6393538 m N MGA94 53
CONTRACTOR: Drilling Solutions

LOCATION: Port Augusta
INCLINATION: -90°
LOGGED: AMH DATE: 30/3/17

JOB NO: 1776468
HOLE DEPTH: 5.00 m
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					SM	Silty SAND fine to coarse grained, orange brown			
			1	1.10	SPT 1.00-1.45 m 4, 7, 8 N=15			SC	Clayey SAND fine to coarse grained, orange brown, mottled white, low plasticity clay		MD	weakly cemented from 1.9-2.2 m depth
			2		PP 2.10 m >600 kPa BH101-G-1 DS 2.25-2.45 m							piece of quartz-sandstone gravel (~ 50 mm size) at 2.1 m depth
ADH	M			2.45	SPT 2.50-2.95 m 12, 22, 24 N=46			CL	Sandy CLAY low plasticity, orange brown, mottled white, fine to coarse grained sand	D		calcareous layer from 3.4-3.5 m depth
			3	3.60								
				3.70					3.6-3.7 m, layer of Clayey SAND		H - Fb	
			4		PP 3.90 m =340 kPa SPT 4.00-4.45 m 20, 22, 24 N=46							calcareous layer, containing fine calcareous gravel at 3.9 m depth
					BH101-G-2 DS 4.50-4.80 m							
			5		PP 4.80 m =400 kPa							calcareous layer from 4.85-5.00 m depth
									END OF BOREHOLE @ 5.00 m GROUNDWATER NOT ENCOUNTERED			
			6									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF BOREHOLE: BH102

SHEET: 1 OF 2

CLIENT: DP Energy
DRILL RIG: Investigator MK5/2

PROJECT: Renewable Energy Park
COORDS: 768293 m E 6391890 m N MGA94 53
CONTRACTOR: Drilling Solutions

LOCATION: Port Augusta
INCLINATION: -90°
LOGGED: AMH DATE: 31/3/17

JOB NO: 1776468
HOLE DEPTH: 11.95 m
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					SC / CL	Clayey SAND / Sandy CLAY fine to medium grained, orange brown, low plasticity clay		MD	Saltbush at surface
				1.00								
ADH			1		SPT 1.00-1.45 m 4, 7, 11 N=18			SC	Clayey SAND fine to coarse grained, dark orange brown, low plasticity clay			
				1.30				CL	Sandy CLAY low plasticity, dark orange brown, some mottled white, fine to coarse grained sand		St - VSt	
				1.50	BH102-G-1 DS 1.50-1.95 m			SC	Clayey SAND fine to coarse grained, orange brown, some mottled pale brown/white, low plasticity clay			
				1.95								
			2		BH102-G-2 DS 2.00-2.50 m				trace fine grained, angular gravel	D		
	L-M			2.60	SPT 2.50-2.95 m 13, 28, 28 N=56				orange brown		D - VD	
			3		BH102-G-3 DS 3.55-3.95 m							
				3.95					3.95-4.00 m, Gravel layer, gravel is fine to coarse grained, sub-angular to sub-rounded, quartz-sandstone			
			4		SPT 4.00-4.45 m 8, 12, 15 N=27						MD	
				4.25				CH	CLAY high plasticity, red brown, mottled grey, trace fine to coarse grained sand			
	M				PP 4.50 m >600 kPa							
			5		BH102-G-4 DS 4.70-5.00 m PP 4.70 m =500 kPa PP 4.85 m >600 kPa					M (<PL)	H	
					SPT 5.50-5.95 m 8, 15, 19 N=34							
			6									

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REPORT OF BOREHOLE: BH102

SHEET: 2 OF 2

CLIENT: DP Energy
DRILL RIG: Investigator MK5/2

PROJECT: Renewable Energy Park
COORDS: 768293 m E 6391890 m N MGA94 53
CONTRACTOR: Drilling Solutions

LOCATION: Port Augusta
INCLINATION: -90°
LOGGED: AMH DATE: 31/3/17

JOB NO: 1776468
HOLE DEPTH: 11.95 m
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADH	M		6		PP 6.10 m >600 kPa			CH	CLAY high plasticity, red brown, mottled grey, trace fine to coarse grained sand			Water added to hole by driller during drilling process.
					PP 6.30 m >600 kPa							
				6.40					with some fine to coarse grained sand			
					PP 6.50 m >600 kPa							
				6.70								
					BH102-G-5 DS 6.70-6.85 m				6.70-6.85 m, layer of Clayey SAND			piece of quartz-sandstone gravel (~ 40 mm size) at 6.7 m depth
				6.85	PP 6.70 m =320 kPa PP 6.80 m =350 kPa				trace fine to coarse grained sand			
			7		PP 6.90 m >600 kPa SPT 7.00-7.45 m 10, 18, 25 N=43							
				7.50					7.50-7.75 m, layer of Sandy CLAY			
				7.75	PP 7.70 m =240 kPa				trace fine to coarse grained sand			
					PP 7.80 m >600 kPa							
			8	8.05	PP 8.00 m >600 kPa				8.05-8.15 m, layer of Sandy CLAY			
				8.15	PP 8.15 m =460 kPa BH102-G-6 DS 8.20-8.50 m				with some fine to coarse grained sand	M (<PL)		
					PP 8.30 m >600 kPa SPT 8.50-8.95 m 10, 13, 20 N=33 PP 8.50 m >600 kPa							
			9								H	
					PP 9.30 m >600 kPa							
					PP 9.50 m >600 kPa PP 9.60 m >600 kPa							
					PP 9.80 m >600 kPa							
			10		SPT 10.00-10.45 m 10, 18, 20 N=38							
				10.50					as above, CLAY, with some sand, to Sandy CLAY			Moisture condition and strength of material recovered from 10.5-11.95 m depth inferred to be affected by addition of too much water (i.e. recovered core has increased moisture and lower strength than in-situ material).
			11		BH102-G-7 DS 11.00-11.50 m					M (>PL)		
					PP 11.40 m =350 kPa SPT 11.50-11.95 m 9, 16, 21 N=37							
									END OF BOREHOLE @ 11.95 m GROUNDWATER NOT ENCOUNTERED			
			12									

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REPORT OF BOREHOLE: BH103

SHEET: 1 OF 2

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 771147 m E 6386263 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 29/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					CL	Silty CLAY low plasticity, dark brown to brown, with some fine grained sand		St	Borehole located between two earth bunds. Sparse salt bush at surface.
				1.00								
			1		SPT 1.00-1.45 m 8, 17, 24 N=41			SC	Clayey SAND fine to coarse grained, orange brown, low plasticity clay		D	
				1.80				CL	Sandy CLAY low plasticity, orange brown, some mottled pale brown, fine to coarse grained sand	D	H	
			2									
				2.60	SPT 2.50-2.75 m 24, 30/100mm HB N>30			SC	Clayey SAND fine to coarse grained, orange brown, some mottled pale brown/white, low plasticity clay		D - VD	
ADH	L-M		3									calcareous layer from 3.5-3.6 m depth
				3.85				CL	Sandy CLAY low plasticity, orange brown, mottled pale brown/white, fine to coarse grained sand, trace fine grained gravel		H	
			4		SPT 4.00-4.37 m 24, 36, 20/70mm HB N>56							
				4.37					No Recovery			
				4.50				CL	Sandy CLAY low plasticity, orange brown mottled pale brown/white, fine to coarse grained sand			
					PP 4.80 m >600 kPa PP 4.90 m >600 kPa							
	M		5									calcareous layer from 4.9-5.0 m depth
				5.30					orange brown	M (<<PL)	H	
					SPT 5.50-5.84 m 14, 24, 10/40mm HB N>34							
			6									

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REPORT OF BOREHOLE: BH103

SHEET: 2 OF 2

CLIENT: DP Energy
DRILL RIG: Investigator MK5/2

PROJECT: Renewable Energy Park
COORDS: 771147 m E 6386263 m N MGA94 53
CONTRACTOR: Drilling Solutions

LOCATION: Port Augusta
INCLINATION: -90°
LOGGED: AMH DATE: 29/3/17

JOB NO: 1776468
HOLE DEPTH: 11.95 m
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADH	M		6	6.05				SC	Clayey SAND fine to coarse grained, pale orange brown mottled white, low plasticity clay	D	D - VD	
				6.90				CL	Sandy CLAY low plasticity, orange brown mottled white, fine to coarse grained sand			
			7		SPT 7.00-7.36 m 13, 23, 24/60mm HB N>47							
				7.30				CI-CH	CLAY medium to high plasticity, red brown, some mottled grey, with some fine to coarse grained sand			
					BH103-G-1 DS 7.50-8.00 m							
					PP 7.80 m >600 kPa							
			8		PP 8.00 m >600 kPa							
				8.10	PP 8.10 m >600 kPa				trace fine to coarse grained sand			
					PP 8.30 m >600 kPa							
					PP 8.40 m >600 kPa							
					SPT 8.50-8.95 m 9, 15, 26 N=41							
			9		PP 9.00 m >600 kPa							
					PP 9.20 m >600 kPa							
					PP 9.50 m >600 kPa						H	
	H			9.70					with some fine to coarse grained sand	M (<PL)		
				9.95					9.95-10.00 m, pale grey and pale brown layer, with some fine to coarse grained gravel			
			10		SPT 10.00-10.45 m 15, 20, 30 N=50							
				10.50	BH103-G-2 DS 10.50-10.80 m PP 10.60 m >600 kPa			CH	CLAY high plasticity, orange brown mottled grey, trace fine to coarse grained sand			Water added to hole by driller during drilling process.
				10.90	PP 10.80 m >600 kPa				red brown, some mottled grey			
			11		PP 11.00 m >600 kPa							
					SPT 11.50-11.95 m 8, 15, 22 N=37							
									END OF BOREHOLE @ 11.95 m GROUNDWATER NOT ENCOUNTERED			
			12									

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REPORT OF BOREHOLE: BH104

SHEET: 1 OF 2

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 774358 m E 6389835 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 28/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					CL	Silty CLAY low plasticity, dark brown, with some fine grained sand			Saltbush at surface.
			1		SPT 1.00-1.45 m 2, 4, 5 N=9						St - Fb	
					BH104-G-1 DS 1.50-2.00 m							
			2	2.20						D		
	L-M			2.60	SPT 2.50-2.95 m 4, 6, 10 N=16			SC	Clayey SAND fine to medium grained, orange brown, low plasticity clay		L - MD	
ADH			3					CL / SC	Sandy CLAY / Clayey SAND low plasticity, orange brown, fine to medium grained sand		MD	
				3.55				SC	Clayey SAND fine to coarse grained, orange brown, mottled white, low plasticity clay, trace fine grained, angular, grey gravel			
			4	4.05	SPT 4.00-4.36 m 20, 21, 15/60mm HB N>36			GP	Sandy GRAVEL fine to medium grained, angular, grey and brown, with some low plasticity clay		D - VD	
	M			4.36					No Recovery			
				4.50				SC	Clayey SAND fine to coarse grained, orange brown mottled white, low plasticity clay, trace fine to coarse grained gravel	D	D - VD	
				4.70				GP	Sandy GRAVEL fine to medium grained, angular, grey and brown, fine to coarse grained sand			
			5	5.00				SC	No Recovery			
	M-H			5.40					Clayey SAND fine to medium grained, orange brown, low plasticity clay, trace fine grained, angular, grey gravel with some fine grained, angular, grey gravel	D	VD	
				5.85	SPT 5.50-5.85 m 18, 35, 15/50mm HB N>50							
			6	6.00					No Recovery			

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REPORT OF BOREHOLE: BH104

SHEET: 2 OF 2

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 774358 m E 6389835 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 28/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADH	M-H		6	6.40				SC	Clayey SAND fine to coarse grained, orange brown, low plasticity clay, with some fine to medium grained, sub-rounded to sub-angular, grey gravel	D	D - VD	
				6.50					6.4-6.5 m, layer of fine to coarse grained gravel			
				6.70	BH104-G-2 DS 6.70-7.00 m			GC	Clayey GRAVEL fine to coarse grained, sub-rounded, grey, low plasticity clay			Gravel in silty clay matrix
			7	7.25	SPT 7.00-7.25 m 28, 30/100mm HB N>30				No Recovery			
				7.50				GC	Clayey GRAVEL fine to coarse grained, sub-rounded, grey, low plasticity clay		VD	Poor recovery from 7.5-8.0 m
			8	8.15				CL	Sandy CLAY low plasticity, orange brown, fine to coarse grained sand			
				8.45	PP 8.20 m >600 kPa PP 8.40 m >600 kPa SPT 8.50-8.95 m 20, 25, 30 N=55				with some fine to medium grained, sub-angular and sub-rounded, grey and purple brown gravel no gravel	D	H	
			9	9.10				GC	Clayey GRAVEL fine to coarse grained, sub-rounded to sub-angular, grey, yellow and purple brown, low plasticity clay, with some fine to coarse grained sand		VD	
				9.70				CL	Sandy CLAY low plasticity, orange brown, fine to coarse grained sand, trace fine grained gravel		H	
			10	10.24	SPT 10.00-10.24 m 21, 30/90mm N>30				No Recovery			piece of coarse gravel at 10.1 m depth
				10.50				CL	Sandy CLAY low plasticity, orange brown mottled pale brown, fine to coarse grained sand, trace fine to medium grained gravel	D	H	
			11	11.63	SPT 11.50-11.63 m 40/130mm HB N=R				No Recovery END OF BOREHOLE @ 11.95 m GROUNDWATER NOT ENCOUNTERED			
			12									

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REPORT OF BOREHOLE: BH105

SHEET: 1 OF 2

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 776026 m E 6389459 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 29/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					CL	Sandy Silty CLAY low plasticity, dark brown to brown, fine to medium grained sand			Salt bush at surface
			1		SPT 1.00-1.45 m 3, 4, 6 N=10						St - Fb	
			2	2.10					dark brown to orange brown			
ADH	L-M				PP 2.20 m =300 kPa SPT 2.50-2.95 m 12, 11, 11 N=22							
			3		BH105-G-1 DS 3.00-3.50 m PP 3.20 m =200 kPa PP 3.40 m =250 kPa					D		
			4		SPT 4.00-4.45 m 6, 7, 11 N=18						VSt - Fb	
			5	5.20	PP 5.10 m =190 kPa PP 5.30 m =450 kPa SPT 5.50-5.95 m 8, 8, 9 N=17			CL	Silty CLAY low plasticity, dark brown to orange brown, with some fine grained sand			
			6									

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REPORT OF BOREHOLE: BH105

SHEET: 2 OF 2

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 776026 m E 6389459 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 29/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADH	L-M		6	6.40	PP 6.20 m =450 kPa			CL	Silty CLAY low plasticity, dark brown to orange brown, with some fine grained sand		VSt - Fb	
				6.50				GC	Clayey GRAVEL fine to coarse grained, sub-rounded, grey, pale brown and yellow, low plasticity, orange brown clay, with some fine to coarse grained sand		VD	
			7	7.35	SPT 7.00-7.35 m 15, 30, 20/50mm HB N>50			CL	CLAY low plasticity, orange brown and white, with some fine to medium grained sand, trace fine to medium grained gravel	D	H	
				7.50					No Recovery			
	M-H							GP	GRAVEL coarse grained, grey, with some low plasticity clay, with some fine to medium grained gravel	D		
			8	8.00					No Recovery			
				8.25				SC	Clayey SAND fine to coarse grained, orange brown to red brown, low plasticity clay, trace fine to medium grained, grey gravel			
				8.70	BH105-G-2 DS 8.25-8.70 m SPT 8.50-8.95 m 8, 12, 22 N=34			SC	Clayey SAND fine to coarse grained, red brown, low plasticity clay, with some fine to medium grained, sub-rounded and sub-angular, grey and pale brown gravel	D	D	
			9	9.25					trace gravel			
				9.50	PP 9.30 m >600 kPa PP 9.40 m >600 kPa			CI	CLAY medium plasticity, orange brown to red brown, with some fine to coarse grained sand, trace fine grained, sub-rounded gravel	M (<<PL)	H	
				9.85				SC	Clayey SAND fine to coarse grained, orange brown to red brown, some mottled pale brown, low plasticity clay, with some fine to medium grained, grey gravel			
			10	10.00	SPT 10.00-10.45 m 17, 24, 27 N=51				9.85-10 m, layer of Clayey GRAVEL			Gravel in sandy clay matrix
				10.85						D	D	
			11	11.00	BH105-G-3 DS 11.00-11.50 m				10.85-11.0 m, layer of Clayey GRAVEL trace fine to medium grained gravel			
					SPT 11.50-11.95 m 12, 18, 19 N=37				END OF BOREHOLE @ 11.95 m GROUNDWATER NOT ENCOUNTERED			
			12									

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GAP gINT FN. F01a
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REPORT OF BOREHOLE: BH106

SHEET: 1 OF 2

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 776719 m E 6387330 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 28/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					SM	Silty SAND fine to medium grained, orange brown		L - MD	Saltbush at surface
			1		SPT 1.00-1.45 m 5, 6, 6 N=12							
				1.75				CL	Silty CLAY low plasticity, dark brown to dark red brown, trace fine grained sand			
ADH	M		2	2.00	PP 1.80 m >600 kPa				with some fine grained sand, trace fine grained, angular, grey gravel	D	VSt - Fb	Small conical shell (~20 mm size) at 1.8 m depth
					BH106-G-1 DS 2.50-2.95 m SPT 2.50-2.95 m 5, 10, 13 N=23							
			3	3.80				CL	Sandy CLAY low plasticity, brown and pale brown, fine to coarse grained sand, trace fine grained, sub-rounded to angular gravel			
			4		PP 3.90 m =450 kPa SPT 4.00-4.45 m 9, 11, 12 N=23							
				4.50	BH106-G-2 DS 4.50-4.90 m				as above, CLAY, with some sand			
			5		PP 4.90 m >600 kPa							
				5.30				CL	CLAY low plasticity, brown, mottled pale brown and white, with some fine to medium grained sand		H - Fb	
					SPT 5.50-5.95 m 10, 14, 19 N=33							
				5.80					orange brown			
			6									

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REPORT OF BOREHOLE: BH106

SHEET: 2 OF 2

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 776719 m E 6387330 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 28/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADH	M		6	6.80				CL	CLAY low plasticity, brown, mottled pale brown and white, with some fine to medium grained sand		H - Fb	
					PP 6.90 m >600 kPa				orange brown and white, trace fine to medium grained, angular, grey gravel			
			7	7.15	SPT 7.00-7.23 m 18, 20/80mm HB N>20			GC	Clayey GRAVEL fine to coarse grained, sub-angular to angular, grey and purple brown, low plasticity, red brown clay, with some fine to coarse grained sand	D	D - VD	Gravel in sandy clay matrix, with some interbedded layers of clayey sand
	H				PP 7.80 m >600 kPa PP 7.90 m >600 kPa							
			8	8.00				SC	Clayey SAND fine to coarse grained, red brown, low plasticity clay, with some fine to coarse grained, sub-angular to angular gravel			
				8.40				GC	Clayey GRAVEL fine to coarse grained, sub-angular to angular, grey and purple brown, low plasticity, red brown clay, with some fine to coarse grained sand			
				8.71	SPT 8.50-8.71 m 15, 20/60mm HB N>20				No Recovery			
			9	9.00				SC	Clayey SAND fine to coarse grained, orange brown to brown, low plasticity clay, with some fine to coarse grained gravel	D	VD	
				9.50				GC	Clayey GRAVEL fine to coarse grained, sub-angular to angular, grey and purple brown, low plasticity, orange brown clay, with some fine to coarse grained sand			
				9.80					9.8-9.9 m, layer of Clayey SAND			
	M-H			9.90								
			10	10.17	SPT 10.00-10.17 m 23, 20/20mm HB N>20				No Recovery			
				10.50				SM	Silty SAND fine to medium grained, orange brown to brown		VD	
					BH106-G-3 DS 10.50-11.00 m							
			11	11.10				CL	Silty CLAY low plasticity, brown and pale brown, with some fine grained sand	D	H	
					PP 11.20 m >600 kPa PP 11.40 m >600 kPa SPT 11.50-11.95 m 10, 16, 21 N=37				END OF BOREHOLE @ 11.95 m GROUNDWATER NOT ENCOUNTERED			
			12									

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REPORT OF BOREHOLE: BH107

SHEET: 1 OF 2

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 777095 m E 6386255 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 28/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					SM	Silty SAND fine to medium grained, orange brown	D	L - MD	Salt bush at surface.
			1		BH107-G-1 DS 1.00-1.45 m SPT 1.00-1.45 m 6, 10, 12 N=22						MD	
			2	2.00				SC	Gravelly Clayey SAND fine to coarse grained, brown, low plasticity clay, fine to medium grained, sub-rounded to sub-angular gravel			
	M				SPT 2.50-2.95 m 14, 16, 19 N=35							
				2.75	BH107-G-2 DS 2.75-2.95 m			GC	Clayey Sandy GRAVEL fine to coarse grained, sub-angular, grey and brown, fine to coarse grained sand, low plasticity clay		D	
ADH			3	3.40				CL	Sandy Silty CLAY low plasticity, orange brown and brown, fine to coarse grained sand			
	L-M		4		SPT 4.00-4.45 m 4, 7, 10 N=17						VSt	
			5		BH107-G-3 DS 4.50-5.00 m							
	M				SPT 5.50-5.95 m 7, 13, 19 N=32						H	
			6									

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REPORT OF BOREHOLE: BH107

SHEET: 2 OF 2

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 777095 m E 6386255 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 28/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADH	M		6		BH107-G-4 DS 6.10-6.40 m			CL	Sandy Silty CLAY low plasticity, orange brown and brown, fine to coarse grained sand	D	H	
			7		SPT 7.00-7.45 m 8, 15, 22 N=37							
				7.85					orange brown, some mottled brown and white			
			8	8.10					orange brown to brown, trace fine grained, sub-angular, grey gravel			
					SPT 8.50-8.95 m 10, 32, 29 N=61							
			9	9.10	BH107-G-5 DS 9.10-9.40 m			GC	Clayey GRAVEL fine to coarse grained, sub-angular to angular, grey, brown and pale brown, with some fine to coarse grained sand		D - VD	Gravel in sandy clay matrix
			10		SPT 10.00-10.34 m 12, 30, 15/40mm HB N>45							
			11		SPT 11.50-11.74 m 20, 30/90mm N>30							
				11.74					No Recovery			
			12						END OF BOREHOLE @ 11.95 m GROUNDWATER NOT ENCOUNTERED			

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REPORT OF BOREHOLE: BH108

SHEET: 1 OF 1

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 769490 m E 6394466 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 5.00 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 30/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					SM	Silty SAND fine to coarse grained, orange brown		L - MD	Saltbush at surface
			1		SPT 1.00-1.45 m 4, 7, 11 N=18							
				1.25				SC	Clayey SAND fine to coarse grained, orange brown, mottled pale brown and white, low plasticity clay, trace fine to medium grained, sub-rounded gravel, gravel is quartz-sandstone			
			2	2.00					gravel is fine grained, sub-angular to sub-rounded		MD	
					BH108-G-1 DS 2.20-2.60 m					D		
					SPT 2.50-2.95 m 9, 12, 16 N=28							
ADH	L-M		3	2.75				CL	Sandy CLAY low plasticity, orange brown, fine to coarse grained sand		VSt - Fb	
				3.20				SC	Clayey SAND fine to coarse grained, orange brown and pale brown/white, low plasticity clay, trace fine grained gravel			
				3.50					orange brown			
				3.70					orange brown mottled white			
			4		SPT 4.00-4.45 m 14, 21, 33 N=54						H	weakly cemented, calcareous layer from 3.95-4.00 m depth
			5						END OF BOREHOLE @ 5.00 m GROUNDWATER NOT ENCOUNTERED			
			6									

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REPORT OF BOREHOLE: BH109

SHEET: 1 OF 1

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 770301 m E 6395486 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 5.00 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 30/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					SM	Silty SAND fine to medium grained, orange brown		MD	Saltbush at surface. Borehole positioned near to water course (dry at time of investigation).
			1	1.00	SPT 1.00-1.45 m 14, 21, 29 N=50			SC / CL	Clayey SAND fine to coarse grained, orange brown, low plasticity clay			Interbedded layers of clayey sand and sandy clay
				1.25					1.25-1.5 m, layer of Sandy CLAY			
				1.50								
				1.75	BH109-G-1 DS 1.75-2.00 m				1.75-2.0 m, layer of Sandy CLAY		D - MD	
			2	2.00								
				2.40					2.40-2.45m, gravel layer, coarse grained	D		
				2.77	SPT 2.50-2.77 m 15, 32/120mm N>32				No Recovery			
ADH	L-M		3	3.00				GP	Sandy GRAVEL fine to coarse grained, sub-rounded to sub-angular, grey, fine to coarse grained sand, with some low plasticity clay		D - VD	
				3.50					orange brown and grey brown			
				3.65	BH109-G-2 DS 3.50-3.65 m			SC	Clayey SAND fine to coarse grained, orange brown, low plasticity clay, with some fine to medium grained, sub-angular gravel			
				3.75				CL	Sandy CLAY low plasticity, orange brown, fine to coarse grained sand, trace fine to medium grained gravel		H	piece of coarse quartz-sandstone at 3.95 m depth
			4	4.70	SPT 4.00-4.42 m 16, 30, 30/120mm N>60				orange brown and white			
					PP 4.90 m >600 kPa							
			5						END OF BOREHOLE @ 5.00 m GROUNDWATER NOT ENCOUNTERED			
			6									

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GAP gINT FN. F01a
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REPORT OF BOREHOLE: BH110

SHEET: 1 OF 1

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 771207 m E 6393192 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 5.00 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 30/3/17
CHECKED: THH DATE: 4/4/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AS	L		0					SM	Silty SAND fine to medium grained, orange brown		L - MD	Saltbush at surface. Borehole positioned near to existing fence line.
			1		SPT 1.00-1.45 m 6, 11, 16 N=27							
				1.30				SC	Clayey SAND fine to medium grained, orange brown, low plasticity clay		MD - D	
				1.80					orange brown mottled white	D		
ADH	L-M		2									
					SPT 2.50-2.95 m 16, 28, 35 N=63						VD	
			3									
				3.35					3.35-3.5 m, layer of Sandy CLAY		Fb	
				3.50	PP 3.40 m =410 kPa						VD	
				3.95								
			4		PP 3.95 m >600 kPa SPT 4.00-4.27 m 19, 30/120mm HB N>30			CL	CLAY low to medium plasticity, orange brown some pale brown, with some fine to coarse grained sand		H	
				4.27					No Recovery			
				4.50				CL	Sandy CLAY low plasticity, orange brown, mottled pale brown and white, fine to coarse grained sand, trace fine grained, angular gravel	D	H	
					PP 4.80 m =450 kPa PP 4.90 m >600 kPa							
			5						END OF BOREHOLE @ 5.00 m GROUNDWATER NOT ENCOUNTERED			
			6									

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GAP gINT FN. F01a
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REPORT OF CORE PHOTOGRAPHS: BH100

		SHEET: 1 OF 1	
CLIENT: DP Energy		DRILL RIG: Investigator MK5/2	
PROJECT: Renewable Energy Park	COORDS: 765914 m E 6394284 m N MGA94 53	CONTRACTOR: Drilling Solutions	
LOCATION: Port Augusta	INCLINATION: -90°	LOGGED: AMH	DATE: 30/3/17
JOB NO: 1776468	HOLE DEPTH: 5.00 m	CHECKED: THH	DATE: 4/4/17

BH100, 00.00 m to 05.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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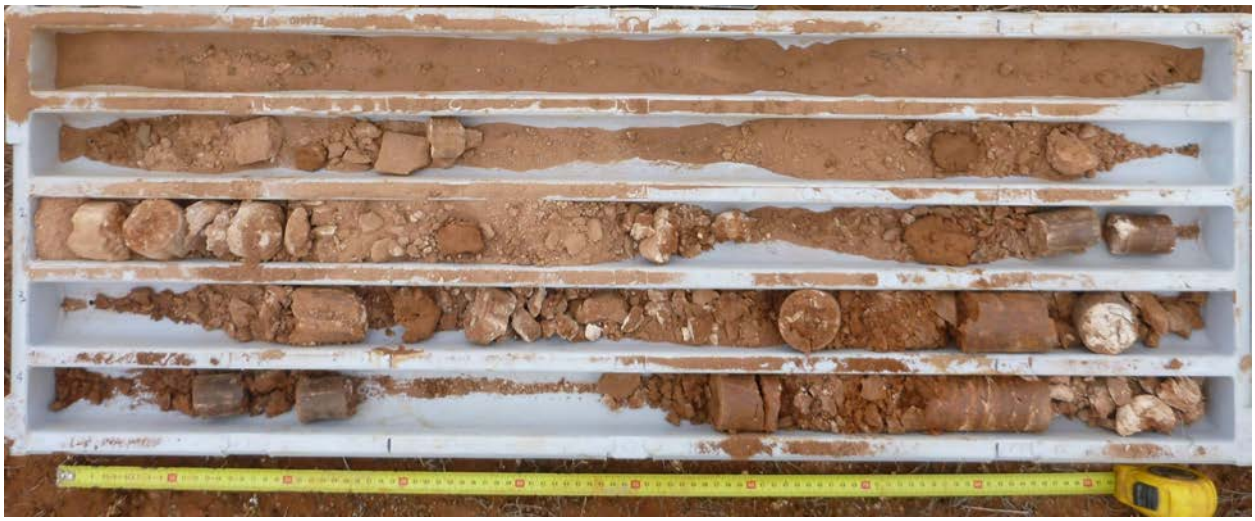
REPORT OF CORE PHOTOGRAPHS: BH101

CLIENT:	DP Energy		SHEET: 1 OF 1
PROJECT:	Renewable Energy Park	COORDS: 768901 m E 6393538 m N MGA94 53	DRILL RIG: Investigator MK5/2
LOCATION:	Port Augusta	INCLINATION: -90°	CONTRACTOR: Drilling Solutions
JOB NO:	1776468	HOLE DEPTH: 5.00 m	LOGGED: AMH DATE: 30/3/17
			CHECKED: THH DATE: 4/4/17



BH101, 00.00 m to 05.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH102

SHEET: 1 OF 2

CLIENT: DP Energy
DRILL RIG: Investigator MK5/2
PROJECT: Renewable Energy Park
COORDS: 768293 m E 6391890 m N MGA94 53
CONTRACTOR: Drilling Solutions
LOCATION: Port Augusta
INCLINATION: -90°
LOGGED: AMH DATE: 31/3/17
JOB NO: 1776468
HOLE DEPTH: 11.95 m
CHECKED: THH DATE: 4/4/17

BH102, 00.00 m to 05.00 m

BH102, 05.00 m to 10.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH102

SHEET: 2 OF 2

CLIENT:	DP Energy	DRILL RIG:	Investigator MK5/2
PROJECT:	Renewable Energy Park	CONTRACTOR:	Drilling Solutions
LOCATION:	Port Augusta	LOGGED: AMH	DATE: 31/3/17
JOB NO:	1776468	CHECKED: THH	DATE: 4/4/17
		COORDS: 768293 m E 6391890 m N MGA94 53	
		INCLINATION: -90°	
		HOLE DEPTH: 11.95 m	

BH102, 10.00 m to 11.95 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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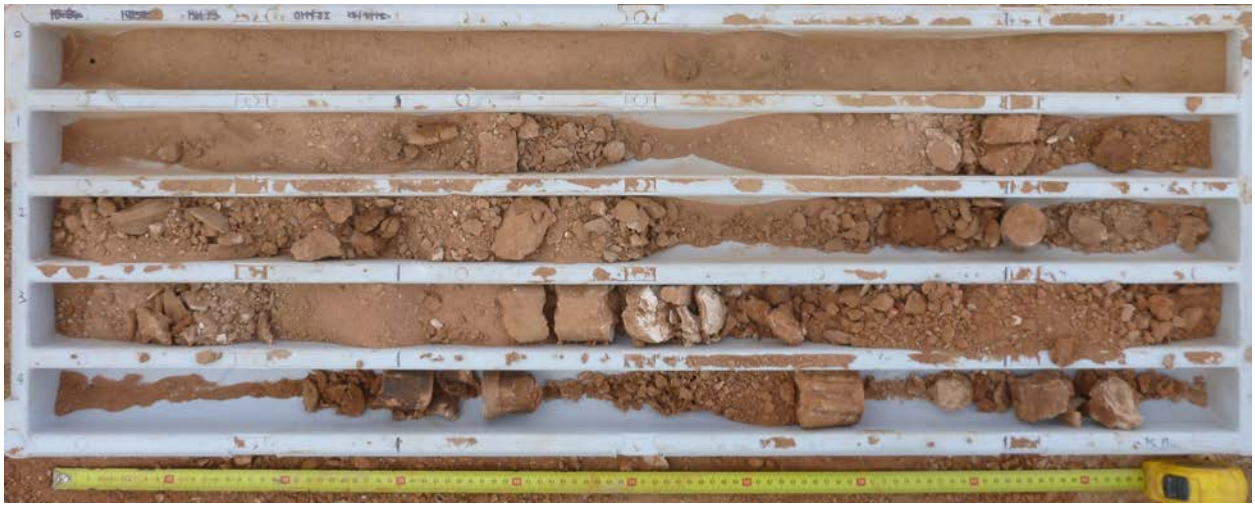
REPORT OF CORE PHOTOGRAPHS: BH103

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 771147 m E 6386263 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 29/3/17
CHECKED: THH DATE: 4/4/17



BH103, 00.00 m to 05.00 m

BH103, 05.00 m to 10.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH103

SHEET: 2 OF 2

CLIENT:	DP Energy	DRILL RIG:	Investigator MK5/2
PROJECT:	Renewable Energy Park	CONTRACTOR:	Drilling Solutions
LOCATION:	Port Augusta	LOGGED: AMH	DATE: 29/3/17
JOB NO:	1776468	CHECKED: THH	DATE: 4/4/17
		COORDS: 771147 m E 6386263 m N MGA94 53	
		INCLINATION: -90°	
		HOLE DEPTH: 11.95 m	

BH103, 10.00 m to 11.95 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH104

			SHEET: 1 OF 2
CLIENT:	DP Energy		DRILL RIG: Investigator MK5/2
PROJECT:	Renewable Energy Park	COORDS: 774358 m E 6389835 m N MGA94 53	CONTRACTOR: Drilling Solutions
LOCATION:	Port Augusta	INCLINATION: -90°	LOGGED: AMH DATE: 28/3/17
JOB NO:	1776468	HOLE DEPTH: 11.95 m	CHECKED: THH DATE: 4/4/17

BH104, 00.00 m to 05.00 m

BH104, 05.00 m to 10.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH104

SHEET: 2 OF 2

CLIENT:	DP Energy		DRILL RIG:	Investigator MK5/2	
PROJECT:	Renewable Energy Park	COORDS: 774358 m E 6389835 m N MGA94 53	CONTRACTOR:	Drilling Solutions	
LOCATION:	Port Augusta	INCLINATION: -90°	LOGGED:	AMH	DATE: 28/3/17
JOB NO:	1776468	HOLE DEPTH: 11.95 m	CHECKED:	THH	DATE: 4/4/17

BH104, 10.00 m to 11.95 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH105

CLIENT:	DP Energy		SHEET: 1 OF 2
PROJECT:	Renewable Energy Park	COORDS: 776026 m E 6389459 m N MGA94 53	DRILL RIG: Investigator MK5/2
LOCATION:	Port Augusta	INCLINATION: -90°	CONTRACTOR: Drilling Solutions
JOB NO:	1776468	HOLE DEPTH: 11.95 m	LOGGED: AMH DATE: 29/3/17
			CHECKED: THH DATE: 4/4/17

BH105, 00.00 m to 05.00 m

BH105, 05.00 m to 10.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH105

SHEET: 2 OF 2

CLIENT:	DP Energy	DRILL RIG:	Investigator MK5/2
PROJECT:	Renewable Energy Park	CONTRACTOR:	Drilling Solutions
LOCATION:	Port Augusta	LOGGED: AMH	DATE: 29/3/17
JOB NO:	1776468	CHECKED: THH	DATE: 4/4/17
		COORDS: 776026 m E 6389459 m N MGA94 53	
		INCLINATION: -90°	
		HOLE DEPTH: 11.95 m	

BH105, 10.00 m to 11.95 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH106

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 776719 m E 6387330 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 28/3/17
CHECKED: THH DATE: 4/4/17

BH106, 00.00 m to 05.00 m

BH106, 05.00 m to 10.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH106

CLIENT:	DP Energy		SHEET: 2 OF 2
PROJECT:	Renewable Energy Park	COORDS: 776719 m E 6387330 m N MGA94 53	DRILL RIG: Investigator MK5/2
LOCATION:	Port Augusta	INCLINATION: -90°	CONTRACTOR: Drilling Solutions
JOB NO:	1776468	HOLE DEPTH: 11.95 m	LOGGED: AMH DATE: 28/3/17
			CHECKED: THH DATE: 4/4/17

BH106, 10.00 m to 11.95 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH107

CLIENT: DP Energy
PROJECT: Renewable Energy Park
LOCATION: Port Augusta
JOB NO: 1776468

COORDS: 777095 m E 6386255 m N MGA94 53
INCLINATION: -90°
HOLE DEPTH: 11.95 m

DRILL RIG: Investigator MK5/2
CONTRACTOR: Drilling Solutions
LOGGED: AMH DATE: 28/3/17
CHECKED: THH DATE: 4/4/17

BH107, 00.00 m to 05.00 m

BH107, 05.00 m to 10.00 m

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REPORT OF CORE PHOTOGRAPHS: BH107

SHEET: 2 OF 2

CLIENT:	DP Energy	DRILL RIG:	Investigator MK5/2
PROJECT:	Renewable Energy Park	CONTRACTOR:	Drilling Solutions
LOCATION:	Port Augusta	COORDS:	777095 m E 6386255 m N MGA94 53
JOB NO:	1776468	INCLINATION:	-90°
		HOLE DEPTH:	11.95 m
		LOGGED:	AMH DATE: 28/3/17
		CHECKED:	THH DATE: 4/4/17

BH107, 10.00 m to 11.95 m

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REPORT OF CORE PHOTOGRAPHS: BH108

CLIENT:	DP Energy		SHEET: 1 OF 1
PROJECT:	Renewable Energy Park	COORDS: 769490 m E 6394466 m N MGA94 53	DRILL RIG: Investigator MK5/2
LOCATION:	Port Augusta	INCLINATION: -90°	CONTRACTOR: Drilling Solutions
JOB NO:	1776468	HOLE DEPTH: 5.00 m	LOGGED: AMH DATE: 30/3/17
			CHECKED: THH DATE: 4/4/17

BH108, 00.00 m to 05.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH109

		SHEET: 1 OF 1	
CLIENT: DP Energy		DRILL RIG: Investigator MK5/2	
PROJECT: Renewable Energy Park	COORDS: 770301 m E 6395486 m N MGA94 53	CONTRACTOR: Drilling Solutions	
LOCATION: Port Augusta	INCLINATION: -90°	LOGGED: AMH	DATE: 30/3/17
JOB NO: 1776468	HOLE DEPTH: 5.00 m	CHECKED: THH	DATE: 4/4/17

BH109, 00.00 m to 05.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF CORE PHOTOGRAPHS: BH110

		SHEET: 1 OF 1	
CLIENT: DP Energy		DRILL RIG: Investigator MK5/2	
PROJECT: Renewable Energy Park	COORDS: 771207 m E 6393192 m N MGA94 53	CONTRACTOR: Drilling Solutions	
LOCATION: Port Augusta	INCLINATION: -90°	LOGGED: AMH	DATE: 30/3/17
JOB NO: 1776468	HOLE DEPTH: 5.00 m	CHECKED: THH	DATE: 4/4/17

BH110, 00.00 m to 05.00 m

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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APPENDIX B

Geotechnical Laboratory Test Results

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS1726 Appendix A (Sec. A2)

Golder Associates Pty Ltd

ADELAIDE GEOTECHNICAL LABORATORY
118 Franklin Street,
Adelaide,
South Australia 5000

Test request #:	**TRA17-0098**	**Lab sample ID:**	LADL201704041
Client:	DP Energy		
Client address:			
Project ID:	**1776468**	**Lab report ref.:**	LADL_17008425
Project name:	Renewable Energy Park	**Exploratory Hole**	**BH102**
Location:		**Project reference:**	

Sample depth (m): 1.50 - 1.95

Client sample ref: BH102-G-1

Specimen description: (AS 1726 Appendix A, Section A2)

(Cl) Sandy CLAY, medium plasticity, brown, approximately 45% fine to medium grained sand

Sampling co-ordinates		Reduced Level
Easting (m)	Northing (m)	

PARTICLE SIZE DISTRIBUTION AS 1289.3.6.1

Sieve Size	Passing	LB S	UB S
125 mm	100%		
75 mm	100%		
63 mm	100%		
53 mm	100%		
37.5 mm	100%		
26.5 mm	100%		
19 mm	100%		
13.2 mm	100%		
9.5 mm	100%		
6.7 mm	100%		
4.75 mm	100%		
2.36 mm	100%		
1.18 mm	100%		
600 µm	100%		
425 µm	96%		
300 µm	90%		
150 µm	65%		
75 µm	52%		

Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1	
	Moisture content	**1 point Liquid limit**	**Plastic limit**	**Plasticity index**	**Linear shrinkage**	**Curling/ Crumbling/ Cracking**
Result:	8.9% As Rcvd.	35%	13%	22%	9.0%	Cracking / Curling
LB S:						-
UB S:						-

Preparation method:	Dry sieved	**LSM length (mm):**	250

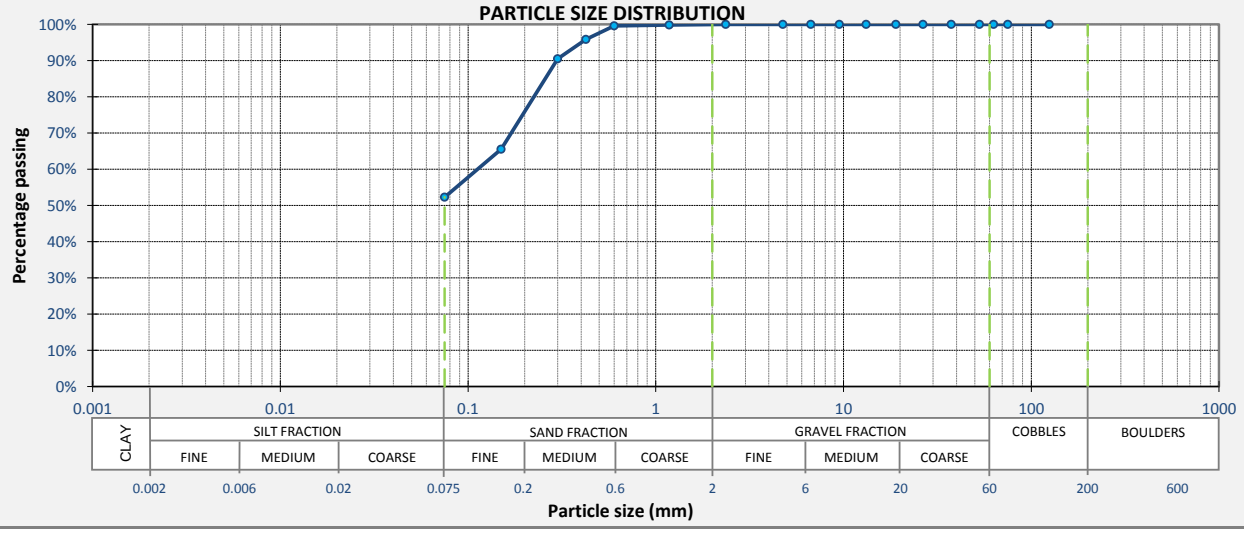
Specimen history/notes: Preparation of specimen and testing performed on sample supplied to the laboratory

Definitions:
LB S = Lower bound specification
LSM = Linear shrinkage mould
UB S = Upper bound specification
N/A = Not applicable
ND = Not determined; SIB = Slip in bowl
NO = Not obtainable; NP = Non plastic

GRADING SUMMARY

Fines (<75 µm)	Sand* (>75 µm - <2 mm)	Gravel* (>2 mm - <60 mm)	Cobbles* (>60mm - <200 mm)
52.3%	**47.7%**	**0.0%**	**0.0%**

* *Proportions based on linear interpolation between sieve of nearest size and smaller*



Testing performed by: DB **Results reviewed by:** DBergen **Date reported:** 7/04/2017

Cert. ref.: **1776468_BH102_TRA17-0098_PSD_1704041_Rep17008425**

Approved signatory:

NATA accreditation number: 1961 - Site:1954 - Adelaide
Accredited for compliance with ISO/IEC 17025

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

Daniel Bergen - Laboratory Technician

Phone: +61 (08) 8213 2100 **Fax:** +61 (08) 8213 2101 **E-mail:** adlgeolab@golder.com.au **Web:** www.golder.com.au

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS1726 Appendix A (Sec. A2)

Golder Associates Pty Ltd

ADELAIDE GEOTECHNICAL LABORATORY

118 Franklin Street,
Adelaide,
South Australia 5000

Test request #:	**TRA17-0098**	**Lab sample ID:**	LADL201704042
Client:	DP Energy		
Client address:			
Project ID:	**1776468**	**Lab report ref.:**	LADL_17008426
Project name:	Renewable Energy Park	**Exploratory Hole**	**BH104**
Sample depth (m):	6.70 - 7.00		
Client sample ref:	BH104-G-2		
Location:		**Project reference:**	

Specimen description: (AS 1726 Appendix A, Section A2)

(CL) Gravelly CLAY, low plasticity, grey brown, approximately 35% fine to medium gravel, trace fine to coarse grained sand

Sampling co-ordinates		Reduced Level
Easting (m)	**Northing (m)**	

PARTICLE SIZE DISTRIBUTION AS 1289.3.6.1

Sieve Size	Passing	LB S	UB S
125 mm	100%		
75 mm	100%		
63 mm	100%		
53 mm	100%		
37.5 mm	100%		
26.5 mm	100%		
19 mm	100%		
13.2 mm	83%		
9.5 mm	78%		
6.7 mm	73%		
4.75 mm	70%		
2.36 mm	67%		
1.18 mm	66%		
600 µm	65%		
425 µm	64%		
300 µm	63%		
150 µm	61%		
75 µm	55%		

Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1	
	Moisture content	**1 point Liquid limit**	**Plastic limit**	**Plasticity index**	**Linear shrinkage**	**Curling/ Crumbling/ Cracking**
Result:	6.1% As Rcvd.	28%	16%	12%	6.0%	Cracking / Curling
LB S:						-
UB S:						-
Preparation method:		Dry sieved		**LSM length (mm):**		250

Specimen history/notes: Preparation of specimen and testing performed on sample supplied to the laboratory

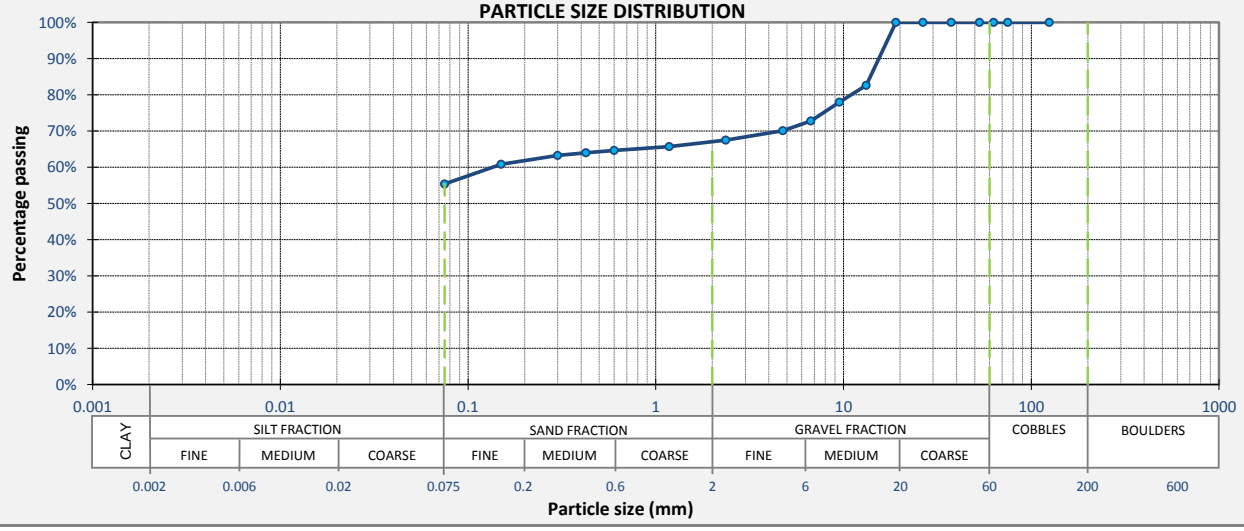
Definitions:
LB S = Lower bound specification
LSM = Linear shrinkage mould
UB S = Upper bound specification
N/A = Not applicable
ND = Not determined; SIB = Slip in bowl
NO = Not obtainable; NP = Non plastic

GRADING SUMMARY

Fines (<75 µm)	Sand* (>75 µm - <2 mm)	Gravel* (>2 mm - <60 mm)	Cobbles* (>60mm - <200 mm)
55.4%	**11.6%**	**33.1%**	**0.0%**

* *Proportions based on linear interpolation between sieve of nearest size and smaller*

PARTICLE SIZE DISTRIBUTION



Testing performed by: DB **Results reviewed by:** DBergen **Date reported:** 7/04/2017

Cert. ref.:	**1776468_BH104_TRA17-0098_PSD_1704042_Rep17008426**	**Approved signatory:**
NATA	**NATA accreditation number: 1961 - Site:1954 - Adelaide** Accredited for compliance with ISO/IEC 17025	DBergen
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	**Daniel Bergen - Laboratory Technician**

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS1726 Appendix A (Sec. A2)

Golder Associates Pty Ltd

ADELAIDE GEOTECHNICAL LABORATORY

118 Franklin Street,
Adelaide,
South Australia 5000

Test request #:	**TRA17-0098**	**Lab sample ID:**	LADL201704043
Client:	DP Energy		
Client address:			
Project ID:	**1776468**	**Lab report ref.:**	LADL_17008427
Project name:	Renewable Energy Park	**Exploratory Hole**	**BH105**
Sample depth (m):	3.00 - 3.50		
Client sample ref:	BH105-G-1		
Location:		**Project reference:**	

Specimen description: (AS 1726 Appendix A, Section A2) — (CL) CLAY,low plasticity, brown, trace fine grained sand

Sampling co-ordinates: Easting (m) | Northing (m) — **Reduced Level**

PARTICLE SIZE DISTRIBUTION AS 1289.3.6.1

Sieve Size	Passing	LB S	UB S
125 mm	100%		
75 mm	100%		
63 mm	100%		
53 mm	100%		
37.5 mm	100%		
26.5 mm	100%		
19 mm	100%		
13.2 mm	100%		
9.5 mm	100%		
6.7 mm	100%		
4.75 mm	100%		
2.36 mm	100%		
1.18 mm	100%		
600 µm	100%		
425 µm	100%		
300 µm	100%		
150 µm	99%		
75 µm	93%		

Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1	
	Moisture content	**1 point Liquid limit**	**Plastic limit**	**Plasticity index**	**Linear shrinkage**	**Curling/ Crumbling/ Cracking**
Result:	7.4% As Rcvd.	30%	16%	14%	7.0%	Curling
LB S:						-
UB S:						-
Preparation method:		Dry sieved		**LSM length (mm):**		250

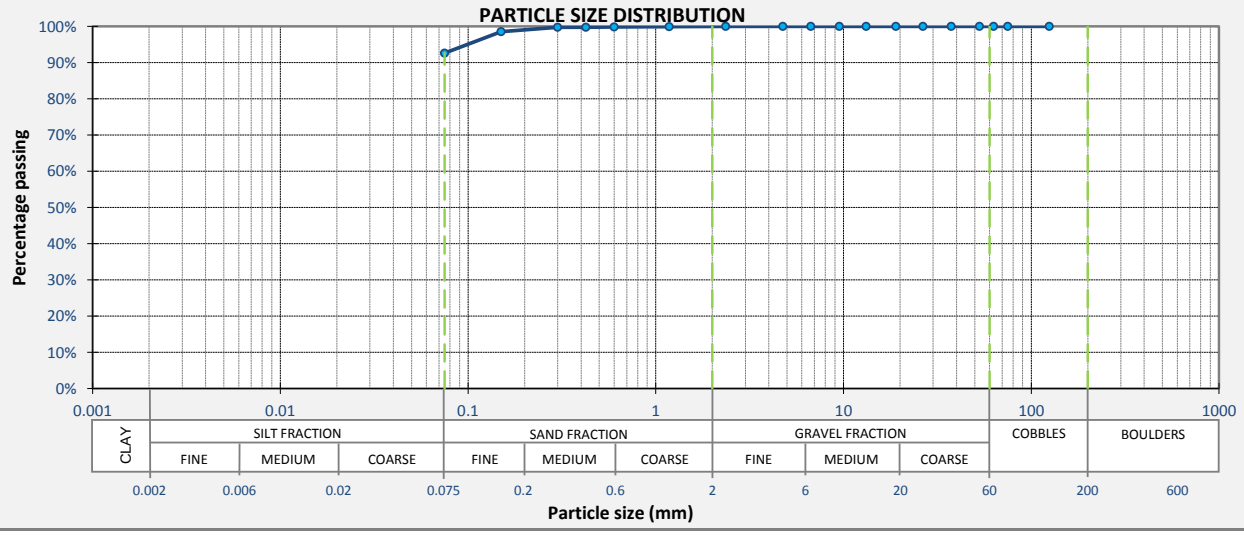
Specimen history/notes: Preparation of specimen and testing performed on sample supplied to the laboratory

Definitions:
LB S = Lower bound specification
LSM = Linear shrinkage mould
UB S = Upper bound specification
N/A = Not applicable
ND = Not determined; SIB = Slip in bowl
NO = Not obtainable; NP = Non plastic

GRADING SUMMARY

Fines (<75 µm)	Sand* (>75 µm - <2 mm)	Gravel* (>2 mm - <60 mm)	Cobbles* (>60mm - <200 mm)
92.6%	**7.4%**	**0.0%**	**0.0%**

* *Proportions based on linear interpolation between sieve of nearest size and smaller*



Testing performed by: DB **Results reviewed by:** DBergen **Date reported:** 7/04/2017

Cert. ref.: **1776468_BH105_TRA17-0098_PSD_1704043_Rep17008427**

Approved signatory:

NATA accreditation number: 1961 - Site:1954 - Adelaide
Accredited for compliance with ISO/IEC 17025

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

Daniel Bergen - Laboratory Technician

Phone: +61 (08) 8213 2100 **Fax:** +61 (08) 8213 2101 **E-mail:** adlgeolab@golder.com.au **Web:** www.golder.com.au

These tests were carried out in accordance with the Australian standards identified in this certificate.

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS1726 Appendix A (Sec. A2)

Golder Associates Pty Ltd

ADELAIDE GEOTECHNICAL LABORATORY

118 Franklin Street,
Adelaide,
South Australia 5000

Test request #:	**TRA17-0098**	**Lab sample ID:**	LADL201704044
Client:	DP Energy		
Client address:			
Project ID:	**1776468**	**Lab report ref.:**	LADL_17008428
Project name:	Renewable Energy Park	**Exploratory Hole**	**BH109**
Sample depth (m):	1.75 - 2.00	**Client sample ref:**	BH109-G-1
Location:		**Project reference:**	

Specimen description: (AS 1726 Appendix A, Section A2)

(CL) Sandy CLAY, low plasticity, brown, approximately 40% fine to coarse grained sand, trace fine gravel

Sampling co-ordinates		Reduced Level
Easting (m)	**Northing (m)**	

PARTICLE SIZE DISTRIBUTION AS 1289.3.6.1

Sieve Size	Passing	LB S	UB S
125 mm	100%		
75 mm	100%		
63 mm	100%		
53 mm	100%		
37.5 mm	100%		
26.5 mm	100%		
19 mm	100%		
13.2 mm	100%		
9.5 mm	100%		
6.7 mm	100%		
4.75 mm	100%		
2.36 mm	99%		
1.18 mm	99%		
600 µm	99%		
425 µm	98%		
300 µm	97%		
150 µm	84%		
75 µm	60%		

Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1	
	Moisture content	**1 point Liquid limit**	**Plastic limit**	**Plasticity index**	**Linear shrinkage**	**Curling/ Crumbling/ Cracking**
Result:	7.3% As Rcvd.	29%	12%	17%	7.5%	Cracking / Curling
LB S:						-
UB S:						-
Preparation method:		Dry sieved		**LSM length (mm):**		250

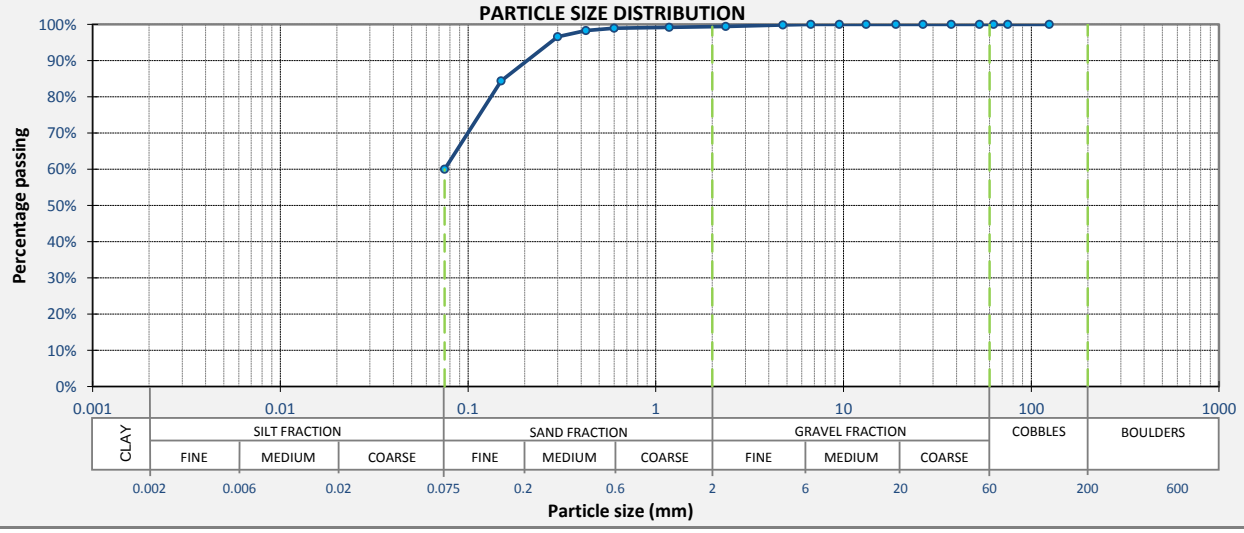
Specimen history/notes: Preparation of specimen and testing performed on sample supplied to the laboratory

Definitions:
LB S = Lower bound specification
LSM = Linear shrinkage mould
UB S = Upper bound specification
N/A = Not applicable
ND = Not determined; SIB = Slip in bowl
NO = Not obtainable; NP = Non plastic

GRADING SUMMARY

Fines (<75 µm)	Sand* (>75 µm - <2 mm)	Gravel* (>2 mm - <60 mm)	Cobbles* (>60mm - <200 mm)
60.0%	**39.4%**	**0.6%**	**0.0%**

* *Proportions based on linear interpolation between sieve of nearest size and smaller*



Testing performed by: DB **Results reviewed by:** DBergen **Date reported:** 7/04/2017

Cert. ref.: **1776468_BH109_TRA17-0098_PSD_1704044_Rep17008428**

Approved signatory:

NATA accreditation number: 1961 - Site:1954 - Adelaide
Accredited for compliance with ISO/IEC 17025

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

Daniel Bergen - Laboratory Technician

Phone: +61 (08) 8213 2100 **Fax:** +61 (08) 8213 2101 **E-mail:** adlgeolab@golder.com.au **Web:** www.golder.com.au

These tests were carried out in accordance with the Australian standards identified in this certificate.

APPENDIX C

Chemical Laboratory Test Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1704061**	Page	: 1 of 2
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Melbourne
Contact	: GOLDER CONTACT	Contact	: Steven McGrath
Address	: 118 FRANKLIN ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 03 8862 3500	Telephone	: +61-3-8549 9600
Project	: 1776468	Date Samples Received	: 04-Apr-2017 10:55
Order number	: Project Number 1776468	Date Analysis Commenced	: 05-Apr-2017
C-O-C number	: ----	Issue Date	: 10-Apr-2017 11:17
Sampler	: ADELAIDE HARBISON		
Site	: Renewable Energy Park, Port Augusta		
Quote number	: EN/002/16 v2		
No. of samples received	: 4		
No. of samples analysed	: 4		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Chris Lemaitre	Non-Metals Team Leader	Melbourne Inorganics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH100-G-3_2.50-2.95	BH103-G-1_7.50-8.00	BH105-G-2_8.25-8.70	BH108-G-1_2.20-2.60	----
			Client sampling date / time	30-Mar-2017 00:00	29-Mar-2017 00:00	29-Mar-2017 00:00	30-Mar-2017 00:00	----
Compound	CAS Number	LOR	Unit	EM1704061-001	EM1704061-002	EM1704061-003	EM1704061-004	--------
				Result	Result	Result	Result	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.0**	**8.9**	**9.0**	**8.8**	**----**
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	**4.7**	**13.5**	**4.1**	**4.8**	**----**
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	**562**	**427**	**1540**	**613**	**----**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**560**	**1300**	**160**	**2420**	**----**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**2630**	**4140**	**930**	**1530**	**----**

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM1704061**	Page	: 1 of 3
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Melbourne
Contact	: GOLDER CONTACT	Contact	: Steven McGrath
Address	: 118 FRANKLIN ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 03 8862 3500	Telephone	: +61-3-8549 9600
Project	: 1776468	Date Samples Received	: 04-Apr-2017
Order number	: Project Number 1776468	Date Analysis Commenced	: 05-Apr-2017
C-O-C number	: ----	Issue Date	: 10-Apr-2017
Sampler	: ADELAIDE HARBISON		
Site	: Renewable Energy Park, Port Augusta		
Quote number	: EN/002/16 v2		
No. of samples received	: 4		
No. of samples analysed	: 4		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Chris Lemaitre	Non-Metals Team Leader	Melbourne Inorganics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA002 : pH (Soils) (QC Lot: 824141)									
EM1704061-002	BH103-G-1_7.50-8.00	EA002: pH Value	----	0.1	pH Unit	8.9	8.9	0.00	0% - 20%
EA002 : pH (Soils) (QC Lot: 825525)									
EM1704061-001	BH100-G-3_2.50-2.95	EA002: pH Value	----	0.1	pH Unit	9.0	9.1	1.10	0% - 20%
EA055: Moisture Content (QC Lot: 826468)									
EM1704057-006	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	6.4	6.7	4.78	No Limit
EM1704062-006	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	18.5	18.4	0.00	0% - 50%
ED040S: Soluble Major Anions (QC Lot: 824142)									
EM1704061-002	BH103-G-1_7.50-8.00	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	1300	1310	0.00	0% - 20%
ED040S: Soluble Major Anions (QC Lot: 825524)									
EM1704061-001	BH100-G-3_2.50-2.95	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	560	560	0.00	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 824143)									
EM1704061-002	BH103-G-1_7.50-8.00	ED045G: Chloride	16887-00-6	10	mg/kg	4140	4080	1.40	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 825523)									
EM1704061-001	BH100-G-3_2.50-2.95	ED045G: Chloride	16887-00-6	10	mg/kg	2630	2640	0.630	0% - 20%

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED040S: Soluble Major Anions (QCLot: 824142)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	----	----	----	----
ED040S: Soluble Major Anions (QCLot: 825524)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	----	----	----	----
ED045G: Chloride by Discrete Analyser (QCLot: 824143)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	107	93	111
				<10	5000 mg/kg	103	93	111
ED045G: Chloride by Discrete Analyser (QCLot: 825523)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	107	93	111
				<10	5000 mg/kg	106	93	111

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED045G: Chloride by Discrete Analyser (QCLot: 824143)							
EM1704061-003	BH105-G-2_8.25-8.70	ED045G: Chloride	16887-00-6	2000 mg/kg	107	93	125
ED045G: Chloride by Discrete Analyser (QCLot: 825523)							
EM1704061-004	BH108-G-1_2.20-2.60	ED045G: Chloride	16887-00-6	2000 mg/kg	102	93	125

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1704061**	Page	: 1 of 4
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Melbourne
Contact	: GOLDER CONTACT	Telephone	: +61-3-8549 9600
Project	: 1776468	Date Samples Received	: 04-Apr-2017
Site	: Renewable Energy Park, Port Augusta	Issue Date	: 10-Apr-2017
Sampler	: ADELAIDE HARBISON	No. of samples received	: 4
Order number	: Project Number 1776468	No. of samples analysed	: 4

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA002 : pH (Soils)								
Soil Glass Jar - Unpreserved (EA002)								
BH103-G-1_7.50-8.00,	BH105-G-2_8.25-8.70	**29-Mar-2017**	**05-Apr-2017**	05-Apr-2017	✓	**05-Apr-2017**	05-Apr-2017	✓
Soil Glass Jar - Unpreserved (EA002)								
BH100-G-3_2.50-2.95,	BH108-G-1_2.20-2.60	**30-Mar-2017**	**06-Apr-2017**	06-Apr-2017	✓	**06-Apr-2017**	06-Apr-2017	✓
EA055: Moisture Content								
Soil Glass Jar - Unpreserved (EA055-103)								
BH103-G-1_7.50-8.00,	BH105-G-2_8.25-8.70	**29-Mar-2017**	**----**	----	----	**06-Apr-2017**	12-Apr-2017	✓
Soil Glass Jar - Unpreserved (EA055-103)								
BH100-G-3_2.50-2.95,	BH108-G-1_2.20-2.60	**30-Mar-2017**	**----**	----	----	**06-Apr-2017**	13-Apr-2017	✓
ED040S : Soluble Sulfate by ICPAES								
Soil Glass Jar - Unpreserved (ED040S)								
BH103-G-1_7.50-8.00,	BH105-G-2_8.25-8.70	**29-Mar-2017**	**05-Apr-2017**	26-Apr-2017	✓	**06-Apr-2017**	03-May-2017	✓
Soil Glass Jar - Unpreserved (ED040S)								
BH100-G-3_2.50-2.95,	BH108-G-1_2.20-2.60	**30-Mar-2017**	**06-Apr-2017**	27-Apr-2017	✓	**07-Apr-2017**	04-May-2017	✓
ED045G: Chloride by Discrete Analyser								
Soil Glass Jar - Unpreserved (ED045G)								
BH103-G-1_7.50-8.00,	BH105-G-2_8.25-8.70	**29-Mar-2017**	**05-Apr-2017**	26-Apr-2017	✓	**07-Apr-2017**	03-May-2017	✓
Soil Glass Jar - Unpreserved (ED045G)								
BH100-G-3_2.50-2.95,	BH108-G-1_2.20-2.60	**30-Mar-2017**	**06-Apr-2017**	27-Apr-2017	✓	**07-Apr-2017**	04-May-2017	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Chloride Soluble By Discrete Analyser	ED045G	2	7	**28.57**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055-103	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chloride Soluble By Discrete Analyser	ED045G	4	7	**57.14**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride Soluble By Discrete Analyser	ED045G	2	7	**28.57**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	2	4	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride Soluble By Discrete Analyser	ED045G	2	7	**28.57**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	In house: Referenced to APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3) (Method 103)
Moisture Content	EA055-103	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Resistivity (1:5)	EA080	SOIL	In house: Calculated from Electrical Conductivity
Major Anions - Soluble	ED040S	SOIL	In house: Soluble Anions are determined off a 1:5 soil / water extract by ICPAES.
Chloride Soluble By Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500-Cl- E. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm. Analysis is performed on a 1:5 soil / water leachate.

Preparation Methods	Method	Matrix	Method Descriptions
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

Chain of Custody Record - Soil/Sediment Samples

Sheet ..1... of ...1..

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Renewable Energy Park, Port Augusta	**DATE RESULTS REQUIRED:**	
PROJ No.:	1776468	**E-MAIL RESULTS:**	aharbison@golder.com.au
SAMPLED BY:	Adelaide Harbison	**CC RESULTS:**	astomski@golder.com.au
CONTACT:	Adelaide Harbison	**LABORATORY:**	ALS
		QUOTE No:	MSA

Analyses Required ☑

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	pH, Sulphate, Chloride, Electrical Resistivity
1	BH100-G-3	30/03/2017	Natural	2.50 - 2.95	☑
2	BH103-G-1	29/03/2017	Natural	7.50 - 8.00	☑
3	BH105-G-2	29/03/2017	Natural	8.25 - 8.70	☑
4.	BH108-G-1	30/03/2017	Natural	2.20 - 2.60	☑
				Totals :	4

Environmental Division
Melbourne
Work Order Reference
EM1704061

Telephone : + 61-3-8549 9600

FREIGHT

Any samples heavily contaminated? No

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	A.Harbison	Golder Associates	(Yes)/No	(Yes)/No	3/4/17		
RECEIVED BY:	Alex	TNT	*Esky Intact* / Yes / No	*Security Seals Intact* / Yes / No	3/4/17	2h0	
RELEASED BY:			Yes / No	Yes / No			
RECEIVED BY:		4/4/17	*Esky Intact* / Yes / No	*Security Seals Intact* / Yes / No			

Laboratory Use Only

Tomasz Lubacz

From: Bronwyn Sheen
Sent: Monday, 3 April 2017 5:35 PM
To: COC Melbourne
Subject: FW: Samples couriered today - job no. 1776468, COC attached
Attachments: 1776468 COC for ALS.pdf

Hi Ranil,
These samples will arrive tomorrow.

Kind regards,

Bronwyn Sheen
Client Services Manager – Springvale
Environmental

T +61 3 8549 9600 D +61 3 8549 9636
F +61 3 8549 9626 M +61 4 3817 4359
bronwyn.sheen@alsglobal.com
2-4 Westall Rd
Springvale Vic 3171
Australia

From: Harbison, Adelaide [mailto:Adelaide_Harbison@golder.com]
Sent: Monday, 3 April 2017 5:22 PM
To: Bronwyn Sheen <bronwyn.sheen@alsglobal.com>
Subject: Samples couriered today - job no. 1776468, COC attached

Hi Bronwyn,

TNT collected some samples from our office this afternoon (Con. note no. 9802 3027 1916) for delivery to your lab. However, I noticed that they left the COC behind – please see attached.

As per the COC, please can you analyse each sample for pH, sulfate (as SO_4^{2-}), chloride, and electrical resistivity.

Kind Regards
Adelaide

Adelaide Harbison (BEng (Civil & Structural, Hons), BFin, BTech) | Geotechnical Engineer | **Golder Associates Pty Ltd**
118 Franklin Street, Adelaide, South Australia 5000, Australia
T: +61 8 8213 2100 | **D:** +61 8 8213 2222 | **F:** +61 8 8213 2101 | **M:** +61 438 344 658 | **E:** AHarbison@golder.com.au | **www.golder.com**

Winner of 22 BRW Client Choice Awards

Work Safe, Home Safe

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ALS Group: Click here to report this email as spam.

APPENDIX D

Important Information

IMPORTANT INFORMATION RELATING TO THIS REPORT

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Appendix 7.1.1
Flora and Fauna Survey

Port Augusta Renewable Energy Park Stage 2

Development Application Volume 4: Technical Appendices

December 2017

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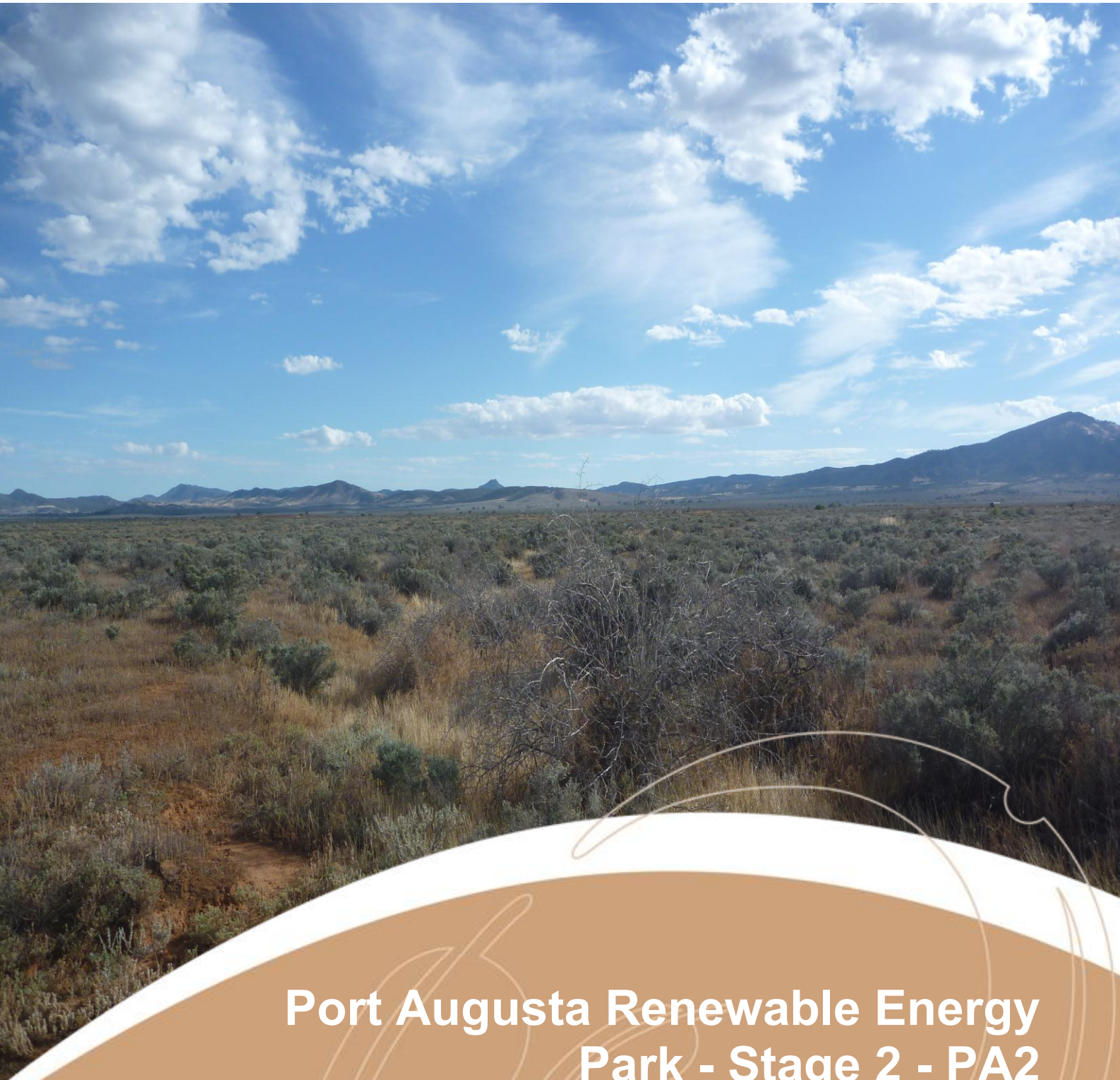

Port Augusta Renewable Energy Park - Stage 2 - PA2

Fauna and Flora Survey

Port Augusta Renewable Energy Park - Stage 2 - PA2 Fauna and Flora Survey

27 October 2017

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Prepared by EBS Ecology for DP Energy

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GLOSSARY AND ABBREVIATION OF TERMS

BDBSA	Biological Database of South Australia (managed by DEWNR)
DEWNR	Department of Environment, Water and Natural Resources
DPEA	DP Energy Australia Pty Ltd
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
NPW Act	*National Parks and Wildlife Act 1972*
NRM Act	*Natural Resources Management Act 2004*
NVC	Native Vegetation Council
NVIS	Native Vegetation Information System
SEB	Significant Environmental Benefit
ssp.	sub-species
spp.	species (plural)

EXECUTIVE SUMMARY

EBS Ecology was engaged by DP Energy Australia Pty Ltd (DPEA) to undertake an ecological assessment for the Stage 2 of the proposed Port Augusta Renewable Energy Park (PA2). The ecological assessment was comprised of a desktop and field assessment for flora and fauna; surveys were undertaken of the east site in December 2016 and of the west site in 2012/13 (as part of Port Augusta Renewable Energy Park Stage 1 (PA1) assessments).

Data was collated as part of the desktop assessment, using the Protected Matters Search Tool and the Biological Database of South Australia, to determine the potential for presence of species listed under the *Environmental Protection Biodiversity Conservation* (EPBC) *Act 1999* as well as the *National Parks and Wildlife (*NPW*) Act 1972*. The likelihood of occurrence for each EPBC Act and NPW Act species was then assessed, based on the habitat within the survey area, date of last record and the conspicuousness of the species. There were three fauna species listed as threatened and 13 fauna species listed as migratory under the EPBC Act that have potential to occur in PA2. However, these were all coastal bird species. No flora species listed under the EPBC Act were considered to have potential to occur. A total of 9 flora and 16 fauna species listed under the NPW Act were considered to have potential to occur in PA2. Eleven of the NPW Act listed fauna species were coastal species.

The vegetation assessment was undertaken of the east site in December 2016 and of the west site October 2012 – January 2013. No threatened flora were recorded during the survey. The vegetation associations over PA2 were largely homogenous, with *Maireana pyramidata* (Black Bluebush) Low Open Shrubland covering 99.6% of the land parcel. The remaining land was covered by *Alectryon oleifolius* (Bullock Bush) Open Shrubland over *Maireana pyramidata* and *Maireana sedifolia*/*Maireana pyramidata* Low Open Shrubland (0.4% cover). The vegetation condition over the site varied from 0:1 (very poor) to 4:1 (poor).

DP Energy submitted a Native Vegetation Clearance application to the Native Vegetation Council in June 2017.

The fauna survey on the eastern sector of PA2 was performed on 13 December 2016. Three point count sites were surveyed, during which 44 birds from nine species were observed. There were no threatened fauna recorded during the survey. However, the Elegant Parrot (*Neophema elegans*), which is State listed as Rare, has been locally observed within the same vegetation associations that are present in PA2, and therefore are likely to occur.

Fauna were surveyed in the more southerly sections of PA1 from October 2012 – January 2013 as part of investigations for Port Augusta Renewable Energy Park Stage 1 (PA1). This dataset has been utilised to determine the bird community likely to be present within each vegetation association mapped over the western sector of PA2.

It is recommended that areas with high ecological value are avoided, including vegetation association 8 - *Alectryon oleifolius* Open Shrubland over *Maireana pyramidata*, as it is listed as Vulnerable in the Gawler IBRA region in the Provisional List of Threatened ecosystems of South Australia.

Additionally, it is recommended that a Construction Environmental Management Plan is in place, prior to construction. This will provide specific, detailed methods to avoid environmental and ecological damage during the construction phase.

Table of Contents

List of Tables

List of Figures

1 INTRODUCTION

1.1 Background and Objectives

In December 2016, EBS Ecology was engaged by DP Energy Australia Pty Ltd (DPEA) to undertake an ecological assessment for Stage 2 of the proposed Port Augusta Renewable Energy Park (REP) (PA2). The project consists of installed capacity of up to 500MW (AC) of PV arrays, up to 400MW (AC) of electrochemical energy storage and up to 3000MWs of synchronous condenser capacity.

The ecological assessment comprised vegetation and bird surveys, which were conducted on the east site in December 2016 and on the west site between October 2012-March 2013 (as part of Stage 1 assessments) as shown in Figure 1[1].

This report summarises the data collected in PA2 from the 2016 and 2012/13 surveys and provides an overview of:

- the type and condition of vegetation within the project site, including threatened ecological communities, threatened species and declared weeds;
- fauna species present or likely to occur, including targeted surveys for birds;
- the significance of vegetation as wildlife habitat; and
- the ecological constraints for the project.

Mitigation measures are recommended within this report to minimise potential impacts on flora and fauna associated with the proposed development.

1.2 Project site

The proposed Port Augusta Renewable Energy Park Stage 2 is situated in the Far North region of South Australia (Figure 1). The Project site is located approximately 12 km to the south-east of the city of Port Augusta in South Australia in the coastal region bordering the southern Flinders Ranges. The City of Port Augusta is a local government area located at the northern end of Spencer Gulf, and is situated approximately 320 km north of Adelaide.

The Project site is divided into two parts, an east site, and a west site, lying to the east and the west of the Augusta Highway respectively (the PA2 west site is located exclusively within the bounds of the Port Augusta Renewable Energy Park Stage 1 project site (PA1) as shown in Figure 1).

[1] The PA2 west site is located exclusively within the bounds of the Port Augusta Renewable Energy Park Stage 1 project site (PA1).

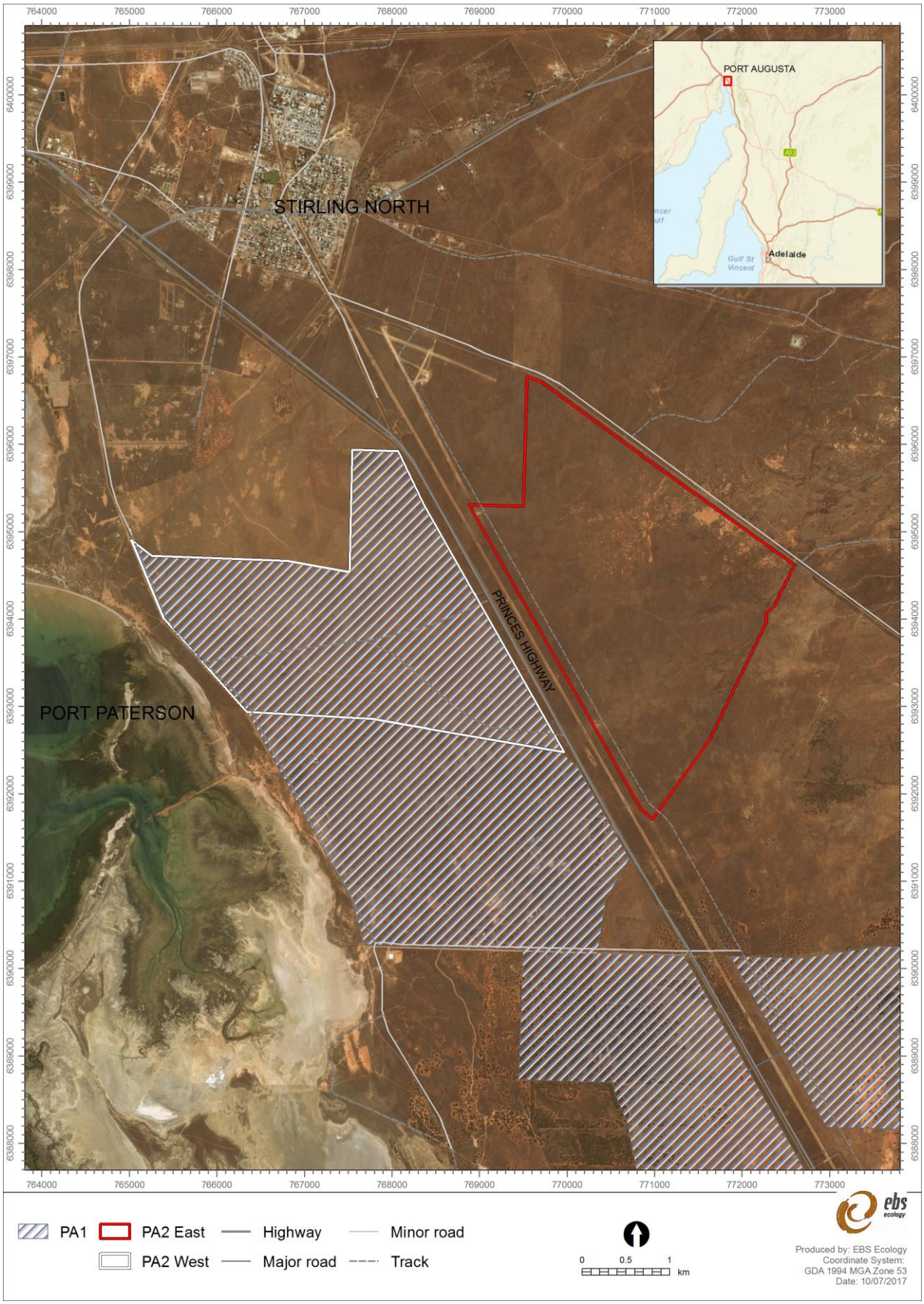


Figure 1. Location of PA2 east and west within the proposed Port Augusta Renewable Energy Park, South Australia.

2 COMPLIANCE AND LEGISLATIVE SUMMARY

A summary of relevant State and Commonwealth environment legislation is provided below, with further detail in Table 1.

2.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) provides protection for matters of national environmental significance. Any action that has, will have or is likely to have a significant impact on matters of national environmental significance requires referral under the EPBC Act. Conservation significant flora and fauna species, and ecological communities listed under the EPBC Act are known from and/or could potentially occur within the project site.

2.2 Native Vegetation Act 1991

Native vegetation within the project site is protected under the *Native Vegetation Act 1991* and *Regulations 2003*. Any proposed clearance of native vegetation in South Australia (unless exempt under the regulations) is to be assessed against the Principles of Clearance under the Act, and requires approval from the Native Vegetation Council (NVC). EBS considers that an assessment against the Native Vegetation Clearance Principles is not required as the clearance complies with Exemption 5(1) (d) Building or provision of infrastructure including infrastructure in the public interest. However, exemption from the Native Vegetation Clearance Principles will need to be approved by the NVC.

A net environmental benefit is generally conditional on an approval for native vegetation clearance being granted. DP Energy submitted a Native Vegetation Clearance application to the Native Vegetation Council in June 2017.

2.3 National Parks and Wildlife Act 1972

Native plants and animals in South Australia are protected under the *National Parks and Wildlife Act 1972.* It is an offence to take a native plant or protected animal without approval. Conservation significant flora and fauna species listed on Schedules 7, 8, or 9 of the *National Parks and Wildlife Act 1972* could potentially occur within the project site.

2.4 Natural Resources Management Act 2004

Under the *Natural Resources Management Act 2004* (NRM Act), landholders have a legal responsibility to manage declared pest plants and animals and prevent land and water degradation. The Northern and Yorke Regional NRM Board has the statutory role of enforcing this within the project site.

Table 1. Summary of relevant Commonwealth and State legislation.

Legislation	Summary	Relevance
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999	The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance. The nine matters of national environmental significance to which the EPBC Act applies are: • world heritage properties • national heritage places • wetlands of international importance (listed under the Ramsar Convention) • listed threatened species and ecological communities • migratory species protected under international agreements • Commonwealth marine areas • the Great Barrier Reef Marine Park • nuclear actions (including uranium mines) • a water resource, in relation to coal seam gas development and large coal mining development.	Under the EPBC Act, actions that have, or are likely to have, a significant impact on a matter of national environmental significance require approval from the Australian Government Minister for the Environment. The Minister will decide whether assessment and approval is required under the EPBC Act. An action is defined broadly in the EPBC Act and includes: a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. The significant impact guidelines provide overarching guidance on determining whether an action is likely to have a significant impact on a matter of national environmental significance protected by the EPBC Act.
South Australia		
National Parks and Wildlife Act 1972	The *National Parks and Wildlife Act 1972* (NPW Act) allows for: the protection of habitat and wildlife through the establishment of parks and reserves (both on land and in State waters); provides for the protection of native flora and fauna; identifies flora and fauna species considered to be of conservation significance (under Schedules 7, 8, and 9 of the Act); and provides for the use of approved wildlife through a system of permits allowing certain actions, i.e. keeping and selling (s.58), harvesting (s.60G), farming (s.60C), hunting (s.68A), releasing (s.55) and undertaking scientific research (s.53) on/of native fauna species, and for the taking of plants (s.49).	A person must not "take" a native plant, protected animal or the eggs of a protected animal without approval (s.48A). Significant penalties apply. To take a native plant means to remove the plant or part of the plant, from the place in which it is growing; or to damage the plant. To take a protected animal means to remove, hunt, catch, restrain, kill or injure an animal, or attempt to do so. A person may take non-prescribed plant species from private land with the consent of the owner; however these species may also be covered under the *Native Vegetation Act 1991*. There are a number of non-complying activities in parks and reserves that result in penalty (parts 4-6).
Native Vegetation Act 1991	The *Native Vegetation Act 1991* (NV Act) provides protection for native vegetation in South Australia and sets out a process for applying to clear vegetation. The *Native Vegetation Regulations 2003* allow certain clearance activities to be exempt from the Act. The *Native Vegetation (Credit for Environmental Benefits) Regulations 2015* relate to Credit and Third Party SEB Offsets and the SEB Register. This NV Act applies on public and private land throughout South Australia,	Approval is required for the clearance of native vegetation. Clearance activities include but are not limited to: • the killing, destruction or removal of whole plants • the removal of branches, limbs, stems or trunks (including brush cutting and woodcutting) • the burning, poisoning and slashing of native vegetation

Legislation	Summary	Relevance
	with the exception of some areas of metropolitan Adelaide. Native vegetation refers to any naturally occurring local plant species that is indigenous to South Australia, from small ground covers and native grasses to large trees and water plants. It also includes naturally occurring regrowth and in certain circumstances, dead trees. In some circumstances, the management of native vegetation is protected by legislation. The Native Vegetation Council (NVC) is responsible for providing advice and making decisions about the removal and re-establishment of native vegetation in line with the Act. The NVC will take into account the impacts of the proposed clearance and may grant consent, refuse consent or grant consent subject to certain conditions. Applications will usually be denied when the vegetation is considered an 'intact stratum', meaning it has not been seriously degraded by human activity within the last 20 years. A net environment benefit is generally conditional on an approval being granted.	• any other substantial damage to native vegetation including activities such as drainage for reclamation of wetlands or flooding of land • grazing by animals (in some circumstances). When assessing an application to clear native vegetation, the NVC must consider the principles of clearance as set out in the Act, except where the vegetation has been considered exempt under the *Native Vegetation Regulations 2003*. Significant penalties apply if a person clears native vegetation without consent. The NVC can also take civil enforcement proceedings in the District Court for an order that the native vegetation be re-instated. The Act also provides the opportunity for landholders to enter into voluntary "Heritage Agreement(s)" to ensure vegetation on private land is protected for perpetuity.
Natural Resources Management Act 2004	The *Natural Resources Management Act 2004* (NRM Act) promotes and facilitates integrated and sustainable management of all natural resources (water, soil, biodiversity etc.); and provides for arrangements to involve the community in the development and implementation of regional initiatives to improve the management of the natural resources. Key components of the Act include: the establishment of regional Natural Resource Management (NRM) Boards and development of regional NRM Plans; the ability to control water use through prescription, allocations and restrictions; requirement to control pest plants and animals, and activities that might result in land degradation. Section 188(5) of the Act requires that the NRM Board must take into account any relevant provision of the regional NRM plan. The NRM Board may appoint authorised officers to administer and enforce the Act. Authorised officers possess powers of entry, powers to give directions, powers to collect evidence and seize and remove animals and plants. An authorised officer may issue a protection order for the purpose of securing compliance with specified provisions of the Act.	A 'duty of care' is a fundamental component of this Act, i.e. ensuring one's environmental and civil obligation by taking reasonable steps to prevent land and water degradation. Persons can be prosecuted if they are considered negligent in meeting their obligations. An owner of land who is, or is likely to be, in breach of the general statutory duty under the Act resulting or likely to result in land degradation may be required to prepare an action plan. Failure to comply with a notice requiring preparation of an action plan is an offence. An NRM authority or a State authorised officer may issue a reparation order in certain circumstances where a person has caused harm to a natural resource and repair is necessary. Enforcement action in the Environment, Resources and Development Court can be taken if necessary.

Note: this summary is not intended to be a substitute for particular legal advice and does not address the legal implications of every set of circumstances.

3 BACKGROUND INFORMATION

3.1 Environmental setting

The proposed Port Augusta REP Stage 2 is situated in the mid-north region of South Australia. This region contains a number of operational wind farms, and several others are approved or proposed for the region. Other than Port Augusta, minor towns in the region include Stirling North to the north of the project site and Winninowie to the south east (Figure 1).

The mid-north region has some of the best agricultural and pastoral land in the SA, with 78% of land used for either cropping or pastures. The region experiences a Mediterranean climate with warm to hot summers and mild to cool winters, with an annual rainfall of between 300-700 mm (Graham *et al.* 2001).

3.1.1 Interim Biogeographical Regionalisation of Australia (IBRA)

The project area falls within the IBRA regions of Gawler and Flinders Lofty Block, and within the subregions of Gawler Lakes (Table 2) and Southern Flinders (Table 3). Data on the Buckaringa IBRA Association is currently unpublished.

Table 2. IBRA region, sub-region and environmental association landscape summary – Gawler IBRA region.

Gawler IBRA region	
Semi-arid to arid, flat topped to broadly rounded hills of the Gawler Range Volcanic and Proterozoic sediments, low plateaux on sandstone and quartzite with an undulating surface of Aeolian sand or gibbers and rocky quartzite hills with colluvial footslopes, erosional and depositional plains and salt encrusted lake beds, with black oak (Belah) and myall low open woodlands, open mallee scrub, bluebush/saltbush open chenopod shrublands and tall mulga shrublands on shallow loams, calcareous earths and hard red duplex soils.	
Gawler Lakes (GAW 3) IBRA sub-region	
An undulating upland plain underlain by quartzite and sandstone, with shallow loamy soils. Encompasses the Woomera plateau, which is characterised by the absence of trees and tall shrubs, except on floodplains, where *Acacia aneura* (Mulga), *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) occasional *Eucalyptus camaldulensis* (Red gums) and other species may be found. The gibber-covered areas are either bare or carry a scattered growth of *Halosarcia* sp. (Samphire) and *Sclerolaena* sp. (Bindyi). The depositional plains to the south and south-west of the plateau are covered with deep calcareous earths characteristically carrying an open *Acacia papyrocarpa* (Myall) woodland with a *Maireana sedifolia* (Bluebush) understorey, or red Aeolian sand sheets and dunes with open mulga shrubland or low woodland of *Casuarina pauper* or *Callitris glaucophylla.*	
Arden IBRA association	
Landform	Plains with sand dunes and numerous lakes along the overflow course of Lake Torrens, and Samphire or mangrove flats along the coastline.
Geology	Alluvium and sand.
Soil	Reddish calcareous earths, reddish sands and grey calcareous loams.
Vegetation	Chenopod shrubland of saltbush and bluebush, low open woodland of myall and black oak, low woodland of mangroves and chenopod shrubland of Samphire.

Sources: Remnancy figures - DEH (2007a). Landscape descriptions - DEWNR (2010).

Table 3. IBRA region, sub-region and environmental association landscape summary – Flinders Lofty Block IBRA region.

Flinders Lofty Block IBRA bioregion
Temperate to arid Proterozoic ranges, alluvial fans and plains, and some outcropping volcanics, with the semi-arid to arid north supporting native cypress, black oak (belah) and mallee open woodlands, *Eremophila* and *Acacia* shrublands, and bluebush/saltbush chenopod shrublands on shallow, well-drained loams and moderately-deep, well-

drained red duplex soils. The increase in rainfall to the south corresponds with an increase in low open woodlands of *Eucalyptus obliqua* and *E. baxteri* on deep lateritic soils, and *E. fasciculosa* and *E. cosmophylla* on shallower or sandy soils.	
Southern Flinders IBRA subregion	
This subregion is characterised by a series of high quartzite hogback ridges with shallow loamy soils and intervening plains and lowlands with red duplex soils. To the south, intermontane plains are extensive, commonly with flat alluviated floors. Native pine (*Callitris glaucophylla*), mallee (*Eucalyptus socialis*, *E. oleosa* and *E. brachycalyx*) and black oak (Casuarina pauper) dominate the slopes of the ridges although in the south these communities merge with eucalypt forests (*E. cladocalyx*, *E. goniocalyx* and *E. leucoxylon*). The understorey of the ridge is generally sparse, with scattered shrubs including *Dodonaea viscosa* ssp. *angustissima*, wattles (e.g. *Acacia rivalis*) and porcupine grass (*Triodia irritans*), giving way near the summits to yacca (*Xanthorrhoea quadrangulata*).	
Remnant vegetation	Approximately 75% (540906 ha) of the subregion is mapped as remnant native vegetation, of which 5% (25971ha) is formally conserved
Landform	Ranges and hills with extensive rock outcrop and shallow soils; stony pediments and small basin plains; some remnants of stony downs; narrow valleys, some with gorges. Ranges and hills in form of hogback ridges in quartzite
Geology	Bare rock; some alluvium & colluvium (sand, silt & clay); less common dune sand & some sand mantles. Calcreted gravels derived from silcrete deposits & probably equate with Ripon Calcrete. Younger Telford gravels (Middle Pleistocene)
Soil	Loamy soils with weak pedologic development, Crusty loamy soils with red clayey subsoils
Vegetation	Assumed native vegetation cover
Conservation significance	45 species of threatened fauna, 110 species of threatened flora. 1 wetlands of national significance.
Buckaringa IBRA association	

3.1.2 Administrative boundaries

The proposed Port Augusta REP Stage 2 project site is within the Northern and Yorke Natural Resources Management Board, and is covered under the *Biodiversity Plan for the Northern Agricultural Districts of South Australia* (Graham *et al*. 2001). The proposed development falls within the Port Augusta City Council and in the Hundreds of Davenport administrative boundaries.

3.1.3 Previous surveys conducted

The most comprehensive available climate dataset is from the Port Augusta weather station approximately 9 km north of the project site. Both rainfall and temperature follow a warm desert climate with cool wet winter months and hot dry summer months. The long-term mean annual rainfall for the area is 255.3 mm, with May through to October typically the wettest months and some summer rainfall (BOM 2011) (Figure 2).

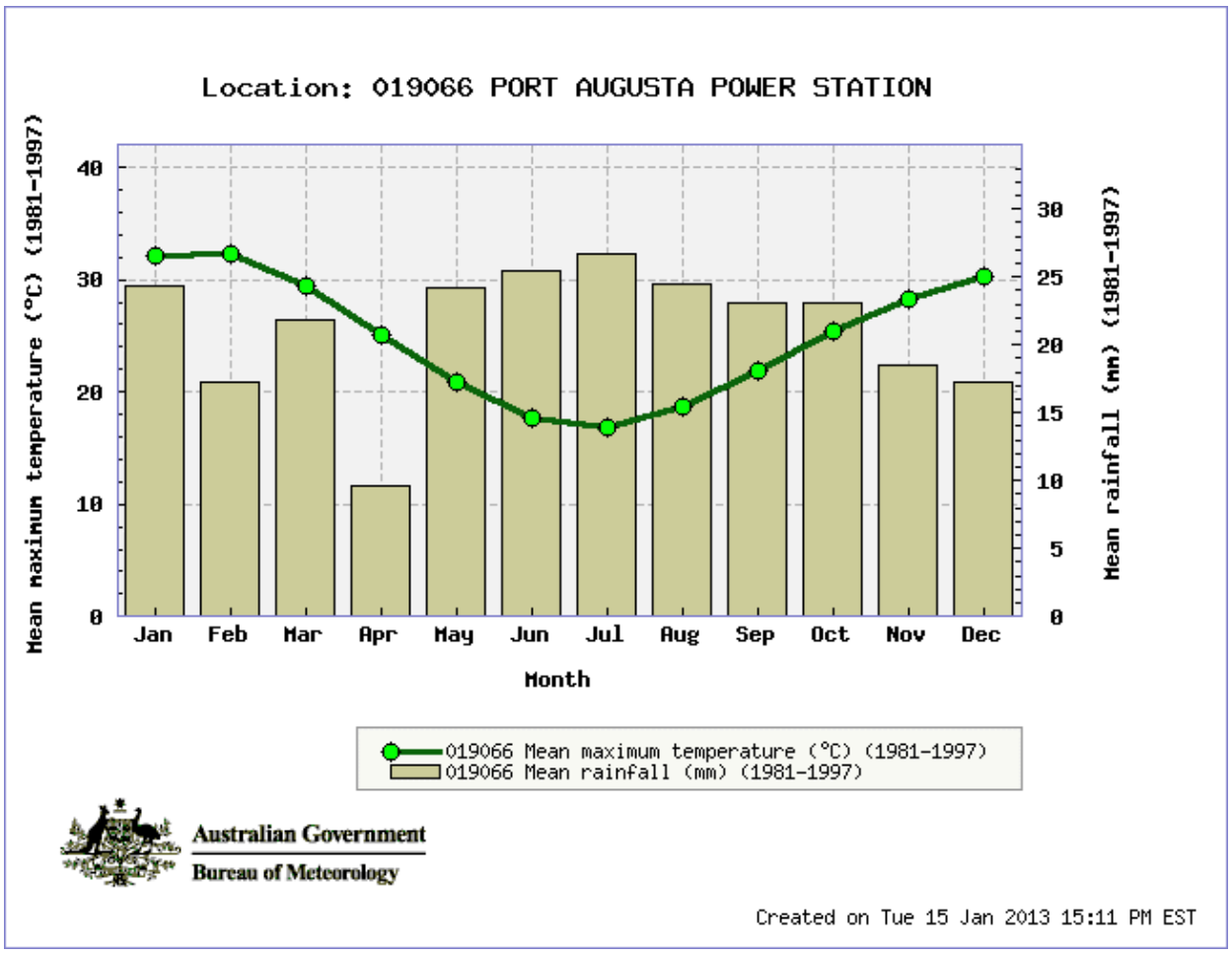


Figure 2. Mean maximum temperature and rainfall data for Port Augusta Power Station weather station (1981-2010). Data source: Bureau of Meteorology 2017.

4 METHODS

4.1 Desktop

A Protected Matters Report was generated on 10 July 2017 to identify matters of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that may occur or may have suitable habitat occurring within the project site. The search radius was 10 km from the centre of the project area. Threatened Ecological Communities possibly occurring within the project site were identified in the EPBC Report and the Provisional List of Threatened Ecosystems of South Australia (DEH unpublished 2008).

A Biological Database of South Australia (BDBSA) search was obtained from the Department of Environment, Water and Natural Resources (DEWNR) in January 2017, to identify flora and fauna species previously recorded within and around the project area (DEWNR, 2017). A search radius of 25 km was used from the centre of the project area. The BDBSA is comprised of an integrated collection of corporate databases which meet DEWNR standards for data quality, integrity and maintenance. In addition to DEWNR biological data, the BDBSA also includes data from partner organisations (Birds Australia, Birds SA, Australasian Wader Study Group, SA Museum, and other State Government Agencies). This data is included under agreement with the partner organisation for ease of distribution, but they remain owners of the data and should be contacted directly for further information.

Existing spatial datasets, relevant literature, aerial imagery and previous survey information, where relevant, was reviewed.

This information was used to build a picture of:

1 native vegetation cover within the project area and immediate surrounds;
2 previous survey effort in the area;
3 vegetation associations present (including associations of significance) and their condition; and
4 flora and fauna species (including species of national or state conservation significance known or likely to occur in the area).

Any threatened species previously recorded within the area, or highlighted as potentially occurring in the area, were researched (if necessary) to determine whether suitable habitat for these species occurs within the project area.

4.2 Field survey

4.2.1 Flora and Vegetation Associations

The vegetation surveys were performed in December 2016 and October/November 2012. During the surveys, flora species and the main vegetation associations on site were recorded and each vegetation association was assigned a significant environmental benefit (SEB) condition rating, or offset ratio. The SEB condition rating scores are based on assessment criteria for the condition of vegetation communities, which are presented in Table 4. Additionally, the Provisional List of Threatened

Ecosystems of South Australia (DEH unpublished 2008) was referenced to identify threatened ecosystems within the project site.

4.2.2 Fauna Survey

As the desktop assessment did not highlight any potential for threatened mammal, reptile or amphibian species to occur in the project area the fauna survey focused on birds.

4.2.3 Terrestrial Birds

Terrestrial birds were surveyed over three sites at PA2 East on 13 December 2016 (Figure 3). At each site, the surveyor spent 20 minutes recording all birds heard and observed within a 100 m radius of the centre of the site. If birds were heard or observed outside the 100 m search radius, they were recorded as 'off-site'.

Point count sites were positioned in accessible areas which were predicted to offer high bird species richness.

In addition to this, other point count sites were established over the local area during the 2012/2013 surveys. From this dataset, bird communities have been determined for the vegetation associations over the PA2 West site.

4.2.4 Opportune Birds

Fauna observed outside of point count surveys and targeted searches were classed as opportune. Species of raptor, previously un-observed species, and mammals and reptiles comprised the majority of opportune records.

For all bird observations, the following was recorded:

- Species observed;
- Number of individuals;
- GPS location;
- Habitat;
- Use of habitat;
- Behaviour;
- Distance from observer; and
- Flight height (for raptors).

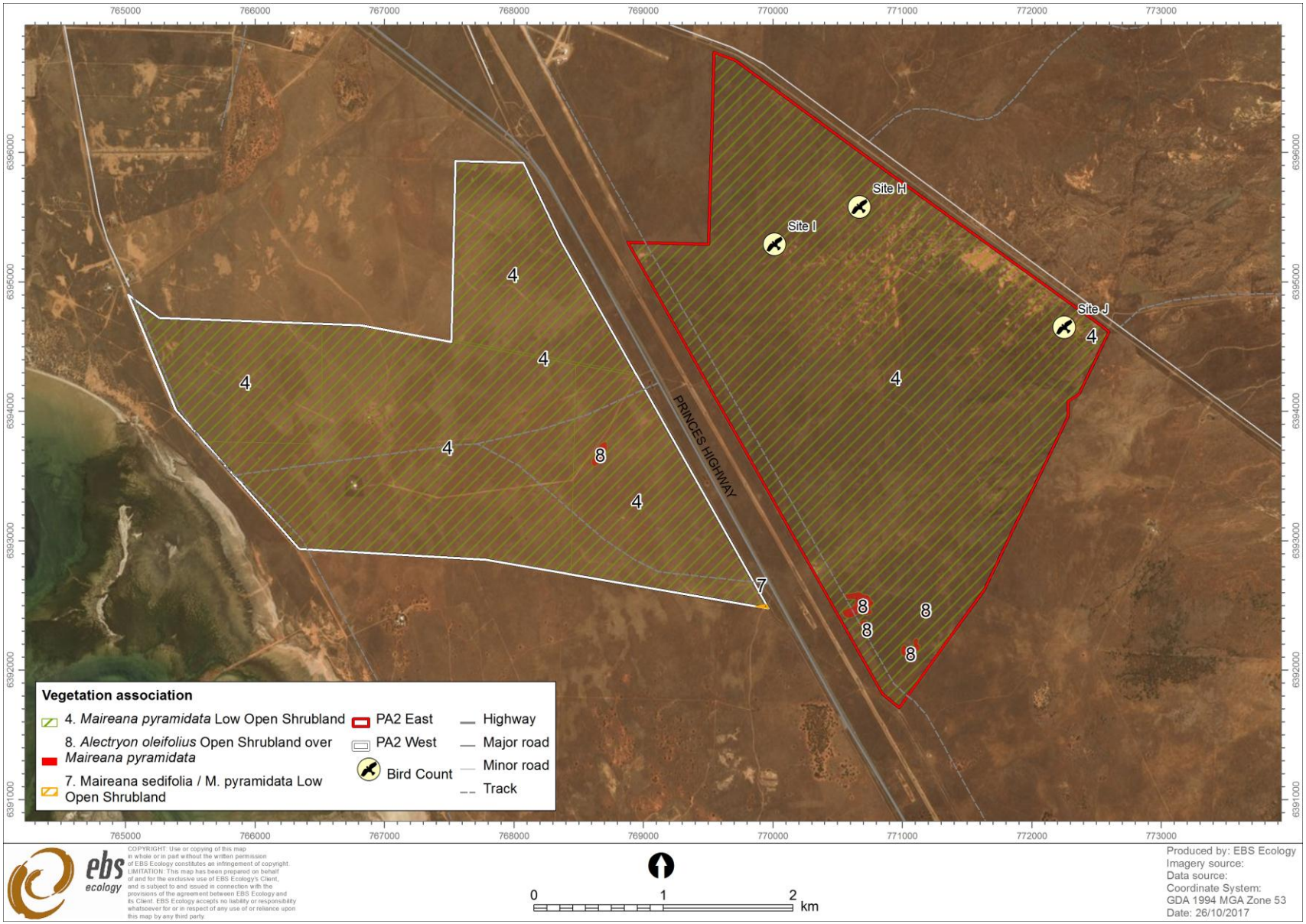


Figure 3. Bird point count sites within PA2 east.

4.3 Limitations

The search radius for the centre of the PA2 project area were 10 km for the EPBC Protected Matters Search and 25 km for the BDBSA flora and fauna search (a 5 km increase in both cases from those searches undertaken for PA1). It is acknowledged that the presence of species may not be adequately represented by database records, and hence the database results may not highlight all threatened flora and fauna species that may occur in the area. In addition to this, the spatial accuracy of the BDBSA records range from 100 m to over 100 km.

Table 4. Criteria for assessment of vegetation condition.

Condition	SEB ratio	% total indigenous cover	Overstorey condition description	Understorey condition description	Indicators	NVC Interim Policy (1.2.11)
Very Poor	**0:1**	<10%	No overstorey stratum remaining.	Complete destruction of indigenous understorey* (by grazing &/or introduced plants).	Vegetation structure no longer intact (e.g. removal of one or more vegetation strata). Scope for regeneration, but not to a state approaching good condition without intensive management. Dominated by very aggressive weeds. Partial or extensive clearing (> 50% of area). Evidence of heavy grazing (tracks, browse lines, species changes, complete depletion of soil surface crust).	Where proposed clearance is considered to be minor and of limited biodiversity impact, e.g. lopping of overhanging limbs only or minor clearance of shrubs in areas otherwise considered as highly disturbed.
	1:1	10-19%	Scattered trees in poor health and/or representing an immature stand.	Almost complete destruction of indigenous understorey* (by grazing &/or introduced plants) - reduced to scattered clumps and individual plants.		
	2:1	20-29%	Scattered trees either immature in good health, or mature in poor/moderate health. Alternatively, the dominant overstorey stratum is largely intact and an immature stand (or regrowth), and is generally in poor health.			Where proposed clearance is in areas dominated by introduced species, the area of native vegetation is largely reduced to scattered trees, indigenous understorey reduced to scattered clumps and individual plants.
Poor	**3:1**	30-39%	Dominant overstorey stratum is largely intact and a moderately healthy mature stand.	Heavy loss of native plant species (by grazing &/or introduced plants). The understorey* consists predominately of alien species, although a small number of natives persist.	Vegetation structure substantially altered (e.g. one or more vegetation strata depleted). Retains basic vegetation structure or the ability to regenerate it. Very obvious signs of long-term or severe disturbance. Weed dominated with some very aggressive weeds. Partial clearing (10 – 50% of area). Evidence of moderate grazing (tracks, browse lines, soil surface crust extensively broken).	
	4:1	40-49%	Dominant overstorey stratum is largely intact and is a healthy mature stand with high wildlife habitat value (e.g. hollows).			Where the proposed clearance is of mostly intact overstorey vegetation but there is still considerable weed infestation amongst the understorey flora
Moderate	**5:1**	50-59%	Dominant overstorey stratum is largely intact – any condition+	Moderate loss of native understorey diversity. Weed-free areas small. Substantial invasion of aliens resulting in significant	Vegetation structure altered (e.g. one or more vegetation strata depleted). Most seed sources available to	

Condition	SEB ratio	% total indigenous cover	Overstorey condition description	Understorey condition description	Indicators	NVC Interim Policy (1.2.11)
				competition, but native understorey* persists; for example, may be a low proportion of native species and a high native cover, or a high proportion of native species and low native cover.	regenerate original structure. Obvious signs of disturbance (e.g. tracks, bare ground). Minor clearing (<10% of area). Considerable weed infestation with some aggressive weeds. Evidence of some grazing (tracks, soil surface crust patchy).	
	6:1	60-69%	Dominant overstorey stratum is largely intact – any condition+	Moderate but not severe weed infestation amongst the understorey flora.		Where the proposed clearance is of mostly intact overstorey vegetation with moderate but not severe weed infestation amongst the understorey flora. Clearance is **not** seriously at variance with the Principles.
Good	**7:1**	70-79%	Original overstorey stratum is still dominant and intact – any condition+	Understorey only slightly modified. High proportion of native species and native cover in the understorey*; reasonable representation of probable pre-European vegetation.	Vegetation structure intact (e.g. all strata intact). Disturbance minor, only affecting individual species. Only non-aggressive weeds present. Some litter build-up.	
	8:1	80-89%	Original overstorey stratum is still dominant and intact – any condition+	Understorey only slightly modified. High proportion of native species and native cover in the understorey*; reasonable representation of probable pre-European vegetation.		Where the proposed clearance is of mostly intact overstorey and understorey vegetation, weed infestation is moderate to low, but the original vegetation is still dominant. Clearance is assessed by the Native Vegetation Council to be at variance with the Principles.
Excellent	**9:1**	> 89%	Original vegetation is still dominant and intact. Overstorey individuals in good condition and represent a mature stand.	Diverse vegetation with very little weed infestation.Understorey largely undisturbed, minimal loss of plant species diversity. Very little or no sign of alien vegetation in the understorey*; resembles probable pre-European condition.	All strata intact and botanical composition close to original. Little or no signs of disturbance. Little or no weed infestation. Soil surface crust intact. Substantial litter cover.	
	10:1		Original vegetation is still dominant and intact. Overstorey individuals in good condition and represent a mature stand, with high habitat value (e.g. hollows).			Where the proposed clearance is of diverse vegetation with very little weed infestation. Clearance is assessed by the Native Vegetation Council to be seriously at variance with the Principles.
*Or all strata if the upper and lower strata are difficult to distinguish						

Condition	SEB ratio	% total indigenous cover	Overstorey condition description	Understorey condition description	Indicators	NVC Interim Policy (1.2.11)
+ Ratio assessment will largely depend upon condition of understorey associated with an intact overstorey stratum. Adapted from *Guide to Roadside Vegetation Survey Methodology for South Australia* (Stokes *et al.* 1998) and *Guidelines for a Native Vegetation Significant Environmental Benefit Policy (*DWLBC 2005).						

5 RESULTS

5.1 EPBC Database Searches

The EPBC Protected Matters Search identified 37 nationally threatened species, 36 migratory species, and two nationally threatened ecological communities that may be present within the project site. These are summarised in Table 5 and the relevant matters of national environmental significance are discussed below.

Table 5. Matters of significance identified in the EPBC Protected Matters Search.

Search Area	Matters of National significance under the EPBC Act 1999	Potentially present in the search area
	World Heritage Properties	No
	National Heritage Properties	No
	Wetlands of International Significance	No
	Commonwealth Marine Areas	No
	Commonwealth Lands	1
	Commonwealth Reserves	No
	Commonwealth Heritage Places	No
	Whales and other Cetaceans	8
	Critical Habitats	No
	Nationally Threatened Species	37
	Nationally Threatened Ecological Communities	2
	Migratory Species	36
	Invasive Species	28
	State and Territory Reserves	No

5.1.1 EPBC Threatened Ecological Communities

The EPBC Protected Matters Search identified that two Threatened Ecological Communities (TEC) have the potential to occur within the project site: Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia, listed as critically endangered, and Subtropical and Temperate Coastal Saltmarsh, listed as vulnerable. Subtropical and Temperate Coastal Saltmarsh occurs locally, however, is not present within PA2. Peppermint Box (*Eucalyptus odorata*) Grassy Woodland is not present within the PA2.

5.1.2 Threatened Flora

The EPBC Protected Matters search identified the potential for six threatened flora species to be present in the project site. The six species were comprised of four species listed as endangered and two listed as vulnerable. The likelihood of occurrence within the project area was considered to be unlikely for all species (Table 6).

5.1.3 Threatened Fauna

The EPBC Protected Matters Search identified the potential for 24 fauna species to be present in the project site. A further seven species were identified by the Protected Matters Search; however, these were exclusively marine species such as sea turtles, whales, the Great White Shark (*Carcharodon carcharias*) and Australia Sea Lion (*Neophoca cinerea*). The 24 fauna species identified in the Protected Matters Search, included 23 species of bird and one species of mammal (Table 7). There were no threatened bats or amphibians identified in the search. The classifications of threatened fauna were 16 vulnerable species, three endangered species and five critically endangered species. The likelihood of occurrence for three species received a classification of possible or greater:

- Western Alaskan Bar-tailed Godwit (*Limosa lapponica baueri)* – Possible;
- Far Eastern Curlew (*Numenius madagascariensis)* – Known (from coastal surveys); and
- Australian Fairy Tern (*Sternula nereis*) – Possible.

The three species which are known to occur or may possibly occur are waterbird species, and therefore would not be present within PA2 unless they were flying over.

5.1.4 Migratory species

A total of 26 migratory bird species were identified from the Protected Matters Search as potentially occurring within the project site (Table 8). A further 10 species were identified by the Protected Matters Search; however, these were exclusively marine species such as sea turtles and whales. The likelihood of occurrence was assessed ‘possible’ for ten species and known for three species. Migratory shorebirds accounted for 11 of the 13 species which had a likelihood of ‘possible’ or higher, while the Osprey (*Pandion haliaetus*) and Fork-tailed Swift (*Apus pacificus*) comprised the remaining two species. The Fork-tailed Swift is listed under the EPBC Act as migratory and marine; however, they do occur inland. Whilst in Australia, the Fork-tailed Swift is almost exclusively aerial. The remaining migratory species are coastal and therefore would not be present within PA2 unless they were flying over.

Table 6. Flora species identified in EPBC Protected Matters Search as potentially occurring within the area.

Species name	Common name	Conservation status		Habitat preference	Most recent record (BDBSA)	Likelihood of occurrence within project site	Possible Impact (Y/N)
		Aus	SA				
Caladenia gladiolata	Bayonet Spider-orchid	EN	E	Grows on moderate to steep slopes in sandy loam soils with scattered shale and quartzite. Grows in *Eucalyptus leucoxylon* and *E. cladocalyx* woodland with understorey which includes *Acacia pycnantha*, *A. gracilifolia* and *Cassinia laevis*.		Unlikely, habitat was degraded and is likely to be restricted to the range east of project site.	N
Caladenia macroclavia	Large-club Spider-orchid	EN		Grows in mallee-Broombush woodland in sandy loam over limestone. Canopy is dominated by *Eucalyptus gracilis*, *E. socialis* and *E. incrassata*. Understorey includes *Alyxia buxifolia*, *Melaleuca uncinata*, chenopod, sedges and grasses.		Unlikely, habitat highly degraded	N
Caladenia tensa	Rigid Spider-orchid	EN		Various habitats have been described including Cypress Pine / Yellow Gum Woodland, Pine / Box woodland, mallee-heath sites, healthy woodland and mallee woodland, generally with rock outcrops	1996	Unlikely, habitat was degraded and is likely to be restricted to the range foothills east of project site.	N
Caladenia woolcockiorum	Woolcock's Spider-orchid	VU	E	Found in loamy soils near gullies on gentle or moderate slopes in *Eucalyptus cladocalyx* and *E. leucoxylon* open forest or woodland with *Hibbertia exutiacies*, *Lomandra densiflora* or *Bulbine bulbosa* understorey.		Unlikely, habitat was degraded and is likely to be restricted to the range east of project site.	N
Frankenia plicata	Sea Heath	EN	E	*Frankenia plicata* occurs on stony and sandy plains, foot slopes on rocky hills, minor drainage lines, major drainage lines, and within road side vegetation The species may exhibit a preference for drainage lines and swales, which take the first run-off after rain. The soil within which the species has occurred varies from sandy loam to clay.		Unlikely, the project area falls outside the extent of occurrence of the species.	N

Senecio megaglossus	Superb (or Large-flower) Groundsel	VU	E	Mostly confined to rocky creek banks and gorge and valley slopes. Has been recorded in drainage lines, on the edge of an erosion gully, in sand hills and arid hills. Associated vegetation communities include herb land or grassland often with *Lomandra effusa*, tall open shrubland dominated by *Pittosporum angustifolium*, *Acacia calamifolia* sparse heathland and *Cassinia laevis* low sparse shrubland		This species can grow in varied habitats, some of which occur in the project site however the level of degradation within the sites makes it unlikely	N

Aus: Australia (Environment Protection and Biodiversity Conservation Act 1999). **SA**: South Australia (National Parks and Wildlife Act 1972). Conservation Codes: **CE**: Critically Endangered**. EN/E**: Endangered**. VU/V**: Vulnerable**. R**: Rare. **Mi (Ma**): Migratory – Marine, **Mi (T)**: Migratory Terrestrial, **Mi (W)** – Migratory Wetlands, **Ma** (Marine)

Table 7. Threatened fauna identified by the EPBC Protected Matters Search as potentially occurring within the project area.

Species name	Common name	Conservation status		Habitat preference	Most recent record (for BDBSA only).	Likelihood of occurrence within project site	Possible Impact (Y/N)
		Aus	SA				
Birds							
Amytornis textilis myall	Western Grasswren	VU		Strong association with chenopod shrublands, however also inhabits Acacia shrubland and lignum.		Unlikely - Distribution of species does not extend in to the project area.	N
Calidris canutus	Red Knot	EN		Inhabits intertidal mudflats, sandflats and sheltered sandy beaches. Forages at the edge of the water or in flats exposed at low tide		Unlikely (Coast) – Suitable coastal habitat is available, however there are few records around the Port Paterson area.	N
Calidris ferruginea	Curlew Sandpiper	CE		Mainly occurs on intertidal mudflats in sheltered coastal areas. Forage on mudflats and in shallow <6cm deep water	2002	Possible (Coast) - Suitable habitat exist around Port Paterson, however the species is more commonly found in Northern parts of Australia.	N
Diomedea antipodensis	Antipodean Albatross	VU		The species is marine, pelagic and aerial.		Unlikely (Coast) – Forages in the open water south of New Zealand. Has not been recorded in South Australian waters.	N
Diomedea epomophora (sensu stricto)	Southern Royal Albatross	VU	V	The species is marine, pelagic and aerial.		Unlikely (Coast) – Forages in the open water of the Southern Ocean. Few records of the species over the continental shelf in South Australia.	N
Diomedea exulans (sensu lato)	Wandering Albatross	VU	V	The species is marine, pelagic and aerial.		Unlikely (Coast) - infrequent visitor to South Australian waters, and preferring deeper, open ocean conditions. Has occurred close to shore in South Australia, however there are no records in the Spencer Gulf.	N
Diomedea sanfordi	Northern Royal Albatross	EN	E	The species is marine, pelagic and aerial.		Unlikely (Coast) - infrequent visitor to South Australian waters, and preferring deeper,	N

Species name	Common name	Conservation status		Habitat preference	Most recent record (for BDBSA	Likelihood of occurrence within project site	Possible Impact (Y/N)
						open ocean conditions. There are no records in the Spencer Gulf.	
Leipoa ocellata	Malleefowl	VU	V	Occupies shrublands and low woodlands dominated by mallee vegetation. Habitat type includes *Eucalypt* or native pine *Callitris* woodlands, *Acacia* shrublands, *Melaleuca uncinata* vegetation or coastal heathlands.		Unlikely- suitable habitat exists at the site, however the mallee remnant patches are extremely fragmented, and as such it is unlikely that Malleefowl would find the area suitable.	N
Limosa lapponica baueri	Western Alaskan Bar-tailed Godwit	VU		Present in tidal coastal areas, including mudflats, beaches and mangroves.		Possible (Coast) – suitable habitat is present adjacent to land parcels. There are also numerous records of the species around Whyalla.	N
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	CE	R	See above		Unlikely (Coast) – Only the subspecies baueri has been recorded in SA	N
Macronectes giganteus	Southern Giant Petrel	EN	V	Occurs in both pelagic and inshore waters. It is attracted to land at sewage outfalls and scavenges at colonies of penguins and seals	2000	Unlikely (Coast) - frequenting open waters, a feature lacking at Port Paterson, this species maybe only a fly-over during winter months	N
Macronectes halli	Northern Giant Petrel	VU		Range extends into subtropical waters mainly between winter and spring. It is attracted to land at sewage outfalls and scavenges at colonies of penguins and seals		Unlikely (Coast) - similar in habits to the Southern, this species prefers open water, and is a rare visitor north of sub-Antarctic waters, with immatures being the most frequent recorded.	N
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	CE	V	Found along the coastline, at intertidal estuaries, mangroves, sand spits and mudflats.	2016	Known (Coast) - this species was observed during the 2012, 2016 surveys	N
Pachyptila turtur subantarctic	Fairy Prion (southern)	VU		Occasionally will forage over the continental shelf and slope. The species breeds on coastal islands.		Unlikely (Coast) – Has not been recorded in the Spencer Gulf	N

Species name	Common name	Conservation status		Habitat preference	Most recent record (for BDBSA	Likelihood of occurrence within project site	Possible Impact (Y/N)
Pedionomus torquatus	Plains-wanderer	CE	E	Inhabits sparse native grasslands and old stubble. The density of grass influences habitat suitability, with the species avoiding areas where it is too dense or too sparse.	2000	Unlikely –The project area has little to no cover by native grasslands.	N
Pezoporus occidentalis	Night Parrot	CE	E	Present within arid grasslands, dominated by spinifex. Have also been recorded in chenopod shrublands.		Unlikely – Closest distribution is the Gammon and Gawler Ranges. No recent records of the species in SA.	N
Phoebetria fusca	Sooty Albatross	VU	E	The species is marine, pelagic and aerial.		Unlikely (Coast) - Rarely present over coastal waters and has not been recorded in the upper Spencer Gulf.	N
Rostratula australis	Australian Painted Snipe	VU	V	Generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands. Typical sites include those with emergent tussocks of grass, sedges, rushes, reeds or Samphire often with clumps of Muehlenbeckia spp. or *Melaleuca* spp.		Unlikely (Wetlands) - an uncommon visitor to South Australia. Although suitable habitats are found in the region, it is unlikely to occur at the site; if so rarely.	N
Sternula nereis	Australian Fairy Tern	VU	E	A coastal species that will inhabit wetlands varying from fresh to saline, and beaches. Typically associated with sheltered water bodies.	2002	Possible (Coast) – This species has been sighted throughout the upper Spencer Gulf, including adjacent to the project area	N
Thalassarche cauta	Shy Albatross	VU	E	Occurs in subantarctic and subtropical waters, can occur over continental shelves, inshore and offshore and enters bays and harbors when not breeding.		Unlikely (Coast) - this species of Albatross is less dependent of deep pelagic waters, and can be found closer to land. However, they not been observed in the upper Spencer Gulf.	N
Thalassarche cauta steadi	White-capped Albatross	VU		The species is marine, pelagic and aerial.		Unlikely (Coast) - The species has been recorded over continental shelves, however, is typically a pelagic species. Has not been recorded off South Australia.	N

Species name	Common name	Conservation status		Habitat preference	Most recent record (for BDBSA	Likelihood of occurrence within project site	Possible Impact (Y/N)
Thalassarche impavida	Campbell Albatross	VU	V	Known to forage in Australian waters, primarily in waters south of 25°		Unlikely (Coast) - infrequent visitor to South Australian waters, and preferring deeper, open ocean conditions.	N
Thalassarche melanophris	Black-browed Albatross	VU	V	The species is marine, pelagic and aerial.		Unlikely (Coast) - Has rarely been recorded over the continental shelf. Has not been recorded in the Spencer Gulf	N
Mammals							
Petrogale xanthopus	Yellow-footed Rock-wallaby	VU		Inhabits rocky outcrops in semi-arid sandstones, limestone and conglomerates in the Flinders Ranges. Evidence suggests that colonies travel up to 5km for fresh water supplies.	2007	Unlikely- although this species is well established in areas close to Port Paterson, the species need large, rocky outcrops, with suitable cliffs and caves for predatory avoidance. All of these are lacking from the site.	N

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare. **Mi (Ma)**: Migratory – Marine**, Mi (T)**: Migratory Terrestrial, **Mi (W)** – Migratory Wetlands, **Ma** (Marine).

Table 8. Migratory fauna (bird) species identified in EPBC Protected Matters Search as potentially occurring within the project area.

Species name	Common name	Conservation status		Habitat preference	Most recent record (BDBSA only)	Likelihood of occurrence within project site	Possible Impact (Y/N)
		Aus	SA				
Migratory Marine Birds							
Apus pacificus	Fork-tailed Swift	Mi		Asian origin - species is aerial during its stay in Australia.	2000	Possible - this species can be classed as common throughout its range frequently observed ahead of large storm fronts, hawking for insects. An Australian summer visitor	N
Ardenna carneipes	Flesh-footed Shearwater	Mi	R	A locally common visitor to waters of the continental shelf and continental slope off southern Australia		Unlikely (Coast) – While present off the South Australian coast, its occurrence does not extend up the Spencer Gulf.	N
Diomedea epomophora (sensu stricto)	Southern Royal Albatross	Mi (VU)	V	The species is marine, pelagic and aerial.		Unlikely (Coast) – Forages in the open water of the Southern Ocean. Few records of the species over the continental shelf in South Australia.	N
Diomedea exulans (sensu lato)	Wandering Albatross	Mi (VU)	V	The species is marine, pelagic and aerial.		Unlikely (Coast) - infrequent visitor to South Australian waters, and preferring deeper, open ocean conditions. Has occurred close to shore in South Australia, however there are no records in the Spencer Gulf.	N
Macronectes giganteus	Southern Giant Petrel	Mi (EN)	V	Occurs in both pelagic and inshore waters. It is attracted to land at sewage outfalls and scavenges at colonies of penguins and seals		Unlikely (Coast) - frequenting open waters, a feature lacking at Port Paterson, this species maybe only a fly-over during winter months	N
Macronectes halli	Northern Giant Petrel	Mi (VU)		Range extends into subtropical waters mainly between winter and spring. It is attracted to land at sewage outfalls and scavenges at colonies of penguins and seals		Unlikely (Coast) - similar in habits to the Southern, this species prefers open water and is a rare visitor north of sub-Antarctic waters, with immatures being the most frequent	N

Species name	Common name	Conservation status		Habitat preference	Most recent	Likelihood of occurrence within project site	Possible Impact
						recorded.	
Phoebetria fusca	Sooty Albatross	Mi (VU)	E	The species is marine, pelagic and aerial.		Unlikely (Coast) - Rarely present over coastal waters and has not been recorded in the upper Spencer Gulf.	N
Thalassarche cauta	Shy Albatross, Tasmanian Shy Albatross	Mi (VU)	E	Occurs in subantarctic and subtropical waters, can occur over continental shelves, inshore and offshore and enters bays and harbours when not breeding.		Unlikely (Coast) - this species of Albatross is less dependent of deep pelagic waters, and can be found closer to land. However, they not been observed in the upper Spencer Gulf.	N
Thalassarche melanophris	Black-browed Albatross	Mi (VU)	V	The species is marine, pelagic and aerial.		Unlikely (Coast) - Has rarely been recorded over the continental shelf. Has not been recorded in the Spencer Gulf	N
Migratory Terrestrial Birds							
Motacilla cinerea	Grey Wagtail	Mi		Found near fresh water, often at higher altitudes		Unlikely – inappropriate habitat available and few Australian records	N
Motacilla flava	Yellow Wagtail	Mi		Inhabits damp and short grass habitats, including: swamp margins, sewage and salt works, saltmarshes, and paddocks.		Unlikely – saltmarshes may be available but this species is an irregular visitor to Australia.	N
Migratory Wetland Birds							
Actitis hypoleucos	Common Sandpiper	Mi	R	Inhabits the intertidal zone of coastal habitats as well as inland and coastal wetlands. The species is predominantly observed on muddy edges or rocky shores	2004	Possible (Coast) – Suitable habitat is present for the species at Port Patterson.	N
Arenaria interpres	Ruddy Turnstone	Mi	R	A coastal species that inhabits rocky shores and beaches; especially those with kelp.	1998	Possible (Coast) – Suitable habitat is present and the species has been observed at Winninowie Conservation Park	N

Species name	Common name	Conservation status		Habitat preference	Most recent	Likelihood of occurrence within project site	Possible Impact
Calidris acuminata	Sharp-tailed Sandpiper	Mi		Prefers muddy edges of shallow fresh or brackish wetlands with inundated or emergent sedges, saltmarsh or other low vegetation.	2005	Possible (Coast) - commonly found during the Australian summer, this species occurs throughout much of the Gulf regions in South Australia on passage from breeding grounds in Siberia	N
Calidris alba	Sanderling	Mi	R	Almost always found on the coast, mostly on open sandy beaches where they forage in the wave-wash zone.		Possible (Coast) - this species is likely to be found in the Port Paterson area during non-breeding movements, during the Australian summer. Large areas of suitable beach are located along the western coast for this species.	N
Calidris canutus	Red Knot, Knot	Mi (EN)		Inhabits intertidal mudflats, sandflats and sheltered sandy beaches. Forages at the edge of the water or in flats exposed at low tide		Unlikely (Coast) – Suitable coastal habitat is available, however there are few records around the Port Paterson area.	N
Calidris ferruginea	Curlew Sandpiper	Mi (CE)		Mainly occurs on intertidal mudflats in sheltered coastal areas. Forage on mudflats and in shallow <6cm deep water	2002	Possible (Coast) - Suitable habitat exist around Port Paterson, however the species is more commonly found in Northern parts of Australia.	N
Calidris ruficollis	Red-necked Stint	Mi		Mostly found in sheltered coastal areas. Forages on bare wet mud on intertidal mudflats, sandflats or in very shallow water.	2016	Known (Coast) - this species was observed during the 2012, 2016 surveys	N
Charadrius veredus	Oriental Plover, Oriental Dotterel	Mi		Found in coastal and wetland habitats such as tidal flats and marshes, as well as terrestrial environments, such as open plains and bare clay pans.		Unlikely - infrequently recorded in South Australia	N
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	Mi	R	This species prefers soft wet ground or shallow water with tussocks, irrigated areas. Summer migrant.		Unlikely (Wetlands) - suitable habitat is not present for this species within the project area.	N

Species name	Common name	Conservation status		Habitat preference	Most recent	Likelihood of occurrence within project site	Possible Impact
Limosa lapponica	Bar-tailed Godwit	Mi (VU)	R	Present in tidal coastal areas, including mudflats, beaches and mangroves.		Possible (Coast) – suitable habitat is present adjacent to land parcels. There are also numerous records of the species around Whyalla.	N
Limosa	Black-tailed Godwit	Mi	R	Forages in sheltered coastal areas with large intertidal mudflats or sandflats	1984	Possible (Coast) – suitable habitat is present for this species in the Port Paterson region. There are also records of the species presence within the upper Spencer Gulf.	N
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Mi (CE)	V	Found along the coastline, at intertidal estuaries, mangroves, sand spits and mudflats.	2016	Known (Coast)- this species was observed during the 2012, 2016 surveys	N
Pandion haliaetus	Osprey	Mi	E	Inhabits the coastline, including mangroves and estuaries, as well as inland rivers.		Possible (Coast) – suitable coastal habitat is available. The species has been observed in Winninowie Conservation Park.	N
Tringa nebularia	Common Greenshank	Mi		Found at waterbodies inland and coastline. Will inhabit tidal mudflats, mangroves, fresh and saline wetlands, salt works and flooded crops.	2016	Known (Coast)- this species was observed during the 2012, 2016 surveys	N
Tringa stagnatilis	Marsh Sandpiper, Little Greenshank	Mi		Lives in permanent or ephemeral wetlands of varying salinity. Forages in the shallow water at the edge of wetlands	2006	Possible (Coast) - found in suitable habitats, this species has been recorded in and around Whyalla, and is identified as a key region on the Spencer's Gulf.	N

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare. **Mi (Ma)**: Migratory – Marine**, Mi (T)**: Migratory Terrestrial, **Mi (W)** – Migratory Wetlands, **Ma** (Marine).

5.2 BDBSA Database Search

5.2.1 Flora

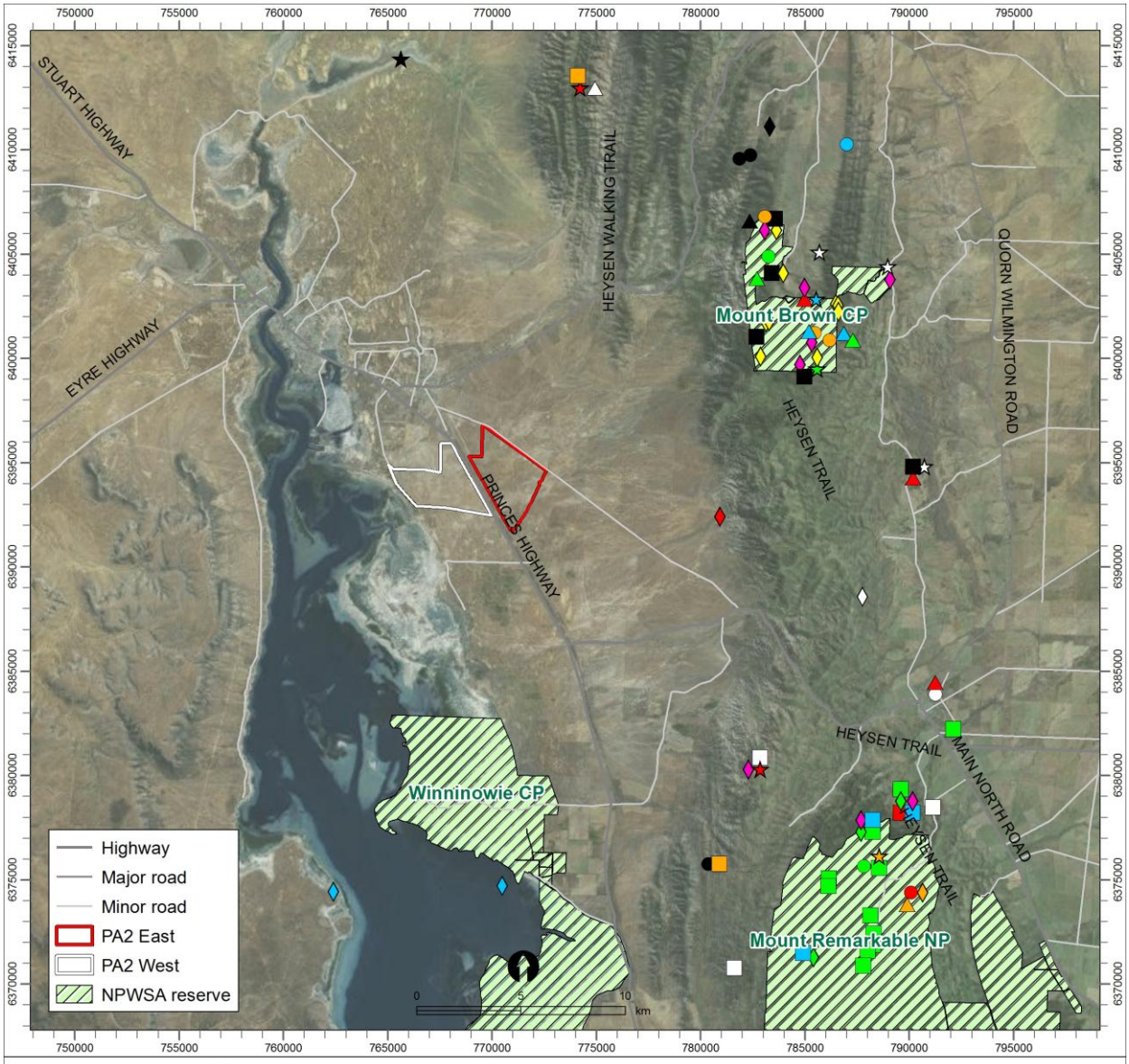
The BDBSA search identified records for 31 flora species within a 25 km radius of the centre point of the project site (DEWNR, 2017) (Table 9). Most of the records are over 20 years old, however it is considered that nineof the species have the potential to occur within the project site. The search results for flora are mapped in Figure 4.

Table 9. Results of the BDBSA search for flora.

Species Name	Common Name	NPW Act	EPBC Act	Most recent record	Likelihood	Possible Impact (Y/N)
Acacia gracilifolia	Graceful Wattle	R		1999	Unlikely	N
Anogramma leptophylla	Annual Fern	R		1992	Unlikely	N
Asperula syrticola	Southern Flinders Woodruff	R		1992	Unlikely	N
Austrostipa breviglumis	Cane Spear-grass	R		1994	Possible	N - All Austrostipa species are possibly present within the area; however, these are very unlikely to be significant remnants and endemic to the project site only. All species are most likely resident in the foothills and ranges area east of the project site.
Austrostipa gibbosa	Swollen Spear-grass	R		1992	Possible	
Austrostipa pilata	Prickly Spear-grass	V		1996	Possible	
Austrostipa tenuifolia	Spear-grass	R		1994	Possible	
Brachyscome ciliaris var. subintegrifolia	Variable Daisy	R		1996	Unlikely	N
Cryptandra campanulata	Long-flower Cryptandra	R		1994	Unlikely	N
Deyeuxia densa	Heath Bent-grass	R		1994	Unlikely	N
Dianella longifolia var. grandis	Pale Flax-lily	R		1996	Unlikely	N
Echinopogon ovatus	Rough-beard Grass	R		1999	Unlikely	N
Eryngium ovinum	Blue Devil	V		1996	Possible	N - More commonly restricted to hills and low ranges, If present, highly unlikely to represent endemic local community
Eucalyptus cajuputea	Green Mallee	R		1996	Unlikely	N
Eucalyptus percostata	Ribbed White Mallee	R		2003	Unlikely	N
Eucalyptus polybractea	Flinders Ranges Box	R		1992	Unlikely	N
Eucalyptus viridis ssp. viridis (NC)	Green Mallee	R		1994	Unlikely	N
Lepidium pseudotasmanicum	Shade Peppercress	V		1994	Unlikely	N
Logania saxatilis	Rock Logania	R		1996	Unlikely	N
Maireana excavata	Bottle Fissure-plant	V		1994	Unlikely	N
Malacocera gracilis	Slender Soft-horns	V		1996	Possible	N - Suitable habitat for species; however,

Species Name	Common Name	NPW Act	EPBC Act	Most recent record	Likelihood	Possible Impact (Y/N)
						all existing records nearby are north of Port Augusta
Ozothamnus scaber	Rough Bush-everlasting	V		1995	Unlikely	N
Phyllangium sulcatum	Mountain Mitrewort	V		1992	Unlikely	N
Prasophyllum pallidum	Pale Leek-orchid	R	VU	1992	Unlikely	N
Pycnosorus globosus	Drumsticks	V		1996	Possible	N - While possibly within the project area, this species is most likely to occur within intact overstorey vegetation of good condition.
Rumex dumosus	Wiry Dock	R		1992	Unlikely	N
Rytidosperma tenuius	Short-awn Wallaby-grass	R		1993	Possible	N - If present, unlikely to represent endemic community and be widespread locally.
Santalum spicatum	Sandalwood	V		1997	Possible	N – Not observed on field survey, despite being large and distinctive.
Thelymitra grandiflora	Great Sun-orchid	R		1996	Unlikely	N
Thysanotus tenellus	Grassy Fringe-lily	R		1995	Unlikely	N
Veronica decorosa	Showy Speedwell	R		1994	Unlikely	N

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare. **Mi (Ma)**: Migratory – Marine**, Mi (T)**: Migratory Terrestrial, **Mi (W)** – Migratory Wetlands, **Ma** (Marine).



Threatened flora (BDBSA records)

- *Acacia gracilifolia* (Graceful Wattle) SA: R
- *Anogramma leptophylla* (Annual Fern) SA: R
- *Asperula syrticola* (Southern Flinders Woodruff) SA: R
- *Austrostipa breviglumis* (Cane Spear-grass) SA: R
- *Austrostipa gibbosa* (Swollen Spear-grass) SA: R
- *Austrostipa pilata* (Prickly Spear-grass) SA: V
- *Austrostipa tenuifolia* SA: R
- *Brachyscome ciliaris var. subintegrifolia* SA: R
- *Caladenia tensa* (Inland Green-comb Spider-orchid) AUS: EN
- *Cryptandra campanulata* (Long-flower Cryptandra) SA: R
- *Deyeuxia densa* (Heath Bent-grass) SA: R
- *Dianella longifolia var. grandis* (Pale Flax-lily) SA: R
- *Echinopogon ovatus* (Rough-beard Grass) SA: R
- *Eryngium ovinum* (Blue Devil) SA: V
- *Eucalyptus cajuputea* (Green Mallee) SA: R*
- *Eucalyptus percostata* (Ribbed White Mallee) SA: R
- *Eucalyptus polybractea* (Flinders Ranges Box) SA: R
- *Eucalyptus viridis ssp. viridis (NC)* (Green Mallee) SA: R
- *Lepidium pseudotasmanicum* (Shade Peppercress) SA: V
- *Logania saxatilis* (Rock Logania) SA: R
- *Maireana excavata* (Bottle Fissure-plant) SA: V
- *Malacocera gracilis* (Slender Soft-horns) SA: V
- *Ozothamnus scaber* (Rough Bush-everlasting) SA: V
- *Phyllangium sulcatum* SA: V
- *Prasophyllum pallidum* (Pale Leek-orchid) AUS: VU, SA: R
- *Pycnosorus globosus* (Drumsticks) SA: V
- *Rumex dumosus* (Wiry Dock) SA: R
- *Rytidosperma tenuius* (Short-awn Wallaby-grass) SA: R
- *Santalum spicatum* (Sandalwood) SA: V
- *Thelymitra grandiflora* (Great Sun-orchid) SA: R
- *Thysanotus tenellus* (Grassy Fringe-lily) SA: R
- *Veronica decorosa* (Showy Speedwell) SA: R

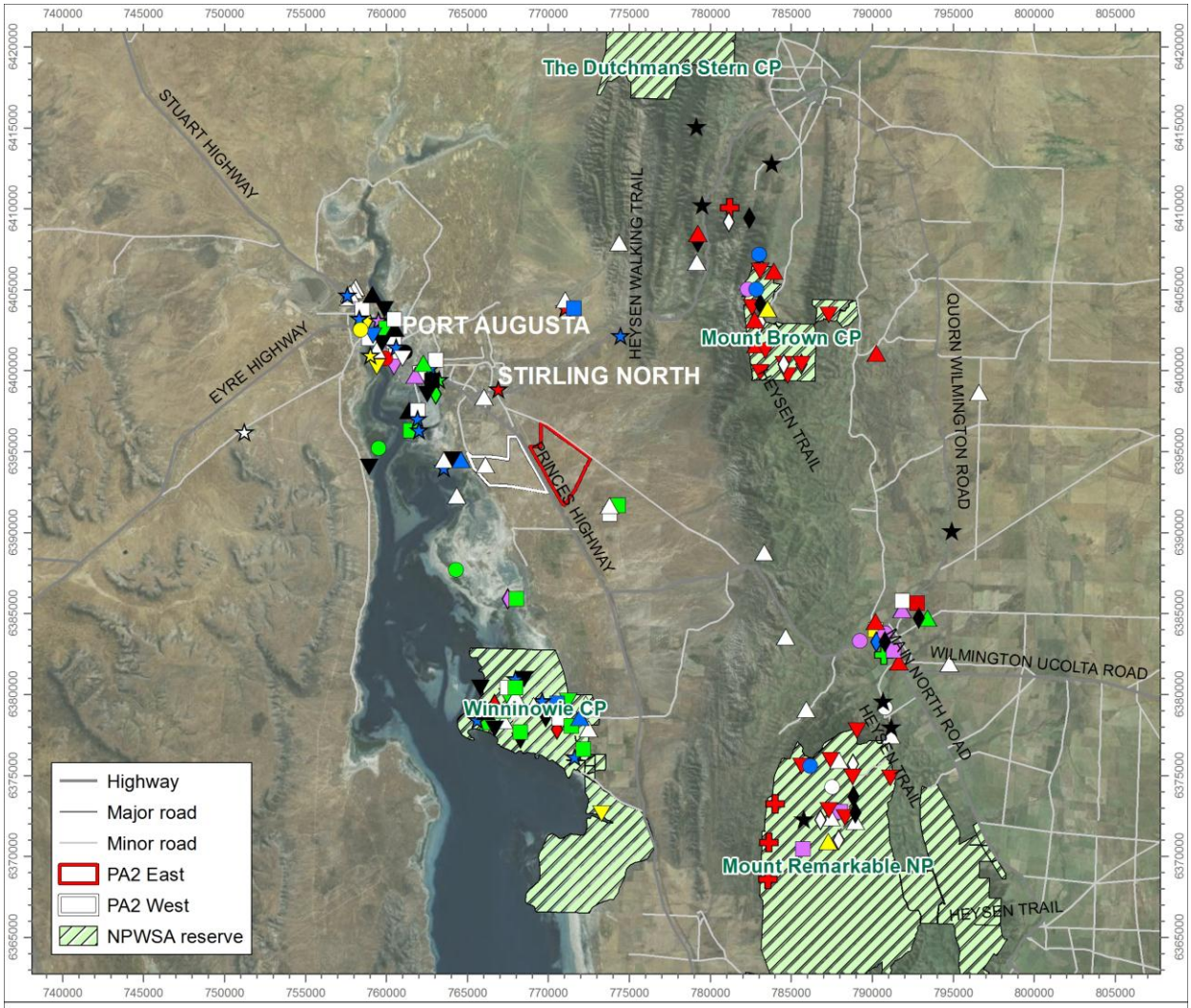
Produced by: EBS Ecology
Coordinate System:
GDA 1994 MGA Zone 53
Date: 10/07/2017

Figure 4. Threatened flora results from BDBSA search.

5.2.2 Fauna

The BDBSA search provided records for 41 fauna species within a 25 km radius of the centre point of the project site (DEWNR, 2017). The 41 species consisted of one amphibian, two mammal species, three reptile species and 35 bird species (Table 10). The results of the threatened fauna search are presented in Figure 5 and listed in Table 10.

The likelihood of rare or threatened amphibians, mammals and reptiles occurring within the project site was nil (extinct or marine) or unlikely for all species identified. A total of 16 bird species were considered to have the potential to occur on site, of which four have been observed on EBS surveys over the broader project area. The 16 species were comprised of 11 species which would only occur within coastal habitats unless flying over PA2, and a further five species which could occur within the terrestrial habitats of PA2. A further two State listed species have been observed on EBS surveys over the broader project area; the Intermediate Egret (*Ardea intermedia*) and Gilbert's Whistler (*Pachycephala inornata*). However, the Intermediate Egret would only occur in coastal habitats (Pizzey and Knight 2007), and the absence of mallee or open woodland means that the habitats within PA2 are unsuitable for the Gilbert's Whistler (OEH 2014).



Threatened fauna (BDBSA records)

- (Australian) Pied Oystercatcher (*Haematopus longirostris*) SA: R
- Australasian Shoveler (*Anas rhynchotis*) SA: R
- Banded Stilt (*Cladorhynchus leucocephalus*) SA: V
- Black-tailed Godwit (*Limosa limosa*) SA: R
- Blue-winged Parrot (*Neophema chrysostoma*) SA: V
- Brown Quail (*Coturnix ypsilophora*) SA: V
- Brown Toadlet (*Pseudophryne bibronii*) SA: R
- Bryde's Whale (*Balaenoptera edeni*) SA: R
- Burrowing Bettong (*Bettongia lesueur* AUS: EX, SA: E
- Carpet Python (*Morelia spilota*) SA: R
- Cattle Egret (*Ardea ibis*) SA: R
- Chestnut-rumped Heathwren (*Calamanthus (Hylacola) pyrrhopygius* AUS: V
- Common Sandpiper (*Actitis hypoleucos*) SA: R
- Crested Shriketit (*Falcunculus frontatus*) SA: R
- Curlew Sandpiper (*Calidris ferruginea* AUS: CR
- Diamond Firetail (*Stagonopleura guttata*) SA: V
- Elegant Parrot (*Neophema elegans*) SA: R
- Fairy Tern (*Sternula nereis* AUS: VU, SA: E
- Far Eastern Curlew (*Numenius madagascariensis* AUS: CR, SA: V
- Flinders Worm-lizard (*Aprasia pseudopulchella* AUS: VU
- Freckled Duck (*Stictonetta naevosa*) SA: V
- Great Crested Grebe (*Podiceps cristatus*) SA: R
- Grey Falcon (*Falco hypoleucos*) SA: R
- Kelp Gull (*Larus dominicanus*) SA: R
- Lace Monitor (*Varanus varius*) SA: R
- Little Egret (*Egretta garzetta*) SA: R
- Loggerhead Turtle (*Caretta caretta*) AUS: EN, SA: E
- Major Mitchell's Cockatoo (*Cacatua leadbeateri*) SA: R
- Musk Duck (*Biziura lobata*) SA: R
- Orange-bellied Parrot (*Neophema chrysogaster* AUS: CR, SA: E
- Painted Buttonquail (*Turnix varius*) SA: R
- Peregrine Falcon (*Falco peregrinus*) SA: R
- Plains-wanderer (*Pedionomus torquatus* AUS: CR, SA: E
- Restless Flycatcher (*Myiagra inquieta*) SA: R
- Rock Parrot (*Neophema petrophila*) SA: R
- Ruddy Turnstone (*Arenaria interpres*) SA: R
- Scarlet Robin (*Petroica boodang*) SA: ssp
- Slender-billed Thornbill (western ssp) (*Acanthiza iredalei iredalei*) SA: R
- Sooty Oystercatcher (*Haematopus fuliginosus*) SA: R
- Southern Giant Petrel (*Macronectes giganteus* AUS: EN, SA: V
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*) SA: E
- White-browed Treecreeper (*Climacteris affinis*) SA: R
- White-winged Chough (*Corcorax melanorhamphos*) SA: R
- Yellow-footed Rock-wallaby (*Petrogale xanthopus xanthopus* AUS: VU

0 5 10 km

Produced by: EBS Ecology
Coordinate System:
GDA 1994 MGA Zone 53
Date: 10/07/2017

Figure 5. Threatened fauna results from BDBSA search.

Table 10. Results of the BDBSA search for fauna.

Species Type	Species Name	Common Name	NPW Act	EPBC Act	Most recent record (BDBSA	Likelihood	Possible Impact (Y/N)
Amphibians	*Pseudophryne bibronii*	Brown Toadlet	R		2009	Unlikely	N – unsuitable habitat
Birds	*Acanthiza iredalei*	Slender-billed Thornbill (western ssp.)	R		1936	Possible	Y – loss of habitat
	Actitis hypoleucos	Common Sandpiper	R		2004	Possible (Coast)	N – coastal
	Anas rhynchotis	Australasian Shoveler	R		2006	Unlikely (Wetland)	N – unsuitable habitat
	Ardea ibis	Cattle Egret	R		1994	Unlikely	N – unsuitable habitat
	Arenaria interpres	Ruddy Turnstone	R		1998	Possible (Coast)	N – coastal
	Biziura lobata	Musk Duck	R		2006	Unlikely (Wetland)	N – unsuitable habitat
	Cacatua leadbeateri	Major Mitchell's Cockatoo	R		2013	Unlikely	N – unsuitable habitat
	Calamanthus (Hylacola) pyrrhopygius pedleri	Chestnut-rumped Heathwren (Southern Flinders ssp.)	V		1999	Unlikely	N – unsuitable habitat
	Cladorhynchus leucocephalus	Banded Stilt	V		2006	Possible (Coast)	N – coastal
	Climacteris affinis	White-browed Treecreeper	R		2000	Unlikely	N – few local records
	Corcorax melanorhamphos	White-winged Chough	R		2011	Unlikely	N – few local records
	Coturnix ypsilophora	Brown Quail	V		2002	Unlikely	N - unsuitable habitat
	Egretta garzetta	Little Egret	R		2005	Likely (Coast)	N – coastal
	Falco hypoleucos	Grey Falcon	R		2006	Possible	N – rarely present, nomadic.
	Falco peregrinus	Peregrine Falcon	R		2003	Possible	N – irregularly present
	Falcunculus frontatus	Crested Shrike-tit	R		1999	Unlikely	N – unsuitable habitat
	Haematopus fuliginosus	Sooty Oystercatcher	R		2006	Known (Coast)	N – coastal

Species Type	Species Name	Common Name	NPW Act	EPBC Act	Most recent record (BDBSA	Likelihood	Possible Impact (Y/N)
	Haematopus longirostris	(Australian) Pied Oystercatcher	R		2004	Known (Coast)	N – coastal
	Haliaeetus leucogaster	White-bellied Sea-Eagle	E		2013	Known (Coast)	N – coastal
	Larus dominicanus	Kelp Gull	R		1982	Unlikely (Coast)	N – coastal
	Limosa limosa	Black-tailed Godwit	R		1984	Possible (Coast)	N – coastal
	Macronectes giganteus	Southern Giant Petrel	V	EN	2000	Unlikely (Coast)	N – unsuitable habitat
	Myiagra inquieta	Restless Flycatcher	R		2002	Unlikely	N – unsuitable habitat
	Neophema chrysogaster	Orange-bellied Parrot	E	CR	1982	Unlikely (Coastal vegetation)	N - <40 birds remaining in the wild. Birds rarely come to SA.
	Neophema chrysostoma	Blue-winged Parrot	V		2006	Possible	Y – loss of habitat
	Neophema elegans	Elegant Parrot	R		2008	Known (Coastal vegetation), Inland (Likely)	Y – loss of habitat
	Neophema petrophila	Rock Parrot	R		1998	Possible (Coastal vegetation)	N – coastal
	Numenius madagascariensis	Far Eastern Curlew	V	CR	2004	Known (Coast)	N – coastal
	Pedionomus torquatus	Plains-wanderer	E	CR	NA	Unlikely	N – no records within the search area for many decades
	Petroica boodang	Scarlet Robin (Nominate race)	R		2004	Unlikely	N – unsuitable habitat
	Podiceps cristatus	Great Crested Grebe	R		2002	Unlikely (Coast)	N – unsuitable habitat
	Stagonopleura guttata	Diamond Firetail	V		2002	Unlikely	N – coastal
	Sternula nereis	Fairy Tern	E	VU	2002	Possible (Coast)	N – coastal
	Stictonetta naevosa	Freckled Duck	V		2005	Unlikely (Wetlands)	N – unsuitable habitat

Species Type	Species Name	Common Name	NPW Act	EPBC Act	Most recent record (BDBSA	Likelihood	Possible Impact (Y/N)
	Turnix varius	Painted Button-quail	R		1999	Unlikely	N – unsuitable habitat
Mammals	*Balaenoptera edeni*	Bryde's Whale	R		1989	Marine	N – marine
	Bettongia lesueur	Burrowing Bettong	E	EX	NA	Extinct	N – extinct
Reptiles	*Caretta*	Loggerhead Turtle	E	EN	1992	Marine	N – marine
	Morelia spilota	Carpet Python	R		2007	Unlikely	N – unsuitable habitat
	Varanus varius	Lace Monitor	R		2015	Unlikely	N – unsuitable habitat

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare. **Mi (Ma)**: Migratory – Marine**, Mi (T)**: Migratory Terrestrial, **Mi (W)** – Migratory Wetlands, **Ma** (Marine).

5.3 Field survey

5.3.1 Flora and Vegetation associations

A total of three vegetation associations were present over PA2, with two associations in the eastern and three in the western sections, respectively (Figure 9; Table 11).

The vegetation associations over PA2 were largely homogenous, with *Maireana pyramidata* (Black Bluebush) Low Open Shrubland covering 99.6% of the land parcels. The remaining land was covered by *Alectryon oleifolius* (Bullock Bush) Open Shrubland over *Maireana pyramidata* and *Maireana sedifolia*/*Maireana pyramidata* Low Open Shrubland (0.4% cover) (Table 11). The vegetation condition over the site varied from 0:1 to 4:1 (Figure 10; Table 11).

Table 11. Vegetation associations which cover PA2 within the proposed Port Augusta Renewable Energy Park.

Vegetation Association	SEB Condition Range	Area (ha)	Percentage of veg surveyed
4 - Maireana pyramidata Low Open Shrubland	0:1 – 4:1	1667 ha	99.6%
7 – Maireana sedifolia/Maireana pyramidata Low Open Shrubland	0:1 – 2:1	0.135 ha	<0.00001%
8 - *Alectryon oleifolius* Open Shrubland over *Maireana pyramidata*	3:1 – 4:1	6.75 ha	0.4%
Total Area		**1673.75 ha**	

Vegetation Association 4 - *Maireana pyramidata* (Black Bluebush) Low Open Shrubland

Maireana pyramidata (Black Bluebush) Low Open Shrubland (Vegetation Association 4) was the dominate vegetation association across PA2, and covered 1667 ha. This vegetation association was assessed to be in very poor to poor condition and was given an SEB score of 0:1 to 4:1.

It was extremely degraded from grazing with often only two species present, *Maireana pyramidata* (Black Bluebush) and the introduced alien species *Carrichtera annua* (Ward's Weed). The declared weed species *Marrubium vulgare* (Horehound) was present in some sections.

Species recorded are listed in Table 12 and a photograph of the vegetation association is provided as Figure 6.

Table 12. Vegetation Association 4 species list and condition assessment 2016.

Emergent and midstorey species	**Emergent species** • *Acacia ligulata* (Umbrella Bush) • *Acacia oswaldii* (Umbrella Wattle) • *Acacia papyrocarpa* (Western Myall) • *Acacia victoriae* ssp. *victoriae* (Elegant Wattle) • *Eremophila longifolia* (Weeping Emubush) • *Myoporum platycarpum* ssp. *platycarpum* (False Sandalwood) • *Senna artemisioides* ssp. *coriacea* (Broad-leaf Desert Senna) • *Senna cardiosperma* (Curved-leaf Senna) **Midstorey species** • *Abutilon halophilum* (Plains Lantern-bush) • *Maireana brevifolia* (Short-leaf Bluebush) • *Maireana erioclada* (Rosy Bluebush) • *Maireana georgei* (Satiny Bluebush) • *Maireana pyramidata* (Black Bluebush) • *Maireana sedifolia* (Bluebush)

	• *Nitraria billardierei* (Nitre-bush) • *Pimelea microcephala* (Shrubby Riceflower) • *Rhagodia spinescens* (Spiny Saltbush) • *Rhagodia ulicina* (Intricate Saltbush) • *Scaevola spinescens* (Spiny Fanflower)
Understorey species	**Indigenous understorey species** • *Austrodanthonia* sp. (Wallaby-grass) • *Austrostipa* sp. (Spear-grass) • *Enchylaena tomentosa* (Ruby Saltbush) • *Sclerolaena divaricata* (Tangled Bindyi) • *Sclerolaena obliquicuspis* (Oblique-spined Bindyi) • *Sida sp.* (Sida) • *Tecticornia tenuis* (Slender Glasswort) • *Vittadinia* sp. (New Holland Daisy) • *Zygophyllum eremaeum* (Climbing Twinleaf)
	Exotic understorey species • ***Marrubium vulgare* (Horehound) • ***Xanthium spinosum* (Bathurst Burr) • *Asphodelus fistulosus* (Onion Weed) • *Avena barbata* (Bearded Oat) • *Brassica tournefortii* (Wild Turnip) • *Carrichtera annua* (Ward's Weed) • *Medicago minima var. minima* (Little Medic) • *Mesembryanthemum nodiflorum* (Slender Iceplant) • *Nicotiana glauca* (Tree tobacco) • *Rostraria pumila* (Tiny Bristle Grass) • *Salvia verbenaca* (Wild Sage)
Conservation significant species	No national or state conservation rated flora species were recorded during the current survey.
Vegetation condition	Very Poor to Poor (0:1 – 4:1)

****** Indicates a declared weed

Figure 6. Vegetation Association 4 - *Maireana pyramidata* (Black Bluebush) Low Open Shrubland within PA2 of the proposed Port Augusta Renewable Energy Park.

Vegetation Association 7 - *Maireana sedifolia* (Pearl Bluebush) / *M. pyramidata* (Black Bluebush) Low Open Shrubland

Maireana sedifolia (Pearl Bluebush)/*M. pyramidata* (Black Bluebush) Low Open Shrubland covered 0.135 ha. This vegetation association was assessed to be in very poor condition and was given an SEB score of 0:1 to 2:1. This area was degraded from grazing and had a number of weeds including two declared species *Lycium ferocissimum* (African Boxthorn) and *Marrubium vulgare* (Horehound).

Species recorded are listed in Table 13 and a photograph of the vegetation is provided as Figure 7.

Table 13. Vegetation Association 7 species list and condition assessment 2016.

Overstorey and midstorey species	**Overstorey species included:** • *Acacia oswaldii* (Umbrella Wattle) • *Acacia papyrocarpa* (Western Myall) • *Pittosporum angustifolium* (Native Apricot) **Midstorey Species included:** • *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) • *Amyema* sp. (Mistletoe) • *Lycium australe* (Australian Boxthorn) • *Maireana eriocladа* (Rosy Bluebush) • *Maireana georgei* (Satiny Bluebush) • *Maireana pyramidata* (Black Bluebush) • *Maireana sedifolia* (Bluebush) • *Pimelea microcephala* (Shrubby Riceflower)
Understorey species	**Common native species included:** • Austrodanthonia sp. (Wallaby-grass) • *Austrostipa* sp. (Spear-grass) • *Chenopodium curvispicatum* (Cottony Goosefoot) • *Disphyma crassifolium ssp crassifolium* (Round-leaf Pigface) • *Enchylaena tomentosa var. tomentosa* (Ruby Saltbush) • *Sclerolaena patenticuspis (Spear-fruit Bindyi)* • *Sclerolaena ventricosa (Salt Bindyi)* • *Sida sp.* (Sida) • *Vittadinia sp.* (New Holland Daisy)
	Common weed species included: • **Asphodelus fasciculosus* (Onion Weed) • **Carrichtera annua* (Ward's Weed) • ***Lycium ferocissimum* (African Boxthorn) • ***Marrubium vulgare* (Horehound) • **Medicago minima var. minima* (Little Medic) • **Rostraria pumila* (Tiny Bristle-grass)
Conservation significant species	No national or state conservation rated flora species were detected during the current survey
Vegetation condition	Very Poor (0:1 – 2:1)

Figure 7. Vegetation Association 7 – *Maireana sedifolia* (Pearl Bluebush)/*M. pyramidata* (Black Bluebush) Low Open Shrubland within PA2 of the proposed Port Augusta Renewable Energy Park.

Vegetation Association 8: Alectryon oleifolius (Bullock Bush) Open Shrubland over *Maireana pyramidata* (Black Bluebush)

Alectryon oleifolius (Bullock Bush) Open Shrubland over *Maireana pyramidata* (Black Bluebush) (Vegetation Association 8) was the remaining vegetation association across PA2, and covered 6.75 ha. This vegetation association was assessed to be in poor condition and was given an SEB score of 3:1 to 4:1.

This association is listed as Vulnerable in the Gawler IBRA region in the Provisional List of Threatened ecosystems of South Australia (DEH 2005). There were only a few patches of this association, which were in poor condition due to weed invasion.

Species recorded are listed in Table 14 and a photograph of the vegetation association is provided as Figure 8.

Table 14. Vegetation Association 8 species list and condition assessment 2016.

Overstorey and midstorey species	**Overstorey species included:** • *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) • *Myoporum platycarpum* ssp. *platycarpum* (False Sandalwood) • *Acacia oswaldii* (Umbrella Wattle) • *Acacia victoriae ssp. victoriae* (Elegant Wattle) **Midstorey species:** • *Maireana pyramidata* (Black Bluebush) • *Maireana brevifolia* (Short-leaf Bluebush) • *Atriplex vesicaria* (Bladder Saltbush)

	• *Maireana sedifolia* (Bluebush) • *Pimelea microcephala* (Shrubby Riceflower)
Understorey species	**Common native species included:** • *Austrostipa* nitida (Spear-grass) • *Sclerolaena obliquicuspis* (Oblique-spined Bindyi) • *Austrodanthonia sp*. (Wallaby-grass) • *Chenopodium curvispicatum* (Cottony Goosefoot) • *Enchylaena tomentosa var. tomentosa* (Ruby Saltbush) • *Sclerolaena diacantha (Grey Bindyi)* • *Sclerolaena ventricosa (Salt Bindyi)* • *Senna artemisioides* ssp. *artemisioides* (Silver Senna)
	Common weed species included: • ***Lycium ferocissimum (African Boxthorn)* • *Carrichtera annua* (Ward's Weed)
Conservation significant species	No national or state conservation rated flora species were recorded during the current survey
Vegetation condition	Poor (3:1 – 4:1)

** Weeds of National Significance (WONS)

Figure 8. Vegetation Association 8 - *Alectryon oleifolius* (Bullock Bush) Open Shrubland over *Maireana pyramidata* (Black Bluebush) within PA2 of the proposed Port Augusta Renewable Energy Park.

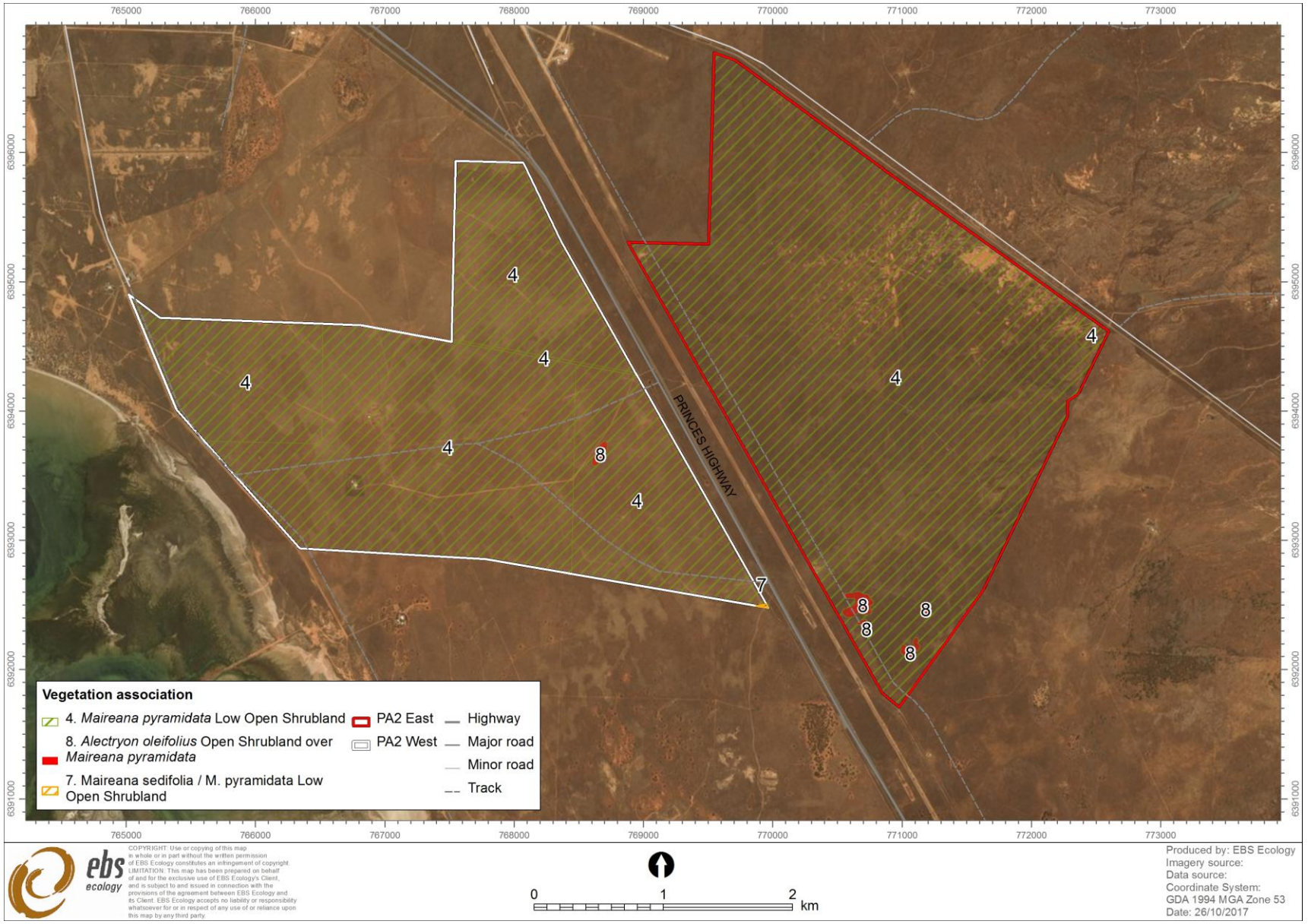


Figure 9. The vegetation associations mapped over PA2 East and West.

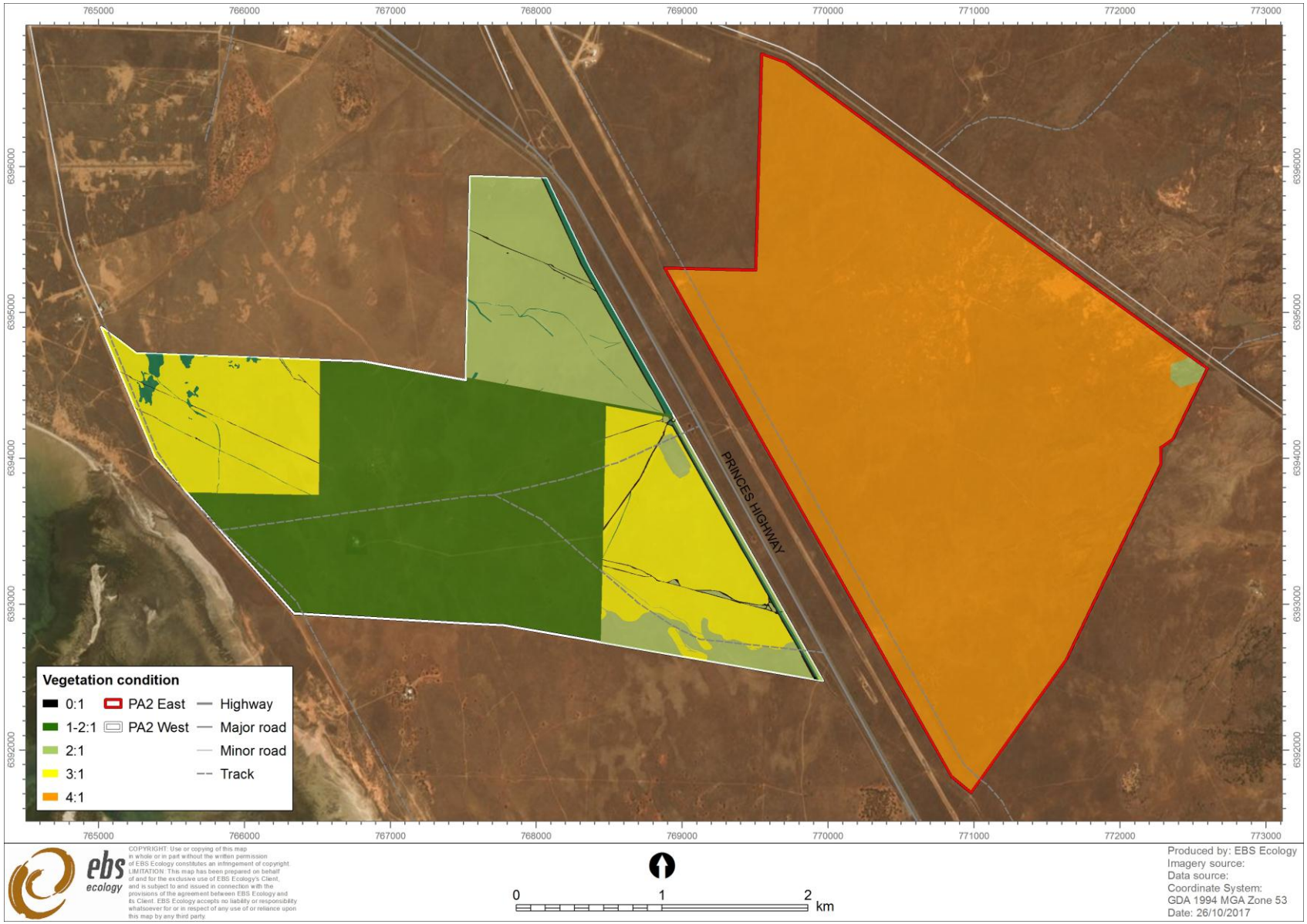


Figure 10. The vegetation condition mapped over PA2 East and West.

5.3.2 Fauna

Three point count sites were surveyed in the eastern section of PA2 (Figure 3). All surveyed sites were within *Maireana pyramidata* Low Open Shrubland (Vegetation Association 4). The results from the three sites have been split based upon the emergent species present, with two sites (Sites H and I) within sporadic *Acacia spp.* and one site with African Boxthorn (*Lycium ferocissimum*) isolated in a drainage line (Site J).

Chenopod shrubland with sporadic Acacia (Site H and I)

A total of 26 birds from seven species were observed over the two Chenopod shrublands with sporadic Acacia sites on PA2 (Appendix 1). The bird community comprised of seven small to medium sized (<22 cm in length) insectivorous species and one granviorous species; the Crested Pigeon (*Ocyphaps lophotes*). The most abundant species was the White-winged Fairy-wren (*Malurus leucopterus*), followed by the Variegated Fairy-wren (*Malurus lamberti*).

Chenopod shrubland with Boxthorn (Site J)

A total of 18 birds from five species were observed at the one Chenopod shrubland with Boxthorn on site at PA2 (Appendix 1). The most abundant species were the White-winged Fairy-wren and Variegated Fairy-wren, while two Rufous Fieldwren (*Calamanthus campestris*) were also observed.

Bird species within the western section of PA2 have not been surveyed, however, the bird species present within *Maireana pyramidata* Low Open Shrubland (Vegetation Association 4) have been determined locally. Within this vegetation association, a total of 18 species having been observed, which predominantly consisted of common semi-arid zone species (Appendix 2). This included the Elegant Parrot, which is listed under the NPW Act as Rare.

There were no EPBC Act listed species observed within PA2.

6 DISCUSSION

6.1 Flora

Maireana pyramidata (Black Bluebush) formed an intact community albeit in poor condition. The poor condition was largely due to the impacts of grazing from cattle and sheep. This has reduced the natural perennial species diversity through preferential browsing and providing vectors for weed invasion. Facelli and Springbett (2009) showed that inappropriate grazing regimes contribute to the dominance of *Maireana pyramidata*, especially in areas within close proximity to watering points and high traffic zones such as gates and natural contours. Disturbed soils crusts allow this species to preferentially germinate and out-compete species more palatable to stock. The soil crust at the time of the survey was regularly intact and with good seasonal conditions it would be expected that a large range of annual species would still persist in this area. This may indicate that this area has a history of being poorly managed but has made some recovery with a more suitable stocking rate allowing the recovery of soil crusts. Weed species observed were typical of arid region pastoral use areas with the annual species *Carrichtera annua* (Wards Weed) and perennial species such as *Marrubium vulgare* (Horehound) and *Asphodelus fistulosus* (Onion Weed) providing the most obvious exotic species cover and in higher frequency when close to watering points.

It is recommended that the *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) Very Low Open Woodland Tall Shrubland be avoided during construction, despite its poor condition, as it is listed as Vulnerable in the Provisional List of Threatened Ecosystems of South Australia (DEH 2009). Although this vegetation association is very widespread, there is limited regeneration of the *Alectryon oleifolius* ssp. *canescens* and the associated understorey is often severely degraded due to the impacts of rabbits and stock grazing. As such, this vegetation community is in decline. The association is mapped in Figure 9.

6.2 Birds

6.2.1 Terrestrial

There were no species listed under the EPBC Act that would be considered to use the terrestrial habitats within PA2, however the BDBSA search and former EBS surveys (EBS 2013) identified five species of terrestrial bird listed under the NPW Act that could possibly occur.

The species considered to possibly occur within PA2 are:

- Slender-billed Thornbill (*Acanthiza iredalei iredalei*);
- Peregrine Falcon (*Falco peregrinus*);
- Blue-winged Parrot (*Neophema chrysostoma*);
- Elegant Parrot (*Neophema elegans*); and
- Grey Falcon (*Falco hypoleucos*).

The Slender-billed Thornbill (western) was not sighted on the EBS surveys of 2013 or 2016 (EBS 2013). The last BDBSA record for the species in the project area occurred in 1935, however there is a record

from Winninowie Conservation Park in 2010 (ALA 2017). The chenopod shrublands within PA2 were determined to be suitable habitat for this species (EBS 2013). The Slender-billed Thornbill (western) is unlikely to be significantly impacted by the Project, as the species has a stable population, which in South Australia extends west Port Augusta and across the Nullarbor Plain (TSSC 2013). Furthermore, the species has not been observed in the Project area following extensive search effort.

The Elegant Parrot and Blue-winged Parrot, are closely related species and share a similar ecology. While both species would be more common in the coastal habitats adjacent to the project area or within the woodlands of Winninowie Conservation Park, they may occur within PA2 due to the presence of chenopod shrublands (Pizzey and Knight 2007). The Elegant Parrot is expected to occur as it has been observed within the boarder project area in *Maireana pyramidata* Low Open Shrubland (EBS 2013), which dominates PA2. The key habitats locally for these species would be coastal samphire and mallee, due to the provision of food and nesting resources (Pizzey and Knight 2007; Pers. Obs.), which do not occur within the site. Therefore, these species will not be significantly impacted by the clearance of native vegetation associated with the proposed development.

The Peregrine Falcon has not been observed within the project area, however, is known to be present within the Port Augusta region (Birds SA 2016). This species requires a platform at height to nest, which typically take the form of a cliff ledge, however may also include an abandoned raptor or corvid nest or man-made structure (Pizzey and Knight 2007). There are no known nesting records of this species within the vicinity of PA2, however, they may use the area for foraging, given the wide variety of habitats they may be observed within. It is expected that the presence of Peregrine Falcons in the Project area would be irregular or rare, and therefore, the species will not be significantly impacted by the Project.

The Grey Falcon is Australia's rarest raptor species. It is nomadic, ranging throughout the arid zone. The last recorded on BDBSA within 25 km of the PA2 occurred in 2006. Whilst suitable habitat for this species exists within PA2, it is considered unlikely that the species will be present given its rarity, particularly within the south of its range, and therefore will not be significantly impacted by the Project.

7 RECOMMENDATIONS

- It is recommended that the *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) Very Low Open Woodland Tall Shrubland be avoided during construction, despite its poor condition, as it is listed as Vulnerable in the Provisional List of Threatened Ecosystems of South Australia (DEH 2009). The bird community associated with this vegetation association is also significantly more diverse and abundant than that of *Maireana pyramidata* (Black Bluebush) Low Open Shrubland which covers 99.6% of the Project area.
- Utilise areas adjacent to stock watering points, where vegetation and soil structure are most degraded. This would limit ecological impacts.
- Ensure that a Construction Environmental Management Plan has been developed prior to construction. This will provide specific, detailed methods to avoid environmental and ecological damage during the construction phase.
- Best practice environmental management measures should be implemented during and following construction. Staff training and awareness of ecological issues, flora and fauna species, their values and threats is important for successfully minimising impacts during construction and operation.

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9 APPENDICES

Appendix 1. The abundance of each observed fauna species at PA2 east.

Common Name	Site H		Site I	Site J	
	On	Off	On	On	Off
Crested Pigeon			2		
Dusky Woodswallow		1			
Eurasian Skylark		1			1
Little Raven					2
Redthroat			1		
Rufous Fieldwren				2	
Variegated Fairy-wren			4	5	
White-browed Babbler		2			
White-winged Fairy-wren	11		4	8	

Appendix 2. The species of bird observed within vegetation association 4 - *Maireana pyramidata* Low Open Shrubland over the broader project area within the proposed Port Augusta Renewable Energy Park.

Scientific Name	Common Name	NPW Act	EPBC Act
Alauda arvensis	Eurasian Skylark		
Aphelocephala leucopsis	Southern Whiteface		
Artamus cinereus	Black-faced Woodswallow		
Artamus cyanopterus	Dusky Woodswallow		
Calamanthus campestris	Rufous Fieldwren		
Corvus mellori	Little Raven		
Epthianura albifrons	White- Fronted Chat		
Falco cenchroides	Nankeen Kestrel		
Gymnorhina tibicen	Australian Magpie		
Lalage tricolor	White-winged Triller		
Lichenostomus virescens	Singing Honeyeater		
Malurus lamberti	Variegated Fairy-wren		
Malurus leucopterus	White-winged Fairy-wren		
Manorina flavigula	Yellow-throated Miner		
Neophema elegans	Elegant Parrot	R	
Ocyphaps lophotes	Crested Pigeon		
Pomatostomus superciliosus	White-browed Babbler		
Psophodes cristatus	Chirruping Wedgebill		

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Appendix 7.2.1
Archaeological Risk Assessment

Port Augusta Renewable Energy Park Stage 2

Development Application Volume 4: Technical Appendices

December 2017

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25 July 2017

Gaby Powell
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Dear Gaby,

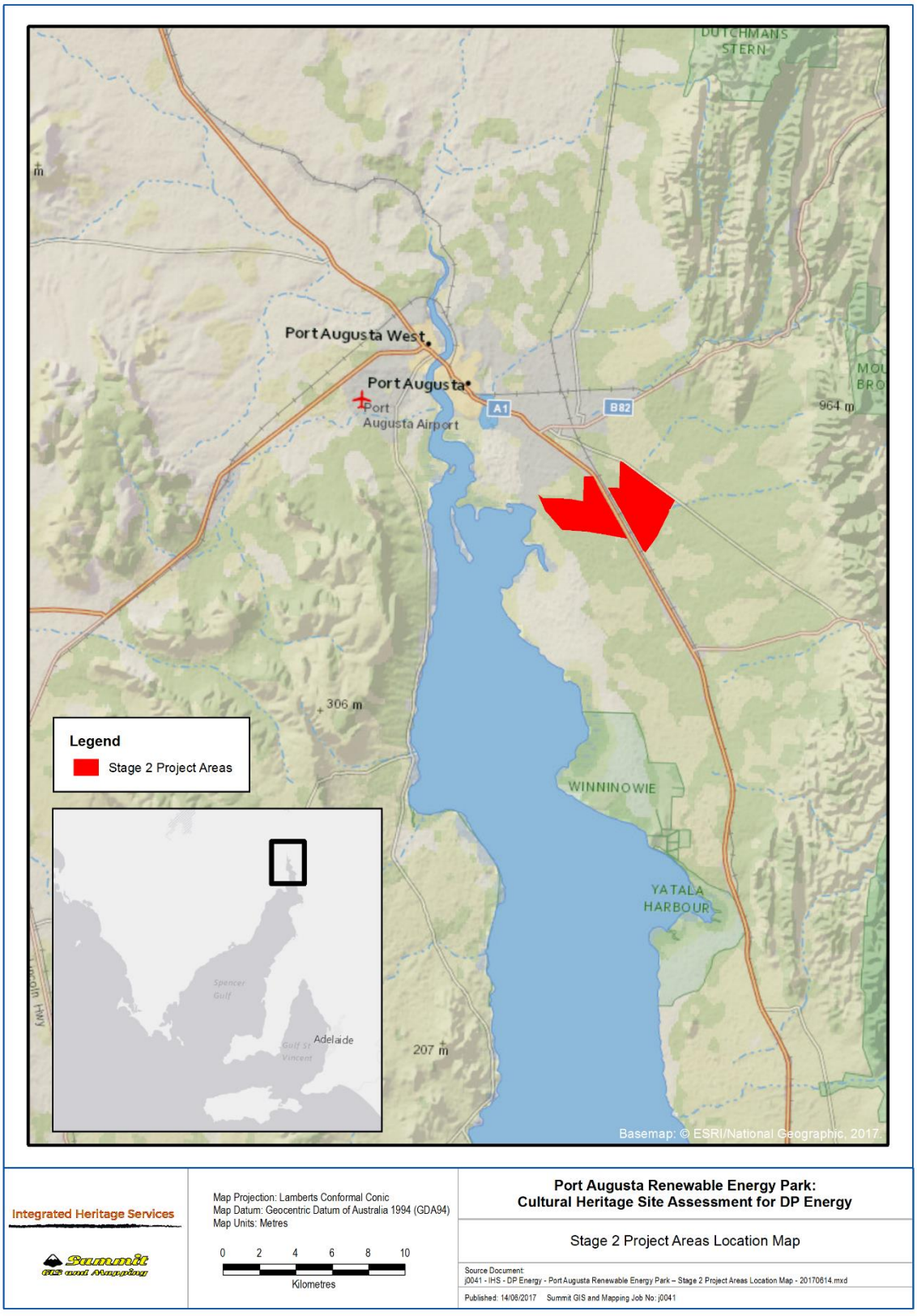
LETTER REPORT
ARCHAEOLOGICAL RISK ASSESSMENT FOR DP ENERGY AUSTRALIA'S PORT AUGUSTA PROJECTS – PORT AUGUSTA RENEWABLE ENERGY PARK STAGE 2

Introduction
Integrated Heritage Services Pty Ltd (IHS) has been engaged by DP Energy Australia Pty Ltd (DPEA) to undertake a preliminary archaeological risk assessment of the areas within the proposed Port Augusta Renewable Energy Park Stage 2 (Stage 2) project site that are additional to those areas assessed by Australian Cultural Heritage Management (ACHM) for Port Augusta Renewable Energy Park Stage 1 (Stage 1) (See Map 1). The archaeological risk assessment has been undertaken via a broad pedestrian and vehicular field inspection designed to identify areas ranging from low to high risk in considering Aboriginal archaeological cultural heritage and European heritage.

The work has been designed to align with previous Aboriginal and European heritage studies undertaken for the wider Stage 1 footprint (see Field & Morley 2014). Desktop research has been previously covered in the 2014 report and will not be repeated here. The current work includes reporting on the updated Central Archive (Register of Aboriginal Sites and Objects) search undertaken by DPEA.

The current works have been conducted to inform DPEA of any significant heritage concerns in these initial planning stages including the delineation of areas of heritage sensitivity as described above. Recommendations in relation to management of cultural heritage for Stage 2 are congruent with those proposed for the wider Stage 1 through the 2014 work.

The field inspection, of Stage 2 areas that were not surveyed by ACHM in 2014, was undertaken on the 16 May 2017 by IHS Senior Archaeologist David Mott.



Map 1 – Stage 2 Project Areas

Methodology

The Field and Morley 2014 report was studied prior to fieldwork to provide relevant background details regarding previous cultural heritage research for the general area. The 2014 report also provided methodological values around general sites types prevalent for the general region coupled with the more specific analyses of the general principles of association between Aboriginal sites and environmental features that was applied here.

Desktop work also included analysis of aerial photography enabling targeted field inspection of areas featuring greatest ground surface visibility. High resolution aerial photography combined with project area delineations on a GPS provided additional support in efficient and targeted fieldwork.

Liaison with DPEA determined the results of the updated search of the Register of Aboriginal Sites and Objects held at the Central Archive, Department of State Development – Aboriginal Affairs and Reconciliation (DSD-AAR). Access points were worked out and provided as GPS files to assist in efficient fieldwork.

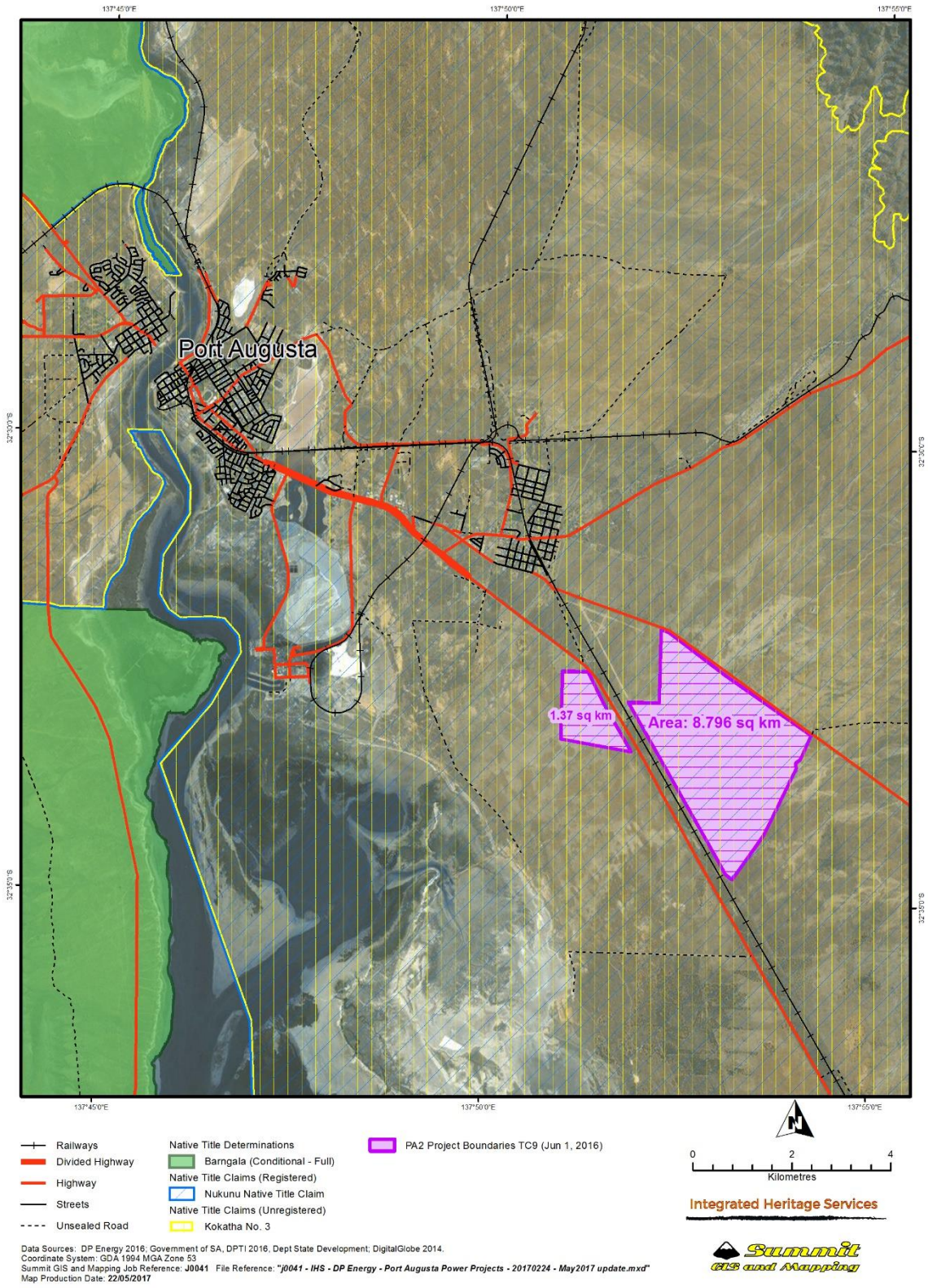
Fieldwork was started at the Stage 2 east site north east boundary extent and sandy exposures featuring greatest ground surface visibility were inspected first. Pedestrian transects were undertaken over the landscape with focus on sandy exposures that offered excellent ground surface visibility (up to 100%). Areas of lesser ground surface visibility (less than 10% visibility in approximately 60% of the total project area) were afforded less intensive inspection using a combination of pedestrian transects and where possible, vehicular inspection (along formed tracks only).

Standard GPS was used to delineate Aboriginal heritage sites and isolated artefacts discussed in this report. Artefacts and the general project area were recorded with digital photography.

Identification of Aboriginal Stakeholders - Native Title and Traditional Owners

The Field and Morley 2014 report identifies the Nukunu Traditional Owners as primary Aboriginal stakeholders for the Stage 1 project areas as discussed in that report. Stage 2 west site is situated within and to the north of the previously studied main Stage 1 project area and falls within the Nukunu native title claim (NNTT No SC1996/05, Federal Court No SAD6012/1998) and is intersected by the more recently lodged claim, the Kokatha No. 3 native title claim (NNTT No SC2016/002, Federal Court No SAD83/2016 - not registered but pending further negotiations presumably to deal with the overlap). Regardless of native title boundaries (See Map 2) the central piece of legislation for protection of Aboriginal heritage sites in South Australia is the SA *Aboriginal Heritage Act 1988* (AHA) that seeks to consult and involve "traditional owners" defined in the AHA as, "traditional owner of an Aboriginal site or object means an Aboriginal person who, in accordance with Aboriginal tradition, has social, economic or spiritual affiliations with, and responsibilities for, the site or object" (AHA 1988: 4).

DSD-AAR is the Department responsible for administering the AHA and the Central Archive search undertaken with DSD-AAR for Stage 2 recently advised that there are "are various Aboriginal groups/organisations/traditional owners that may have an interest" (Langeberg 2017: 1). The letter lists Barngarla Aboriginal Corporation, Kokatha Aboriginal Corporation and the Nukunu Peoples Council Inc. but does not provide absolute certainty as to which groups should be consulted.



Map 2 – Stage 2 survey areas relative to Native Title Claim Boundaries

The Barngarla native claim (NNTT No SCD2016/001) determined in June 2016 does not intersect the Stage 2 project areas with its nearest point being 6.73 kilometres to the west and outside of the westernmost extent of Stage 2. It is unlikely Barngarla have traditional owner interests for Stage 2 for this reason.

The Kokatha were consulted in the earlier stages of the 2014 Stage 1 work that included Stage 2 west site areas (excluding Section 708 Hundred 330600) and lands south of Stage 2 east site. and they stated that the Stage 1 site was outside of their area of interest;

> *"Senior Kokatha man Andrew Starkey was contacted and invited to participate in the heritage works. However, Mr Starkey declined the invitation on behalf of the Kokatha People, as the Nukunu people are the Traditional Owners of this area as defined under the AHA. Further, Mr Starkey advised ACHM's CEO and Principal Heritage Advisor, Neale Draper, that the current survey area is outside their area of interest." (Field & Morley 2014: 13)*

Considering the Kokatha position as advised above and as the Stage 2 site is within (west site) and adjacent to (east site) the 2014 Stage 1 project areas, combined with the recently rejected (2 August 2016) registration test decision for Kokatha No. 3 native title claim, it is unlikely Kokatha have traditional owner interests for Stage 2.

The Nukunu claim does intersect with the entirety of the Stage 2 project area and as discussed in the 2014 report it has been established that the Stage 1 site is within the traditional owner interests of the Nukunu (represented by the Nukunu Peoples Council). Nukunu are assessed here as being the primary traditional owners for Stage 2 in relation to the identification and management of Aboriginal cultural heritage sites and objects as defined by the AHA.

Updated search of the Central Archive – Register of Aboriginal Sites and Objects

The updated search of the Central Archive, incorporating Stage 2, was undertaken by DPEA and no Aboriginal heritage sites were recorded for the area. The letter does note;

> "The applicant is advised that sites or objects may exist in the proposed development area, even though the Register does not identify them. All Aboriginal sites and objects are protected under the *Aboriginal Heritage Act 1988* (the Act), whether they are listed in the Register or not." (Langeberg 2017: 1)

The absence of previously recorded sites or objects does not necessarily mean sites do not exist in the area; it may simply mean that no cultural heritage surveys have been undertaken in the area to date, and as a result unrecorded sites may be present. It is an offence under section 23(a) of the AHA to damage, disturb or interfere with any Aboriginal site, object or remains.

It is noted, and delineated on Map 2, that there are two previously recorded sites held on the Central Archive that are situated just outside the westernmost border of Stage 2. Sites 2960 and 29591 are artefact scatters recorded in 1990 during then transmission line surveys. They are situated well beyond the current project area with Site 2960 being the nearest at approximately 280 metres to the west.

Updated search of Relevant European Heritage Lists

Updated searches of relevant heritage lists finding that no non-Aboriginal European heritage sites occur within the current project area. Resources searched include World Heritage Areas, National Heritage List, Commonwealth Heritage List, National Estate Register (now defunct), South Australian Heritage Places, and South Australian Heritage Areas.

Results

The archaeological inspection of Stage 2 was conducted on 16 May 2017.

The project area mainly consisted of flat open, previously cleared paddocks with occasional minor undulations and considerable evidence of intensive cattle grazing (old troughs and feeders, fencing, pens and other infrastructure, an artificial dam etc.). Farm tracks crisscross the landscape and a few minor drainage gullies are present in the eastern side of the project area. No significant creeks, trees or remnant (undisturbed) landscape was noted. Figures 1 and 2 illustrate typical land characteristics across most the project area.

At least 60% of the total project area is vegetated with primarily low lying grasses and saltbush (*Atriplex sp.*). Very few trees occur in Stage 2 and all noted were introduced (i.e. Willow and Pepper trees) and only occur around the fringes, artificial dams or near dilapidated farm infrastructure. The vegetated areas offered very low ground surface visibility (less than 10%). The remaining 30-40% of project area offering greater ground surface visibility has been subject to considerable natural and artificial erosion (mainly cattle, wind and water) causing sandy exposures that offered 'windows' of visibility beyond the otherwise thick, low vegetation. This was primarily the case in the east site of Stage 2. The west site of Stage 2 (Lot 708) was completely flat and vegetated with low ground surface visibility. Despite this and given the proximity of Site 2960 some 280 metres west outside of Stage 2, several transects were undertaken across the paddocks that yielded no results.

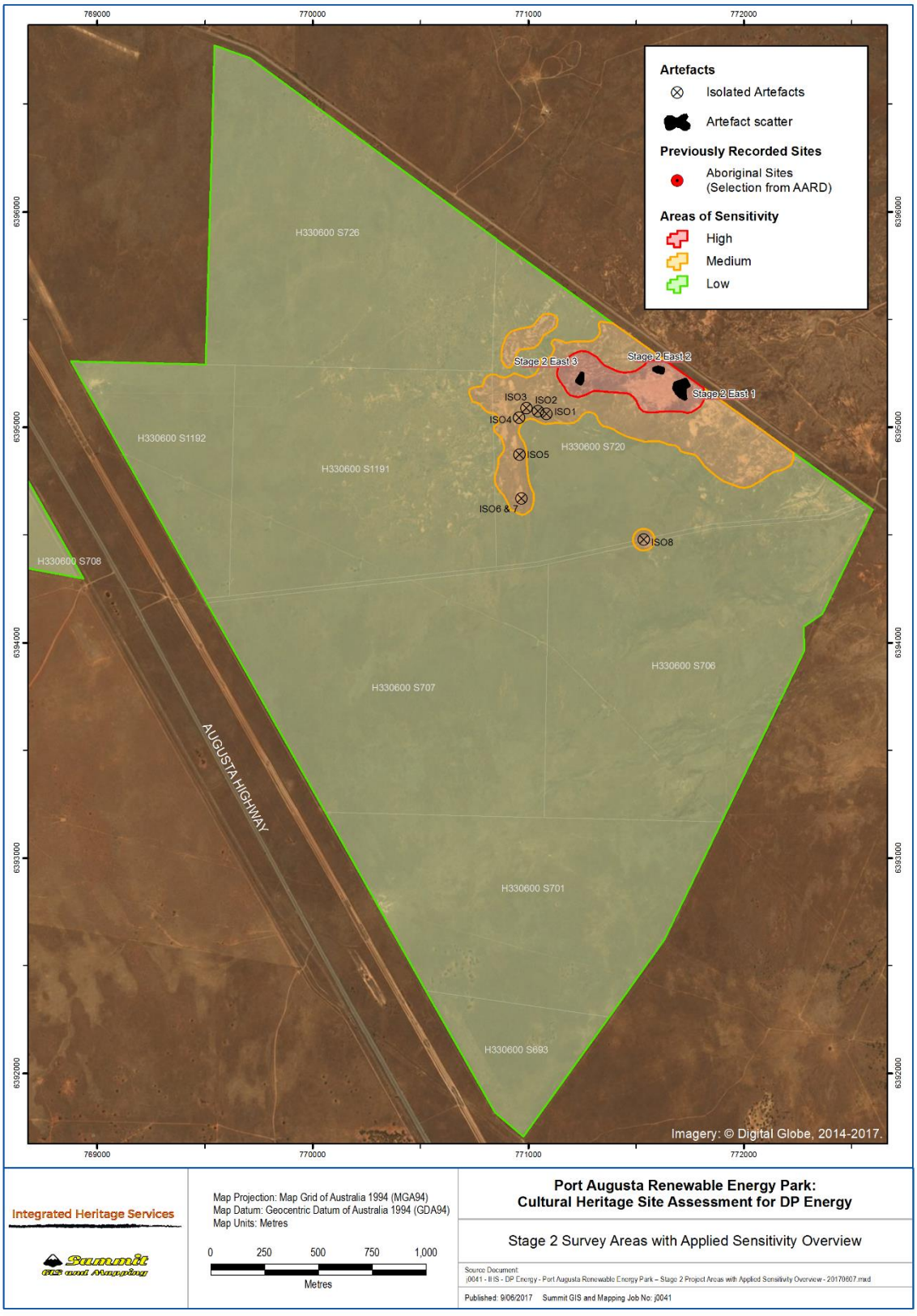
The archaeological inspection of Stage 2 resulted in the recording of three Aboriginal archaeological sites (artefact scatters) and eight isolated artefacts that helped form the basis of the current risk profile (See Map 3). As the current field inspection was designed to be a broad-level inspection to designate a risk profile across Stage 2, detailed recording was not undertaken. Boundaries for the sites have been recorded as well as a brief overview of site contents and characteristics.

The sites, isolated artefacts and areas of sensitivity are delineated on Map 3 for the eastern section of the project area and Map 4 delineates the areas of sensitivity for the western section of the project area. Descriptions of sites and isolated artefacts follow the maps.

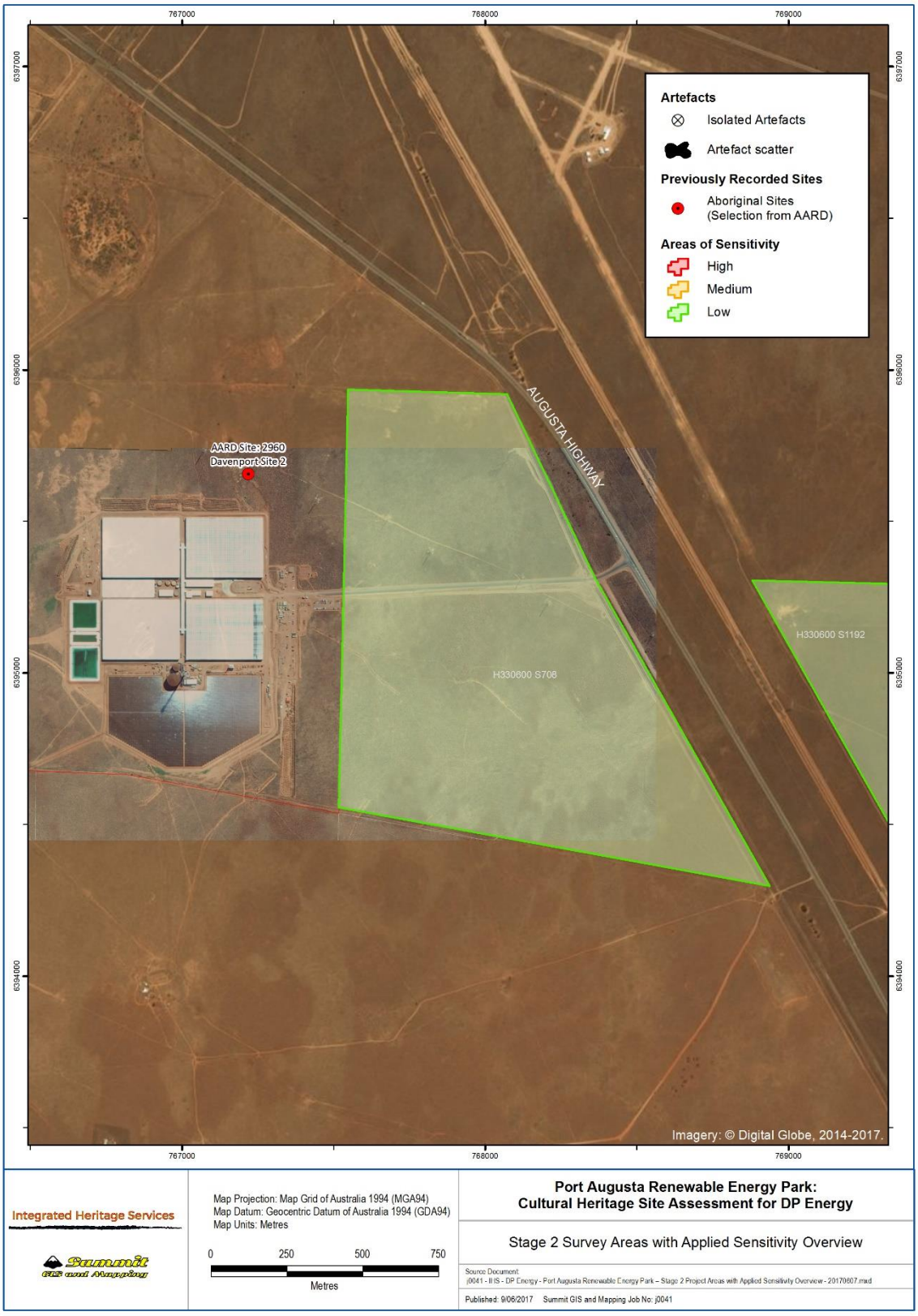
No sites or areas of European heritage significance were recorded in the project area.

Figure 1 – View to north showing typical vegetation across Stage 2

Figure 2 – View of dilapidated farm infrastructure southeast Stage 2



Map 3 – Results showing Aboriginal Sites, Isolated Artefacts & Risk Profile – Stage 2 east



Map 4 – Results showing Risk Profile – Stage 2 west

Stage 2 East 1:

Stage 2 East 1 is situated within an exposed and disturbed landscape on the middle-eastern fringe of Stage 2 and consists of 30+ artefacts including flakes, broken flakes and a small core. The site is subject to regular inundation and wind erosion. The primary raw material represented is silcrete and there is also quartz and a light brown chert at the site. The artefacts are spatially relatable and as such represent a locus of human activity constituting an Aboriginal site. The artefacts are subject to natural disturbances in the form of wind and water erosion and it is possible that some artefacts are buried in the loose sands. See Figures 3-5.

Figure 3 – View to north across Stage 2 East 1

Figure 4 – Fine grained silcrete flake with retouched edge

Figure 5 – Small chert core

Stage 2 East 2:

Stage 2 East 2 is situated approximately 80 metres to the north of Stage 2 East 1 within the same exposed and disturbed landscape on the middle-eastern fringe of the project area. The site is subject to regular inundation and wind erosion. Stage 2 East 2 consists of 15+ artefacts including flakes and broken flakes. The primary raw material represented is silcrete and there is also quartz and a light-medium brown chert at the site. The artefacts are spatially relatable and as such represent a locus of human activity constituting an Aboriginal site. Artefact density is variable and would average about 1/4m2. The artefacts are subject to natural disturbances in the form of wind and water erosion and it is possible that some artefacts are buried in the loose sands. See Figures 6-8.

Figure 6 – View south across Stage 2 East 2

Figure 7 – Chert and silcrete flakes

Figure 8 – Partially buried silcrete flake

Stage 2 East 3:

Stage 2 East 3 is situated approximately 270 metres to the west of Stage 2 East 2. The vegetation is thicker towards the inner sections of the paddocks with sandy exposures being less frequent. The site is subject to regular inundation and wind erosion. A distinct sandy exposure features approximately 15 artefacts including flakes and broken flakes and one core (including one broken quartz flake with distinct edge work). The primary raw material represented is silcrete and quartz at the site. The artefacts are spatially relatable and as such represent a locus of human activity constituting an Aboriginal site. Artefact density is variable and would average about 1/5m2. The artefacts are subject to natural disturbances in the form of wind and water erosion and it is possible that some artefacts are buried in the loose sands. See Figures 9-10.

Figure 9 – View southeast across Stage 2 East 3

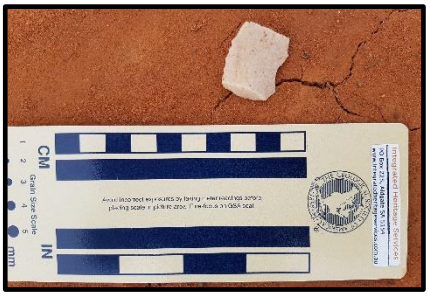
Figure 10 – Broken silcrete flake

Isolated artefacts

A total of eight isolated artefacts were recorded in the same middle-eastern section of Stage 2 at seven distinct locations (two isolated artefacts recorded within a metre of each other and counted here as one location). Some time was spent inspecting these locations and no other artefacts could be found. It is possible these are purely isolated occurrences and considering the lack of supporting archaeological materials do not constitute Aboriginal sites as defined by the AHA. They are 'objects' as defined by the AHA. It is possible further artefacts are located in buried sands or beneath vegetation but it was not possible within the scope of this work to investigate further. The isolated artefacts are detailed in Figure 11.

ISO 1

ISO 2



ISO 3

ISO 4

ISO 5

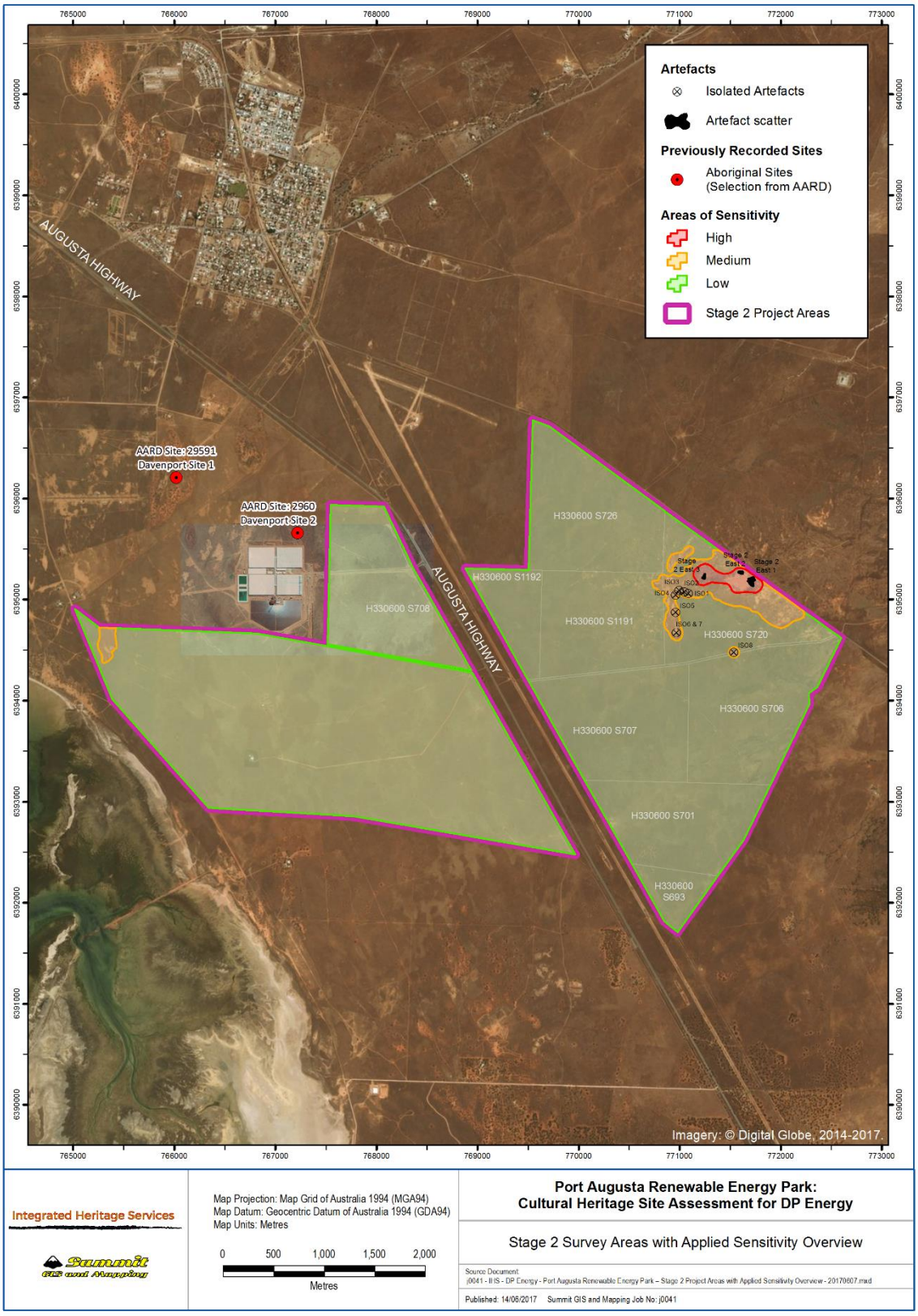
ISO 6 & 7

ISO 8

Number	Description
ISO 1	Silcrete flake
ISO 2	Silcrete flake; retouched both sides
ISO 3	Silcrete flake (broken)
ISO 4	Silcrete core
ISO 5	Quartzite flake
ISO 6	Silcrete flake (broken) – LHS in pic
ISO 7	Silcrete flake – RHS in pic
ISO 8	Chert flake

Figure 11 – Isolated artefacts 1-8

For reference, Map 5 shows the findings of this survey and with the sensitivity findings of ACHM in 2014 which together cover the entirety of the Stage 2 project site.



Map 5 –Stage 2 Project Area showing results from 2014 and 2017 inspections

Summary & Recommendations

IHS was engaged by DPEA to undertake a preliminary archaeological risk assessment of the proposed Stage 2 section of the Stage 1 footprint (See Map 1).

The work has been designed to align with previous heritage studies undertaken for the wider Stage 1 footprint (see Field & Morley 2014).

The current works have been conducted to inform DPEA of any significant heritage concerns in these initial planning stages including the delineation of areas of heritage sensitivity.

Recommendations in relation to management of cultural heritage for Stage 2 are congruent with those proposed for the wider Stage 1 through the 2014 work.

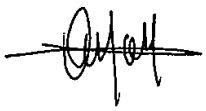
The archaeological inspection of Stage 2 resulted in the recording of three Aboriginal archaeological sites (artefact scatters) and eight isolated artefacts.

No sites or areas of European heritage significance were recorded in the project area.

As a result of the inspection work the following recommendations are made:

1. A cultural heritage survey (archaeological and anthropological), including Traditional Owner participation, should be undertaken of the infrastructure footprint prior to the commencement of ground disturbing work. This is particularly recommended for areas designated as High or Medium Sensitivity.
2. Aboriginal heritage sites and Objects should be treated in accordance with the requirements of the South Australian *Aboriginal Heritage Act* 1988 (AHA).
3. Areas designated as High or Medium Sensitivity have more potential to contain surface or subsurface archaeological material than areas designated as Low Sensitivity. It is therefore recommended that the extent of proposed infrastructure within these areas be minimised and it is anticipated that a cultural heritage survey will assist in refining recommendations in relation to these areas.
4. Following cultural heritage survey of the final footprint, a Cultural Heritage Management Plan should be developed for the long-term management of cultural heritage sites within Stage 2.

Yours sincerely,



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References

Field, M. & Morley, A. 2014 Port Augusta Renewable Energy Park: Cultural Heritage Site Assessment. Report prepared for DP Energy Pty Ltd.

Langeberg, P. 2017 *Letter response to Central Archive search for PA2 (File No. AHRCA17/11)*. Letter to Gabrielle Powell, DP Energy.

Legislation

Aboriginal Heritage Act 1988 (SA)

Native Title Act 1993 (Cwth)

Appendix 7.2.2
Port Augusta REP Stage 1
Cultural Heritage Site Assessment

Port Augusta Renewable Energy Park Stage 2

Development Application Volume 4: Technical Appendices

December 2017

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Port Augusta Renewable Energy Park: Cultural Heritage Site Assessment

Anthropological and Archaeological

By: Michael Field & Andrew Morley

Date: February 2014

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Port Augusta Renewable Energy Park: Cultural Heritage Site Assessment

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Reviewed by:	Fiona Sutherland Nick Butler	Date: 11/12/2013 28/01/2014
Approved by:	David Mott	Date: 06/02/2014

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The professional advice and opinions contained in this document are those of the consultants, Australian Cultural Heritage Management Pty Ltd, and do not represent the opinions and policies of any third party.

The professional advice and opinions contained in this document do not constitute legal advice.

Spatial Data

Spatial data captured by Australian Cultural Heritage Management Pty Ltd in this document for any newly recorded sites has been obtained by using hand held or differential GPS units using the GDA94 co-ordinate system.

Abbreviations

Term	Meaning
AARD	Aboriginal Affairs and Reconciliation Division (SA)
ACHM	Australian Cultural Heritage Management Pty Ltd
AHA	*Aboriginal Heritage Act 1988* (SA)
AHC	Aboriginal Heritage Committee
DPC	Department of the Premier and Cabinet (SA)
DP Energy	DP Energy Australia Pty Ltd
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (amended 2003) (Cwth)
GIS	Geographic Information Systems
NPC	Nukunu Peoples Council
NTA	*Native Title Act 1993* (Cwth)
RNE	Register of the National Estate
SAM	South Australian Museum

Executive Summary

Australian Cultural Heritage Management Pty Ltd (ACHM) was engaged by DP Energy Australia Pty Ltd (DP Energy) to undertake an anthropological heritage survey and an initial archaeological heritage site assessment of the proposed Port Augusta Renewable Energy Park footprint (the Project Site), taking into account Aboriginal (anthropological and archaeological) and European (archaeological) cultural heritage (the heritage works). The brief for this cultural heritage assessment included undertaking desktop research as well as conducting the heritage works for the footprint of the proposed layout of 59 turbines, two solar areas and known associated infrastructure. The aims of the heritage works were threefold:

- To identify and record any Aboriginal heritage sites through consultation with a representative of the Nukunu Traditional Owners.
- To provide a risk assessment of the proposed project footprint and categorise areas of High, Medium and Low Sensitivity, including an archaeological assessment of places with the potential to contain surface and sub-surface cultural material.
- To document any points of interest with regard to European heritage.

Please note that this report does not provide classification of areas which are **Cleared** and **Not Cleared** archaeologically, but rather provides a risk assessment regarding the likelihood of surface and subsurface archaeological materials being located within the Project Site. Future archaeological surveys will be able to refine this assessment and define **Cleared** and **Not Cleared** heritage areas.

The heritage works were conducted from 2 to 3 September 2013 with a view to informing DP Energy of any significant heritage concerns in the initial planning stages. Two ACHM consultants, one archaeologist and one anthropologist, along with a representative of the Nukunu people were involved in the assessment. At the request of the Nukunu people the survey was undertaken by males.

The following provides a brief summary of the results of this cultural heritage assessment, and recommendations arising from the study.

Heritage Database Searches

Conducted as part of the desktop research for the study, a search of the Department of Premier and Cabinet - Aboriginal Affairs and Reconciliation Division's Central Archive found that one registered site and four reported sites lie within 1 km of the Project Site. One of these is located within the Project Site. The site types are all listed as 'Archaeological' and are generally located in the western, coastal section of the Project Site. Upon completion of the heritage works, it was determined that the Aboriginal site located within the Project Site should not be affected by the proposed works provided any changes to the layout do not result in a reduced clearance between the turbines and the sites.

A search of the South Australian Museum Anthropology Database returned 252 results for finds in the vicinity of the Project Site. Although the records are not detailed enough to indicate the exact locations of these finds, these results provide some indication of the extent of occupation of Aboriginal people within the region, and the likelihood of uncovering other such objects within the Project Site.

Previous Research

A review of relevant literature shows that the Project Site lies entirely within the traditional lands of the Nukunu People. The literature states that from 1849, when they were under considerable pressure from pastoralists moving onto their traditional country, the Nukunu remained together in small communities around Orroroo, Melrose, Wilmington, Stirling North and at Baroota (Hercus 1992: 11).

The Project Site and surrounds have received little attention regarding its history of European settlement. A search of the Australian Heritage Database did not return any results within the Project Site. The search parameters were widened to historical sites within 1 km of the Project Site. This search still resulted in no historical sites being listed. One site on the now defunct Register of National Estate (RNE) is located near, but not within, the Project Site.

Anthropological Site Survey Results

During the anthropological survey, it was determined by the Traditional Owners that the majority of the proposed infrastructure associated within the Project Site was clear of anthropologically significant areas.

Several areas within the Project Site were deemed to be of higher risk as they may contain Aboriginal heritage sites. These areas include ephemeral and permanent water sources and watercourses, sand dunes and areas of undisturbed native vegetation.

One watercourse was deemed to be highly significant during the heritage works. However, this area is located well outside of the Project Site and is not likely to be impacted by the proposed works.

Archaeological Initial Site Assessment Results

Aboriginal Heritage

The archaeological site assessment identified no new archaeological sites and no known Aboriginal sites intersect with the proposed infrastructure within the Project Site.

The archaeological site assessment resulted in the identification of areas of Medium and Low Sensitivity in terms of archaeological potential. Areas of Medium Sensitivity include the pockets of remnant vegetation located within the Project Site and the permanent and ephemeral watercourses mentioned above. Further, coastal areas were deemed to be of Medium Sensitivity. The remainder of the Project Site is considered to be of Low Sensitivity.

The above assessment relates to the following features:

- Medium Sensitivity relating to turbines intersecting with watercourses (turbines 55 to 58)
- Medium Sensitivity relating to turbines intersecting with Sand dunes and undisturbed areas (turbines 16, 42, 43, 50 and 51)
- Low Sensitivity relating to all other turbines (turbines 1 to 8, 10 to 15, 17 to 23, 25, 26, 31 to 34, 36 to 39, 40 to 41, 44 to 49, 52 to 54 and 59 to 67)
- Low Sensitivity relating to the two Solar Array areas, with the exception of a small area within the western Solar Array area which was determined to have Medium Sensitivity

Coastal areas within the Project Site have a greater risk of containing Aboriginal heritage sites, even those that have been highly disturbed.

European Heritage

No new European heritage sites were recorded during the heritage works. However, several old homesteads, wells and stone water tanks were noted. All of these places were noted as being greater than 1 km from the proposed turbine locations and associated infrastructure. Further, the current proposed layout does not impact on any of these places. These European places are all located along the already established tracks outside of the Project Site. It is possible that similar sites exist within the Project Site but were not located due to the nature of the archaeological inspection.

One State Heritage place and one place on the now defunct RNE was noted through desktop research as being close to, but not within, the Project Site.

Recommendations

As a result of the anthropological survey and archaeological site assessment, and in consultation with a representative of the Nukunu people, the following recommendations are made:

1. A thorough archaeological pedestrian cultural heritage survey, including Traditional Owner participation, should be undertaken of the infrastructure footprint prior to the commencement of ground disturbing work. This is particularly recommended in the case that any infrastructure will disturb areas designated as being of Medium Sensitivity.
2. All previously recorded Aboriginal heritage sites should be treated in accordance with the requirements of the South Australian *Aboriginal Heritage Act* 1988 (AHA). Section 23 of the AHA states that it is an offence to 'damage, disturb or interfere' with any Aboriginal site or object, without Ministerial approval. It should be noted that no known Aboriginal sites intersect with proposed infrastructure within the Project Site.
3. Areas designated as being of Medium Sensitivity have more potential to contain surface or subsurface archaeological material than other areas. It is therefore recommended that the extent of proposed infrastructure within these areas be minimised and it is expected that a full archaeological survey will assist in refining recommendations in relation to these areas.
4. Should a future archaeological survey identify any previously unreported Aboriginal archaeological sites within the refined Project Site, section 23 approval will be required if DP Energy wishes to damage, disturb or interfere with those sites.
5. Following an archaeological pedestrian cultural heritage survey of the final footprint, a Cultural Heritage Management Plan should be developed to provide for the long term management of significant cultural heritage sites within the Project Site that will not be subjected to a section 23 application. As part of the Cultural Heritage Management Plan, a site discovery procedure similar to the example supplied in Appendix 1 of this report should be developed.

6. As all waterways (permanent and ephemeral) are of High Significance to Aboriginal people and are more likely to contain surface and/or subsurface archaeological materials, work in these areas should be avoided.
7. No new European heritage sites were recorded during the heritage works. However, several old homesteads, wells and stone water tanks were noted outside of the proposed Project Site. Should similar European places be located within the Project Site, they should be avoided where possible until the proposed archaeological survey is completed. Please note that the current proposed development footprint does not impact on any noted historical places.

Table of contents

List of figures

List of maps

1 Introduction

Australian Cultural Heritage Management Pty Ltd (ACHM) was engaged by DP Energy Australia Pty Ltd (DP Energy) to undertake an anthropological survey and an initial archaeological site assessment of the proposed Port Augusta Renewable Energy Park footprint (the Project Site), taking into account Aboriginal (anthropological and archaeological) and European (archaeological) cultural heritage (the heritage works). The brief for the heritage works included undertaking desktop research as well as conducting the heritage works for the footprint of the proposed layout of 59 turbines, two solar areas and known associated infrastructure. DP Energy provided ACHM with shape files of the Project Site and proposed infrastructure which ACHM used to inform the spatial scope of the heritage works. The aims of the site assessment were threefold:

- To identify and record any Aboriginal heritage sites through consultation with a representative of the Nukunu Traditional Owners.
- To provide a risk assessment of the proposed project footprint and categorise areas of High, Medium and Low Sensitivity, including an archaeological assessment of places with the potential to contain surface and sub-surface cultural material.
- To document any points of interest with regard to European heritage.

The heritage works were conducted with a view to informing DP Energy of any significant heritage concerns in the initial planning stages, and resulted in the delineation of areas of sensitivity as described above, and specific recommendations with regard to the cultural heritage management of any significant areas within the Project Site. A thorough archaeological survey of the precise final footprint is recommended to take place prior to the commencement of ground disturbing work. This methodology was discussed in the field between ACHM and Nukunu on 2 September, 2013 and agreed to by DP Energy.

This report includes information relating to the project and the Project Site, basic environmental data, relevant Aboriginal and European heritage legislation, the results of heritage register searches, an overview of previous research relating to the Project Site, background information relating to the Nukunu people and the methodology employed during the site assessment. The report also includes the results of the heritage works and the recommendations that arose from these works for the protection of cultural heritage (both Aboriginal and European) within the Project Site.

1.1 Survey Participation

The anthropological site assessment and initial archaeological site assessment took place on 2 and 3 September 2013 and included the following participants:

- D'Arcy Evans (Nukunu Representative)
- Aylza Donald BA (Hons), BA (Soc Sci) (ACHM Anthropologist)
- Michael Field MA, Grad Dip., BA (Arch) (ACHM Archaeologist)
- Andrew Morley BA (Hons) (ACHM Senior Anthropologist)

2 Project Description and Project Site

The following section briefly describes the project, providing information about the proposed infrastructure, solar areas and turbine layout.

2.1 Project Description and Proposed Impacts

DP Energy proposes to install 59 wind turbines, two fields of solar modules and associated infrastructure. The development will likely connect to the Davenport Substation. Associated infrastructure such as underground cables and laydown areas will also be required to complete these works.

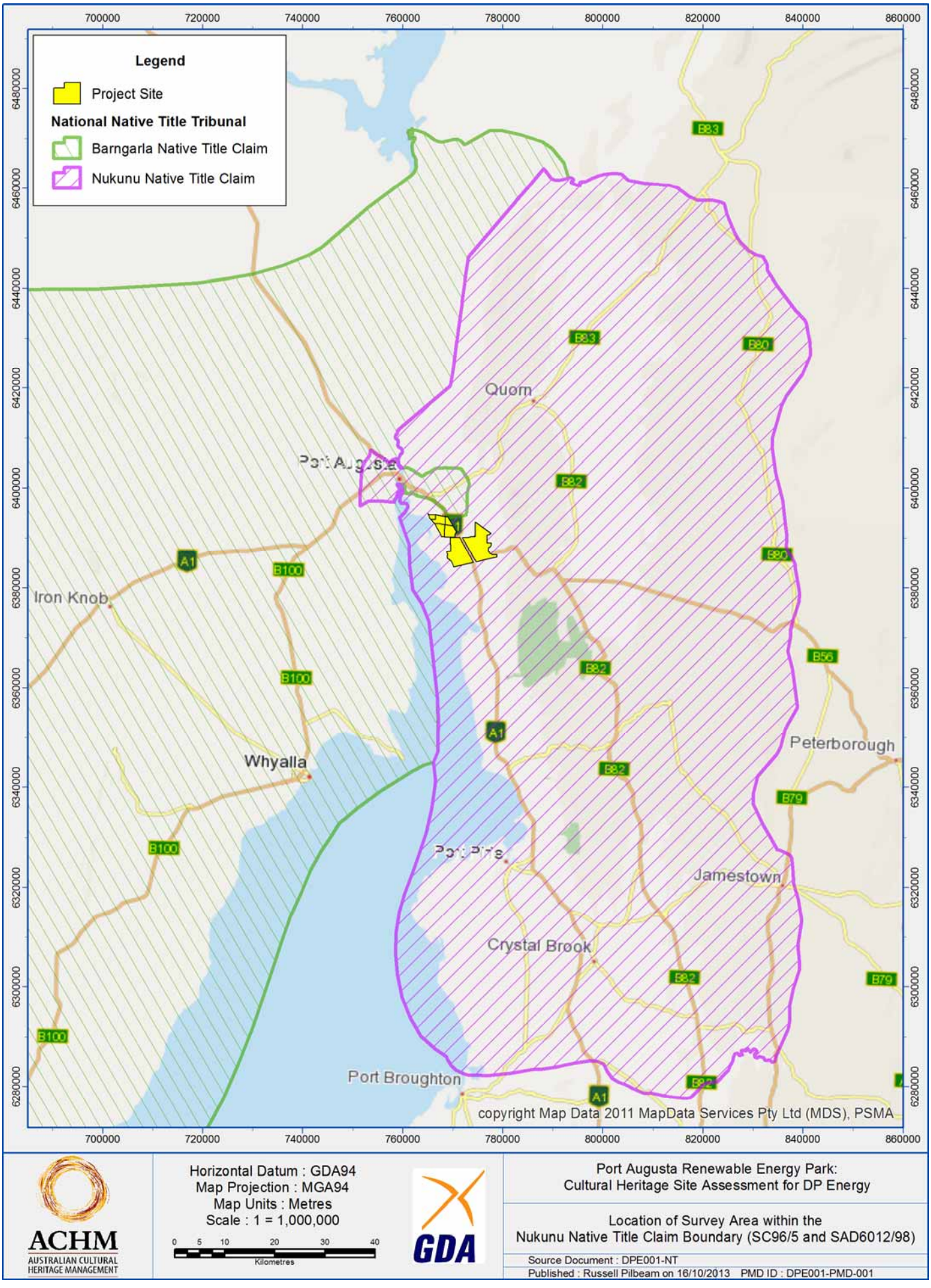
2.2 Project Site

The Project Site is on flat coastal plains just southeast of Port Paterson, on the eastern side of the Spencer Gulf, South Australia (Map 2-2). The Project Site is located within private (mostly disturbed) land. Two active transmission lines transect the eastern section of the Project Site heading north northwest and then northwest towards Davenport substation. Several inactive lines were also noted during the heritage works. A major train line and water pipe follow the Port Augusta Highway through the Project Site.

The general landscape is riddled with access tracks that make navigation through the Project Site easy. Very few of these tracks, however, align with the proposed development.

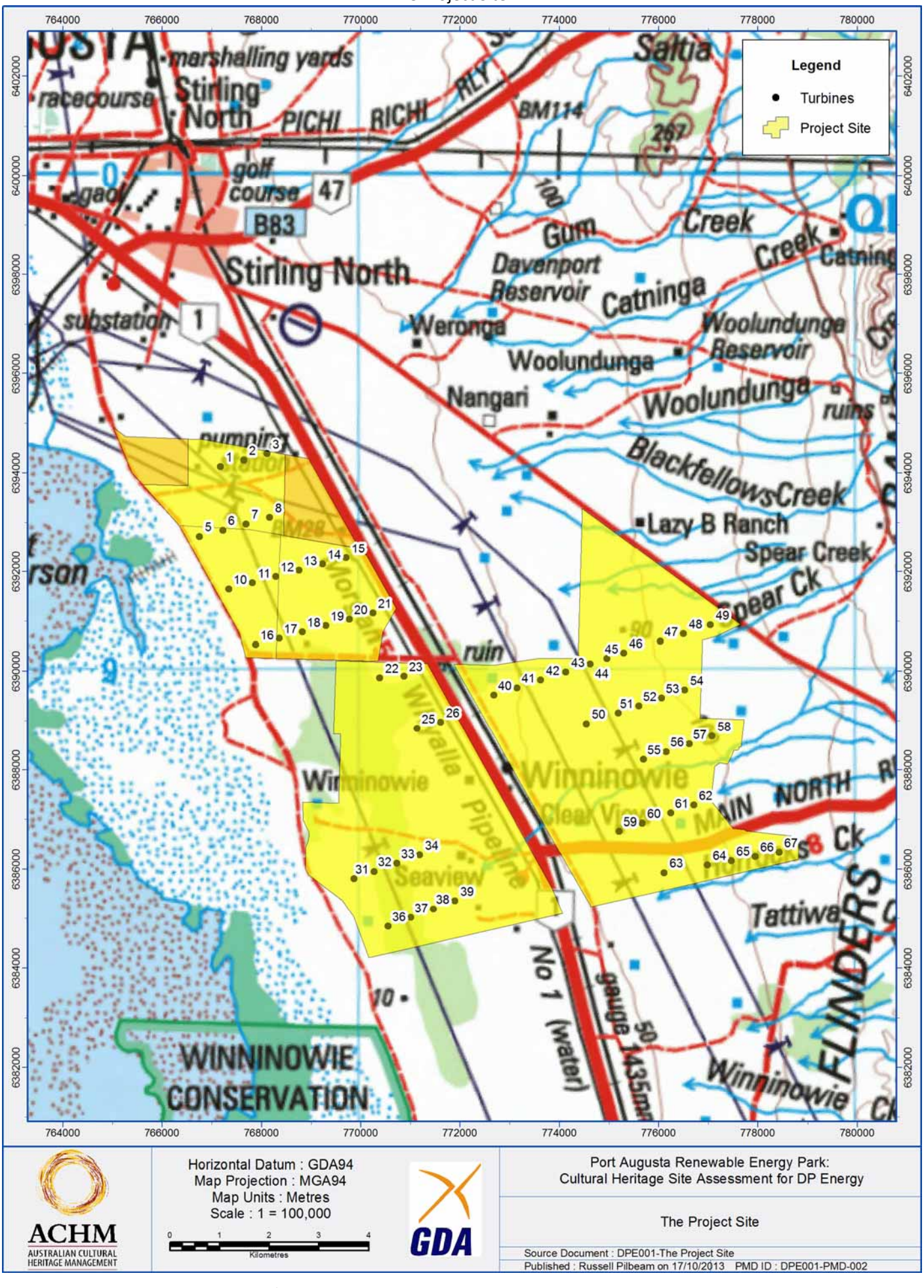
2.3 Nukunu Native Title Claim area (SC96/5 and SAD6012/98)

The Nukunu people have an active Native Title Claim (SC96/5 and SAD6012/98) over 12587 km² of the surrounding region, encompassing both the Port Pirie and Port Augusta metropolitan areas. Their claim extends from Broughton in the south to Jamestown and Rye in the east, and includes an area to the north and east of Port Augusta (Map 2-1). The Project Site falls within the Nukunu claim area. Please see section 6 for a discussion of the relevant stakeholder groups.



Map 2-1: Location of Project Site within the Nukunu Native Title Claim area (SC96/5 and SAD6012/98) and adjacent Barngarla Native Title Claim area.

The Project Site



Map 2-2: The Project Site

3 Environmental Background

3.1 The Project Site

The Project Site is geographically situated to the southeast of the top of Spencer Gulf, south of the established township of Stirling North. The area is semi-arid with a mean annual rainfall of 215.5 mm. The mean maximum annual temperature for Port Augusta is 26.2°C and the mean minimum annual temperature is 12.1°C (Bureau of Meteorology 2013).

The greater environmental area once consisted of ancient dune systems running parallel northwest to southeast which have now been disconnected by road, rail and grazing country terminating at the eastern shores of the Spencer Gulf. Vegetated by large trees including sheoak (*Casuarina sp.* and *Allocasuarina sp*.) and native pine (*Callitris sp*.), the interdunal swales often featured seasonal standing freshwater on a clay base. They presented as attractive habitation rich in resources for Aboriginal people.

General images of the Project Site can be seen in Figures 3-1 to 3-4.

3.2 Topography

The environmental characteristics of the wider area surrounding the Project Site include sandy plains featuring some well-established linear dunes gently sloping down to the Gulf. To the eastern areas within the Project Site are distinctive higher land systems, which lead to steep features, their sides etched with highly delineated drainage courses leading down to the ephemeral watercourses noted during the heritage works.

The Project Site is largely cleared for grazing on gently undulating plains, with a series of late Quaternary aged red sand dunes running in a west-east direction, eventually subsiding just east of the coastal and tidal flats adjacent to the Gulf. The maximum height of the dunes is 30 m, with the remainder of the area varying between 0-20 m (Ecological Associates 2009).

3.3 Vegetation

In the central area of the Project Site, the dunes are stabilised by sparse Western Myall (*Acacia papyrocarpa*) low open woodland or sparse Northern Cypress pine (*Callitris glaucophylla*) Woodland. Mixed Mallee shrubland sometimes co-occurs with Northern Cypress-pine woodland on the dunes.

The vegetation within this landscape is dominated by the plains' Chenopod shrubland, including bluebush (*Maireana sp*.) and saltbush (*Atriplex sp*.) communities. This Chenopod shrub understorey is used for livestock grazing (see Laut et al. 1977: 38). The intertidal saltmarsh and tidal flats were composed of Chenopod and samphire shrubland. Samphire shrubland, constituting saltbush species of the genus *Tecticornia*, typically occurs in frequently flooded, low lying, highly saline areas. These coastal flats had formerly been vegetated with Sandalwood (*Santalum spicatum*) which was cut down in colonial times for export of its fragrant oil to Asia.

3.4 Geology and Geomorphology

The plains and foothills west of the northern Mount Lofty and southern Flinders Ranges are generally calcareous soils formed on calcrete or soft rubbly calcareous sediments. These are usually loams or sands. The nature of the geology of Port Augusta indicates that the Project Site is likely to feature:

- Quaternary Sediments – comprising a mixture of gravel, sand and clay layers – including red sandy or clay soils, calcrete and gravel layers – deposited in outwash alluvium along the present and ancient creek lines
- Tertiary Sediments – which comprise a mixture of sand, limestone and clay layers. The type of Tertiary sediments present depends on location within the basin
- Proterozoic Basement Rocks – these outcrop in the Flinders Ranges to the east and the Stuart Shelf to the west and underlie the sedimentary layers in the low topographic area between (Australian Water Environments 2009)

Bores completed in the near surface Quaternary sediments show that standing water levels within the Quaternary sediments range from 4.6 m to 15 m below ground level.

The configuration of the original parallel red sand dune system that crosses the Project Site from the northwest to the southeast supports the suggestion by Bowler (1975) that they are part of the linear dune field formed during the Pleistocene winds that blew from west-northwest in the Late Quaternary period. Modern winds from the southwest have subsequently stripped off up to 3 m of upper sand levels over parts of these dunes exposing a firm calcareous horizon which has become the base surface for the remaining artefact assemblages and bone

fragments. Bowler (1975) argues that the last phase of the late Quaternary dune building occurred between 17,000 and 15,000 years ago.

3.5 Land Use

The current use of the allotments includes rural living and cattle and sheep grazing. Grazing remains the predominant activity within the Project Site.

Several transmission lines run southeast to northwest towards Davenport substation. The Augusta Highway bisects the Project Site, running parallel with a water pipe and associated infrastructure and a major train line connecting Port Augusta with the southern part of the Project Site.

Figure 3-1: Project Site facing north towards turbine 14

Figure 3-2: Project Site facing north east towards turbine 49 from turbine 44

Figure 3-3: Project Site facing south towards turbine 63 from Main North Road

Figure 3-4: Project Site facing west towards turbines 25 and 26 (400 m)

4 Desktop Research Methodology

4.1 Desktop research

Desktop research was conducted for the general area in the vicinity of the Project Site. A constraints analysis has also been conducted with predictive modelling in order to determine the likelihood of surface and subsurface archaeological sites and places being located within the Project Site.

An initial archaeological site assessment has been conducted within the Project Site and this has informed the predictive modelling.

The following methodology was utilised with respect to the desktop research:

- Heritage register searches of the Register of Aboriginal Sites and Objects and the Central Archive held by the Department of Premier and Cabinet (DPC) – Aboriginal Affairs and Reconciliation Division (AARD), the South Australian Museum (SAM) Anthropology Register, the Australian Heritage Database and ACHM archive for previously recorded Aboriginal sites in or adjacent to Project Site
- Identification of environmental features known to be commonly associated with Aboriginal sites in the region
- Identification of the Aboriginal cultural groups with traditional cultural interests in the Project Site, and their representation and interests with respect to Aboriginal heritage and native title issues
- Identification of the legal representatives of the Aboriginal groups with interests in the project localities
- Identification of both State and Commonwealth legislative requirements relating to Aboriginal heritage and native title
- Outline of a methodology for conducting any Aboriginal heritage field survey and consultation with the Aboriginal groups
- Owing to the substantial size of the Project Site, ACHM has included a section that highlights landforms that often have associations with archaeological and anthropological sites. This is intended to facilitate the effective targeting of resources for heritage management and to inform the decision making process that will determine the final Project Site layout

4.2 Predictive Modelling and Data analysis

4.2.1 Predictive Desktop Study of Site Locations and Associations

A desktop study using Geographic Information Systems (GIS) was undertaken to map locations of archaeological sites and places of Aboriginal cultural significance within the Project Site. The aim was to produce a regional predictive model enabling identification of culturally sensitive locations (for example, places of high archaeological probability, wetlands, springs, etc.). This involved conducting a spatial analysis of archaeological, cultural, topographical and environmental (particularly soils and native vegetation) features.

4.2.2 GIS Analysis

GIS spatial analysis of environmental and archaeological/cultural heritage includes analysis of site proximity with physical characteristics such as gradient, aspect and proximity to water.

The GIS analysis is based upon:

- A digital database of water catchment
- Types/categories of archaeological remains
- Land use and land cover
- Geological and soil type
- Native vegetation
- Types/categories of topographical features (including slope and aspect if relevant), including water bodies
- Neighbourhood proximities

GIS analysis will show how the variables relate spatially by:

- Showing patterns in the database and

- Predicting the juxtaposition between the cultural and the topographical in relation to the catchment, given a specified set of characteristics from the database.

In summary, the GIS component of the desktop study provides both a comprehensive mapping of known Indigenous sites in the assessment area, as well as extrapolating from these data and associated landscape characteristics to provide a predictive analysis of site types, locations, and associated management issues.

4.2.3 Database of Aboriginal sites and significant cultural places

Desktop research is an integral part of predictive modelling. Searches of the Register of Aboriginal Sites and Objects and the Central Archive held by AARD, the SAM Anthropology Register, the Australian Heritage Database and ACHM archive for previously recorded Aboriginal sites in or adjacent to the proposed Project Site were undertaken to identify existing heritage features and inform predictive modelling. Environmental features known to be commonly associated with Aboriginal sites in the region were also identified.

4.2.4 Zones of Sensitivity

To frame the risk assessment in a way that provides clear and concise recommendations in relation to the likelihood of archaeological materials and anthropological sites being present at the Project Site, the following definitions are made. Please note that areas have been assessed based on an initial archaeological assessment and a desktop analysis. Given the Project Site lies between costal and mountain range areas there is a risk of surface and subsurface archaeological materials being present.

- Low Sensitivity: Areas designated as Low Sensitivity should be viewed as those which have some level of risk of containing surface or subsurface archaeological materials. These are those located on disturbed land (i.e. ploughed and cleared or built up) with a low topographical relief. Generally these are also confined to inland areas and are not located near natural features associated with Aboriginal heritage sites such as limestone outcrops, sand dunes, hills and watercourses or water sources.
- Medium Sensitivity: Areas designated as Medium Sensitivity are areas with a heightened or greater risk of there being surface or subsurface archaeological materials. These areas may be heavily vegetated with native bushland and offer very poor ground surface visibility. These areas are often located near, or on, natural features usually associated with Aboriginal heritage sites, such as limestone outcrops, hills, sand dunes, watercourses and water sources. Areas that are reasonably undisturbed are also given a Medium Sensitivity status.
- High Sensitivity: Areas designated as High Sensitivity are those on totally undisturbed land and that ACHM archaeologists have observed other archaeological sites within. These areas often have a high topographical relief, such as hills or dune systems. They may occur in association with rocky outcrops, watercourses or water sources. High Sensitivity areas are also those where Aboriginal heritage places or objects have been noted within close proximity.

Given the nature of the landscape, all areas within the Project Site have some level of sensitivity and therefore a certain amount of risk for containing archaeological sites. A full pedestrian archaeological survey will allow the classification of specific **Cleared** and **Not Cleared** areas for development.

5 Heritage Protection Legislation

There are a number of pieces of Commonwealth and State legislation that may have relevance to projects carried out in South Australia. This section provides an outline of the applicable Aboriginal and European heritage protection legislation.

5.1 *Aboriginal Heritage Act 1988* (SA)

The *South Australian Aboriginal Heritage Act 1988* (AHA) is administered by the Aboriginal Affairs and Reconciliation Division (AARD) of the Department of the Premier and Cabinet (DPC). It provides blanket protection for any Aboriginal site, object or remains, whether previously recorded or not.

Section 3 of the AHA defines an Aboriginal heritage site as follows:

> *"Aboriginal Site" means an area of land*
>
> *(a) That is of significance according to Aboriginal tradition; or*
>
> *(b) That is of significance according to Aboriginal archaeology, anthropology or history.*

Under section 23 of the AHA it is an offence to damage, disturb or interfere with an Aboriginal site, object or remains unless written authorisation from the Minister for Aboriginal Affairs and Reconciliation has been obtained. Penalties for an offence under this section are up to $10,000 or six months imprisonment in the case of an individual, or $50,000 in the case of a corporate body.

Under section 35 of the AHA it is an offence to divulge information relating to an Aboriginal site, object, remains or Aboriginal tradition without authorisation from the relevant Aboriginal group or groups. Penalties for an offence under this section are up to $10,000 or six months imprisonment.

The AHA is the most relevant piece of legislation for projects undertaken in South Australia. While the AHA provides no legal requirement to carry out Aboriginal heritage surveys these are often undertaken during the planning stage of a project. Surveys provide a risk minimisation and due diligence strategy to reduce the prospect of delays during construction, and to avoid an inadvertent breach of the AHA.

5.2 *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cwth)

The *Commonwealth Aboriginal and Torres Strait Islander Heritage Protection Act 1984* provides a mechanism for the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities to make declarations regarding the protection of an Aboriginal area. It may be applied in cases where the Minister is satisfied that State or Territory law does not provide effective protection of the area from a threat of injury or desecration. Declarations made under this Act may involve restricting activities and/or access to an Aboriginal site.

Under section 22 of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cwth) it is an offence to conduct behaviour or participate in an action that contravenes a declaration made by the Minister. Where this relates to an Aboriginal place or site, the penalties for an individual are $10,000 or imprisonment for five years, or both, and $50,000 for a corporate body. Where an Aboriginal object is concerned, the penalties for an individual are $5000 or imprisonment for two years, or both, and $25,000 for a corporate body.

The provisions of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cwth) may become relevant if the requirements of the AHA are not adhered to.

5.3 *Environment Protection and Biodiversity Conservation Act 1999* (amended 2003) (Cwth)

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (amended 2003)* (EPBC Act) fulfils Australia's obligations as a signatory to the World Heritage Convention 1972 by protecting World Heritage properties in Australia. The EPBC Act also protects places of national cultural and environmental significance from damage and interference by establishing a National Heritage List (for places outside of Commonwealth land) and a Commonwealth Heritage List (for places within Commonwealth land).

Under the EPBC Act any action that has, will have or is likely to have a significant impact on a place of national cultural and/or environmental significance must be referred to the Minister for Sustainability, Environment, Water, Population and Communities for approval. The EPBC Act sets out a procedure for obtaining approval, which may include the need to prepare an environmental impact statement for the proposed action (an action is defined in section 523 of the Act to include a project, a development, an undertaking, or an activity or series of activities).

Breaches of the EPBC Act attract penalties of up to 5,000 penalty units for an individual, or 50,000 penalty units for a body corporate. The monetary value of a penalty unit is defined by under Section 4AA (1A) of the *Crimes Act 1914* (Cwth).

The EPBC Act is only relevant in relation to an Aboriginal site if the site is (1) within the boundaries of a World Heritage-listed property, or (2) entered onto the National or Commonwealth Heritage Lists. There is currently no requirement for referral to the Commonwealth Department for Sustainability, Environment, Water, Population and Communities under the EPBC Act if the site is not entered onto one of these lists.

5.4 *Native Title Act 1993* (Cwth)

The *Commonwealth Native Title Act 1993* (NTA) is part of the Commonwealth's response to the High Court's decision in Mabo v Queensland (No. 2). It adopts the common law definition of native title, defined as the rights and interests that are possessed under the traditional laws and customs of Aboriginal people in land and waters, and that are recognised by the common law. These rights may exist over Crown Land but do not exist over land held under freehold title.

The NTA recognises the existence of an Indigenous land ownership tradition where connections to country have been maintained and where acts of government have not extinguished this connection. The NTA requires that consultation must occur between DP Energy and Nukunu native title representatives if any land subject to native title is to be affected.

5.5 Native Title (South Australia) Act 1994

The Commonwealth NTA makes provision for States and Territories to develop their own native title legislation, provided that such legislation does not conflict with the Commonwealth Act.

South Australia has enacted an alternative State right to negotiate scheme as authorised by the Commonwealth under section 43 of the NTA. The principal instrument is the *Native Title (South Australia) Act 1994*, which provides the legal definition of native title and the legal framework for determination of native title in South Australia. In addition other pieces of legislation incorporate the principles of the Act, which include:

- *Land Acquisition (Native Title) Amendments Act 1994* (SA)
- *Mining (Native Title) Amendment Act 1994* (SA)
- *Opal Mining Act 1995* (SA)

Regulations are in force for all these Acts together with the *Environment, Resources and Development Court (Native Title) Regulations 1995* (SA).

5.6 *Heritage Places Act 1993* (SA)

The *South Australian Heritage Places Act 1993* is the paramount European heritage protection legislation in South Australia. This Act established the SA Heritage Register (Part 3 of the Act), which consists of a list of 'State Heritage Places' and 'State Heritage Areas'. Section 16 of this Act defines the criteria to be used to assess whether a place qualifies for listing on the SA Heritage Register. Buried cultural material relating to the non-Aboriginal settlement or exploration of Australia (i.e. archaeological artefacts) is included under the Act as a component of a listed 'State Heritage Place' or 'State Heritage Area'.

It is a requirement under section 27(2) that the discovery of a non-Aboriginal 'archaeological artefact' of 'heritage significance' is reported to the South Australian Heritage Council. Section 36 of the Act makes it an offence to damage a heritage place entered onto the SA Heritage Register. Offences under Section 36 provides penalties ranging from $50,000 to $120,000. Section 37(5) of the Act provides exclusion to penalties based on authorisations and approvals given under other listed pieces of legislation.

ACHM staff undertake searches of the SA Heritage Register as a routine part of their desktop research in regard to work undertaken for clients.

5.7 *Development Act 1993* (SA)

The South Australian *Development Act 1993* provides the legislative framework within which State-wide planning and development work must comply. *The Development Act 1993*(SA) along with its subordinate legislation regulates the use and management of land and buildings as well as the design and construction of buildings, and makes provisions for the maintenance and conservation of land and buildings, where appropriate.

With regard to heritage issues the *Development Act 1993*(SA) sets out the procedures required for development or modification of places listed under the *Heritage Places Act 1993* (SA) and makes provision for the designation of local heritage areas when creating development plans.

5.8 Discussion

The central legislation to Aboriginal heritage in the Project Site is the AHA as the Project Site contains one Aboriginal site, and may contain more previously unrecorded sites, objects or remains covered by this Act. The auxiliary application of the NTA provides a process for identifying the native title claimant group and any consultation that may need to occur with that group.

Non-Aboriginal heritage (early colonial, European) is not afforded the same blanket protection as Aboriginal heritage, and as such, DP Energy has no statutory obligation to manage unlisted non-Aboriginal heritage. Should the development of the Port Augusta Renewable Energy Park affect any places listed, the South Australian *Heritage Places Act 1993* would be the applicable legislation. Additionally, in accordance with the *Heritage Places Act 1993*, any site of heritage significance uncovered during the course of development must be reported. No such places were identified within the Project Site during the course of the desktop research and heritage works.

No Aboriginal or European heritage sites were noted as being potentially impacted by the proposed development.

6 Aboriginal Stakeholder Groups in the Port Augusta Area

South Australian cultural heritage protocols are governed by the AHA which is enforced and officially administered by the State Government agency, the DPC-AARD. Under the AHA, DPC-AARD officially recognises that the Nukunu people are the primary Aboriginal traditional owners of the region within which the Project Site is located. The relevant Aboriginal traditional owners are defined under the AHA as: Aboriginal person[s] who, in accordance with Aboriginal tradition, has or have social, economic or spiritual affiliations with, and responsibilities for, the site or object (Section 3).

However, it is recognised that two other Aboriginal groups have an interest in the region within which the project is located: the Kokatha People and the Barngarla People.

6.1 Nukunu

The Nukunu people are recognised as having traditional interests across a region which includes the Nukunu Native Title claim application area. The Project Site lies within this application area. Contemporary Nukunu cultural heritage interests are administered through the Nukunu Peoples Council (NPC), an incorporated community organisation run by Nukunu representatives. AARD recommends that NPC is consulted in relation to heritage interests under the AHA. This is further confirmed through the nominated NNTT legal representative, Amy Sobels at Sykes Bidstrup, who advises consulting with NPC on heritage matters under the AHA. Any native title matters should be referred to Sykes Bidstrup. The Nukunu people are the Traditional Owners of this country as defined under section 5 of the AHA. Initial communications with Mr D'Arcy Evans of the NPC resulted in advice to ACHM that this area is culturally sensitive and restricted to men.

6.2 Kokatha

The Kokatha people, represented by Kokatha Mula Nation Land Council, carry significant cultural knowledge and have cultural heritage connections across a large region extending from northern Eyre Peninsula, through the head of the gulf and north to the Woomera-Lake Torrens area (then continuing into the traditional country of other groups). This includes the present Project Site through traditional and historical associations (see ACHM 2007).

Senior Kokatha man Andrew Starkey was contacted and invited to participate in the heritage works. However, Mr Starkey declined the invitation on behalf of the Kokatha People, as the Nukunu people are the Traditional Owners of this area as defined under the AHA. Further, Mr Starkey advised ACHM's CEO and Principal Heritage Advisor, Neale Draper, that the current survey area is outside their area of interest.

6.3 Barngarla

Many Barngarla people have important ongoing connections with Port Augusta (whereas others are more closely associated with the Gawler Ranges or Eyre Peninsula), and there is a substantial overlap between Barngarla and Kokatha families in this situation, often with dual descent from ancestors in both groups. Barngarla people have often participated in heritage surveys in the region within which the Project Site is located, however they have no heritage interests in the current Project Site. Please also note that while there is some overlap between the Barngarla and Nukunu Native Title Claims, the Project Site is located exclusively within the Nukunu Claim.

6.4 Traditional Owner Consultation

Mr D'Arcy Evans, representative of the Nukunu native title claimants, participated in this survey.

7 Nukunu Background

This section provides a brief overview of the Nukunu people and the anthropological background of the Project Site.

7.1 A History of Nukunu Occupation of the Project Site and Wider Region

7.1.1 Geographical Area and Tribal Boundaries

The Project Site is within the Nukunu Native Title Claim area (SC96/5 and SAD6012/98) (see Map 2-1). Nukunu is one of the languages sometimes collectively called Thura-Miru ('Parnkalla-Tyura-Meyu' in Schmidt's classification (1919: 56, cited in Hercus 1992: 1)). Schmidt's classification of three sub-groups within the language group still stands (Schmidt 1919, cited in Hercus 1992). Hercus notes that the Nukunu language is closely related to the neighbouring Nharangka (Narangga), Kaurna and Ngadjuri languages (Hercus 1992: 1).

The Nukunu were called the 'Nukuna' by the neighbouring Barngarla, and in the Kaurna language Teichelmann and Schurmann, cited by Hercus (1992: 11) and Tindale (1974: 216), state that this name means 'assassin'.

The name derives from the fact that, unlike the Kaurna, the Nukunu practised both circumcision and subincision and considered those tribes who did not to be 'incestuous'. This perception arose out of differences in the kinship system between the two groups. Elkin (1934-1938) showed that the Nukunu people were the southeasternmost of those people who had a matrilineal kinship system and used the terms *Mathari* and *Kararru* for their moieties (Elkin 1934-1938: 421).

Tindale (1974: 216) wrote of the Nukunu:

> ***Nukunu***
>
> ***Location:*** Eastern side of Spencer Gulf from a little north of the mouth of the Broughton River and vicinity of Crystal Brook northward to Port Augusta; east to Melrose, Mount Remarkable, Gladstone, and Quorn; at Baroota. The Ngaiawang of the Murray River used the term Nulonno as name of a fabulous Being who went about at night killing people. The Kaurna tribe term ['nokun:a] has a meaning of an imaginary being, like a man, who prowls at night and kills, an assassin (Teichelmann and Schurmann 1840). The Nukunu were the southeasternmost tribe to practice subincision, in addition to circumcision, as a male intiation rite. Pangkala men used the pronunciation ['Nukuna] for the name. The few survivors are settled at Baroota inland from Port Germein where they are known as the Barutadura.
>
> ***Coordinates:*** *138º10'E x 32º55'S.*
>
> ***Area:*** *2,200 sq .m. (5,700 s. kms.).*
>
> ***Alternatives:*** *Wongaidja (valid alternative), Nukuna, Nukunnu, Nugunu, Nookoona, Nukunna, Noocoona, Nokunna, Nuguna, Pukunna (misprint), Wongaidja, Wongaiydya, Tura (['tura] = man), Tyura, Doora, Eura (general term for several tribes), Warra (name of language), Barutadura (men of Baroota)*

An early copy of Tindale's map relating to tribal boundary research shows Nukunu territory very much as defined in his 1974 map (Figure 7-1). Hercus (1992: 10, map by V. Potezry) also defined Nukunu territory, but without providing the often problematic boundaries between Aboriginal groups (Figure 7-2).

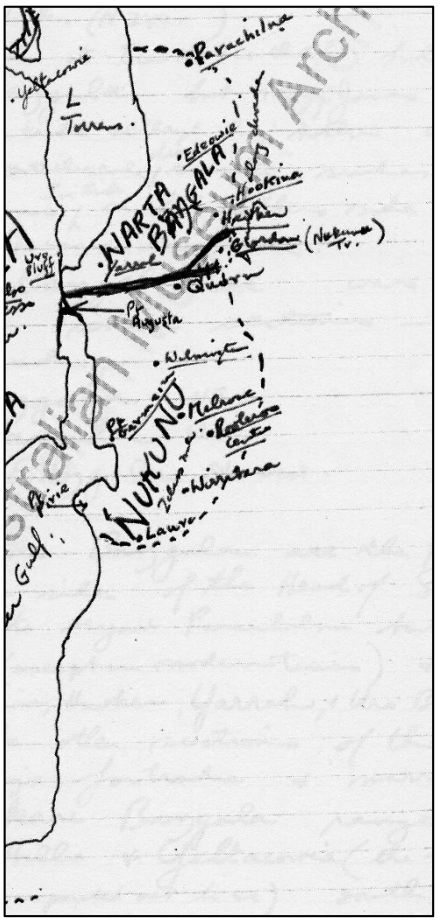


Figure 7-1: Original map showing Nukunu territory (Tindale 1938-1939: 1030)

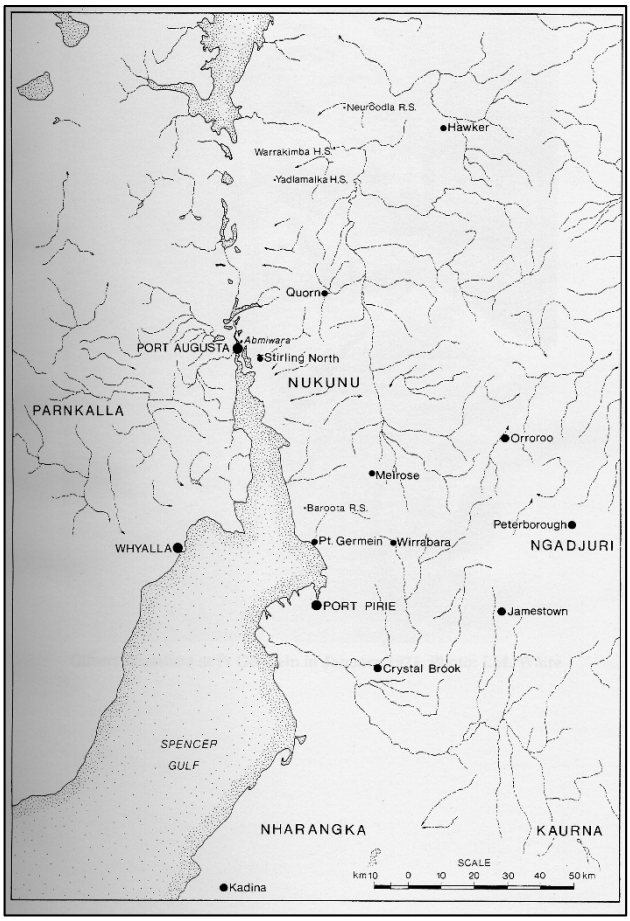


Figure 7-2: Nukunu country and adjacent areas (map by V. Potezny, in Hercus 1992: 10)

Historical evidence suggests that the Kokatha, Barngarla, Nukunu and, to a lesser extent, the Adnyamathanha, (Tindale's Wailpi), all had social, cultural and ceremonial interests in the Port Augusta region and shared strong historical, cultural and linguistic bonds. These included similar social systems, similar/shared ceremonies and related languages. Elkin wrote:

> *Early this century, a mixed group of Wirangu and Parnkalla [Barngarla] came from the Gawler Ranges to Denial Bay (Wirangu territory) and made one of my informants wilyaru. Actually, there were some Wirangu who were wilyaru and some who were 'djibari'. As elsewhere in Australia, groups on common tribal borders took part in each other's [sic] initiation rituals (Elkin 1964: 218).*

Berndt attempted to describe their kinship system as one making up a wider 'Western Desert culture', focussed on small patrilineal local territorial descent groups that had mythic associations with particular sites (Berndt 1987). In his compendium of information on the Aboriginal people of South Australia, Taplin (1879) included the following entry from James Bryant of Yardea that gives a very brief summary of the tribe and customs, as he believed them to be:

> *The name of the tribe inhabiting the Gawler Ranges is Willeuroo. It is divided into two clans, the Muthery clan and the Cariero clan. These clans intermarry. Blood relations are not allowed to intermarry. A Chief or King governs them. The only punishment for offences is death; but they have no form of trial. At death they think they go up to the stars. They believe in an evil spirit called Pokeybideny. Their weapons are spears, waddies, boomerangs, mutela, or baskets. Their only implement is a bit of flint. The principal disease amongst them is consumption. To cure disease they suck one another's blood. They have ceremonies called "purnpa chitelia" and "willieroo". The Hillery tribe and the northern tribe knock out the front teeth. Circumcision is practised (Bryant in Taplin 1879).*

7.1.2 Language

There are connections between the languages and people of the Gawler Ranges and Port Augusta area. These connections have been identified by people such as Margot Barefoot (1997: 18), who noted that many Nukunu words were closely affiliated with Wirangu. This conclusion was also supported by Luise Hercus and Jane Simpson who, quoting O'Grady (1966), wrote:

> *O'Grady (1966) claimed that the languages of central and southern Australia surrounding Spencer's Gulf and the Gulf of St Vincent form a subgroup, dubbed 'Yura'. These languages include at least Barngala, Nukunu, Narrangu, Kuyani, Ngadjuri, Adnyamathanha and Kaurna, with Nauo and Wirangu as possible outliers. In this paper we outline evidence for considering them a subgroup, which we call 'Thura-Yura' in recognition of the th→y lenition which distinguishes some northern members of the sub-group. We support this supposed subgroup by reconstruction of an ancestral case system for those languages for which inflectional data is recorded (Barngala, Nukunu, Kuyani, Adnyamathanha, Kaurna and Wirnagu) (Hercus & Simpson n.d.)*

Hercus and Simpson argue that the Thura-Yura languages were at the edge of the Western Desert expansion. This can be seen territorially by stories of events that date before European settlement of the region and, Barefoot suggests, through analysis of linguistic similarities of place name formation throughout the region (Hercus & Simpson n.d.).

7.1.3 European Contact

Hercus notes that, from 1849 when they were under considerable pressure from pastoralists moving onto their traditional country, the Nukunu remained together in small communities around Orroroo, Melrose, Wilmington, Stirling North and at Baroota (Hercus 1992: 11). In conversations with Nukunu people, Hercus documented a good understanding of the extent of Nukunu territory. Fred Graham stated:

> *I was brought up by my grandmother Mary, she was pure Aboriginal. Her own parents were frightened when they first saw white man, thought it was a ghost: it was when some crew (from a ship) came up into the hills. I was born at Wirrabara, Mount Remarkable tribe, Nukunu. (Hercus 1992: 12).*

Important sites are located throughout the traditional country of the Nukunu. Hercus noted that Nukunu country contained the sites that marked the beginning of the longest known continuous sequence of rituals, the *Urumbula.* The ceremonial sequences centred around the *Urumbula* stretched from Port Augusta to the Gulf of Carpentaria (Hercus 1992: 13). Hercus noted that the main feature of the ceremonies was an enormous tree that reached so high that it was like an enormous ceremonial pole, which in turn represented the Milky Way (Hercus 1992: 13).

The ethno-historical data places the Nukunu people within the project land, and confirms this Aboriginal group's heritage interests in the area.

7.2 Dreaming stories associated with the general area

It is important to note that the song cycles and ceremonies associated with the Pleiades and Orion enacted by Aboriginal people are long and complex, and concern a great deal of secret and sacred knowledge that does not constitute 'public' or 'open' knowledge. It is therefore essential to note that many of the following descriptions are brief summaries of the stories so as to not offend Aboriginal cultural tradition.

7.2.1 Seven Sisters

Myths associated with the constellations known as the Pleiades and Orion are amongst the most common and widely recorded in the world. In Australia, such myths extend across the country, from as far north as Arnhem Land and Melville Island to western Victoria. The ceremonies and myths associated with these Dreamtime Beings are divided into several categories including Male 'Closed' Business, Male 'Open' Business, Female 'Closed' Business, Female 'Open' Business, and 'Public' Business. In general though, it must be accepted that most of the information published by previous ethnographers, including photographs and films, was (and still is) highly sensitive. Reproducing this information is unacceptable to Aboriginal people.

Several important Ancestor Creation (or 'Dreaming') stories travelled through this region, linking the tribal groups through ceremony and ritual. One such story was the *Urumpula*, which concerns the travels of the Malbunga, or the Native Cat Ancestor and his followers. This myth starts in the MacDonnell Ranges and travels through to Port Augusta and on to Stuart creek via Euro Bluff, Arcoona and Andamooka (Hercus 1992).

In another Nukunu Creation Ancestor story, Gilbert Bramfield told Luise Hercus that:

> *An Ancestor from Pt Germain made that kangaroo bone and made that sea right through (he carved out Spencer Gulf). The bloke that went this way with his kangaroo bone he broke it at Pt Augusta, and then he was digging with a really short stumpy one and made all these lakes all the way through (the salty lakes up from Pt Augusta) (Hercus 1992: 16).*

A definitive description of the *Kungkarungkara*, 'Seven Sisters' myth, (also known as *Okaralja, Aragutja Ilknarindja*), is given by Tindale. He wrote:

> *In Western Desert lore the Pleiades and the Morning Star are ancestral Women Beings…They climbed into the sky and became stars to escape the attentions both of a man named Njiru, and of his son Jula. These women attacked Njiru with packs of dogs that they kept as their protectors. In the sky of autumn, the early morning appearance of the Pleiades, low down in the east, marks to beginning of the aboriginal New Year and the commencement of the season when dingo dogs (papa) give birth to their young. Since these pups serve as food for men, Increase Ceremonies for the dingo are a feature of the autumn season. The stories of the would-be virgin women are made complex because the names of some of the principal beings are changed and even become transposed in some tribal versions of the story (Tindale 1959: 305).*

In Jangkundjara belief, the activities of all of these ancestral beings are closely linked together, with them all living their lives at about the same time and some being descendants of others or all being associated with each other as people are through their kinship systems. Tindale describes the Jangkundjara version of the Pleiades Myth. In this version, the women begin their journey at the opposite end of their territory from Konkatjutanja, the place named in the Pindiini version. Instead, the *Kungkarungkara* women appear at Uluru, where they attempt to kill *Koneia*, the great snake of Uluru. They were unsuccessful and fled south until they eventually came to Owalinja.

The *Kungkarungkara* women are then believed to have fled south across the Musgrave Ranges and Tindale stated that Jangkundjara senior men told him that they understood that the *Kungkarungkara* women went south into;

> *…the Pangkala territory near Port Augusta with Njiru still in pursuit. They have the idea that the Beings made a circuitous eastward journey returning again to the north. During the journey Njiru and the Kelilbi (Star Women) are supposed to have visited a big jabu (hill) beside the sea, south and east of Port Augusta… (Tindale 1959: 321).*

One of the most interesting things noted by Tindale is a process of displacement of the Jangkundjara people by Pitjantjatjara after 1914. He wrote:

> *The area in which the Owalinja (Cave) stands was until 1914 the territory of a northern group of the Jangkundjara, but following the serious drought of that and the following year, Pitjantjatjara men, forced eastwards out of their usual living areas in the Mann and Tomkinson Ranges by the drying up of waters, successfully moved into the Owalinja country and deprived these people of their territory. They killed some and forced others to move south to the Everard Ranges. This shift forced some hordes of the Jangkundjara to attempt and migration still further south. They in their turn seem to have displaced some Kokatha people, who from fear of the "Northerners", moved south-eastward, away from Ooldea towards Kingoonya; others went to the coast at Fowler Bay. In making this migration the Jangkundjara moved along the boundary zone between the Ngalea and Kokatha peoples following the track of an ancient traditional trade route (Tindale 1959: 325).*

The Seven Sisters Dreaming is a long myth and song cycle that links many Aboriginal tribes. Its great cultural significance is that it provides ceremonial occasions that include people from the regions covering the story.

Hagen states that the accounts of the Kunkaralinya, (Seven Sisters story), given to him by various informants confirmed the above but 'it was usually referred to as starting from Port Augusta' (variant versions were given) (Hagen 1983: 7). Male and female versions of the myth co-exist from many groups. Hagen wrote:

> *From Arcoona the sisters travelled to the west, creating the sand-hills in the Phillip Ridge area, and at the site of the proposed new town. (see Mountford, 1976 for an analogous version from parts of Central Australia). They travel on through Lake Blanche (Matlumpa), heading towards Kingoonya, then turn to the north-east, towards Stuart Ck…They travel to a place west of Fregon…This track also passes through the Cane Grass Dam area according to my informants (Hagen 1983: 7-8).*

7.3 Discussion

The above section provides a brief overview of the Nukunu people and the anthropological background of the Project Site. It highlights that the Nukunu people have been considered the Traditional Owners of their country as far back as the 1930s. Their native title claim confirms that the Nukunu people are the Traditional Owners of this area.

8 General Background Research

Prior to the heritage works, heritage register searches were undertaken of the DPC-AARD Central Archive, the SAM Anthropology Database, the Australian Heritage Database (including the now defunct Register of the National Estate (RNE) and the South Australian Heritage Register. These searches returned information on the existence of previously recorded Aboriginal and European sites within or near the Project Site. Relevant and accessible anthropological and archaeological literature relating to the Project Site and to the history of the Nukunu people was also reviewed. The results of this research are presented below.

8.1 Aboriginal Heritage Searches

The following sections discuss the results of the heritage search results regarding Aboriginal heritage.

8.1.1 DPC-AARD Central Archive

The Central Archive is maintained by AARD and includes the Register of Aboriginal Sites and Objects (Register). The Central Archive is a record of known and suspected Aboriginal sites in South Australia, which are divided into three types: reported, recorded and archived. The Register can be searched for known Aboriginal sites within a particular area prior to development activities taking place. A lack of entries relating to a particular parcel of land does not mean sites do not exist in the area; it may simply mean that no cultural heritage surveys have been undertaken in the area to date, and as a result unrecorded sites may be present.

Under section 20 of the AHA, an owner or occupier of a piece of land, or an agent working on her/his behalf, must report the findings of a potential Aboriginal heritage site or object to the Minister as soon as practicable. Potential sites will be listed as 'reported' on the Register of Aboriginal Sites and Objects until the Minister is given the opportunity to determine whether or not it is a site as defined under section 3 of the AHA, according to the steps and considerations outlined in section 13.

It is an offence under section 23(a) of the AHA to damage, disturb or interfere with any Aboriginal site, even if the site has not been through a section 13 examination. A section 13 examination should, however, clearly identify which reported sites meet the definition of a site set out in the AHA and which do not. Those reported sites which are found to not meet this definition are, as a result, not protected under the AHA.

Section 13 states that the Minister must consult with the Aboriginal Heritage Committee (AHC) and any Aboriginal organisation, Traditional Owner and/or any other Aboriginal persons who, in the opinion of the Minister, have a particular interest in the matter. According to section 8(1)(a)(i) of the AHA, if a site meets the criteria for registration under the AHA, the AHC may then make a recommendation to the Minister to register the site on the Register of Aboriginal Sites and Objects. Once a section 13 determination has found that a reported site qualifies for protection under the AHA, it becomes a registered AARD site.

At the time of writing, section 13 considerations are usually made at the same time as section 23 applications for permission to damage, disturb or interfere with a site.

8.1.2 DPC-AARD Central Archive Search Results

The Central Archive was searched for records of Aboriginal sites in and adjacent to the proposed Project Site.

According to the Central Archive, one Aboriginal site lies within the Project Site (Map 8-1).

A total of five archaeological sites were identified within 1 km of the Project Site (see Table 8-1 below). The distribution of these sites in relation to the Project Site is also shown in Map 8-1. Four of the heritage sites are reported while 6432-2962 (shown as two separate polygons due to the site being disturbed by the construction of the Davenport substation) is currently listed as Registered. Please note that ACHM has undertaken a significant amount of work at 6432-2962 and can confirm its location and site condition.

Table 8-1: Previously registered and recorded AARD sites within 1 km of the Project Site.

MAP NUMBER	SITE NUMBER	SITE STATUS	SITE TYPE
6432	4700	Reported	Archaeological/ Artefact
6432	4701	Reported	Archaeological/ Artefact

6432	4702	Reported	Archaeological/ Artefact
6432	4703	Reported	Archaeological/ Artefact
6432	2962	Registered	Archaeological

8.2 South Australian Museum Anthropology Database

The SAM Anthropology Database contains information about Aboriginal cultural material and human remains held by the SAM. The database documents material items and skeletal remains the museum holds. How and when these objects and human remains were acquired is also recorded in many cases, and can be used to infer information about the types of Aboriginal objects that may exist within the Project Site.

8.2.1 South Australian Museum Anthropology Database Search Results

To ascertain if any culturally sensitive material had been located in the vicinity of the Project Site, the SAM database was searched using the locality and station names as search terms. Locality names searched include Port Paterson, Winninowie, Woolundunga, Port Augusta and Davenport. 252 entries were noted on the SAM Museums Collection and Human remains databases with the search of 'Port Augusta' (see Appendix 2).

Station names were also searched. These include Araluen, Weronga, Nangari, Lazy B Ranch, Clearview (or Clear View) and Seaview (or Sea View). Only the Nangari search identified any entries in the database. The search for 'Nangari' resulted in 12 entries attributed to the Nangari area. However, given that this station is located more than 5 km from the Project Site, these results have no impact on the proposed development. These sites are also listed in Appendix 2.

As the SAM database does not always specify exactly where cultural material items and human remains were found and its contents are often the result of specifically targeted expeditions and accidental finds, the database is best viewed as an indicative tool. These results indicate that a significant level of cultural activity could have occurred in the vicinity of Port Augusta. Of particular note are several entries regarding human remains located south of Port Augusta. This information, combined with other research outlined within this report, indicates that it is likely that unrecorded Aboriginal sites are located within undisturbed sections of the Project Site.

8.3 South Australian Heritage Places Database

The South Australian Heritage Places Database is maintained by the South Australian Government Department of Planning & Local Government. It is a searchable database to assist people in locating heritage places and associated information within specified areas in South Australia. The SA Heritage Places Database is a comprehensive listing of State Heritage Places from the SA Heritage Register, Local Heritage Places from SA Development Plans and Contributory Items from SA Development Plans.

8.3.1 South Australian Heritage Places Database Search

Prior to the survey taking place DP Energy undertook a review of the South Australian Heritage Places Database. The review found no heritage sites within the Project Site. ACHM also conducted a search of the Database. No South Australian heritage places were listed within 1 km of the Project Site.

8.4 Australian Heritage Database

The Australian Heritage Database is maintained by the Federal Government Department of the Environment. This searchable database provides details of heritage items listed on the World Heritage List, the National Heritage List, the Commonwealth Heritage List, the former RNE, the List of Overseas Places of Historic Significance to Australia and any place under consideration, or previously considered, for any of these lists. The RNE was closed in 2007 and is now an archive of information maintained on a non-statutory basis as a publicly available archive and educational resource. Information on the RNE may continue to be current and may be relevant to statutory decisions about protection while places may be protected under appropriate state, territory or local government heritage legislation (Department of the Environment 2012). It is also possible for heritage places on the RNE to be transferred onto the National or Commonwealth Heritage Lists.

8.4.1 Australian Heritage Database Search

Prior to the survey taking place DP Energy undertook a review of the Australian Heritage Database. No places listed on the Australian Heritage Database were identified within the current Project Site.

ACHM has since conducted searches for listed places and can confirm that no registered heritage places exist within 1 km of the Project Site.

One place was noted as being on the RNE. The Upper Spencer Gulf Marine Park includes the body of water north of the Whyalla-Cowleds Landing Aquatic Reserve and Jarrold Point (Map 9-1). Please note, however, that this place is outside of the Project Site. Further, the RNE is now defunct and places previously on this register may or may not have been reported to become places of National, State or Local Heritage significance.

8.5 Previous ACHM Cultural Heritage Survey Reports

The ACHM corporate archive provides a record of all heritage surveys conducted by ACHM consultants since the company began in the late 1990s. ACHM has conducted several cultural heritage surveys (both anthropological and archaeological) in the vicinity of the current Project Site. Three ACHM cultural heritage survey reports are considered relevant to the current Project Site and are summarised below. The first concerns the Port Augusta Highway and the other two concern the Davenport Substation. ACHM conducted two Aboriginal cultural heritage surveys for the Davenport substation at Port Augusta, South Australia. The relevant Traditional Owner groups for the project region were identified as Barngarla, Kokatha and Nukunu (Draper, Mott & Mollan 2005a; Australian Cultural Heritage Management 2005). The Barngarla and Kokatha surveys, consultation and monitoring were managed by ACHM. Vivienne Wood and Phil Fitzpatrick conducted the management of the cultural heritage survey, consultation and monitoring for Nukunu (Wood and Fitzpatrick 2005).

8.5.1 Mott 2008 [TSA18]

In May 2008 ACHM carried out an Aboriginal cultural heritage survey of two truck parking bays and one turning lane, at Warnertown and Winninowie, South Australia. The survey involved representatives from the NPC and ACHM. During the course of the survey the project areas were inspected for the presence of Aboriginal sites. No Aboriginal archaeological or anthropological sites were identified within the project areas. Two recommendations were made to manage heritage responsibilities under the AHA. Firstly, that Aboriginal monitors be present for any excavations carried out at a depth greater than 30 cm from the lowest point in the project areas. This was due to the likelihood of undisturbed sediments that could potentially feature archaeological material occurring beneath the disturbed top surfaces. Secondly, that any new borrow pits required for the proposed works should be subject to cultural heritage survey. Registered quarry locations and previously disturbed soils were exempt from this recommendation.

8.5.2 Draper, Mott & Mollan 2005a [ELE10]

ACHM undertook an Aboriginal cultural heritage survey in July and August 2005 with the Barngarla people as part of the ElectraNet Davenport Substation Expansion. Monitoring was also conducted during this time. A previously recorded archaeological site was re-assessed and the boundary was revised. Two areas were designated as containing sensitive landforms for Barngarla people. The Barngarla cultural heritage field survey team recommended that the proposed development works were undertaken providing certain conditions were adhered to, including monitoring by Traditional Owners and archaeologists.

8.5.3 Draper, Mott & Mollan 2005b [ELE10]

ACHM also undertook a separate Aboriginal cultural heritage survey in July and August 2005 with the Kokatha people for the ElectraNet Davenport Substation Expansion. Findings and recommendations from this report were very similar to those in the Barngarla field survey, with appropriate Kokatha Traditional Owners monitoring works.

8.6 Other Previous Cultural Heritage Reports

A search of the ACHM corporate archive also found the Wood & Fitzpatrick (2005) cultural heritage survey report mentioned above. The findings of this report are summarised below (section 8.6.1).

8.6.1 Wood & Fitzpatrick 2005

This report presents the results of two field studies of the proposed work locations for the Davenport Substation near Port Augusta, South Australia. The studies were undertaken by Vivienne Wood and Phil Fitzpatrick with representatives of the NPC during July and August 2005. The report recommended that works proceed with a number of restrictions: that appropriate Nukunu people and archaeologists monitor specified portions of the proposed work areas and that two nearby areas, different from the area mentioned in both the Barngarla and Kokatha reports above, be specifically avoided if possible. Further, the report stated that Nukunu were happy for salvaged cultural material, with the exception of skeletal remains, to be handled by an appropriately qualified archaeologist and that future works within the existing Davenport Substation boundary did not need Nukunu involvement.

8.7 Discussion

A search of the DPC-AARD Central Archive, requested by DP Energy, found one recorded Aboriginal heritage site within the Project Site. This AARD reported site (6432-4703) is located less than 400 m southwest of proposed turbine 31. However, unless the current plans are revised, this site should not be affected by the proposed development. A total of fifteen Aboriginal heritage sites were identified in the general Port Paterson area. A search of the SAM Database by ACHM returned numerous results of stone artefacts from the Nangari station area. The

records are not detailed enough to indicate the exact find of locations. These results provide some indication of the extent of occupation of Aboriginal people within the region, and the likelihood of uncovering other such objects in the Project Site.

Searches of the Australian Heritage Database and South Australian Heritage Places Database were also requested by DP Energy. No places on the Australian Heritage Database were identified within the Project Site. One State heritage place listed on the South Australian Heritage Places Database is located within 5 km of the Project Site, although not within the development footprint. One place is listed on the now defunct RNE as being within 1 km of the Project Site, although not within the development footprint.

Previous cultural heritage reports carried out in the general area (Draper, Mott & Mollan 2005a; Draper, Mott & Mollan 2005b; Wood & Fitzpatrick 2005) note that the Nukunu, Barngarla and Kokatha people have varying interests in the project area and this has been discussed in Section 6.0. It should be noted, however, that these three groups have overlapping interest in the Port Augusta region generally, but the interests of Barngarla and Kokatha relate to Creation Ancestor stories associated with all three groups, and which have specific associated sites and Creation Ancestor tracks ('songlines') located in the traditional lands of the Nukunu people. In summary, even though Barngarla, Kokatha and Nukunu have, to varying degrees, general interests in the Project Site, only Nukunu has the right to speak for this particular piece of country because Barngarla and Kokatha's interests pertain mainly to the prominent geographic features (i.e. the hills) that are outside the Project Site.

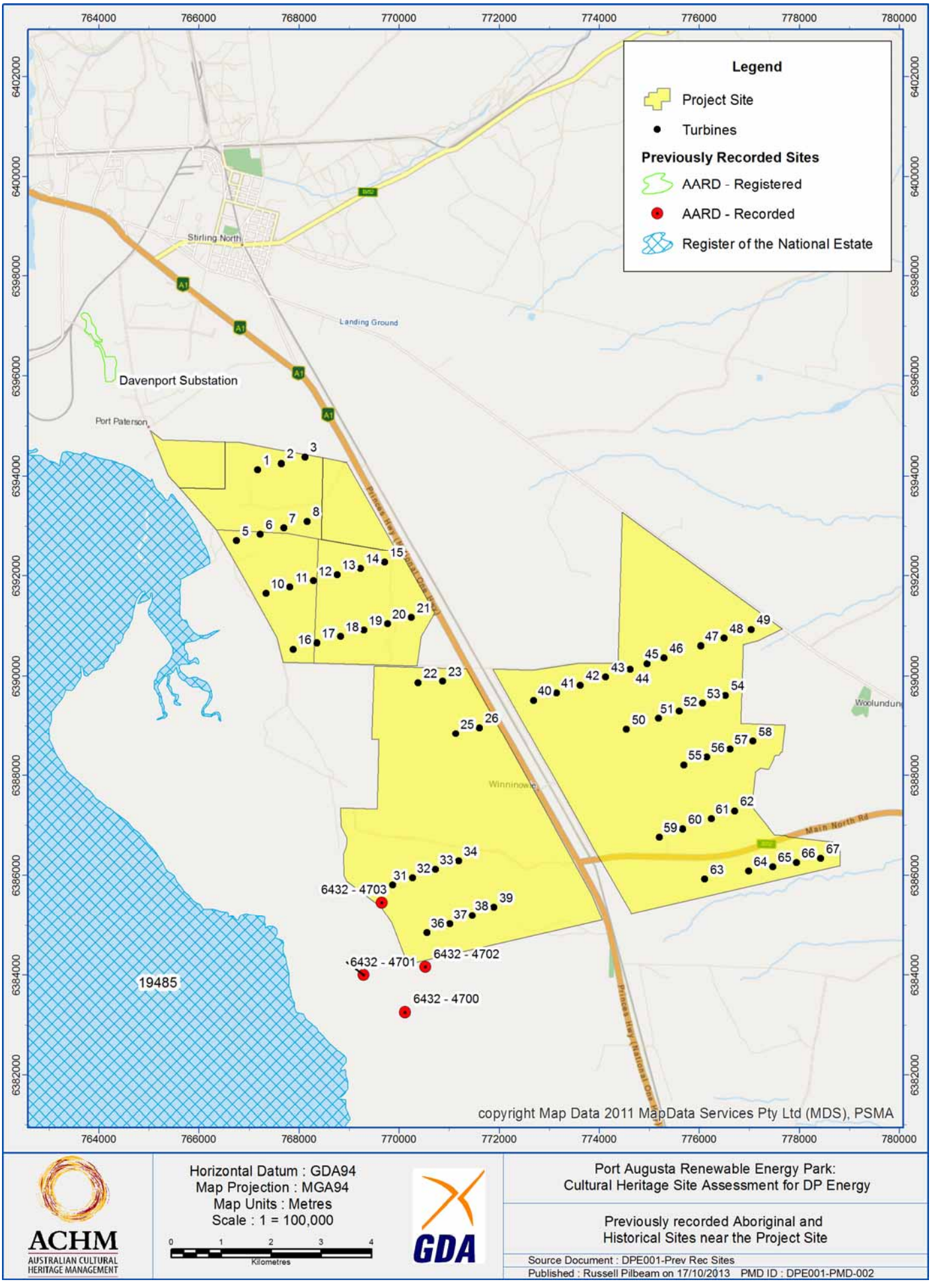
8.8 European Settlement of the Region

Despite initial surveying of the Eyre Peninsula in 1802 by Captain Finders and land investigations on land by John Edwards Eyre in 1839, it was not until 1852 that Messrs Elder and Grainger resolved to build a port in the area as a result of need for the import and export of goods, mainly wool, from the Mount Remarkable region (Port Augusta City Council 2009: 6; Manning 2006: 32). Being a gateway between the north and south of the state, the Township grew quickly and in its first ten years had a population of approximately 500 people.

Despite severe droughts in the region during the early 1860s (Gibbs 1969: 102-103), the township survived and by the 1870s began to overcome its economic problems with the introduction of the first overland telegraph line to Darwin. In the early 1900s, Port Augusta became the headquarters for the rail extension across the Nullarbor Plain to Western Australia which is still credited with 'seeing Port Augusta through the worldwide depression of the 1930’s and with substantially assisting with Australia’s effort in the world wars' (Port Augusta City Council 2009: 6). It was towards the end of the Second World War that Aboriginal people began moving to the township from overcrowded reserves looking for employment. This movement also coincided with the necessity for government to 'accept more responsibility for Aboriginal welfare and make a more vigorous attempt to improve Aboriginal Conditions' (Gibbs 1969: 132-133). With the introduction of diesel locomotives and the Transcontinental Railway line in 1952, the port eventually closed in 1974.

By the time the port officially closed, the Playford Power Station had begun operation and was supplying electricity to Port Augusts and Adelaide. The Northern Regional Power Station soon followed, commencing operations in 1985 (Port Augusta City Council 2009: 6).

The areas to the south of Port Augusta and Stirling North, including the Project Site, are still used for grazing cattle and sheep. Evidence of long term European settlement in the area was noted during the heritage works with remnant homesteads, wells and water tanks observed.



Map 8-1: Previously recorded Aboriginal and non-Aboriginal heritage sites

9 Aboriginal Site Types Prevalent in the General Region

The traditional lands of the Nukunu people includes many archaeological and anthropological/mythological sites. Mythological sites are usually directly related to particular landscape features which have particular significance because of their association with or representation of Creation Ancestors. The following section discusses generally the principles of association between Aboriginal sites and environmental features.

9.1 General Principles of Association: Aboriginal Sites and Environmental Features

Although not exhaustive, the following points can be used as a general guide to where Aboriginal sites may be located within a particular landscape feature. Note that not all environmental features listed below may be applicable to the Project Site, however the specific environmental features associated with the Project Site are discussed further below.

- Dominant land features such as hills and mountain ranges are often associated with mythological sites.
- Sand dunes and associated hardpan swale areas, the sandy banks of watercourses, the sandy margins of cane grass swamps and the margins of clay pans are often associated with archaeological sites. In addition, sand dunes are often associated with mythological sites.
- Long term water sources are often associated with both mythological sites and large archaeological sites (greater than 100 m across), less reliable water sources and sandy areas near large swamps are often associated with medium sized archaeological sites, and temporary water sources are often associated with small archaeological sites.
- Gibber plateaus contain few, if any, archaeological sites, although where dunes are located on a plateau small to medium sized archaeological sites may occur.
- Gibber flats, mesa tablelands and outcrops of quartzite, sandstone and silcrete are often associated with stone quarry sites. These outcrops are also often associated with mythological sites.
- Drainage channels (extending from plateau to plain) often have archaeological sites along their watercourses and associated clay pans. Watercourses are also often associated with mythological sites.
- Clay pans, salt lakes and plateaus are often associated with stone arrangements. These are one type of archaeological site but may also be a mythological site depending on the specific context.
- Cane grass swamps, clay pans, salt lakes and unusual landscape features are often culturally significant mythological sites.
- Drainage gullies where water collects are associated with quartzite pavements, and are often associated with engraving sites. These are one type of archaeological site but may also be a mythological site depending on the specific context.
- Rock shelters with quartzite pavements are often associated with painting sites. These are one type of archaeological site but may also be a mythological site depending on the specific context.

9.2 Aboriginal Sites and Environmental Features within the Project Site

Certain landforms where the potential is medium for an Aboriginal site to be located within the Project Site include the following:

- **Sand dunes and associated hardpan swale areas** typically have a strong association with Aboriginal sites. It is very common for swales between sand dunes to contain Aboriginal campsites, particularly when the sand dunes are isolated on gibber plains and provides the only location for kilometres where there may be freshwater. Sand dunes themselves are often associated with mythological sites.
- **Salt lakes and associated soaks** are an important source of freshwater for both Aboriginal people and animals. Consequently, salt lakes have a high number of Aboriginal campsites associated with them. Campsites are mainly found in sand dunes that border salt lakes. Salt lakes also have a high degree of association with mythological sites, and it is common for salt lakes to have a mythological story connected to them.
- **Water Features.** Some other kinds of water features often have important mythological associations and significance. These include permanent and ephemeral water sources and watercourses such as creeks, waterholes, cane grass swamps, tree lined drainage lines and rock holes that hold water after rain and. There are frequently archaeological sites near the margins of these features.

- **Unusual Landscape Features.** As with water features, unusual landscape features also often have important mythological associations and significance. Such features can include hills (such as the ranges to the east of the Project Site), stands of trees, low rises, sand dunes and other notable landscape features.
- **Built Environments.** Most early built environments (i.e. homesteads, bore sites) were a focus of Aboriginal-colonial interaction for the distribution of rations, fringe camps and ceremonial activity. These environments also contain pastoral access and land use issues, and should be avoided where possible.

9.3 Discussion

The above provides a description of landforms and general environmental zones that are more likely to feature Aboriginal heritage sites within the Project Site. Archaeological sites can be identified by the archaeological material present, however mythological sites may not include any archaeological material, and their presence can only be confirmed by consultation with the Traditional Owners with knowledge of the Creation Ancestor stories that may relate to the Project Site. During the heritage works, no previously unknown anthropological sites were noted within the Project Site. However, an emphasis on the likelihood of archaeological materials being located within areas with sand dunes and watercourses was discussed with the Traditional Owner survey participant.

10 Cultural Heritage Survey and Site Assessment Methodology

The anthropological survey and archaeological site assessment was undertaken largely by vehicle, with specific areas of interest visited on foot. The survey team met initially near the Keith Jones Memorial Park, where they viewed maps of the Project Site and decided upon the best way to proceed with the site assessment.

10.1 Anthropological Survey and Consultation Methods

Entry to the Project Site was made through the available property access points, with much of the Project Site traversed by existing tracks. The area was generally surveyed from the highest points, with the Nukunu representative identifying areas of interest after viewing the aerial and topographic maps. On the first day, the survey was restricted to the turbines and solar farms located in the northwestern section of the Project Site. The second day was spent exclusively in the eastern and southern sections of the Project Site.

At specific locations and vantage points, the team stopped for closer inspection of the surrounding areas, and the anthropologist consulted with the Nukunu representative present about the cultural significance of those places and the Project Site in general.

Ethnographic information provided by the Nukunu representative was recorded in note form. Digital photographs of specific places of interest were taken, and the locations of these places were recorded spatially using a hand held GPS unit. These points were then used with aerial imagery to delineate High, Medium and Low Sensitivity areas as seen in the results section below.

10.2 Archaeological Site Assessment Methods

The archaeological survey involved examining targeted areas within the proposed Project Site. The purpose of this archaeological site assessment was to produce an archaeological profile of the Project Site with zones deemed as High, Medium or Low Sensitivity in terms of Aboriginal cultural significance. The ACHM archaeologist spent the majority of the time assessing the land contained within the Project Site in order to identify archaeologically sensitive areas within the landscape and any surface archaeological material. Throughout the survey, the ground surface was monitored for the presence of sites or artefacts. Background research and aerial photography indicated that the land within the Project Site had been significantly disturbed through land clearance and pastoral activity.

11 Cultural Site inspection Results

The following section details the results of the initial anthropological and archaeological site assessment.

11.1 Anthropological and Archaeological Site Assessment and Consultation Results

11.1.1 Anthropological Survey Results

During the heritage works no previously unknown anthropological sites were noted as being within the Project Site. However, the Nukunu representative present during the site assessment identified the ranges to the east of the Project Site and the coastline to the west as being culturally significant. Neither of these areas will be impacted upon by the current project footprint.

Comment was made by the Nukunu representative that the sand dunes and ephemeral and permanent water sources within the Project Site are important to the Nukunu people as places that are likely to contain archaeological sites. These features should be avoided where possible. Future archaeological surveys will, however, confirm whether or not there are any surface archaeological materials within the Project Site.

11.1.2 Archaeological Initial Site Assessment Results

Conditions during the initial archaeological site assessment were favourable with warm clear days.

Although ground visibility was very low, soil types were noted as was the general condition of the landscape. The soils mainly consisted of orange sands with small areas of clay, some overlain with detrital gravels or calcrete stones. In undisturbed areas, dark orange sand dunes were noted. Within the Project Site, towards the coast, dense woodlands were observed as being of a slightly higher elevation than that of the cleared areas.

The disturbed areas appear to have been cleared for grazing with the undulating landscape covered in pits and hummocks. Introduced vegetation species including pepper trees (*Schinus sp.*) and saltbush (*Atriplex sp.*) imported from America for grazing (pers. comm. Mr Evans 2 September, 2013). Water runoff from the large ranges to the east was noted as a possible factor influencing site integrity, since the ephemeral waterways were frequently encountered in the eastern section of the Project Site.

No new European heritage sites were recorded during the heritage works. However, several old homesteads, wells and stone water tanks were noted outside of the proposed Project Site. Should similar European places be located within the Project Site, they should be avoided where possible until the proposed archaeological survey is completed. Please note that the current proposed development footprint does not impact on any noted historical places.

One State Heritage place and one place on the now defunct RNE were noted through desktop research as being close to, but not within, the Project Site.

No new Aboriginal objects or sites were noted during these works. During archaeological initial site assessment, areas within the proposed Project Site were assessed as being of either low or medium archaeological sensitivity.

11.2 Discussion

Section 9 above provides a description of landforms and general environmental zones that are more likely to feature Aboriginal heritage sites within the Project Site. Archaeological sites can be identified by the archaeological material present, however anthropological sites may or may not include archaeological material and their presence can only be confirmed through consultation with the Traditional Owners with knowledge of the Creation Ancestor stories that relate to the Project Site. During the heritage works, no anthropological sites were noted within the Project Site. However, the higher likelihood of archaeological materials being located within areas with sand dunes and watercourses was discussed with the Traditional Owner survey participant.

11.2.1 Zones of Sensitivity

Medium Sensitivity areas were those that are located close to existing known Aboriginal sites or are in areas with a higher likelihood of archaeological sites being found. These include sand dunes, remnant vegetation, waterways and coastal locations. Areas outside of these parameters were assessed as being of Low Sensitivity although these may also contain subsurface archaeological materials. While these areas have been classified as Low Sensitivity, there is still a possibility that Aboriginal archaeological sites are present in subsurface deposits. The archaeological site assessment identified no new archaeological sites.

While areas of sensitivity have been provided it must be stated that all areas within the Project Site have an inherent risk of containing Aboriginal sites, whether they be surface or subsurface. As stated above, when conducting any sort of predictive modelling, landscape features provide information regarding how Aboriginal people may have interacted with the landscape. In areas such as the Project Site, where there are several land feature types, previously recorded Aboriginal sites and undisturbed areas of land, specific soil types (i.e. sandy soils) and low ground surface visibility, the risk of archaeological materials being present is increased. As previously stated, there is a risk of all areas within the Project Site containing Aboriginal heritage sites. The only way of assuring that all heritage places are accounted for, is to conduct a pedestrian archaeological survey of the proposed development footprint.

The turbines were assessed as follows:

- Medium Sensitivity relating to turbines intersecting with watercourses (turbines 55 to 58, see Figure 11-2)
- Medium Sensitivity relating to turbines intersecting with sand dunes and undisturbed areas (turbines 42, 16, 43, 50 and 51, see Figure 11-1)
- Low Sensitivity relating to all other turbines (turbines 1 to 8, 10 to 15, 17 to 23, 25, 26, 31 to 34, 36 to 39, 40 to 41, 44 to 49, 52 to 54 and 59 to 67)
- Low Sensitivity relating to the two Solar Array areas, with the exception of a small area within the western Solar Array area which was determined to have Medium Sensitivity

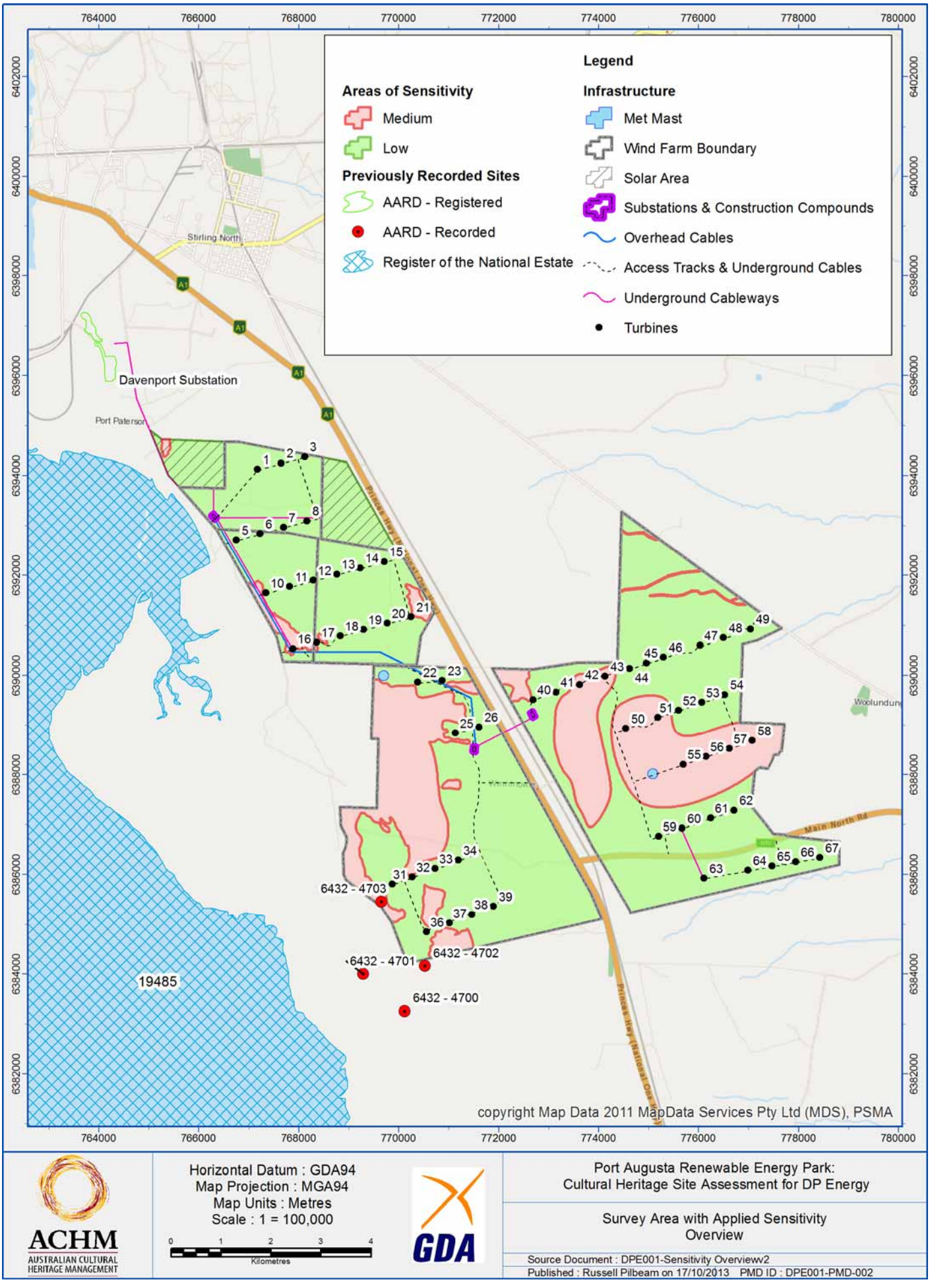
Coastal areas within the Project Site have a greater risk of containing Aboriginal heritage sites, even those that have been highly disturbed. However, rather than provide DP Energy with an arbitrary boundary delineating these areas, it is recommended that an archaeological survey be conducted in order to provide a more definitive assessment on the level of risk in these areas.

Figure 11-1: Sand dunes near turbines 50 and 51. Image facing east.

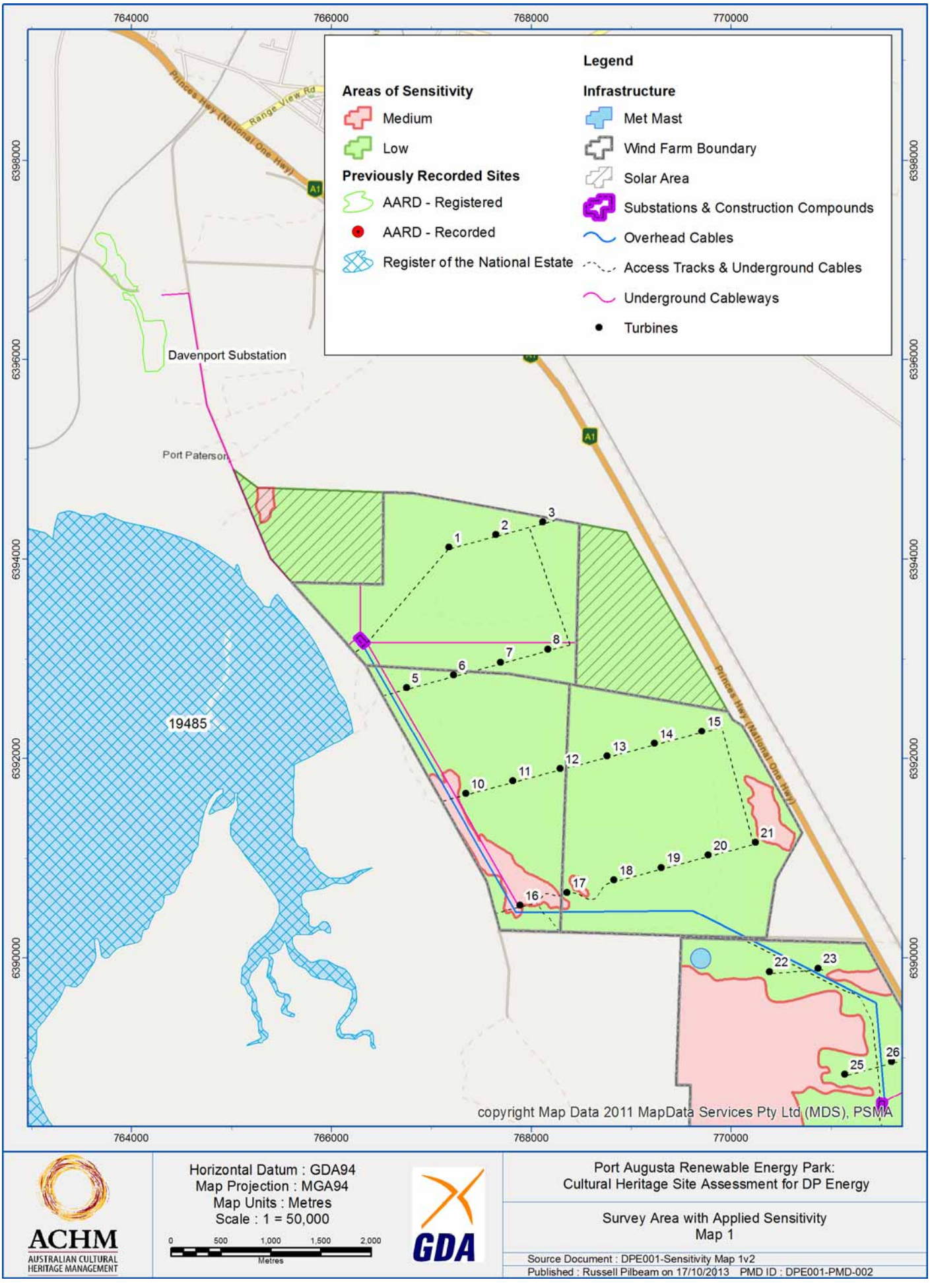
Figure 11-2: Project Site facing east near turbine 55. Note ephemeral water way running along proposed turbine alignment to the right of slide.

11.3 Discussion

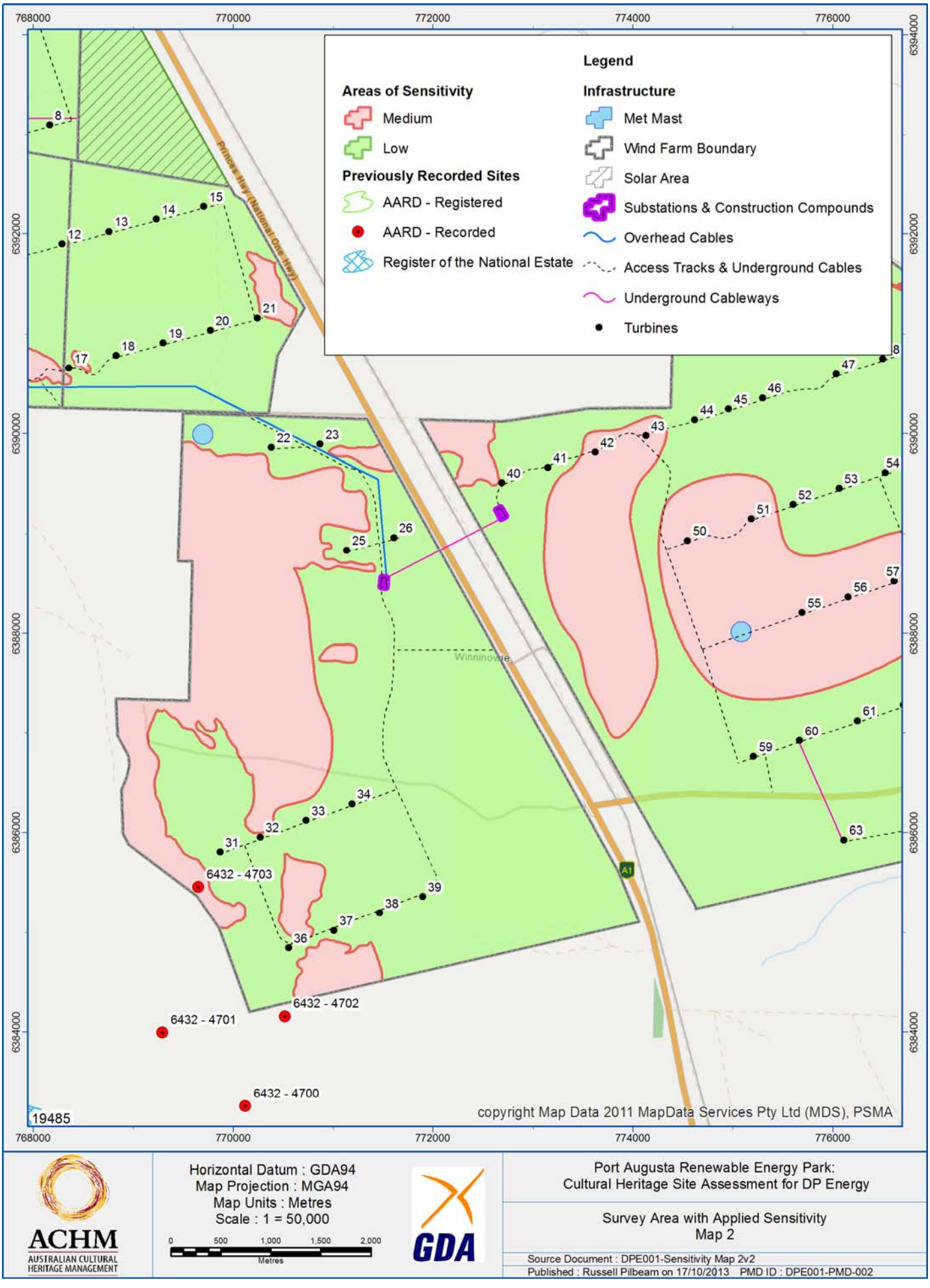
No new Aboriginal or European heritage places were recorded during the heritage works. The below maps (Maps 11-1 to 11-4) show areas which are of Medium and Low Sensitivity with regards to surface and subsurface archaeological materials. Further archaeological surveys will be able to add to this information and refine risk areas. Please note that the below map is not provided to give areas that are Cleared or Not Cleared of heritage places. This information can only be provided following a full archaeological survey. These areas should also not be seen as 'no go zones', rather as areas that need further assessment and archaeological survey before providing heritage clearances.



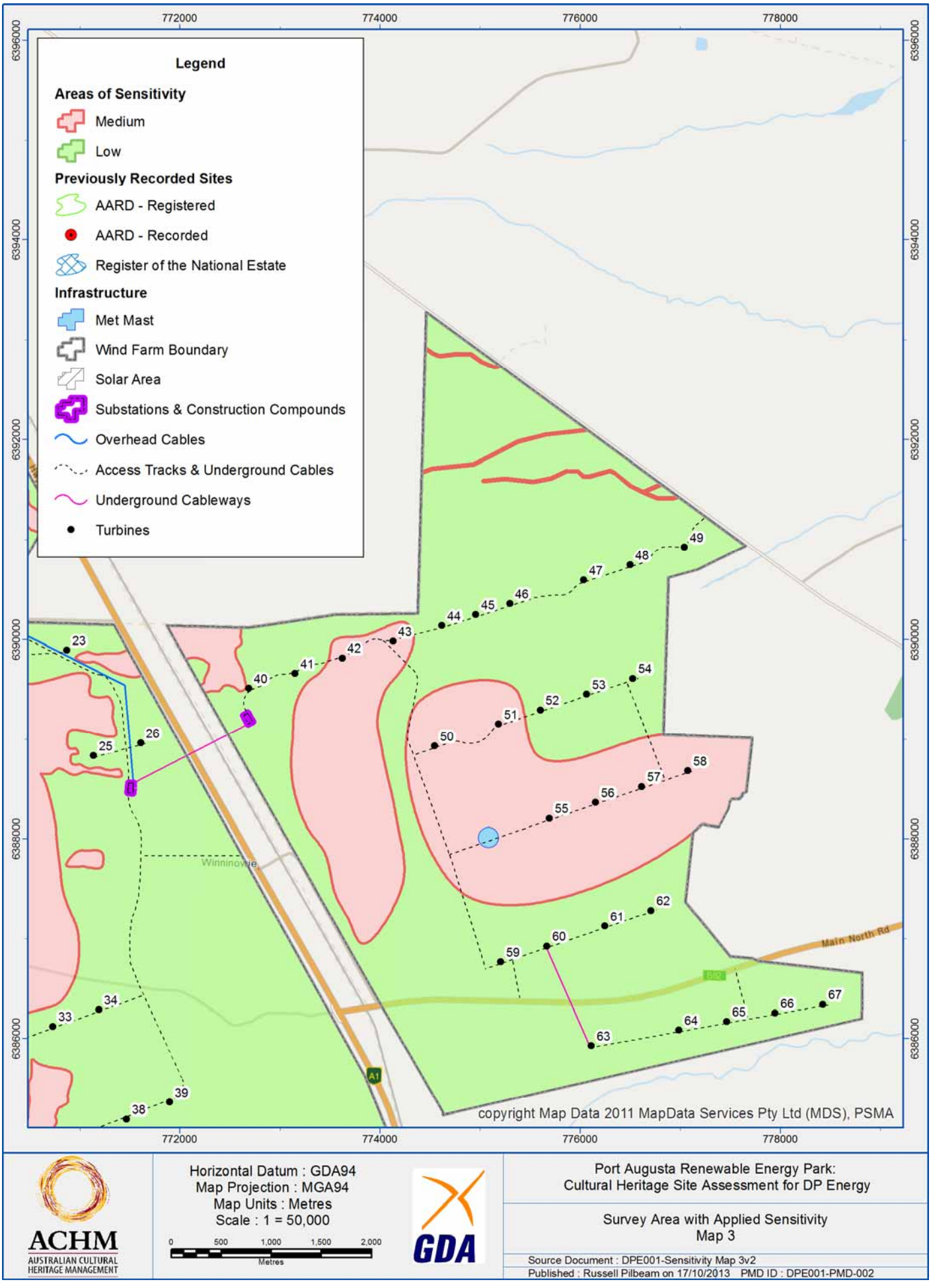
Map 11-1: Project Site and results



Map 11-2: Northern section of the Project Site



Map 11-3: Western section of the Project Site



Map 11-4: Eastern section of the Project Site

12 Summary and Recommendations

The following provides a summary of the content of this report, and recommendations with regard to the protection and management of cultural heritage within the Project Site, taking into account both the results of the site assessment and the desktop research.

12.1 Summary

ACHM was engaged by DP Energy to undertake an anthropological heritage survey and initial archaeological site inspection of the proposed Port Augusta Renewable Energy Park Project Site, taking into account Aboriginal (anthropological and archaeological) and European (archaeological) cultural heritage. The brief for this cultural heritage assessment included undertaking desktop research as well as conducting the heritage works for the footprint of the proposed layout of 59 turbines, two solar areas and known associated infrastructure. The aims of the site assessment were threefold:

- To identify and record any Aboriginal heritage sites through consultation with a representative of the Nukunu Traditional Owners
- To provide a risk assessment of the proposed project footprint and categorise areas of High, Medium and Low Sensitivity, including an archaeological assessment of places with the potential to contain surface and subsurface cultural material
- To document any points of interest with regard to European heritage

This initial site assessment was conducted with a view to informing DP Energy of any major heritage concerns in the initial planning stages, and resulted in the delineation of areas of sensitivity as described above, and specific recommendations with regard to the cultural heritage management of any significant areas within the Project Site.

12.1.1 Heritage Searches

Conducted as part of the desktop research for the study, a search of the DPC-AARD Central Archive found that one registered site and four reported sites lie within 1 km of the Project Site. One of these is located within the Project Site. The site types are all listed as 'Archaeological' and are generally located in the western, coastal section of the Project Site. However, upon completion of the heritage works, it was determined that these sites will not be affected by the proposed works.

A search of the SAM Anthropology Database returned 252 results for finds in the vicinity of the Project Site. Although the records are not detailed enough to indicate the exact locations of these finds, these results provide some indication of the extent of occupation of Aboriginal people within the region, and the likelihood of uncovering other such objects in the Project Site.

12.1.2 Previous Research

A review of relevant literature shows that the Project Site lies entirely within the traditional lands of the Nukunu People.

The Project Site has received little attention regarding its history of European settlement. One European heritage site registered on the South Australian Heritage Register lies near the Project Site, although not within it. Further, one site on the now defunct Register of National Estate is located near the Project Site.

12.1.3 Anthropological Site Survey Results

During the anthropological survey, it was determined by the Nukunu representative that the Project Site was clear of anthropologically significant areas.

One watercourse was deemed as culturally significant during the heritage works. However, this area is located well outside of the Project Site.

12.1.4 Archaeological Initial Site Assessment Results

Aboriginal Heritage

The archaeological site assessment identified no new archaeological sites.

The archaeological site assessment resulted in the identification of areas of Medium and Low Sensitivity in terms of potential to contain archaeological sites. Areas of Medium Sensitivity include the pockets of remnant vegetation located within the Project Site and the permanent and ephemeral watercourses mentioned above. Further, coastal

areas were deemed to be of Medium Sensitivity. The remainder of the Project Site is considered to be of Low Sensitivity.

The above assessment relates to the following features:

- Medium Sensitivity relating to turbines intersecting with watercourses (turbines 55 to 58)
- Medium Sensitivity relating to turbines intersecting with sand dunes and undisturbed areas (16, 42, 43, 50 and 51)
- Low Sensitivity relating to all other turbines (turbines 1 to 8, 10 to 15, 17 to 23, 25, 26, 31 to 34, 36 to 39, 40 to 41, 44 to 49, 52 to 54 and 59 to 67)
- Low Sensitivity relating to the two Solar Array areas, with the exception of a small area within the western Solar Array area which was determined to have Medium Sensitivity
- Medium sensitivity relating to coastal areas within the Project Site

European Heritage

No new European heritage sites were recorded during the heritage works. However, several old homesteads, wells and stone water tanks were noted. These European sites are all located along the already established tracks outside the Project Site. The current proposed layout does not impact on any of these places.

One State Heritage place and one place on the now defunct RNE were noted through desktop research as being close to, but not within the Project Site.

12.2 Recommendations

As a result of the cultural heritage survey, and in consultation with a representative of the Nukunu people, the following recommendations are made:

1. A thorough archaeological pedestrian cultural heritage survey, including Traditional Owner participation, should be undertaken of the infrastructure footprint prior to the commencement of ground disturbing work. This is particularly recommended in the case that any infrastructure will disturb areas designated as being of Medium Sensitivity.
2. All previously recorded Aboriginal heritage sites should be treated in accordance with the requirements of the South Australian *Aboriginal Heritage Act* 1988 (AHA). Section 23 of the AHA states that it is an offence to 'damage, disturb or interfere' with any Aboriginal site or object, without Ministerial approval. It should be noted that no known Aboriginal sites intersect with proposed infrastructure within the Project Site.
3. Areas designated as being of Medium Sensitivity have more potential to contain surface or subsurface archaeological material than other areas. It is therefore recommended that the extent of proposed infrastructure within these areas be minimised and it is expected that a full archaeological survey will assist in refining recommendations in relation to these areas.
4. Should a future archaeological survey identify any previously unreported Aboriginal archaeological sites within the refined Project Site, section 23 approval will be required if DP Energy wishes to damage, disturb or interfere with those sites.
5. Following an archaeological pedestrian cultural heritage survey of the final footprint, a Cultural Heritage Management Plan should be developed to provide for the long term management of significant cultural heritage sites within the Project Site that will not be subjected to a section 23 application. As part of the Cultural Heritage Management Plan, a site discovery procedure similar to the example supplied in Appendix 1 of this report should be developed.
6. As all waterways (permanent and ephemeral) are of High Significance to Aboriginal people and are more likely to contain surface and/or subsurface archaeological materials, work in these areas should be avoided.
7. No new European heritage sites were recorded during the heritage works. However, several old homesteads, wells and stone water tanks were noted outside of the proposed Project Site. Should similar European places be located within the Project Site, they should be avoided where possible until the proposed archaeological survey is completed. Please note that the current proposed development footprint does not impact on any noted historical places.

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Legislation

Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cwth)

Aboriginal Heritage Act 1988 (SA)

Crimes Act 1914 (Cwth)

Development Act 1993 (SA)

Environment Protection and Biodiversity Conservation Act 1999 (amended 2003) (Cwth)

Environment, Resources and Development Court (Native Title) Regulations 1995 (SA)

Heritage Places Act 1993 (SA)

Land Acquisition (Native Title) Amendment Act 1994 (SA)

Mining (Native Title) Amendment Act 1994 (SA)

Native Title Act 1993 (Cwth)

Native Title (South Australia) Act 1994 (SA)

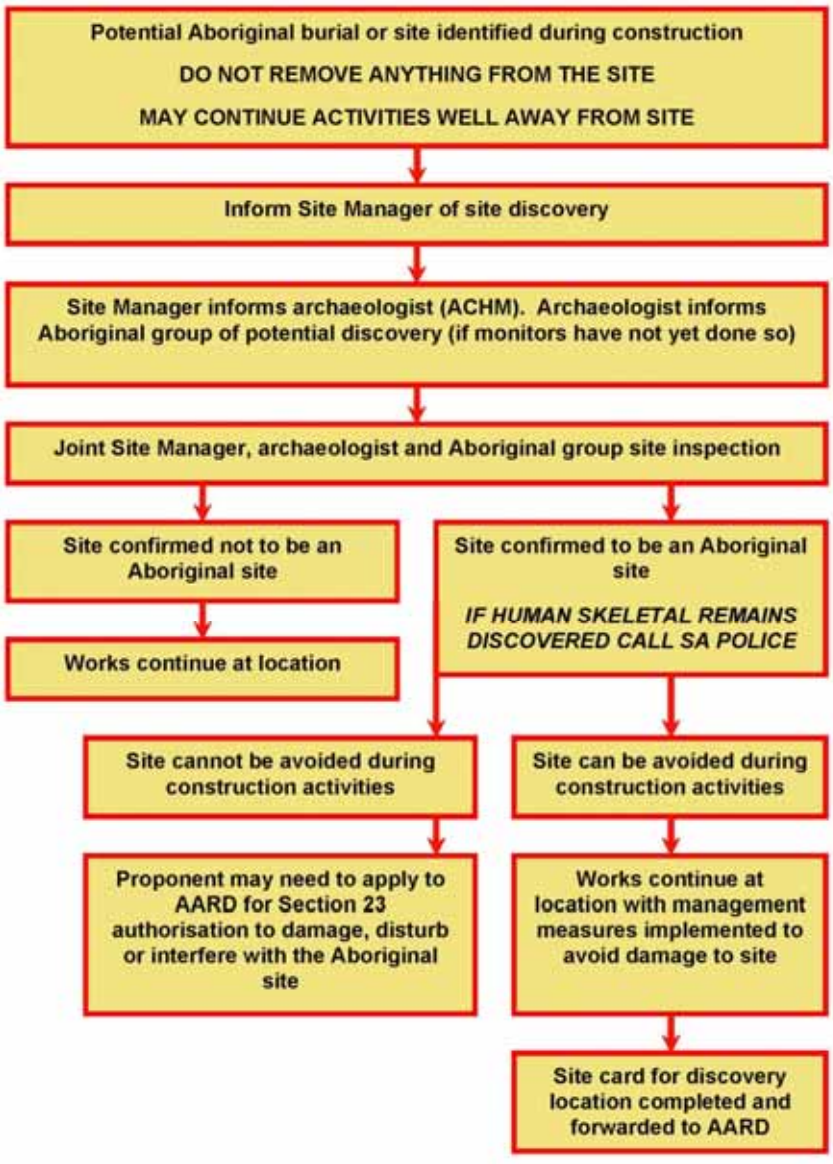
Opal Mining Act 1995 (SA)

14 Appendices

14.1 Appendix 1: Site Discovery Procedure

ACHM
AUSTRALIAN CULTURAL HERITAGE MANAGEMENT

Procedure to follow if potential Aboriginal skeletal remains and/or an archaeological site are found



14.2 Appendix 2: South Australian Museum Anthropology Database Search Results

Registry Number	Lot	Description	Region	Locality	Acquired From
A	2842		Eyre Peninsula, Port Augusta	Port Augusta	Black, E.C., Dr.
A	3515		Eyre Peninsula, Port Augusta	Tent Hill South	Weathersbee, R.D.J.
A	3515		Eyre Peninsula, Port Augusta	Tent Hill South	Weathersbee, R.D.J.
A	3516		Eyre Peninsula, Port Augusta	Tent Hill South	Weathersbee, R.D.J.
A	3517		Eyre Peninsula, Port Augusta	Port Augusta West PA211-N-1	Weathersbee, R.D.J.
A	3518		Eyre Peninsula, Port Augusta	Port Augusta West PA211-N-1	Weathersbee, R.D.J.
A	3519		Eyre Peninsula, Port Augusta	Port Augusta West PA211-N-1	Weathersbee, R.D.J.
A	3522		Eyre Peninsula, Port Augusta	El Alamein	Weathersbee, R.D.J.
A	3523		Eyre Peninsula, Port Augusta	Port Augusta - 212, 227, 245 and Rubbish Dump	Weathersbee, R.D.J.
A	3524		Eyre Peninsula, Port Augusta	Port Augusta - Nangari VII	Weathersbee, R.D.J.
A	3525		Eyre Peninsula, Port Augusta	Port Augusta W PA 205-5-1	Weathersbee, R.D.J.
A	3526		Eyre Peninsula, Port Augusta	Port Augusta W PA 205-5-1	Weathersbee, R.D.J.
A	3527		Eyre Peninsula, Port Augusta	Port Augusta W PA 205-5-1	Weathersbee, R.D.J.
A	3528		Eyre Peninsula, Port Augusta	Port Augusta PA 210, PA 211, PA 236, PA 245/250	Weathersbee, R.D.J.
A	3529		Eyre Peninsula, Port Augusta	Port Augusta 215 S	Weathersbee, R.D.J.
A	3530		Eyre Peninsula, Port Augusta	Port Augusta 215 S	Weathersbee, R.D.J.
A	3531		Eyre Peninsula, Port Augusta	Port Augusta West	Weathersbee, R.D.J.
A	3532		Eyre Peninsula, Port Augusta	Port Augusta Airstrip	Weathersbee, R.D.J.
A	3533		Eyre Peninsula, Port Augusta	Port Augusta W PA 211-N-2	Weathersbee, R.D.J.
A	3534		Eyre Peninsula, Port Augusta	Port Augusta West	Weathersbee, R.D.J.
A	3535		Eyre Peninsula, Port Augusta	Port Augusta 245 S1	Weathersbee, R.D.J.
A	3536		Eyre Peninsula, Port Augusta	Port Augusta 245 S1	Weathersbee, R.D.J.
A	3537		Eyre Peninsula, Port Augusta	Port Augusta 215 S	Weathersbee, R.D.J.
A	3538		Eyre Peninsula, Port Augusta	Port Augusta 215 S and El Alamein	Weathersbee, R.D.J.
A	3539		Eyre Peninsula, Port Augusta	Port Augusta PA 217 NW	Weathersbee, R.D.J.
A	3540	Including 2 slate scrapers	Eyre Peninsula, Port Augusta	Port Augusta PA 205 N	Weathersbee, R.D.J.
A	3543		Eyre Peninsula, Port Augusta	Port Augusta PA206N, 211-N-1, 205-5-1 and LII	Weathersbee, R.D.J.
A	3559		Eyre Peninsula, Port Augusta	Nangari VII	Weathersbee, R.D.J.
A	3560		Eyre Peninsula, Port Augusta	Nangari VII	Weathersbee, R.D.J.
A	3561		Eyre Peninsula, Port Augusta	Nangari VII	Weathersbee, R.D.J.
A	3562		Eyre Peninsula, Port Augusta	Nangari VII	Weathersbee, R.D.J.

Registry Number	Lot	Description	Region	Locality	Acquired From
A	3563		Eyre Peninsula, Port Augusta	Nangari VII	Weathersbee, R.D.J.
A	3564		Eyre Peninsula, Port Augusta	Nangari VII	Weathersbee, R.D.J.
A	3565		Eyre Peninsula, Port Augusta	Euro Bluff W70	Weathersbee, R.D.J.
A	3582		Eyre Peninsula, Port Augusta	Port Augusta PA 211-S-1	Weathersbee, R.D.J.
A	3583		Eyre Peninsula, Port Augusta	Nangari VII	Weathersbee, R.D.J.
A	3584		Eyre Peninsula, Port Augusta	Nangari IV	Weathersbee, R.D.J.
A	3585		Eyre Peninsula, Port Augusta	Nangari IV	Weathersbee, R.D.J.
A	3586		Eyre Peninsula, Port Augusta	Corraberra W70	Weathersbee, R.D.J.
A	3588		Eyre Peninsula, Port Augusta	Euro Bluff W70	Weathersbee, R.D.J.
A	3810		Eyre Peninsula, Port Augusta	Iron Knob	Gallus, S.A.
A11511	0	Skull with jaw and part skeleton	Eyre Peninsula, Port Augusta	Port Augusta	Police
A14214	21	Flint chippings from recent campsite	Eyre Peninsula, Port Augusta	Port Augusta, 1 mile west of	Tindale, N.B.
A14214	141	Flint chippings from recent campsite	Eyre Peninsula, Port Augusta	Port Augusta, 1 mile west of	Tindale, N.B.
A14214	1760	Flint chippings from recent campsite	Eyre Peninsula, Port Augusta	Port Augusta, 1 mile west of	Tindale, N.B.
A14214	3218	Flint chippings from recent campsite	Eyre Peninsula, Port Augusta	Port Augusta, 1 mile west of	Tindale, N.B.
A25561	0	Skull	Eyre Peninsula, Port Augusta	Port Augusta	Dr. Rogers
A25562	0	Skull	Eyre Peninsula, Port Augusta	Port Augusta	Dr. Rogers
A26665	141		Eyre Peninsula, Port Augusta	Port Augusta	Leichardt Search Pty
A26666	141		Eyre Peninsula, Port Augusta	Port Augusta	Leichardt Search Pty
A26667	141		Eyre Peninsula, Port Augusta	Port Augusta	Leichardt Search Pty
A26668	141		Eyre Peninsula, Port Augusta	Port Augusta	Leichardt Search Pty
A26669	141		Eyre Peninsula, Port Augusta	Port Augusta	Leichardt Search Pty
A26670	141		Eyre Peninsula, Port Augusta	Port Augusta	Leichardt Search Pty
A26671	141		Eyre Peninsula, Port Augusta	Port Augusta	Leichardt Search Pty
A27514	1616	Chopper	Eyre Peninsula, Port Augusta	Port Augusta West, 2 miles south of	Tindale, N.B.
A27515	1616	Chippings	Eyre Peninsula, Port Augusta	Port Augusta West, 2 miles south of	Tindale, N.B.
A27516	1616	Food debris, Arca trazepia [sic]	Eyre Peninsula, Port Augusta	Port Augusta West, 2 miles south of	Tindale, N.B.
A27526	1616		Eyre Peninsula, Port Augusta	Port Augusta, sandhill site ½ north of town	Tindale, N.B.
A27557	1616	Food, shells, Arca sp.	Eyre Peninsula, Port Augusta	Port Augusta	Tindale, N.B.
A27558	1616	Implement, pirri type	Eyre Peninsula, Port Augusta	Port Augusta	Tindale, N.B.
A27559	1616	Chopper	Eyre Peninsula, Port Augusta	Port Augusta	Tindale, D.M.
A28164	1616		Eyre Peninsula, Port Augusta	Port Augusta West, windblown pan 3 - 4 miles west of	Tindale, N.B.

Registry Number	Lot	Description	Region	Locality	Acquired From
A28165	1616		Eyre Peninsula, Port Augusta	Port Augusta West, windblown pan 3 - 4 miles west of	Tindale, N.B.
A28166	1616		Eyre Peninsula, Port Augusta	Port Augusta West, windblown pan 3 - 4 miles west of	Tindale, N.B.
A28167	1616		Eyre Peninsula, Port Augusta	Port Augusta West, windblown pan 3 - 4 miles west of	Tindale, N.B.
A28168	1616		Eyre Peninsula, Port Augusta	Port Augusta West, windblown pan 3 - 4 miles west of	Tindale, N.B.
A28169	1616		Eyre Peninsula, Port Augusta	Port Augusta West, windblown pan 3 - 4 miles west of	Tindale, N.B.
A28170	1616		Eyre Peninsula, Port Augusta	Port Augusta West, windblown pan 3 - 4 miles west of	Tindale, N.B.
A28171	1616		Eyre Peninsula, Port Augusta	Port Augusta West, windblown pan 3 - 4 miles west of	Tindale, N.B.
A28172	1616		Eyre Peninsula, Port Augusta	Port Augusta West, windblown pan 3 - 4 miles west of	Tindale, N.B.
A28173	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28174	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28174	1760		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28175	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28176	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28177	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28178	1616		Eyer Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28179	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28180	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28181	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28182	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28183	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28184	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28185	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28186	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.

Registry Number	Lot	Description	Region	Locality	Acquired From
A28187	1616		Eyre Peninsula, Port Augusta	Port Augusta West, 4 miles from, beside road to Whyalla	Tindale, N.B.
A28425	141		Central Lakes, Torrens	Philip Pond, Port Augusta, 115 miles northwest of	Jones, J.W.
A28494	141	Reg. number appears to include: Pipe, clay, broken	Eyre Peninsula, Port Augusta	Port Augusta, 3 miles west of	Campbell, T.D.
A28525	141		Eyre Peninsula, Port Augusta	Port Augusta	No data
A30035	141		Eyre Peninsula, Port Augusta	Port Augusta West	Cooper, H.M.
A30036	37		Eyre Peninsula, Port Augusta	Port Augusta West	Cooper, H.M.
A30036	129		Eyre Peninsula, Port Augusta	Port Augusta West	Cooper, H.M.
A30036	1695		Eyre Peninsula, Port Augusta	Salt Lagoon, Port Augusta West	Cooper, H.M.
A30036	1696		Eyre Peninsula, Port Augusta	Salt Lagoon, Port Augusta West	Cooper, H.M.
A30036	1702		Eyre Peninsula, Port Augusta	Salt Lagoon, Port Augusta West	Cooper, H.M.
A30036	2782		Eyre Peninsula, Port Augusta	Salt Lagoon, Port Augusta West	Cooper, H.M.
A30036	3218		Eyre Peninsula, Port Augusta	Salt Lagoon, Port Augusta West	Cooper, H.M.
A30214	135		Eyre Peninsula, Port Augusta	Yadlamalka	Cooper, H.M.
A30214	269		Eyre Peninsula, Port Augusta	Yadlamalka	Cooper, H.M.
A30216	135		Eyre Peninsula, Port Augusta	Georges Gate, ½ mile west of	Cooper, H.M.
A30216	293		Eyre Peninsula, Port Augusta	Georges Gate, ½ mile west of	Cooper, H.M.
A30241	36		Eyre Peninsula, Port Augusta	Pines, Yadlamalka	Cooper, H.M.
A30241	131		Eyre Peninsula, Port Augusta	Pines, Yadlamalka	Cooper, H.M.
A30241	135		Eyre Peninsula, Port Augusta	Pines, Yadlamalka	Cooper, H.M.
A30241	269		Eyre Peninsula, Port Augusta	Pines, Yadlamalka	Cooper, H.M.
A30242	269		Eyre Peninsula, Port Augusta	Fox-hole, Yadlamalka	Cooper, H.M.
A30242	1565		Eyre Peninsula, Port Augusta	Fox-hole, Yadlamalka	Cooper, H.M.
A30242	1567		Eyre Peninsula, Port Augusta	Fox-hole, Yadlamalka	Cooper, H.M.
A30243	135		Eyre Peninsula, Port Augusta	Woolly Tank Fence, Yadlamalka	Cooper, H.M.
A30243	269		Eyre Peninsula, Port Augusta	Woolly Tank Fence, Yadlamalka	Cooper, H.M.
A30244	135		Eyre Peninsula, Port Augusta	Salty (fish) Hole, Yadlamalka	Cooper, H.M.
A30244	269		Eyre Peninsula, Port Augusta	Salty (fish) Hole, Yadlamalka	Cooper, H.M.
A30244	3218		Eyre Peninsula, Port Augusta	Salty (fish) Hole, Yadlamalka	Cooper, H.M.
A30245	269		Eyre Peninsula, Port Augusta	Old Lake Hut, Yadlamalka	Cooper, H.M.
A30245	3218		Eyre Peninsula, Port Augusta	Old Lake Hut, Yadlamalka	Cooper, H.M.
A30246	269		Eyre Peninsula, Port Augusta	Tragedy Corner, Yadlamalka	Cooper, H.M.

Registry Number	Lot	Description	Region	Locality	Acquired From
A30247	269		Eyre Peninsula, Port Augusta	Soakage Tank, Yadlamalka	Cooper, H.M.
A30248	135		Eyre Peninsula, Port Augusta	Yadlamalka, sandhills 2 miles west of	Cooper, H.M.
A30248	269		Eyre Peninsula, Port Augusta	Yadlamalka, sandhills 2 miles west of	Cooper, H.M.
A30265	131		Eyre Peninsula, Port Augusta	Yorkeys Crossing	Cooper, H.M.
A30265	274		Eyre Peninsula, Port Augusta	Yorkeys Crossing	Cooper, H.M.
A30265	1813		Eyre Peninsula, Port Augusta	Yorkeys Crossing	Cooper, H.M.
A30435	286	Cleaver, stone	Eyre Peninsula, Port Augusta*	Lincoln Gap *	Australian Museum
A30672	126		Eyre Peninsula, Port Augusta	Fiddle Hill	Mitchell & Gross
A30672	1458		Eyre Peninsula, Port Augusta	Fiddle Hill	Mitchell & Gross
A30672	1675		Eyre Peninsula, Port Augusta	Fiddle Hill	Mitchell & Gross
A30673	2103		Eyre Peninsula, Port Augusta	Birthday Well - Cariewerloo	Mitchell & Gross
A30674	125		Eyre Peninsula, Port Augusta	Porchina	Mitchell & Gross
A30674	1230		Eyre Peninsula, Port Augusta	Porchina	Mitchell & Gross
A30674	1696		Eyre Peninsula, Port Augusta	Porchina	Mitchell & Gross
A30674	1712		Eyre Peninsula, Port Augusta	Porchina	Mitchell & Gross
A30873	141		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	145		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	155		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	1252		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	1625		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	4264	Core, horsehoof	Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	1764		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	1769		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	1814		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	1819		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	1836		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30873	4029		Eyre Peninsula, Port Augusta	Dempseys Lagoon	Campbell, T.D.
A30928	335		Eyre Peninsula, Port Augusta	Yadlamalka	Cooper, H.M.
A33369	140		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A33379	140		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A33380	140		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A33380	1760		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.

Registry Number	Lot	Description	Region	Locality	Acquired From
A33380	1834		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A33382	140		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A33383	140		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A33383	1815		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A33384	140		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A33384	1815		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34180	139		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34180	2310		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34180	1778		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34181	139		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34181	140		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34182	139		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34183	139		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34184	139		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34184	1828		Eyre Peninsula, Port Augusta	Port Augusta West	Black, E.C., Dr.
A34185	139		Eyre Peninsula, Port Augusta	Port Augusta East	Black, E.C., Dr.
A34186	139		Eyre Peninsula, Port Augusta	Port Augusta East	Black, E.C., Dr.
A34187	139		Eyre Peninsula, Port Augusta	Port Augusta East	Black, E.C., Dr.
A34209	1828		Eyre Peninsula, Port Augusta	Port Augusta	Black, E.C., Dr.
A36460	1241	Hammerstone and chippings	Eyre Peninsula, Port Augusta	Black Point	Campbell & Walsh
A38715	0	Skull, jaw and part skeleton.	Eyre Peninsula, Port Augusta	S.A., Port Augusta.	Police
A38887	0	Bones, 1 pt. parietal, 1 pt. temporal, 1 pt. occipital, 2 pt. scapula.	Eyre Peninsula, Port Augusta	S.A., Saltia.	Dist. Clerk Kanyaka
A41883	1696		Eyre Peninsula, Port Augusta	Port Augusta	Tindale & Birdsell
A42591	138		Eyre Peninsula, Port Augusta	Port Augusta, 8 miles south of	Lawton, R.S.
A42591	1760		Eyre Peninsula, Port Augusta	Port Augusta, 8 miles south of	Lawton, R.S.
A42596	138	Includes pipe, clay, broken barrel of	Eyre Peninsula, Port Augusta	Port Augusta West, 5½ miles south of	Lawton, R.S.
A42596	1458	Includes pipe, clay, broken barrel of	Eyre Peninsula, Port Augusta	Port Augusta West, 5½ miles south of	Lawton, R.S.
A42596	1760	Includes pipe, clay, broken barrel of	Eyre Peninsula, Port Augusta	Port Augusta West, 5½ miles south of	Lawton, R.S.
A42599	1760	Includes pipe, clay, broken barrel of	Eyre Peninsula, Port Augusta	Port Augusta, 5 miles South of	Lawton, R.S.
A43681	137		Eyre Peninsula, Port Augusta	Lincoln Gap	Bartlett, H.K.
A43689	138		Eyre Peninsula, Port Augusta	Port Augusta (east)	Bartlett, H.K.
A43700	137		Eyre Peninsula, Port Augusta	Lincoln Gap	Bartlett, H.K.

Registry Number	Lot	Description	Region	Locality	Acquired From
A43700	1712		Eyre Peninsula, Port Augusta	Lincoln Gap	Bartlett, H.K.
A43700	1760		Eyre Peninsula, Port Augusta	Lincoln Gap	Bartlett, H.K.
A43700	1814		Eyre Peninsula, Port Augusta	Lincoln Gap	Bartlett, H.K.
A43700	4030		Eyre Peninsula, Port Augusta	Lincoln Gap	Bartlett, H.K.
A43717	138		Eyre Peninsula, Port Augusta	Port Augusta	Bartlett, H.K.
A43982	126		Eyre Peninsula, Port Augusta	Iron Knob, 2 miles from	Bartlett, H.K.
A47511	136		Eyre Peninsula, Port Augusta	Port Augusta West	Cooper, H.M.
A47511	147		Eyre Peninsula, Port Augusta	Port Augusta West	Cooper, H.M.
A47511	148		Eyre Peninsula, Port Augusta	Port Augusta West	Cooper, H.M.
A47511	1769		Eyre Peninsula, Port Augusta	Port Augusta West	Cooper, H.M.
A47511	1813		Eyre Peninsula, Port Augusta	Port Augusta West	Cooper, H.M.
A47511	3193		Eyre Peninsula, Port Augusta	Dempseys Lagoon (Reg. loc. Port Augusta West)	Cooper, H.M.
A47512	138		Eyre Peninsula, Port Augusta	Port Augusta, 2 miles north of	Cooper, H.M.
A50556	152	Includes fragment of clay pipe, bowl of	Eyre Peninsula, Port Augusta	Port Augusta, 5 miles south of	Bartlett, H.K., Rev.
A50556	1760	Includes fragment of clay pipe, bowl of	Eyre Peninsula, Port Augusta	Port Augusta, 5 miles south of	Bartlett, H.K., Rev.
A50556	2041	Includes fragment of clay pipe, bowl of	Eyre Peninsula, Port Augusta	Port Augusta, 5 miles south of	Bartlett, H.K., Rev.
A50556	2920	Includes fragment of clay pipe, bowl of	Eyre Peninsula, Port Augusta	Port Augusta, 5 miles south of	Bartlett, H.K., Rev.
A50556	3218	Includes fragment of clay pipe, bowl of	Eyre Peninsula, Port Augusta	Port Augusta, 5 miles south of	Bartlett, H.K., Rev.
A50556	4029	Includes fragment of clay pipe, bowl of	Eyre Peninsula, Port Augusta	Port Augusta, 5 miles south of	Bartlett, H.K., Rev.
A52759	152		Eyre Peninsula, Port Augusta	Port Augusta, Hd. Copley (no section number)	Black, E.C., Dr.
A52759	1681		Eyre Peninsula, Port Augusta	Port Augusta, Hd. Copley (no section number)	Black, E.C., Dr.
A52759	1792		Eyre Peninsula, Port Augusta	Port Augusta, Hd. Copley (no section number)	Black, E.C., Dr.
A52759	1835		Eyre Peninsula, Port Augusta	Port Augusta, Hd. Copley (no section number)	Black, E.C., Dr.
A52759	2921		Eyre Peninsula, Port Augusta	Port Augusta, Hd. Copley (no section number)	Black, E.C., Dr.
A52881	152		Eyre Peninsula, Port Augusta	Port Augusta, near	Fairhall, A.E.
A52881	1458		Eyre Peninsula, Port Augusta	Port Augusta, near	Fairhall, A.E.
A52881	1760		Eyre Peninsula, Port Augusta	Port Augusta, near	Fairhall, A.E.
A52925	34		Eyre Peninsula, Port Augusta	Port Augusta, 3 miles north of	Bartlett, H.K., Rev.
A55287	149		Eyre Peninsula, Port Augusta	Port Augusta West, 10 miles south of	Lawton, R.S., Rev.
A56132	4229	Hammerstone	Central Lakes, No data	Port Augusta - Tarcoola, between	Cleland, J.B.

Registry Number	Lot	Description	Region	Locality	Acquired From
A56452	146		Eyre Peninsula, Port Augusta	Port Augusta, Weathersbee's sites LI & LII	Weathersbee, R.D.J.
A57265	21		Eyre Peninsula, Port Augusta	Port Augusta, Weathersbee's site 205N	Weathersbee, R.D.J.
A57265	151		Eyre Peninsula, Port Augusta	Port Augusta, Weathersbee's site 205N	Weathersbee, R.D.J.
A57265	1696		Eyre Peninsula, Port Augusta	Port Augusta, Weathersbee's site 205N	Weathersbee, R.D.J.
A57266	142		Eyre Peninsula, Port Augusta	Port Augusta, Weathersbee's site 204NW	Weathersbee, R.D.J.
A57266	1696		Eyre Peninsula, Port Augusta	Port Augusta, Weathersbee's site 204NW	Weathersbee, R.D.J.
A58968	149		Eyre Peninsula, Port Augusta	Port Augusta	Edwards, R.
A59077	144		Eyre Peninsula, Port Augusta	Port Augusta, from campsite immediately north of P.A.	Weathersbee, R.D.J.
A59078	1696	Animal bones	Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59079	1696	Shells, land snails	Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59086	143		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59086	150		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59086	1489		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59086	1696		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59087	143		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59087	2310		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59088	143		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59088	1696		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59089	143		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59089	150		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59090	150		Eyre Peninsula, Port Augusta	Port Augusta	Weathersbee, R.D.J.
A59090	2310		Eyre Peninsula, Port Augusta	Port Augusta 210	Weathersbee, R.D.J.
A60028	149		Eyre Peninsula, Port Augusta	Port Augusta, 11 miles southwest of	Griffin, L.
A60102	25	Implement, stone, Yoda	Eyre Peninsula, Port Augusta	Lake Windabout, Port Augusta - Whyalla pipeline	Davis, P.J.
A61810	149	Trimmed flakes, cores etc.	Eyre Peninsula, Port Augusta	Port Augusta	Davis, P.J.
A62100	128	Stone implements, large	Eyre Peninsula, Port Augusta	Port Augusta	Black, E.C., Dr.
A62100	2310	Stone implements, large	Eyre Peninsula, Port Augusta	Port Augusta W7	Black, E.C., Dr.
A62101	2310	Grindstones, 4 of	Eyre Peninsula, Port Augusta	Port Augusta W2	Black, E.C., Dr.

Registry Number	Lot	Description	Region	Locality	Acquired From
A64855	1658	Scraper, slate, reniform, miniature	Eyre Peninsula, Port Augusta	Port Augusta, north of, on the Woomera road	Weathersbee, R.D.J.
B	3520		Eyre Peninsula, Port Augusta	Yorkey Crossing - Port Augusta 283	Weathersbee, R.D.J.
B	3540		Eyre Peninsula, Port Augusta	Port Augusta PA 211-N	Weathersbee, R.D.J.
B	3543		Eyre Peninsula, Port Augusta	Port Augusta VII - Nangari A	Weathersbee, R.D.J.
B	3592		Eyre Peninsula, Port Augusta	Port Augusta 215S	Weathersbee, R.D.J.
C	3592	Stone implements etc.	Eyre Peninsula, Port Augusta	Port Augusta - Nectar Brook XXIV	Weathersbee, R.D.J.
E	2696		No Loc.	Port Augusta - Tarcoola	
F	3540		Eyre Peninsula, Port Augusta	Port Augusta LI Site A	Weathersbee, R.D.J.
G	3540		Eyre Peninsula, Port Augusta	Port Augusta LII Site B	Weathersbee, R.D.J.
J	2722		Eyre Peninsula, Port Augusta	Port Augusta	
M	2846		Eyre Peninsula, Port Augusta	Port Augusta	Black, E.C., Dr.
W	2798		Eyre Peninsula, Port Augusta	Port Augusta West	
Z	2800		Eyre Peninsula, Port Augusta	Port Augusta West	
A	2842		Eyre Peninsula, Port Augusta	Port Augusta	Black, E.C., Dr.
A	3515		Eyre Peninsula, Port Augusta	Tent Hill South	Weathersbee, R.D.J.