



Leigh Creek Energy

Environmental Impact Report

Geophysical Operations

Petroleum Exploration Licence 650



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Leigh Creek Energy acknowledge the Adnyamathanha people, the traditional owners of the land on which our operations occur and pay our respects to their Elders past and present.

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Summary

Leigh Creek Energy holds Petroleum Exploration Licence 650 located at Leigh Creek in South Australia, 550 km north of Adelaide. The geophysical surveys proposed to be conducted on Petroleum Exploration Licence 650 as a part of the Leigh Creek Energy Project (the Project) are by their very nature are to be performed in a manner which results in very low to minimal ground disturbance.

The Leigh Creek Coalfield has a long history of mining commencing at a commercial scale in the 1940s, initially under the auspices of the South Australian Engineering and Water Supply and then the Electricity Trust of South Australia. Over a period of 80 years different owners (both public and private) have operated the mine under various regulatory, social and environmental expectations and conditions. In addition to the naturally occurring hydrocarbons and other chemicals of potential concern, there has been documented soil and groundwater contamination resulting from mining activities which has been assessed and documented with the South Australian Environment Protection Authority (EPA).

An environmental risk assessment on geophysical surveys has been undertaken as part of this Environmental Impact Report. It indicates that the level of risk is manageable and relatively low for the key areas of concern identified by stakeholders (cultural heritage, soil contamination, groundwater, surface water and impact on flora). No high or unacceptable risks have been identified. Leigh Creek Energy will ensure that the planned design for the geophysical surveys are in accordance with relevant standards, risk assessment and management procedures and environmental management systems to ensure that all potential risks are appropriately managed.

Stakeholder engagement will continue to be an ongoing priority and third-party stakeholders, including pastoral landowners, will be kept informed prior to, during and at the completion of the surveys. A targeted online Community Portal has been established (since 2018) where community members can share their experiences of the Project, leave feedback, and locate or request information. The portal provides enhanced two-way communication where community users can track the progress of any requests made and include reminders to ensure their questions are answered by LCK in a timely manner.

The Community Portal can be accessed through the Leigh Creek Energy's website 'Contact Us' section (www.lcke.com.au/contact) and direct through <http://lcke.c3register.com/>. Leigh Creek Energy is committed to open and transparent communication with stakeholders and encourages community members to use the Community Portal to ask questions and leave feedback regarding this document.

1 Introduction

Leigh Creek Energy Limited (LCK) holds Petroleum Exploration Licence (PEL) 650 located at Leigh Creek in South Australia (SA), 550 km north of Adelaide. LCK plans to undertake geophysical (including seismic survey) activities within PEL 650 to identify and delineate potential structures and the depth of the coal seams for the Leigh Creek Energy Project (LCEP). This Environmental Impact Report (EIR) has been prepared as a requirement of the *Petroleum and Geothermal Energy Act 2000* (PGE Act) to provide information on the proposed activities, potential environmental impacts and management thereof.

The site is approximately 8.5 km from Copley and 12 km from Leigh Creek.

The Adnyamathanha People are the formally recognised Traditional Owners over a large area encompassing the northern Flinders Ranges region, within which PEL 650 is located. In order to ensure the Adnyamathanha's cultural heritage is protected, LCK and the Adnyamathanha Traditional Lands Association (ATLA) as the prescribed body corporate for the native title area, entered into a Work Area Clearance Agreement (WACA) in September 2016. The WACA provides a clear process for the completion of work area clearances related to LCK's project and includes a Cultural Heritage Policy to ensure that Aboriginal sites, objects and remains, as well as non-Aboriginal Heritage sites and or items are protected if they are discovered during geophysical activities.

ATLA and LCK successfully implemented the WACA for the purposes of the LCK Pre-Commercial Demonstration (PCD) project, which was subject to earlier regulatory approvals.

LCK continues to seek the support of ATLA to undertake a work area clearance for the geophysical activities which are related to this EIR. Overall, it is LCK's aim to build a close and mutually beneficial working relationship with ATLA for the currently proposed activities and future development of the Project.

LCK plans to produce energy from coal using a process known as in situ gasification (ISG). The ISG process converts coal from its solid state into a gaseous form, resulting in the generation of synthesis gas (syngas) containing methane, hydrogen and other valuable components. Pending a final commercial decision to be made at a later date, the syngas can either be used to produce electricity directly or further refined into a variety of products including methane and ammonia.

A better understanding of the geology of PEL 650 is required, so various geophysical surveys (including seismic surveys) will be conducted over PEL 650 in the next few years. This document addresses the geophysical surveys proposed to be conducted over PEL 650 only. Once completed, the information from the geophysical surveys will be used to conduct drilling programs. The drilling activities will be covered in the separate EIR and accompanying Statement of Environmental Objectives (SEO).

The location of PEL 650 is shown in Figure 1-1.

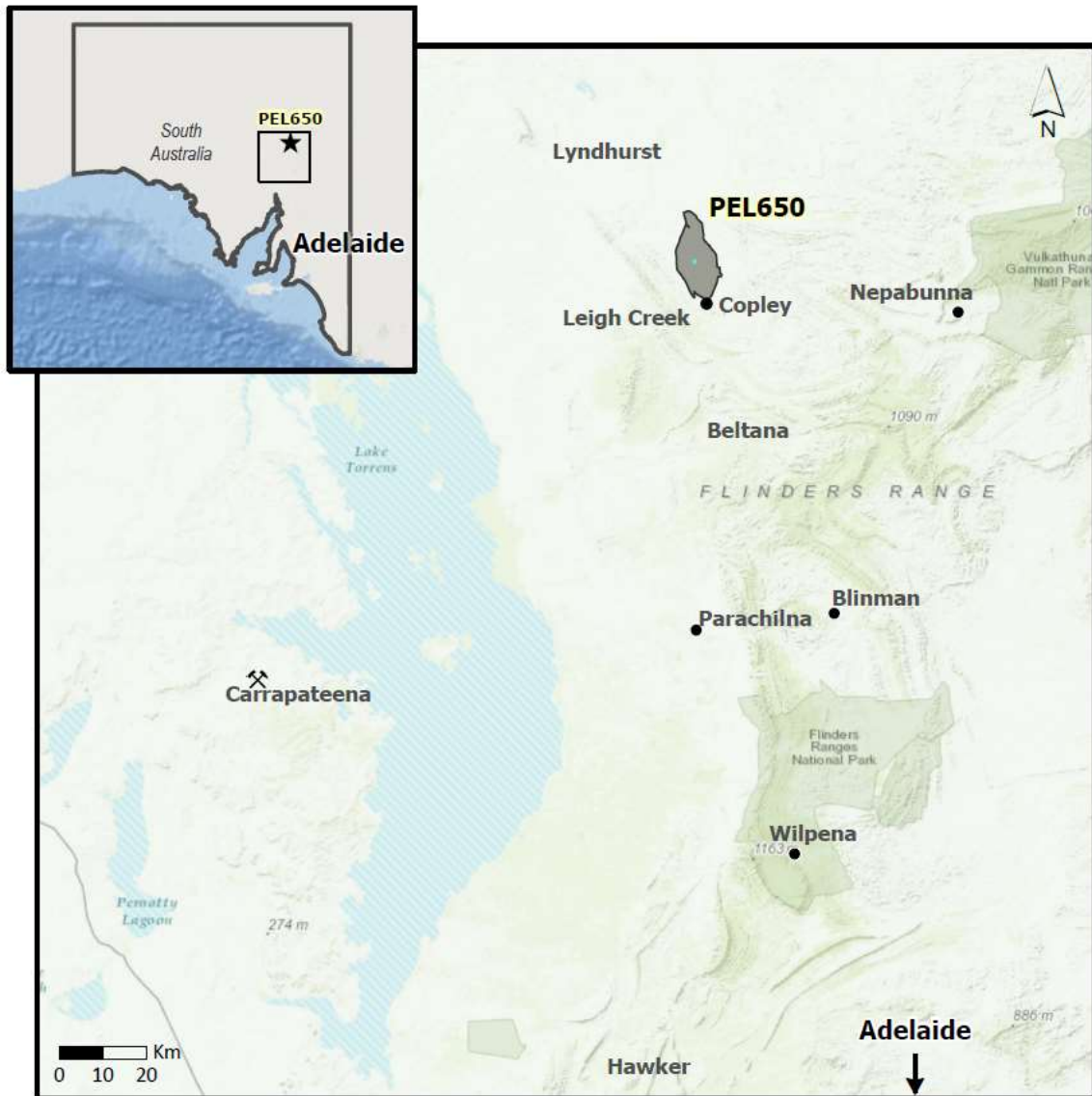


Figure 1-1: Project Location

1.1 Project Proponent

LCK is an emerging gas company focussed on developing the LCEP (Leigh Creek Energy Project) in northern SA. LCK is listed on the Australian Securities Exchange (ASX) under the ASX code of LCK and is headquartered in Adelaide, SA.

LCK (through wholly owned subsidiary Leigh Creek (Operations) Pty Ltd) holds PEL 650, which covers an area of 93 km² over the Leigh Creek Coalfield, and Gas Storage Exploration Licence (GSEL) 662 which covers the same area. LCK also hold Petroleum Exploration Licence Application (PELA) 647 adjacent to PEL 650.

1.2 About this Document

This document has been prepared to satisfy the requirements of an EIR under the PGE Act for the proposed geophysical surveys over PEL 650. It has been prepared in accordance with the current legislative requirements, in particular Section 97 of the PGE Act, and Regulation 10 of the *Petroleum and Geothermal Energy Regulations 2013* (PGE Regulations).

A SEO for the geophysical activities of LCEP will be prepared based on this EIR¹.

This EIR covers:

- line surveying
- line and access track preparation
- surface placement of geophysical instrumentation (i.e. geophones, ground penetrating radar, etc.)
- recording (seismic, gravimetric, ground magnetic and electromagnetic)
- campsites and associated activities, where required
- monitoring and auditing of selected locations (before and after line preparation and after restoration)
- line access track and campsite restoration where required (after completion of recording).

2 Legislative Framework

This section briefly describes the legislative framework that currently applies to petroleum activities in SA.

2.1 Petroleum and Geothermal Energy Act

Petroleum² exploration and production activities are governed by the PGE Act and the PGE Regulations. This legislation is administered by the Energy and Resources Division of the Department for Energy and Mining (DEM).

2.1.1 Statement of Environmental Objectives

As a requirement of Part 12 of the PGE Act, a regulated activity can only be conducted if an approved SEO has been developed. The SEO outlines the environmental objectives that the regulated activity is required to achieve and the criteria upon which the objectives are to be assessed.

The SEO is developed based on information provided in an EIR (this document).

2.1.2 Environmental Impact Report

In accordance with Section 97 of the PGE Act, the EIR must:

- take into account cultural, amenity and other values of Aboriginal and other Australians in so far as those values are relevant to the assessment
- take into account risks inherent in the regulated activities to the health and safety of the public
- contain sufficient information to make possible an informed assessment of the likely impact of the activities on the environment.

As per Regulation 10 of the PGE Regulations the following information must be provided for the purposes of an EIR:

¹ Or the SEO may be required to be prepared on the basis of an environmental impact assessment under the Development Act, depending on the classification of the activities under Section 98 of the PGE Act, as discussed in Section 2.1.

² The definition of petroleum under the PGE Act includes coal or shale occurring in circumstances where the use of techniques for in situ gasification would be appropriate and also includes hydrocarbons that are a product of coal gasification (produced below or above ground) for the purposes of the production of synthetic petroleum.

- a description of the regulated activities to be carried out under the licence (including their location)
- a description of the specific site features of the environment that can reasonably be expected to be affected by the activities, with particular reference to the physical and biological aspects of the environment and existing land uses
- an assessment of the cultural values of Aboriginal and other Australians which could reasonably be foreseen to be affected by the activities in the area of the licence, and the public health and safety risks inherent in those activities (insofar as these matters are relevant in the particular circumstances)
- a description of reasonably foreseeable events associated with the activity that could pose a threat to the relevant environment (including events during the construction, operational and abandonment stages, atypical events, estimated frequency of events and the basis of predictions)
- an assessment of the potential consequences of these events on the environment (including size and scope, duration, cumulative effects (if any), the extent to which these consequences can be managed or addressed and proposed management actions)
- an explanation of the basis on which these consequences have been predicted
- a list of all owners of the relevant land
- information on consultation undertaken during the preparation of the EIR.

2.1.3 Assessment and Approval

The EIR is submitted to DEM and an Environmental Significance Assessment is undertaken to determine whether the activities described in the EIR are to be classified as 'low', 'medium' or 'high' impact. A corresponding draft SEO is prepared, reflecting the impacts and measures identified in the EIR or other assessments that may be required as determined by the classification.

The classification also determines the level of consultation DEM will be required to undertake prior to final approval of the SEO as follows:

- Low impact activities do not require public consultation and are subjected to a process of internal government consultation and comment on the EIR and draft SEO prior to approval.
- Medium impact activities require a public consultation process for the EIR and draft SEO, with comment sought for a period of at least 30 business days.
- High impact activities are required to undergo an environmental impact assessment under the provisions of the *Development Act 1993*. A draft SEO for high impact activities must be prepared on the basis of this environmental impact assessment.

The level of environmental impact of a particular activity is assessed and classified by DEM on the basis of predictability and manageability criteria required by section 98 of the PGE Act (DMITRE 2013).

Once the approval process is complete, all documentation, including this EIR and its associated SEO, must be entered on an Environmental Register. This Environmental Register is accessible to the public from the DEM website.

2.1.4 Activity Notification / Approval Process

Prior to commencing a regulated activity, Section 74(3) of the PGE Act requires that:

- the Minister's prior written approval is required for activities requiring high level supervision with a notice of activities to be provided 35 days in advance (as per Regulation 19), and

- notice of activities requiring low level supervision is to be given at least 21 days in advance (as per Regulation 18).

The application for the Minister's approval and notification of activities must provide specific technical and environmental information on the proposed activity and include an assessment to demonstrate that it is covered by an existing SEO.

Consequently, this activity notification process provides an additional opportunity for DEM to ensure that the proposed activities and their impacts can be effectively managed and are consistent with the approvals obtained in the EIR and SEO approval process.

2.2 Other Legislation

A variety of legislation applies to petroleum exploration activities, and those of relevance to the proposed geophysical surveys are listed below (note that this is not a comprehensive list of all applicable legislation).

Table 2-1: Summary of applicable legislation

Jurisdiction	Legislation
Commonwealth	<i>Aboriginal and Torrens Strait Islander Heritage Protection Act 1984</i> <i>Environment Protection and Biodiversity Conservation Act 1999</i> <i>Native Title Act 1993</i>
South Australia	<i>Aboriginal Heritage Act 1988</i> <i>Crown Land Management Act 2009</i> <i>Environment Protection Act 1993</i> <i>Fire and Emergency Services Act 2005</i> <i>Heritage Places Act 1993</i> <i>National Parks and Wildlife Act 1972</i> <i>Native Title (South Australia) Act 1994</i> <i>Native Vegetation Act 1991</i> <i>Natural Resources Management Act 2004</i> <i>Natural Trust of SA Act 1955</i> <i>Road Traffic Act, 1961</i> <i>South Australian Public Health Act 2011</i> <i>Work Health and Safety Act 2012</i>

2.2.1 Commonwealth Environment Protection and Biodiversity Conservation Act

Referral and approval under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required for actions that will have, or are likely to have a significant impact on matters of national environmental significance including World Heritage properties, National Heritage places, Ramsar wetlands of international importance, listed threatened species and ecological communities, listed migratory species and a water resource, in relation to coal seam gas development and large coal mining development.

As discussed in Sections 3.1 and 5 of this EIR, there are no matters of national environmental significance present or likely to be significantly impacted as a result of the planned geophysical surveys. The proposed geophysical surveys are generally considered a low impact non-destructive activity and are therefore expected to have minimal to no impact within the project area. Consequently, LCK believes that a requirement for referral and approval under the Act is not likely

to be triggered. LCK will continue to review proposed activities against the EPBC Act triggers and will submit a referral under the EPBC Act if necessary.

2.2.2 Environment Protection Act

The *Environment Protection Act 1993* (EP Act) imposes a “general environmental duty” of care not to undertake an activity that pollutes or might pollute the environment unless all reasonable and practicable measures have been taken to prevent or minimise any resulting environmental harm. Environmental authorisations are required to undertake activities prescribed under the EP Act.

The EP Act does not apply to exploration activity undertaken under the PGE Act, or to wastes produced in the course of an activity (not being a prescribed activity of environmental significance) authorised by a licence under the PGE Act, when produced and disposed of to land and contained within the area of the licence.

2.2.3 Native Vegetation Act

The *Native Vegetation Regulations 2017* permit clearance of vegetation incidental to exploratory operations authorised under the PGE Act. Under Regulation 15, clearance is permitted if it is undertaken in accordance with approved industry standards that are directed towards minimising impact and encouraging regrowth of any native vegetation that is cleared.

All geophysical activities will be undertaken in accordance with a SEO, which is the approved industry standard for activities under the PGE Act.

2.2.4 Natural Resources Management Act – Water Management

The *Natural Resources Management Act 2004* (NRM Act) applies to a range of aspects of natural resource management. As the proposed geophysical surveys are generally considered a low impact non-destructive activity, any potential impact on natural resources including surface water or groundwater is expected to be minimal. A requirement for a permit for water affecting activities is not expected to be triggered by the proposed geophysical activities.

PEL 650 lies within the non-prescribed surface water and groundwater resources area of the South Australian Arid Lands Natural Resources Management (SAAL NRM) Region (Penney 2015). It is outside the Far North Prescribed Wells Area and there is no Water Allocation Plan in place over the project area (SAAL NRM Board, 2009).

2.2.5 Native Title Act

The Commonwealth *Native Title Act 1993* and the *Native Title (South Australia) Act 1994* provide for the recognition and protection of native title. Native title will exist in those areas of land or water (e.g. on vacant or unallocated crown land) where it has not been extinguished by the conduct of Public Works or the grant of land tenure (such as freehold) or where there is clear intent to extinguish freehold tenure and certain other forms of land title. Native title is discussed further in Section 4.12.3.

3 Description of Activities

The series of various geophysical surveys will be conducted across PEL 650 in the future.

The purpose of the geophysical surveys is to collect data on the geological structure of the area and the location of the faults and coal seams in the area. The type of geophysical surveys that are proposed to be conducted include:

- Seismic surveys
- Gravimetric surveys
- Ground magnetic surveys
- Electromagnetic surveys
- Ground penetrating radar surveys
- TSIM surveys
- any other low impact non-destructive geophysical survey

Activities associated with geophysical operations are as follows:

- Line surveying
- Line and track preparation
- Recording and data acquisition of information
- Camp sites and associated activities (only if required)
- Monitoring and auditing of selected locations (pre and post line preparation and post restoration)
- Line access track and camp site rehabilitation (only if required)

Technical terms used in this section are explained in the Glossary (Section 9).

3.1 Seismic Surveys Method

Seismic surveys are undertaken to collect geological information of the ground structure beneath the ground surface. This is achieved by using an energy source, such as a vibrator truck, to generate acoustic waves, which travel into the ground and are then reflected from subsurface geological structures. The returning reflections are recorded in a digital format and sent to a seismic data processing centre to produce a series of 'cross sections' of the layers under the ground surface. These 'cross sections' can then be combined to form a 3D image of the structures under the ground surface.

Once the exploration team of an exploration company have proposed a seismic program, the seismic program is plotted onto detailed topographic and/or satellite images. There are two basic types of seismic survey.

- 2D operations are typically independent lines with the source effort operating on the receiver line. This produces a 2D cross section of the sub-surface along that traverse.
- A 3D survey records data over a 'grid' of lines simultaneously, giving a three-dimensional view of the subsurface, beneath an area generally covering 1–25 km². The surveys may have energy source lines at right angles to the geophone lines and have a closer line spacing typically ranging between 15–100 m.

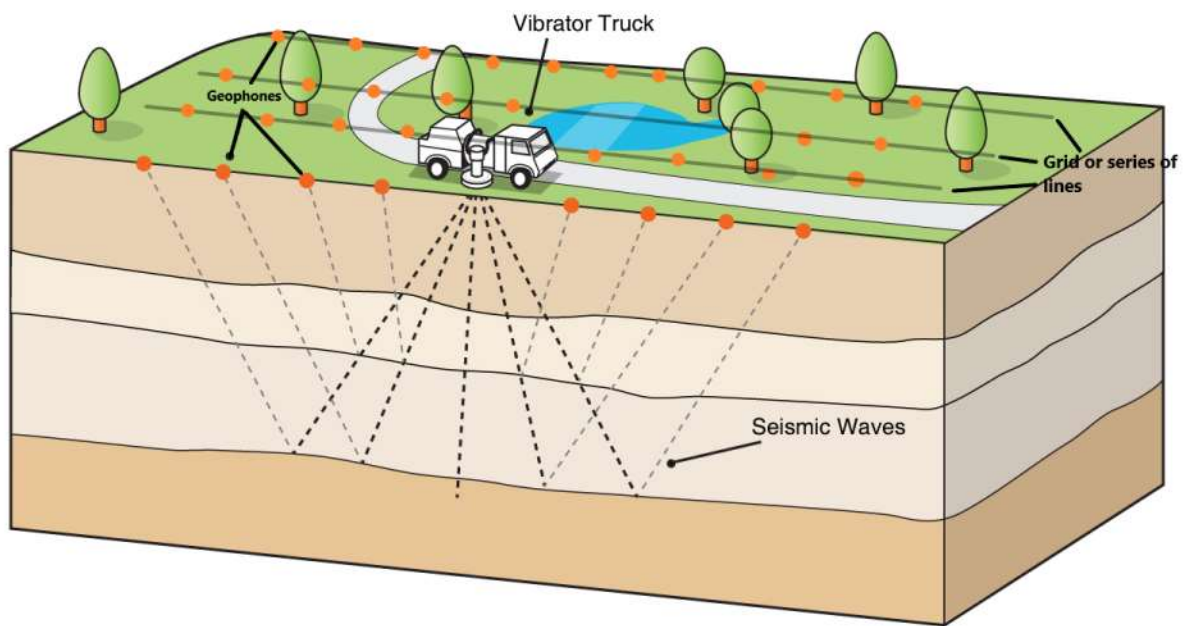


Figure 3-1: 3D Seismic Survey

The key aspect of field acquisition is to move equipment (usually vehicular based) and personnel along the planned seismic lines and acquire sufficient data to adequately 'image' the subsurface. The safety of field personnel is a key consideration of any field seismic operation. This involves compromise between what is logistically, environmentally and economically possible.

3.2 Seismic Line and Access Track Preparation

3.2.1 Seismic lines

The seismic lines are carefully laid out to avoid sensitive sites such as known heritage sites, environmental sites, cultural features (e.g. buildings, dams, water wells). The amount of line preparation will only be enough to allow the all-terrain vehicles to travel safely. If there has been recent rain and the grass vegetation is thick, then slashing along the seismic lines may be required for safety reasons. This is usually 4 metres wide to allow vehicle access and associated above ground cables. All seismic lines that require rehabilitation, will be rehabilitated as per Section 3.10.

3.2.2 Access tracks

Unlike drilling activities, the preparation of access tracks to bring seismic vehicles to an area is not usually required. The equipment used is all wheel drive and able to traverse most terrains.

The PEL 650 contains a network of earthen bunding that contributes to the long-term surface water management. Disturbance of these bunds will be avoided but, in the event, that any bunds are impacted they will be reprofiled/reinstated to their prior contours. Access tracks may be required in areas of no existing roads (e.g. undisturbed areas, on waste piles or within open pits from previous coal mining). Minimal vegetation and soil disturbance will be used in the construction of access tracks. All access tracks will be rehabilitated once the seismic survey is completed, refer to Section 3.10.

3.2.3 Cultural and environmental clearance for track and line preparation

If access track and/or line preparation is required, cultural clearance will be sought. In the event that cultural clearance is received, the access track/line preparation can proceed. Due to the

topography at Leigh Creek, most of the area is relatively flat and so the only soil disturbance may be in areas where an access track/seismic line crosses an ephemeral creek with shallow erosional sidewalls or an erosion gully. Any environmental sensitive areas are flagged and avoided during the preparation of the access tracks and seismic lines.

3.3 Line Surveying

Typically, the surveying will commence shortly after line preparation, by surveyors using real time GPS receivers. Points along the lines will be marked with either biodegradable paint, pin flags or wooden pegs. Where pins and pegs are used, these will be removed at the end of the recording phase.

Biodegradable flagging is sometimes used to mark detours and will be removed at the end of the recording phase. The survey team consists of 1 to 2 Surveyors with a light 4WD vehicle and they will generally only pass over a given section of line once.

3.4 Recording

Recording usually commences within one to two weeks after the start of line preparation and typically takes from 4 to 21 days, depending on the type of seismic survey and the size of the area. The recording phase is also the time when there are the most personnel on site. The amount of personnel on site during this time depends on the size of the area and will usually involve between 10 and 30 personnel and 5 to 15 vehicles.

3.4.1 2D Operations

Work commences with the laying of cable and deployment of geophone bundles from light 4WD vehicles. The geophones are on lines of cable and the geophones are planted in the ground by personnel on foot (refer Figure 3-2). Once planted, the string is connected to a 'take out', on the recording cable. The recording cable is spooled out from the side of the vehicle and offset to one side of the line to prevent damage from following vehicles.

Recording in 2D mode would normally commence when enough length of cable / geophone or nodal system have been laid. This layout is termed 'the spread' and a pre-selected 'live' section of it picks up the acoustic energy reflected from subsurface layers, converts it to electrical energy and transmits it to the instrument recording truck.



Figure 3-2: Laying out Geophones (source Terrex)

The instrument recording truck (refer Figure 3-3) that collects, decodes and amplifies these signals, sets up at a suitable location approximately 100 m from the spread and connects to it. Once the instruments and spread have been satisfactorily tested, recording is ready to commence.

The acoustic energy source is normally from between one to four truck-mounted vibrator units electronically synchronised to vibrate in phase with each other (refer Figure 3-4:). They line up along a source line, a few metres apart, centred on a source point. Each unit, on command from the instrument truck, inputs one or more frequency sweeps into the ground at each source point. Each sweep lasts for only a few seconds. Generally, four seconds of reflected data is recorded. The source points are approximately 15 to 100 m apart, depending on the size of the survey and the detail required. On completion of one source point the set of vibrators quickly move to the next source point.



Figure 3-3: Recording Truck (Source: PIRSA)



Figure 3-4: Vibrator truck (Source: Terrex Seismic website)

The live section of the spread is the only part of the spread where signal is recorded for any given source position. The live spread is moved (controlled by the recording truck operator) as the vibrators move up. As spread becomes redundant behind the vibrators (back end of line) it is picked up and transported to the front end of the line. This cycle continues until the line is completed. The recording truck may move once or twice during the day to keep pace with the spread.

All operational vehicles stay on the prepared line, the exceptions being parked vehicles, spare vibrators, vibrator service truck and instrument truck, all of which have to park off line to avoid causing noise on the spread and interference with line traffic.

Along any single line the following vehicle passes can be expected to occur during normal operations:

- Vibrators 1 pass for each truck
- Instrument truck 1 pass
- Light vehicles 15–20 passes in total
- Vibrator service truck 1 pass.

3.4.2 3D Operations

For 3D surveys, the major differences from 2D operations are that the vibrators vibrate on separate source lines to the cable/geophone lines (now termed receiver lines). Source lines are often designed to be orthogonal to the receiver lines, but other orientations may be employed.

The vibrators and associated equipment use the receiver lines for access from one source line to the next, so the amount of traffic on a receiver line will be very similar to a 2D line (as above). However, the source lines carry limited traffic i.e. the vibrators and their associated equipment plus any supervisory 4WD vehicle passes. Also, vibrator marks will only be left on the source lines.

Typically, receiver points are 16 m apart on the receiver lines and source points are 27 m apart on the source lines, depending on the design of the seismic program and the amount of detail required.

Successive receiver lines are anywhere from 75 m to 120 m apart as are the source lines. On occasions receiver point intervals may be as low as 15 m or as high as 100 m.

Instead of having one receiver line, as in 2D surveys there are now generally eight or more receiver lines recording at any time, with a further two redundant (one being picked up and moved to the front, and one at the front ready for use). Recording in 3D mode would normally commence when enough area of cable and geophones have been laid.

Along any single line the following vehicle passes can be expected to occur during normal operations:

- Vibrators - 1 pass for each truck (source lines)
- Vibrator service truck - 1 pass (source lines)
- Instrument truck - 1 pass (receiver lines)
- Light vehicles - 15–20 passes in total (receiver lines)

3.5 Uphole Drilling and Logging

Uphole drilling is carried out to provide data on surface layers for use in processing of seismic data. LCK intend to use previously recorded data for the region and do not propose to carry out any uphole drilling for the seismic surveys.

3.6 Other geophysical surveying operations

Other geophysical surveys do not have the same extent of operations as seismic surveying. Most use 4WD vehicles or are done on foot and involve taking some measurement along ground surfaces traverses (similar to 2D seismic lines) but are more like activities involved in line surveying (Section 3.3 above). Often no significant line or access track preparation is required. Measurements can be of a passive nature, such as measurement of gravity, magnetic or electromagnetic fields, or involve input of some signal into the earth, such as small electrical or electromagnetic signals.

3.7 Water Usage

The LCEP has access to mains water supplied by SA Water and will not need to extract groundwater.

3.8 Site Access

Site access for the geophysical surveys on PEL 650 is via the existing paved public highway B83 (the Outback Highway), from Leigh Creek. Once on PEL 650, the existing mine roads will be utilised as much as possible and the need to move off these roads and tracks will be minimal.

3.9 Camp Sites and Associated Activities

As the size of the seismic survey areas will be small and the duration of the seismic survey will be short (less than 3 weeks), the survey and seismic crews will be accommodated in the nearby towns of Leigh Creek and Copley.

In the unlikely event that accommodation is not available in Leigh Creek and Copley, then a temporary mobile camp will be set up on the LCEP site. The mobile camp will be set up as close

as practical to existing tracks or roads and on previously disturbed areas used as a former mobile camp site. This will avoid the need for clearance of native vegetation and subsequent disturbance of natural habitats. The same camp will be used for the entire duration of the seismic survey.

Putrescible domestic wastes (e.g. food waste, paper) created at campsites are stored on site along with other wastes (such as plastics, cans and glass) prior to transportation to a licensed waste disposal facility. Recyclable materials are segregated for recycling where practicable and are also transported to a licensed waste facility. Storage methods consider, issues such as scavenging animals, to avoid litter scattering and impacts on wildlife.

Campsites require the provision of systems for the management of sewage wastes, which must be managed in accordance with the *South Australian Public Health (Wastewater) Regulations 2013* or to the satisfaction of the Department of Health. Approved environmental treatment units may be utilised where practical and appropriate. Following treatment via an approved system wastewater may be disposed of on-site (onto land, well away from any place from which it is reasonably likely to enter any waters, and well away from any infrastructure) when in remote areas. The method of disposal for wastewater must comply with the Standard for the Construction, Installation and Operation of Septic Tank Systems in SA, or be to the satisfaction of the Department of Health.

All fuel, oil and chemicals will be stored and handled in accordance with relevant standards including AS 1940 and EPA guideline 050/07 Bunding and Spill Management. Hazardous materials will be transported and disposed in accordance with appropriate standards and legislative requirements, including the Australian Dangerous Goods Code. Appropriate spill response equipment and MSDS will be available on site for all fuels and chemicals used on site. Drip trays are positioned at the refuelling bowser and mechanical workshop to eliminate fuel and oil ground contamination. Any uncontained spillage onto the ground surface will be removed and suitably disposed of at an EPA licenced facility. In the unfortunate event of a larger spill, a spill remediation approach will be adopted based on the volume and estimated horizontal and vertical impact. The impacted soil will then be removed to an EPA licensed facility and replaced with clean fill.

Once the campsite has been vacated rehabilitation is undertaken, including ensuring no rubbish or any man-made items are left in situ and, when necessary and terrain permitting, the area is tyre ripped to remove compaction and wheel tracks. Shoulders of adjacent formed tracks are reinstated.

3.10 Restoration Activities

If undertaken correctly, the majority of seismic lines, access tracks and camp sites do not require restoration work as one of the main objectives is to prepare and utilise them in a way that will facilitate rapid natural recovery. However, restoration activities are required where the following has occurred:

- wheel ruts caused during the crossing wet or soft ground
- the removal of windrows on the edge of existing tracks where they were intersected by seismic lines
- soil compaction
- heavily trafficking of routes between camp sites and the nearest public track
- the generation of bulldust on access tracks due to extensive seismic traffic
- disturbance to earthen bunds
- watercourse channel infill and or restriction of natural flows.

Methods used for rehabilitation include (dependant on existing environment and the level of previous disturbance e.g. on waste piles or within open pits from previous coal mining):

- ripping of compacted areas where required (note: ripping will not be undertaken on unsuitable soils)
- windrow material pushed onto line and smoothed
- existing track windrows reinstated, where removed
- wheel rut material used to infill affected areas
- reprofiling/reinstatement of any earthen bunds to their prior contours.
- affected watercourse channels and creek banks reinstated.

Seismic lines, access tracks and campsites will be restored and rehabilitated to the highest level practicable.

4 Existing Environment

4.1 Historical Activity Overview

Proposed geophysical operations will be undertaken within PEL650 which is located within the Leigh Creek Coalfield in northern SA. Coal was initially discovered at Leigh Creek in 1888 and intermittent testing and mining took place with limited success over the next 55 years. Open cut mining officially commenced in 1943 under the management of the Engineering and Water Supply Department (EWS) until the Electricity Trust of South Australia (ETSA) took control of the Coalfield in 1948 as part of the process of developing the Port Augusta Power Station.

The Leigh Creek Coalfield was originally defined as comprising three distinct basins; Copley Basin (Lobes A and E), Telford Basin (Lobe B) and Northfield Basin (Lobes C and D). Three of these Lobes (Lobes B, C and D) have been actively mined. The Copley Basin (Lobes A and E) were not included in any mining operations and are excluded from PEL 650.

Open cut mining commenced in 1943 in Lobe B, which was known as the 'Telford Open Cut'. Mining at Lobe D and Lobe C to the north began in 1948 and 1963, respectively. These deposits were mined until September 1977 using conventional open cut mining methods with overburden broken by blasting, and dragline cuts into coal.

The coalfield was enlarged after the decision in the 1970s to build an additional power station at Port Augusta. This involved new methods to extract deeper coal, increasing production, building a retention dam to divert Leigh Creek and prevent possible flooding of the field and diverting the main highway around the coalfield. The Leigh Creek township was relocated from the coalfield to its current location. Open pit strip mining was employed at the pits on Lobes C and D of the Leigh Creek Coalfield until the early 1990s when the terrace (or haulback) mining method was adopted to extend the life of the Lobe B mine (PIRSA 1997).

Mining ceased in November 2015, following a decision by Alinta Energy to close the mine as it had become uneconomic. FPP (previously a subsidiary of Alinta Energy) is currently undertaking closure activities at the Leigh Creek Coalfield.

The Leigh Creek Coalfield includes the following components, which are shown in Figure 4-1:

- Lobe B (the Telford Basin) which is the largest and deepest of the basins in the coalfield; it encompasses the large Main Series Pit, the smaller Lower and Upper Series pits, extensive waste rock dumps (which cover an area of over 10 km²), the remnants of the original township of Leigh Creek and mine site offices and other buildings
- Lobes C and D to the north, including pits and waste rock dumps
- numerous access roads, power lines, train loading facilities and the train line to the east
- the Retention Dam to the south of Lobe B, which captures and diverts the flow of Leigh Creek around the site and is also used by the public for recreational activities
- a town landfill to the west of Lobe B.

Other features of note in the area include the townships of Copley and Leigh Creek to the south, and associated infrastructure including the airport and Aroona Dam.

Most of the site has been highly disturbed as a result of previous mining activities, including earthworks across the site, depressurisation and dewatering of aquifers in the Telford Basin (to the south of the Upper Series Pit), diversion of natural surface water flows, and significant disturbance to native vegetation. At present there are no ongoing coal mining operations and the coalfield is in the process of rehabilitation and closure. The features within and surrounding PEL 650 are shown below in Figure 4-1 to Figure 4-6.



Figure 4-1: Leigh Creek Coalfield and surrounds



Figure 4-2: Upper Series Pit at the Leigh Creek Coalfield



Figure 4-3: Typical waste rock stockpiles at the Leigh Creek Coalfield



Figure 4-4: Looking west from the waste rock stockpile to the public highway B83 (the Outback Highway)



Figure 4-5: Old railway line looking north to Lobe C



Figure 4-6: Upper series of Leigh Creek coalfield

4.2 Cultural Heritage

4.2.1 Aboriginal Cultural Heritage

PEL 650 is located in the northern Flinders Ranges region which is culturally significant to the Adnyamathanha Aboriginal People. The Adnyamathanha have a long history of occupation in this region which was significantly disrupted when the country was opened up to pastoral settlement and mining following European exploration during the 1840's (Northern Flinders Ranges SCB 2004).

The Adnyamathanha maintain a strong connection to the project region including ownership of the Myrtle Springs and Leigh Creek pastoral stations adjoining PEL 650, the community of Nepabunna and Iga Warta, management of the Nantawarrina Indigenous Protected Area (IPA) located approximately 50 km south-east and co-management of the Vulkathunha - Gammon Range National Park located 50 km to the east. The IPA and national park are of great cultural significance and the locations of culturally important sites. Areas of cultural heritage significance to the Adnyamathanha people and evidence of long-term occupation in the region include song lines, stone arrangements, rock art, occupation sites, graves and ochre quarries (DoE 2013; DEH 2006). The Leigh Creek area forms part of the Adnyamathanha Dreaming journey of Yurlu the Kingfisher Man to Wilpena Pound (Ikara).

The Federal Court awarded the Adnyamathanha people non-exclusive rights to over 41,000 square kilometres of land in the state's biggest ever native title claim on March 30th, 2009. The vast area of land included the 918 sq. km Flinders Ranges National Park that also includes the Wilpena Pound, a natural amphitheatre of mountains, and the Iga Warta cultural tourism centre.

A search of the Central Archive, which contains the Register of Aboriginal Sites and Objects (DSD-AAR 2016) indicated that there are 22 registered or reported sites within 10 km of PEL 650. One registered site and two reported sites are located within the PEL 650. Site types on the Register identified in the region include objects, archaeological sites, engravings, quarries, and ceremonial and burial sites. Two of the sites located outside the PEL 650 are identified as restricted sites.

The *Aboriginal Heritage Act 1988* applies to the entirety of the Leigh Creek Coalfield (including PEL 650) and provides for the protection of all Aboriginal sites, objects and remains, including recorded, reported, or undiscovered heritage. The protection extends to Aboriginal sites, object and remains which may exist in areas which have been disturbed in the past and / or subject to a cultural heritage survey or work area clearance.

LCK has executed (September 2016) a Work Area Clearance Agreement (WACA) with the Adnyamathanha Traditional Lands Association (ATLA), as the prescribed body corporate for the native title area and will work within the terms of this agreement for the proposed works within nominated areas of PEL 650, for the purpose of avoiding damage and disturbance to any Aboriginal site object or remains with those areas.

The WACA was successfully implemented for LCK's Pre-Commercial Demonstration (PCD) project and LCK is continuing to seek ATLA's involvement in a work area clearance for the geophysical activities which are the subject of this EIR.

4.2.2 Non-Aboriginal Heritage

Non-Aboriginal heritage in the region dates to early exploration of the region by Edward Eyre beginning in 1839 and the subsequent opening up of the area through pastoral expansion and small-scale mining. By the end of the 1850's many mines (mostly copper) had been established in the Northern Flinders Ranges. Coal bearing shales were discovered at Leigh Creek in 1888 and later abandoned, and it was not until the 1940's that the deposits were reconsidered for exploration. Many of the historical sites in the region are associated with early mining exploration and production works (Northern Flinders Ranges SCB 2004).

A number of sites relating to the early pastoral and mining history in the broader region are listed on the South Australian Heritage Register (DEWNR 2016b). The closest to PEL 650 is the Copper King Copper and Ochre Mine located 15 km to the south. Other sites include:

- Paull's Consolidated Mine - 27 km east of PEL 650
- Sliding Rock Mine - 30 km south-east
- Beltana Stage Heritage Area - 30 km south
- Beltana Station HS - 32 km south.

There are also sites of palaeontological and geological interest listed on the South Australian Heritage Register situated within the region; the closest being the Ajax Mine Fossil Reef, approximately 21 km south of PEL 650, and the most significant being the Ediacara Fossil Reserve Palaeontological Site located 39 km south-west of PEL 650. The Ediacara Fossil Site – Nilpena, which is entered on the National Heritage List is located a further 20 km to the south of this location (DEWNR 2016b, AHPI 2016).

There are no registered sites of non-Aboriginal heritage significance within PEL 650. There are potentially some heritage values associated with parts of the original Leigh Creek township and mine (e.g. the cemetery). These areas are clearly marked and are exempt from any seismic surveys.

4.3 Climate

The site is in the Northern Flinders Ranges, which has an arid climate with hot, very dry summers, cool to mild winters, and a low annual rainfall. In the hotter part of the year (late November to March), mean maximum temperatures exceed 30°C while mean minimum temperatures in the cooler months can drop below 5 °C. Frost days recorded at Leigh Creek are most common from June to August (Northern Flinders Ranges SCB 2004).

The average annual rainfall at Leigh Creek is 224 mm and the median annual rainfall (which is a more appropriate measure where rainfall is erratic) is 200 mm. Rainfall can occur at any time of year, is highly variable and widespread significant rainfall is infrequent. Rainfall in the warmer months is highly erratic, and most often in the form of heavy showers associated with thunderstorms (Northern Flinders Ranges SCB 2004). Average annual evaporation is over 2400 mm (BOM 2016).

A summary of climate records for Leigh Creek Airport (Station #017110) for the period 1982 - 2016 is provided in Table 4-1 (BOM 2016).

Table 4-1: Temperature and rainfall records for Leigh Creek

	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Mean Max Temp (°C)	35.6	34.6	31.2	26.3	21.1	17.0	16.6	19.2	23.5	27.1	30.8	33.2	26.3
Mean Min Temp (°C)	20.8	20.5	17.4	13.0	8.9	5.5	4.7	6.1	9.4	12.6	16.2	18.7	12.8
Mean Rainfall (mm)	22	27.1	20.2	14.7	18.3	16.7	16.4	15.0	17.2	17.1	18.6	23.2	224.2
Median Rainfall (mm)	6.5	17.6	5.3	6.4	9.4	9.2	8.4	8.0	8.7	13.5	11.2	19.2	200.4
Mean Daily Evaporation (mm)*	14.5	13.2	10.5	7.0	4.3	3.0	3.3	4.8	7.2	9.7	11.9	13.4	8.6

* Evaporation data are from Woomera Aerodrome, Station 016001, for the period 1967-2016

Prevailing winds are from the south and east, with northerly winds also relatively common. Figure 4-7 shows the wind rose for Leigh Creek Airport. Each branch of the rose represents wind coming from that direction.

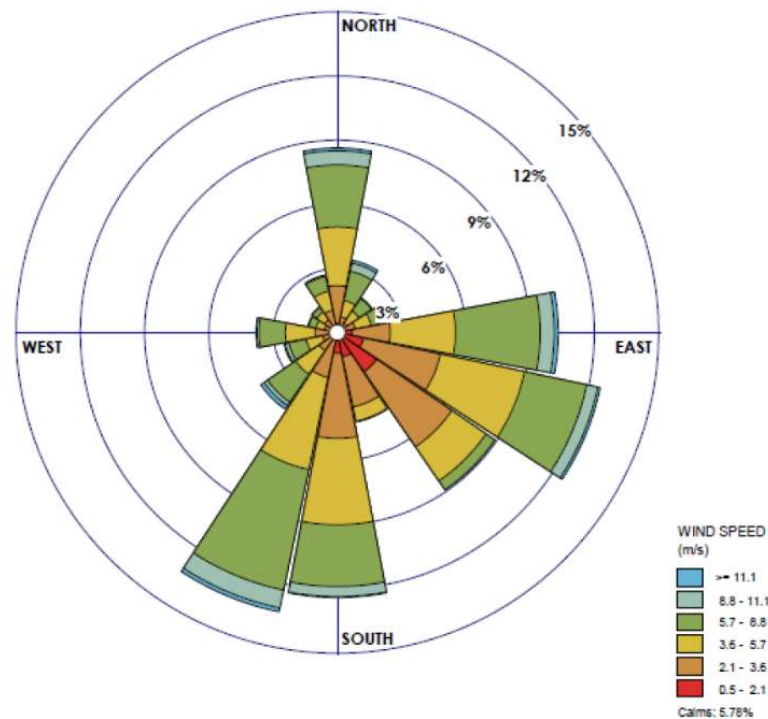


Figure 4-7: Wind rose for Leigh Creek Airport (2010/2011)

4.4 Bioregions, Land Systems and Soils

4.4.1 Bioregional Setting

PEL 650 is located on the boundary of the Stony Plains biogeographical region (or bioregion) and the Flinders Lofty Block bioregion³.

The western half of PEL 650 lies in the southern-most section of the Stony Plains bioregion, in the Murnpeowie subregion, which is characterised by stony downs and alluvial plains. The eastern half of PEL 650 (and the extreme south-western margin of the PEL 650) lies in the Flinders Lofty

³ Bioregions and subregions are defined by the IBRA Version 7.0. Bioregions are broad landscape units based on major geomorphic features.

Block bioregion, in the Northern Flinders subregion which is characterised by ranges and hills with rock outcrops, stony pediments and small basin plains, narrow valleys with some gorges, and some remnants of stony downs.

The Interim Biogeographic Regionalisation for Australia (IBRA) subregions can be further divided into land systems⁴, which provide a smaller mapping unit. Three land systems have been mapped in PEL 650: Paradise (in the western half of PEL 650), Morris (in the eastern half of the PEL 650), and Umberatana (on the extreme south-western margin of the PEL 650), as shown in Figure 4-8.

⁴ Land systems are an area, or group of areas, throughout which there is a recurring pattern of geology, topography, soils and vegetation (DEH 2005). Land systems used in this document are based on the SA Land Systems data that was developed as part of land system mapping of the pastoral areas of South Australia (DWLBC 2007, Naturemaps 2016b).

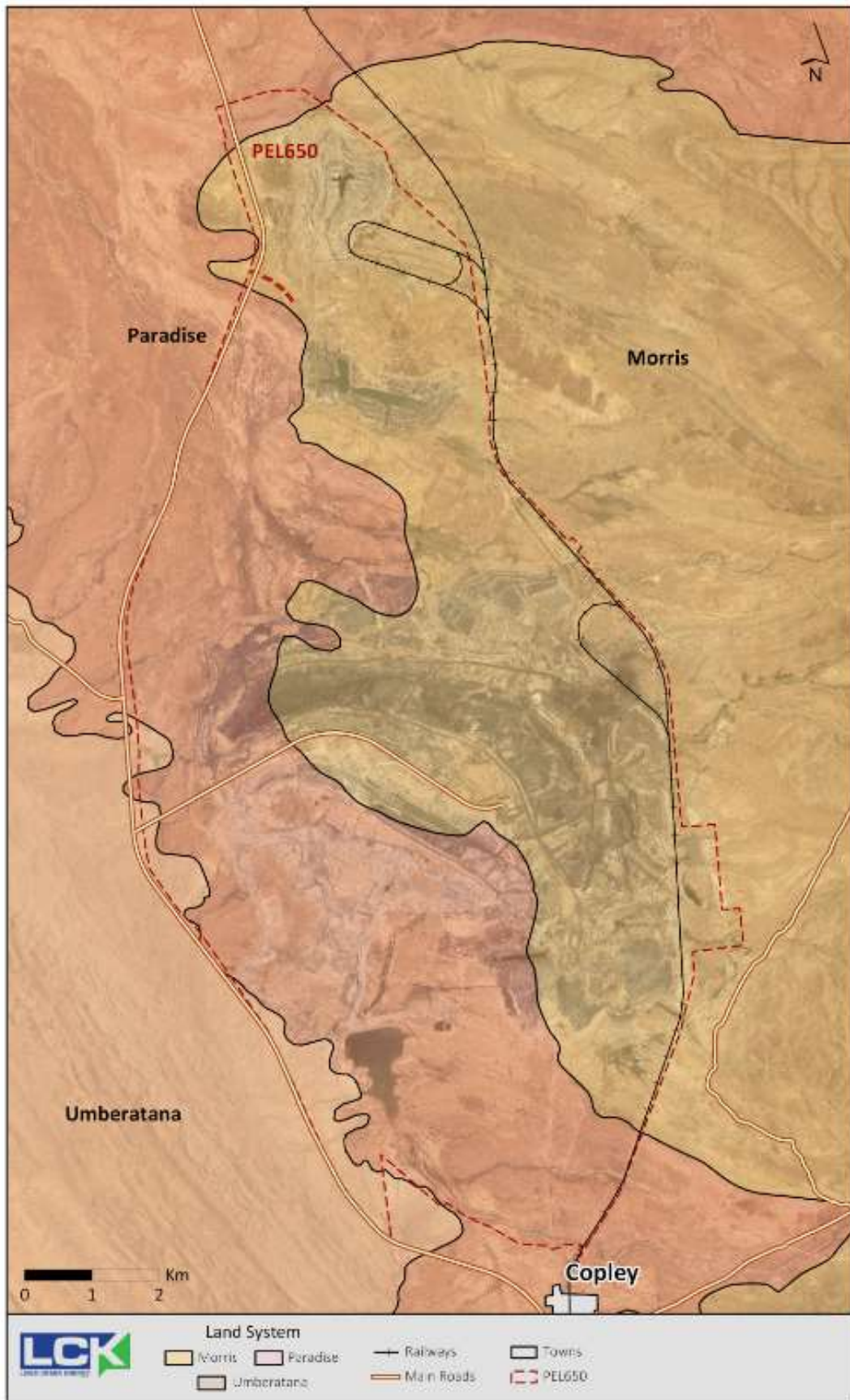


Figure 4-8: Map of land systems within PEL 650

Descriptions of these land systems are provided in Table 4-2. It is noted that across a significant proportion of PEL 650, these land systems have been heavily modified and little of the natural land form or vegetation remains intact.

Table 4-2: Land systems in PEL 650

Bioregion	Land system	Description
Stony Plains	Paradise	Flood outs, stony flats and alluvial plains; clay loam soils. Large creeks - River Red Gum, Coolibah, Broughton Willow, River Cooba, Plumbush and Prickly Wattle Floodouts - Old Man Saltbush, Cottonbush, Samphire, Plategrass, Swamp Canegrass Stony hills and flats - Bladder Saltbush, Blackbush, Mitchell grass and Bindyis.
Flinders Lofty Block	Umberatana	Hills and low hills - shallow, skeletal fine-textured soils; Dead Finish, Prickly Wattle, Rock Fuchsia Bush, Bullock Bush woodland over Copperburrs and grasses Stony calcareous plains - Low Bluebush, Bladder Saltbush and annual grasses Creeks - River Red Gum, Prickly Wattle and White Tea-tree.
	Morris	Low hills and rises with sandy loam soils - Low Bluebush and Bladder Saltbush shrublands; patches of Red Mallee or Blackoak woodland flats with annual, Wards Weed and Bottlewashers.

4.4.2 Landform and Soils in PEL 650

PEL 650 and the Leigh Creek Coalfield are located at an elevation of approximately 200 m. In the immediate area of the PEL, the landform is generally a gently undulating plain comprised of reddish powdery calcareous soils and low rocky outcrops. At the base of the nearby ranges, alluvial fans and closely spaced dunes of crusty red duplex soil and loose aeolian sands extend over the plains (AECOM 2016).

Most of the landform and ground surface within the coalfield in PEL 650 has been heavily disturbed and modified by over 70 years of open cut coal mining activities. The coalfield is dominated by the main Lobe B with the large Main Series Pit and the smaller Upper and Lower Series Pits. The smaller Lobe C and D pits are located 5 km and 8 km north of Lobe B.

The pits within the coalfield are surrounded by extensive mine spoil piles and waste rock dumps. Other earthworks have also been undertaken extensively across the coalfield site, including construction of the retention dam and numerous berms around the site to modify water flows, and construction of numerous access tracks. Two quarries (now water-filled) are located south of the Lobe B Upper Series Pit.

The pits and other main features associated with PEL 650 are shown in Figure 4-9.



Figure 4-9: Leigh Creek Coalfield Disturbance

4.5 Existing Site Contamination

Historical mining activities and associated infrastructure have involved numerous potentially contaminating activities at a range of locations.

In addition, Flinders Power submitted a Voluntary Site Contamination Assessment Proposal (VSCAP) to the Environment Protection Authority for the Leigh Creek Coalfield. Flinders Power engaged Coffey Environments Pty Ltd to undertake the site contamination assessment to determine the nature and extent of existing site contamination and the actual or potential risk to human health or the environment resulting from such contamination. The Coffey Environments Pty Ltd report '*The Detailed Site Investigation of the Leigh Creek Coal Mine (Lobe B)*' identified 14 areas of environmental concern including but not limited to former crusher refuelling facility, Telford rail siding fuel storage tanks, asbestos landfill, permanent and temporary refuelling tanks, transformer graveyard, mining operations area, town landfill and explosive storage compounds.

Areas and activities across the Leigh Creek Coalfield that may have had potentially contaminating activities are shown in Figure 4-7 below. (AECOM 2016).

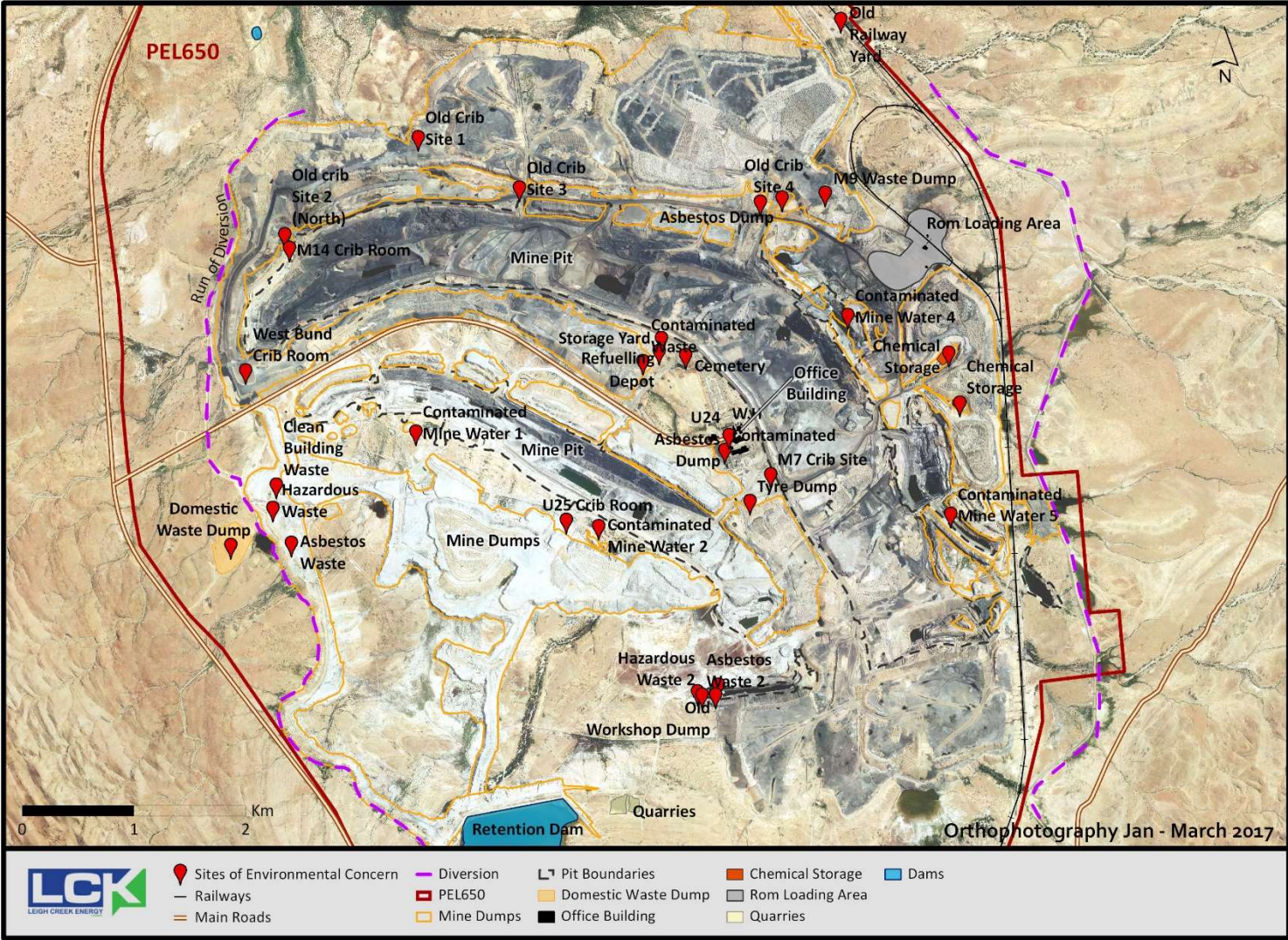


Figure 4-10: Known sites of environmental concern within PEL 650

4.6 Geology

4.6.1 Regional Geology

The geology of the Telford Basin and surrounds, within PEL 650 is previously described in Parkin (1953), Johns (1970) and Springbett (1995).

In general, the areas surrounding Leigh Creek are characterised by ranges and low undulating hills of variably weathered and folded rocks of the Adelaide Geosyncline. These Adelaidean aged basement rocks in the region include those of the Heysen Supergroup (the Wilpena Group and the Umberatana Group), and the Warrina Supergroup (the Burra Group). These rocks are generally well indurated (hardened) and are predominantly steeply dipping with the strike extent of the unit often readily identifiable at the surface. Lithologies, which are highly weathered, include laminated siltstone and shale, dolomitic siltstone, quartzitic boulder tillite, quartzite, and sandstone.

The Telford Basin (Lobe B) and North Field Basins (Lobe C & D) are Mesozoic (Late Triassic to Early Jurassic) basins hosted within the complexly folded Neoproterozoic Adelaidean metasediments of the Adelaide Geosyncline. The surrounding hills and ranges are often flanked by alluvium covered plains of Quaternary sands, gravels, silts and clays. Refer to Figure 4-11 below.

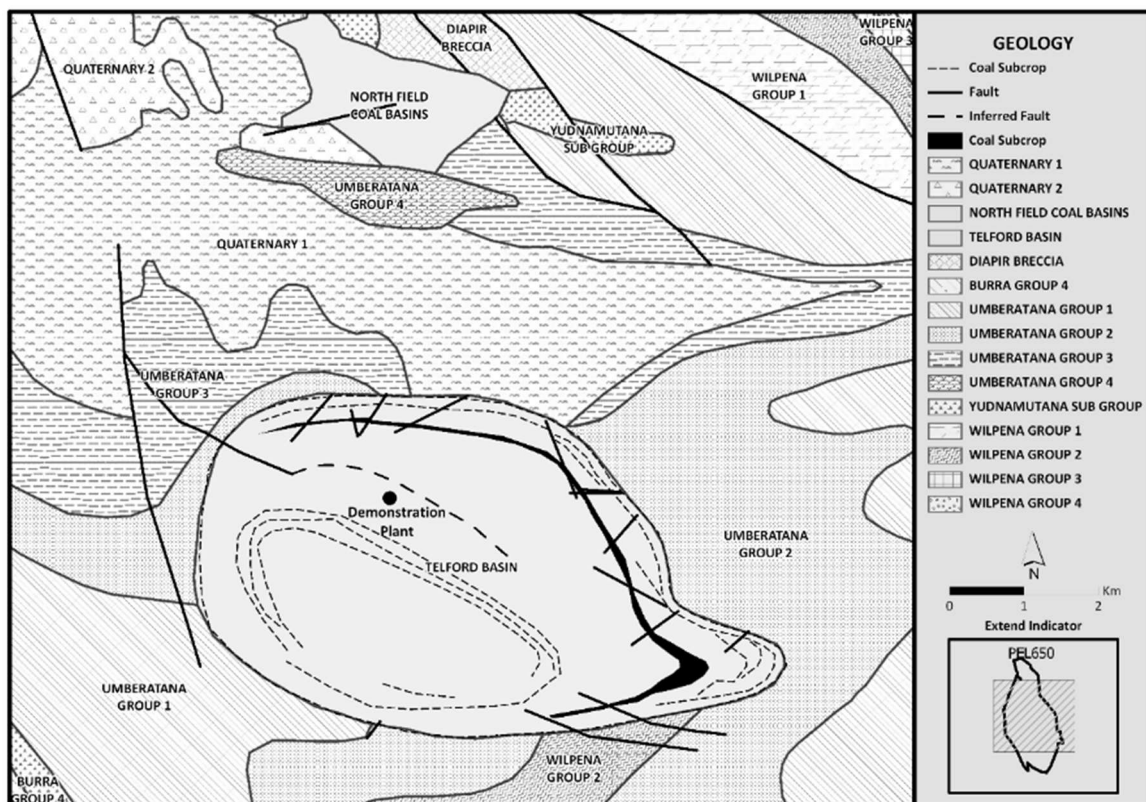


Figure 4-11: Surface geology of the Telford Basin and surrounding region

4.7 Hydrogeology

This section presents an overview of the hydrogeology of the Telford Basin and surrounds, based on existing information and hydrogeological data generated for the Leigh Creek Coalfield, and drilling and hydrogeological investigations undertaken by LCK.

There are small sedimentary basins which is contained within rocks of the Adelaidean basement. The Leigh Creek Coalfield occupies the entire footprint of the Telford Basin.

The Great Artesian Basin is, at its closest, approximately 50 km to the north and has no connection with groundwater in the Telford Basin (see Figure 4-12).

Natural springs in the region include the Aroona, Top Well and Myrtle Springs. These springs are outside the Telford Basin and PEL650, eight to twelve kilometres from the site, and are not hydraulically connected to the Telford Basin.

Within the Leigh Creek project area, both surface flows and groundwater would have been substantially modified as a result of historical mining activities. With regards to wetland/surface expression of groundwater, there are a number of areas of surface water (including old quarry areas and the retention dam) that would be considered to be reliant on the water table aquifer. These derived groundwater dependent ecosystems provide habitat for substantial populations of waterbirds and are also known to support populations of fish.

Further details including a comprehensive list of flora species can be found in the flora and fauna assessment undertaken for LCK (Appendix A, T&M Ecologists, 2018).

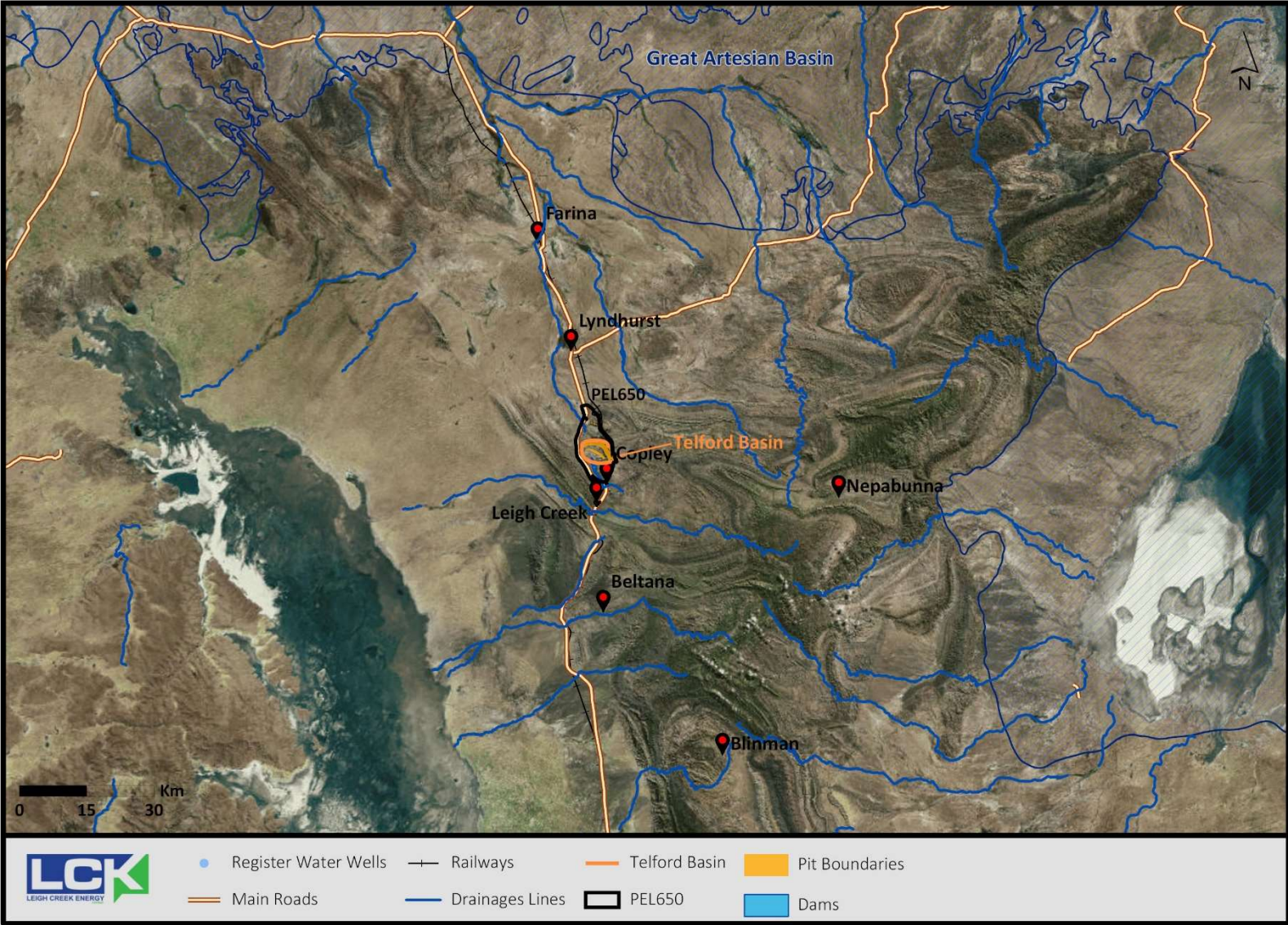


Figure 4-12: Regional hydrogeology

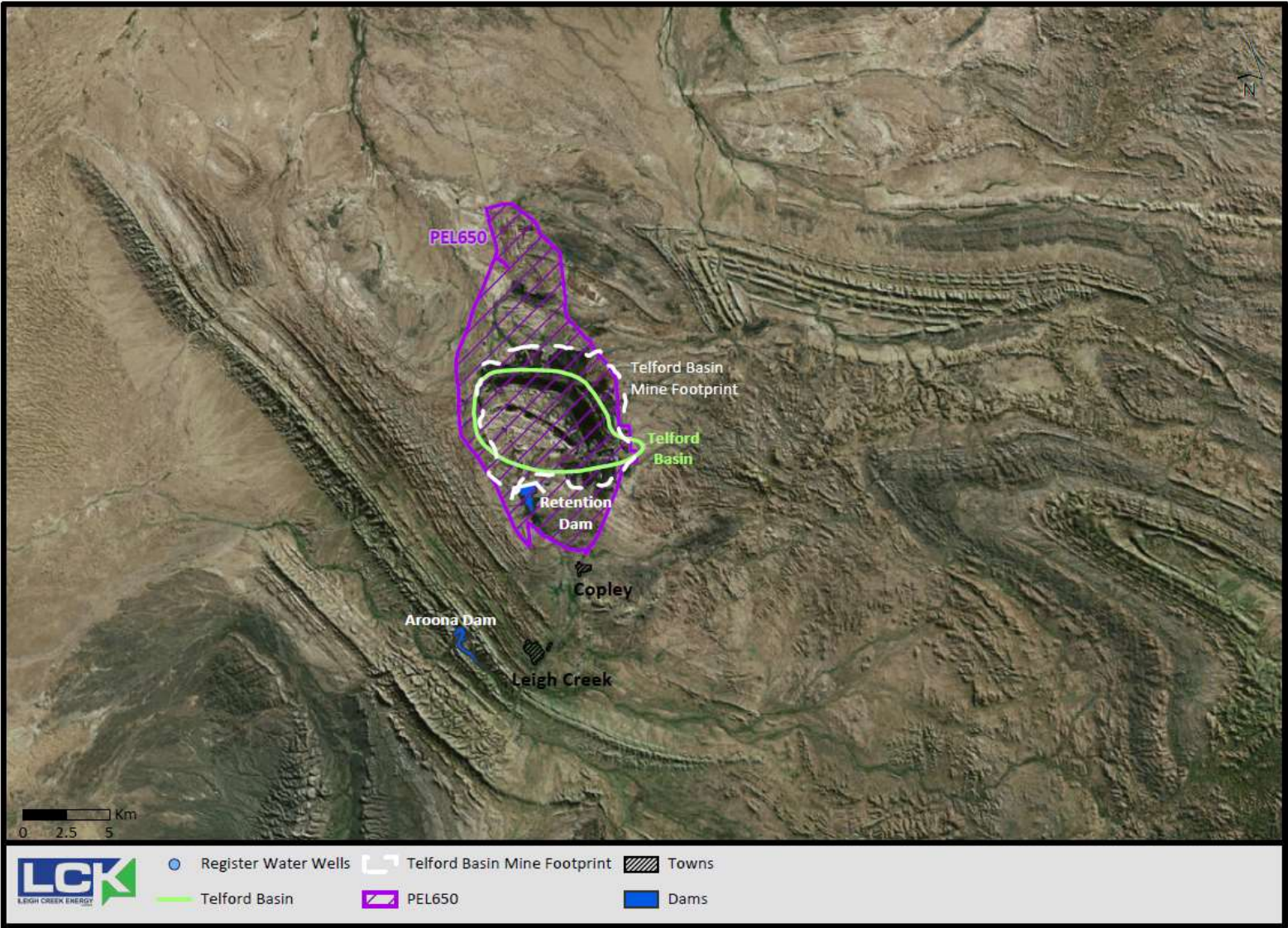


Figure 4-13: PEL 650 and surrounds - hydrogeological features

4.8 Surface Water

PEL 650 lies in the catchment of Leigh Creek, which is on the southern edge of the Lake Eyre Basin and drains north-west towards Lake Eyre. The major surface water features in the region are Lake Torrens, located approximately 55 km to the west, and Lake Frome which is located approximately 110 km east of PEL 650, on the eastern side of the Gammon Ranges.

Leigh Creek is the main surface water system in PEL 650. It enters PEL 650 on the southern boundary, north of Copley and exits PEL650 near Lobe C of the Leigh Creek Coalfield at PEL 650 north-western boundary.

Ridge lines located to the west and east of PEL 650 direct runoff via numerous small drainage lines towards the gently undulating plain where PEL 650 is located. Under natural (pre-mining) conditions, surface water would have moved generally northwards through PEL 650 from south to north-west, discharging to the Leigh Creek floodplain where it crosses the current Outback Highway. Figure 4-14 below shows the regional surface water features.

Modifications to drainage patterns by mining operations have resulted in much of the flow of Leigh Creek and its tributaries being retained on the southern, eastern and western boundaries of Lobe B. The Retention Dam captures the majority of flow in Leigh Creek, and two earthen walls have been constructed on the eastern and western margins of the coalfield to intercept flows towards the pits from the eastern and western ranges. A gap in the western wall allows water overflowing from the Retention Dam to flow closer to the coalfield through a purpose built diversion drain.

Surface water within the Telford Basin is inferred to remain predominantly within the basin, given the likelihood of mine pits acting as groundwater depressions and the reduced surface water runoff contributions from the ranges due to interception by the earthen walls. Transport downstream of the Telford Basin is confined to surface water overflow around the north-eastern and north-western margins of the site (outside the earthen walls) and via limited flow in the shallow water table aquifer, primarily in the floodplain sediments from recharge north of the Main Series Pit. As discussed in Section 4.7, the Main Series and Upper Series pits act as groundwater sinks and would capture any shallow groundwater from south of the Main Series Pit in the Telford Basin.

There are artificial water storages across the site, including the Retention Dam, dams formed by the eastern and western earthen walls, the two quarries located east of the Retention Dam, the mine pits and numerous constructed surface depressions where water pools after rain. Water in the Retention Dam, the quarries and the Lobe C, Lobe D and Lower Series pits is permanent.

Aroona Dam and its catchment is outside PEL 650 and outside the Leigh Creek catchment. Aroona Dam and its feeding creeks, Emu and Windy Creeks, are part of the Lake Torrens catchment draining to the west.

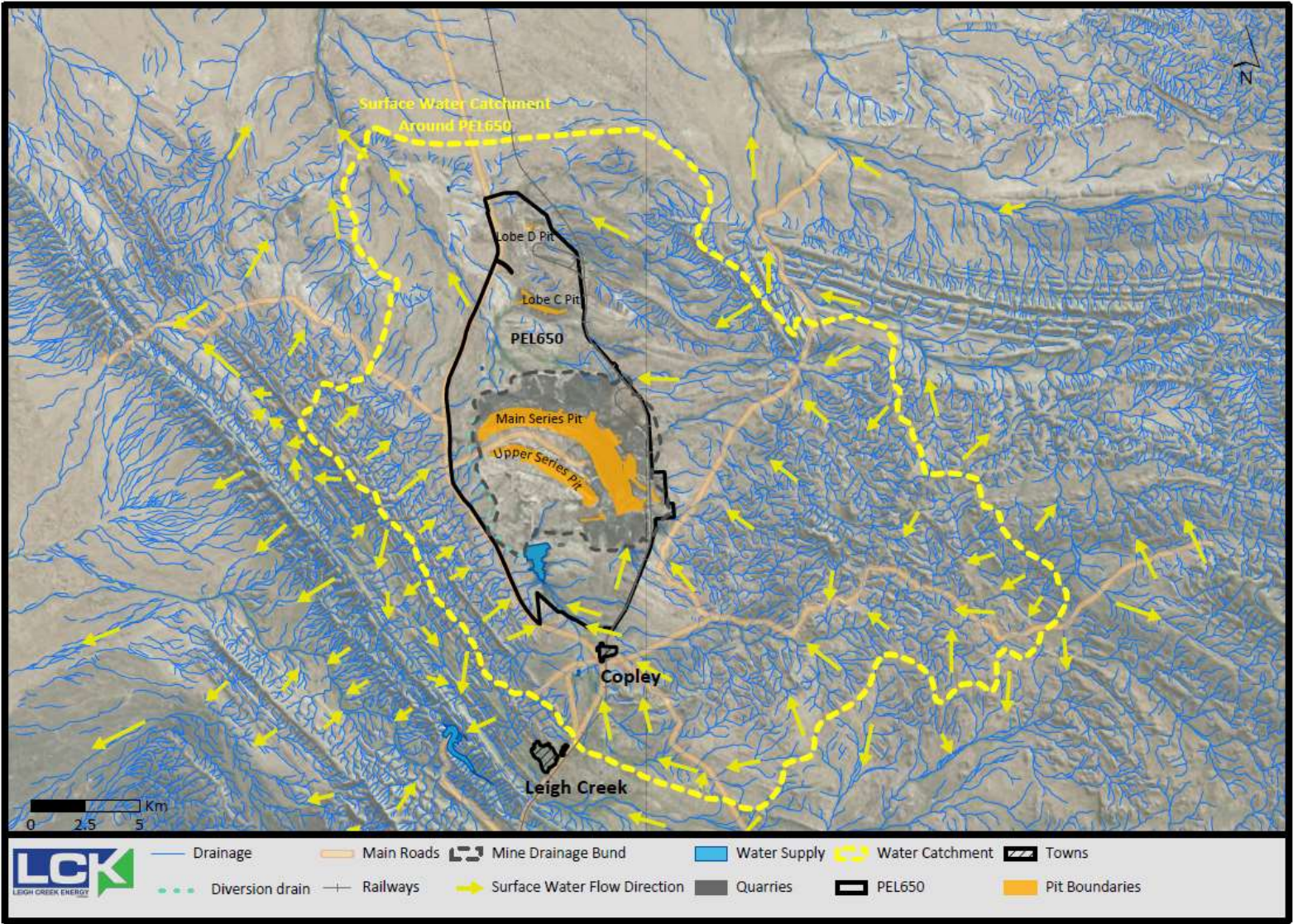


Figure 4-14: Regional surface water feature

4.9 Flora and Fauna

4.9.1 Vegetation

Six native vegetation groupings are classified within the PEL (Appendix A, T&M Ecologists, 2018).

1. Red Gum (*Eucalyptus camaldulensis ssp. arida*) woodland. This vegetation type is principally found along Leigh Creek. The overstorey is comprised of Red Gums (*Eucalyptus camaldulensis ssp. arida*).
2. Red Gum (*Eucalyptus camaldulensis ssp. arida*) low open woodland on rocky outcrops. There is only a small patch of this vegetation type present in the site. It occurs in rocky areas around the edge of the retention dam and is to some extent a community that has been created by the construction of the dam. The overstorey is comprised of relatively open, low (<10m) Red Gums (*Eucalyptus camaldulensis ssp. arida*) and the understorey contains species generally associated with seasonally inundated areas (such as Samphires (*Tecticornia spp.*) and sedges (*Cyperus gymnocaulus*), along with more typical arid zone species, such as Native Myrtle (*Myoporum montanum*), Bindyi's (*Sclerolaena spp.*), and chenopod shrubs, including Saltbush (*Atriplex spp.*) and Bluebush (*Maireana spp.*).
3. *Acacia victoriae* shrubland along drainage lines. This vegetation type occurs in shallow depressions and drainage lines across the site, and in some of the wash-out areas where Red Gum is not present in the overstorey. Elegant Wattle (*Acacia victoriae*) is persistent throughout this habitat type but ranges in density from >40% cover to only scattered individuals. Many other medium to tall shrubs (>1.5 metres) are also represented in this vegetation type, but the density, cover and type of these shrubs vary. Common species include Native Myrtle (*Myoporum montanum*), Native Apricot (*Pittosporum angustifolium*), Sennas (*Senna spp.*), Emubushes (*Eremophila spp.*), Shrubby Riceflower (*Pimelea microcephala*), and Plumbush (*Santalum lanceolatum*). The understorey has many of the chenopod shrubs typical of the adjoining plains vegetation, but grass species, particularly Lemon-grass (*Cymbopogon ambiguus*), are more prevalent than in adjacent shrublands.
4. *Nitraria billardieri* open shrubland with scattered emergent tall shrubs. This vegetation type is found at the southern end of PEL650, adjacent to Leigh Creek. The dominant overstorey plant is Nitre Bush (*Nitraria billardieri*), growing to up to 2 metres in height, with Nitre Goosefoot (*Chenopodium nitrariaceum*) of a similar size also present, along with scattered emergent shrubs, predominantly Native Myrtle (*Myoporum montanum*). Dominant understorey (<1m) shrubs are chenopodaceous, including Bladder Saltbush (*Atriplex vesicaria*), Baldoo (*Atriplex lindleyi ssp. lindleyi*), Low Bluebush (*Maireana astrotricha*) and Short-leaf Bluebush (*Maireana brevifolia*).
5. *Maireana spp.* This is the most common vegetation type on the PEL. It is characterised by a sparse to moderate (10-40% cover) layer of low to medium chenopod species, with Low Bluebush (*Maireana astrotricha*) and Bladder Saltbush (*Atriplex vesicaria*) generally dominant. Bindyi (*Sclerolaena spp.*) species are common in the understorey and Ward's Weed (*Carrichtera annua*). There are sparse and patchy emergent taller (>1.5 metre) shrubs, comprising species such as Elegant Wattle (*Acacia victoriae ssp. victoriae*), Emubush (*Eremophila spp.*), Native Myrtle (*Myoporum montanum*), Native Apricot (*Pittosporum angustifolium*) and Sennas (including Silver Senna (*Senna artemisioides ssp. artemisioides*) and Broad-leaf Desert Senna (*Senna artemisioides ssp. coriacea*)). These

taller shrubs are taking advantage of small depressions or drainage lines where water may accumulate. There are scattered rocky outcrops, generally aligned east to west in the central sections of the PEL, where Bluebush (*Maireana sedifolia*) and Brilliant Hop Bush (*Dodonaea microzyga* var. *microzyga*) occur in addition to the dominant chenopod species. Surface rock strew, generally less than 5cm diameter, is generally present, although absent in some of the lower lying areas. To the west of the retention dam there has been some revegetation activity in this vegetation type, with various Eucalypts (most of which are not indigenous to the site) being the key revegetation species.

6. *Tecticornia* spp. ± *Cyperus* sp. *sapphire low shrubland*. This vegetation type is found in areas which are infrequently to regularly inundated, generally around the edge of the retention dam. Samphires (*Tecticornia* spp.) are the dominant shrub, but are generally less than 70cm in height, and typically cover between 20 and 40%. In areas where inundation is more frequent Spiny Flat Sedge (*Cyperus gymnocaulos*) can become dominant. This habitat generally intergrades into the *Maireana* spp. shrubland on higher ground.

Further details can be found in the flora and fauna assessment (Appendix A, T&M Ecologists, 2018).

4.9.2 Fauna

Both the Euro (*Macropus robustus*) and Red Kangaroo (*Osphranter rufus*) were observed to be very common in the PEL. Small mammals, including the Bolam's Mouse (*Pseudomys bolami*), Fat-tailed Dunnart (*Sminthopsis crassicaudata*) and Stripe-faced Dunnart (*Sminthopsis macroura*) are found in PEL650.

Eighteen (18) species of reptiles have previously been observed in PEL 650. A further sixteen (16) species are considered to be possible or likely to be present based on an assessment of known records and habitat preferences. Further details can be found in the flora and fauna assessment (Appendix A, T&M Ecologists, 2018).

The total number of birds that have now been recorded in PEL 650 is 137 (based upon Atlas of Living Australia records). More species were observed in the Red Gum woodland area along Leigh Creek than in other vegetation types. The retention dam also forms significant habitat, with eighteen species observed in this area that are considered to be waterbirds.

Two species of amphibians, the Desert Tree Frog (*Litoria rubella*) and Sudell's Frog (*Neobatrachus sudelli*) have been observed in PEL 650. The presence of permanent water in the retention dam, along with good fringing habitats, provide suitable habitat for frog species that require semi-permanent to permanent water (Northern Flinders Ranges Froglet (*Crinia flindersensis*), Spotted Grass Frog (*Limnodynastes tasmaniensis*) and Desert Tree Frog (*Litoria rubella*), and so these species are likely to be present.

Further details including a comprehensive list of fauna species can be found in the flora and fauna assessment (Appendix A, T&M Ecologists, 2018).

4.9.3 Threatened Flora and Fauna with international obligations

A search of the EPBC Act and DEWNR flora and fauna databases has identified a number of rare or threatened flora and fauna species as being present or likely to occur in the general area of the PEL650 (DEE 2016a; DEWNR 2016a).

Species of conservation significance are considered unlikely to occur within Lobe B, given the habitats present and the highly disturbed nature of the site⁵.

There are no nationally listed threatened ecological communities known to be present in the area.

A number of State-listed threatened ecological communities have been identified as conservation priorities within the Stony Plains and Flinders Lofty Block bioregions, including Coolibah and River Red Gum woodland on drainage lines and floodplains, Old-man Saltbush on floodplains, Queensland Bluebush shrubland on cracking clay depressions and Bullock Bush tall shrubland (DEH 2009).

4.9.4 Weeds and Pest Animals

All sites from the flora and fauna assessment (Appendix A, T&M Ecologists, 2018) contained two or more introduced (weed) species – the least number of weed species was found in samphire habitats, and the highest number of weeds was found in the Red Gum community along Leigh Creek. Two Weeds of National Significance (WoNS) have been previously recorded in the PEL 650⁶ – Jerusalem Thorn (*Parkinsonia aculeata*) and Athel Pine (*Tamarix aphylla*).

Athel Pine (*Tamarix aphylla*) is present in the site and has been recorded in three habitat types. Athel pines have a number of impacts on native ecosystems, including:

- The species forms a dense canopy that provides inferior habitat for wildlife and inhibits regeneration of native plants;
- It has deep roots that taps soil water, and can lower the water table;
- In saline groundwater situations, Athel Pine extracts the salt and excretes it through gland on the leaves. This process can increase the salinity of the surface soil and eliminates less salt-tolerant plants from the site;
- Along watercourses Athel Pine can trap sediments, which can reduce channel capacity and modify riparian landforms⁷.

Whilst not being a WoNS, the Declared Plant Buffel Grass (*Cenchrus ciliaris*), a perennial tussock grass from Africa and Asia, has the capacity to spread widely and dominate arid zone habitats. This species was introduced for rangeland improvement and is now widespread across northern Australia.

Pest animals in the region that could potentially occur on site include cats, goats, foxes, rabbits and wild dogs. The area is inside (south of) the Dog Fence where wild dogs / dingoes are a declared pest under the Natural Resources Management Act, and numbers are generally low. Goats are widespread in the Flinders Ranges but are typically more common in hills and rockier areas. European Carp (*Cyprinus carpio*) was known to be present in the Leigh Creek Retention Dam following its illegal introduction (Ehmann 2009) however surveys in 2012 did not locate any carp following eradication work undertaken in previous decades (FPP 2017).

⁵ The site inspection was carried out in late autumn following generally dry conditions, although there had been some significant rainfall approximately two months prior and one week prior to the inspection. Due to the timing and preceding conditions, there may be annual or ephemeral species present at the site, or migratory species that use the site, that were not evident at the time of the inspection. However, given the highly disturbed nature of both the site and the vegetation community present, it is considered unlikely that any species of conservation significance would occur.

⁶ www.naturemaps.sa.gov.au accessed 10/1/2018.

⁷ Government of South Australia (2014). Declared Plant Policy under the *Natural Resources Management Act 2004*; athel pine (*Tamarix aphylla*).

4.10 Air Quality

Air quality in the broader region is expected to be typical of a remote rural environment and influenced by a range of activities such as:

- dust from stock and vehicle movements or high winds
- vehicle and equipment exhaust fumes.

Air quality in the vicinity of the Leigh Creek Coalfield is also likely to be influenced by:

- dust generation from spoil dumps and mining / rehabilitation activities
- particulates, vapour and combustion emissions from spontaneous combustion of mine spoil dumps. The pits are surrounded by mine spoil dumps which are known to spontaneously combust releasing particulates and sulphurous and phenolic odours.

The closest residences are at Copley which is located approximately 8.5 km south of the majority of the exploration drilling programs and approximately 1 km south of the southern boundary of PEL 650.

The occurrence of odours at Copley (e.g. the smell of rotten eggs) has been informally raised by several stakeholders in mid to late 2016 (before any activities with the potential to release odour had been undertaken by Leigh Creek Energy).

A preliminary background odour assessment was carried out in June 2017 (Pacific Environment 2017a). This detected odour from the coalfield (a smoky character consistent with fugitive emissions from spontaneous combustion) at approximately 5 km. Odour was also recorded in Copley from the caravan park wastewater irrigation area. Winds were not blowing towards Copley at the time of the site visit for field odour observations, which meant that there was no opportunity to observe odour from the coalfield at Copley. However, it is understood that odour from the coalfield is occasionally present in Copley and that coalfield odour has been observed as far south as Leigh Creek.

Further baseline air quality monitoring was undertaken between July 2018-May 2019 under an approved Air Quality Monitoring Plan during different phases of the PCD operation using air diffuse samplers. The air diffuse samplers measure background volatile organic carbons (measured as BTEX⁸), hydrogen sulphide (H₂S), nitrogen dioxide (NO₂) and sulphur dioxide (SO₂).

The samplers were installed in Leigh Creek, Copley, Flinders Power site office, Leigh Creek Energy site office, Retention dam, Leigh Creek Waste Water Treatment Plant and the 10m weather station. The Department of Energy and Mining concluded that LCK met the requirements of the Air Quality Monitoring Plan and demonstrated compliance with the SEO, in particular the assessment criteria that 'regular air quality measurements indicate levels are below relevant health-based air quality criteria (as listed in the *Environment Protection (Air Quality) Policy*) at sensitive receptors (i.e. towns or residences).' The *Environment Protection (Air Quality) Policy 2016* ('EPP') establishes maximum ground level concentrations (GLCs) for air pollutants. The results from the air quality monitoring demonstrated that all the parameters (volatile organic carbons, H₂S, NO₂ and SO₂) were all below the EPP maximum GLC concentration limits.

⁸ BTEX is an acronym for the group of chemicals Benzene, Toluene, Ethylbenzene and Xylene

4.11 Noise

The existing noise environment in the region is typical of sparsely populated regional and pastoral areas, with generally low levels of background noise dominated by natural sources (e.g. wind, animals and insects) and intermittent background noise from traffic on the nearby Outback Highway. Mining activities, including blasting, would have influenced the noise environment in proximity to the mine prior to closure. Ongoing mine closure activities by Flinders Power are expected to generate intermittent noise (e.g. from heavy machinery operation), with locations and noise levels dependent on the activities being undertaken.

The region is extremely sparsely populated and there are no residences or other sensitive receptors within PEL 650. The closest residences are at Copley which is located approximately 1 km south of the southern boundary of PEL 650.

4.12 Land Use

4.12.1 Land Owners

The PEL 650 is located in the Leigh Creek Coalfield, which is constituted by a number of different titles.

A list of all land owners for PEL 650 (as defined by the PGE Act) is provided in Table 4-3 below. PEL 650 is located on Crown Lease 1545/20 (Section 324).

Table 4-3: Land Owners for PEL 650

Name	Land Owner
Leigh Creek Coalfield	Perpetual Crown Lease CL 1067/36 Section S320 Transferred to Flinders Power Pty Ltd 23/04/1999
	Perpetual Crown Lease CL 1234/37 Section S319 Transferred to Flinders Power Pty Ltd 23/04/1999
	Perpetual Crown Lease CL 1545/20 Sections S321, S324, S418, S485, S486 and S489 Transferred to Flinders Power Pty Ltd 23/04/1999
	CL 6163/703 Section Q3003 Transferred to Generation Lessor Corporation (State Government) 19/06/2003
PEL 650	Leigh Creek Operations Pty Ltd

4.12.2 Land Use

The major land uses in the region are mining, pastoralism, conservation and tourism.

The closest population centres to PEL 650 are Copley (1 km south of the PEL), Leigh Creek (5 km south of the PEL650) and Lyndhurst (12 km north of the PEL650). Beltana is located 30 km to the south of the PEL650 and Neppabunna is located 51 km to the east (see Figure 4-15).

4.12.2.1 Mining

Mining has been undertaken in the project region since the 1850's. There are a number of Mining Leases (ML) in the region surrounding PEL 650, the closest of which (the Mountain of Light Copper Mine) is located approximately 3 km south of PEL 650. Commodities produced in the region include copper, marble, gold and magnesite. Several Mining Exploration Licences (EL) are also in place in the region primarily west, south and east of PEL 650, covering exploration for magnesite, gold, silver, copper, lead, zinc, base metals and marble. There are numerous abandoned mines in the broader region from which minerals such as copper, radium and uranium were extracted (Northern Flinders Ranges SCB 2004).

The primary land use in PEL 650 was open cut coal mining which commenced in Leigh Creek in the 1940s. The Leigh Creek open cut mine was originally established under a Crown Agreement issued by the South Australian Government to the Electricity Trust of South Australia (ETSA) in an effort to secure the State's electricity supply. After the *Mining Act 1971* came into effect to regulate mining in the state, the Leigh Creek area continued to be reserved from its provisions rather than operating under a conventional Mining Lease issued under the Mining Act (AECOM 2016).

The Leigh Creek Coalfield was most recently operated by Alinta Energy. Mining ceased in November 2015 after it became increasingly uneconomic. Mine closure activities are currently being undertaken within PEL 650 by Flinders Power. As a part of mine closure, Flinders Power is required to undertake a minimum of 5 years of care and maintenance.

4.12.2.2 Pastoralism

Pastoralism, in the form of livestock grazing (cattle and sheep) on native pastures, has a long history in the region, beginning in the 1850s and continues to be the most extensive regional land use.

Pastoral leases in the region around PEL 650 are listed in Table 4-4 and shown in Figure 4-15.

Table 4-4: Pastoral leases in the region of PEL 650

Pastoral lease	Distance from PEL 650 (station boundary)
Myrtle Springs (Vinya Aboriginal Corporation)	Adjacent (west)
Leigh Creek (Adnyamathanha Land Council Inc)	Adjacent (east)
Farina	6 km north
North Moolooloo	6 km south-east
Burr Well	7 km east
Beltana	15 km west
Puttapa	10 km south
Mount Lyndhurst	12 km north

4.12.2.3 Conservation

The Vulkathunha - Gammon Range National Park (50 km east of PEL 650) and Ikara-Flinders Ranges National Park (81 km south of PEL 650) are the largest protected areas in the region. The parks are co-managed by the Department of Environment, Water and Natural Resources and the Adnyamathanha traditional owners. The Adnyamathanha people also manage the 58,000 ha Nantawarrina Indigenous Protected Area, which adjoins the southern boundary of the Vulkathuna – Gammon Ranges National Park.

Lake Torrens National Park is located 48 km west of PEL 650 and protects Lake Torrens, a large ephemeral Salt Lake. Lake Torrens is listed in the Directory of Important Wetlands as 'Inland Saline Lake' together with Lake Frome and Lake Callabonna (DEE 2016b). This series of inland lakes together form a complex of relatively pristine playa and ephemeral wetlands providing habitat for large wader (bird) populations when in flood.

Ediacara Conservation Reserve is located 35 km south-west of PEL 650 and was established to protect an internationally significant fossil assemblage and places of Aboriginal and non-Aboriginal cultural heritage.

Aroona Sanctuary, which encompasses Aroona Dam and areas around the Leigh Creek township and was gazetted as a sanctuary under the National Parks and Wildlife Act in 1995, is approximately 3 km south of the PEL.

Warraweena, a former pastoral station which is operated as a private conservation reserve, is located approximately 25 km south-east of PEL 650.

There are no protected areas within PEL 650.

Conservation reserves in the area are shown in Figure 4-15.

4.12.2.4 Tourism

Tourism in the region is mainly focussed on 'outback' and 'wilderness' experiences, particularly associated with the national parks located in the Flinders Ranges. Tours of the region are offered by tour operators and provide a range of activities including coach tours, personalised 4WD tours, camel trekking, horse riding, bushwalking, town tours and scenic flights. Many pastoral stations in the region also offer accommodation and activities such as self-drive 4WD tours for tourists (Northern Flinders Ranges SCB 2004).

The community at Nepabunna offers visitors to the region accommodation and tours to locations such as painting and carving sites, ochre pits, and local gorges which would otherwise be inaccessible without a local Adnyamathanha guide (Nepabunna Community Inc 2016). Iga Warta, located approximately 5 km west of Nepabunna, is an Aboriginal cultural tourism centre which offers a unique opportunity for visitors to experience Adnyamathanha, Aboriginal culture, living, sharing and learning in an Aboriginal community setting (Iga Warta 2016).

The most regular visitation to the Leigh Creek area is by self-drive, independent and RV (recreational vehicle) travellers, with caravan and camping enjoyed by 35% of domestic and 55% of international tourists to the area (DSD 2016). Leigh Creek Township is utilised as a base for day trips to destinations such as Beltana, Copley, Lyndhurst and Farina.

The Outback Highway (the Hawker-Lyndhurst Road) which passes the township of Leigh Creek and the Leigh Creek Coalfield, is utilised by tourists travelling to and from outback South Australia, Queensland and the Northern Territory via the Oodnadatta, Birdsville and Strzelecki Tracks.

The South Australian Government is focusing on developing further tourism opportunities for the area following the closure of the Leigh Creek Coalfield and the transition of Leigh Creek Township from a 'closed' community solely dedicated to the operation of the coalfield, to an open independent regional service centre (DSD 2016).

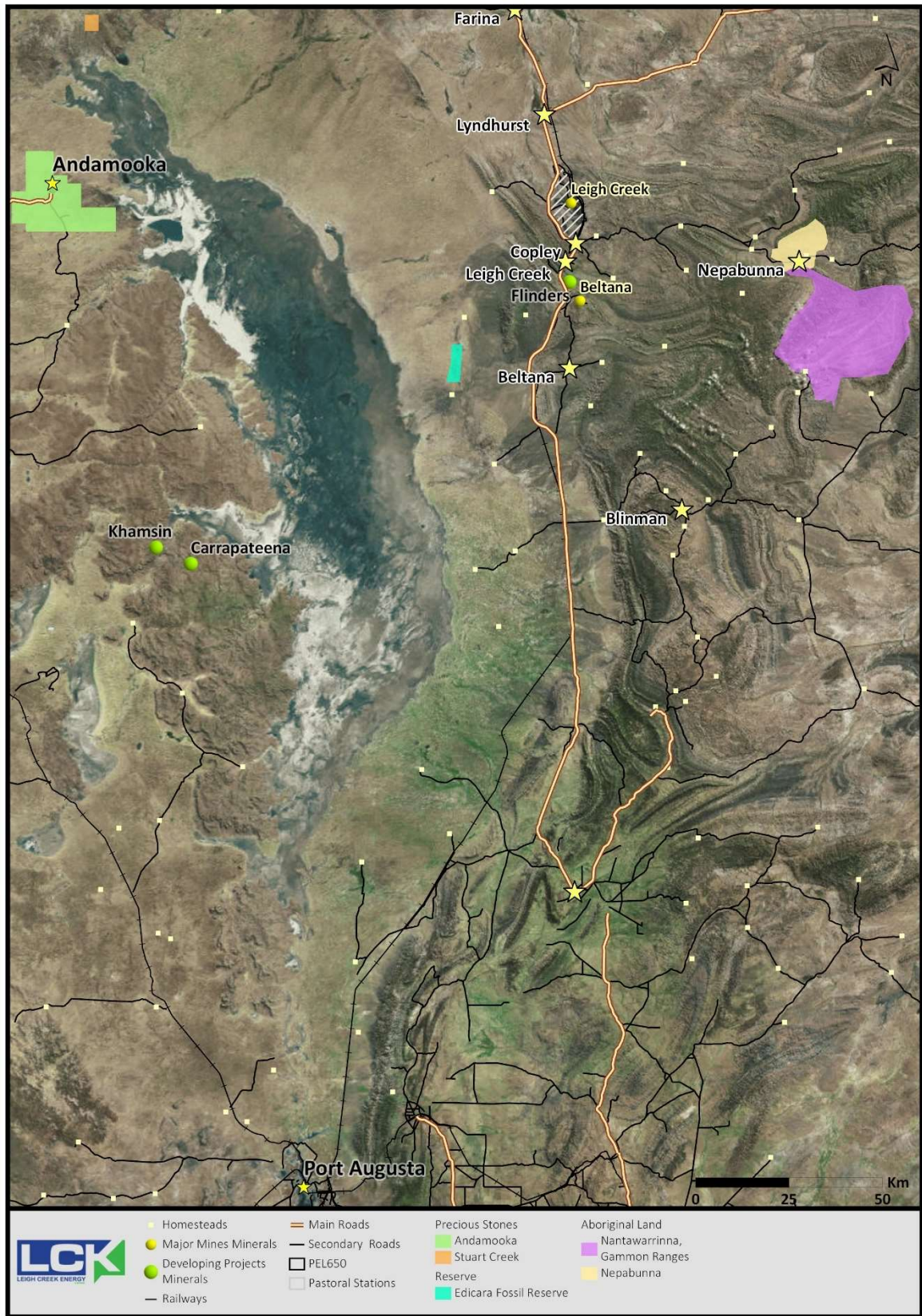


Figure 4-15: Regional topography and land use

4.12.3 Native Title

PEL 650 lies within the boundaries of the Adnyamathanha No 1 Native Title determination. The State of South Australia granted PEL 650 on the basis that native title within the land has been extinguished. Irrespective of the incidence of tenure history, LCK recognise and respect the Adnyamathanha as the traditional owners of the region and therefore as key stakeholders. LCK has entered into a heritage protection agreement (WACA) with the Adnyamathanha Traditional Lands Association (ATLA) and is continuing to consult with ATLA in relation to proposed activities within PEL 650.

There are a number of Indigenous Land Use Agreements currently agreed between the South Australian Government and the Adnyamathanha Native Title claimants in the broader region covering issues including mineral exploration and co-management of national parks.

4.13 Socio-economic

The region is located in the Unincorporated area (i.e. out of Councils area) of South Australia. Jurisdiction for the area falls under the responsibility of the Outback Communities Authority (OCA). The OCA has legislative responsibility to provide administration and management support for outback communities.

The main population centre in the region is Leigh Creek Township, built in 1982 by the State Government to support the State-owned electricity company. The township was leased to Alinta Energy and operated as a 'closed' town until the closure of the Leigh Creek Coalfield in 2016. As of 1 January 2017, the OCA had taken over municipal responsibility for the township, with the transition involving a range of government agencies led by the Department of Planning, Transport and Infrastructure (OCA 2017).

Flinders Power has handed the management of Leigh Creek Township to the OCA (OCA 2016).

At its peak the population of the Leigh Creek Township was in excess of 1000 people (OCA 2016), but by 2011 the resident population had fallen to 505 (ABS 2016). Following announcement of the coalfield closure, the population has continued to decrease incrementally with data indicating 220 residents in the town in April 2016, comprised of residual families, contractors, government employees and business employees (DSD 2016).

The town of Copley, located 6 km north of Leigh Creek township, had a population of 103 in 2011, 45% of whom were Aboriginal and Torres Strait Islanders (ABS 2016). The population of Copley has also reduced to 72 people in 2016 (ABS 2016).

The township of Leigh Creek is an important regional service centre providing essential services including water supply, an airport, a school, a hospital, emergency services, a supermarket, a post office and shops. Almost all government employees in the region are accommodated in Leigh Creek. Leisure services are also provided with the town having a tavern, swimming complex, a caravan park, community buildings and parks. Leigh Creek is expected to continue to provide essential services for about 700 people in the township and surrounding region (DSD 2016).

The Outback Highway (the Hawker-Lyndhurst Road) which passes the township of Leigh Creek and the Leigh Creek Coalfield is the main transport and tourism access road in the region.

The Stirling North-Telford Railway was constructed to transport coal from the Leigh Creek Coalfield to the Port Augusta power stations. Following closure of the coalfield, the railway remains operational despite no further coal trains being operated. The railway has been transferred from Flinders Power to the government (Flinders Power 2016).

ElectraNet's Davenport to Leigh Creek 132 kV high-voltage transmission line and sub-station which supply power to Leigh Creek Township and the coalfield are located south-west and west of PEL 650.

In December 2016 SA Water took over the management of water services in Leigh Creek from Flinders Power. Since the announcement of the mine closure at Leigh Creek a cabinet submission recommended that the SA State Government support services in Leigh Creek for five years, appointing SA Water to manage the towns water supply. Leigh Creek draws drinking water from a number of local bores (Windy Creek, Emu Creek and Emu Creek South). Due to the relatively high salinity of the ground water supply, a small desalination plant is used to treat the water. The plant is capable of producing up to 1.25ML of drinking water per day. (SA Water, 2018).

5 Environmental Impact Assessment

This section discusses potential and perceived environmental impacts related to the proposed geophysical surveys.

Sections 5.1 to 5.10 provide a detailed discussion of the components of the environment that are potentially impacted by the proposed geophysical activities.

The discussion is supported by an environmental risk assessment. The risk assessment is presented in Table 5-1 (in Section 5.11), which outlines the potential hazards, the potential consequences and their likelihood, the management measures that will be applied and the resulting level of risk.

Reference is made to the results of the risk assessment where relevant throughout the discussion.

5.1 Cultural Heritage

Due to the minimal land disturbance required for the proposed activities, potential impacts to cultural heritage may arise from:

- Vehicular movement on roads, access tracks and seismic lines
- Earthworks associated with survey line preparation and construction of access tracks
- Activity outside designated / approved areas.

The main area of investigation by the geophysical surveys is located on existing disturbed areas within the Leigh Creek Coalfield. Some geophysical surveys may be required outside of areas of existing disturbance, but this is expected to be minimal. The site and its surrounds have been subject to extensive, heavy disturbance from previous coal mining and associated activities.

Work Area Clearances with ATLA have been carried out on nominated areas within PEL 650 previously and will be carried out for all ongoing activities as per the formal Work Area Clearance Agreement (WACA) entered into with ATLA. Signage and fencing (where required) will be installed to delineate approved areas and any restricted areas. If sites of cultural heritage significance are present in the vicinity they will be flagged and/or fenced off where necessary to prevent any disturbance. In addition, procedures are in place to deal with the incidental discovery of cultural heritage material.

The level of risk to cultural heritage in relation to line preparation and construction of access tracks has been assessed as moderate. Any Aboriginal heritage sites, objects and remains discovered during operations will be appropriately reported and responded to, consistent with the *Aboriginal Heritage Act 1988*.

5.2 Soils

Potential impacts to soils arise mainly from:

- Ground disturbance associated with line preparation and access track construction
- Spills or leaks associated with storage and handling of fuel and chemicals
- Storage, handling and disposal of waste
- Vehicular movement on roads, access tracks and seismic lines.

5.2.1 Earthworks

Line preparation and access track construction activities have the potential for localised impacts to soil through inversion, compaction or increased erosion.

The site is relatively flat and has been subject to heavy disturbance related to previous coal mining activities. Any earthworks outside the areas of previous disturbance will be surveyed and monitored to ensure minimal impact to the environment.

Disturbance to soils will be localised and restricted to defined areas, refer Section 3.2. Following the completion of activities at the site, it will be rehabilitated in accordance with industry standards, to ensure that revegetation of indigenous species occurs and that sites are left in a clean, tidy and safe condition, refer Section 3.10.

Given the disturbed nature of the majority of the site, any impacts resulting from the geophysical surveys are deemed to be low.

5.2.2 Spills or leaks of fuel or chemicals

Improper storage and handling of fuel or chemicals has the potential to result in localised contamination of soil. In order to minimise this risk, all fuel, oil and chemicals on site are stored and handled in accordance with relevant standards and guidelines including AS 1940 and EPA guideline 050/07 Bunding and Spill Management. Fuel and chemicals will be stored in designated areas with appropriate secondary containment as required (e.g. lined, bunded areas or on self-bunded pallets). Any spills will be immediately cleaned up and any contaminated material removed off-site for appropriate treatment or disposal. If larger scale spills that cannot be immediately contained and cleaned up occurred, they would be assessed consistent with the requirements of the NEPM⁹ and, where required, remediated in accordance with relevant guidelines (e.g. EPA guidelines). Hazardous materials will be transported and disposed in accordance with appropriate standards and legislative requirements, including the Australian Dangerous Goods Code. Appropriate spill response equipment and MSDS will be available on site for all fuels and chemicals used on site.

5.2.3 Waste management

Inappropriately managed waste has the potential to result in localised disturbance or contamination of soil. Storage of waste and transport to licensed disposal or recycling facilities will be undertaken in accordance with relevant legislation and guidelines. Waste generation will be minimised where practicable, waste will be stored securely, and appropriately licensed waste contractors will be used for waste transport.

5.2.4 Vehicle movement

Movement of heavy machines and vehicles on roads, access tracks and seismic lines may lead to soil erosion and compaction. To manage this, vehicles will use appropriate tyre pressures and reduced speeds to minimise risk of potential rutting. Balloon tyres on vibrator machines, or tracked vibrator machines, will be used to reduce ground pressures and minimise impact on soils.

5.2.5 Risk Assessment

The level of risk has been assessed as low for these potential hazards (see Table 5-1).

5.3 Groundwater

Potential risks arise mainly from spills or leaks of fuels or chemicals (see 5.2.2 above).

Spills or leaks of fuel or chemicals have the potential to result in localised contamination of any unconfined water table aquifer, if present.

⁹ *National Environment Protection (Assessment of Site Contamination) Measure (1999)* amended in 2013

5.4 Surface Water

Potential impacts to surface water arise mainly from:

- Ground disturbance associated with survey line preparation and access track construction (refer Section 3.2) and rehabilitation (refer Section 3.10) (e.g. disturbance to natural drainage patterns, increased erosion / sedimentation)
- Spills or leaks associated with storage and handling of fuel and chemicals
- Storage, handling and disposal of waste.

5.4.1 Line clearance activities

Line clearance activities may disturb natural drainage patterns resulting in increased sedimentation of surface water features.

The potential for impact is low but in order to manage the risk natural drainage channels will be left clear at line crossings and all access through watercourses will be carefully assessed to determine the locations of least impact to channels and creek banks.

Minor earthworks (if required) will only be done at a limited number of locations to decrease the entry and exit angles for vehicles.

Any required remediation work carried out as soon as possible after completion of all activities.

5.4.2 Waste management

Measures to ensure secure storage and handling of waste will be implemented as outlined in Section 5.2 above.

5.4.3 Risk Assessment

The level of risk has been assessed as low for these potential hazards (see Table 5-1).

5.5 Flora and Fauna

Potential impacts to flora and fauna arise mainly from:

- earthworks associated with survey line and access track preparation
- spills or leaks associated with storage and handling of fuel and chemicals
- activity outside designated / approved areas
- presence of personnel, lighting, general site activity and road use
- storage, handling and disposal of waste.

5.5.1 Earthworks

Survey line and access track preparation have the potential for localised impacts to native vegetation and wildlife habitats. There are no nationally listed threatened ecological communities known to be present in the area. Nevertheless, vegetation is removed only when absolutely necessary, this is avoided by weaving lines through vegetated areas and making use of existing routes/disturbed areas where practicable.

Any disturbance will be rehabilitated in accordance with standard regulatory criteria, as discussed in Section 5.2.1. Impacts to vegetation and wildlife habitats will not be significant or long term.

Any direct impacts to fauna are expected to be short term and localised. This will also be managed by ensuring there is no unauthorised off-road or off-line driving or creation of shortcuts.

As the activities will have no or minimal impact of available habitat in the region, the activities are not likely to have any significant impact on fauna populations.

Line preparation and movement of vehicles can also result in the introduction or spread of weeds. Standard measures will be implemented to minimise this risk. For example, vehicles and equipment will be cleaned (and washed down where necessary) before commencing work at site or after operating in an area of known weed infestation. If geophysical activities result in the introduction or increased densities of pest plants, a weed control plan will be developed and implemented in consultation with the land manager and the relevant NRM officer where appropriate.

5.5.2 Spills or leaks of fuel, chemicals

Spills of fuel, chemicals have the potential to damage native vegetation. As discussed in Section 5.2, this risk will be minimised by appropriate storage, handling and spill response in accordance with relevant standards and guidelines.

Access to fuel and chemicals presents a potential hazard for wildlife. Access to chemicals and fuel will be prevented by storing and handling them appropriately in designated areas and implementing immediate containment and clean-up if any spills occur. Emus and kangaroos are occasionally present on site and to prevent access stock-proof fencing will be erected around the fuel and chemical storage areas.

5.5.3 Activity outside designated / approved areas

Activities outside designated / approved areas have the potential to impact vegetation and fauna. To manage this all activities will be confined to designated areas, and there will be no unauthorised off-road or off-line driving or creation of shortcuts.

5.5.4 Presence of personnel, lighting and general site activity and road use

The presence of personnel, lighting and general activity on site have the potential to impact vegetation and fauna. Use of roads and tracks could also result in injury or death of small numbers of fauna. Impacts will be relatively localised and are not expected to have any significant impact on fauna populations, particularly given the disturbed nature of vegetation and habitats present.

5.5.5 Waste management

Measures to ensure secure storage and handling of waste will be implemented as outlined in Section 5.2.3. Covered bins will be used to prevent native fauna and pest animals accessing or spreading waste.

5.5.6 Risk Assessment

The level of risk has been assessed as low for these potential hazards (see Table 5-1).

5.6 Air Quality

Potential impacts to air quality arise mainly from:

- dust generation from survey line and access tracks preparation
- dust generation from vehicle movement on roads, access tracks and seismic lines.

5.6.1 Dust generation

Survey line preparation and the use of unsealed roads have the potential to generate dust.

Survey line and access tracks preparation will be limited in scale and short term. Dust emissions will be less than those from previous mining operations and ongoing rehabilitation operations. There are no sensitive receptors within the PEL650 likely to be impacted from dust generated from geophysical activities.

Vehicle speeds will be restricted at the site and dust control measures (e.g. water spraying for dust suppression) will be implemented if required.

5.7 Noise

Potential impacts associate with noise emissions include:

- disturbance to wildlife.

Noise emissions generated at the site during the proposed geophysical surveys will be localised and short term and are not likely to have a significant impact on any sensitive receptors. There are no residences within the PEL 650. Noise levels will not be higher than those associated with previous mining operations, ongoing rehabilitation activities at the site and current vehicular traffic on the highway. Equipment will be operated and maintained in accordance with manufacturer specifications in order to minimise noise emissions.

Limited numbers of wildlife are present and geophysical survey noise will not have a significant impact.

5.7.1 Risk Assessment

The level of risk associated with noise emissions has been assessed as low (see Table 5-1).

5.8 Land Use

The proposed activities are not likely to have any significant impact on land uses (e.g. mining / mine rehabilitation, pastoralism, conservation or tourism) or landholders within the region. All geophysical survey activities will be undertaken in consultation with the landowners i.e. Flinders Power to ensure there is minimal impact from the geophysical surveys.

The majority of the PEL 650 is not visible from the adjacent Outback Highway. It is distant from public roads or pastoral stations (see Figure 4-15) and separated from them by the mine boundary. Consequently, it will have little to no impact on pastoral activities or visual amenity. There are no conservation reserves in close proximity.

5.8.1 Risk Assessment

There were no credible potential environmental impacts to land use identified by the risk assessment (see Table 5-1).

5.9 Public Safety and Risk

The key areas where potential or perceived impacts to public safety and risk could arise are:

- unauthorised access resulting in exposure to site hazards during operations
- use of roads and movement of vehicles and heavy machinery

5.9.1 Unauthorised access

PEL 650 is located within the Leigh Creek Coalfield, where public access is prohibited. In addition to security at the mine site entrance, measures such as signage and fencing will be in place to warn of the hazards at the site and restrict access into the site (PEL 650). Access to the area of the geophysical survey by other third parties (e.g. Flinders Power personnel) is also strictly controlled with suitable exclusion zones to achieve safety of personnel. Landowners, such as Flinders Power will be notified of the activities, so that they are aware of where and when the activities are occurring. Potentially hazardous areas will be flagged and if necessary securely fenced with

warning signs in place. The site of the geophysical survey will be attended by a supervisor during the activity, enabling any unauthorised access to be detected or deterred.

5.9.2 Use of roads

The existing public road network is already heavily used by the transport, mining, oil and gas and pastoral industries and the incremental change as a result of geophysical surveys is not likely to be significant. Measures to mitigate the risks to the public will be in place including signage near the site entrance, speed restrictions and education programs.

As noted in Section 5.2.3, transport of waste to licensed disposal or recycling facilities will be undertaken in accordance with relevant legislation and guidelines.

5.10 Economic Impact

The geophysical surveys are very unlikely to result in adverse economic impact on stakeholders. The economic impacts will be localised and low impact.

The geophysical surveys have a number of potential benefits. These include:

- increased understanding of the cultural heritage aspects of the region (in collaboration with the traditional owners, subject to their desire to participate)
- direct economic benefits to the Leigh Creek and Copley townships resulting from supply of fuel, food, accommodation and other services during the geophysical surveys
- direct economic benefit via payments to local supply and service companies
- potential employment opportunities for local personnel during various phases of the surveys
- increased understanding of the water, air, fauna and flora of the region.

5.11 Environmental Risk Assessment Summary

As discussed above, Leigh Creek Energy has undertaken an environmental risk assessment of the proposed geophysical surveys in PEL 650. This section summarises the process and presents the risk assessment.

Environmental risk is a measure of the likelihood and consequences of environmental harm occurring from an activity. Environmental risk assessment is used to separate the minor acceptable risks from the major risks and to provide a basis for the further evaluation and management of the major risks.

The risk assessment process involves:

- identifying the potential hazards or threats posed by the project
- categorising the potential consequences and their likelihood of occurring
- using a risk matrix to characterise the level of risk.

The level of risk for the proposed geophysical surveys has been assessed based on the assumption that management measures that are discussed in this EIR, will be in place. The risk assessment was prepared by JBS&G and LCK, based on knowledge of the existing environment, understanding of proposed geophysical survey and previous experience of LCK personnel with similar operations.

The risk assessment process was based on the procedures outlined in Australian and New Zealand Standard AS/NZS ISO 31000:2009 (*Risk Management*) and HB 203:2012 (*Managing environment-related risk*).

5.11.1 Environmental Risk Assessment Definitions and Risk Matrix

The risk assessment uses the risk matrix and definitions for consequences and likelihood that are outlined below in Figure 5-1.



LCK Risk Matrix

		MANAGEMENT RESPONSE									
		Corporate ¹	Operational								
1-6	LOW	Activity may proceed with care and observance of local environment. Risks are to be reduced to ALARP.	Activity may proceed with care and observance of local environment. Risks are to be reduced to ALARP.								
7-15	MODERATE	Activities may proceed only with authorisation of a LCK Executive Manager. Risks are to be reduced to ALARP.	Activities may proceed only with authorisation of a LCK Site Manager. Risks are to be reduced to ALARP.								
16-21	HIGH	Health, Safety and Environment: Activity must not proceed until further risk reduction implemented. Authorisation to accept People or Environment risk as ALARP and proceed required from MD or delegate.	Health, Safety and Environment: Activity must not proceed until risks are reduced to ALARP. Authorisation to accept People or Environment risk as ALARP and proceed required from MD or delegate.								
		Financial and Reputation: Authorisation to accept Financial and Reputation Risk required from MD or delegate.	Financial and Reputation: Authorisation to accept Financial and Reputation Risk required from MD or delegate.		LIKELIHOOD						
22-25	EXTREME	Activity must not proceed. LCK Board notification required.									Frequency of an Event
¹ Corporate includes project design and long-term planning.					Historical	Unusual across industry	Has occurred once or twice in industry	Has occurred several times in industry, but not in the company	Has occurred multiple times in industry, or once or twice in company	Has occurred frequently in industry, or multiple times in company	
CONSEQUENCE						RARE	UNLIKELY	POSSIBLE	LIKELY	ALMOST CERTAIN	
Health & Safety	Project Variance	Environment	Financial	Reputation		A	B	C	D	E	
No injury, report only	<5%	Minor consequences, local response. Minimal impacts to environment.	Less than \$20K.	Local mention only, quickly forgotten, freedom to operate unaffected.	MINOR	I	1	2	4	7	11
First aid injury	5-10%	Minor local environmental impact and/or regulatory notification is required.	\$20K-\$150K.	Short term local concern. Some impact on asset level non- production activities.	MODERATE	II	3	5	8	12	16
Medically treated injury	10-20%	Significant local environmental impact and/or regulatory intervention	\$150K-\$1M.	Attention from government, media or persistent community concern.	SERIOUS	III	6	9	13	17	20
Lost time injury permanent disability	20%-30%	Significant ecological or cultural impact and/or regulatory intervention.	\$1M-\$5M. Significant business reorganisation.	Persistent national concern. Major venture/asset operations restricted.	MAJOR	IV	10	14	18	21	23
Any potential fatality or fatality	>30%	Critical ecological or cultural impact and/or regulatory intervention.	Greater than \$5M. Extreme business reorganisation.	Serious national concern. Serious public or media outcry. Legal action. Long term brand impact.	CRITICAL	V	15	19	22	24	25

Figure 5-1: LCK risk matrix (version 2.0 November 2018)

5.11.2 Environmental Risk Assessment Summary Table

A summary of the level of environmental risk for geophysical operations is provided in Table 5-1 below. As noted previously, the level of risk has been assessed based on the assumption that the management measures outlined in this EIR will be in place.

Table 5-1: Environmental risk assessment for geophysical operations within PEL 650

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
Line and access tracks preparation and vehicle movement	Earthworks	Cultural Heritage	Disturbance to Cultural Heritage	<ul style="list-style-type: none"> Where possible, existing tracks, roads or seismic lines are used for access. By way of risk mitigation, areas of proposed land disturbance will be subject to a cultural heritage Work Area Clearance as per the WACA executed in September 2016 and the land disturbance will then be undertaken in accordance with conditions of the completed Work Area Clearance. Areas of sensitivity (e.g. cultural heritage exclusion areas, if present) will be flagged and/or fenced off where necessary to prevent disturbance. Training for all personnel on Aboriginal cultural heritage as well as their obligations under the Aboriginal Heritage Act 1988 If suspected cultural heritage material is discovered during operations, immediately stop any further work in the area, secure the site and ensure no further ground disturbing activity takes place in the immediate area. Options include risk managing the area with ATLA's assistance or other available legislative processes. If Aboriginal sites, objects and remains are discovered, the discovery is reported to the Department of Premier and Cabinet, Aboriginal Affairs and Reconciliation (AAR) division. 	Major	Unlikely	Moderate (14)
Line and access tracks preparation and vehicle movement	Earthworks	Soil impacts	Localised impacts to soil through inversion, compaction or increased erosion	<ul style="list-style-type: none"> Where possible, existing tracks, roads or seismic lines are used for access. Areas where there is potential for (or signs of) soil erosion or sedimentation occurring will be stabilised and control measures implemented. Training and induction for all personnel to educate them on the importance of remaining within designated / approved areas. Any earthen bunds impacted will be reprofiled/reinstated to their prior contours. 	Minor	Unlikely	Low (2)

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
Line and access tracks preparation and vehicle movement	Earthworks	Surface water	Disturbance to natural drainage patterns, increased erosion / sedimentation	<ul style="list-style-type: none"> Newly disturbed areas reinstated once they are no longer required e.g. by restoring natural contours, ripping areas of compacted soil and respreading topsoil and stockpiled vegetation. Existing drainage patterns will be restored. 	Minor	Rare	Low (1)
Line and access tracks preparation and vehicle movement	Earthworks	Flora/ Fauna	Damage to native vegetation and fauna habitat	<ul style="list-style-type: none"> Activities confined to clearly defined designated approved work areas to minimise areas of new disturbance. Where possible, existing tracks, roads or seismic lines are used for access. Areas of sensitivity (e.g. significant vegetation if present) flagged and / or fenced off where necessary to prevent disturbance and detoured around. Water supply source will be from existing SA Water fill points within the Leigh Creek Coal Field, to ensure no impact on groundwater wells or existing groundwater dependent ecosystems. Fencing of contaminated areas, if threat is posed, to wildlife. Pre-disturbance site inspection undertaken to document existing conditions. Earth moving equipment cleaned and inspected before commencing work at site or after operating in areas of known weed infestations¹⁰. If project activities result in the introduction or increased densities of weeds, a weed control plan will be developed and implemented. 	Moderate	Unlikely	Low (5)
Line and access tracks preparation and vehicle movement	Dust from earthworks	Public nuisance	Dust nuisance to the public. Noise nuisance to the public.	<ul style="list-style-type: none"> Vehicle speeds will be restricted at the site and dust control measures (e.g. water spraying) will be implemented if required. Local towns are far enough away to not be impacted from these activities. 	Minor	Rare	Low (1)

¹⁰ Note: Weeds are defined in this objective as any invasive plant that threatens native vegetation in the local area, or any species recognised as invasive in South Australia.

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
Line and access tracks preparation and vehicle movement	Earthworks	Community Health and Safety	Exposure to site hazards during operations from unauthorised site access	<ul style="list-style-type: none"> • PEL 650 is in a restricted area, where public access is prohibited, area fenced and signed and monitored with security at the mine site access. • Landowners (Flinders Power) notified of when and where activities are being conducted. • Geophysical surveys designed, operated and maintained in accordance with relevant industry standards and best practice. • Safety, testing, maintenance and inspection procedures are implemented. • Recognised risk management processes implemented in design through to demobilisation to identify threats and controls to mitigate risks. • Site Management Plan implemented as agreed with the third-party documenting health and safety management systems. • Emergency response plan (scenario based) in place and drills conducted. • Signage and site access control measures in place to warn of hazards and restrict access to the site of the geophysical survey. • Safe work permits be obtained to ensure only individuals with proper clearance can conduct works. • Appropriate fire-fighting equipment on site. • Smoking only permitted in designated areas. • Fire and Emergency Services Act 2005 requirements complied with (e.g. permits for 'hot work' on total fire ban days). • Appropriate firebreaks are maintained. 	Serious	Rare	Low (6)
Storage and handling of fuel and chemicals	Spills or leaks of fuel or chemicals	Groundwater	Localised contamination of any unconfined water table aquifer, if present	<ul style="list-style-type: none"> • No refuelling outside of designated refuelling/servicing areas. • All hydrocarbons and chemicals are to be stored/contained within bunds in accordance with the appropriate Australian Standards, including AS1940, Safety Data Sheets and EPA guidelines. Spills and leaks are reported immediately and clean up actions initiated. 	Moderate	Unlikely	Low (5)

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
				<ul style="list-style-type: none"> A record of all spill/leak events and their corrective actions are maintained. Personnel have received training in the use of spill response equipment. 			
Storage and handling of fuel and chemicals	Spills or leaks of fuel or chemicals	Soil contamination	Localised contamination of soil	<ul style="list-style-type: none"> No refuelling outside of designated refuelling/servicing areas. All hydrocarbons and chemicals are to be stored/contained within bunds in accordance with the appropriate Australian Standards, including AS1940, Safety Data Sheets and EPA guidelines. Spills and leaks are reported immediately and clean up actions initiated. A record of all spill/leak events and their corrective actions are maintained. Personnel have received training in the use of spill response equipment. 	Moderate	Unlikely	Low (5)
Storage, handling and disposal of waste	Inappropriately managed waste	Soil contamination	Localised contamination of soil	<ul style="list-style-type: none"> Waste generation minimised (e.g. by compliance with EPA's Waste Hierarchy model (avoid, reduce, reuse, recycle, recover, treat, dispose)). Secure systems used for storage and transport of waste (e.g. covered bins in designated area for waste collection and storage prior to transport). High standards of 'housekeeping' implemented. Waste removed off-site and disposed of at an EPA licensed waste handling facility. Hazardous wastes handled in accordance with relevant legislation and standards. Licensed contractors used for waste transport. Liquid waste (e.g. waste oil stored in appropriate tanks and transported off site to an EPA licensed facility). All wastewater (sewage) disposed in accordance with the South Australian Public Health (Wastewater) Regulations 2013 or to the satisfaction of the Department of Health. 	Minor	Unlikely	Low (2)

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
Storage and handling of fuel and chemicals	Spills or leaks of fuel or chemicals	Surface water	Spills or leaks associated with storage and handling of fuel and chemicals	<ul style="list-style-type: none"> No refuelling outside of designated refuelling/servicing areas. All hydrocarbons and chemicals are to be stored/contained within bunds in accordance with the appropriate Australian Standards, including AS1940, Safety Data Sheets and EPA guidelines. Spills and leaks are reported immediately and clean up actions initiated. A record of all spill/leak events and their corrective actions are maintained. Personnel have received training in the use of spill response equipment. 	Moderate	Unlikely	Low (5)
Storage and handling of fuel and chemicals	Spills or leaks of fuel or chemicals	Flora/ fauna	Damage native vegetation and potential hazard for wildlife	<ul style="list-style-type: none"> No refuelling outside of designated refuelling/servicing areas. All hydrocarbons and chemicals are to be stored/contained within bunds in accordance with the appropriate Australian Standards, including AS1940, Safety Data Sheets and EPA guidelines. Spills and leaks are reported immediately and clean up actions initiated. A record of all spill/leak events and their corrective actions are maintained. Personnel have received training in the use of spill response equipment. 	Minor	Rare	Low (1)
Storage, handling and disposal of waste	Inappropriately managed waste	Surface water	Localised contamination of surface water resources	<ul style="list-style-type: none"> Waste generation minimised (e.g. by compliance with EPA's Waste Hierarchy model (avoid, reduce, reuse, recycle, recover, treat, dispose)). Secure systems used for storage and transport of waste (e.g. covered bins in designated area for waste collection and storage prior to transport). High standards of 'housekeeping' implemented. Waste removed off-site and disposed of at an EPA licensed waste handling facility. Hazardous wastes handled in accordance with relevant legislation and standards. Licensed contractors used for waste transport. 	Moderate	Rare	Low (3)

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
				<ul style="list-style-type: none"> Liquid waste (e.g. waste oil stored in appropriate tanks and transported off site to an EPA licensed facility). All wastewater (sewage) disposed in accordance with the South Australian Public Health (Wastewater) Regulations 2013 or to the satisfaction of the Department of Health. 			
Storage, handling and disposal of waste.	Inappropriately managed waste	Flora/ fauna	Harm to native fauna or increase in feral animals	<ul style="list-style-type: none"> Covered bins will be used to prevent native fauna and pest animals accessing or spreading waste. Waste generation minimised (e.g. by compliance with EPA's Waste Hierarchy model (avoid, reduce, reuse, recycle, recover, treat, dispose)). Secure systems used for storage and transport of waste (e.g. covered bins in designated area for waste collection and storage prior to transport). High standards of 'housekeeping' implemented. Waste removed off-site and disposed of at an EPA licensed waste handling facility. Hazardous wastes handled in accordance with relevant legislation and standards. Licensed contractors used for waste transport. Liquid waste (e.g. waste oil stored in appropriate tanks and transported off site to an EPA licensed facility). All wastewater (sewage) disposed in accordance with the South Australian Public Health (Wastewater) Regulations 2013 or to the satisfaction of the Department of Health. 	Moderate	Rare	Low (3)
Seismic survey recording phase	Dust from seismic survey	Public nuisance	No sensitive receptors near the site that are within the influence to be affected from dust generated from	<ul style="list-style-type: none"> Vehicle speeds will be restricted at the site and dust control measures (e.g. water spraying) will be implemented if required. 	Minor	Rare	Low (1)

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
			geophysical activities				
Seismic survey recording phase	Noise disturbance	Public nuisance	No sensitive receptors near the site that are within the influence to be affected from noise generated from geophysical activities	<ul style="list-style-type: none"> Equipment will be operated and maintained in accordance with specifications to minimise noise emissions. 	Minor	Rare	Low (1)
Seismic survey recording phase	Seismic survey	Impact on other land uses	There were no credible potential environmental impacts to land use identified by the risk assessment	<ul style="list-style-type: none"> Site layout and data acquisition is designed to minimise adverse impacts to existing drainage patterns and secondary impacts to mine site operations. Water supply source will be from existing SA Water fill points within the Leigh Creek Coal Field, to ensure no impact on groundwater well users or existing groundwater dependent users. Relevant stakeholders notified prior to undertaking operations, pursuant to PGE Regulations. All geophysical survey activities will be undertaken in consultation with landowners to ensure there is minimal impact from the geophysical surveys. Liaison with land owners regarding notification / management of works, traffic and site issues. Liaison with local community regarding operations. System in place for logging complaints to ensure that issues are recorded, addressed as appropriate and resolved in a timely manner. High standard of 'housekeeping' maintained. Induction for all employees and contractors covers stakeholder matters. 	Moderate	Unlikely	Low (5)

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
				<ul style="list-style-type: none"> Emergency services and potentially affected landholders / local community will be informed of significant activities (e.g. movement of large items of equipment) on public roads. 			
Use of roads and movement of vehicles and machinery	Traffic incident	Safety of the public and other third parties	Traffic incident causing injury	<ul style="list-style-type: none"> Measures to mitigate the risks to the public will be in place including signage near the site entrance, speed restrictions and education programs. All required authorisations (e.g. DPTI, police) obtained where required for significant activities (e.g. movement of large items of equipment) on public roads. Driver behaviour and vehicle speed limits included in compulsory induction. Traffic and journey management procedures followed 	Major	Likely	High (21)
Activity outside designated/ approved areas	Earthworks	Cultural Heritage	Disturbance to Cultural Heritage	<ul style="list-style-type: none"> Areas of sensitivity (e.g. cultural heritage exclusion areas, if present) will be flagged and / or fenced off where necessary to prevent disturbance. Training and induction for all personnel on cultural heritage issues and the importance of remaining within designated / approved areas. 	Major	Rare	Moderate (10)
Activity outside designated/ approved areas	Earthworks	Flora/ fauna	Damage to native vegetation and fauna habitat	<ul style="list-style-type: none"> All activities will be confined to designated areas, with signage and fencing (where required) installed to delineate approved areas and any restricted areas. 	Moderate	Rare	Low (3)
Presence of personnel, general site activity and road use	Traffic incident	Flora/ fauna	Fauna collision	<ul style="list-style-type: none"> Driver behaviour and vehicle speed limits included in compulsory induction. Traffic and journey management procedures followed 	Minor	Likely	Moderate (7)
Campsite and associated activities	Campsite preparation and site activities	Soil impacts	Soil erosion and compaction	<ul style="list-style-type: none"> Mobile camp will be set up on previously disturbed areas used as a former mobile camp site. Any sumps and excavations shall be backfilled with subsoil being placed below topsoil. 	Minor	Unlikely	Low (2)

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
Campsite and associated activities	Campsite preparation and site activities	Flora/ fauna	Damage to native vegetation and fauna habitat	<ul style="list-style-type: none"> Camps will be located wherever possible on previously disturbed areas and / or areas with minimal vegetation cover. 	Minor	Unlikely	Low (2)
Campsite and associated activities	Campsite preparation and site activities	Cultural Heritage	Disturbance or damage to sites of cultural or heritage significance.	<ul style="list-style-type: none"> Camps will be located away from sites of known cultural or heritage significance and located on previously disturbed areas used as a former mobile camp site. 	Serious	Rare	Low (6)
Campsite and associated activities	Disposal of camp wastewater and waste	Soil impacts	Localised contamination of soil	<ul style="list-style-type: none"> Wastewater (sewage and grey water) disposal where possible in accordance with the South Australian Public Health (Wastewater) Regulations 2013 and/or in consultation with the Department for Health and Wellbeing and/or in accordance with licenses/permits, if any. Department of Health and Wellbeing approved transportable wastewater treatment plants used for camps, or septic tank systems used with collection of wastewater for disposal at a licensed facility Appropriate controls for management of sewage effluent (developed in consultation with Department for Health and Wellbeing) implemented for situations where excursions outside effluent quality guidelines may occur (e.g. during start-up or system upset). Secondary treated sewage wastewater is disposed of onto land well away from any place from which it is reasonably likely to enter any waters, and to minimise spray drift and ponding. 	Minor	Unlikely	Low (2)
Campsite and associated activities	Disposal of camp wastewater and waste	Flora and fauna	Damage to native vegetation and fauna habitat Injury or loss of native fauna	<ul style="list-style-type: none"> Wastewater disposal locations sited to minimise the impact to vegetation, fauna and sensitive ecological areas. Fencing installed where required around irrigation areas. 	Minor	Unlikely	Low (2)
Fire (resulting from activities)	Fire (resulting from activities)	Flora and fauna	Damage to native vegetation and fauna habitat	<ul style="list-style-type: none"> Appropriate fire-fighting equipment on site. Smoking only permitted in designated areas. 	Minor	Unlikely	Low (2)

Impact Identification				Control Strategy	Risk Assessment		
Activity	Event	Type of Impact	Potential Consequences	Key Management Measures	Consequence	Likelihood	Residual Risk
			Injury or loss of native fauna	<ul style="list-style-type: none"> • Fire and Emergency Services Act 2005 requirements complied with (e.g. permits for 'hot work' on total fire ban days). • Appropriate firebreaks are maintained. 			

6 Environmental Management Framework

6.1 Environmental Management System

LCK has designed an Environmental Management System based on the principles of *ISO 14001: Environmental Management Systems*. LCK's Environmental Management System therefore comprises the following components, as described by ISO 14001:

- Environmental Policy
- Planning
- Implementation and Operation
- Checking and corrective action
- Management Review.

Environmental Policy

LCK acknowledges that excellence in environmental management is essential to the success of the LCK. Therefore, LCK's Environmental Policy is a statement of the company's intent to achieve environmental compliance and ensures all environmental activities are consistent with LCK's objectives. The policy is a statement of commitment from management and reflects the values of the LCK Board. The policy is reviewed every year by the Board for its appropriateness and to ensure it is up to date with current legislation. The policy is signed and dated by the Managing Director after every review.

The policy is communicated to people working for or on behalf of LCK through environmental health and safety inductions and is displayed by the entrance to the LCK offices. The policy is made available to the public on the LCK website www.lcke.com.au.

Environmental Objectives

Environmental objectives for the proposed activities have been developed in the accompanying SEO (LCK 2018). These objectives have been designed to provide a clear guide for the management of environmental issues.

Responsibilities

Environmental management and compliance will be the responsibility of all personnel with overall responsibility for environmental compliance lying with Leigh Creek Energy. The indicative organisation roles and responsibilities for personnel overseeing environmental management are detailed in Table 6-1. All contractors and individuals will also be responsible and accountable through their conditions of employment or contract. The training of all personnel will ensure that everyone is aware of their environmental responsibility.

Table 6-1: Indicative roles and responsibilities

Role	Accountabilities
Managing Director	<ul style="list-style-type: none"> • Accountable for facilitating the achievement of the project objectives, including the environmental objectives and the operation of the project. • Responsible for relationships with regulatory authorities. • Endorsing the environmental policy • Ensure that resources are made available so that all accountabilities below are actioned by the relevant people
Environmental Approvals and Compliance Manager	<ul style="list-style-type: none"> • Implement the environmental policy • Implement programs for achieving set objectives and targets • Monitoring and measurement of environmental performance • Overall responsibility for system implementation
General Manager - Operations	<ul style="list-style-type: none"> • Support the implementation of the EMS through approval of adequate resources and budgets. • Ensure management systems are implemented and maintained to ensure compliance with legislative requirements as required by the EMS. • Facilitate geophysical operations in accordance with the EMS, in particular, with the operational and environmental plans and procedures. • Monitor adherence to legal and corporate requirements and the effectiveness of all relevant procedures and standards. • Ensure any potential or actual issue (environmental incident) is reported in accordance with legal requirements and the corporate standard. • Liaising with and keeping the DEM informed on issues relating to environmental compliance affecting the project and environmental requirements through the commissioning, operational and decommissioning contract phases. • Communicate EMS responsibilities to site employees
Health & Safety Manager	Ensure that all employees, contractors and visitors have been inducted in health and safety and appropriate training and awareness programs are delivered to all project team members, contractors and visitors.
Senior Environmental Scientist	<ul style="list-style-type: none"> • Overall responsibility for EMS implementation • Implement programs for achieving set objectives and targets • Day to day implementation of EIR/SEO • Monitoring and measurement of environmental performance • Environmental internal reporting • Investigate environmental incidents and implement emergency responses and corrective actions. • Implement a system of corrective actions and continuous improvements
Employees, contractors and visitors	Adhere to policies and procedures at all times

Environmental Management Plan

All Leigh Creek Energy employees and contractors are responsible for ensuring compliance with the Leigh Creek Energy Environmental Management System (EMS) for the Leigh Creek Energy Project and associated environmental legislation. Leigh Creek Energy conducts periodic environmental reviews to assess the appropriateness of the EMS to meeting Leigh Creek Energy's policy, legislative requirements and environmental objective commitments and whether the environmental management plan (EMP) has been properly implemented and maintained.

Job Safety Analysis (Permit to Work)

Job Safety Analysis (**JSA**) is a process used to identify hazards associated with a job, by assessing the risks and implementing control measures to ensure the job can be conducted in a safe manner. LCK conducts JSAs for tasks where a work procedure does not exist, where the task has not previously been conducted by the personnel assigned to the task, or where additional hazards are present.

Induction and Training

Prior to the start of field operations all field personnel are required to undertake an environmental and cultural heritage induction to ensure they understand their role in protecting the environment and identified cultural heritage values of the area. This induction is part of a general induction process which also includes safety procedures. Site specific environmental requirements will be documented in the work program or work instruction. A record of induction and attendees will be maintained.

6.2 Emergency Response and Contingency Planning

Emergency response plans (ERPs) will be developed to guide actions to be taken to minimise the impacts of accidents and incidents. ERPs will be reviewed and updated on a regular basis to incorporate new information arising from any incidents, near misses and hazards and emergency response simulation training sessions. These plans will also include the facilitation of fire danger season restrictions and requirements.

Emergency response drills will also be undertaken at regular intervals to ensure that personnel are familiar with the plans and the types of emergencies to which it applies, and that there will be a rapid and effective response in the event of a real emergency occurring.

6.3 Environmental Monitoring and Audits

Ongoing monitoring and auditing of the geophysical survey activities will be undertaken to determine whether significant environmental risks are being managed, minimised and where reasonably possible, eliminated.

Monitoring programs will be designed to assess:

- compliance with regulatory requirements (particularly the SEO)
- integrity of bunding and containment systems
- site contamination
- site revegetation following completion and any restoration.

6.4 Incident Management, Recording and Corrective Actions

LCK and its contractors have a system in place to record environmental incidents, near misses and hazards, track the implementation and close out of corrective actions, and allow analysis of such incidents to identify areas requiring improvement. The system also provides a mechanism for recording 'reportable' incidents, as defined under the PGE Act and PGE Regulations.

6.5 Reporting

Internal and external reporting procedures will be implemented to ensure that environmental issues and / or incidents are appropriately responded to. A key component of the internal reporting will be contractors' progress and incident reports to LCK.

External reporting (e.g. incidents, annual reports) will be carried out in accordance with PGE Act requirements and the SEO. Annual reports are available for public viewing on the DEM website.

7 Consultation

LCK is committed to the principles of stakeholder engagement as outlined by the International Association of Public Participation (IAP2). LCK recognises its stakeholders as any individual, group of individuals, organisation or entity with an interest in its activities.

LCK is committed to respectful and transparent communications, and aims to:

- have informed discussions and proactively work with stakeholders
- engage openly and honestly with stakeholders
- identify and address issues or opportunities raised by stakeholders
- build long term relationships of trust with stakeholders.

LCK aims to continue to engage stakeholders for the lifecycle of the project to ensure that all potential concerns are identified and appropriately addressed. Stakeholder correspondence is registered and documented to ensure that issues are appropriately addressed.

LCK has been undertaking a program of consultation with directly affected parties and other stakeholders, as outlined below. Issues raised to date have been integrated into this report where relevant to the scope of the proposed geophysical activities.

To meet these commitments LCK has employed a dedicated Stakeholder Relations team with experience in mining and petroleum projects throughout South Australia.

7.1 Stakeholder Consultation

Stakeholders in the Leigh Creek region include the Adnyamathanha Traditional Lands Association (ATLA), the local communities of Copley, Leigh Creek, Nepabunna, Iga Warta and Hawker, Flinders Power, regulatory agencies, industry groups and environmental organisations.

LCK has been undertaking stakeholder engagement from the inception of the Leigh Creek Energy Project (project) and is committed to informing stakeholder throughout the project lifecycle. Early engagement centred around the PCD plant and has evolved into future explorations programs (geophysical and drilling) for a commercial ISG facility.

The consultation undertaken by LCK for this EIR and supporting SEO (LCK 2018) involved circulation of the draft documents for comment along with face-to-face sessions in the townships of Copley and Leigh Creek. Comments and questions received from stakeholders from the project's inception and during the November / December 2018 consultation sessions in Copley and Leigh Creek can be found below in Section 7.2.

LCK disseminated this EIR and supporting SEO (LCK 2018) as drafts to key stakeholders on Friday 23 November 2018 and afforded a 20-business day window to make comment on the documents. Review of any comments were then fed into the final documents prior to formal submission to the Department of Mining and Energy (DEM). Key stakeholders who were sent the draft documents included:

- ATLA
- Outback Communities Authority (OCA)
- Leigh Creek Community Progress Association
- Copley and Districts Progress Association
- Surrounding pastoral properties
- Regional Development Australia (RDA) Far North
- Natural Resources SA Arid Lands
- North Flinders NRM Group

- Department for Energy and Mining (DEM)
- Environment Protection Authority (EPA)
- Department of Environment and Water (DEW)
- Aboriginal Affairs and Reconciliation (AAR)
- Department of Planning, Transport and Infrastructure (DPTI)
- Safework SA
- SA Health

ATLA requested further time to provide feedback and comments on the draft documentation. Out of respect and in good faith, LCK supported additional time for ATLA to submit their comments and feedback.

In addition to the targeted consultation on the proposed geophysical activities in relation to this document and supporting SEO, Table 7-1 identifies the key stakeholders engaged with since the commencement of the project and highlights the activities undertaken with each stakeholder.

Table 7-1: Summary of stakeholder consultation for the project

Stakeholder Category	Stakeholder	Activities undertaken
Traditional Owners	Adnyamathanha Traditional Lands Association (ATLA)	Email communications, project updates, presentations and workshops. Execution of a Work Area Clearance Agreement (WACA) occurred in September 2016 as part of LCK consultations with ATLA.
Community	Aroona Council	Email communications and project updates
	Blinman	Project updates
	Copley	Email communications, information sessions and project updates
	Farina	Project updates
	Hawker	Information sessions and project updates
	Iga Warta	Project updates
	Leigh Creek	Email communications, information sessions and project updates
	Lyndhurst	Project updates
	Nepabunna	Project updates
Progress Associations	Parachilna	Project updates
	Blinman Progress Association	Project updates
	Copley and Districts Progress Association	Email communications and project updates
	Leigh Creek Community Progress Association	Email communications and project updates
Landholders	Lyndhurst Progress Association	Project updates
	Flinders Power	Project updates, meetings, FP morning meetings
Pastoralists	Angepena Station	Email communications and project updates

Stakeholder Category	Stakeholder	Activities undertaken
	Beltana Station	Email communications and project updates
	Depot Springs Station	Email communications and project updates
	Farina Station	Email communications and project updates
	Leigh Creek Station	Email communications and project updates
	Maynards Well Station	Email communications and project updates
	Mount Lyndhurst Station	Email communications and project updates
	Mt Serle Station	Email communications and project updates
	Myrtle Springs Station	Email communications and project updates
	North Moolooloo Station	Email communications and project updates
	Nilpena Station	Email communications and project updates
	Puttapa Station	Email communications and project updates
	Wilpoorinna Station	Email communications and project updates
Regional Councils	Flinders Ranges Council	Project updates
	Nepabunna Council	Project updates
	Outback Communities Authority	Email communications and project updates
	Port Augusta Council	Email communications and project updates
	Whyalla Council	Project updates
Government Departments and Bodies	Aboriginal Affairs and Reconciliation	Email communications
	Department of Energy and Mining – Energy Resources Division	Meetings, project updates and email communications
	Department of Energy and Mining – Minerals Division	Project updates and email communications
	Department of Environment and Water	Email communications
	Department of Planning Transport and Infrastructure	Email communications
	Environment Protection Authority	Email communications
	Leigh Creek Taskforce	Meetings and email communications
	Natural Resources Management (NRM) Board	Board briefings, meetings and email communications
	NRM – Far North Flinders Group	Project updates and email communications

Stakeholder Category	Stakeholder	Activities undertaken
	Pastoral Board	Meetings and project updates
	Regional Development Australia Far North	Meetings, project updates and email communications
	Regional Development Australia Mid North	Meetings and project updates
	Regional Development Australia Whyalla and Eyre Peninsula	Meetings and project updates
	Safework SA	Project updates and email communications
	SA Health	Email communications
	Upper Spencer Gulf and Outback Taskforce	Meetings, project updates, email communications
Non-Government Organizations	Conservation Council SA	Project briefings
	Global Maintenance Upper Spencer Gulf	Project updates
	Friends of the Vulkathunha - Gammon Ranges	Project updates
	Nature Foundation SA	Project briefings
	Wilderness Society	Project briefings

7.2 Stakeholder Feedback

LCK submitted draft copies of the EIR and SEO to the ATLA and had targeted consultations with the local communities of Copley and Leigh Creek in November/December 2018. Table 7-2 identifies the key stakeholder issues raised over the life of the project and indicates the sections of the EIR which relate to proposed geophysical activities. It has been amended to include further comments that arose from the November/December 2018 consultation sessions in Copley and Leigh Creek as well as questions received from other stakeholders via email and the online portal.

Table 7-2: Responses to stakeholder questions regarding proposed geophysical activities

Comment	Where covered in EIR	Summary of Response
What land disturbance will be required for the geophysical surveys?	Section 3.2, 3.9, 5.2.1	Minimal. The area is relatively flat, and the vehicles are all terrain. Some slashing of grass maybe required for the personal safety of the workers. No trees will be disturbed. For steep erosion gullies, some earthworks will be required for safe vehicle and personnel access,
What will happen if an aboriginal site or objects are located during the geophysical survey?	Section 3.2	Although the site of the geophysical surveys is within and around an old coal mine and the area is heavily disturbed, all personnel conducting the geophysical survey will be inducted on cultural heritage and will be instructed to report any suspected sites or objects. If any sites or objects are discovered, the site will be flagged for inspection and detoured around. In addition, LCK has sought the participation of ATLA to undertake a WAC over the area, however we are yet to receive feedback from ATLA to this initial December 2018 (and subsequent) request. LCK entered into a Work Area Clearance Agreement (WACA) in September 2016 and on this basis LCK continues to seek ATLA's participation in the requested WAC to

Comment	Where covered in EIR	Summary of Response
		provide a further level of confidence that sites or objects, should they exist in the area, are protected.
Will it affect surface water?	N/A	Surface water will not be affected. The geophysical survey does not use any chemicals. Surface water drainage patterns will not be affected by the access track or line preparation construction works. Spill response procedures are in place to prevent any fuel spills.
How does the seismic work?	Section 3.1	The seismic survey works by vibrating the ground using a vibrator truck. These vibrations travel through the rock and bounce off the different rock layers and travel back to the ground surface, where the slight vibrations are picked up by the sensitive geophones.
Why are you doing seismic surveys?	Section 3	There is a lack of geological data beneath the ground surface on PEL 650. The seismic survey gives a good approximation of where the coal seams are and where the faults are. Once we get the approximate location, we can then target the drilling for that area, to avoid any unnecessary drilling.
Are the geophysical surveys related to the PCD project?	N/A	No. The geophysical surveys are designed to allow us to collect more data on the geology beneath the ground surface within PEL 650 and help us to better determine where exploration drilling will need to be targeted for the design of any future gasifiers.
Are the seismic surveys loud and will they be felt in town?	N/A	As the seismic surveys will be using a vibrator truck, the noise levels are not loud enough to require the operators to wear hearing protection. The vibrations are quickly absorbed by the ground and cannot be heard or felt by people further than 200m from the vibrator truck.
Will the seismic survey affect the ground or the ground water or the native animals?	Section 4.11, 5.3 & 5.5	The vibrations will not affect the ground or the groundwater, due to the low levels of vibrations. The ground vibrations will not be felt by any animals further than 200m from the vibrator truck. Fish and aquatic life in nearby dams will not be affected by the vibrations.
Will explosives be used in the seismic survey?	N/A	There is no plan to use explosives in the seismic survey. The vibrator trucks will be enough to generate an acoustic signal for the survey. If explosives are to be used in later seismic surveys, then a separate EIR and SEO will be created for approval.
What about earthquakes?	N/A	The vibrations are too low level to affect the ground or faults. There is no evidence of seismic surveys ever causing earthquakes.
Where will the people doing the seismic survey be living?	Section 3.9	The people conducting the seismic survey will be accommodated in Copley and/or Leigh Creek. If there is no adequate accommodation available, then they will setup a mobile camp in the old Leigh Creek coalmine.
How long will the seismic survey take?		The first seismic survey is expected to take 5 days to complete with another 2 days of survey work. Future seismic surveys could take up to 2 weeks to complete depending on the size of the area.
What other types of geophysical surveys are planned?	Section 3	At this stage, the only other type of geophysical survey that may occur in the near future is TSIM (Theil Surface Impedance Method). This involves dragging a shoe box size electronic instrument behind a person, which detects changes in the resistivity of the ground.

Comment	Where covered in EIR	Summary of Response
What affect will other types of geophysical surveys have on the environment?	Section 3.6	All other types of geophysical surveys (gravity, magnetic, TSIM, etc.) only require a person to walk across the ground surface with an electronic instrument which detects changes to the magnetic field, gravity, resistivity, etc. The only preparation for these surveys would be the slashing of any tall grass for the safety of the person conducting the survey (i.e. from snakes).
What are the employment opportunities?	N/A	Short term contracts for the geophysical surveys will be managed by the geophysical companies engaged to undertake the required works.
Are there any waste products?	Section 3.9	The geophysical surveys will only generate some domestic waste (e.g. food waste, paper, etc.).
Where does any waste go?	Section 3.9, 5.2.3	All domestic waste will be taken to the Leigh Creek landfill. Any non-domestic waste will be taken offsite to a EPA licensed landfill
How come you are doing these surveys at Leigh Creek?	Section 1	The remaining resource at the Leigh Creek Coalfield is deep and no longer economic to mine using conventional methods. Due to the depth of the remaining coal, there is a lack of data on the geology at these depths. ISG technology is able to access the deep coal via a system of linked wells. Leigh Creek was chosen specifically using a series of environmental and technical criteria. The seismic survey allows us to determine the best locations of the future wells.
The document does not stipulate how many 2D lines are recorded, nor what the size is of the 3D survey, except stating “a three-dimensional view of the subsurface, beneath an area generally covering 1-25 km ² ” (p13, 3.1 Seismic survey method), which requires a surface footprint larger than 1-25km ² .	Section 1	A better understanding of the geology of PEL 650 is required, so various geophysical surveys (including seismic surveys) will be conducted over PEL 650 in the next few years. As there will be a series of small 2D and/or 3D seismic programs conducted over the next few years, it is not practical to determine the exact number of 2D seismic lines or the exact area of each 3D seismic survey. This will be determined by determining where the seismic surveys are required and what areas are to be excluded due to areas of heritage significance. The first 3D seismic survey planned for 2019 will cover a surface area of 1 km ² . The second 3D seismic survey will cover an area of less than 3 km ² . After these 2 seismic surveys are completed, future 2D and/or 3D seismic surveys are expected to cover areas less than 10 km ² for each seismic survey.
The Geophysical Ops EIR states (p31. 4.5 Existing Site contamination): “The Coffey Environments Pty Ltd report ‘The Detailed Site Investigation of the Leigh Creek Coal Mine (Lobe B)’ identified 14 areas of environmental concern including but not limited to former crusher refueling facility, Telford rail sliding fuel storage tanks, asbestos landfill, permanent and temporary refueling tanks, transformer graveyard, mining operations area, town landfill and explosive storage compounds.”	Section 4.5	This section of the EIR highlights the existing contaminated sites within the PEL 650 due to past mining activities. The activities from the Geophysical Operations will not add to the amount of contaminated areas within PEL 650.

Comment	Where covered in EIR	Summary of Response
It is unclear what the risks of these sites are or whether they align with the sites shown in figure 4-7 from AECOM 2016 (p. 32)		

7.3 Online Community Portal

LCK has introduced a targeted online community portal via the LCK website for interested stakeholders. Community members can easily login and share their experiences of the project, leave feedback, and locate or request information. The portal offers enhanced two-way communication where community users can track the progress of any requests they make and add reminders so that their questions are answered in a timely manner.

The site has been designed for ease of use and will be monitored by the Stakeholder Relations team. The Community Portal can be accessed through the LCK website's 'Contact us' section (www.lcke.com.au/contact) and directly through <http://lcke.c3register.com/>.

In addition, a suite of educational materials about the company and the project have been developed for use in community engagement activities and more will be developed as questions are asked through the Community Portal and ongoing community meetings.

7.4 Formal Public Consultation

7.4.1 Outline of the Formal Public Consultation

The EIR and Draft SEO were submitted to DEM for assessment on 31 January 2019. After an assessment against the Petroleum and Geothermal Energy Act and Regulations, DEM classified the project as medium impact and invited public comments to the EIR and Draft SEO.

Copies of the EIR and Draft SEO were made available for members of the public to review and submit comments to DEM by 15th April 2019. DEM received 630 individual email submissions with a common response generated via an online 'campaign' using the *Do Gooder* website platform.

In addition to the online campaign responses, there were nine unique submissions from the public in response to DEM's invitation for public comments and 14 video submissions. Note that three of the nine unique submissions wished to remain confidential and did not want their submissions to be made public.

Appendix B.1 and B.2 present a summary of the public and government agency submissions and LCK responses respectively. Appendix C provides a summary of the submissions that includes the topics raised and the number of submissions that were raised for each of these topics.

Each submission has been reviewed by LCK, and questions, concerns, comments or suggestions about the proposed geophysical activities have been categorised into topics for response. The scope of the consultation on the EIR and SEO is the assessment of the potential environmental impacts of the proposed geophysical activities over PEL 650. Some submissions provided comments which did not relate to the proposed geophysical activities but were of a more general nature related to the overall project plans. LCK's responses for the purposes of this SEO/EIR have focused on those matters directly raised in relation to the proposed scope of the activities to be undertaken as part of this SEO/EIR request.

Section 7.4.2 provides a summary of LCK's response to the main topics raised in the submissions in relation to the proposed geophysical activities.

7.4.2 Summary of Main Topics Raised in Responses

7.4.2.1 General opposition

Submissions were received stating general opposition to underground coal gasification (UCG).

The concerns were in relation to;

- Potential impact to Aboriginal Heritage, including preference for the land that has been previously mined to be rehabilitated and to 'heal' for Aboriginal cultural purposes.
- Potential human health impacts associated with ISG
- Potential environmental impacts associated with ISG, including the potential emissions impact on climate change.
- The UCG/ISG industry and LCK's common executive member past association with Linc Energy.
- Potential environmental impacts of ISG on the Telford Basin and its impact on the Great Artesian Basin.

These concerns will be addressed in their entirety in the approval's documents (EIR and SEO) that relate to the commercial production of ISG. This EIR relates only to proposed exploration in relation to geophysical activities and is therefore considered outside of the scope of this EIR and SEO.

7.4.2.2 Weed management

A submission was received seeking assurance that no new weeds will be introduced into areas of disturbance. Section 5.5.1 of this assessment documents that LCK will implement a weed control plan in consultation with the relevant NRM officer, if required.

7.4.2.3 Biodiversity

A submission was received concerning the potential impact of the project on the Thick-billed Grasswren that is listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). During the operation of the PCD (EIR 2017) Leigh Creek Energy made a presentation to the Federal Department of the Environment and Energy in Canberra regarding a submission on the impact of the Thick-billed Grasswren. The feedback from the Federal Regulator was that the Department would not take any further action under the EPBC Act.

7.4.2.4 Geophysical survey and future approval decisions

A submission indicated that the scope needs to reference how the results of the geophysical surveys will inform future approval decisions.

The results of the geological survey will form part of a detailed geological assessment to confirm the expected geological conditions of the PEL 650 and any reporting requirements will be consistent with the requirements for exploration projects under the PGE Act.

7.4.2.5 Aboriginal heritage

Submissions were received which raised concerns regarding cultural impacts to Aboriginal Heritage. These concerns were regarding impact on cultural heritage specifically to 'Yurlu's coal', potential impacts on heritage sites within PEL650 and community health impacts (cancer, asthma and respiratory problems) to Aboriginal people in the surrounding townships of Copley and Leigh Creek.

As previously indicated in the EIR for the ISG Demonstration Plant (LCK 2017) LCK acknowledges the significance of the Leigh Creek area in the context of the Yurlu Ngukandanha *Muda*, and the suggested disturbance by cultural heritage custodians to the *Muda* from historical coal mining operations. LCK is committed to conducting its operations in accordance with the requirements of the *Aboriginal Heritage Act 1988* and will continue to engage with ATLA to build a co-operative and mutually beneficial relationship with the Traditional Owners of the region.

In order to address Aboriginal cultural heritage concerns regarding LCK's PEL 650 project, ATLA and LCK entered into a Work Area Clearance Agreement (WACA) in September 2016 to establish a clear mechanism for identifying and protecting, where possible, cultural heritage sites or objects, known or identified during work area clearances, or which are previously known to exist. The WACA was successfully implemented with ATLA's participation for previous SEO/EIR requests for activities within the PEL 650.

With regard to this current EIR/SEO request, LCK has sought the participation of ATLA under the previously executed WACA to undertake a work area clearance over the area in which activities are to be conducted. This request was initiated in December 2018, with further discussions and requests to complete the WACA in January 2019. Further to this, additional correspondence providing an overall project update and again seeking ATLA's support to undertake a work area clearance has been provided to ATLA in October 2019. To date, LCK is yet to receive any formal response to the requests made, however LCK will continue to actively seek the participation of ATLA in this regard while working within the conditions of the agreed WACA.

Concerns were also raised concerning health impacts. LCK is committed to complying with all applicable laws and regulations regarding public health and safety including but not limited to the *South Australian Public Health Act 2011* and South Australia Public Health (Wastewater) Regulations 2013.

Specifically, ATLA's submission raised concerns regarding;

- the "moderate" risk for handling and storing fuel, chemicals and waste. The assessment of the risks relating to the handling and storing fuel, chemicals and waste is discussed in Sections 5.2.2, 5.2.3 and 5.5.2 and Table 5-1 of this EIR. As noted in this assessment, the impacts relating to the handling and storing fuel, chemicals and waste is moderate to minor without implementing the proposed key management measures. Consequently, with the implementation of the key management measures the level of risk has been assessed as low.
- that the term "clearance" is ambiguous, and therefore the risk assessment provided in the Draft Environmental Documents should not be relied on. LCK notes in Table 5-1 of this assessment that the term 'clearance' is sometimes used in the conduct of Aboriginal heritage surveys although the term 'clearance' is not in the *Aboriginal Heritage Act 1998* and therefore has no legal standing under the Act. As indicated in Section 4.2 and 5.1 of this EIR LCK has previously signed a Work Area Clearance Agreement (WACA) with the ATLA and will work within the confines of this Agreement for the proposed works within nominated areas of the PEL650.
- that the EIR lacks appropriate details in respect of the risk to native fauna, how many 2D lines are recorded, and the size of the 3D survey. Measures regarding the protection of native fauna is discussed in sections 5.5.5 and Table 5-1 of this assessment. Regarding the details on how many 2D lines are recorded, and the size of the 3D survey this has been addressed in Table 7-2 of this assessment.
- that the risk of known contaminated sites is unclear. The activities from the Geophysical Operations will not add to the amount of contaminated areas within PEL 650 and this has been addressed in Table 7-2 of this assessment.

7.4.2.6 Cultural Heritage Procedure

One submission received referred to the LCK Cultural Heritage Discovery Procedure referenced in this assessment. This should have read *Cultural Heritage Policy*. The mistake has been noted and the amendment made.

LCK is committed to the recognition and protection of places of cultural heritage as outlined by the International Council on Monuments and Sites (“the Burra Charter”). LCK recognises cultural heritage significance as aesthetic, historic, scientific, social or spiritual value for past, present or future generations. LCK will achieve this by maintaining an effective and robust Cultural Heritage Management Plan developed with traditional land owners that will further enforce the WACA that LCK has entered with ATLA as a risk mitigation approach to ensure the protection of cultural heritage within PEL 650. Additional risk mitigation approaches, including engaging an external expert to assess cultural heritage matters associated with the designated work areas will also be considered by LCK, should the need arise.

7.4.2.7 Training and induction – Cultural Heritage

A submission was received regarding training and induction on cultural heritage issues. All LCK staff and contractors undergo an online training and induction regarding Aboriginal cultural heritage and the importance of remaining within designated / approved areas. These requirements are covered in Table 5-1 of this assessment.

7.5 Government Agency Submissions

As part of the formal consultation process, copies of the EIR and SEO were provided by DEM to the following South Australian government agencies:

- Department for Environment and Water (DEW)
- Environment Protection Authority (EPA)
- Department of Planning, Transport and Infrastructure (DPTI)
- Department of the Premier and Cabinet - Aboriginal Affairs and Reconciliation (AAR)
- SA Health: Department for Health and Wellbeing
- Primary Industries and Regions South Australia (PIRSA)
- Natural Resources SA Arid Lands (NR SAAL)
- Outback Communities Authority (OCA).

DEM received five submissions from EPA, OCA, AAR, DEW and SA Health. The feedback and comments raised by these agencies, and the responses provided by LCK, have been incorporated into Appendix B.2 of this EIR.

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9 Abbreviations and Glossary

Adelaide Geosyncline	A major central South Australian geological province that extends from the northern parts of the Flinders Ranges to Kangaroo Island and includes the Mount Lofty Ranges. The sedimentary rocks were primarily deposited in the Neoproterozoic era. Lithology includes siltstone, shale and limestone.
Aquifer	Geologic materials with high hydraulic conductivity that are able to receive, store and transmit groundwater in quantities sufficient for use as a water supply.
Aquitard	Geologic materials with low hydraulic conductivity that are able to receive and store groundwater but cannot transmit the groundwater in quantities sufficient for use as a water supply.
ASX	Australian Securities Exchange. Prior to December 2006 it was known as the Australian Stock Exchange.
ATLA	Adnyamathanha Traditional Lands Association
BOM	Bureau of Meteorology.
Contamination	Contamination means the condition of land or water where any chemical substance or waste has been added as a direct or indirect result of human activity at above background level and represents, or potentially represents, an adverse health or environmental impact.
DEE	Department of Environment and Energy.
DEH	Department of Environment and Heritage (SA) (now DEWNR).
DEM	Department of Energy and Mining.
DEWNR	Department of Environment, Water and Natural Resources (SA).
DSD	Department of State Development.
EIR	Environmental Impact Report.
EMP	Environmental Management Plan.
EPA	Environment Protection Authority (SA).
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth).</i>
EPP	<i>Environment Protection (Air Quality) Policy 2016</i> ground level concentrations (GLCs)
Ephemeral	Existing for only a short time, often dependent upon climatic influences.
ETSA	Electricity Trust of South Australia.
Gasification	Process that converts coal into gas, principally carbon dioxide, hydrogen and carbon monoxide.
GLC	Ground level concentrations.
GSEL	Gas storage exploration licence.
IBRA	Interim Biogeographic Regionalisation for Australia.
<i>In situ</i>	In position.
ISG	<i>In situ</i> gasification. In situ (underground) conversion of coal into an energy-rich product gas.
Independent Scientific Panel	Independent Scientific Panel for Underground Coal Gasification, established in Queensland in 2013, to review and report on outcomes of UCG trial activities in Queensland.
Jurassic	Relating to the period of geological time approximately 205 to 141 million years ago.
LCEP	Leigh Creek Energy Project.
LCK	Leigh Creek Energy Ltd.
Mesozoic	Relating to the era of geological time including Triassic, Jurassic and Cretaceous ages, approximately 250-65 million years ago.
Neoproterozoic	Relating to the era of geological time 1000-545 million years ago, which precedes the Palaeozoic era.

NEPM	<i>National Environment Protection (Assessment of Site Contamination) Measure (1999)</i> amended in 2013.
OCA	Outback Communities Authority.
Overburden	Rock or soil overlying a mineral deposit which would need to be removed for the deposit to be mined.
PEL	Petroleum Exploration Licence.
PELA	Petroleum Exploration Licence Application.
Quaternary	Relating to the period of time approximately 1.8 million years ago to the present.
Receptor	A person, animal, plant, ecosystem, property or water with the potential to be adversely affected or impacted by an activity
SAAL NRM Board	South Australian Arid Lands Natural Resources Management Board.
SEO	Statement of Environmental Objectives.
SIL	Safety Integrity Level.
Syngas	Synthesis gas. The product of gasification composed mainly of carbon dioxide, hydrogen, carbon monoxide, methane, nitrogen, steam and gaseous hydrocarbons.
Triassic	Relating to the period of geological time approximately 251 to 205 million years ago.
UCG	Underground coal gasification. UCG is equivalent to ISG.
WACA	Work Area Clearance Agreement
WoNS	Weeds of National Significance

Appendix A: Flora and Fauna Information

Table A-1: Plant species recorded on site, as well as previously recorded from the PEL650 (T&M Ecologists, 2018)

Name	Common Name	*Conservation Status			Vegetation Community						
		EPBC	NPWSA	OU	1. Red Gum woodland creekline	2. Red Gum open woodland on rocky outcrops	3. Acacia victoriae shrubland	4. Nitraria billardieri open shrubland	5a. Maireana spp. low shrubland	5b. Maireana spp. low shrubland	6. Samphire low shrubland
<i>Abutilon leucopetalum</i>	Desert Lantern-bush					1	T			N	
<i>Abutilon malvaefolium</i>	Scrambling Lantern-bush			NT			X				
<i>Acacia aneura</i> var. <i>aneura</i>	Mulga										
<i>Acacia beckleri</i> ssp. <i>beckleri</i>	Beckler's Rock Wattle										
<i>Acacia beckleri</i> ssp. <i>megaspherica</i>	Beckler's Rock Wattle										
<i>Acacia brachystachya</i>	Turpentine Mulga										
<i>Acacia georginae</i>	Georgina Gidgee		RA	RA							
<i>Acacia oswaldii</i>	Umbrella Wattle										
<i>Acacia rigens</i>	Nealie			RA							
<i>Acacia salicina</i>	Willow Wattle										
<i>Acacia tetragonophylla</i>	Dead Finish					N				E	
<i>Acacia victoriae</i> ssp. <i>victoriae</i>	Elegant Wattle				1	N	O/2	E	E	E	
<i>Alectryon oleifolius</i> ssp. <i>canescens</i>	Bullock Bush									X	
<i>Amyema miraculosa</i> ssp. <i>boormanii</i>	Fleshy Mistletoe			NT							
<i>Amyema preissii</i>	Wire-leaf Mistletoe									X	

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<i>Arabidella trisecta</i>	Shrubby Cress										
<i>Aristida nitidula</i>	Brush Three-awn			NT	N	T				N	
<i>Atriplex angulata</i>	Fan Saltbush										
<i>Atriplex eardleyae</i>	Eardley's Saltbush										
<i>Atriplex fissivalvis</i>	Gibber Saltbush										
<i>Atriplex holocarpa</i>	Pop Saltbush					T					
<i>Atriplex lindleyi ssp. conduplicata</i>	Baldoo										
<i>Atriplex lindleyi ssp. lindleyi</i>	Baldoo					1		1/U			
<i>Atriplex lindleyi ssp. quadripartita</i>	Baldoo			NT							
<i>Atriplex nummularia ssp. nummularia</i>	Old-man Saltbush					N					
<i>Atriplex obconica</i>				NT							
<i>Atriplex suberecta</i>	Lagoon Saltbush			NT							
<i>Atriplex vesicaria</i>	Bladder Saltbush				N		N	2/U	1/O	1/O	
<i>Austrostipa nitida</i>	Balcarra Spear-grass				X					X	
<i>Austrostipa sp.</i>						T	N		T	N	
<i>Boerhavia dominii</i>	Tar-vine				N	T	T			T	
<i>Brachyscome ciliaris var. ciliaris</i>	Variable Daisy				T	1	T	N	T	T	

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		EPBC	NPWSA	OU	1. Red Gum woodland creekline	2. Red Gum open woodland on rocky outcrops	3. Acacia victoriae shrubland	4. Nitraria billardieri open shrubland	5a. Maireana spp. low shrubland	5b. Maireana spp. low shrubland	6. Samphire low shrubland
<i>Brachyscome ciliaris</i> var. <i>lanuginosa</i>	Woolly Variable Daisy									X	
<i>Brachyscome dichromosomatica</i> var. <i>dichromosomatica</i>	Large Hard-head Daisy			RA							
<i>Brachyscome lineariloba</i>	Hard-head Daisy										
<i>Carpobrotus rossii</i>	Native Pigface								N		
<i>Casuarina pauper</i>	Black Oak								X		
<i>Chenopodium curvispicatum</i>	Cottony Goosefoot			NT	N					T	
<i>Chenopodium desertorum</i> ssp. <i>microphyllum</i>	Small-leaf Goosefoot			NT							
<i>Chenopodium nitriaceum</i>	Nitre Goosefoot						N	1		1	
<i>Convolvulus eyreanus</i>	Silver Bindweed										
<i>Convolvulus recurvatus</i> ssp. <i>nullarborensis</i>				RA							
<i>Convolvulus remotus</i>	Grassy Bindweed				N				N	X	
<i>Cullen australasicum</i>	Tall Scurf-pea										
<i>Cymbopogon ambiguus</i>	Lemon-grass			NT	1	1	1			N	
<i>Cynanchum viminalis</i> ssp. <i>australe</i>	Caustic Bush			?							
<i>Cyperus gymnocaulos</i>	Spiny Flat-sedge					1/U					2/O

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<i>Digitaria brownii</i>	Cotton Panic-grass								X		
<i>Dissocarpus biflorus</i> var. <i>biflorus</i>	Two-horn Saltbush										
<i>Dissocarpus paradoxus</i>	Ball Bindyi									N	
<i>Dodonaea microzyga</i> var. <i>microzyga</i>	Brilliant Hop-bush			NT					T		
<i>Dodonaea viscosa</i> ssp. <i>angustissima</i>	Narrow-leaf Hop-bush										
<i>Duma florulenta</i>	Lignum										
<i>Dysphania melanocarpa</i>	Black-fruit Goosefoot						X				
<i>Einadia nutans</i> ssp. <i>nutans</i>	Climbing Saltbush			NT		N	N				
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush				1	1	N	T			
<i>Enneapogon avenaceus</i>	Common Bottle-washers					1		N	T	T	
<i>Enneapogon cylindricus</i>	Jointed Bottle-washers				N					N	
<i>Enneapogon polyphyllus</i>	Leafy Bottle-washers										
<i>Enteropogon acicularis</i>	Umbrella Grass			NT					N		
<i>Eragrostis infecunda</i>	Barren Cane-grass		RA	VU	1						
<i>Eremophila alternifolia</i>	Narrow-leaf Emubush			NT	N						
<i>Eremophila duttonii</i>	Harlequin Emubush			NT							

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<i>Eremophila freelingii</i>	Rock Emubush						X		E		
<i>Eremophila longifolia</i>	Weeping Emubush				N						
<i>Eremophila maculata ssp. maculata</i>	Spotted Emubush			NT	N						
<i>Eremophila oppositifolia ssp. oppositifolia</i>	Opposite-leaved Emubush			NT							
<i>Eriachne mucronata</i>	Mountain Wanderrrie			NT							
<i>Eriochiton sclerolaenoides</i>	Woolly-fruit Bluebush									N	
<i>Erodium carolinianum</i>	Clammy Heron's-bill										
<i>Eucalyptus camaldulensis ssp. arida</i>	Northern River Red Gum			NT	2/O	1/O					
<i>Eucalyptus camaldulensis ssp. minima</i>	River Red Gum			NT							
<i>Eucalyptus intertexta</i>	Gum-barked Coolibah			RA							
<i>Eucalyptus socialis ssp. socialis</i>	Beaked Red Mallee										
<i>Euphorbia drummondii s.str.</i>					N					N	
<i>Euphorbia multifaria</i>											
<i>Euphorbia tannensis ssp. eremophila</i>	Desert Spurge								T		
<i>Frankenia serpyllifolia</i>	Thyme Sea-heath										
<i>Frankenia subteres</i>			RA	NT	T	T					

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<i>Glinus lotoides</i>	Hairy Carpet-weed										
<i>Gnephosis arachnoidea</i>	Spidery Button-flower										
<i>Goodenia fascicularis</i>	Silky Goodenia									N	
<i>Grevillea nematophylla</i> ssp. <i>nematophylla</i>	Water Bush										
<i>Gunniopsis kochii</i>	Koch's Pigface			NT							
<i>Gunniopsis papillata</i>	Twin-leaf Pigface										
<i>Gunniopsis tenuifolia</i>	Narrow-leaf Pigface			RA							
<i>Hakea leucoptera</i> ssp. <i>leucoptera</i>	Silver Needlewood										
<i>Ixiochlamys cuneifolia</i>	Silverton Daisy			NT			X				
<i>Juncus kraussii</i>	Sea Rush			NT							
<i>Lawrenzia glomerata</i>	Clustered Lawrenzia										
<i>Leiocarpa websteri</i>	Narrow Plover-daisy						X				
<i>Lepidium phlebopetalum</i>	Veined Peppergrass										
<i>Lotus cruentus</i>	Red-flower Lotus										
<i>Lysiana exocarpi</i> ssp. <i>exocarpi</i>	Harlequin Mistletoe					N	N		N		
<i>Maireana aphylla</i>	Cotton-bush						N	N			

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<i>Maireana appressa</i>	Pale-fruit Bluebush										
<i>Maireana astrotricha</i>	Low Bluebush					1	N	1	2/O3	2/O	
<i>Maireana brevifolia</i>	Short-leaf Bluebush			NT	T	T	T	1/U	N		
<i>Maireana campanulata</i>	Bell-fruit Bluebush			NT						1	
<i>Maireana eriantha</i>	Woolly Bluebush										
<i>Maireana pentatropis</i>	Erect Mallee Bluebush			NT		T			1		
<i>Maireana pyramidata</i>	Black Bluebush							T		X	
<i>Maireana radiata</i>	Radiate Bluebush			NT							
<i>Maireana sedifolia</i>	Bluebush			NT					T		
<i>Maireana spongiocarpa</i>	Spongy-fruit Bluebush										
<i>Maireana trichoptera</i>	Hairy-fruit Bluebush			NT						X	
<i>Malvastrum americanum var. americanum</i>	Malvastrum				1	1	T		T	T	
<i>Marsdenia australis</i>	Native Pear			NT						N	
<i>Melaleuca glomerata</i>	Inland Paper-bark			RA	N	T					
<i>Menkea crassa</i>	Fat Spectacles			NT							
<i>Minuria annua</i>	Annual Minuria			NT							

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<i>Minuria cunninghamii</i>	Bush Minuria					N		N	N	T	
<i>Myoporum montanum</i>	Native Myrtle			NT	1/U	1/U	3/U	E	E	E	E
<i>Myoporum platycarpum ssp. platycarpum</i>	False Sandalwood			NT							
<i>Nitraria billardieri</i>	Nitre-bush				N			2/O	N		
<i>Orobanche cernua var. australiana</i>	Australian Broomrape		RA	NT							
<i>Osteocarpum acropterum var. acropterum</i>	Tuberculate Bonefruit										
<i>Osteocarpum dipterocarpum</i>	Two-wing Bonefruit										
<i>Osteocarpum salsuginosum</i>	Inland Bonefruit			RA				N			T
<i>Oxalis perennans</i>	Native Sorrel			NT			X				
<i>Petalostylis labicheoides</i>	Butterfly Bush			NT	N						
<i>Pimelea microcephala ssp. microcephala</i>	Shrubby Riceflower			NT	N		N		N		
<i>Pittosporum angustifolium</i>	Native Apricot				N		2/O		E		
<i>Plantago drummondii</i>	Dark Plantain										
<i>Pluchea dentex</i>	Bowl Daisy			NT							
<i>Polycalymma stuartii</i>	Poached-egg Daisy										

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<i>Pseudognaphalium luteoalbum</i>	Jersey Cudweed										T
<i>Pterocaulon sphacelatum</i>	Apple-bush				T	1	T			N	
<i>Ptilotus disparilis</i>	Small-leaf Mulla Mulla			VU							
<i>Ptilotus obovatus</i>					T	T			1	T	
<i>Pycnosorus pleiocephalus</i>	Soft Billy-buttons										
<i>Rhagodia spinescens</i>	Spiny Saltbush					T1	1/U		N		
<i>Rhodanthe corymbiflora</i>	Paper Everlasting			NT							
<i>Rhodanthe microglossa</i>	Clustered Everlasting										
<i>Rytidosperma sp.</i>									T		
<i>Salsola australis</i>	Buckbush									N	
<i>Santalum lanceolatum</i>	Plumbush				N		3/O			N	
<i>Santalum spicatum</i>	Sandalwood		VU	NT							
<i>Sarcozona praecox</i>	Sarcozona			NT							
<i>Scaevola spinescens</i>	Spiny Fanflower								X		
<i>Sclerolaena bicornis var. bicornis</i>	Goat-head Bindyi										
<i>Sclerolaena brachyptera</i>	Short-wing Bindyi								1	1/U	
<i>Sclerolaena constricta</i>											

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<i>Sclerolaena cuneata</i>	Tangled Bindyi					1					
<i>Sclerolaena decurrens</i>	Green Bindyi									X	
<i>Sclerolaena diacantha</i>	Grey Bindyi									X	
<i>Sclerolaena divaricata</i>	Tangled Bindyi								1		
<i>Sclerolaena limbata</i>	Pearl Bindyi										
<i>Sclerolaena longicuspis</i>	Long-spine Bindyi						T	1		1/U	
<i>Sclerolaena obliquicuspis</i>	Oblique-spined Bindyi					1	1		1/U	T	
<i>Sclerolaena parallelicuspis</i>	Western Bindyi										
<i>Sclerolaena patenticuspis</i>	Spear-fruit Bindyi					N					
<i>Sclerolaena tatei</i>	Tate's Bindyi			NT							
<i>Sclerolaena tricuspis</i>	Three-spine Bindyi			NT						T/U	
<i>Sclerolaena ventricosa</i>	Salt Bindyi										
<i>Senecio cunninghamii</i> var. <i>cunninghamii</i>	Shrubby Groundsel				T		N	N	N	N	
<i>Senecio lanibracteus</i>	Inland Shrubby Groundsel										
<i>Senecio magnificus</i>	Showy Groundsel									N	
<i>Senecio runcinifolius</i>	Thistle-leaf Groundsel			RA							

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<i>Senna artemisioides ssp. artemisioides</i>	Silver Senna				T		T		E		
<i>Senna artemisioides ssp. coriacea</i>	Broad-leaf Desert Senna								E	X	
<i>Senna artemisioides ssp. petiolaris</i>							N		E		
<i>Senna cardiosperma ssp. gawlerensis</i>	Gawler Ranges Senna			NT						E	
<i>Senna phyllodinea</i>											
<i>Sida fibulifera</i>	Pin Sida				T	T			T	1/U	
<i>Sida intricata</i>	Twiggy Sida					T	T				
<i>Sida petrophila</i>	Rock Sida			NT		1					
<i>Sida trichopoda</i>	High Sida										
<i>Sigesbeckia australiensis ssp. australiensis</i>	Australian Sigesbeckia										
<i>Solanum ellipticum</i>	Velvet Potato-bush					T		N		N	
<i>Solanum sturtianum</i>	Sturt's Nightshade			NT						X	
<i>Spergularia marina</i>	Salt Sand-spurrey			NT							
<i>Stemodia florulenta</i>	Bluerod										1
<i>Stenopetalum lineare</i>	Narrow Thread-petal										

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<i>Swainsona fissimontana</i>	Broken Hill Pea			RA						N	
<i>Swainsona stipularis</i>	Orange Swainson-pea			NT							
<i>Tecticornia disarticulata</i>				NT							
<i>Tecticornia indica ssp. leiostachya</i>	Brown-head Samphire			NT		2					3/O
<i>Tecticornia pergranulata ssp. divaricata</i>	Black-seed Samphire			NT							3/O
<i>Tecticornia sp.</i>								T	N		1
<i>Teucrium racemosum</i>	Grey Germander										
<i>Thyridia repens</i>	Creeping Monkey-flower										2
<i>Trichanthodium skirrophorum</i>	Woolly Yellow-heads										
<i>Tripogon loliformis</i>	Five-minute Grass										
<i>Vittadinia cuneata var. cuneata</i>	Fuzzy New Holland Daisy				N	1			N	T	
<i>Vittadinia sulcata</i>	Furrowed New Holland Daisy									X	
<i>Wahlenbergia communis</i>	Tufted Bluebell									N	
<i>Zygophyllum apiculatum</i>	Pointed Twinleaf			NT						N	
<i>Zygophyllum aurantiacum ssp. aurantiacum</i>	Shrubby Twinleaf							T	N		

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<i>Zygophyllum aurantiacum ssp. verticillatum</i>	Shrubby Twinleaf			NT							
<i>Zygophyllum confluens</i>	Forked Twinleaf			NT							
<i>Zygophyllum iodocarpum</i>	Violet Twinleaf			NT							
<i>Zygophyllum prismatothecum</i>	Square-fruit Twinleaf										

***Conservation Status**

EPBC = Environment Protection and Biodiversity Conservation Act 1999

NPWSA = Schedules of the National Parks and Wildlife Act 1972 accessed May 2016

OU = Gillam, S. and Urban, R. (2013) Species Risk Assessment Pilot Project Phase 1 Report: Regional Species Conservation Assessments, Outback Region. Department for Environment and Heritage, South Australia.

CR = Critically Endangered, EN = Endangered, VU = Vulnerable, RA = Rare, NT = Near Threatened

Vegetation Community Cover Abundance Codes (adapted from the Biological Survey of SA):

N = Not many (1-10 plants and <5%)

T = sparsely present; cover small (<5%)

1 = plentiful, but of small cover (<5%)

2 = any number of individuals covering 5-25% of area

3 = any number of individuals covering 25-50% of area

4 = any number of individuals covering 50-75% of area

5 = covering more than 75% of area

Dominant/Co-dominant species:

O = Overstorey

U = Understorey

E = Emergent

Table A-2: Rare or Threatened species potentially occurring within the PEL650 (T&M Ecologists, 2018)

Species	Status		Location / comment
	SA ¹	Cth ²	
Flora			
Australian Broomrape (<i>Orobanche cernua</i> var. <i>australiana</i>)	R		Record 4 km S of PEL (Mountain of Light mine), Record 15 km W of PEL (Mt Parry). Herb 15-45 cm, found in dry sandy creek beds.
Bentham's Goodenia (<i>Goodenia anfracta</i>)	R		Record 15 km N of PEL (N of Lyndhurst). Perennial herb, occurs in saline or sub-saline conditions.
Blackfruit Blue-bush (<i>Maireana melanocarpa</i>)	R		Record 8 km N of PEL (Punch's Rest), 18.5 km NE of PEL (Strzelecki Track). Perennial shrub found on sandy rises around salt lakes.
Bushy Peppergrass (<i>Lepidium pseudoruderale</i>)	R		Record (1883) 15 km W of PEL (Mt Parry). Rare annual or ephemeral herb species in semi-arid regions.
Eichler's Saltbush (<i>Atriplex eichleri</i>)	R		Record (1917) 12 km N of PEL (Lyndhurst). Small annual to 30 cm tall, usually on heavier soils and associated with drainage lines or floodplains.
Five-wing Bonefruit (<i>Osteocarpum pentapterum</i>)	E		Records 15 km W of PEL (Mt Parry). Small perennial shrub. Occurs in heavy soils subject to flooding.
Flinders Ranges Goodenia (<i>Goodenia saccata</i>)	R		Record 6.5 km SW of PEL (Aroona Dam). Shrub to 1 m. Found on stony slopes and creek beds in the Flinders Ranges.
<i>Frankenia cupularis</i>	R		Record 15 km N of PEL (N of Lyndhurst). Small sea-heath. Occurs in floodout areas in Lake Eyre region. Prefers saline to semi-saline soils subject to flooding.
<i>Frankenia plicata</i>	V	E	Predicted by EPBC database. Grows in a range of habitats, including on small hillside channels, which take the first run-off after rain (Leigh et al., 1985). Species is found in a wide range of vegetation communities that have good drainage (Neagle, 2002).
<i>Frankenia subteres</i>	R		Records in PEL 650 and north. Small shrub. Grows in rocky drainage lines in Lake Eyre, Flinders Ranges region.
Georgina Gidgee (<i>Acacia georginae</i>)	R		Record in PEL 650. Stocky, gnarled or spreading tree 2-7 m high with a dense crown. Most records in far north of SA (low open woodland) and Georgina Basin in Queensland.
<i>Atriplex morrisii</i>	V		Record 12 km N of PEL (Lyndhurst rail line). Branching annual forb. In good seasons may be found in small localised patches in various habitats including rocky hillsides.
Lee's Swainson-pea (<i>Swainsona leeana</i>)	R		Record 6.5 km SW of the PEL (Aroona Dam). A small prostrate annual or perennial to 10 cm. Found in the northern Flinders Ranges in South Australia in dry stony soil or clay-loam in tussock grassland, saltbush and mulga woodland.
Murray Swainson-pea <i>Swainsona murrayana</i>	V	V	Predicted by EPBC database. Prostrate, ascending to erect perennial herb. Often grows in heavy soils, especially depressions. Grey and brown heavy clay and clay loam soils in bladder saltbush, black box and grassland communities.
Sandalwood (<i>Santalum spicatum</i>)	V		Record in PEL 650, 8 km W of PEL; Leigh Creek township 6 km S of PEL. Shrub or small tree in woodland or shrubland. Found throughout the arid to semi-arid zone In E of range in SA occurs in clayey soils on stony hillsides and flats in gullies, and along watercourses.
Short-stem Daisy (<i>Brachyscome eriogona</i>)	R		Record 4 km S of PEL (Mountain of Light mine). Small ephemeral herb to 25 cm occurring on sandy clay soils to cracking clays in chenopod shrublands on gibber plains or herb lands in run-off or floodplain areas
Slender Bell-fruit (<i>Codonocarpus pyramidalis</i>)	E	V	Predicted by EPBC database. Record (1938) 12 km N of PEL (Lyndhurst); 24 km NW of PEL (1958). Small tree with scruffy drooping appearance and smooth grey-green bark. Occurs on sandy soils and stony rises and creek banks in the Flinders Ranges.
Wilga (<i>Geijera parviflora</i>)	R		Record at Leigh Creek township 6 km S of PEL. Shrub or small tree to 8 m. Usually occurs on areas with calcareous red clay loams, less common on alluvial soils and hillslopes with shallow soils.
Yellow Burr-daisy (<i>Calotis lappulacea</i>)	R		Record (1883) 15 km W of PEL (Mt Parry). Perennial herb or undershrub 20-50 cm. Occurs on loamy sand to clay loam red earths. Found in all mainland States.
Birds			
Australasian Darter (<i>Anhinga novaehollandiae</i>)	R		Found across most of mainland Australia. Inhabits lakes, rivers, swamps and estuaries.
Australian Painted Snipe (<i>Rostratula australis</i>)	V	E, Ma	Predicted by EPBC database. EPBC Act database predicts presence. Inhabits wetlands. No suitable habitat presence at the site.
Australasian Shoveler (<i>Anas rhynchotis</i>)	R		Records in PEL 650 (retention dam). Nomadic and dispersive across SE and SW Australia. Occurs in wetlands in good years.
Banded Stilt (<i>Cladorhynchus leucocephalus</i>)	V		Record in PEL 650 (retention dam). Nomadic and often in dense flocks. Occurs in fresh and saltwater marshes and large ephemeral lakes.
Bluebonnet (<i>Northiella haematogaster</i>)	R (ssp.)		Record 14 km W of PEL (Myrtle Springs homestead) Inhabits semi-arid woodlands. Naretha Bluebonnet <i>N. h. narethae</i> (which occurs in the Nullarbor region) is listed as Rare; this subspecies would not occur here.
Blue-billed Duck (<i>Oxyura australis</i>)	R		Records in PEL 650 (retention dam) and Aroona Dam. Occupies a range of wetlands, relatively sedentary.

Species	Status		Location / comment
	SA ¹	Cth ²	
Blue-winged Parrot (<i>Neophema chrysostoma</i>)	V		Record 11 km E of PEL. Usually seen in grasses in a wide variety of habitats, nests in hollows in eucalypt or stump.
Cattle Egret (<i>Ardea ibis</i>)	R	Ma, Mg	Predicted by EPBC database. Inhabits tropical and temperate grasslands, wooded lands and terrestrial wetland and uses shallow, open and fresh wetlands. Records in arid and semi-arid regions are rare.
Chestnut-backed Quailthrush (<i>Cinlosoma castanotum</i>)	R (ssp.)		Record 3 km SE of PEL (1900) at Woolly Bore and 19 km E (1925) at Depot Springs. Inhabits casuarina-cypress woodland, mallee woodland, sand-plain hummock grass fields. <i>C. c. castanotum</i> (which occurs in the Murray Mallee and Flinders Ranges) is listed as Rare.
Chestnut-breasted Whiteface (<i>Aphelocephala pectoralis</i>)	R		Records 12 km N of PEL (Lyndhurst), 13 km W of PEL (Myrtle Springs homestead) Inhabits stony plains.
Common Greenshank (<i>Tringa nebularia</i>)		Ma, Mg	Predicted by EPBC database. Several records in the Flinders Ranges. Migratory wader. Found in a wide variety of inland wetlands and lakes and sheltered coastal habitats.
Common Sandpiper (<i>Actitis hypoleucos</i>)	R	Ma, Mg	Records in PEL 650 (retention dam). Migratory wader. Widespread in small numbers and found along all coastlines of Australia and in many areas inland.
Elegant Parrot (<i>Neophema elegans</i>)	R		Multiple records in PEL 650 (retention dam) and region surrounding the PEL. Occurs in open country and semi-arid scrublands.
Fork-tailed Swift (<i>Apus pacificus</i>)		Ma, Mg	Predicted by EPBC database. Known to use many habitat types, including coastal, arid and urban areas, migrating across broad regions of Australia.
Freckled Duck (<i>Stictonetta naevosa</i>)	V		Records in PEL 650 (retention dam) Prefers heavily vegetated permanent freshwater swamps, moving to permanent open lakes during drought. Breeds in large swamps created by floods in Bulloo and Lake Eyre Basins.
Glossy Ibis (<i>Plegadis falcinellus</i>)	R		Record in PEL 650 (retention dam). Frequents swamps and lakes throughout much of the Australian mainland.
Great Crested Grebe (<i>Podiceps cristatus</i>)	R		Records in PEL 650 (retention dam). Found on fresh or saline waters such as lakes and lagoons.
Great Egret (<i>Ardea alba</i>)		Ma, Mg	Predicted by EPBC database. Occurs in all states/territories of mainland Australia and in Tasmania. Breeding colonies in Channel Country (NE SA and SW Qld).
Grey Wagtail (<i>Motacilla cinerea</i>)		Ma, Mg	Predicted by EPBC database. Included in international agreements but extremely uncommon migrant. Strong association with water, particularly rocky substrates along water courses but also lakes and marshes.
Hooded Robin (<i>Melanodryas cucullata</i>)	R (ssp.)		Record 3 km SW Leigh Creek. Found in Eucalypt woodland and mallee and Acacia shrubland. <i>M. c. cucullata</i> (which occurs in south-east SA to Port Augusta) is listed as Rare.
Musk Duck (<i>Biziura lobata</i>)	R		Records in PEL 650 (retention dam). Found in permanent swamps with dense vegetation from north-west Australia through the south and east to southern Queensland.
Night Parrot (<i>Pezoporus occidentalis</i>)	E	E	Predicted by EPBC database. Thought to inhabit <i>Triodia</i> grasslands and samphire and chenopod shrublands in arid and semi-arid Australia. Current distribution is possibly limited to western Queensland and the Pilbara but is poorly understood due to difficulty in detection and very limited numbers of sightings.
Painted Finch (<i>Emblema pictum</i>)	R		Record S of the PEL (1940). Occurs on spinifex covered stony hills and rocky landscapes across Northern and Central Australia.
Peregrine Falcon (<i>Falco peregrinus</i>)	R		Record in PEL 650 (retention dam). Inland and coastal areas, with a preference for heavily timbered and rugged mountainous country. Most of Australia, except central Australia, western SA and Tasmania.
Plains-wanderer (<i>Pedionomus torquatus</i>)	E	CE	Predicted by EPBC database. Inhabits sparse, treeless, lowland native grasslands with around 50% bare ground and occasionally in chenopod shrublands (Harrington et al. 1988).
Oriental Plover (<i>Charadrius veredus</i>)		Ma, Mg	Predicted by EPBC database. Known to occupy dry plains and semi-arid regions, highly mobile, migrating annually between Mongolia, China, and Australia. Prefers to forage among short grass or on hard stony bare ground (McCrie 1984, Close 1982).
Rainbow Bee-eater (<i>Merops ornatus</i>)		Ma, Mg	Predicted by EPBC database. Common migrant from September to April in woodland and timbered plains throughout Australia. Nests in sand banks or sloping sandy soil.
Restless Flycatcher (<i>Myiagra inquieta</i>)	R		Record W of the PEL (4 Mile Bore). Inhabits open forests and woodlands. Migrant or nomadic in much of its range.
Slender-billed Thornbill (<i>Acanthiza iredalei</i>)	R		Records in PEL 650 (1900, 1910). Inhabits chenopod and samphire shrublands and saline flats around salt lakes.
Thick-billed Grasswren (<i>Amytornis modestus</i>)		V	Predicted by EPBC database. Distributed in Northern Territory and catchments of Lake Frome and western Lake Eyre Basin in South Australia. Preferred habitat is chenopod shrublands dominated by <i>Atriplex</i> spp. and <i>Maireana</i> spp., generally on gibber or other hard soils.
Yellow Wagtail (<i>Motacilla flava</i>)		Ma, Mg	Predicted by EPBC database. Included in international agreements but extremely uncommon migrant. Mostly well-watered open grasslands and the fringes of wetlands.
Mammals			
Plains Rat (<i>Pseudomys australis</i>)	V	V	Predicted by EPBC database. Generally associated with low lying patches of deep cracking clay soils characteristic of drainage depressions and gilgais in stony plains and gentle slopes supporting sparse chenopod shrublands and other ephemeral vegetation after rain.

Species	Status		Location / comment
	SA ¹	Cth ²	
Yellow-footed Rock-wallaby (<i>Petrogale xanthopus xanthopus</i>)	V	V	Predicted by EPBC database. Inhabits rocky outcrops in semi-arid country, ranging from sandstones, limestones and conglomerates in the Flinders Ranges, to granites in the Gawler Ranges and Olary Hills (Copley & Alexander 1997)

1. *South Australian National Parks and Wildlife Act 1972* status: Endangered (E); Vulnerable (V); Rare (R). Subspecies (ssp) indicates that a subspecies is listed under the NPW Act but database records do not identify which subspecies was recorded.
2. *Environment Protection and Biodiversity Conservation Act 1999* status: Critically Endangered (CE), Endangered (E); Vulnerable (V); Rare (R), Listed Marine (M), Listed Migratory (Mg).

Database records within approximately 25 km of the PEL have been included in this table.

Appendix B.1: Public Submissions and Responses

#	Author	EIR/SEO Reference	Topic/ Issue	Issue/Comment Raised in Submission	Response
1	Dr Gerilyn McCarron	EIR section 7	Potential safety of underground coal gasification. Potential impacts to Aboriginal Heritage.	Poor safety record of underground coal gasification and its impact on groundwater and air emissions.	<p>This EIR and SEO relates to geophysical exploration activities and not to any potential ISG activities, which will be covered by a separate EIR/SEO.</p> <p>LCK acknowledges the significance of the Leigh Creek area in the context of the <i>Yurlu Ngukandanha Muda</i>, and the suggested disturbance by cultural heritage custodians to the <i>Muda</i> from historical coal mining operations.</p> <p>LCK is committed to conducting its operations in accordance with the requirements of the <i>Aboriginal Heritage Act 1988</i> and will continue to engage with ATLA to build a co-operative and mutually beneficial relationship with the Traditional Owners of the region. This includes following the agreed and executed WACA as a clear mechanism for identifying and protecting, where possible, cultural heritage sites or objects, known or identified during work area clearances, or which are previously known to exist. Additional risk mitigation measures will be considered by LCK, outside of the WACA, if deemed necessary to meet LCK's obligations under the Act.</p>
2	Gayle Mather	EIR Table 5-1 EIR section 4.2.1 EIR section 3.2.3 EIR section 2.2 EIR section 3.9	Potential impacts to Aboriginal Heritage. Potential health impacts.	Concern that aboriginal heritage sites may be missed and disturbed. Questions were raised on if there was a procedure and training in place and if suitably qualified personnel would be conducting the cultural heritage clearances.	<p>EIR Table 5-1 has LCK's has in place a Control Strategy for Cultural Heritage during line and access tracks preparation and vehicle movement.</p> <p>EIR Section 4.2.1 states that LCK has signed a Work Area Clearance Agreement (WACA) with the Adnyamathanha Traditional Lands Association and will work within the confines of this agreement for the proposed works within nominated areas of the PEL650, for the purpose of avoiding damage and disturbance to any Aboriginal site object or remains within those areas."</p> <p>EIR Section 3.2.3 states that "If a cultural heritage site is discovered during the access track/line preparation operation, then the site will be flagged, recorded and detoured around."</p> <p>LCK is committed to complying with all applicable laws and regulations regarding public health and safety including but not limited to the South Australian Public Health Act 2011 and South Australia Public Health (Wastewater) Regulations 2013.</p>
3	Hon. Mark Parnell		Greenhouse gas emissions Potential impacts to Aboriginal Heritage	Impact of the project on climate change and the Adnyamathanha people.	<p>The submission is noted.</p> <p>LCK notes that this EIR and SEO relates to geophysical exploration activities and not to any potential ISG activities, which will be covered by a separate EIR/SEO.</p>
4	Tim Kelly	EIR section 5.5.1	Weeds and Pests Future approval decisions	Spread of weeds and pests due to poor baseline and insufficient implementation of weed and pest control measures (i.e. wash down procedure). Scope needs to reference how the results of the geophysical surveys will inform future approval decisions.	<p>Section 5.5.1 of this assessment documents that LCK will implement a weed control plan in consultation with the relevant NRM officer, if required.</p> <p>The results of the geological survey will form part of a detailed geological assessment to confirm the expected geological conditions of the PEL 650 and any reporting requirements will be consistent with the requirements for exploration projects under the PGE Act.</p>

#	Author	EIR/SEO Reference	Topic/ Issue	Issue/Comment Raised in Submission	Response
5	Vince Coulthard/ATLA	EIR section 7.4.2.4 EIR section 7.4.2.5 EIR sections 4.2, 5.2.2, 5.2.3, 5.5.2 and 5.5.5. Table 5-1 Table 7-2	Potential impacts to Aboriginal Heritage Geophysical impacts	Aboriginal cultural heritage impacts. "Moderate" risk for handling and storing fuel, chemicals and waste. Interpretation of the term "clearance" is ambiguous. Risk to native fauna and number of 2D lines are recorded, and the size of the 3D survey. Risk of known contaminated sites is unclear.	As previously indicated in the EIR for the ISG Demonstration Plant (LCK 2017) LCK acknowledges the significance of the Leigh Creek area in the context of the <i>Yurlu Ngukandanha Muda</i> , and the suggested disturbance by cultural heritage custodians to the <i>Muda</i> from historical coal mining operations. LCK is committed to conducting its operations in accordance with the requirements of the Aboriginal Heritage Act 1988 and will continue to engage with ATLA to build a co-operative and mutually beneficial relationship with the Traditional Owners of the region including the agreed signed WACA to establish a clear mechanism for identifying and protecting, where possible, cultural heritage sites or objects, known or identified during work area clearances, or which are previously known to exist. Additional risk mitigation measures will be considered by LCK, outside of the WACA, if deemed necessary to meet LCK's obligations under the Act. The impacts relating to the handling and storing fuel, chemicals and waste is moderate to minor without implementing the proposed key management measures. Consequently, with the implementation of the key management measures the level of risk has been assessed as low. LCK notes in Table 5-1 of this assessment that the term 'clearance' is sometimes used in the conduct of Aboriginal heritage surveys although the term 'clearance' is not in the Aboriginal Heritage Act and therefore has no legal standing under the Act. As indicated in Section 4.2 and 5.1 of this EIR LCK has signed a Work Area Clearance Agreement (WACA) with the ATLA and will work within the confines of this agreement for the proposed works within nominated areas of the PEL 650 and the Aboriginal Heritage Act 1988. Additional risk mitigation measures will be considered by LCK, outside of the WACA, if deemed necessary to meet LCK's obligations under the Act. Measures regarding the protection of native fauna is discussed in sections 5.5.5 and Table 5-1 of this EIR. Regarding the details on how many 2D lines are recorded, and the size of the 3D survey this has been addressed in Table 7-2 of this EIR. On the risk of contaminated sites, the activities from the Geophysical Operations will not add to the amount of contaminated areas within PEL 650 and this has been addressed in Table 7-2 of this assessment.
6	Bob Ellis on behalf of the EDO NSW		Potential impacts to Cultural Heritage	The submission acknowledges that it is <i>the actions associated with gasification of the coal deposits which most directly pose a threat to the traditional cultural values of the Adnyamathanha and that future potential land use and landscape modification resulting from some of the matters listed may be the subject of a formal Work Area Clearance Assessment.</i> Bob Ellis indicates that he <i>has not sought to specify events associated with a proposed activity which may lead to adverse environmental consequences since he has no relevant expertise in exploration or seismic testing methodology.</i>	LCK acknowledges the submission and further notes that this EIR and SEO relates to geophysical exploration activities and not to any potential gasification activities, which will be covered by a separate EIR/SEO. Nevertheless, LCK is committed to conducting its operations in accordance with the requirements of the Aboriginal Heritage Act 1988 and will continue to engage with ATLA to build a co-operative and mutually beneficial relationship with the Traditional Owners of the region including the agreed signed WACA to establish a clear mechanism for identifying and protecting, where possible, cultural heritage sites or objects, known or identified during work area clearances, or which are previously known to exist. Additional risk mitigation measures will be considered by LCK, outside of the WACA, if deemed necessary to meet LCK's obligations under the Act.

#	Author	EIR/SEO Reference	Topic/ Issue	Issue/Comment Raised in Submission	Response
7	Campaign via <i>Do Gooder website</i> .		Potential impacts to Aboriginal Heritage. Impacts on Copley Dam. Air emissions.	The submissions stated opposition to ISG at Leigh Creek and the distress of the underground coal gasification to the Traditional Land Owners and the wider community. Copley is a unique wetland. Benzenes are known carcinogens.	LCK acknowledges these submissions and as outlined in Section 7 of the EIR, will continue to provide opportunities for engagement and communications for all stakeholders. LCK notes that this EIR and SEO relates to geophysical exploration activities and not to any potential ISG activities, which will be covered by a separate EIR/SEO. With regards to Copley dam and benzene, LCK notes that in situ gasification, either by exploration or production, is regulated by the PGE Act and Regulations, but is outside the scope of this EIR/SEO. LCK is committed to avoiding the contamination of surface water and groundwater resources while minimizing the disturbance to surface drainage patterns as highlighted in the Statement of Environmental Objectives #3.

Appendix B.2: Summary of Government Agency Submissions and Responses

#	Agency	EIR/SEO Reference	Topic/ Issue	Issue/Comment Raised in Submission	Response
EPA					
1	EPA	EIR Table 5-1	Environmental risk assessment	The EPA supports the key management measures that will be adopted under the EIR.	This is noted.
2	EPA	EIR section 3.9, Camp Sites and Associated Activities, para 5	Small and large surface land spills of fuel	In the event of small 'surface' land spills with limited vertical extent, in-situ chemical treatment or bioremediation may be acceptable but requires a treatment plan and subsequent verification to demonstrate that treatment has been successful. The EPAs preference is that the impacted soil is removed. Likewise, for larger spills, the impacted soil is removed and replaced with clean fill.	This is noted and has been included in section 3.9. Any uncontained spillage onto the ground surface will be removed and suitably disposed of at an EPA licenced facility. In the unfortunate event of a larger spill, a spill remediation approach will be adopted based on the volume and estimated horizontal and vertical impact. The impacted soil will then be removed to an EPA licensed facility and replaced with clean fill.
3	EPA	EIR Section 5.2.2, 'Spills or leaks of fuel or chemicals'	Environmental Impact assessment	Preventative actions, spill response and the treatment and disposal of impacted soil has been addressed adequately.	This is noted.
4	EPA	EIR Section 3.2.2. Access Tracks	Earthen bunding	The PEL 650 contains a network of earthen bunding that contributes to the long-term surface water management. Disturbance of these bunds will be avoided but, in the event, that any bunds are impacted they will be reprofiled/reinstated to their prior contours.	This is noted and has been included in section 3.2.2 the EIR.
5	EPA	SEO - Objective 2	Soil disturbance and contamination	Fuel, chemical and produced fluids storage and handling have been adequately addressed	This is noted.
6	EPA	SEO - Objective 3	Surface water contamination	Fuel, chemical and produced fluids storage and handling have been adequately addressed. Whilst an impact to groundwater is very unlikely, no reference was made to the protection of groundwater in this document.	This is noted. The SEO objective no.3 now reads 'Avoid contamination of surface water and groundwater resources and minimize disturbance to surface drainage patterns'.
7	EPA	SEO - Objective 8	Waste management hierarchy	Reference to the EPA Waste Hierarchy model has been noted.	This is noted.
8	EPA	SEO - Objective 2	Earthen bunding	The PEL 650 contains a network of earthen bunding that contributes to the long-term surface water management. Disturbance of these bunds will be avoided but, in the event, that any bunds are impacted they will be reprofiled/reinstated to their prior contours.	This is noted. A mitigation measure now includes a statement that reads 'Areas where there has been disturbance to earthen bunds will be reprofiled/reinstated to their prior contours'. This has also been included in the last row of the Goal Attainment Scaling Criteria Appendix A of the SEO.
OCA					
9	OCA	EIR section 3.9, Camp Sites and Associated Activities, para 3	Putrescible and recyclable wastes	We anticipate the licensed waste facility might be at Leigh Creek. Having regard to the time frame for the campsite and the number of inhabitants, we do not believe the use of the Leigh Creek facility should be a cause for concern provided the quantities to be transferred are managed appropriately. The Outback Communities Authority encourages Leigh Creek Energy to identify the facility and expected quantiles of waste to be transferred.	Correct. The licensed waste facility will be at Leigh Creek. LCK will make use of the waste facility and record the types and volumes of waste to be transferred there.

#	Agency	EIR/SEO Reference	Topic/ Issue	Issue/Comment Raised in Submission	Response
	SA Health				
10	SA Health	EIR	Acts and Regulations	Reference has been made to the following Acts and Regulations: - 2.2 (pg11) Table 2.1 references the South Australian Public Health Act 2011 - 3.9 (pg18) Campsites & Associated Activities reference to South Australia Public Health (Wastewater) Regulations 2013 - Table 5.1 (pgs 62, 64, 67) reference to South Australia Public Health (Wastewater) Regulations 2013.	This is noted.
11	SA Health	SEO	Acts and Regulations	Reference has been made to the following Regulation: South Australia Public Health (Wastewater) Regulations 2013.	This is noted
	DEW				
12	DEW	EIR	Surface water control measures	EIR Table 1, page 9, Objective 3 (surface water). Assessment criteria to include no unauthorised modifications to watercourses. Objective can be achieved by applying for water affecting activity permits where relevant through Natural Resources SA Arid Lands.	These suggestions were taken onboard, and the wording updated in the EIR.
	AAR				
13	AAR	SEO	Wording regarding Aboriginal cultural heritage	Specific wording to be corrected and reference the AHA was suggested when referring to training and induction and the procedure for a discovery.	These suggestions were taken onboard, and the wording updated in the SEO.
14	AAR	EIR	Wording regarding Aboriginal cultural heritage	Specific wording to be corrected and reference the AHA was suggested when referring to training and induction and the procedure for a discovery.	These suggestions were taken onboard, and the wording updated in the EIR.

Appendix C: Summary of Topics Raised and number of Submissions that Raised Specific Topics

#	Topic	Public Submission #	Summary of the submissions	Response
1	General Opposition			
	<p>Opposition to <i>In situ</i> gasification (ISG) activities only, which is not relevant to this EIR/SEO.</p> <p>There is no reference to geophysical exploration activities in the submissions.</p>	5, 6, 7, 8, 9, 13-643, 645, video submissions	<p>A number of submissions were received stating general opposition to ISG at Leigh Creek and the distress of the underground coal gasification to the Traditional Land Owners and the wider community.</p> <p>No objection or reference was made to the Geophysical exploration activities on PEL 650, which is what this EIR/SEO relates to.</p>	<p>LCK acknowledges these submissions and as outlined in Section 7 of the EIR, will continue to provide opportunities for engagement and communications for all stakeholders. LCK notes that this EIR and SEO relates to geophysical exploration activities and not to any potential ISG activities, which will be covered by a separate EIR/SEO. LCK also notes that in situ gasification, either by exploration or production, is regulated by the PGE Act and Regulations, and will develop the project within this legislative framework.</p> <p>In addition, LCK recognises that excellence in environmental management is essential to the success of the proposed project. Environmental objectives for the proposed activities have been developed in the accompanying SEO (LCK 2019). These objectives have been designed to provide a clear guide for the management of environmental issues.</p>
2	General Support			
	EIR Table 5-1 Environmental Risk Assessment	1	The EPA supports the key management measures that will be adopted under the EIR.	This is noted.
	<u>Site location</u> : The Leigh Creek region is well serviced by local infrastructure and services. EIR Section 3.9 "Camp Sites and Associated Activities" Paragraph 3	2	We anticipate the licensed waste facility might be at Leigh Creek. Having regard to the time frame for the campsite and the number of inhabitants, we do not believe the use of the Leigh Creek facility should be a cause for concern provided the quantities to be transferred are managed appropriately. The Outback Communities Authority encourages Leigh Creek Energy to identify the facility and expected quantiles of waste to be transferred.	Correct. The licensed waste facility will be at Leigh Creek. LCK will make use of the waste facility and record the types and volumes of waste to be transferred there.
	EIR - Good reference to Acts and Regulations	3	<p>Good reference has been made to the following Acts and Regulations:</p> <ul style="list-style-type: none"> - 2.2 (pg11) Table 2.1 references the South Australian Public Health Act 2011 - 3.9 (pg18) Campsites & Associated Activities reference to South Australia Public Health (Wastewater) Regulations 2013 - Table 5.1 (pgs 62, 64, 67) reference to South Australia Public Health (Wastewater) Regulations 2013. 	This is noted.
	SEO - Good reference to Acts and Regulations	3	Good reference has been made to the following Regulation: South Australia Public Health (Wastewater) Regulations 2013.	This is noted.
	<u>Environmental Impact Assessment</u> . EIR Section 5.2.2 "Spills or leaks of fuel or chemicals"	1	Preventative actions, spill response and the treatment and disposal of impacted soil has been addressed adequately.	This is noted.

#	Topic	Public Submission #	Summary of the submissions	Response
3	Aboriginal heritage			
	General opposition to project	5, 13-643, and video submissions	<p>In their submission ATLA and community representatives from Copley and Leigh Creek state opposition to the project on several grounds, primarily in the area of protection of Aboriginal heritage and environmental.</p> <p>A separate submission highlighted the Traditional Owners strong opposition to the project.</p>	<p>A submission was received from the Adnyamathanha Traditional Lands Association (ATLA) and video submissions from representatives from Copley and Leigh Creek.</p> <p>In their submission ATLA states opposition to the project on a number of grounds including protection of Aboriginal heritage, the “moderate” risk for handling and storing fuel, chemicals and waste, the ambiguity of the interpretation of the term “clearance”, the risk to native fauna and number of 2D lines recorded, the size of the 3D survey and the risk of known contaminated sites is unclear.</p> <p>As previously indicated in the EIR for the ISG Demonstration Plant (LCK 2017) LCK acknowledges the significance of the Leigh Creek area in the context of the Yurlu Ngukandanha Muda, and the suggested disturbance by cultural heritage custodians to the Muda from historical coal mining operations. LCK is committed to conducting its operations in accordance with the requirements of the <i>Aboriginal Heritage Act 1988</i> and will continue to engage with ATLA to build a co-operative and mutually beneficial relationship with the Traditional Owners of the region. Additional risk mitigation measures will be considered by LCK, outside of the WACA, if deemed necessary to meet LCK’s obligations under the Act.</p> <p>The impacts relating to the handling and storage of fuel, chemicals and waste is moderate to minor without implementing the proposed key management measures. Consequently, with the implementation of the key management measures the level of risk has been assessed as low.</p>
	Disturbance to Aboriginal heritage	5, 13-643, 644 and video submissions		
	Social Licence to Operate	645		

#	Topic	Public Submission #	Summary of the submissions	Response
				<p>LCK notes in Table 5-1 of this assessment that the term 'clearance' is sometimes used in the conduct of Aboriginal heritage surveys although the term 'clearance' is not in the Aboriginal Heritage Act and therefore has no legal standing under the Act. As indicated in Section 4.2 and 5.1 of this EIR LCK has signed a Work Area Clearance Agreement (WACA) with the ATLA and will work within the confines of this agreement for the proposed works within nominated areas of the PEL650. Additional risk mitigation measures will be considered by LCK, outside of the WACA, if deemed necessary to meet LCK's obligations under the Act.</p> <p>Measures regarding the protection of native fauna is discussed in sections 5.5.5 and Table 5-1 of this EIR.</p> <p>Regarding this current EIR/SEO, LCK has sought the participation of ATLA under the previously executed WACA to undertake a work area clearance over the area in which activities are to be conducted. This request was initiated in December 2018, with further discussions and requests to complete the WACA in January 2019. Further to this, additional correspondence providing an overall project update and again seeking ATLA's support to undertake a work area clearance has been provided to ATLA in October 2019. To date, LCK is yet to receive any formal response to the requests made, however LCK will continue to actively seek the participation of ATLA in this regard and progress on the basis of the WACA.</p> <p>Regarding the details on how many 2D lines are recorded, and the size of the 3D survey this has been addressed in Table 7-2 of this EIR.</p> <p>On the risk of contaminated sites, the activities from the Geophysical Operations will not add to the amount of contaminated areas within PEL 650. This has been addressed in Table 7-2 of the EIR.</p>
	Cultural Heritage Discovery procedure	7 and 644	A submission raised the concern that aboriginal heritage sites may be missed and disturbed. Questions were raised if there was a procedure and training in place and if suitably qualified personnel would be conducting the cultural heritage clearances.	<p>As indicated in the Introduction to this EIR, LCK has a WACA in place that provides a clear process for the completion of work area clearances related to LCK's project and includes a Cultural Heritage Policy to ensure that Aboriginal sites, objects and remains, as well as non-Aboriginal Heritage sites and or items are protected if they are discovered during geophysical activities.</p> <p>EIR Table 5-1 has LCK's has in place a Control Strategy for Cultural Heritage during line and access tracks preparation and vehicle movement.</p> <p>EIR Section 4.2.1 states that LCK executed (in September 2016) a Work Area Clearance Agreement with the Adnyamathanha Traditional Lands Association (ATLA), as the prescribed body corporate for the native title area and will work within the terms of this agreement for the proposed works within nominated areas of PEL 650, for the purpose of avoiding damage and disturbance to any Aboriginal site object or remains with those areas.</p>

#	Topic	Public Submission #	Summary of the submissions	Response
4	UCG projects in other jurisdictions			
	General opposition based on media (newspaper/tv/others)	6	A significant number of submissions raised issues relating to environmental impacts caused by a number of UCG trials undertaken in Queensland, particularly in relation to impacts to groundwater.	This is noted. UCG projects and operating activities are outside of the scope of this EIR/SEO. This EIR/SEO relates to exploration geophysical activities, which have been used for over 50 years in Australia and globally with very little environmental impact to the environment.
	Environmental impacts	6		
	Ban on ISG	6		
	QLD pilot trials in general	6		
	UCG in Scotland and the Scottish report on UCG	6 and 645	Comments were also provided regarding the Queensland Government decision in 2017 to no longer permit UCG projects in Queensland. A small number of comments also raised the issue of 'fracking'. One submission commented on the status of UCG in Scotland.	ISG in South Australia, either by exploration or production, is legally governed by the PGE Act and Regulations, and LCK is committed to developing the project within this legislative framework.
5	Environmental Impacts			
	General environmental impacts	5, 6, 8, 10	Several submissions were received expressing environmental impact concerns, including potential impacts to groundwater quality, biodiversity / ecosystems, soil and geological integrity.	This is noted, and all environmental impacts and mitigation measures have been addressed in section 5 of the EIR.
	Impacts to soil and water by fuel at camp facility. (EIR section 3.9, paragraph 5)	1, 4	Surface fuel spills at the camp site need to be treated. Small spills can be treated by in-situ chemical treatment or bioremediation. A treatment plan and subsequent verification is required to show that the treatment has been successful. Larger spills require removal of impacted soil with replacement by clean fill.	This is noted and has been included in section 3.9. Any uncontained spillage onto the ground surface will be removed and suitably disposed of at an EPA licenced facility. In the unfortunate event of a larger spill, a spill remediation approach will be adopted based on the volume and estimated horizontal and vertical impact. The impacted soil will then be removed to an EPA licensed facility and replaced with clean fill.
	Water usage and the impact of the project on surface and ground water and the future sustainability of Australia	645	A submission received raised concerns over the potential environmental impacts of ISG on the Telford Basin and its impact on the Great Artesian Basin. A submission received raised concerns over increased water usage and the replenishment of groundwater and the possible risk of water contamination from the plant.	This is noted. Section 4.7 of the EIR states that the Leigh Creek Coalfield occupies the entire footprint of the Telford Basin and the Great Artesian Basin is, at its closest, approximately 50 km to the north and has no connection with groundwater in the Telford Basin. Any further details regarding the impact of the Telford Basin on the GAB is beyond the scope of this geophysical EIR. As explained in Table 5-1 of this EIR water will be used for line and access tracks preparation and vehicle movement. No groundwater resources will be accessed for the geophysical activities.
	Impacts to earthen bunds from access tracks (EIR Section 3.2.2 "Access Tracks")	1	The PEL 650 contains a network of earthen bunding that contributes to the long-term surface water management. Disturbance of these bunds will be avoided but, in the event, that any bunds are impacted they will be reprofiled/reinstated to their prior contours.	This is noted and has been included in section 3.2.2 the EIR.

#	Topic	Public Submission #	Summary of the submissions	Response
	Weed Management	10	Ensure that no new weeds are introduced into areas of disturbance. This would be via a weed management program to ensure; sites are monitored pre and post disturbance, earthmoving equipment is effectively cleaned, and a management plan is implemented if new weeds are introduced or weed density increases.	This noted and has been addressed in section 5.5.1 of this EIR. LCK will implement a weed control plan in consultation with the relevant NRM officer, if required.
	Biodiversity and soil contamination	645	A submission was received concerning the potential impact of the project on the Thick-billed Grasswren that is listed as vulnerable under the EPBC Act.	This is noted. During the operation of the PCD (EIR 2017) Leigh Creek Energy made a presentation to the Department of the Environment and Energy under the Federal Government in Canberra regarding a submission on the impact of the Thick-billed Grasswren. The feedback from the Federal Regulator was that the Department would not take any further action under the EPBC Act. Any impacts and proposed mitigation measures to soil contamination have been addressed in Table 5-1 of this EIR.
6	Adequacy of the Statement of Environmental Objectives			
	Objective 2 - Soil disturbance and contamination	1	Fuel, chemical and produced fluids storage and handling have been adequately addressed.	This is noted.
	Objective 2 - Earthen bunding	1	The PEL 650 contains a network of earthen bunding that contributes to the long-term surface water management. Disturbance of these bunds will be avoided but, in the event, that any bunds are impacted they will be reprofiled/reinstated to their prior contours.	This is noted. A mitigation measure now includes a statement that reads 'Areas where there has been disturbance to earthen bunds will be reprofiled/reinstated to their prior contours'. This has also been included in the last row of the Goal Attainment Scaling Criteria Appendix A.
	Objective 3 - Surface water and groundwater contamination	1	Fuel, chemical and produced fluids storage and handling have been adequately addressed. Whilst an impact to groundwater is very unlikely, no reference was made to the protection of groundwater in this document.	This is noted. The SEO objective #3 now reads 'Avoid contamination of surface water and groundwater resources and minimize disturbance to surface drainage patterns'.
	Objective 8 - Waste management hierarchy	1	Reference to the EPA Waste Hierarchy model has been noted.	This is noted.
	How geophysical surveys will inform future approval decisions.	10	There is a need to use the information from the geophysical surveys to contribute useful and tangible information for any future planning approval for a production stage.	As documented in the EIR (Section 1 - Introduction), the information from the geophysical exploration activities will be used to conduct drilling programs. The drilling activities will be covered in a separate EIR and accompanying SEO. It should be noted that the information from the geophysical surveys will be used to plan the exploration drilling activities and it will be the information from the exploration drilling program, that will be used to contribute useful and tangible information for any future planning approval for a potential production stage. The geophysical surveys themselves will not contribute any major useful information.
7	Issues raised outside the scope of the EIR and SEO			
	Objection to ISG/UCG including climate change, operation of a USG plant and regulation of complex development projects.	5, 6, 645 and video submissions		This is noted. UCG projects and operating activities are outside of the scope of this EIR/SEO. This EIR/SEO relates to exploration geophysical activities.

Submission #	Name/Organisation
1	EPA
2	OCA (Outback Council of Australia)
3	S.A. Health
4	<i>Wishes submission to remain confidential</i>
5	ATLA (includes EDO submission)
6	Dr Geralyn McCarron
7	Gayle Mather
8	Hon Mark Parnell
9	<i>Wishes submission to remain confidential</i>
10	Tim Kelly
11	<i>Wishes submission to remain confidential</i>
12	Department for Environment and Water (DEW)
13-643	Campaign submissions via Do Gooder (www.dogooder.co)
644	Aboriginal Affairs and Reconciliation (AAR)
645	Doctors for the Environment Australia and Conservation Council of South Australia
Video submissions	Copley and Leigh creek community