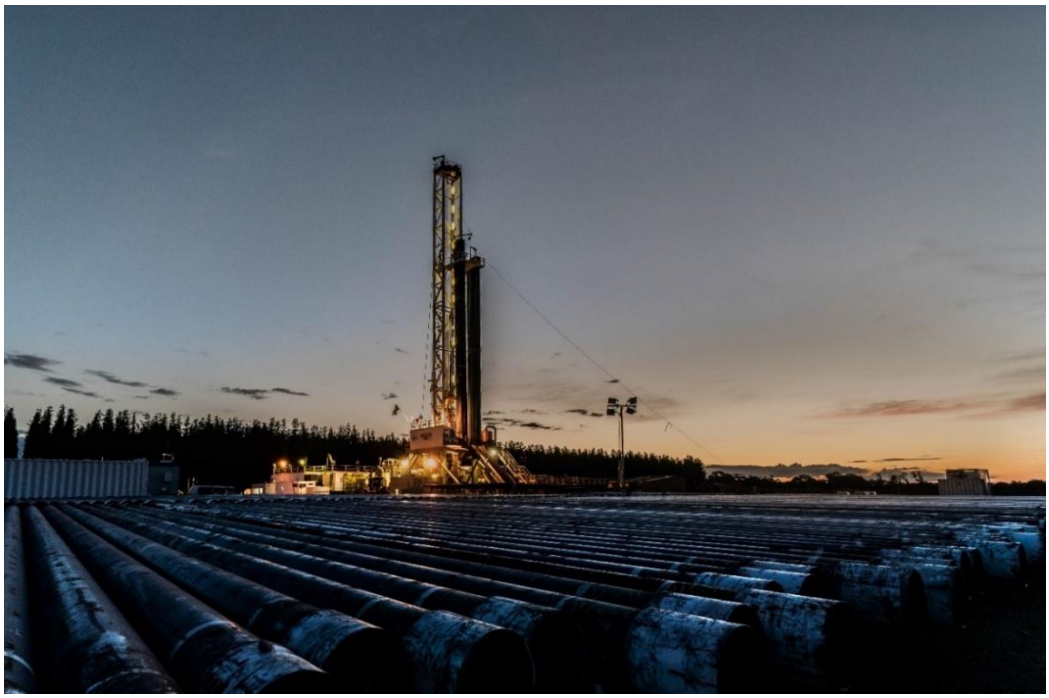
Report

Environmental Impact Report

Drilling, Completion and Well Production Testing in the Otway Basin, South Australia



August 2025 DRAFT

Revision History (last 3 revisions)

Revision	Date	Reason for issue	Reviewer/s	Consolidator	Approver
7e	18/6/2025	5-year review – Beach SME review	CK, PJ, LJ, CN, CG, NW, PK, MO	CK	
7f	21/7/2025	5-year review – DRAFT for DEM	CK, CN, CG	CK	CG
7g	28/8/2025	5-year review – DRAFT for consultation	CK	CK	BM

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Summary

Beach Energy Limited and its group subsidiaries (Beach) hold a number of petroleum exploration, production and retention licences in the onshore Otway Basin in the South East of South Australia. This Environmental Impact Report (EIR) has been prepared under the *Energy Resources Act 2000* to cover Beach's ongoing drilling activities and related well operations in the region. It updates and supersedes the Environmental Impact Report (and associated Statements of Environmental Objectives (SEO)) that have previously been developed to cover drilling activities in the region.

Background

Exploration for hydrocarbons in the South East first commenced in the 1890s and the first deep exploration well, Robe-1, was drilled in 1915. The Katnook gas plant near Penola was established in 1991 following the first commercial gas discovery at Katnook in 1987 and the subsequent discovery of further commercial gas fields. Since this time, companies such as Beach, Origin Energy and Adelaide Energy have continued to explore for hydrocarbons, with a number of successful wells discovering new gas fields.

This EIR relates to Beach's ongoing drilling activities, well completions / workovers and well production testing located within Beach's licence areas in the onshore Otway Basin in the South East of South Australia. It does not cover other petroleum exploration or production activities such as seismic operations or processing operations at the Katnook gas plant site. Fracture stimulation activities are not proposed and are not covered by this document. This EIR (and the resultant SEO) is 'generic' in nature, covering activities in current and future Beach licences located within the onshore Otway Basin which encompasses a relatively broad geographical area in the South East of South Australia, rather than relating to a specific site or sites.

Land Use and Environment

The fertile land of the South East supports a diverse range of industries including wool, meat, dairy, forestry, wine grapes, cereal cropping, horticulture crops and seed production, which are heavily dependent upon water resources in the region. Groundwater is the primary source of water, with the irrigation industry being the most significant user.

The region has low topographical relief and a general absence of surface watercourses. A network of constructed drains is present, which has allowed formerly inundated land to be developed, minimising seasonal waterlogging and removing salt from the region. The alteration of wetland flooding and drying regimes has resulted in a decline in biodiversity in some areas. Native vegetation clearance across the South East is extensive, with an average of 10% of native vegetation remaining. A number of threatened ecological communities and threatened flora and fauna species occur in the region, and are generally confined to or reliant on areas of remnant vegetation.

The region hosts an extensive network of limestone sinkholes and caves, including the World Heritage-listed Naracoorte Caves which are located predominantly north of the Beach licence areas. Eleven *National Parks and Wildlife Act* 1972 reserves are present within the licence areas, however this EIR does not cover activities in National Parks and Wildlife Act reserves.

Penola is the largest town centre within the Beach licence areas. Other nearby population centres include Naracoorte and Lucindale (to the north of the licence areas), Millicent (to the south) and Robe and Beachport (to the west).

Environmental Impact Assessment

This EIR assesses the potential impacts on elements of the environment posed by hazards that may result from drilling, completion and well production testing activities. Potential hazards addressed include:

- well site, access track and camp site construction and rehabilitation
- physical presence of drill rig and camp and personnel
- emissions from drilling and workover activities (air, noise, light)
- use of roads and movement of vehicles and heavy machinery
- drilling through shallow aquifers
- well control incidents (e.g. blowout or kick)
- other downhole issues (e.g. lost circulation, sloughing shales, stuck pipe or drill pipe failure, loss of radioactive source down hole)
- loss of well integrity (e.g. casing or cement failure)
- spills or leaks
- unauthorised access by third parties
- fire
- storage, handling and disposal of waste.

The Impact assessment contained in this EIR indicates that the level of risk posed by drilling, completion and well production testing activities is generally low and can be adequately managed to prevent unacceptable environmental impacts. In particular:

- Potential impacts to land use and property management are mitigated through consultation with landowners regarding the location, management and timing of proposed activities, with the aim of minimising disturbance. Ongoing liaison with landowners will be carried out following drilling (and throughout a well's life if it is successful). Sites will be rehabilitated to the satisfaction of landowners following the conclusion of activities, with stockpiled topsoil re-spread, site contours reinstated and pasture or vegetation re-established, unless landowners request that paved areas (e.g. access tracks) are left in place.
- Significant impacts to flora and fauna are avoided through the environmental assessment and planning process undertaken for individual well sites. This will include locating wells in previously disturbed or cleared areas, fencing to prevent fauna (or stock) access, weed and fire prevention measures and transport procedures. Areas of high quality or significant native vegetation and significant wetland areas will be avoided.
- Spills or leaks of fuels, oils or chemicals are mitigated by restricting the storage and handling of fuel and chemicals to designated areas on the paved drill pad, use of appropriate secondary containment

and immediate clean-up and remediation of any spills. The drilling sump will be lined with an appropriate impermeable liner to prevent percolation into the soil and sump contents will be removed on completion of the activities.

- Aquifers will be protected by casing and cementing of wells. Well integrity will be maintained via appropriate design, installation and monitoring of wells during drilling and throughout the well's life in line with Beach's well engineering and integrity standards.
- Well control incidents are extremely rare, particularly in areas such as the Otway Basin. Considerable safety measures including guidelines, procedures, safety practices, design considerations, certification of trained individuals and an emergency response plan will be in place.
- Traffic management and noise limitation procedures will be implemented, and adequate buffers will be maintained between well sites and residences. Impacts to landholders and communities will be mitigated through ongoing consultation regarding the proposed activities, with the aim of identifying potential issues and minimising disturbance.

A range of management measures that will be implemented are listed in the EIR. The accompanying Statement of Environmental Objectives will set out the environmental objectives and associated leading performance and assessment criteria.

1. Introduction

Beach Energy Limited and its group subsidiaries (Beach) hold a number of petroleum exploration, production and retention licences in the onshore Otway Basin in the South East of South Australia.

Under Regulation 13 of the *Energy Resources Regulations 2013*, an approved Statement of Environmental Objectives (SEO) must be reviewed at least once in every five years. Beach's Otway Basin Drilling SEO was originally approved in 2013. This Environmental Impact Report (EIR) has been prepared to use as a basis for preparation of the revised SEO.

1.1 Background

The Otway Basin is located along the south-east margin of the Australian mainland and is second only to the Cooper and Eromanga Basins as the most explored province in South Australia for oil and gas. About 70% of the basin is offshore, commencing in South Australian waters south-east of Kangaroo Island in the west where the basin passes into the Duntroon Basin and continues to the east of Port Phillip Bay in Victoria (**Figure 1**). The South Australian onshore sector of the Otway Basin is located in the South East region and covers approximately 9,650 km^2 (Boult and Hibburt 2002).

Figure 1: Location of the Otway Basin

Exploration for hydrocarbons in the South East commenced in the 1890s, with the first deep exploration well, Robe-1, drilled in 1915. The first commercial gas discovery was made at Katnook in 1987, followed by discovery of the Ladbroke Grove Field in 1989. Since then, the Katnook, Haselgrove, Haselgrove South and

Redman commercial gas fields have been discovered and the Katnook gas plant was established in 1991. Since this time, Origin Energy, Adelaide Energy and Beach have continued to explore for hydrocarbons, with a number of successful wells discovering new gas fields including Wynn-2 in 2005 and Jacaranda Ridge-2 in 2007. Beach has a long history of exploration in the onshore Otway Basin, with Beach's first well in the basin (Geltwood Beach-1) drilled in 1963. Beach has drilled a total of 33 wells in the onshore Otway Basin across South Australia and Victoria. Most recently, Beach drilled the Haselgrove-3 well approximately 8 km south of Penola in September 2017.

Beach considers the Otway Basin to have substantial exploration potential because of its existing conventional gas, condensate and oil discoveries.

Beach plans to continue exploration for hydrocarbons in the Otway Basin and has prepared this EIR to cover ongoing drilling activities within licensed areas in the South East of South Australia.

1.2 Beach Energy Company Profile

Beach Energy is an ASX listed oil and gas exploration and production company headquartered in Adelaide, South Australia. It has operated and non-operated, onshore and offshore, oil and gas production from five producing basins across Australia and New Zealand, and is a key supplier to the Australian east coast gas market.

Beach's asset portfolio includes ownership interests in strategic oil and gas infrastructure, such as Moomba processing facility, as well as a suite of high potential exploration prospects.

Beach currently holds two petroleum exploration licences (PEL), three petroleum production licences (PPL) and four production retention licences (PRL) in the South Australian section of the onshore Otway Basin, both in its own right and with joint venture partners. The locations of Beach's operations are shown in **Figure 2**.

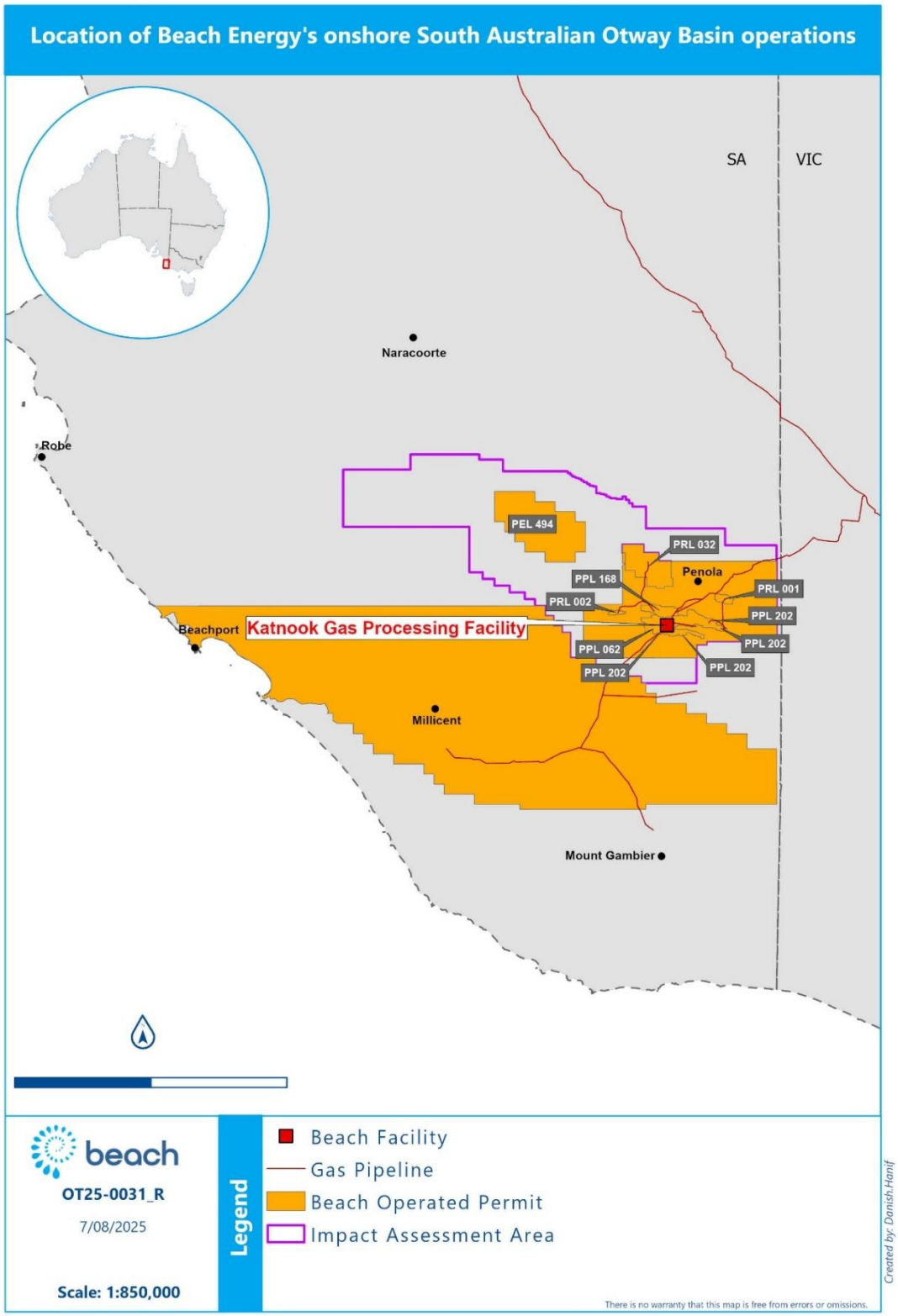

Figure 2: Beach Energy's onshore South Australian Otway Basin licences and the impact assessment area

1.3 Scope of This Document

This document has been prepared to satisfy the requirements of an Environmental Impact Report (EIR) under the *Energy Resources Act 2000*. It has been prepared in accordance with current legislative requirements, in particular Section 97 of the Act and Regulation 10 of the *Energy Resources Regulations 2013*.

This document (and the accompanying SEO) covers drilling, completion and well production testing activities within Beach licences that fall within the impact assessment area defined in **Figure 2**. This covers a relatively broad geographical area located in the South East of South Australia within the onshore Otway Basin and subsequently the document is 'generic' in nature, rather than relating to a specific site or sites, or to specific projects. This approach has been applied in many other EIRs and SEOs that have been developed under the *Petroleum and Geothermal Energy Act 2000* (which was superseded by the *Energy Resources Act 2000* in April 2024*)* including previous EIRs and SEOs developed by Origin Energy, Adelaide Energy and Beach Energy for exploration in the onshore Otway Basin.

As discussed in Section 2.2, prior to the commencement of drilling activities, additional site-specific and technical detail for operations at individual well sites must be provided to DEM under the activity notification / approval requirements of the Act, including a demonstration that the activities are covered by (and are compliant with) an applicable SEO.

This document relates to drilling activities, well completions / workovers (associated with a drilling program and typically performed by a drilling rig), well production testing and decommissioning following drilling[1] in the onshore Otway Basin in South Australia.

This EIR and the accompanying SEO do not apply to petroleum activities such as:

- seismic exploration activities
- fracture stimulation
- production and processing operations beyond well production testing
- production and processing operations at the Katnook gas plant site
- well operations (after drilling has finished) including production completions and workovers, well integrity management, artificial lift and well head production equipment, gas well deliquification and downhole decommissioning following production[2]
- field production / processing equipment installation, operation, post operation decommissioning and rehabilitation
- pipeline construction, operation and decommissioning.

These activities are covered by other EIRs and SEOs. The relevant SEOs in place at the time of preparation of this document include:

- *Statement of Environmental Objectives: Onshore Otway Basin Petroleum Production Operations* (Beach 2025).

[1] Decommissioning of wells is equivalent to 'abandonment', which is the technical term used in the Energy Resources Regulations.

- *Statement of Environmental Objectives for Geophysical Activities in the Otway Basin, South Australia* (Beach 2021).

Operation of major transmission pipelines in the region not owned by Beach Energy ,such as the SEA Gas or SESA pipelines, are not covered by this EIR and SEO.

1.4 Limitations on Use

This document has been prepared to satisfy the requirements of the *Energy Resources Act 2000* (SA) and *Energy Resources Regulations 2013* (SA), and is to be submitted to the Department of Energy and Mining and the relevant Minister.

Beach does not authorise this document to be used by third parties for any other purpose.

2. Legislative Framework

This chapter briefly describes the legislative framework that currently applies to petroleum activities in South Australia.

2.1 Energy Resources Act

The legislation governing onshore petroleum exploration and production in South Australia is the *Energy Resources Act 2000* (ER Act) and *Energy Resources Regulations 2013* (the Regulations). This legislation is administered by Department for Energy and Mining (DEM). This legislation came into effect in April 2024, superseding the *Petroleum and Geothermal Energy Act 2000* and *Petroleum and Geothermal Energy Regulations 2013* under which EIR and SEO reports (including the earlier version of this report) were produced.

Key objectives of the legislation include:

- to create an effective, efficient and flexible regulatory system for exploration and recovery or commercial utilisation of petroleum and other regulated resources
- to minimise environmental damage from the activities involved in exploration and recovery or commercial utilisation of petroleum and other regulated resources
- to establish appropriate consultative processes involving people directly affected by regulated activities and the public generally
- to protect the public from risks inherent in regulated activities.

The ER Act and Regulations are objective-based rather than prescriptive. An objective-based regulatory approach principally seeks to ensure that industry effectively manages its activities by complying with performance standards that are cooperatively developed by the licensee, the regulatory authority and the community. This contrasts with prescriptive regulation where detailed management strategies for particular risks are stipulated in legislation.

Regulated resources, as defined in Part 1 of the Act, are:

- a naturally occurring underground accumulation of a regulated substance,
- a source of geothermal energy, or
- a natural reservoir.

A reference in the Act to petroleum or another regulated substance extends to a mixture of substances of which petroleum or other relevant substance is a constituent part. Regulated substances as defined in Part 1 of the Act are:

- petroleum
- hydrogen sulphide
- nitrogen
- helium

- carbon dioxide
- any other substance that naturally occurs in association with petroleum; or
- any substance declared by regulation to be a substance to which the Act applies.

Regulated activities, as defined in Section 10 of the Act, are:

- exploration for petroleum or another regulated resource
- operations to establish the nature and extent of a discovery of petroleum or another regulated resource, and to establish the commercial feasibility of production and the appropriate production techniques
- production of petroleum or another regulated substance
- utilisation of a natural reservoir to store petroleum or another regulated substance
- production of geothermal energy
- construction of a transmission pipeline for carrying petroleum or another regulated substance
- operation of a transmission pipeline for carrying petroleum or another regulated substance.

2.1.1 Statement of Environmental Objectives

As a requirement of Part 12 of the Act, a regulated activity can only be conducted if an approved Statement of Environmental Objectives (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.

Under Regulation 14 of the Regulations, an approved SEO must be reviewed at least once in every five years. Beach's Otway Basin Drilling SEO was originally approved in 2013. This Environmental Impact Report (EIR) has been prepared to use as a basis for preparation of the revised SEO.

2.1.2 Environmental Impact Report

In accordance with Section 97 of the Act, an Environmental Impact Report must:

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

As per Section 96A of the Act, the Minister has determined environmental impact assessment criteria. These criteria form the basis of the assessment completed in Section 5:

- Elements of the environment.
- Potential impact events.
- Confirmation of impact events.
- Control and management strategies and uncertainty assessment.

- Environmental significance assessment.
- Statement of environmental objectives (Beach Energy, 2025).

As per Regulation 10 of the Regulations, for the purposes of an EIR, a licensee must provide:

- a description of the regulated activities to be carried out under the licence (including their location)
- a description of the specific 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)
- if required by the Minister – a prudential assessment of the security of natural gas supply
- a description of the reasonably foreseeable events associated with the activity that could pose a threat to the relevant environment, including information on:
    - events during the construction stage (if any), the operational stage and the abandonment stage
    - events due to atypical circumstances (including human error, equipment failure or emissions, or discharges above normal operating levels)
    - information on the estimated frequency of these events
    - an explanation of the basis on which these events and frequencies have been predicted
- an assessment of the potential consequences of these events on the environment, including information on
    - the extent to which these consequences can be managed or addressed
    - the action proposed to be taken to manage or address these consequences
    - the anticipated duration of these consequences
    - the size and scope of these consequences and
    - the cumulative effects (if any) of these consequences when considered in conjunction with the consequences of other events that may occur on the relevant land (insofar as this is reasonably practicable)
- an explanation of the basis on which these consequences have been predicted
- a list of all owners of the relevant land
- information on any consultation that has occurred with the owner of the relevant land, any Aboriginal groups or representatives, any agency or instrumentality of the Crown, or any other interested person or parties, including specific details about relevant issues that have been raised and any response to those issues, but not including confidential information.

2.2 Activity Notification / Approval Process

Section 74(1) of the ER Act requires that activities to be undertaken in accordance with the ER Act are classified as requiring either high level of low level official surveillance. In accordance with Section 72(2), Beach Energy has been classified as a low level official surveillance operator for well activities (drilling, completions and well testing).

Section 74(3) of the ER Act and Regulation 18 of the ER Regulations requires that low level official surveillance operators provide an Activity Notification to the Minister at least 21 days in advance of commencing an activity.

The Activity Notification 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 as per the requirements of Regulation 20 of the ER Regulations and Energy Regulation Guideline 017: Preparation of an Activity Notification.

Consequently, the 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 EIR and SEO approval process. This is particularly relevant for activities that are conducted under an SEO that applies to a broad geographical area, as it provides site-specific detail that is not usually contained in the generic documents.

The detail provided as part of the Activity Notification process would include an assessment of the environment of the proposed location, investigation of site specific issues and any proposed site specific measures to minimise impacts to elements of the environment as defined in **Table 8** in Section 5 of the EIR.

2.3 Other Legislation

A variety of legislation applies to petroleum activities. Legislation that is particularly relevant to petroleum exploration is listed below (note that this is not a comprehensive list of all applicable legislation) and additional detail on key legislation is provided in the following list.

Commonwealth

Aboriginal and Torrens Strait Islander Heritage Protection Act 1984
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
Native Title Act 1993

South Australia

Aboriginal Heritage Act 1988
Crown Land Management Act 2009
Planning, Development and Infrastructure Act 2016
Explosives Act 1936
Environment Protection Act 1993
Fire and Emergency Services Act 2005
Forestry Act 1950
Heritage Places Act 1993
Marine Parks Act 2007
National Parks and Wildlife Act 1972
Native Title (South Australia) Act 1994
Native Vegetation Act 1991
Native Vegetation Regulations 2017
Landscape South Australia Act 2019
National Trust of SA Act 1955
South Australian Public Health Act 2011
Work Health and Safety Act 2012

2.3.1 Commonwealth Environment Protection and Biodiversity Conservation Act

Approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required for activities that impact matters of national environmental significance including World Heritage properties, National Heritage places, Ramsar wetlands of international importance, listed threatened species and ecological communities, migratory species, Commonwealth marine areas, the Great Barrier Reef Marine Park, nuclear actions and a water resource in relation to coal seam gas development and large coal mining development.

With regard to operations in the onshore Otway Basin, issues that may trigger approval requirements under the EPBC Act can generally be avoided by site selection. Based on current expectations, Beach believes that a requirement for approval under the EPBC Act is not likely to be triggered.

2.3.2 Native Vegetation Act

Exploration activities that are approved under the ER Act do not require approval under the *Native Vegetation Act 1991* for clearance of native vegetation, provided that the activities are undertaken in accordance with approved industry standards that are directed towards minimising impact and encouraging regrowth of any native vegetation that is cleared (see Regulation 15 of the *Native Vegetation Regulations 2017*).

As discussed in Section 5.9, Beach plans to avoid activities in areas of high quality or significant remnant vegetation.

2.3.3 Environment Protection Act

The *Environment Protection Act 1993* imposes a general 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 Act.

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

2.3.4 Landscape South Australia Act

Drilling of a new water sourcing bore requires a permit under the Landscape South Australia Act (Landscape Act). Extraction of groundwater within a prescribed wells area (including the Lower Limestone Coast Prescribed Wells Area) generally requires a licence / allocation under this Act, however there is an authorisation in place under Section 128 of the Landscape Act to take groundwater for use in drilling, construction and testing of hydrocarbon exploration wells.

The Landscape Act also set out a number of water affecting activities that must not be undertaken without a permit. These are usually avoidable by careful planning and siting of infrastructure to avoid watercourses and surface water features and maintain water flows. The Landscape Act also governs the control of declared pest plants and animals.

2.3.5 Planning, Development and Infrastructure Act

The *Planning, Development and Infrastructure Act 2016* (PDI Act) has special provisions relating to activities carried out under the *Petroleum and Geothermal Energy Act 2000* (now replaced by the ER Act) and it only applies in some cases. Activities classified as 'designated matters' are required to be assessed under the provisions of the PDI Act. DEM must refer applications for production tenements or Statements of Environmental Objectives to the Department for Infrastructure and Transport (DIT) in some cases (e.g. in Schedule 20 areas).

2.3.6 Aboriginal Heritage Act

The South Australian *Aboriginal Heritage Act 1988* (Act) provides protection for all Aboriginal sites, objects and remains across the state. The Act applies to all land and bodies of water, including Beach Energy's Otway Basin operations. The Act vests the powers to protect and preserve Aboriginal heritage to the Minister for Aboriginal Affairs and Reconciliation, who is required to take such measures as are practicable for protecting and preserving Aboriginal sites, objects and remains. Authorisation is required for any damage, disturbance or interference to Aboriginal sites, objects or remains. Penalties apply for failure to comply.

Where Aboriginal sites, objects and remains are encountered on private land, the *Aboriginal Heritage Act 1988* (Act) requires Beach Energy to report these discoveries to the Minister for Aboriginal Affairs and Reconciliation as soon as practicable. Once reported, AAR will notify the relevant Aboriginal group of the discovery.

Further, where Aboriginal sites, objects and remains are discovered, mitigation measures should be implemented to ensure the heritage is avoided. If the works cannot be relocated to avoid the Aboriginal site, object or remains, an authorisation is required pursuant to section 23 of the Act.

Under section 28(1) of the *Coroners Act 2003*, SA Police (SAPOL) must be notified if skeletal remains are discovered. SAPOL will determine whether the remains are Aboriginal ancestral remains. If the remains are determined to be Aboriginal remains, Beach Energy must contact AAR. AAR will then liaise with Beach Energy and the relevant Traditional Owners regarding the management and protection of the Aboriginal remains.

In the event of any heritage discovery, Beach Energy must ensure that the heritage is not damaged, disturbed with or interfered. To achieve this, works should halt in the vicinity of the discovery and advice should be sought from the Traditional Owners, a qualified heritage consultant or from AAR.

3. Description of Activities

Well design and construction, and operation and decommissioning are undertaken in accordance with management systems that specify detailed requirements. Beach maintains a suite of well engineering and integrity standards and guidelines that well design and operation must conform to, to ensure fit-for-purpose wells delivery with integrity assurance at all lifecycle stages (construction, maintenance, production, suspension and decommissioning). Following the drilling of a well which is identified as a production opportunity, and completion of well construction, the integrity of the producing well during the operation and maintain phase of the well's life cycle is safeguarded through application of Beach's Well Integrity Standards (WIS). These standards have been developed by Beach Energy and are based on internationally accepted industry practices.

All appropriately assigned staff and contractors, must be familiar with the contents of the Beach standards, and are responsible for the application of these standards for all design work and operations that they undertake, supervise, report, verify or approve.

The following section provides an overview of drilling, completion and well production testing activities.

3.1 Well Site, Access and Camp

3.1.1 Well Site

Drilling operations require the construction of a stable drill pad for the placement of the drilling rig, with areas for associated equipment including generators, fuel and chemical storage, casing and pipe storage and site offices.

A drill pad area of approximately 150 m x 150 m will be levelled and paved for the drill rig and associated equipment. At most well sites, topsoil is removed from the pad area and stockpiled adjacent to the pad for use in site rehabilitation. Any subsoil removed (e.g. from excavations) is stockpiled separately. In some circumstances, alternate construction methods such as laying paving materials on geotextile or directly on topsoil may be used (e.g. where very heavy soils are present or where the landowner has requested that the pad remains after drilling).

The pad will be paved with gravel to a depth of approximately 30 cm. Thicker paving (50 cm) may be required for the rig base (approximately 40 m x 20 m). The pad will be constructed so that any runoff from upslope of the pad will be directed away from the pad.

If the grass is dry or operations are within the fire season, the pad will be surrounded by a 10 m wide ploughed or graded firebreak.

A shallow sump (typically in the order of 25 m x 30 m x 2 m deep) will be constructed to hold drill cuttings and waste drilling muds. This sump will be lined with a polyethylene liner which is removed when the sump is rehabilitated. A 'turkey's nest' (a circular dam, lined with plastic to prevent water loss) may also be constructed to hold clean, fresh water on site prior to use in drilling, if required. If a turkey's nest is used, the liner would be removed at the end of drilling to prevent degradation issues.

A flare will be located adjacent to the drill pad for emergency situations during drilling operations and for use during well production testing. A firebreak will be ploughed or graded around the flare if required.

A fence will be constructed to enclose the well site area (approximately 3 hectares) and the access track, if required. Lockable gates will be placed across the start, or an appropriate section, of the access track. All activities will be confined to within the fenced area. A firebreak may be ploughed or graded along the outside of the fence.

Figure 3 shows an indicative layout of a well lease for a petroleum drilling rig.

3.1.2 Access Track

A short access track will be constructed from the public road to the drill pad, along an alignment approved by the landowner. Access tracks are typically 4 m wide except on bends and at entry and exit points to the camp and pad where the width is 8 m. There will generally be a ring road built for safety and for keeping trucks to the gravelled areas rather than causing wheel ruts in the undisturbed lease areas. If adjacent grass is dry, a graded or ploughed firebreak along each side of the access track will be constructed.

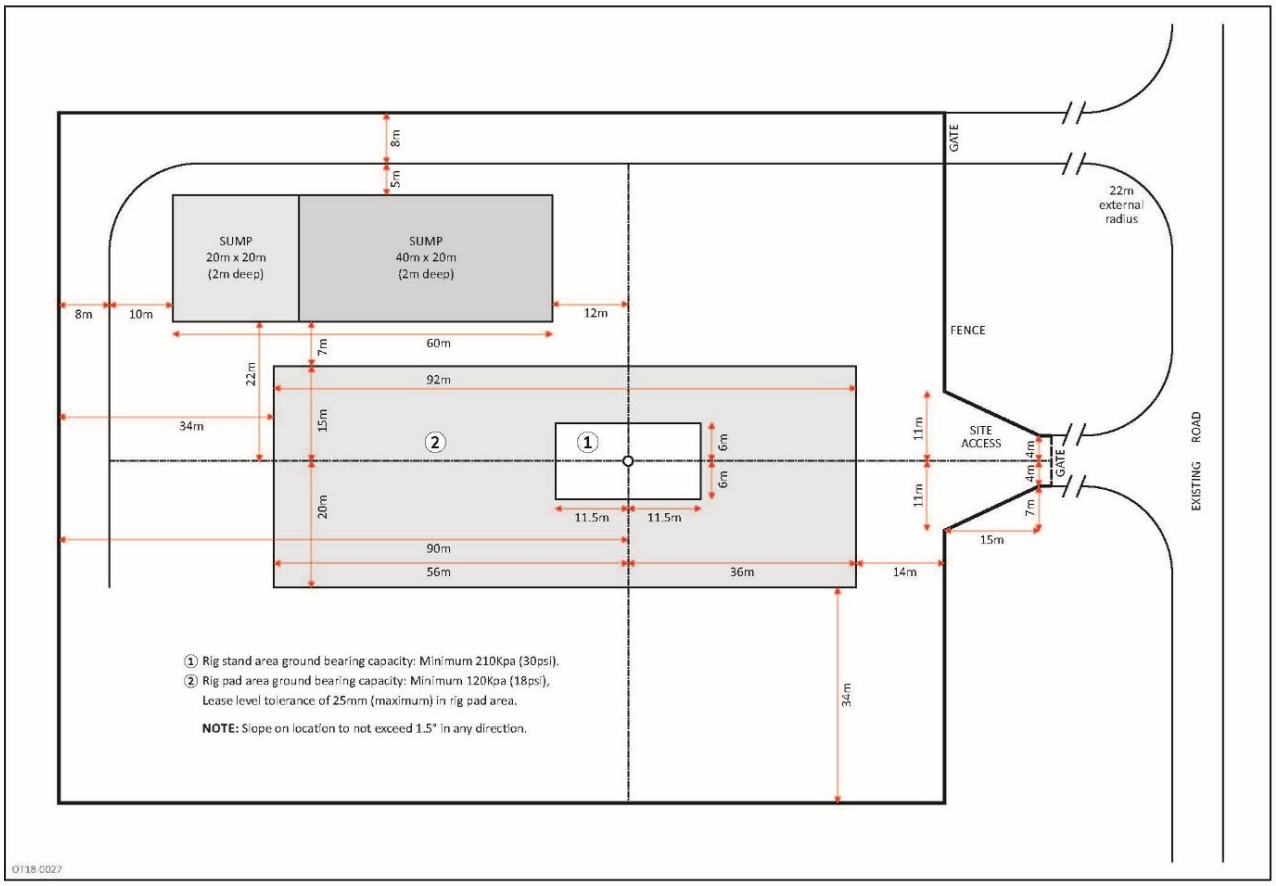

Figure 3: Indicative well lease layout diagram

3.1.3 Water Supply

A volume of less than 4 ML of water is typically required to drill a well. If a nearby water bore is acceptable, water will be pumped from it, subject to agreement of the landowner. A new bore may be required to be drilled on site if this is not an option. This will be drilled by a local licensed water well driller, with all necessary approvals (e.g. well construction permit) obtained from the relevant authority.

3.1.4 Camp

A camp will be required to house the drilling crew during construction. An area of approximately 80 m x 50 m adjacent to the drill pad will be used for a self-contained 58-person re-locatable camp equipped with wastewater processing units and septic tanks. Disturbance to the soil surface will be kept to a minimum. It will be necessary to lightly pave the camp area with gravel.

Sewage wastes are handled using septic tanks or on-site treatment systems that are approved and managed under the South Australian *Public Health (Wastewater) Regulations 2013* and in compliance with the South Australian Health On-site Wastewater Systems Code. Toilet facilities with wastewater processing units and septic tanks will be provided at the camp and the well site. Septic tanks will be used to contain all wastewater (black water and grey water) and will be pumped out by licensed contractors as required for disposal at a licensed facility. Small pits may be constructed to house the tanks which will be removed after drilling operations are completed. Any necessary approvals (e.g. local council) for the installation of the septic tanks will be obtained.

3.2 Drilling Operations

Drilling activities will be typical of standard onshore petroleum exploration and development drilling. Drilling of a well in the onshore Otway Basin typically takes 21 to 50 days and is carried out on a 24-hour, seven day per week basis. **Plate 1** shows a typical drilling rig in operation in the onshore Otway Basin.

Drilling operations involve drilling to a projected depth (typically 2000 m to 4500 m) with a rotary drilling rig using recirculated water-based muds (and possibly synthetic based muds (SBM) in deep sections of the well) and running and cementing various casing strings.

A diagram of a well showing the various casing strings for an indicative well design for the onshore Otway Basin is presented in **Figure 4**. The drilling process for this indicative well design would involve:

- installing and cementing the conductor pipe at the surface
- drilling the surface section and installing and cementing the surface casing so that the surface aquifers are not in communication with the well bore
- drilling the intermediate section to approximately top of the reservoir, and installing and cementing the intermediate casing in place
- drilling to the total depth of the well, running the final casing string in the hole and cementing it in place.

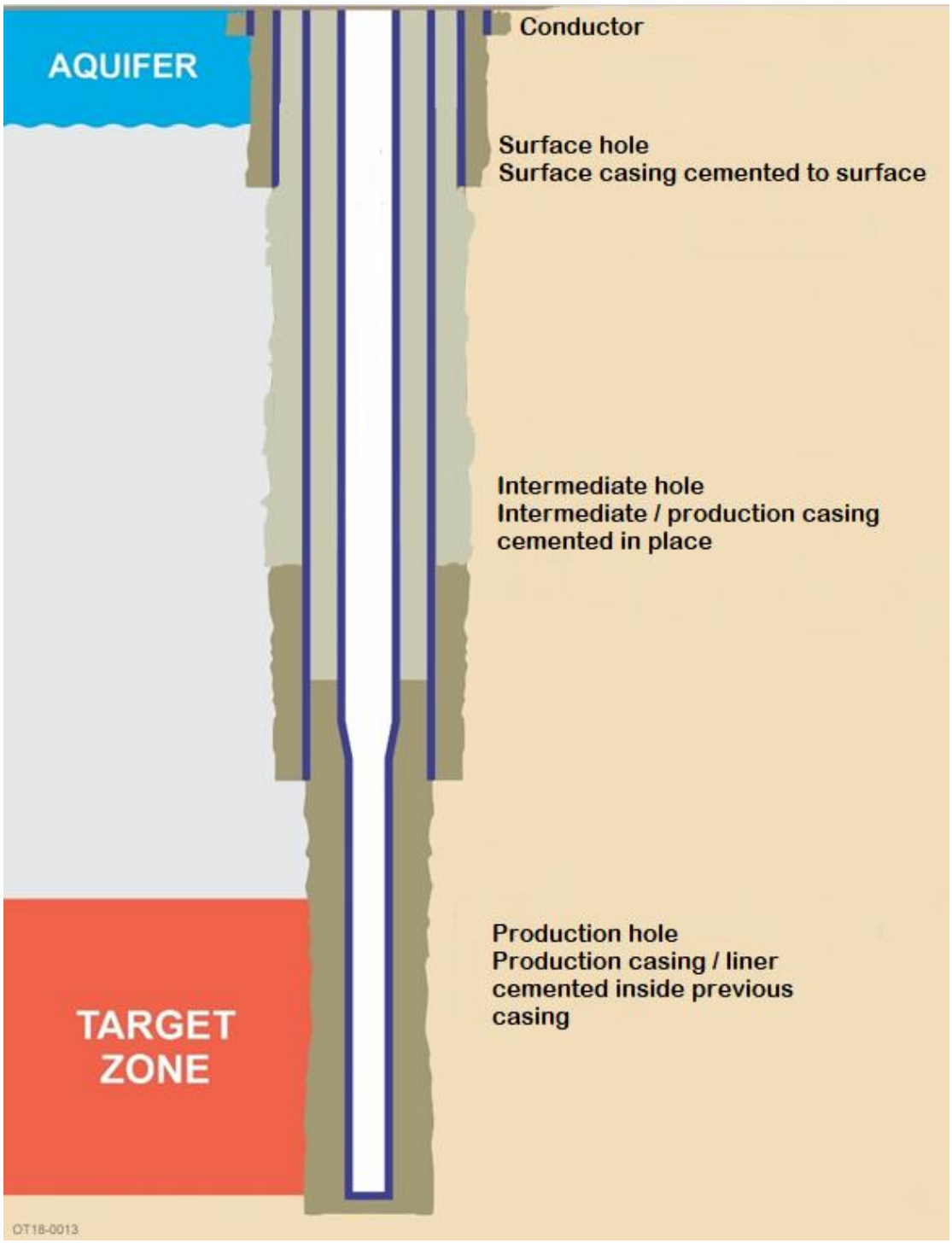

Figure 4: Indicative well design showing various casing strings

In line with the Drilling and Completions Technical Standards, the composition of cement is determined at the Basis of Design stage for each well taking into consideration the well conditions and lessons learnt from a regional and local level. Specialist technical engineers design the cementing program for a well in accordance

with international standards and placement of the cement slurries in accordance with the Technical Standards.

Variations to this indicative well design are possible, however the general principles of drilling, casing and cementing would remain the same. It is possible that wells could also be drilled with directional sections. The well construction is likely to be similar to that shown in **Figure 4** except that while drilling the deepest part of the hole (the 8 ½" hole 2), the well trajectory would be gradually steered from the vertical to the required angle in the target layer.

Logging is carried out during or after drilling, to measure the physical properties of the target formation to provide information on the lithology, formation fluid, formation porosity and formation permeability. Cores may be taken to obtain samples of the rock at specific depths. Reservoir pressure data and fluid samples may also be acquired. Logging can be performed whilst drilling or using wireline logging tools.

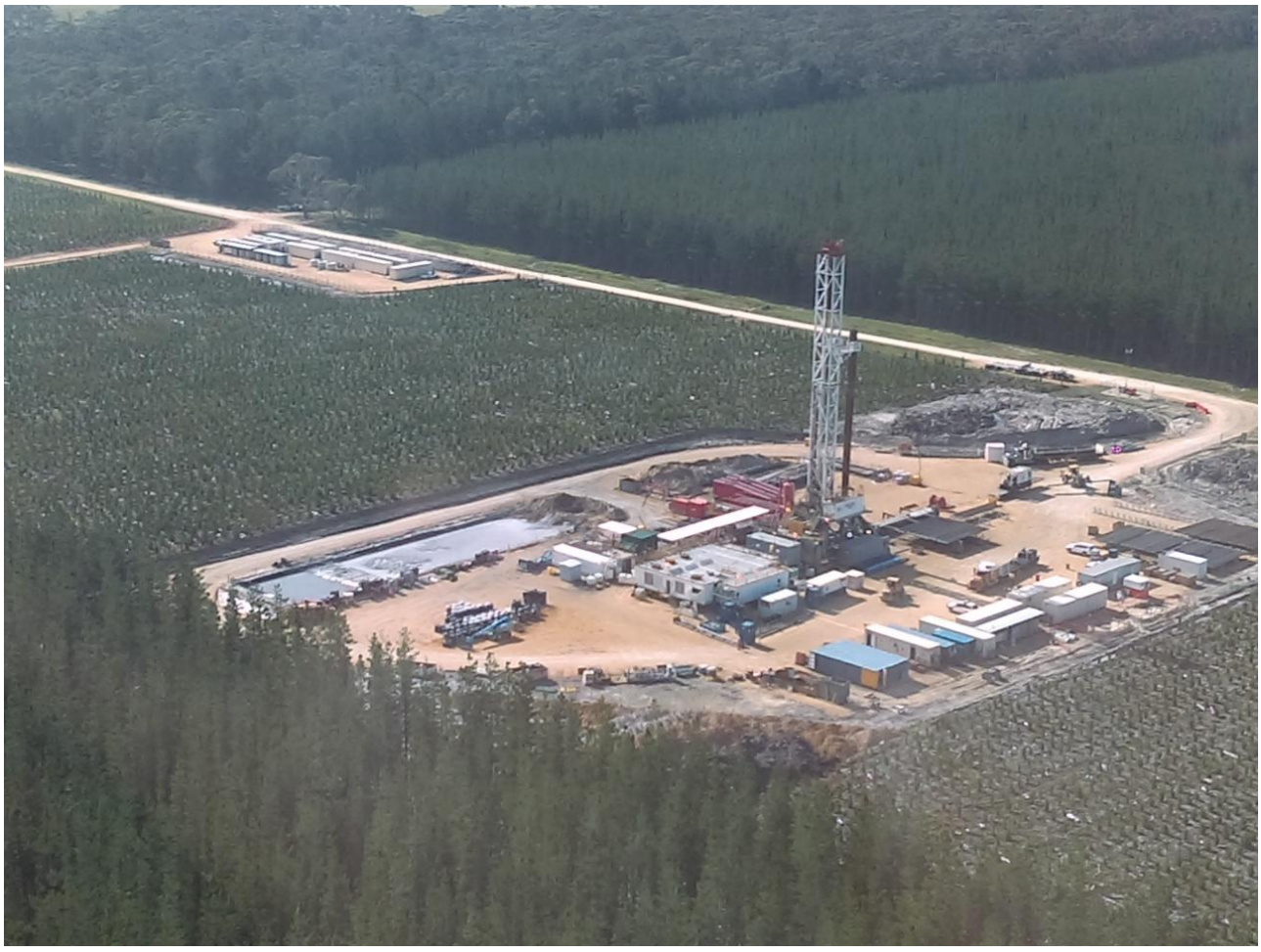

Plate 1: Drilling rig operating in the onshore Otway Basin, near Penola (Haselgrove-3, 2017).

Well testing may be used to evaluate pressures and production from any potential hydrocarbon producing formation(s). Drill stem tools would be set to cover the zone of interest, and if the well has potential to flow, it will produce to the surface where it is measured. The production would flow through a separator tank or to a flare stack. Any small quantities of water produced would be directed to the sealed tank and removed off site for appropriate disposal at a licensed facility.

A range of chemicals may be used during drilling, completion and testing operations, including but not limited to:

- polymers e.g. PHPA (partially-hydrolysed polyacrylamide)
- barites
- biocide
- bentonite
- caustic soda
- LCM (lost circulation material)
- potassium chloride
- sodium chloride
- sodium sulphite
- synthetic base fluid for synthetic based mud (SBM) drilling fluids.

Drilling fluids are used to transport drilling cuttings to the surface, maintain well-control, preserve wellbore stability, and cool and lubricate the drill bit and drill string during drilling. Water-based fluids (water-based muds, WBM) will predominantly be used for drilling operations. Water-based fluids consist of water mixed with potassium chloride, bentonite clay and barite to control mud density. Other substances are added to gain the desired fluid properties to assist with drilling parameters and removing drilled cuttings from the hole.

Water-based mud would be used to drill to the top of the Laira formation. However, synthetic based muds (SBM) may be used below this point to assist with drilling parameters and hole stability if required. SBM are emulsions where the base fluid is a synthetic fluid. As with water-based fluids, weighting materials such as barite are used to provide sufficient fluid density. SBM were developed for offshore drilling to improve both the technological and environmental profile of drilling fluids over traditional oil-based fluids. This fluid has superior inhibition characteristics when compared to WBM as it limits clay swelling and dispersion as well as improving clay stability. The use of SBM also reduces drag, torque and friction as a result of improved lubrication. SBM are also designed to be readily biodegradable and undergo technical review and improvement based on performance. Appendix B provides further information on SBM. Different SBM providers may have their own proprietary compounds, which are generally from the same group of chemicals but with different amounts of, or slightly different, active ingredients. It is expected that the additives used by different providers in the future are likely to be similar to those outlined in this document.

Drilling fluids selection and management will be undertaken in line with the Beach Drilling and Completions Technical Standards to ensure that handling, management and disposal of drilling fluids does not pose an unacceptable risk to the environment.

Cuttings and drilling fluids will be contained in the lined sump or tanks during drilling operations and subsequently tested and disposed of at appropriately licensed waste disposal facilities.

When drilling sections with SBM the lined sump will not be used to manage drill cuttings. The drill cuttings will be separated from the drilling fluids by means of bunded solids separation equipment. The drill cuttings will be held in specially designed cuttings bins and transferred via EPA licensed waste contractors for disposal

at a licensed facility. Fixation material (e.g. sawdust) will be used as required to ensure the waste is fit for transport.

If commercial quantities of hydrocarbons are discovered, well production testing may be carried out, as discussed in Section 3.4. If a well fails to discover commercial quantities of hydrocarbons it will be decommissioned as discussed in Section 3.5.

3.2.1 Fuel and Chemical Storage

A variety of fuels and chemicals are required for drilling and well operations. These include fuel, lubes, oils, solvents and drilling mud additives. The volumes and types of chemicals used are dependent upon the type of operation. Fuels, oils and chemicals are stored in accordance with applicable standards and guidelines (e.g. AS 1940, EPA guideline *080/16 Bunding and Spill Management* and the Australian Dangerous Goods Code), typically in approved containers in polythene lined bunded areas or on bunded pallets.

3.2.2 Waste

A range of wastes are generated during drilling and well operations. They include:

- domestic waste (e.g. food waste and packaging, plastic, glass, cans and paper)
- industrial waste (e.g. workshop waste (rags, filters), chemical bags and cardboard packaging materials, scrap metals, used chemical and fuel drums, chemical wastes and timber pallets).

Waste streams are segregated on site and collected and stored in covered bins before being collected for transport off-site by a licensed regulated waste contractor to an appropriately licensed facility for reuse / recycling (where possible) or disposal. Waste management practices will be guided by the principles of the waste hierarchy (i.e. avoid, reduce, reuse, recycle, recover, treat, dispose).

3.3 Completions and Workovers

In the event of a significant gas or oil discovery, well completion activities may be carried out by the drilling rig to prepare the well for production testing. They are carried out after running and cementing the production casing and installation of the well head, and may include cleaning out the casing, perforating the zones of interest, running tubulars, setting packers, installation of well head valves to control the flow of hydrocarbons, running production logging tools and static gradients.

Workover operations may also be carried out on a well. These activities may include cleaning sand out of the well, replacing liners, plugging the well, repairing casing, drilling deeper, drilling around any obstructions in the well, and re-perforating existing zones in production. Some workovers require only wireline equipment to lower tools into the hole to conduct operations, but others require a workover rig to be moved to the location. Pumps and storage tanks are required for operations that need to circulate workover fluids in the well. Workovers typically occur later in a well's life span and in this instance would be undertaken under the *Statement of Environmental Objectives: Onshore Otway Basin Petroleum Production Operations* (Beach 2025).

3.4 Well Production Testing

In the event of a significant gas or oil discovery, the well will be completed and a well production test undertaken. Initial well production tests typically take place over a period of several days, however, extended

well production testing may be necessary over a number of weeks on exploration and appraisal wells to allow for more detailed information on the reservoir.

3.4.1 Well Production Testing – Gas

In the case of a potentially producing gas discovery, a single / multirate flow and build-up operation would be undertaken, with produced gas flared off. Details will be dependent on the outcome of drilling, but a well production test for gas, while 'producing' under the meaning of the Petroleum Act, will not require significant additional surface infrastructure. A separator may be required to remove liquids to a tank for measurement and subsequent transportation by a licensed contractor to a processing or licensed waste disposal facility. If well production testing were successful, approval would be sought for upgrading to production rather than exploration facilities. An example of gas well production testing using a vertical flare is shown in **Plate 2**.

3.4.2 Well Production Testing – Oil

If warranted by oil shows, a drill stem test(s) would run with open / shut-in times based on hole and drilling conditions. Any zones would be progressively tested, based upon quality of oil shows. Total oil volume produced from such drill stem tests is low, likely from nil to 50 barrels maximum. Further oil well production testing may be performed to provide increased confidence in the commercial possibilities of the discovery. This testing would be conducted over a 24-hour to 7 day period following completion of the well. Produced oil would be stored in a special purpose tank for subsequent transport to a processing facility.

Plate 2: Gas Well Production Testing in the onshore Otway Basin (Haselgrove-3, 2018).

3.5 Well Decommissioning

Following the drilling of a well and testing and evaluation of its potential, a decision is made on whether to proceed with production of the well or to decommission it. If a decision is made to decommission the well the following steps are undertaken:

- bond logs, if conducted, are evaluated to ensure that the cement behind the production casing is adequate to avoid crossflow of potential aquifers with other aquifers or hydrocarbon producing zones
- if isolation is deemed insufficient, a decision may be made to access outer annuli to place appropriate plugs to achieve isolation of potential aquifers from other aquifers or hydrocarbon producing zones
- plugs are set to isolate all formations that have hydrocarbons[3]
- plugs are set across separate aquifers[3]
- a plug is set at the surface prior to cutting off the well head
- an abandonment plaque is posted (generally on the nearest fenceline).

The well site is then cleaned up and reinstated as described in Section 3.6 below.

Decommissioning programs are submitted to DEM for prior approval.

3.6 Site Clean-up and Reinstatement

Rehabilitation and restoration of the access road, camp and drill pad will be completed to meet the landowner's approved requirements.

If the well is decommissioned following drilling (i.e. 'plugged and abandoned' as a dry well) and the landowner does not seek to use the paved area, all paving material brought to the site will be removed. If the well is completed for production, the site will be partially restored, leaving sufficient pad and access required for a production well.

A fence will be installed around the sump following drilling. Contents of the sump will be tested to analyse their suitability for reuse, industrial recycling, fill or disposal as waste. Water from the sump may be removed for reuse if water quality meets applicable criteria for the reuse (e.g. *Environment Protection (Water Quality) Policy 2015*, ANZECC criteria). Sump contents to be disposed as waste will be removed by a licensed

[3] In general, within the Otway Basin and as required within recently decommissioned wells, isolation plugs will be placed across the following zones:

- between the unconfined Gambier Limestone and overlying sediments (including Bridgewater Formation) and the underlying confined Dilwyn Formation;
- between the Dilwyn Formation and the underlying condensed Sherbrook Group, in the event that there is evidence that aquifers are present;
- between unnamed intra-Eumeralla Formation sandstones and any overlying or underlying sandstones;
- between the Windermere/Katnook sandstones and the Laira Formation to ensure isolation from the Pretty Hill and/or Sawpit Sandstones;
- between the Pretty Hill Sandstone and the Upper Sawpit Shale to isolate the deeper Sawpit Sandstone; and
- between the Sawpit Sandstone and any deeper reservoirs within the Crayfish Group.

In the event that any additional sandstones (not identified above) are intersected with flow potential, these must also be isolated as a precautionary measure.

contractor to an EPA licensed waste disposal facility, as soon as possible after drilling is completed. The liner will be removed and the previously excavated sump materials will be returned in the correct order.

All pits including excavations for the septic tanks will be backfilled with previously excavated materials in correct order, so that normal cropping or grazing practices can resume after decommissioning of the site.

The original topography and slope of the well site will be restored and any topsoil evenly redistributed across the disturbed area to ensure that the original drainage and cropping potential are restored.

The whole area previously gravelled will be tine ripped before replacing of stockpiled topsoil. This alleviates soil compaction and enables good rehabilitation back to pasture or crops. Small stones not picked up by front end loaders or excavators will be rolled into the soil as is common farming practice. A final shallow ploughing / harrowing will be carried out to ensure soil aeration and permeability. A crop / pasture will then be sowed for additional soil stabilisation. Perimeter fencing is generally left in place until vegetation is well established.

If well sites are established in areas where native vegetation is present, site-specific rehabilitation methods will be developed. These may include re-spreading of cleared vegetation, reseeding or revegetation with local native species, or encouragement of natural regeneration by appropriate site preparation in areas where this is likely to be successful. Restoration is usually carried out in autumn to avoid the summer heat and dry soil conditions and to make the best use of autumn and winter rains to achieve the maximum vegetation regrowth. All restoration and rehabilitation activities will be undertaken in consultation with, and to the satisfaction of the landowner. If the landowner wishes to retain suitable infrastructure such as tracks or hard stand areas, they may be handed over under a deed of transfer or similar.

Plate 3 shows a rehabilitated well site (Cowrie-1) in the onshore Otway Basin north-west of Penola in July 2013, approximately seven years after drilling and rehabilitation.

Plate 3: Rehabilitated Cowrie-1 well site (July 2013).

3.7 Traffic

Construction of the wellsite, mobilisation and demobilisation of the drilling, rig, camp and other associated equipment and site clean up and reinstatement will result in temporary increases in traffic movements on local and regional roads.

The drilling rig will be mobilised to site using public roads and the well access track. Traffic movements for a drilling operation would typically include 65-75 trucks for the drilling rig move, 10 trucks for the camp move, 15 trucks for casing, 4 trucks for cement, fuel deliveries every 5 days and food supply delivery weekly.

The rig, camp and ancillary services generally arrive on site over a period of 3-4 days at the start of the well and depart in a similar fashion upon conclusion of the well. Stakeholders (e.g. landholders, local councils, potentially affected residents) and emergency services are informed of significant activities such as rig mobilisation and demobilisation.

Daily traffic movements to and from the well site are relatively limited once drilling starts and are generally restricted to low numbers of light vehicles and the supply truck movements noted above. Cementing, logging and testing contractor personnel will be mobilised as required and visitors may access the site under control of the drilling supervisor. Access by the general public will be restricted.

4. Description of the Environment

This section provides an overview of the environment of the lower South East of South Australia, with a focus on the region encompassed by Beach's licence areas. The assessment area (refer **Figure 5**) is based on the previous boundaries of Beach's PEL 494 permit prior to relinquishment of specific portions of this area in early 2025.

4.1 Climate

The climate of the lower South East of South Australia is described as Mediterranean, with warm dry summers and cold wet winters (South East NRM Board 2010). The southern coastal zones of the region typically experience high average rainfall which gradually decreases inland and towards the north. Annual rainfall ranges from approximately 850 mm in the south of the region, to approximately 450 mm further north. A summary of climate records for Coonawarra (Station no. 026091; BOM 2024) is provided in **Table 1**.

Table 1: Temperature and rainfall records for Station #026091 (Coonawarra)

	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Mean Daily Max (°C)	27.6	27.5	25.0	21.0	17.2	14.5	13.9	14.9	17.0	19.6	22.6	25.1	20.5
Mean Daily Min (°C)	11.8	11.8	10.3	7.9	6.9	5.4	5.1	5.4	6.5	7.3	8.9	10.2	8.1
Mean Rainfall (mm)	26.3	18.2	25.6	34.9	54.8	74.2	79.5	79.2	60.9	45.7	35.7	35.9	559.3
Median Rainfall (mm)	18.3	13.9	19.8	29.2	51.2	68.9	75.7	76.8	63.0	42.5	35.2	26.8	541.1

Highest Rainfall (mm)	101.7	55.6	80.0	83.6	120.2	168.9	143.0	160.8	134.4	90.8	80.3	105.4	746.4

Source: Station no. 026091; BOM 2024

The Coonawarra climate data indicate that mean daily maximum temperatures across the Beach licence areas range from approximately 13.9°C in the coolest months (June to August) and 27.6°C in in the hottest months (December to March). Mean daily minimum temperatures range from between 5.1°C in the cooler months to 11.8°C in the hottest months.

Average annual rainfall at Coonawarra is 559 mm. Maximum rainfall occurs during July and August. The highest monthly rainfall recorded is 168.9 mm, in June 2003. The highest daily rainfall event on record (79.6 mm) occurred in January 2007. Winds tend to come from the south during the morning, and from the east and north east during the afternoon.

4.2 Landform and Soils

The South East, known as the Limestone Coast region, is characterised by a series of stranded dune ranges that rise between 20 m and 50 m above interdunal plains. The region hosts an extensive network of limestone sinkholes and caves, including the World Heritage-listed Naracoorte Caves (located approximately 30 km to the north of the licence areas) as shown in **Figure 6**.

Soils vary from sandy pedal mottled-yellow duplex soils, red weakly structured sandy soils, bleached sands and black organic soils. Wetland areas, such as Bool Lagoon, located approximately 5 km north of PEL 494, are black self-mulching cracking clays. The dunal ranges are comprised of a mix of deep sands and the interdunal flats are characterised by either heavier clays that overlie limestone or sands that overlie clay. The swamps are comprised of medium and fine textured saline soils. Along the coast soils are mostly calcareous sand with some small areas of acidic and alkaline peats (SENRCC 2003).

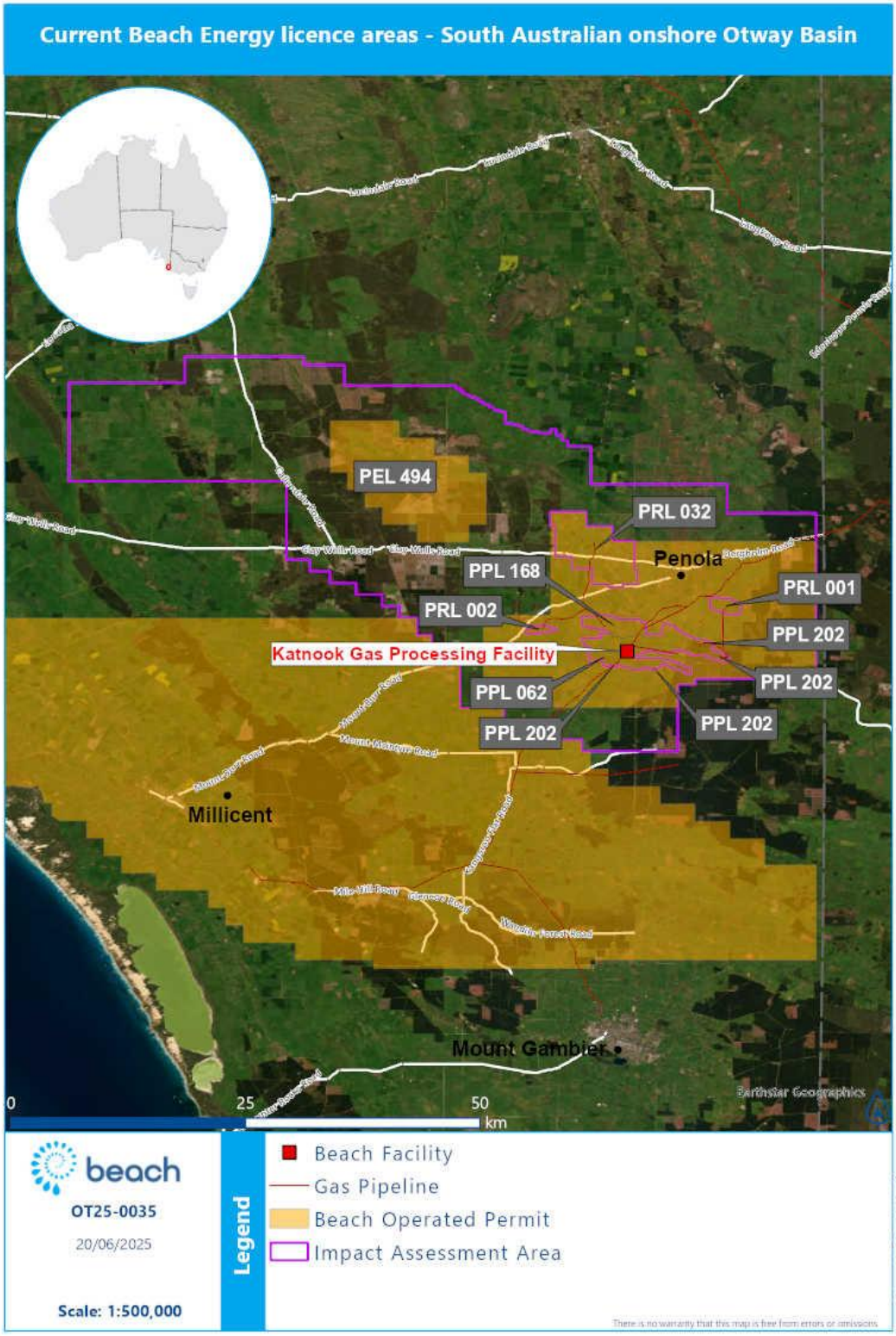

Figure 5: Beach Existing Permits and the Impact Assessment Area

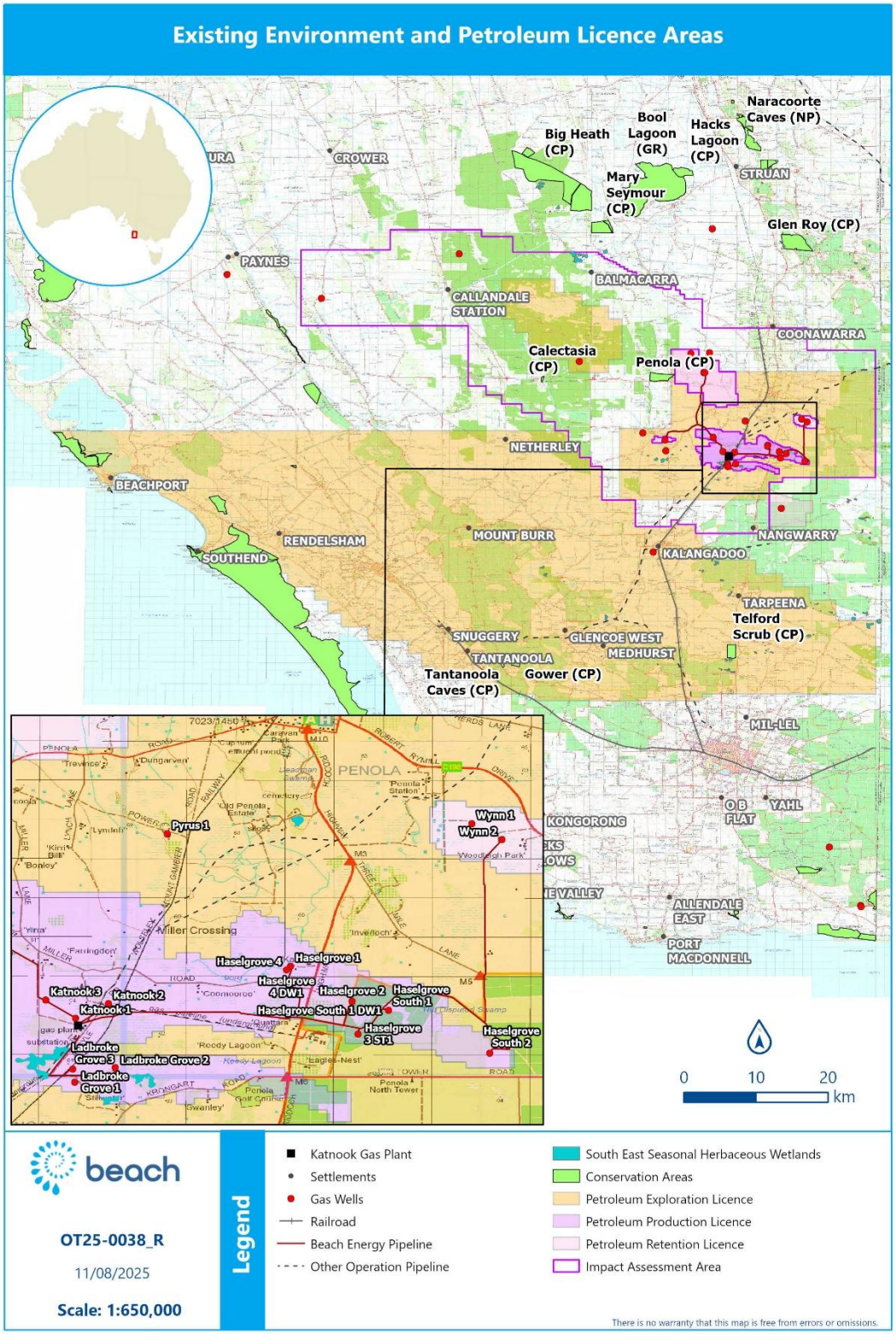

Figure 6: Existing environment and Petroleum Licence Areas

4.3 Petroleum Geology

The Otway Basin began to form in the Late Jurassic / Early Cretaceous as Australia began to separate from Antarctica about 145 million years ago.

Basement in the Otway Basin generally consists of Palaeozoic igneous rocks and metasediments of the Kanmantoo Fold Belt. Dome minor hydrocarbon recovery has occurred from fractured basement sections, when the fault geometry is favourable.

The earliest sediments to be deposited in the subsiding basin were shales of the Casterton Formation. This unit was deposited in a low energy environment (Kopsen and Schofield, 1990) such as a lake and the organic material within is interpreted to be the source of the gas, condensate and oil discoveries in the south-east of South Australia.

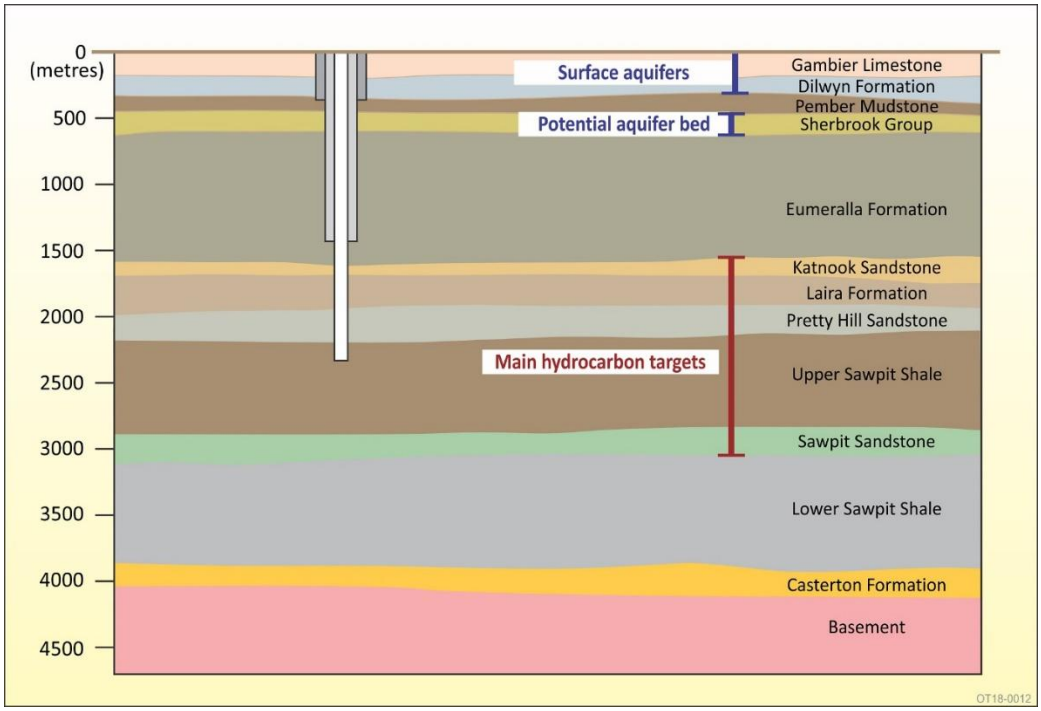

Figure 7: Indicative X-section in the onshore Otway Basin, showing expected stratigraphy and targets

The overlying the Casterton Formation are the Lower Sawpit Shale, Sawpit Sandstone, Upper Sawpit Shale, Pretty Hill Sandstone, Laira Formation and Katnook Sandstone. These were deposited during episodic rifting, driving crustal extension during the Lower Cretaceous. Like the Casterton Formation, the Lower Sawpit Shale was also deposited in a low energy environment, and it may also be the original source of oil, gas and condensate discoveries.

The overlying Sawpit Sandstone and the younger sand units, the Pretty Hill Sandstone and Katnook Sandstone are interpreted to be deposited in a braided stream environment and these units have traditionally been the main target of oil and gas exploration in the south-east of South Australia as they are reservoir rocks. All three units have flowed gas or gas, oil and condensate upon testing. For example, the Katnook Field produces gas that flows out of the Pretty Hill Sandstone reservoir.

The Upper Sawpit Shale and Laira Formations are comprised of siltstone and shale and were deposited in a low energy environment such as a floodplain or lake. Both of these units are important as they act as seals to

the Sawpit Sandstone and Pretty Hill Sandstone respectively thereby trapping hydrocarbons at depth, and isolating the reservoirs from the shallower aquifers.

A period of structural activity occurred after the Katnook Sandstone was deposited about 125 million years ago. The surface was uplifted and eroded before activity waned and a thick sequence of interbedded shales, siltstones and fine-grained sandstones of the Eumeralla formation was deposited on a fairly low relief, slowly subsiding surface possibly in an expansive system of shallow lakes.

The overlying Sherbrook Group of Late Cretaceous age is a thin sandstone sequence in the northerly part of the South Australian Otway Basin but in the south and particularly offshore it thickens and can be subdivided into lithological units representing the facies of a delta system (Moreton, 1990).

The overlying Tertiary aged sediments are also relatively thin onshore, consisting mainly of sandstones of the Dilwyn Formation and shales of the Pember Mudstone and fossiliferous limestones of the Gambier Limestone. The Dilwyn, Pebble Point and Pember formations were probably deposited in a fluvial-deltaic setting (Gravestock *et al*. 1986) and the overlying Gambier Limestone in a prograding marine sequence. All the Tertiary units thicken offshore. The Gambier Limestone and the Dilwyn Formation are important aquifers for the south-east of South Australia.

The Haselgrove-3 ST1 well was drilled in January 2018 as a deviated well to a total measured depth of 4,331 m and targeted the Sawpit Sandstone and shallower Pretty Hill Sandstone.

Figure 7 shows an indicative cross-section in the onshore Otway Basin. The deep formations that are being targeted for hydrocarbon exploration are shown, along with the near-surface aquifers of the Gambier Limestone and Dilwyn Formation.

4.4 Bioregions

The licence areas fall within the Bridgewater, Lucindale and Glenelg Plain IBRA (Interim Biogeographical Regionalisation for Australia) sub-regions of the Naracoorte Coastal Plain IBRA region. The Naracoorte Coastal Plain IBRA region is a broad coastal plain of Tertiary and Quaternary sediments with a regular series of calcareous sand ridges separated by inter-dune swales, and closed limestone depressions.

The area is primarily a coastal plain with clayey lagoon deposits and isolated sand and calcarenite dunes. Adjacent to the coast are indurated dunes of calcareous sand and dunes of orange sand. In some areas, particularly within the Dismal Swamp IBRA association of the Glenelg Plain sub-region, are plains that are locally veneered with sand, frequent swamps and lakes backed by low lunettes (crescent shaped clay dunes).

4.5 Flora and Fauna

4.5.1 Vegetation Communities

There has been widespread vegetation clearance across the Limestone Coast region. The proportion of native vegetation remaining ranges from approximately 2.5% remnant vegetation within the Hundred of Mount Muirhead (north of Millicent) to 19% in the Hundred of Waterhouse. The majority of areas average approximately 10% remnant vegetation. Remnant vegetation mapping in the licence areas indicates native vegetation cover ranging approximately from 8% to 14% (NatureMaps 2018).

Broad vegetation communities present include eucalypt woodland and forest, mallee, coastal shrublands, heath, shrublands, coastal tussock grasslands, sedgeland, and fernland (Croft *et al*. 1999). A list of floristic

communities mapped in areas of remnant native vegetation within Beach's licence areas is provided in Appendix A.

4.5.2 Biodiversity Values

The Limestone Coast of South Australia, together within adjacent areas in Victoria, is considered one of Australia's 15 national biodiversity hotspots (DSEWPC 2009). The Limestone Coast region includes two Ramsar-listed wetlands, with one (Bool Lagoon) approximately 5 km north of PEL 494 and the Piccaninnie Ponds Karst Wetlands located on the coast approximately 55 km south of the boundary of the exploration licence.

The region is a transition zone, grading from the temperate climate to a more arid landscape in the west. As a result, species adapted to temperate environments as well as species adapted to more arid environments are both present.

More than 1,300 native flora species and 750 native fauna species have been recorded in the Limestone Coast (Croft *et al*. 1999). Many of these species are restricted to the Limestone Coast region, including 4% of the plants, 16% of the mammals, 9% of the birds (vagrants and seabirds), 8% of the reptiles (excluding sea turtles), 4% of the frogs and 5% of the fish.

4.5.3 Threatened Ecological Communities

Many ecological communities in the Limestone Coast region are now considered threatened, principally as a result of widespread vegetation clearance. Of the 34 ecological communities that have been mapped in the Limestone Coast region, 27 communities that are considered threatened (i.e. that have less than 10% of the original pre-European settlement area remaining) have been identified (Croft *et al*. 1999). The threatened ecological communities (TECs) are typically grasslands, grassy woodlands, or associated with wetlands and interdunal flats. These communities are now mainly confined to roadsides, railways, drainage reserves and small areas of Crown Land such as water reserves. These are key significant areas of remnant vegetation (Croft *et al*. 1999).

A search of the EPBC Act Protected Matters Database (DCCEEW, 2024) identified three nationally listed threatened ecological communities potentially present within the region (**Table 2**).

Table 2: EPBC Act-listed threatened ecological communities (TECs) potentially occurring within PEL 494

Community Name	EPBC Act Status	Presence
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	Endangered	Community known to occur within area
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area

A review of vegetation mapping (Nature Maps (DEW), 2025) (DCCEEW, 2025) indicated that there are 19 occurrences of the Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains (referred to as Seasonal Herbaceous Wetlands) identified within PEL494 with three of these occurring within the PPL62, including one approximately 150 m south of the KGPF boundary which has been fenced to control stock access, particularly when the wetland is filled. The Seasonal Herbaceous Wetlands ecological community was formally listed as critically endangered under the EPBC Act in March 2012. Seasonal Herbaceous Wetlands occur on lowland plains, where they are generally associated with fertile, poorly draining clays; in some cases, including Gilgai (shrinking/swelling mounded clay soil formations).

Seasonal Herbaceous Wetlands typically fill and dry annually, however, in a drought or unseasonal wet phase they may appear respectively ephemeral or permanent for occasional periods. They are generally very fresh, with salinities of less than 1,000 mg/L, however, during drying it is possible that they may evapo-concentrate, with salinities increasing up to 3,000 mg/L (Dickson *et al.* 2014).

There are no mapped occurrences of the other two TECs within the licence areas (NatureMaps 2018).

4.5.4 Threatened Flora

The Limestone Coast region supports a large number of rare or threatened plant species, which predominantly occur within patches of remnant native vegetation. For the purposes of this discussion, two extents and searches of the Biological Databases of South Australia (DEW 2024[4]) have been carried out. The initial extent covered all areas within PEL 494. The second extent covers all areas within Beach's production and retention licences.

The wider search of PEL 494 identified a total of 135 flora species recorded and listed as rare or threatened at State level; including, 22 endangered species, 33 vulnerable species and 80 rare species. Further detail on these species is provided in Appendix A.

A refined search of Beach's production and retention licence areas identified a total of 17 flora species listed as rare or threatened at State level; including, one endangered species and 12 rare species and one vulnerable species. There were no records of species listed under the EPBC Act recorded within areas covered by Beach's production or retention licences.

A search of the EPBC Protected Matters Search Tool (PMST) was also conducted. Seventeen plant species that are listed under the EPBC Act have been recorded in, are likely to occur or may occur within PEL 494 and these species are listed in **Table 3**.

Table 3: EPBC Act listed plant species or species habitats recorded or potentially occurring in exploration licence area (PEL 494)

Species	Common Name	Conservation Status		Presence
		EPBC	SA	
Caladenia formosa	Elegant spider-orchid	V	V	Likely to occur
Caladenia tensa	Greencomb Spider-orchid	E	E	May occur
Caladenia versicolor	Candy Spider-orchid (or Grampians)	V	E	May occur

[4] This data has been sourced from the South Australian Department of Environment and Water Biological Database of SA.

Species	Common Name	Conservation Status		Presence
		EPBC	SA	
Dipodium campanulatum	Bell-Flower Hyacinth Orchid	E	V	Known to occur
Dodonaea procumbens	Trailing Hop-bush	V	V	Likely to occur
Glycine latrobeana	Clover glycine	V	V	Known to occur
Thelymitra epipactoides	Metallic sun-orchid	E	E	May occur
Thelymitra matthewsii	Spiral Sun-orchid	V	E	Known to occur

EPBC: *Environment Protection and Biodiversity Conservation Act 1999*; SA: *National Parks and Wildlife Act 1972*
Status: V: Vulnerable; R: Rare; E: Endangered; CE: Critically Endangered.

4.5.5 Threatened Fauna

A search of the BDBSA[4] for the wider search of PEL 494 identified a total of 57 fauna species recorded and listed as rare or threatened under the National Parks and Wildlife Act including 10 endangered species, 16 vulnerable species and 31 rare species. An additional 17 are identified under non-statutory listings in SA. Further detail on these species is provided in Appendix A.

A search of Beach's production and retention licence areas identified a total of 11 fauna species listed as rare or threatened at State level including 1 endangered species, 8 rare species and 2 vulnerable species. There are an additional two records of the Red-Tailed Black Cockatoo (*Calyptorhynchus banksii graptogyne*) (listed as Endangered under the EPBC Act) within or in close proximity to areas covered by production licences. There are records of this species 1.8 km west-north west of the Katnook plant facility, and 1.2 km south-east of the current Haselgrove 3 ST1 well. A recent survey of the Haselgrove-3 region[5] did not provide any new records for the species but did identify the presence of foraging habitat, Brown Stringybark Woodland, in proximity to the well.

Six fauna species listed as threatened under the EPBC Act have been recorded in the wider exploration licence area and these species are listed in **Table 4**. Further detail on these species is provided in Appendix A.

Table 4: EPBC Act listed fauna species or species habitat recorded or potentially occurring in the exploration licence area (PEL 494)

Species	Common Name	Conservation Status		Presence
		EPBC	SA	
Birds				
Botaurus poiciloptilus	Australasian Bittern	E	E	May occur
Calyptorhynchus banksii graptogyne	Red-tailed Black-cockatoo, south-eastern	E	E	May occur
Rostratula australis	Australian Painted Snipe	E	E	May occur

[5] South Eastern Red-tailed Black Cockatoo Survey Haselgrove-3. Undertaken by P.G. Tucker, July 2017

Species	Common Name	Conservation Status		Presence
		EPBC	SA	
Amphibians				
Litoria raniformis	Southern Bell Frog	V	V	May occur
Mammals				
Isoodon obesulus	Southern Brown Bandicoot, eastern	E	V	May occur
Miniopterus orianae bassanii	*Large Bent-wing Bat/ Southern Bent wing Bat*	*CE*	*E*	*May occur*

Source: EPBC: *Environment Protection and Biodiversity Conservation Act* 1999; SA: *National Parks and Wildlife Act* 1972

Status: V: Vulnerable; R: Rare; E: Endangered, CE: Critically Endangered

4.5.6 Significant Migratory Species

The EPBC Act Protected Matters Report (DCCEEW 2024) identified 13 migratory species listed under the EPBC Act as potentially occurring within the PEL 494 search area. The BDBSA search indicated that two of these species have been recorded in the area, as listed in **Table 5**.

Table 5: Listed migratory species recorded in the exploration licence area

Species	Common Name	Protected matters – type of presence
Apus pacificus	Fork-tailed swift	Species or species habitat may occur within area
Hirundapus caudacutus	White throated Needletail	Species or species habitat known to occur within area
Myiagra cyanoleuca	Satin Flycatcher	Breeding likely to occur within area
Gallinago hardwickii	*Latham's Snipe*	*Species or species habitat known to occur within area*

Source: BDBSA

4.5.7 Introduced Species

Weed Species

Sixty-four regional weed species declared under the LSA Act have been identified as priority pests by the Limestone Coast Landscape Board (Limestone Coast Landscape Board 2021b). Management goals for these species in the Limestone Coast Landscape Region aim to:

- Eradicate the species from the region (three species).
- Significantly reduce the extent of the species in the region (10 species).
- Prevent the ongoing spread of the species in the board region (21 species).
- Prevent spread to key sites or assets (22 species).
- Manage pests to reduce the overall impact through targeted management (three species).
- Manage sites to reduce the overall impact through targeted management (four species).

- Monitor to detect any significant changes (one species).

An additional 37 declared species have been identified as alert species, which although not present in the Limestone Coast (LSA Act) Region, or present in very limited numbers, are species with the potential for significant negative impacts if they become established (Limestone Coast Landscape Board, 2021b). A list of priority and alert weed species in the Limestone Coast Landscape Region is provided in Appendix A.

Pest Fauna Species

Twenty key pest fauna species have been identified by the Limestone Coast Landscape Board under the LSA Act for priority management in the region and are all declared under the LSA Act. The goal of the Board is to eradicate ten of the species from the region, prevent the ongoing spread of two species in the region, protect key sites or assets by preventing the spread of one species and reduce overall impact through targeted pest management of seven species (Limestone Coast Landscape Board, 2021b). A list of the priority pest fauna species of the Limestone Coast Landscape Region is provided in Appendix A.

Pathogens

Pathogens of potential concern in the region include the soil-borne fungus *Phytophthora cinnamomi,* which affects a wide range of native plant species but is yet to be recorded in the region (South East NRM Board 2010), the grape vine insect pest *Phylloxera* (which has to date been excluded from South Australia), and diseases such as Ovine / Bovine Johne's Disease (OJD / BJD).

4.6 Water Resources

4.6.1 Surface water

The Limestone Coast region has a low relief, with a general gradient toward the coast of 1:1600 and to the north less than 1:5000 (Croft *et al*. 1999). Across most of the region, surface water historically moved slowly towards the coast until meeting one of the ranges (the north-north-west trending low ridges), where it was directed northwards along the eastern side of the range. This resulted in extensive swamps and lakes, which were prevalent at the time of European settlement. There is generally a lack of surface streams and rivers, but where they exist, such as Morambro, Mosquito and Naracoorte Creeks, their catchments originate in western Victoria. Mosquito Creek discharges into the Ramsar listed wetlands of Bool and Hacks Lagoons.

Over the years an extensive drainage system has been constructed throughout the lower Limestone Coast region to drain water from inundated land. This network has altered the movement of surface water, directing it in an east–west direction and discharging it to wetlands, lakes or the coast. The implementation of the drainage system has allowed formerly inundated land to be developed, minimising the effects of water logging and removing salt from the region. In some areas the drainage network has prevented wetlands from receiving water thus altering the usual wetting and drying process typical of these ecosystems. This has caused a decline or change in the biodiversity in some areas (Paydar *et al.* 2009).

4.6.2 Groundwater

Groundwater is the primary source of water for the Limestone Coast and the region's economy, environment and community are all reliant upon this resource. Water resources in the area are also important from a social perspective as they provide drinking water, support recreation activities and enhance the appearance of the landscape. Many ecosystems are dependent on the groundwater of the region including wetlands, riparian

vegetation and near coastal marine environments which are important tourist attractions that contribute to the regional economy (Brown *et al.* 2006).

The groundwater resource that underlies the Limestone Coast encompasses some of the largest groundwater systems in Australia (Brown *et al.* 2006). The resource is made up of two distinct systems, an upper unconfined aquifer referred to as the Tertiary Limestone Aquifer (TLA) and a deeper confined aquifer referred to as the Tertiary Confined Sand Aquifer (TCSA). The flow of groundwater is generally in an east to west direction and originates from the topographic high of the Dundas plateau located in south-western Victoria (Paydar *et al.* 2009). Low permeability aquitards separate the two aquifers. Leakage through the aquitard has been assumed to be generally very low, except in areas where the aquitard is very thin, absent or fractured, such as around Tarpeena-Nangwarry (South East NRM Board 2010). However, recent work has revealed moderate to good hydraulic connection between the two aquifers and indicated that they are more highly connected than previously assumed (South East NRM Board 2019).

The unconfined TLA is utilised more extensively than the TCSA, however there has been increased interest in the resource of the lower TCSA due to the recent allocation of most of the available groundwater from the TLA.

Tertiary Limestone Aquifer (unconfined)

The unconfined TLA is comprised mostly of Gambier Limestone with a water table depth varying both spatially and temporally (SoilAttrib_SA_DepthToWatertable.pdf) (DEW, 2018) across the permit areas but is generally between 2 m to greater than 20 m. The aquifer thickness varies over the region with a maximum of 300 m occurring south of Mount Gambier. As well as primary porosity, the aquifer has significant secondary porosity resulting from karstic features within the limestone. The secondary porosity creates paths for preferential flow and gives rise to high transmissivity (200 m^2 / day to 10,000 m^2 / day). Groundwater flow at the local scale can vary which is largely the result of spatial variability of recharge and discharge (Paydar *et al.* 2009).

Recharge of the aquifer occurs primarily through the diffusion of rainfall on the flats and dunal ranges. Local contributions include seepage from wetlands and swamps, surface water discharge into sinkholes and returns from irrigation drainage. Upward seepage of water from the TCSA may also recharge the TLA in locations where differences in hydraulic head between the aquifers permit flow. Mean annual rates of recharge vary from a few mm / year to more than 150 mm / year with higher rates occurring in locations of higher rainfall or highly permeable soils. Groundwater discharge from the TLA occurs mostly to the sea in the area south of Mount Gambier. Some minor drainage also occurs via drains, wetlands, streams, springs and seeps.

Groundwater salinity varies extensively over the aquifer with less than 500 mg/L found in the south and 3,000 mg/L to 7,000 mg/L in the north and is increasing at a significant rate in some locations. Wells located between the townships of Naracoorte and Penola commonly exceed the resource condition salinity trigger value of 2% increase per year defined in the Water Allocation Plan (South East NRM Board 2019). The increase in salinity levels is likely to be due to either the recycling of irrigation drainage water, vegetation clearance or forestry harvesting with the resulting mobilisation of salt caused by an increase in vertical recharge (South East NRM Board 2019).

The water table has declined in some areas over the last 30 to 40 years and in other areas it has risen. In the area surrounding the Hundred of Stirling (located approximately 105 km north of PEL 494), the water table has fallen due to a drier climate and extraction of groundwater for irrigation, whereas in the upper Limestone

Coast, until recently, the water table was rising due to land clearing (Paydar *et al.* 2009). Throughout the Lower Limestone Coast, a review of the change in depth to the water table in the 10 years to March 2012 has revealed a general decline in depth to water, ranging from 0.5 metres to greater than two metres (South East NRM Board 2019).

Tertiary Confined Sand Aquifer

The TCSA occurs in the Dilwyn Formation within an interbedded sequence of sands, gravel and clays. The aquifer has varying depth and increases in thickness towards the south reaching more than 500 m near the coast. The flow of groundwater is generally in a westerly or southerly direction towards the sea. The aquitard separating the TCSA from the upper TLA is comprised of clay and marl units at the base of the Gambier Limestone and a clay unit at the top of the Dilwyn Formation (SENRCC 2003).

Recharge of the TCSA occurs at a slow rate (Brown *et al.* 2001), primarily on the eastern edge of the aquifer in Victoria and over some areas in SA. As there are very few areas in which the TCSA is exposed at the surface, vertical recharge is primarily through downward leakage of groundwater from the above TLA. This occurs mostly in the east where the head differences between the aquifers and the confining layer permit flow. The opposite is found in the west and south where the hydraulic head gradient provides the potential for upward flow of groundwater from the TCSA to the TLA (Brown *et al.* 2001).

Salinity of the groundwater within the TCSA is generally low, associated with low total dissolved solids (TDS) (less than 700 mg/L); however, there are areas where high salinity levels are found (associated with TDS of more than 1,500 mg/L) (Brown *et al.* 2001).

Deeper Units

Beneath the Dilwyn Formation is a number of deeper aquifers from the Late Jurassic, Early and Later Cretaceous and Tertiary ages of variable water quality and lateral extent down to over 4000 metres, which demonstrate increasing salinity with depth (South East NRM Board 2019). These aquifers are not used for irrigation, industrial or town water supplies due to their depth and generally high salinity (South East NRM Board 2019). The aquifers within these deeper formations are noted in the Lower Limestone Coast Water Allocation Plan (South East NRM Board 2019) as being of potential value as targets for petroleum and geothermal exploration and production. The value of these for alternate water supplies has not been investigated and evaluated.

4.6.3 Groundwater Monitoring

Beach undertake groundwater monitoring at each new drilling site, with groundwater monitoring wells installed as part of the initial works for drilling pad construction. Groundwater monitoring events are undertaken prior to drilling and at the end of the drilling campaign. Review of the results from all monitoring events will determine if continued monitoring is required.

Any results of concern would be reported in accordance with requirements of the ER Act, SEO incident definitions and the Environment Protection Act.

Monitoring bores were installed to 7.0 m below ground level at Haselgrove 3ST1 and the standing water level ranged between 5.6 to 6.4 m below the top of the casing which is typical for groundwater levels in the Penola region.

The monitoring work completed at the Haselgrove 3ST1 site in 2018, including comparison of post-drilling groundwater concentrations with pre-drilling baseline concentrations, showed no evidence of change to the chemical nature of shallow groundwater (including the Gambier Limestone Aquifer) as a result of exploration drilling activities undertaken.

Key observations from the Gambier Limestone monitoring results included:

- Salinity (as Total Dissolved Solids TDS) was 646 mg/L and within the Australia Drinking Water Guidelines (ADWG) limit of 1,200 mg/L for potable water.
- Groundwater pH ranged from 6.47 to 7.06, indicating slightly acidic to neutral groundwater conditions.
- Minor concentrations of multiple heavy metals were detected above the detection limit, some also exceeded the ANZECC guideline limits for freshwater ecosystems and/or irrigation (aluminium, arsenic, copper, lead, mercury, selenium, iron, manganese, phosphorous, nickel, silver and zinc). These elevated heavy metals were considered representative of background conditions.

Samples of shallow groundwater collected post drilling did not indicate concentrations of Total Recoverable Hydrocarbons (TRH) above the laboratory's detection limit. **Table 6** summarises results of the monitoring event at Haselgrove 3ST1.

Table 6: Summary results of Haselgrove 3ST1 groundwater sampling event

Analyte	Concentration	Analyte	Concentration
Aluminium	< 0.05-0.11 mg/L	Potassium	2–12 mg/L
Arsenic	< 0.001-0.009 mg/L	Sodium	88–410 mg/L
Barium	0.02-0.18 mg/L	Chloride	180-1300 mg/L
Beryllium	< 0.001 mg/L	Sulphate	33–57 mg/L
Boron	< 0.05 mg/L	Hardness as CaCO3	241–1250 mg/L
Cadmium	< 0.0001 mg/L	Alkalinity as CaCO3	1200–3500 mg/L
Chromium	< 0.001 mg/L	Ammonia	0.05–0.28 mg/L
Cobalt	< 0.001–0.006 mg/L	Nitrate	< 0.01–0.25 mg/L
Copper	< 0.001-0.007 mg/L	Nitrite	< 0.01-0.02 mg/L
Iron	0.66-9.4 mg/L	Nitrogen	< 0.1–3.0 mg/L
Lead	< 0.001 mg/L	Phosphorus	< 0.02 – 2.47 mg/L
Manganese	< 0.047–0.36 mg/L	TRH C6 – C9	< 0.02 mg/L
Mercury	< 0.0001 mg/L	TRH C10 – C14	< 0.05 mg/L
Molybdenum	< 0.005 mg/L	TRH C15 – C28	< 0.1 mg/L
Nickel	< 0.001–0.015 mg/L	TRH C29 – C36	< 0.1 mg/L
Selenium	< 0.002 mg/L	Benzene	< 0.001 mg/L
Silver	< 0.005 mg/L	Ethylbenzene	< 0.002 mg/L
Strontium	0.62-1.0 mg/L	Toluene	< 0.002 mg/L

Analyte	Concentration	Analyte	Concentration
Thorium	< 1 mg/L	Xylene (Total)	< 0.003 mg/L
Tin	< 0.005 mg/L	Polyaromatic Hydrocarbon (PAH Total)	< 0.1 mg/L
Uranium	< 0.005 mg/L	Electrical Conductivity	988–4900 uS/cm
Vanadium	< 0.005 mg/L	Cyanide (Total)	< 0.005 mg/L
Zinc	0.007–0.564 mg/L	Fluoride	< 0.05 mg/L
Calcium	80-650 mg/L	Reactive Silica	21.7 mg/L
Magnesium	10-42 mg/L		

4.6.4 Water Use

The most significant user of groundwater in the Limestone Coast region is the irrigation industry, accounting for 95% of total volume used (ABS 2016). The main irrigated crops are pasture grasses and lucerne. Groundwater is also used for grapevines, fruit and vegetables for human consumption, cereals, nurseries, stock water and domestic supplies. Most groundwater for consumption is extracted from the Gambier Limestone aquifer. Groundwater from the Dilwyn Formation aquifer is used as the primary water supply for Penola and Kalangadoo. Utilisation of Dilwyn Formation groundwater is likely to increase in the future as shallower groundwater becomes fully allocated. Plantation forests are also a considerable user of groundwater with over 150,000 ha of plantations located in the South East.

The total volume of water extracted from the unconfined aquifer in the Lower Limestone Coast Prescribed Wells Area was approximately 567,000 ML in 2010/11 (South East NRM Board 2019).

The TCSA is used as the primary water supply for eight towns in the region (Beachport, Kalangadoo, Kingston, Lucindale, Naracoorte, Port MacDonnell, Robe and Tarpeena) and is an important source of water for irrigation and aquaculture, particularly around Kingston and Robe (South East NRM Board 2019).

The aquifers that supply the surrounding populations and industry are separated from gas bearing reservoirs by a number of major regional aquitards (low permeability rocks) including the Eumeralla formation, Pember Mudstone and Dilwyn Clay. The major regional aquitards can be more than 1,000 m in thickness.

4.7 Land Use

4.7.1 General Land Use

The Limestone Coast region of South Australia is comprised of exceptionally fertile land accounting for three-quarters of the State's forests and one-third of its pastures. The area supports a diverse range of industries including wool, meat, dairy, cereal cropping, wine grapes, horticulture crops and crop and pasture seed production, all of which are heavily dependent upon water resources in the region. In general, the northern areas of the Limestone Coast are used for cropping and the cooler, wetter southern areas are used for livestock grazing and forestry (Binks 2000). Beef cattle are found throughout the region and are the most prominent livestock in the Limestone Coast region.

There are approximately 2,300 farms in the Limestone Coast region with over 80,000 ha of this land being irrigated. Crops include cereals, pasture for seed, vegetables, vegetable seeds, oil seed, fruit and nuts and fodder crops. The largest areas of grapevines are seen in the long-established Coonawarra district and more recently in the Padthaway area (to the north of the licence areas). The vineyards are located on slightly elevated areas within the plains in friable, highly permeable clays of moderate to high fertility. The lucerne seed industry is concentrated around the town of Keith (north of the licence areas) and there is limited horticultural activity on the loams derived from volcanic ash and drained clay soils of Mount Gambier and Millicent respectively.

Since the establishment of forestry plantations in the late nineteenth century, the commercial forestry industry, has thrived in the area with over 150,000 ha currently planted, representing 84% of the State's total, encapsulating 35% of employment in the region and contributing an estimated $759 million and directly and indirectly to gross regional product (PIRSA, 2017). Radiata Pine (*Pinus radiata*) and Tasmanian Blue Gum (*Eucalyptus globulus*) are the species most commonly planted and are located in the areas of highest rainfall on sandy soils.

Tourism is a large contributor to the local economy, with over 550,000 visitors to the Limestone Coast region per year, directly employing 1,800 people (South Australian Tourism Commission, 2017). Key attractions include coastal resorts at Robe and Beachport, Naracoorte Caves and Tantanoola Caves, Coonawarra, Wrattonbully, Padthaway and Mount Benson wine regions, Bool Lagoon and the Blue Lake (South Australian Tourism Commission, 2017).

Gas production occurs at Beach's Katnook gas plant (located approximately 10 km south of Penola), which is fed by a network of pipelines from approximately 12 wells in surrounding gas fields. Since the 1960's approximately 80 oil and gas wells have been drilled in the region. The Katnook gas plant feeds into the South East Pipeline system, which supplies gas to regional industries and the town of Mount Gambier. Gas production from the Katnook gas plant has declined in recent years, and the majority of the gas fed into the South East pipeline system is currently obtained from the SEA Gas pipeline via the SESA pipeline, which runs from Poolaijelo in Victoria to Katnook. Origin Energy's 86 MW Ladbroke Grove power station is located adjacent to the Katnook plant, and it provides peaking power from its gas-fired turbines during periods of high demand for electricity.

4.7.2 Conservation Areas

The Limestone Coast Landscape Region contains three National Parks, 53 Conservation Parks and four Game Reserves established under the National Parks and Wildlife Act (South East NRM Board 2010). Several reserves established under the National Parks and Wildlife Act are located in the vicinity of, within or overlap the impact assessment area and are shown in **Figure 6**. Two conservation parks occur within the impact assessment area and in proximity to PEL 494:

- Penola Conservation Park (within impact assessment area immediately to the west of PRL 32 and the eastern block of PEL 494)
- Calectasia Conservation Park (within impact assessment area and ~5km south of the western block of PEL 494)

This EIR and the SEO do not cover activities in reserves established under the National Parks and Wildlife Act or exploration activities immediately adjacent to a Marine Park established under the *Marine Parks Act 2007*.

The region also includes a number of other protected areas, including Native Forest Reserves established under the *Forestry Act 1950* and Heritage Agreement Areas established under the *Native Vegetation Act 1991*.

Bool and Hacks Lagoons lie to the north of the impact assessment area and are listed as wetlands of international importance under the 1971 Ramsar Convention and are consequently covered by the Commonwealth EPBC Act.

The World Heritage-listed Naracoorte Caves are located in the Naracoorte Caves National Park and lie to the north of the impact assessment area. This site is also covered by the EPBC Act.

4.8 Social Environment

The Limestone Coast Landscape Region covers seven local government areas (LGAs), and the Beach licence areas are situated within two LGAs:

- Wattle Range Council
- Naracoorte Lucindale Council.

Penola is the largest centre within the licence areas, with a population of 3,107 (ABS 2021). Other population centres in proximity to the licence areas include Naracoorte (located to the north of PEL 494), Millicent (located to the south of PEL 494), Lucindale (located to the north of PEL 494), as well as popular holiday destinations including Robe and Beachport along the coast.

Population statistics for the LGAs are shown in **Table 7**. Census data from 2021 for the two LGAs indicates that the population of 20,574 is distributed relatively evenly across the ages 0 to 74, with steady proportional population decline in older age cohorts. The median weekly household income across the two LGAs ranged from $1,180 to $1,435; this compares to a median weekly household income of $1,455 across South Australia.

Table 7: Population by Local Government Area

Local Government Area	Male	Female	Total
Wattle Range Council	6,012	5,877	11,888
Naracoorte Lucindale District Council	4,513	4,177	8,686

Source: Australian Bureau of Statistics Census Data 2021

The main industries of employment in the region are agriculture, forestry and fishing, with manufacturing employing the second highest number of workers. The high levels of employment within the agriculture, forestry and fishing industry reflects the economic importance of agricultural production within the region.

4.9 Aboriginal Cultural Heritage

All of Beach's petroleum licences are located within the First Nations of the South East #1 (SC2017/002) Native Title claim area (Registered November 2017). Currently South Australian Native Title Services (SANTS) are the contact group for the claim, and the claimants have instructed Beach that the South East Aboriginal Focus Group will continue to manage heritage matters for Beach's operational area.

A central archives search through Aboriginal Affairs and Reconciliation (AAR), Department of Premier and Cabinet in July 2025 has returned records for two Aboriginal sites within the licence areas. One of these sites is an archaeological site, while the second is a scarred tree. Importantly this register is not comprehensive, nor does it capture undiscovered sites.

The South Australian *Aboriginal Heritage Act 1988* (Act) provides protection for all Aboriginal sites, objects and remains across the State as discussed in Section 2.3.6.

Where additional disturbance is required for future activities an Aboriginal Heritage risk assessment will be completed to determine whether additional surveys or mitigations are required. Further, Beach land access and cultural heritage procedures ensure that any sites identified are not disturbed during construction through compliance with Beach inductions, pre-earthworks checklists, and flagging or fencing of sensitive areas.

4.10 Non-Aboriginal Cultural Heritage

A desktop study of South Australian heritage places was conducted using the South Australian Heritage Places Database (SAHPD). The database provides a comprehensive listing of:

- State Heritage Places from the South Australian Heritage Register
- Local heritage places from South Australian Development Plans
- Contributory items from South Australian Development Plans.

A search of heritage places in the Wattle Range Council and Naracoorte Lucindale Council using the SAHPD identified 49 State Heritage Places and 157 local heritage places (SAHPD, 2024). No heritage places are present within Beach's current production licence areas. The majority of the heritage places are buildings (including churches, farmhouses, barns, hotels and shops), as well as cemetery features, and plantations (a sugar gum plantation north of the licence areas). There are five isolated heritage places located within 10 km of the boundary of Beach's current production licence areas. The Yallum Park homestead and Austin Cottage dwelling are located approximately 3 km to the north east of PPL 168 and Kalangadoo House approximately 9 km to the south west of PPL 202. Ulva Cottage Dwelling sits approximately 7 km north of PPL 202, and John Shaw Neilson's former cottage approximately 10 km north of PEL 202.

State Heritage Places located in the region vary with sites including former dwellings, farming homesteads, railway stations, schools, churches, hotels and cemeteries. Local heritage places located in the region are also diverse, ranging from houses, sheds, homesteads and churches to bridges, shopping centres, and recreational parks.

A search of the Australian Heritage Database did not identify any World, Commonwealth or National heritage listed places in the licence areas. The Australian Fossil Mammal Sites (Naracoorte), which is registered as a World Heritage and National Heritage site is located to the north of PEL 494.

5. Environmental Impact Assessment

This section discusses potential environmental impacts related to drilling, completion and well production testing activities in the onshore Otway Basin.

The environmental elements that have the potential to be impacted by these activities are outlined in **Table 8**.

The impact assessment is presented in Sections 5.1 to 5.10. The impact assessment includes discussion of impacts to each environmental value together with control measures, objectives, impact assessment, criteria and significance assessment.

The environmental objectives and criteria that have been used are defined in the SEO (Beach Energy 2025).

Table 8: Environmental Elements, Views of Affected Parties, Legislation, Standards and Receptors

Environmental element	Views of Affected Parties[6]	Applicable Government Legislation	Applicable Non-Legislated Standards	Environmental Receptor
Public health and safety	Stakeholders have identified concern for the following values and impacts: • Fire • Traffic	*Fire and Emergency Services Act 2005 (SA)*	AS 1940-2017: The storage and handling of flammable and combustible liquids AS 1692-2006: Steel tanks for flammable and combustible liquids	Local community Local landholders
Heritage (Aboriginal and non-Aboriginal)	Stakeholders have identified concern for the following values and impacts: • Language use • Effectiveness of control measures • Engagement	*Aboriginal Heritage Act 1988 (SA)* *Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act)* *Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth)* *Native Title Act 1993 (Cth)*	AAR's Managing Aboriginal Heritage in South Australia Dhawura Ngilan Vision and Best Practice Standards Interim Engaging with First Nations People and Communities on Assessments and Approvals under the EPBC Act	Aboriginal heritage sites Non-Aboriginal heritage sites Aboriginal communities Traditional owners
Soil	Stakeholders have identified concern for the following values and impacts: • Monitoring • Contamination from spills and leaks • Spill and leak reporting and management	*Landscape South Australia Act 2019*	No applicable non-legislated standards.	Soil quality Landholders and users Groundwater dependant ecosystems Groundwater Surface water
Groundwater, including quality and quantity	Stakeholders have identified concern for the following values and impacts: • Groundwater dependant ecosystems • Contamination from spills and leaks • Aquifer depth • Groundwater salinity • Cement contamination • Stygofauna • Wastewater disposal • Impact to other groundwater users • Spill and leak reporting and management	*Environment Protection (Water Quality) Policy 2015* *Landscape South Australia Act 2019* *Native Vegetation Act 1991*	Australian and New Zealand guidelines for fresh and marine water quality	Groundwater (quality and quantity) of the aquifer Groundwater users Groundwater dependent ecosystems
Surface water, including quality and quantity	Stakeholders have identified concern for the following values and impacts: • Discharge of solid or liquid waste (including wastewater) to surface water • Disturbance to drainage patterns • Disturbance of wetlands	*Environment Protection (Water Quality) Policy 2015* *Landscape South Australia Act 2019* *Native Vegetation Act 1991*	Australian and New Zealand guidelines for fresh and marine water quality.	Surface water quality Water users Native flora and fauna Wetlands
Air quality	Stakeholders have identified concern for the following values and impacts: • Flaring • Reporting	*Environmental Protection (Air Quality) Policy 2016 (SA)*	No applicable non-legislated standards.	Air quality
Existing land use and infrastructure	Stakeholders have identified concern for the following values and impacts:	*Planning, Development and Infrastructure Act 2016 (SA)*	No applicable non-legislated standards.	Existing land uses

[6] Based on consultation during the preparation of the previous revision of the EIR and SEO (2018)

Environmental element	Views of Affected Parties[6]	Applicable Government Legislation	Applicable Non-Legislated Standards	Environmental Receptor
	• Stock accessing contaminants			
Native fauna	Stakeholders have identified concern for the following values and impacts: • Habitat of red-tailed black cockatoos • Native and honey bees • Noise impact to fauna • Stakeholders have also expressed interest in observing monitoring plans.	*National Parks and Wildlife Act 1972 (SA)* *Environmental Protection and Biodiversity Conservation Act 1999 (Cth)* *Landscape (South Australia) Act 2019 (SA)* *Fire and Emergency Services Act 2005 (SA)* *Planning, Development and Infrastructure Act 2016 (SA)*	AS 1940-2017: The storage and handling of flammable and combustible liquids	Native fauna Fauna habitat
Native vegetation	Stakeholders have identified concern for the following values and impacts: • Large trees • Habitat of red-tailed black cockatoos • Stakeholders have also expressed interest in observing monitoring plans.	*Native Vegetation Act 1991 (SA)* *National Parks and Wildlife Act 1972 (SA)* *Environmental Protection and Biodiversity Conservation Act 1999 (Cth)* *Landscape (South Australia) Act 2019 (SA)* *Fire and Emergency Services Act 2005 (SA)* *Planning, Development and Infrastructure Act 2016 (SA)*	AS 1940-2017: The storage and handling of flammable and combustible liquids	Native vegetation Habitat areas
General amenity	No significant stakeholder concerns have been identified.	*Planning, Development and Infrastructure Act 2016 (SA)*	AS 4282-1997 Control of the obtrusive effects of outdoor lighting	Local community Landholders and users

5.1 Public Health and Safety

Potential impacts to the health and safety of the general public, arise principally from:

- Generation of dust and air emissions.
- Use of roads and movement of vehicles and heavy machinery.
- Unauthorised site access.
- Well control incidents.
- Loss of well integrity.
- Fire.

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 9**.

Potential impacts to the general public that cause nuisance or disturbance are described in later sections for air quality (Section 5.6) and general amenity (Section 5.10).

5.1.1 Generation of dust and air emissions

Generation of dust during site construction and use of unsealed roads and tracks can result in temporary and localised impacts to air quality (see Section 5.6). Dust generation will be minimised by restriction of speeds on unsealed roads and spraying of unsealed roads with water to moderate the potential for dust generation where required.

Emissions from fuel burning equipment, flaring and fugitive emissions from well operations have the potential to cause localised impacts to air quality. Emissions of environmental significance (i.e. atmospheric pollutants) are:

- combustion by-products (e.g. oxides of nitrogen, carbon monoxide and sulphur dioxide)
- methane and organic carbon from fugitive sources
- flared hydrocarbons
- vented CO_2, H_2S, and CO.
- The contribution of these emissions to greenhouse gas production is discussed in Section 5.6.

Poor air quality can increase the risk of long-term health impacts (such as heart and lung diseases) for the local community and general public in proximity to the area.

5.1.2 Use of roads and movement of vehicles and heavy machinery

The use of roads for drilling operations has the potential to result in an increased road hazard for local road users. Use of roads and tracks for drilling operations, particularly unsealed roads or farm tracks can also cause damage or degradation, decreasing safety for existing road and track users.

Impacts of road use are generally short term, with peak traffic movements occurring during rig moves. Landholders, local councils, potentially affected residents and police will be informed of significant activities such as rig mobilisation and demobilisation. Rig movements will detour around town centres where possible.

Warning signs and traffic management measures will be installed where appropriate near well sites. All necessary permits will be obtained for trucks transporting drilling and other equipment. Transport moves will be restricted to daylight hours as far as possible.

Any deterioration of property tracks or infrastructure as a result of drilling-related traffic will be rectified.

5.1.3 Unauthorised site access

Unauthorised or uncontrolled access to the well site, particularly during drilling, could expose members of the public to potential harm. Access to the site will be restricted during operations, the site will be fenced and 'No entry' signage warning of dangers associated with drilling operations will be placed at the entry to the site access track. The access gate to the well site will be closed during testing. Following drilling, the well site will be fenced until rehabilitation is completed. Fencing and signage will be installed to prevent unauthorised access to the well head at any well that is successful.

5.1.4 Well control incidents or loss of well integrity

A well control incident or blowout during drilling could possibly result in an explosion or fire. There are considerable safety measures to avoid a blowout and they are extremely rare, particularly in areas such as the Otway Basin where reservoir pressures are understood. All drilling and completion operations will be carried out in accordance with regulatory requirements and approved well construction standards. The drilling rig will be equipped with fully functional and regularly tested blowout preventers. Guidelines, procedures, safety practices, design considerations, certification of equipment (including valves, casing and tubing) trained individuals and an emergency response plan will be in place.

A loss of well integrity (through failure of the cement or casing in the well) could result in subsidence around the well area, crossflow between aquifers, contamination of aquifers, reduction of pressure in aquifers and possibly the release of water, hydrocarbon and other reservoir gases if present (e.g. carbon dioxide, hydrogen sulphide) to the surface. These impacts could have follow-on effects to public health, through the reduction of air quality and use of contaminated aquifer water. The risk is managed in the well design, construction and decommissioning phases of the well life cycle by the Beach Energy D&C Technical Standards. During the operate (e.g. production) phase, the Beach Energy Well Integrity Management Framework applies.

Measures undertaken to ensure well integrity include:

- Comprehensive review of all available information is undertaken to identify all foreseeable well integrity risks that may arises during operations
- Well design and construction provides the mechanical integrity that reduces the risk to well integrity to as low as reasonably practicable
- Isolation of aquifers behind multiple casing strings that are cemented in place
- Surface casing is cemented to the surface with visible return in accordance with an engineered cementing program
- Specialist technical engineers design the cementing program for a well in accordance with international standards
- Cement bond logs or ultrasonic logs are run to confirm the integrity of cement that fills the space between the casing and the well bore and prevents migration

- Undertaking of remedial action or an integrity management plan where there is evidence of insufficient isolation
- Well integrity barriers undergo verification processes at the time of installation
    - Wells which are handed over into the operate (production) phase are subject to an inspection, testing and maintenance program as governed by the Beach Well Integrity Management Framework

Following a decision to decommission a well after drilling, a specific well decommissioning program is implemented, as discussed in Section 3.5. Cement plugs are installed in the well to isolate all aquifers and prevent cross flow, contamination or pressure reduction.

5.1.5 Fire

Fire initiated by site activities (e.g. flaring, sparks from vehicles or equipment, cigarette butts) has the potential to significantly impact public health through injury or potential loss of life. Measures will be in place to prevent fires including firebreaks, restriction of vehicles to tracks and cleared areas, maintenance of suitable fire-fighting equipment on site and liaison with the CFS. The flare tank or flare stack will be designed and located to avoid radiant heat impacting or burning trees.

Table 9: Public Health and Safety Impact Assessment

Environmental Element	**Public Health and Safety**
Views of Affected Parties	Stakeholders have identified concern for the following values and impacts in previous consultation efforts, as summarised in Section 7: • Fire • Traffic
Applicable Legislation	• Fire and Emergency Services Act 2005 (SA)
Applicable Standards	• AS 1940-2017: The storage and handling of flammable and combustible liquids • AS 1692-2006: Steel tanks for flammable and combustible liquids
Site/Activity Specific Receptors	• General public • Local landholders
Potential Impact Event PHS1	*Risks to the health and safety of the public associated with drilling, completion and well production testing activities - unauthorised access by third parties.*
Source/s	Vehicles, excavation sites, sumps, well heads, machinery, flammable or toxic substances.
Pathway/s	Unauthorised access by third parties
Receptor/s	General public
Confirmation of Source – Pathway- Receptor	Yes

Environmental Element	Public Health and Safety		
Uncertainties and Assumptions	Assumption that any third parties who have accessed the site will be exposed to potentially dangerous sources.		
Sensitivity to Change	Variable. Exposure to potentially dangerous sources may be more or less likely across different sites.		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	"No Entry" signs warning of dangers associated with drilling operations placed at the entry to the site access track. Site area to be fenced with a gate on the access track. Access gate to well site will be closed during testing and appropriate signage will be in place to restrict entry. Drilling Supervisor and Drilling Contractor Manager given authority to refuse entry of unauthorised third parties. All minor excavations (e.g. for septic tank) to be backfilled soon after rig release. Well head and sump to be individually fenced if delay in clean-up / workover rig operations to occur. Necessary measures (e.g. fencing, signage) taken to prevent the public accessing the well head equipment. Effective rehabilitation of the well site so that potentially dangerous variations in ground level do not remain.		
Procedural Controls	Workplace inspections		
Effectiveness of controls	Signage and fencing have previously been shown to be effective in preventing third party access.		
Environmental Objective	Minimise risks to the health and safety of the public associated with drilling, completion and well production testing activities (OB-01)		
Significance Assessment		Beach Risk Assessment	
Frequency	Event-based. Uncommon and unlikely.	Likelihood	Unlikely
Extent	Confined – impact confined within site boundaries.	Consequence	Serious
Duration	Short term (dependant on presence of third parties on site).	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Depends on the nature of the danger or injury, low to very high.		
Sensitivity of Receptor/s	High		

Environmental Element	Public Health and Safety
Cumulative Impact Assessment	No. Incidents are isolated.
Likely Residual Impact Outcome	Controls have been included to prevent the possibility of danger or injury to unauthorised third parties. Possibility of impact event is very low and depends on the actions of the third party. The risk is considered ALARP.
Leading Performance Criteria	Control measures implemented from commencement of construction. Rehabilitation conducted in a timely manner after completion of operations. Inspection schedule established to check appropriate control measures have been implemented. Records of inductions established.
Assessment Criteria	Reasonable measures implemented to ensure no risks to health and safety of the public. No injuries, incidents or adverse health impacts involving the public from drilling, completion or well production testing activities that could have been reasonably prevented by the operator. No unauthorised access reported.
Potential Impact Event PHS2	*Risks to the health and safety of the public associated with drilling, completion and well production testing activities – vehicles on public roads.*
Source/s	Project vehicles and traffic.
Pathway/s	Increased use of roads; movement of vehicles and heavy machinery, disturbance to local road users.
Receptor/s	Local community Landholders and users
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	That an increase in traffic especially from heavy vehicles or machinery has the potential to reduce public safety.
Sensitivity to change	Low.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-

Environmental Element	Public Health and Safety		
Physical Controls	Compliance with relevant speed restrictions on access roads and tracks. Warning signage and traffic management measures installed where appropriate in the vicinity of well sites. Vehicle speed limits to be observed. All required authorisations (e.g. local council, DIT, police) obtained where required for movement of rig along public roads, including joint inspections of roads before and after transport moves if necessary. Rig mobilisation and demobilisation to detour around town centres where possible.		
Procedural Controls	Landholders, local councils, potentially affected residents and emergency services will be informed of significant activities such as rig mobilisation and demobilisation. Driver behaviour and vehicle speed limits to be included in compulsory induction.		
Effectiveness of controls	Both Beach Energy and drilling contractor have extensive experience in identifying and managing potential traffic disruptions associated with their activities.		
Environmental Objective	Minimise risks to the health and safety of the public associated with drilling, completion and well production testing activities (OB-01)		
Significance Assessment		Beach Risk Assessment	
Frequency	Event-based. Uncommon and unlikely.	Likelihood	Unlikely
Extent	Confined – impact confined to site boundary and surrounding roads.	Consequence	Serious
Duration	Short term. Potential danger could be ongoing throughout presence of project. In the event of impact, the extent of the potential injury will determine the duration of the impact.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Severity of the impact can range greatly depending on type of accident and whether it results in injury or fatality.		
Sensitivity of Receptor/s	High.		
Cumulative Impact Assessment	Potential. There could be increased use of shared roads from nearby activities (such as harvesting) which could increase the potential for incidents and the chance of repeated incidents.		
Likely Residual Impact Outcome	Controls have been included to prevent the possibility of danger, injury or fatality to people due to project traffic. Possibility of impact is low and the risk is considered ALARP.		
Leading Performance Criteria	Prestart inspection verifies control measures implemented as appropriate from commencement of construction. Stakeholder engagement and complaints reporting systems in place. Records of inductions established.		
Assessment Criteria	Reasonable measures implemented to ensure no risks to health and safety of the public. No injuries, incidents or adverse health impacts involving the public from drilling, completion or well production testing activities that could have been reasonably prevented by the operator. No traffic incidents reported.		

Environmental Element	**Public Health and Safety**	
Potential Impact Event PHS3	*Risks to the health and safety of the public associated with drilling, completion and well production testing activities - fire from activities.*	
Source/s	Vehicles, machinery, personnel on site	
Pathway/s	Fire (resulting from activities)	
Receptor/s	Local community Landholders and users	Third-party infrastructure
Confirmation of Source – Pathway- Receptor		Yes
Uncertainties and Assumptions	Assumption that the fire started due to failure to comply with control measures surrounding vehicles, machinery and weather.	
Sensitivity to Change	Yes.	
Control Measures		
Type	*Description*	
Elimination	-	
Substitution	-	
Physical Controls	Where necessary (e.g. in fire danger season), fire break constructed around well lease. Flare designed and located to ensure that radiant heat does not impact trees.	
Procedural Controls	Confinement of flammable sources, restrictions on certain procedures and ready access to suitable fire-fighting equipment (e.g. fire unit consisting of trailer with water tank, pump and hoses in high fire danger season). Liaise with CFS regarding operations to ensure fire concerns are addressed and any Fire and Emergency Services Act requirements are met (e.g. permits for 'hot work' on fire ban days if required). Response to fire included in Emergency Response Plan. Emergency response procedures included in staff training. Ensure fire risk is included in the induction and all personnel are fully informed on the fire danger season and associated restrictions.	
Effectiveness of controls	Beach Energy has managed fire risk from project activities at numerous other projects without incident.	
Environmental Objective	Minimise risks to the health and safety of the public associated with drilling, completion and well production testing activities.	
Significance Assessment		Beach Risk Assessment
Frequency	Event-based. Uncommon.	Likelihood: Unlikely
Extent	Non-confined. Fire can extend beyond site boundaries and endanger people external to site boundaries.	Consequences: Serious

Environmental Element	Public Health and Safety		
Duration	Medium to long-term impacts depending on severity of fire.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Medium to high severity. Impact can cause various injuries ranging from minor and severe burns to, smoke inhalation to death.		
Sensitivity of Receptor/s	High.		
Cumulative Impact Assessment	Potential. Cumulative impacts of smoke inhalation may compound and affect a persons' health. It is unlikely that multiple events will occur, or that the same people are impacted if they do.		
Likely Residual Impact Outcome	Controls have been included to prevent the possibility of fire and it causing danger, injury or fatality to people. Possibility of impact is low and risk is considered ALARP.		
Leading Performance Criteria	Control measures implemented from commencement of construction. Engagement with local Emergency Service Providers prior to commencement. Pre-start audit conducted of fire management control measures. Inspection schedule established for regular maintenance of fire management equipment. Record of reviews or updates to the Emergency Response Plan.		
Assessment Criteria	Reasonable measures implemented to ensure no risks to health and safety of the public. No injuries, incidents or adverse health impacts involving the public from fire as a result of drilling, completion or well production testing activities that could have been reasonably prevented by the operator. No fires reported.		
Potential Impact Event PHS4	*Risks to the health and safety of the public associated with drilling, completion and well production testing activities - loss of well integrity (e.g. casing or cement failure).*		
Source/s	Subsidence, gas leakage, aquifer contamination.		
Pathway/s	Loss of well integrity (e.g. casing or cement failure),		
Receptor/s	Local community Landholders and users	Aquifer users	
Confirmation of Source – Pathway- Receptor		Yes	
Uncertainties and Assumptions	Assumption that loss of well integrity will lead to further complications such as subsidence, gas leakage or aquifer contamination.		
Sensitivity to Change	Medium. Loss of well integrity does not always lead to danger or potential injury.		

Environmental Element	Public Health and Safety
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Wells designed to meet pressure, temperature, operational stresses and loads. Effective verified barriers exist to maintain well control and prevent crossflow between aquifers systems or hydrocarbon reservoirs. Aquifers isolated behind casing strings, cemented in place. Surface casing to be cemented to surface with visible return. Water bores to be drilled by licensed driller with knowledge of local aquifers (e.g. the seal above the Dilwyn formation which must not be penetrated). Well Decommissioning (unsuccessful wells) Well decommissioning completed in accordance with work program. Downhole decommissioning carried out to meet worst case expected loads and downhole environmental conditions. Appropriate verified barriers are put in place to prevent crossflow, contamination or further pressure reduction occurring. Pressure testing and / or negative inflow testing performed on barrier envelopes / components where feasible. Inhibited fluid placed between barriers where applicable. Operational reports verify that barrier installation and testing undertaken in accordance with work program.
Procedural Controls	Activities performed in accordance with applicable industry and regulatory standards. Specialist technical engineers design in accordance with international standards. Operational verification reports demonstrate that barriers have been set and/or remedial cement work carried out in accordance with the work program. Monitoring programs implemented (e.g. through well logs or pressure measurements / testing) to aid in the assessment of wellbore barrier conditions during drilling, completion and well production testing activities where appropriate. Where monitoring identifies potential issues during drilling activities, working within Beach Management Systems, risk assessment undertaken to identify hazards / scenarios and propose recommendations and mitigation controls where appropriate to reduce or monitor risk. Emergency response plan in place and drills conducted. Emergency response procedures included in staff training
Effectiveness of controls	Beach Energy has implemented the control measures outlined above at wells within the Otway basin and at other locations in South Australia, Queensland and Northern Territory over a period of several decades.
Environmental Objective	Minimise risks to the health and safety of the public associated with drilling, completion and well production testing activities (OB-01)

Environmental Element	**Public Health and Safety**		
Significance Assessment		Beach Risk Assessment	
Frequency	Event-based. Uncommon.	Likelihood	Unlikely
Extent	Non-confined. Danger from aquifer contamination and gas leakage effects broader environmental areas than the site.	Consequences	Serious
Duration	Short to long term. The potential for danger or injury stems from subsidence, gas leakage or aquifer contamination. Aquifer contamination might have long-term health impacts for users.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low to medium. Ingestion of contaminated sources is unlikely to continue (loss of well integrity failure and potential impacts to groundwater/aquifers will be communicated to public)		
Sensitivity of Receptor/s	High		
Cumulative Impact Assessment	Yes. Repeated loss of well integrity may involve an increase of gas leakage, subsidence or aquifer contamination, all of which increase the risk of danger/injury to people.		
Likely Residual Impact Outcome	Controls have been included to prevent the possibility of a loss of well integrity and it causing danger or injury to people. Possibility of impact is low and risk is considered ALARP.		
Leading Performance Criteria	Wells designed, constructed, operated and maintained in accordance with Beach's Drilling and Completions Technical Standards and Well Integrity Framework. Inspection schedule established to check appropriate control measures have been implemented. Regular review and/or update of the Emergency Response Plan. A well decommissioning completion report is prepared demonstrating compliance with decommissioning program.		
Assessment Criteria	Reasonable measures implemented to ensure no risks to health and safety of the public. No injuries, incidents or adverse health impacts involving the public from drilling, completion or well production testing activities that could have been reasonably prevented by the operator. No identified loss of well integrity e.g. casing or cement failure.		
Potential Impact Event PHS5	*Risks to the health and safety of the public associated with drilling, completion and well production testing activities - well control incidents (e.g. blowout or kick).*		
Source/s	Explosion, fire.		
Pathway/s	Well control incidents (e.g. blowout or kick)		
Receptor/s	Local community Landholders and users		
Confirmation of Source – Pathway - Receptor		Yes	

Environmental Element	Public Health and Safety		
Uncertainties and Assumptions	Assumption that a well control incident will result in an explosion or fire.		
Sensitivity to Change	Low.		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	Competent personnel and contractors on site at all times. Well control equipment used during drilling, coiled tubing, wireline and workover activities.		
Procedural Controls	Wells designed, constructed, operated and maintained in accordance with Beach's Drilling and Completions Technical Standards and Well Integrity Framework. Drill rig, ancillary and any testing equipment to comply with Regulations, meet relevant industry standards and be 'Fit for Purpose'. Periodic review of management systems as required based on learnings and changes to Australian and international leading practice. Blow out prevention precautions in place in accordance with defined procedures and appropriate to the expected downhole conditions. Satisfactory kick tolerance in casing program design. Work is performed as set out in the Drilling Program. Emergency response procedures in place. Emergency response procedures included in staff training. Personnel are trained in the use of spill response equipment.		
Effectiveness of controls	By implementing the physical and procedural controls at other drilling programs Beach Energy has demonstrated its capability to manage this risk.		
Environmental Objective	Minimise risks to the health and safety of the public associated with drilling, completion and well production testing activities (OB-01)		
Significance Assessment		Beach Risk Assessment	
Frequency	Event-based. Uncommon.	Likelihood	Unlikely
Extent	Partially confined. Fire could lead to danger or injury outside of site area.	Consequences	Serious
Duration	Medium to long-term. While the event itself is short, there is potential for it to have significant health and safety repercussions depending on the severity of the well control incident.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	High. Explosion or fire could have a range of impacts from minor or severe burns, smoke inhalation or death.		

Environmental Element	Public Health and Safety
Sensitivity of Receptor/s	High
Cumulative Impact Assessment	Potential. Cumulative impacts of smoke inhalation may compound and affect a persons' health. It is unlikely that multiple events will occur, or that the same people are impacted if they do.
Likely Residual Impact Outcome	Controls have been included to prevent the possibility of well control incident and any potential injuries or danger resulting from it. Possibility of impact is considered ALARP.
Leading Performance Criteria	Wells designed, constructed, operated and maintained in accordance with Beach's Drilling and Completions Technical Standards and Well Integrity Framework. Inspection schedule established to check appropriate control measures have been implemented. Regular review and/or update of the Emergency Response Plan.
Assessment Criteria	Reasonable measures implemented to ensure no risks to health and safety of the public. No injuries, incidents or adverse health impacts involving the public from drilling, completion or well production testing activities that could have been reasonably prevented by the operator. No well control incidents e.g. blowout or kick.

5.2 Heritage (Aboriginal and non-Aboriginal)

Potential impacts to Aboriginal and non-Aboriginal heritage arise predominantly from earthworks during construction and rehabilitation activities. Cultural heritage inspections will be carried out with the relevant Aboriginal heritage group and any identified sites will be avoided and flagged off where necessary. Damage, disturbance or interference to any Aboriginal sites, objects and remains is avoided unless authorisation has been obtained under the *Aboriginal Heritage Act 1988*. Heritage registers and the Heritage Branch, DEW will be consulted regarding the location of non-Aboriginal heritage sites where appropriate. Cultural heritage issues will be covered in inductions and a procedure will be in place to respond in the event that any sites are discovered during activities, in accordance with the requirements of the *Aboriginal Heritage Act 1988* as discussed in Section 2.3.6.

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 10**.

Table 10: Heritage (Aboriginal and non-Aboriginal) Impact Assessment

Environmental Element	**Heritage (Aboriginal and non-Aboriginal)**	
Views of Affected Parties	Stakeholders have identified concern for the following values and impacts in previous consultation efforts, as summarised in Section 7: • Language use • Control measures • Engagement	
Applicable Legislation	• *Aboriginal Heritage Act 1988 (SA)* • *Coroners Act 2003 (SA)* • *Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act)* • *Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth)* • *Native Title Act 1993 (Cth)*	
Applicable Standards	• AAR's Managing Aboriginal Heritage in South Australia • Dhawura Ngilan Vision and Best Practice Standards • Interim Engaging with First Nations People and Communities on Assessments and Approvals under the EPBC Act	
Site/Activity Specific Receptors	• Aboriginal heritage sites • Non-Aboriginal heritage sites	• Aboriginal communities • Traditional owners
Potential Impact Event H1	*Damage to heritage sites - Aboriginal cultural sites*	
Source/s	Well site, access track and camp site construction and rehabilitation.	
Pathway/s	Earthworks Vehicle movements	Presence of people
Receptor/s	Aboriginal cultural heritage sites	
Confirmation of Source – Pathway- Receptor		Uncertain

Environmental Element	Heritage (Aboriginal and non-Aboriginal)
Uncertainties and Assumptions	There is potential for subsurface or obscured cultural heritage sites or artefacts to be found only once earthworks are underway.
Sensitivity to Change	Medium. There is potential for change, as the discovery of cultural heritage sites or artifacts will increase the chance of additional finds.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Cultural heritage inspections of proposed sites and tracks undertaken with relevant Aboriginal heritage group Known sites identified and protected from operations (e.g. using temporary flagging)
Procedural Controls	Search of cultural heritage registers Cultural heritage training and induction Procedure in place for the appropriate response to any sites discovered during activities Record of sites forwarded to the Aboriginal Heritage Branch in compliance with the Aboriginal Heritage Act and the Coroners Act Records relating to sites of cultural heritage significance kept and available for audit
Effectiveness of controls	Beach Energy have managed cultural heritage issues at numerous well sites without incident.
Environmental Objective	Avoid disturbance to sites of cultural and heritage significance due to activities requiring soil disturbance (OB-02).

Significance Assessment		Beach Risk Assessment	
Frequency	Medium frequency. There is rich cultural heritage in the region and the potential for unexpected finds.	Likelihood	Unlikely
Extent	Confined to location of the cultural find, within the project site.	Consequence	Serious
Duration	Long term impacts to the heritage of Aboriginal groups and communities.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	High. Potential for permanent impact to heritage sites.		

Sensitivity of Receptor/s	High
Cumulative Impact Assessment	Yes. Cumulative effects possible both due to the project and compounding on broader impact already within the community.
Likely Residual Impact Outcome	Controls have been implemented to ensure potential impacts are reduced to low. Risk for this impact is considered ALARP.
Leading Performance Criteria	Aboriginal heritage risk assessment to be completed prior to each disturbance activity. Pre earthworks checklist completed.

Environmental Element	Heritage (Aboriginal and non-Aboriginal)
	Known sites marked out using flagging tape or other methods to avoid disturbance prior to and throughout operations. Procedures in place to ensure any unexpected finds are appropriately managed and reported in accordance with regulatory requirements: • Any Aboriginal heritage sites, objects and remains discovered during operations have been appropriately reported and responded to, consistent with the *Aboriginal Heritage Act 1988* • Any discovery of potential human remains has been immediately reported to the Coroner or SAPOL, as required by the Coroner's Act 2003. Records of inductions established.
Assessment Criteria	Aboriginal heritage sites identified and avoided. Unexpected finds are reported in accordance with procedures. Damage, disturbance or interference to any Aboriginal sites, objects and remains (all as defined under the *Aboriginal Heritage Act 1988*) has been avoided unless authorisation has been obtained under the Act. .
Potential Impact Event H2	*Damage to heritage sites -non-Aboriginal cultural sites*
Source/s	Well site, access track and camp site construction and rehabilitation
Pathway/s	Earthworks Vehicle movements Presence of people
Receptor/s	Non-Aboriginal heritage sites
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	There is potential for subsurface or obscured heritage sites or artefacts to be found only once earthworks is underway
Sensitivity to change	Medium. There is potential for change, as the discovery of heritage sites or artifacts will increase the chances of additional finds.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Known sites identified and protected from operations (e.g. using temporary flagging)
Procedure Controls	Inductions for staff on-site Heritage site registers and Heritage Branch, DEW, consulted regarding the location of non-Aboriginal heritage sites where appropriate Procedure in place for the appropriate response to any sites discovered during activities.
Effectiveness of controls	Beach Energy have managed non-aboriginal cultural heritage issues at numerous well sites without incident.
Environmental Objective/s	Avoid disturbance to sites of cultural and heritage significance due to activities requiring soil disturbance (OB-02).

Environmental Element	**Heritage (Aboriginal and non-Aboriginal)**		
Significance Assessments		Beach Risk Assessment	
Frequency	Medium frequency. There is historical heritage in the region and the potential for chance finds.	Likelihood	Unlikely
Extent	Confined to location of the heritage find, within the project site.	Consequence	Serious
Duration	Long term impacts to the heritage of non-Aboriginal groups.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Medium. Potential for permanent impact to non-Aboriginal heritage sites.		
Sensitivity of Receptor/s	Medium		
Cumulative Impact Assessment	Yes. Cumulative effects possible both due to the project and compounding on broader impact already within the community.		
Likely Residual Impact Outcome	Potential impacts are reduced to low through implementation of control measures. Risk for this impact is considered ALARP.		
Leading Performance Criteria	Heritage risk assessment to be completed prior to disturbance activities. Known sites marked out using flagging tape or other methods to avoid disturbance prior to and throughout operations. Procedures in place to ensure any unexpected finds are appropriately managed. Records of inductions established.		
Assessment Criteria	Non-Aboriginal heritage sites identified and avoided. Damage, disturbance or interference to any non-Aboriginal places and related objects protected under the *Heritage Places Act 1993* has been avoided unless authorisation has been obtained under the Act.		

5.3 Soil

Potential impacts to soil arise mainly from:

- Earthworks for well site, access track and camp site construction and rehabilitation (e.g. erosion, inversion, compaction)
- Spills or leaks associated with storage and handling of fuel, oil and chemicals, drilling procedures and well production testing / flaring
- Well control incidents or loss of well integrity
- Storage, handling and disposal of waste.

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 11**. Potential impacts to soil from waste are discussed below.

5.3.1 Earthworks for construction and rehabilitation

Earthworks and site construction activities have the potential for localised impacts to soil through inversion, compaction or increased erosion.

In order to minimise surface impacts and facilitate rehabilitation, landowners will be consulted regarding the earthworks required, the location of the well site, access track and camp site and other relevant issues.

The preferred location of the well site is determined by the sub-surface targets, however it can generally be moved within allowable tolerances to minimise surface disturbance.

Topsoil is removed from the well site and stockpiled for use in rehabilitation, and the well site and access track paved with gravel imported from a licensed quarry. Paving materials are usually removed during rehabilitation (unless the landowner requests that they are retained) and stockpiled topsoil re-spread over the site.

Disturbance to soil from site construction activities is relatively localised and restricted to a defined and agreed area. Rehabilitation will be undertaken in consultation with the landowner, with measures such as ripping of compacted soils, replacement of topsoil that has been removed, restoration of soil profiles and contours and reseeding implemented to ensure rehabilitation success.

5.3.2 Spills or leaks and waste management

Improper storage and handling of fuel, oil, chemicals and waste has the potential to result in localised contamination of soil. In order to minimise this risk, fuel, oil and chemicals on site are stored and handled in accordance with relevant standards and guidelines (e.g. AS 1940, EPA guideline *080/16 Bunding and Spill Management* and the Australian Dangerous Goods Code). Fuel, oil and chemicals will be stored in their product containers with appropriate secondary containment (e.g. lined, bunded areas or on self-bunded pallets). Storage and handling of fuel, chemicals and wastes is restricted to designated areas on the well pad.

Runoff from higher risk areas (e.g. drill rig, generators) is directed into the sump to minimise the risk of movement of contaminants off-site. Any spills will be immediately cleaned up and any contaminated material removed off-site for appropriate treatment or disposal to a licensed facility. If larger scale spills occur that cannot be immediately contained and cleaned up they would be assessed consistent with the requirements

of the National Environmental Protection Measure (NEPM) and, where required, remediated in accordance with relevant guidelines (e.g. EPA guidelines).

Drilling sumps are used to contain drilling fluids and cuttings and may collect surface runoff from the well lease. They have the potential to result in localised contamination of soil. Consequently, sumps will be lined with an impermeable liner to prevent percolation into the soil. The liner material will be selected so as to be compatible with the fluids they will be exposed to.

Drilling muds will generally be water-based, and non-toxic to low toxicity additives will be used. Synthetic based muds (SBM) may be used in some deeper sections of wells. SBM cuttings are separated in real time from the SBM drilling fluid to bunded holding tanks and then transported offsite as drilling progresses. The transport is carried out by an EPA licensed contractor and disposed of at an EPA licensed site. The design of the layout and equipment for drilling waste management for wells in the region would be based on industry standards and utilise information derived from historical drilling campaigns. Beach undertake continuous improvement assessments of projects at the design phase to determine better practice measures if appropriate. The layout of a typical well site is provided in **Figure 3** and typical sump details are discussed in Section 3.1, along with further information on mud handling..

After drilling, excess water from the sump will not be disposed to land (e.g. by irrigation) unless it has landowner agreement and water quality meets applicable criteria (e.g. *Environment Protection (Water Quality) Policy 2015* and ANZECC guidelines) and any relevant approvals (e.g. DEM / EPA) have been obtained. Sump contents to be disposed as waste will be removed by a licensed contractor to an EPA licensed waste disposal facility, as soon as possible after drilling is completed.

Spills or leaks during well production testing activities could also result in localised contamination of soil. Well production testing will be carried out on the paved well lease in accordance with industry standards. Production tanks would be located in lined, bunded areas. All tanks and production lines would be inspected and tested for leaks prior to use. A separator tank would be used to separate any produced liquids from gas before gas is sent to the flare, so that produced fluids are not sent to the flare. If water is produced during well production testing, it would be in small quantities which would be directed to the sealed tank and removed off site for appropriate disposal at a licensed facility. Personnel remain on site during any well production testing activities and fluid levels in production tanks would be continually monitored to avoid overfilling.

5.3.3 Well control incidents or loss of well integrity

Well control and well integrity risks are managed by a range of measures that are discussed in Section 5.1.4. The likelihood of impact to soil from well control or well integrity issues is very low.

Table 11: Soil Impact Assessment

Environmental Element **Soil**	
Views of Affected Parties	Stakeholders have identified concern for the following values and impacts: • Monitoring • Contamination from spills and leaks • Spill and leak reporting and management
Applicable Legislation	• *Landscape South Australia Act 2019*
Applicable Standards	No applicable non-legislated standards.
Site/Activity Specific Receptors	• Soil quality • Landholders and users • Groundwater dependant ecosystems • Groundwater • Surface water
Potential Impact Event S1	*Impacts to soil - erosion, inversion, compaction*
Source/s	Well site, access track and camp site construction and rehabilitation
Pathway/s	Earthworks
Receptor/s	Soil quality
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Uncertainties of the types and/or sizes of earthworks required at each well site, for example, the number of ponds or length of access track. This is likely to differ across sites.
Sensitivity to Change	Low.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Landowner to be consulted about earthworks required, location of access tracks and general information to minimise surface damage and to facilitate rehabilitation. Locate and orientate well lease and access to minimise soil removal and area of cut and fill. Install erosion and sediment control structures as required. Soil removed in construction to be stored on site and returned to its original stratigraphic level upon restoration of the drill site. Separate storage of topsoil, subsoil and clays will be undertaken to assist in regeneration of pasture or crops.

Environmental Element **Soil**			
	Well sites are rehabilitated following drilling or the lease area reduced to the minimum size necessary if the well is successful. Restoration of the well site to be approved by the landowner or in accordance with landowner's wishes should retention of specific parts of the site be requested (e.g. pad or access track). During rehabilitation the soil beneath the tracks, camp and pad will be ripped after removal of imported fill and before the returning of stockpiled topsoil. Soil profile and contours will be reinstated following completion of operations.		
Procedural Controls	HSE PRO 36 Earthworks and Land Disturbance HSE PRO 44 Rehabilitation Management HSE PRO 48 Pre Earthworks Approval Portal		
Effectiveness of controls	High, Beach Energy has extensive experience of undertaking earthworks and returning the land to its prior use.		
Environmental Objective	Minimise disturbance to and avoid contamination of soil (OB-03) Ensure timely and effective rehabilitation of adversely affected land (OB-04)		
Significance Assessment		Beach Risk Assessment	
Frequency	Common. Soil will be disturbed during the construction and rehabilitation phases of each site.	Likelihood	Unlikely
Extent	Confined. Soil disturbed will be only within defined disturbance areas at each site.	Consequence	Serious
Duration	Medium. Soil will remain disturbed until rehabilitation and will likely take months or years to regain original condition. Without application of controls, impacts could be long term and soil could take many years to recover to pre-disturbed condition.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low		
Sensitivity of Receptor/s	Low. Soil is an important component of the environment but areas supporting sensitive or important vegetation will be avoided.		
Cumulative Impact Assessment	Possible. Soil disturbed by earthworks has the potential to also be impacted by contamination events. Soil quality will be further reduced in this instance.		
Likely Residual Impact Outcome	Impacts from earthworks on soil are managed by widely utilised controls and risks are considered ALARP.		
Leading Performance Criteria	Consultation with landholders conducted when relevant prior to construction and prior to rehabilitation. Impacts to soil from earthworks are confined to the smallest areas possible.		
Assessment	Areas with soil impacted from earthworks are rehabilitated at earliest opportunity after		

Environmental Element **Soil**	
Criteria	completion of operations. Soil profiles and contours are consistent with surrounding land after rehabilitation.
Potential Impact Event S2	*Impacts to soil - localised contamination of soil (spills and leaks)*
Source/s	Chemicals, fuels, oils, waste
Pathway/s	Spills or leaks, storage and handling and disposal incidents
Receptor/s	Soil quality
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Assumption that waste storage, handling or disposal incidents (such as spills and leaks) are not occurring indoors or in lined/bunded areas
Sensitivity to change	Low.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Synthetic based mud and cuttings circulated to surface will exit via an enclosed mud system to holding tanks, which will be in a bunded area to ensure containment prior to collection, treatment and disposal at a licensed facility. Any oil contamination of sump from contaminated drill cuttings will be collected and pumped out to a disposal tank. On completion of drilling the drill cuttings and sump water will be tested to analyse their suitability for reuse, industrial recycle, fill or waste and will be disposed of accordingly, along with the sump liner. Sump contents to be disposed as waste will be removed by a licensed contractor to an EPA licensed waste disposal facility. Waste water (e.g. excess water from the sump) will not be disposed to land (e.g. by irrigation) unless it has landowner agreement and water quality meets applicable criteria (e.g. Environment Protection (Water Quality) Policy 2015 requirements, ANZECC criteria) and any relevant approvals (e.g. DEM / EPA) have been obtained. Wastewater is not allowed to drain to surface water drainage features such as swamps. Covered bins are provided for the collection and storage of wastes. All loads of rubbish are covered during transport to an approved waste facility. <u>Fuel and chemical storage and handling</u> Safety Data Sheet information readily available at the well site. All fuel and chemical storage areas will be in accordance with EPA guidelines 080/16 Bunding and Spill Management. Hazardous materials stored, used and disposed of in accordance with relevant legislation on dangerous substances.

Environmental Element **Soil**	
	No refuelling outside designated refuelling or servicing areas. Appropriate drip capture / spill capture methods implemented in refuelling areas (e.g. use of drip trays or liners). Appropriate spill response equipment is available on site. Personnel have received training in the use of spill response equipment. Spills or leaks are immediately reported and clean up actions initiated. All contaminated soil will either be treated in-situ or removed for treatment / disposal at an EPA approved facility. Assessment and remediation of uncontained spills with larger scale impact is consistent with the National Environment Protection (Assessment of Site Contamination) Measure and relevant SA EPA guidelines. Records of spill events and corrective actions are maintained. <u>Well production testing / flaring</u> Production testing tanks to be located in lined bunded areas. Production testing lines and tanks to be inspected prior to use. Personnel remain on site during well production testing. Separator tank used during well production testing to separate any produced liquids from gas before gas is sent to flare. Flare tank is used for emergency well control situations while drilling.
Procedural Controls	EPA's Waste Hierarchy model (avoid, reduce, reuse, recycle, recover, treat, dispose) should be complied with and waste management undertaken with regard to the *Environment Protection (Waste to Resources) Policy 2010*. Waste streams are segregated on site and transported to appropriate facilities to maximise waste recovery, reuse and recycling. Production of waste is minimised by purchasing reusable, biodegradable or recyclable materials All waste disposal is at an EPA licensed facility. Hazardous wastes handled in accordance with relevant legislation and standards. Licensed contractors used for waste transport. All wastewater is disposed in accordance with the *South Australian Public Health (Wastewater) Regulations 2013*. Sewage treatment units and septic tanks used at camp and drill rig ablutions. Septic tanks pumped out on an 'as required' basis by a licensed septic waste removal contractor and disposed of at a licensed facility. Any necessary approvals are obtained for use of wastewater disposal system. Well site is kept free of litter and rubbish.
Effectiveness of controls	High
Environmental Objective/s	Minimise disturbance to and avoid contamination of soil (OB-03) Ensure timely and effective rehabilitation of adversely affected land (OB-04)

Significance Assessments		Beach Risk Assessment	
Frequency	Occasional. Spills and leaks are known to	Likelihood	Possible

Environmental Element **Soil**			
	occur on well sites, although most can be avoided by application of controls.		
Extent	Confined. The spill or leak will impact the soil at a localised location, the size of which will depend on the nature of the incident.	Consequence	Serious
Duration	Variable. Some spills or leaks can have short term impacts, and some longer term depending on the size and the type of contaminant.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low to medium, depending on the size and type of contaminant involved in the spill or leak.		
Sensitivity of Receptor/s	Low. A number of mitigation strategies are implemented to prevent contamination of soil. If contamination was to occur it would be remediated prior to rehabilitation of the site.		
Cumulative Impact Assessment	Unlikely. Any spills or leaks or disturbance are likely to be contained to the well lease pad area.		
Likely Residual Impact Outcome	Impacts from spills and leaks on soil are managed by widely utilised controls and risks are considered ALARP.		
Leading Performance Criteria	Inspection schedule established to demonstrate implementation of control measures such as fuel storage and handling and waste disposal. Fuel and chemical storage areas will be in accordance with EPA guidelines *080/16 Bunding and Spill Management* Records of inductions established. All wastewater disposed of in accordance with the *South Australian Public Health (Wastewater) Regulations 2013* and where appropriate with regard to the EPA Septage Management Guideline (EPA 247/20).		
Assessment Criteria	Any escape of petroleum, processed substance, chemical or fuel to land is either immediately contained and removed for disposal at an appropriately licenced facility or assessed in accordance with NEPM[1] guidelines and remediated in a timely manner. Any irrigation of waste water to meet Environment Protection (Water Quality) Policy 2015 requirements and ANZECC criteria).		
Potential Impact Event S3	*Impacts to soil - contamination of soil (well control incidents)*		
Source/s	Hydrocarbons or other contaminants Soil disturbance		
Pathway/s	Well control incidents (e.g., blowout or kick)		
Receptor/s	Soil quality		
Confirmation of Source – Pathway-Receptor	Yes		

Environmental Element **Soil**			
Uncertainties and Assumptions	Assumption that a blowout or kick incident will result in seepage of contaminants from well into ground, and potential explosion incident resulting in contamination of soil in areas surrounding well.		
Sensitivity to Change	Low. Well control incidents are likely to have soil impacts.		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	Control measures for management of well integrity are described for PHS4 and 5 (**Table 9**).		
Procedural Controls	Control measures for management of well integrity are described for PHS4 and 5 (**Table 9**).		
Effectiveness of controls	High		
Environmental Objective/s	Minimise disturbance to and avoid contamination of soil (OB-03) Ensure timely and effective rehabilitation of adversely affected land (OB-04)		
Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon. Well control incidents are uncommon when controls have been implemented.	Likelihood	Highly Unlikely
Extent	Confined to the soil surrounding a well site, but variable in size depending on severity of well control incident.	Consequence	Serious
Duration	Variable. Impacts to soil may be short-term (i.e. minor contamination from hydrocarbons) or more severe long-term impacts (i.e. disturbance from explosion and major hydrocarbon leak) which may take years to recover to original condition.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low to medium. Depends on the size of the incident.		
Sensitivity of Receptor/s	Low. Soil is an important component of the environment but areas supporting sensitive or important vegetation are unlikely to be impacted by well control incidents as they are avoided as locations for well sites.		
Cumulative Impact Assessment	Likely. Soil around well site that could be impacted by well control incidents is likely already impacted by earthworks during the construction of the well.		
Likely Residual Impact Outcome	Impacts from well control incidents on soil are managed through avoiding these incidents and risks are considered ALARP.		

Environmental Element **Soil**			
Leading Performance Criteria	Wells designed, constructed, operated and maintained in accordance with Beach's Drilling and Completions Technical Standards and Well Integrity Framework. Inspection schedule established to check appropriate control measures have been implemented.		
Assessment Criteria	No well control incidents. Any escape of petroleum, processed substance, chemical or fuel to land is either immediately contained and removed for disposal at an appropriately licenced facility or assessed in accordance with NEPM[7] guidelines and remediated in a timely manner.		
Potential Impact Event S4	*Impacts to soil - contamination of soil (loss of well integrity)*		
Source/s	Hydrocarbons or other contaminants Soil disturbance (subsidence)		
Pathway/s	Loss of well integrity (e.g., casing or cement failure)		
Receptor/s	Soil quality		
Confirmation of Source – Pathway- Receptor		Yes	
Uncertainties and Assumptions	Assumption that loss of well integrity will lead to contamination of soil. Assumption that loss of well integrity will lead to subsidence (soil disturbance) around well site.		
Sensitivity to Change	Medium. Not all losses of well integrity will lead to contamination and subsidence impacts on soil.		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	Control measures for management of well integrity are described for PHS4 and 5 (**Table 9**).		
Procedural Controls	Control measures for management of well integrity are described for PHS4 and 5 (**Table 9**).		
Environmental Objective/s	Minimise disturbance to and avoid contamination of soil (OB-03) Ensure timely and effective rehabilitation of adversely affected land (OB-04)		
Effectiveness of controls	High. The controls outlined are standard within the oil and gas sector and have been demonstrated to minimise the risk of loss of well integrity.		
Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon. Loss of well integrity is uncommon when controls have been implemented	Likelihood	Unlikely
Extent	Confined to the soil surrounding a well site, but variable in size	Consequence	Serious

[7] *National Environment Protection (Assessment of Site Contamination) Measure (1999)* amended in 2013

Environmental Element **Soil**			
	depending on severity of integrity loss.		
Duration	Variable. Impacts to soil may be short-term (i.e. minor contamination from hydrocarbons) or long-term impacts (i.e. subsidence) which may take years to recover to original condition.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low to medium. Depends on the type of impact from loss of well integrity and scale.		
Sensitivity of Receptor/s	Low. Soil is an important component of the environment but areas supporting sensitive or important vegetation are unlikely to be impacted by loss of well integrity as they are avoided as locations for well sites.		
Cumulative Impact Assessment	Likely. Soil around well site that could be impacted by loss of well control is likely already impacted by earthworks during the construction of the well.		
Likely Residual Impact Outcome	Impacts from loss of well integrity on soil are managed through avoiding these incidents and risks are considered ALARP.		
Leading Performance Criteria	Wells designed, constructed, operated and maintained in accordance with Beach's Drilling and Completions Technical Standards and Well Integrity Framework. Inspection schedule established to check appropriate control measures have been implemented.		
Assessment Criteria	No loss of well integrity. No contamination of soil in the result of a loss of well integrity incident. Any escape of petroleum, processed substance, chemical or fuel to land is either immediately contained and removed for disposal at an appropriately licenced facility or assessed in accordance with NEPM[8] guidelines and remediated in a timely manner. No subsidence of soil as a result of a loss of well integrity incident.		

[8] *National Environment Protection (Assessment of Site Contamination) Measure (1999)* amended in 2013

5.4 Groundwater (including quality and quantity)

Groundwater in the Otway basin includes both shallow and deep aquifers such as the TLA and TCSA (described in Section 4.6.2). Potential impacts to groundwater arise mainly from:

- Spills or leaks associated with storage and handling of fuel, oil and chemicals, drilling procedures and well production testing / flaring.
- Well control incidents or loss of well integrity.
- Drilling through aquifers.
- Other downhole issues.

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 12**.

Potential impacts to groundwater from waste are discussed below.

5.4.1 Spills or leaks and waste management

Improper storage and handling of fuel, oil and chemicals has the potential to result in localised contamination of shallow groundwater by seeping through soil. Spills or leaks during well production testing activities could also result in localised contamination of shallow groundwater. Management measures to prevent the potential contamination are discussed above in Section 5.3.

Mismanagement of waste on well sites can lead to localised contamination of soil, surface water and groundwater. The mismanagement of chemical, fuel and oil waste from well activities could result in impacts to these environmental values. Management to avoid contamination from waste includes spill and leak management (as described in Section 5.3.2), avoidance of stockpiling of construction wastes, and possibly the use of bunding and/or ground cover when stockpiling does occur.

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 licensed waste contractors will be used for waste transport.

Septic tanks will be used to contain all wastewater (black water and grey water) which will be pumped out by licensed contractors as required for disposal at a licensed facility consistent with the requirements of the *Environment Protection (Water Quality) Policy 2015*.

Discussion of runoff from higher risk areas, usage of drilling sumps and muds, and disposal of excess drilling sump water are also discussed in Section 5.5, with the management of these contaminants essential to prevent groundwater contamination.

5.4.2 Well control incidents or loss of well integrity

A well control incident or blowout during drilling could result in a loss of containment of hydrocarbons and drilling fluids, possible crossflow between aquifers or loss of aquifer pressure. A loss of well integrity (through failure of the cement or casing in the well) could result in crossflow between aquifers, contamination of aquifers, reduction of pressure in aquifers and possibly the release of water, hydrocarbon and other reservoir gases if present (e.g. carbon dioxide, hydrogen sulphide) to the surface. The risk is restricted to as low as

possible in the well design and construction process and managed through monitoring, during both drilling and the throughout the well's life. Management measures are described in Section 5.1.4.

5.4.3 Drilling through aquifers

Drilling fluids in the down-hole environment have the potential to invade freshwater aquifers near the well bore (including highly important unconfined Tertiary Limestone Aquifer) in the region and cause localised salinisation or contamination. Freshwater muds and native gel (bentonite) mud systems are used when drilling the top section of hole through the Gambier Limestone and Dilwyn formations in the Otway Basin to avoid contamination or salinisation of the freshwater aquifers near the well bore.

Following drilling of the top hole, surface casing is installed and cemented into place, which isolates these freshwater aquifers from drilling fluids used to drill the deeper sections of the hole. Water-based mud would be used to drill to the top of the Laira formation, however, synthetic based muds (SBM) may be used below this point to assist with drilling parameters and hole stability if required, any impact of near-well bore invasion by mud filtrate will be minimal, as mud properties allow for the build-up of filter cake on the borehole wall, which creates a barrier and minimises the potential for the loss of fluids to permeable formations..

The deeper aquifers are not used for irrigation, industrial or town water supplies due to their depth and generally high salinity (South East NRM Board 2019).

5.4.4 Other downhole issues (including loss of radioactive source)

Other hazards associated with down hole operations predominantly include issues that can affect drilling progress but generally have very limited environmental consequences, such as lost circulation, sloughing shales, stuck pipe or drill pipe failure. A loss of a radioactive source down hole can also potentially occur. When the well is open hole logged after drilling, some logging tools emit radiation into the formation and a receiver picks up the signal which is interpreted to relate the characteristics of the formation. The use of downhole radioactive sources will be risk assessed on a case-by-case basis. If the tool is lost down hole, all reasonable attempts will be made to retrieve any downhole sources. However, if it is not possible to retrieve the tool it is cemented in the hole to isolate it from adjacent formations.

Table 12: Groundwater Impact Assessment

Environmental Element	Groundwater
Views of Affected Parties	Stakeholders have identified concern for the following values and impacts in previous consultation efforts, as summarised in Section 7: • Groundwater dependant ecosystems • Contamination from spills and leaks • Contamination from drill cuttings • Aquifer depth • Groundwater salinity • Cement contamination • Stygofauna • Wastewater disposal (including septic) • Impact to other groundwater users

Environmental Element	Groundwater		
	• This section will be updated and completed based on the outcomes from public consultation of the current version of this document (2025), once the consultation period is undertaken.		
Applicable Legislation	• Environment Protection (Water Quality) Policy 2015 • Landscape South Australia Act 2019 • Native Vegetation Act 1991 • *Environment Protection Act 1993* • Environment Protection Regulations 2023 • Environment Protection (Waste to Resources) Policy 2010 (Waste to Resources EPP) • Environment Protection (Movement of Controlled Waste) Policy 2014 • Environment Protection (Used Packaging Materials) Policy 2012 • Planning, Development and Infrastructure Act 2016 (SA)		
Applicable Standards	• Australian and New Zealand guidelines for fresh and marine water quality • EPA (2010) Current criteria for the classification of waste including Industrial and Commercial Waste (Listed) and Waste Soil.		
Site/Activity Specific Receptors	Groundwater (quality and quantity) of the aquifer	Groundwater users	Groundwater dependent ecosystems
	Native fauna	Native vegetation	Soil quality
Potential Impact Event GW1	*Contamination, salinisation, crossflow, or loss of pressure of groundwater*		
Source/s	Exposure of groundwater to hydrocarbons, other contaminants, or other groundwater sources. Drilling.		
Pathway/s	Drilling through Gambier Limestone and Dilwyn shallow freshwater aquifers, or through deeper formations. Other downhole drilling issues (e.g. lost circulation, sloughing shales, stuck pipe or drill pipe failure).		
Receptor/s	Groundwater. Groundwater Dependant Ecosystems.	Stock. Irrigation users.	
Confirmation of Source – Pathway- Receptor		Yes	
Uncertainties and Assumptions	Site specific hydrogeological conditions of the potential project sites are not certain. It is not certain that downhole drilling incidents (e.g. lost circulation, sloughing shales, stuck pipe or drill pipe failure) at potential project sites will result in contamination of groundwater from hydrocarbons or other contaminants, crossflow between groundwater aquifers or loss of pressure. Potential for groundwater crossflow at future well site locations is not certain. Assumption that this contamination will have economic and environmental impacts for other groundwater users. Assumption that contaminant will enter groundwater via seepage through soil.		
Sensitivity to Change	Medium to high. Drilling through groundwater aquifers has potential to cause some local contamination around drill hole. Other types of downhole drilling incidents such as stuck pipe may not always result in release of contaminants and subsequent		

Environmental Element	Groundwater
	contamination of groundwater. Crossflow may not be possible depending on the location of the well site. Differences in assumed understanding of the hydrogeological site will change the likelihood of this impact occurring.
Control Measures	
Type	*Description*
Elimination	There are no elimination controls; the activities described in this report are required for drilling and groundwater is present in the region.
Substitution	Oil based drilling fluids substituted for water or synthetic based drilling fluids.
Physical Controls	Effective verified barriers exist to maintain well control and prevent crossflow between aquifers systems or hydrocarbon reservoirs. Wells designed to meet pressure, temperature, operational stresses and loads. Aquifers isolated behind casing strings, cemented in place. Surface casing is cemented to the surface with visible return in accordance with an engineered cementing program, verified in accordance with the Beach Drilling & Completion Technical Standards. Water-based drilling muds used on the surface hole. Water-based mud used to drill to the top of the Laira formation. Water-based or synthetic based fluids may be used below the top of the Laira formation. The sump collecting cuttings from water based sections of the drill hole will be lined with a suitable impermeable liner to prevent percolation into the soil. Synthetic based mud and cuttings circulated to surface will exit via an enclosed mud system to holding tanks, which will be in a bunded area to ensure containment. Synthetic based mud and cuttings removed from site by a licensed contractor to a licensed treatment or disposal facility. If required, the sump may be pumped and excess fluid disposed of as appropriate. The drill cuttings and sump water will be tested to analyse their suitability for reuse, industrial recycle, fill or waste and will be disposed of accordingly, along with the sump liner, to a licensed EPA facility.
Procedural Controls	Activities performed in accordance with applicable industry and regulatory standards. Operational reports verify that barriers have been set and / or remedial cement work carried out in accordance with the work program. Monitoring programs implemented (e.g. through well logs or pressure measurements / testing) to aid in the assessment of wellbore barrier conditions during drilling, completion and well production testing activities where appropriate. Where monitoring identifies potential issues during drilling activities, working within Beach Management Systems, risk assessment undertaken to identify hazards / scenarios and propose recommendations and mitigation controls where appropriate to reduce or monitor risk. Water bores to be drilled by licensed driller with knowledge of local aquifers (e.g. the seal above the Dilwyn formation which must not be penetrated). Information on muds and chemicals to be readily available on the rig. Drilling fluids selection and management is consistent with Beach D&C Technical Standards and chemical selection process.

Environmental Element	Groundwater		
	EPA's Waste Hierarchy model (avoid, reduce, reuse, recycle, recover, treat, dispose) should be complied with and waste management undertaken with regard to the *Environment Protection (Waste to Resources) Policy 2010*. Covered bins are provided for the collection and storage of wastes. All loads of rubbish are covered during transport to an approved waste facility. Waste streams are segregated on site and transported to appropriate facilities to maximise waste recovery, reuse and recycling. Production of waste is minimised by purchasing reusable, biodegradable or recyclable materials where practical. All waste disposal is at an EPA licensed facility. Hazardous wastes handled in accordance with relevant legislation and standards. Licensed contractors used for waste transport. All wastewater is disposed in accordance with the *South Australian Public Health (Wastewater) Regulations 2013* and with regard to the EPA Septage Management Guideline (EPA 247/20). Sewage treatment units and septic tanks used at camp and drill rig ablutions. Septic tanks pumped out on an 'as required' basis by a licensed septic waste removal contractor and disposed of at a licensed facility. Any necessary approvals are obtained for use of wastewater disposal system. Well site is kept free of litter and rubbish.		
Effectiveness of controls	The control measures outlined above are based on industry practice, and have been demonstrated to be effective at preventing and/or reducing the severity of the impact. There is a low degree of uncertainty for the identified control and management strategies.		
Environmental Objective/s	Minimise loss of aquifer pressures and avoid aquifer contamination (OB-05). Avoid contamination of shallow groundwater resources (OB-06).		
Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon. Measures to prevent groundwater contamination from drilling and storage of fuels/chemicals are well developed.	Likelihood	Unlikely
Extent	Non-confined. May extend further than project boundary.	Consequence	Serious
Duration	Medium to long-term, will be dependent on the type and volume of contaminant that enters the groundwater.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Variable, depending on level of contamination.		
Sensitivity of Receptor/s	High		
Cumulative Impact Assessment	Yes. Groundwater can be affected by other contaminant sources or from external sources (non-project related) which can lead to increased contamination and flow-on impacts.		

Environmental Element	Groundwater	
Likely Residual Impact Outcome	This outcome of the significance assessment (frequency, duration, extent, severity) is considered ALARP due to the implementation of control measures to manage risk of contamination from storage of fuels and chemicals, crossflow or loss of pressure of groundwater from drilling.	
Leading Performance Criteria	Wells designed, constructed, operated and maintained in accordance with Beach's Drilling & Completion Technical Standards, and Well Integrity Management Framework. All fuel and oil storage facilities meet requirements of AS 1940-2017: The storage and handling of flammable and combustible liquids. Records of well design and construction including placement and verification of barriers are maintained. Inspection schedule established to check appropriate control measures have been implemented.	
Assessment Criteria	No groundwater contamination as a result of drilling, completion or well production testing activities. No uncontrolled flow to surface (e.g. blow out)., No spills, leaks or other storage or handling incidents of contaminating wastes. No impact on other groundwater users due to water extraction activities. Water Allocation Plan and water licence conditions are complied with. Appropriate barriers in place to protect separate groundwater systems and / or hydrocarbon reservoirs that are typically in natural hydraulic isolation from each other.	
Potential Impact Event GW2	*Contamination of groundwater – radioactive source loss*	
Source/s	Radioactive source	
Pathway/s	Loss of source down hole	
Receptor/s	Groundwater Groundwater Dependent Ecosystems.	Stock. Irrigation users.
Confirmation of Source – Pathway- Receptor		Yes
Uncertainties and Assumptions	Site specific hydrogeological conditions of the potential project sites are still not certain. Assume the radioactive sources dropped down the holes interact with groundwater. Assume that source is radioactive enough to cause concern. Assume radioactive source is not recovered.	
Sensitivity to change	High. If recovered the magnitude of this impact changes significantly. Differences in assumed understanding of the hydrogeological site will change the likelihood of this impact occurring.	
Control Measures		
Type	*Description*	
Elimination	-	
Substitution	-	
Physical Controls	Immediate retrieval of any radioactive source lost downhole. If retrieval is not possible, tool is cemented in hole to isolate it from adjacent formations. Approval is sought from	

Environmental Element	Groundwater		
	EPA to cement any radioactive tools in hole pursuant to the *Radiation Protection and Regulations 2022*.		
Procedural Controls	Activities performed in accordance with applicable industry and regulatory standards.		
Effectiveness of controls	High. Cementing tool in situ if it cannot be recovered minimises risk of contamination to surrounding groundwater.		
Environmental Objective/s	Minimise loss of aquifer pressures and avoid aquifer contamination (OB-05).		
Significance Assessments		Beach Risk Assessment	
Frequency	Uncommon but possible, even with implementation of control measures as these impacts is largely a result of momentary human error.	Likelihood	Highly Unlikely
Extent	Non-confined. May extend further than project boundaries.	Consequence	Serious
Duration	Medium to long-term, if contamination occurs.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Variable, depending on level of contamination.		
Sensitivity of Receptor/s	Medium to high.		
Cumulative Impact Assessment	Yes. Groundwater can be affected by other contaminant sources or from external sources (non-project related) which can lead to increased contamination and flow-on impacts.		
Likely Residual Impact Outcome	Control measures ensure that the risk and impact of potential contamination of groundwater from radioactive source loss is reduced to ALARP.		
Leading Performance Criteria	Inspection schedule established to assess compliance with all industry and regulatory standards. Equipment records kept of radioactive sources/tools on site.		
Assessment Criteria	No identified groundwater contamination as a result of drilling, completion or well production testing activities. Appropriate barriers in place to protect separate groundwater systems and / or hydrocarbon reservoirs that are typically in natural hydraulic isolation from each other.		
Potential Impact Event GW3	*Contamination, over-pressurisation or crossflow of groundwater – loss of well integrity*		
Source/s	Exposure of groundwater to hydrocarbons, other contaminants, or other groundwater sources.		
Pathway/s	Loss of well integrity (e.g. casing or cement failure).		
Receptor/s	Groundwater Groundwater Dependent Ecosystems	Stocks Irrigation users	
Confirmation of Source – Pathway- Receptor		Yes	

Environmental Element	Groundwater		
Uncertainties and Assumptions	General understanding of the hydrogeological conditions of the potential project sites. Assumption that a loss of well integrity will result in contamination of groundwater from hydrocarbons or other contaminants, groundwater over-pressurisation or crossflow. Assumption that groundwater crossflow is possible at well site location.		
Sensitivity to Change	Medium to high. Production levels at the well site could change the amount of hydrocarbon entering groundwater resources in the event of loss of well integrity. Not all losses of well integrity will result in all of any of these impacts. Crossflow may not be possible depending on the location of the well site. Differences in assumed understanding of the hydrogeological site will change the likelihood of this impact occurring.		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	Effective verified barriers exist to maintain well control and prevent crossflow between aquifers systems or hydrocarbon reservoirs. Wells designed to meet pressure, temperature, operational stresses and loads. Operational reports verify that barriers have been set and / or remedial cement work carried out in accordance with the work program. Aquifers isolated behind casing strings, cemented in place. Surface casing is cemented to the surface with visible return in accordance with an engineered cementing program.		
Procedural Controls	See control measures listed in **Table 9**(Public Health and Safety) impact PHS4 and 5, and in GW1 above. Well designed, constructed, operated and maintained in accordance with Beach's Drilling & Completion Technical Standards, and Well Integrity Management Framework.		
Effectiveness of controls	High. The proposed controls have been used effectively at numerous well sites to prevent contamination of groundwater aquifers.		
Environmental Objective/s	Minimise loss of groundwater pressure and avoid aquifer contamination (OB-05).		
Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon. With control measures, loss of well integrity is unlikely.	Likelihood	• Highly Unlikely
Extent	Non-confined. Extends further than project boundaries throughout groundwater system.	Consequence	• Serious
Duration	Medium to long-term, if contamination, crossflow or loss of pressure occurs	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium

Environmental Element	Groundwater	
Severity	Variable, depending on level of contamination, crossflow or loss of pressure.	
Sensitivity of Receptor/s	Medium to high	
Cumulative Impact Assessment	Yes. Groundwater can be effected by other contaminant sources or from external sources (non-project related) which can lead to increased contamination and flow-on impacts.	
Likely Residual Impact Outcome	Control measures ensure that the risk of contamination, crossflow or loss of pressure contamination of groundwater from loss of well integrity is reduced to ALARP.	
Leading Performance Criteria	Wells designed, constructed, operated and maintained in accordance with Beach's Drilling & Completion Technical Standards, and Well Integrity Management Framework. Compliance with all industry and regulatory standards. Inspection schedule established to check appropriate control measures have been implemented.	
Assessment Criteria	See assessment criteria for GW1. No uncontrolled flow to the surface (i.e. no free-flowing bores). Landholder complaints regarding impact on groundwater users are documented and reasonable steps taken to resolve them can be demonstrated.	
Potential Impact Event GW4	*Localised contamination of groundwater – spills and leaks.*	
Source/s	Chemicals, fuels or oils	
Pathway/s	Spills or leaks	
Receptor/s	Groundwater Groundwater Dependent Ecosystems	Stock Irrigation users
Confirmation of Source – Pathway- Receptor	Yes	
Uncertainties and Assumptions	General understanding of the hydrogeological conditions of the potential project sites. Spills or leaks of these substances that contact soil will seep into groundwater.	
Sensitivity to Change	Medium. It is possible spills and leaks will not seep through soil into groundwater resources. Differences in assumed understanding of the hydrogeological site will change the likelihood of this impact occurring.	
Control Measures		
Type	*Description*	
Elimination	-	
Substitution	-	
Physical Controls	See control measures listed in GW1	
Procedural Controls	-	
Effectiveness of controls	High. Chemicals, fuels and oil stored in accordance with Australian Standards	

Environmental Element	Groundwater		
Environmental Objective/s	Avoid contamination of shallow groundwater resources (OB-06).		
Significance Assessment		Beach Risk Assessment	
Frequency	Unlikely but possible, even with implementation of spill and leak controls.	Likelihood	Highly Unlikely
Extent	Confined to localised groundwater area.	Consequence	Moderate
Duration	Medium to long-term, if contamination occurs.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Low
Severity	Low to medium, depending on level of contamination and type of contaminant.		
Sensitivity of Receptor/s	Medium to high		
Cumulative Impact Assessment	Possible. Groundwater could be effected by multiple incidences in the same area (including from other sources (e.g. involving well control) however this is unlikely.		
Likely Residual Impact Outcome	Control measures ensure that the risk of localised contamination of groundwater from spills and leaks is reduced to ALARP.		
Leading Performance Criteria	Wells designed, constructed, operated and maintained in accordance with Beach's Drilling & Completion Technical Standards, and Well Integrity Management Framework. Inspection schedule established to demonstrate implementation of control measures such as fuel storage and handling and waste disposal. Records of inductions established. All wastewater disposed of in accordance with the South Australian Public Health (Wastewater) Regulations 2013 and where appropriate with regard to the EPA Septage Management Guideline (EPA 247/20).		
Assessment Criteria	No identified groundwater contamination as a result of drilling, completion or well production testing activities. No unauthorised discharge or escape of petroleum, processed substance, chemical, fuel or solid wastes to and/or groundwater.		

5.5 Surface Water (including quality and quantity)

Potential impacts to surface water arise mainly from:

- Earthworks for well site, access track and camp site construction and rehabilitation (e.g. disturbance to natural drainage patterns, increased erosion / sedimentation)
- Spills or leaks associated with storage and handling of fuel, oil and chemicals, drilling and workover operations and well production testing / flaring
- Well control incidents or loss of well integrity

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 13**.

Potential impacts to surface water from waste are discussed below.

5.5.1 Spills or leaks and waste management

The principal risk to surface water results from the potential transport off-site of material from spills or leaks. The measures discussed above in Section 5.3.2 will be implemented to ensure safe storage and handling of fuels, chemicals and wastes and appropriate management of well production testing. Spill containment and clean-up equipment would be present on site and any spills immediately cleaned up. Runoff from higher risk areas would be directed into the lined sump.

Runoff from bunded fuel or chemical storage areas would be similarly contained and would not be allowed to drain off-site. If required (e.g. after heavy rainfall) the sump will be pumped out and the contents disposed at a licensed facility to ensure sufficient capacity is maintained. The risk of flooding is considered in the location and construction of well leases, and if required, additional measures such an appropriately sized berm around the sump to prevent floodwater entering the sump will be implemented.

5.5.2 Earthworks

Earthworks for well site, access track and campsites have the potential to alter natural drainage patterns or result in increased sedimentation of surface water features. This can potentially affect native vegetation and fauna (particularly wetland communities) as discussed in Sections 5.8 and 5.9.

Well sites, access tracks and campsites will be located and constructed to avoid significantly impacting surface drainage patterns or surface water features. Where necessary, temporary culverts will be installed to ensure surface drainage is maintained. Landowners are consulted regarding crossings of features such as drainage channels and appropriate measures (e.g. culverts) are installed where required. 'Water affecting activities' (as defined by the Landscape Act) are not undertaken unless relevant permits have been obtained. Sites will be rehabilitated to restore natural surface profiles and original drainage patterns.

The soil types, general lack of defined drainage and relatively flat nature of the area result in a relatively low risk of erosion or sedimentation. Sediment and erosion control structures such as sediment fences are often not necessary but would be installed where required (e.g. if in close proximity to drains or surface water features).

5.5.3 Well control incidents or loss of well integrity

Well control, well integrity risks and other down hole drilling issues are managed by a range of measures that are discussed in Section 5.1.4 and Section 5.4.2.

Other hazards associated with down hole operations predominantly include issues that can affect drilling progress but generally have very limited environmental consequences, such as lost circulation, sloughing shales, stuck pipe or drill pipe failure.
Severe incidents with well operations may result in the uncontrolled release of water and hydrocarbon to the surface. Movement of this release into surface water values will lead to contamination and to potential flow-on effects to the general public (Section 5.1) and native fauna (Section 5.8) and vegetation (Section 5.9).

The likelihood of impact to surface water from well control, well integrity or other down hole issues is very low.

Table 13: Surface Water Impact Assessment

Environmental Element	**Surface Water**	
Views of Affected Parties	Stakeholders have identified concern for the following values and impacts in previous consultation efforts, as summarised in Section 7: • Discharge of solid or liquid waste (including wastewater) to surface water • Disturbance to drainage patterns • Disturbance of wetlands	
Applicable Legislation	• *Environment Protection Act 1993* • *Environment Protection Regulations 2023* • *Environment Protection (Waste to Resources) Policy 2010* (Waste to Resources EPP) • *Environment Protection (Water Quality) Policy 2015* • *Landscapes South Australia Act 2019* • *Native Vegetation Act 1991*	
Applicable Standards	• Australian and New Zealand guidelines for fresh and marine water quality • EPA (2010) Current criteria for the classification of waste including Industrial and Commercial Waste (Listed) and Waste Soil.	
Site/Activity Specific Receptors	• Surface water quality • Water users • Soil quality	• Native flora and fauna • Wetlands • Landholders
Potential Impact Event SW1	*Disturbance to natural drainage patterns*	
Source/s	Well site, access track and camp site construction and rehabilitation	
Pathway/s	Earthworks and other ground disturbance.	
Receptor/s	Surface water	
Confirmation of Source – Pathway- Receptor		Yes
Uncertainties and Assumptions	No uncertainties and assumptions apply.	
Sensitivity to Change	N/A	
Control Measures		
Type	*Description*	
Elimination	Where possible access tracks to avoid drainage lines.	
Substitution	-	
Physical Controls	Sediment and erosion control measures (e.g. sediment fences) installed where necessary (e.g. if in close proximity to drains or surface water features).	

Environmental Element	Surface Water		
	Any area artificially elevated by pad or access track construction will be lowered to original ground level by removal of paving material unless otherwise instructed by the landowner. Original drainage patterns will be restored. Well sites and access tracks are located to avoid surface water features such as swamps and significant wetland areas and to maintain pre-existing water flows. Temporary drainage depressions / culverts installed where required to maintain surface runoff.		
Procedural Controls	Landowners or infrastructure owners consulted regarding requirements for crossings of artificial drainage channels. Appropriate measures implemented where required (e.g. culverts).		
Effectiveness of controls	High. Significant experience of designing, implementing and removing waterway crossings.		
Environmental Objective/s	Minimise disturbance to drainage patterns and avoid contamination of surface waters (OB-07).		
Significance Assessment		Beach Risk Assessment	
Frequency	Common. Disturbance is likely to occur to some extent.	Likelihood	Possible
Extent	Non-confined. Depending on the type of surface water body, disturbance to natural drainage patterns has the potential to cause downstream impacts which could be external to project boundaries.	Consequence	Moderate
Duration	Medium. Disturbance will likely be maintained for life of the well but rehabilitation efforts will ensure drainage patterns are reinstated.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low to medium, depends on the level of disturbance and importance of the impacted surface water body.		
Sensitivity of Receptor/s	Variable, depending on the type of surface water body. Larger streams or creeks, particularly if important to local communities are of high sensitivity and importance.		
Cumulative Impact Assessment	Yes. Surface water bodies can be also impacted by contamination from project sources. Other activities external to the project (e.g. located upstream of the site) may also contribute to surface water impact.		
Likely Residual Impact Outcome	Implementation of control measures reduces the severity of this impact to levels considered ALARP.		
Leading Performance Criteria	In the event of contamination, surface waters are tested and assessed against relevant water quality parameters. Site inspections schedule established and undertaken to ensure that surface water controls are working effectively.		
Assessment Criteria	Well leases and access tracks are located and constructed to maintain pre-existing water flows as far as practicable. No new 'water affecting activities' (as defined under the Landscape Act) are undertaken unless relevant permits have been obtained. Landholder complaints regarding impacts are documented and reasonable steps taken to resolve them		

Environmental Element	Surface Water		
	can be demonstrated.		
Potential Impact Event SW2	*Sedimentation of surface waters*		
Source/s	Soil disturbance		
Pathway/s	Well site, access track and camp site construction and rehabilitation		
Receptor/s	Surface water and livestock, native fauna using surface water		
Confirmation of Source – Pathway- Receptor		Yes	
Uncertainties and Assumptions	Assumption that soil disturbance will lead to increase in sedimentation of surface water. Uncertainty of the presence of surface water during earthworks activities.		
Sensitivity to change	Low. Sedimentation is likely possible to occur if there is soil disturbance in times of rainfall.		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	Controls outlined in SW1.		
Procedural Controls	-		
Effectiveness of controls	High. Extensive experience in successfully implementing controls to prevent sediment entering surface waters.		
Environmental Objective/s	Minimise disturbance to drainage patterns and avoid contamination of surface water resources (OB-07).		
Significance Assessments		Beach Risk Assessment	
Frequency	Occasional. Sedimentation may occur if sites are chosen poorly	Likelihood	Unlikely
Extent	Non-confined. Depending on the type of surface water body, sedimentation has the potential to travel downstream which could be external to project boundaries.	Consequence	Moderate
Duration	Short to medium, depending on the amount of sedimentation that occurs.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low to medium, depends on the level of disturbance and importance of the impacted surface water body.		

Environmental Element	**Surface Water**
Sensitivity of Receptor/s	Variable, depending on the type of surface water body. Larger streams or creeks, particularly if important to local communities are of high sensitivity and importance.
Cumulative Impact Assessment	Yes. Surface water bodies can be also impacted by contamination from project sources or drainage pattern disturbance. Other activities external to the project (e.g. located upstream of the site) may also contribute to surface water impact.
Likely Residual Impact Outcome	Implementation of control measures has reduced the potential risk for surface water sedimentation to a level considered ALARP.
Leading Performance Criteria	Records of any disturbances to surface water drainage patterns have been kept. Site inspections schedule established and undertaken to ensure that surface water controls are working effectively. Complaints register is available to landowners and any complaints are resolved appropriately.
Assessment Criteria	Well leases and access tracks are located and constructed to maintain pre-existing water flows as far as practicable. No new 'water affecting activities' (as defined under the Landscape Act) are undertaken unless relevant permits have been obtained. Landholder complaints regarding impacts are documented and reasonable steps taken to resolve them can be demonstrated.
Potential Impact Event SW3	*Contamination of surface water (well control incidents)*
Source/s	Hydrocarbons and other contaminants Storage and handling of waste
Pathway/s	Well control incidents (e.g. blowout or kick) Surface water runoff from areas contaminated due to poor waste management practices.
Receptor/s	Surface water (livestock and native fauna using surface water)
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Uncertainty regarding the proximity of surface water resources to potential well sites. Uncertainty regarding the presence or absence of surface water as a result of rain.
Sensitivity to Change	Variable. Production levels at the well site could change the amount of hydrocarbon entering surface water resources in the event of a well control incident.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Control measures for management of well integrity are described for PHS4 and 5 (**Table 9**).
Procedural Controls	Control measures for management of well integrity are described for PHS4 and 5 (**Table 9**).
Effectiveness of controls	High. Procedures to minimise the likelihood of well control incidents are well established as is storage of wastes.

Environmental Element	**Surface Water**		
Environmental Objective/s	Minimise disturbance to drainage patterns and avoid contamination of surface waters (OB-07).		
Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon.	Likelihood	Highly Unlikely
Extent	Depends on the surface water body. Confined if a pond or confined water source, but non-confined if the contamination is to a creek or stream, in which case contamination has the potential to cause downstream impacts which could be external to project boundaries.	Consequence	Serious
Duration	Medium, but variable depending on the type and amount of contaminant that enters the surface water.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Variable depends on the level of contamination and importance of the impacted surface water body.		
Sensitivity of Receptor/s	Variable, depending on the type of surface water body. Larger streams or creeks, particularly if important to local communities are of high sensitivity and importance.		
Cumulative Impact Assessment	Yes. Surface water bodies can be also impacted by drainage pattern disturbance. Other activities external to the project (e.g. located upstream of the site) may also contribute to surface water impact.		
Likely Residual Impact Outcome	Implementation of control measures has reduced the risk of well incidents and potential for surface water contamination due to poor storage and handling of wastes to a level considered ALARP.		
Leading Performance Criteria	Wells are design, construction, operated and maintained in accordance with Beach's Drilling and Completions Technical Standards and Well Integrity Framework.. Records of any disturbances to surface water quality have been kept. Inspection schedule established to check appropriate control measures have been implemented. Stakeholder engagement and complaints reporting systems in place. .		
Assessment Criteria	No well control incidents. No unauthorised discharge or escape of petroleum, processed substance, chemical, fuel or solid wastes to surface water. Landholder complaints regarding impacts are documented and reasonable steps taken to resolve them can be demonstrated.		
Potential Impact Event SW4	*Contamination of surface water (downhole drilling issues).*		
Source/s	Hydrocarbons and other contaminants		
Pathway/s	Other downhole drilling issues (e.g. lost circulation, sloughing shales, stuck pipe or drill pipe failure)		

Environmental Element	**Surface Water**		
Receptor/s	Surface water and livestock, native fauna using surface		
Confirmation of Source – Pathway- Receptor		Yes	
Uncertainties and Assumptions	Assumption that downhole drilling incidents (e.g. lost circulation, sloughing shales, stuck pipe or drill pipe failure) will result in contamination of surface water from hydrocarbons or other contaminants. Uncertainty regarding the proximity of surface water resources to potential well sites. Uncertainty regarding the presence or absence of surface water as a result of rain.		
Sensitivity to Change	High. Downhole drilling incidents may not result in release of contaminants and subsequent contamination of surface water.		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	Controls are consistent to those described for impact GW1 in **Table 12**.		
Procedural Controls	See control measures listed for impact PHS5 in **Table 9**.		
Effectiveness of controls	High. Procedures to manage down hole drilling issues are well established.		
Environmental Objective/s	Minimise disturbance to drainage patterns and avoid contamination of surface waters (OB-07).		
Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon	Likelihood	Highly Unlikely
Extent	Depends on the surface water body. Confined if a pond or confined water source, but non-confined if the contamination is to a creek or stream, in which case contamination has the potential to cause downstream impacts which could be external to project boundaries.	Consequence	Serious
Duration	Medium, but variable depending on the amount of contaminant that enters the surface water.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Variable, depends on the level of contamination and importance of the impacted surface water body.		
Sensitivity of Receptor/s	Variable, depending on the type of surface water body. Larger streams or creeks, particularly if important to local communities are of high sensitivity and importance.		

Environmental Element	**Surface Water**
Cumulative Impact Assessment	Yes. Surface water bodies can be also impacted by drainage pattern disturbance. Other activities external to the project (e.g. located upstream of the site) may also contribute to surface water impact.
Likely Residual Impact Outcome	Implementation of control measures has reduced the risk of well incidents and subsequent surface water contamination to a level considered ALARP.
Leading Performance Criteria	Wells are design, construction, operated and maintained in accordance with Beach's Drilling & Completion Technical Standards, and Well Integrity Management Framework. Inspection schedule established to check appropriate control measures have been implemented. In the event of contamination, surface waters are tested and assessed against relevant water quality parameters.
Assessment Criteria	No unauthorised discharge or escape of petroleum, processed substance, chemical, fuel or solid wastes to surface water and/or groundwater. No identified surface water contamination as a result of drilling, completion or well production testing activities. Landholder complaints regarding impacts are documented and reasonable steps taken to resolve them can be demonstrated.
Potential Impact Event SW5	*Contamination of surface water (loss of well integrity)*
Source/s	Hydrocarbons and other contaminants
Pathway/s	Loss of well integrity (e.g. casing or cement failure)
Receptor/s	Surface water and livestock, native fauna using surface
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Uncertainty regarding the proximity of surface water resources to potential well sites. Uncertainty regarding the presence or absence of surface water as a result of rain.
Sensitivity to Change	Variable. Production levels at the well site could change the amount of hydrocarbon entering surface water resources in the event of loss of well integrity.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	-
Procedural Controls	See control measures listed in **Table 9** (Public Health and Safety) impact PHS4.
Effectiveness of controls	High. Procedures to prevent loss of well integrity combined with well design practices are well established.
Environmental Objective/s	Minimise disturbance to drainage patterns and avoid contamination of surface waters (OB-07).

Environmental Element	**Surface Water**		
Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon	Likelihood	Highly Unlikely
Extent	Depends on the surface water body. Confined if a pond or confined water source, but non-confined if the contamination is to a creek or stream, in which case contamination has the potential to cause downstream impacts which could be external to project boundaries.	Consequence	Serious
Duration	Medium, but variable depending on the amount of contaminant that enters the surface water.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Variable, depends on the level of contamination and importance of the impacted surface water body.		
Sensitivity of Receptor/s	Variable, depending on the type of surface water body. Larger streams or creeks, particularly if important to local communities are of high sensitivity and importance.		
Cumulative Impact Assessment	Yes. Surface water bodies can be also impacted by drainage pattern disturbance. Other activities external to the project (e.g. located upstream of the site) may also contribute to surface water impact.		
Likely Residual Impact Outcome	Implementation of control measures has reduced the risk of well incidents and subsequent surface water contamination to a level considered ALARP.		
Leading Performance Criteria	Wells are design, construction, operated and maintained in accordance with Beach's Drilling & Completion Technical Standards, and Well Integrity Management Framework. Inspection schedule established to check appropriate control measures have been implemented. In the event of contamination, surface waters are tested and assessed against relevant water quality parameters.		
Assessment Criteria	No unauthorised discharge or escape of petroleum, processed substance, chemical, fuel or solid wastes to surface water and/or groundwater. No identified surface water contamination as a result of drilling, completion or well production testing activities. Landholder complaints regarding impacts are documented and reasonable steps taken to resolve them can be demonstrated.		
Potential Impact Event SW6	*Uncontrolled release of water and hydrocarbon to surface*		
Source/s	Hydrocarbons and water		
Pathway/s	Well control incidents (e.g. blowout or kick) Other downhole drilling issues (e.g. lost circulation, sloughing shales, stuck pipe or drill pipe failure)		
Receptor/s	Surface water and livestock, native fauna using surface		

Environmental Element	**Surface Water**		
Confirmation of Source – Pathway- Receptor		Yes	
Uncertainties and Assumptions	Uncertainty regarding the proximity of surface water resources to potential well sites. Uncertainty regarding the presence or absence of surface water as a result of rain. Uncertainty of the substance involved in the spill of leak. Volume of production at well sites.		
Sensitivity to Change	High. The absence of surface water at the time of an uncontrolled hydrocarbon release will prevent this impact from occurring. The production levels at the relevant well site will change the volume of the release and change the magnitude of the impact.		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	Uncontrolled release of hydrocarbons is avoided by controls outlined in Table 5.6 SW1, and Table 5.2 impacts PHS4 and PHS5.		
Procedural Controls	-		
Effectiveness of controls	High. Procedures to prevent loss of well integrity combined with well design practices are well established.		
Environmental Objective/s	Minimise disturbance to drainage patterns and avoid contamination of surface waters (OB-07).		
Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon	Likelihood	Highly Unlikely
Extent	Depends on the surface water body. Confined if a pond or confined water source, but non-confined if the contamination is to a creek or stream, in which case contamination has the potential to cause downstream impacts which could be external to project boundaries.	Consequence	Serious
Duration	Long-term. Uncontrolled release indicates a large volume of contaminant entering the surface water receptor.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	High. Can change depending on importance of the impacted surface water body.		
Sensitivity of Receptor/s	Variable, depending on the type of surface water body. Larger streams or creeks, particularly if important to local communities are of high sensitivity and importance.		
Cumulative Impact Assessment	Yes. Surface water bodies can be also impacted by drainage pattern disturbance. Other activities external to the project (e.g. located upstream of the site) may also contribute to surface water impact.		

Environmental Element	**Surface Water**
Likely Residual Impact Outcome	Implementation of control measures has reduced the risk of well incidents and subsequent surface water contamination to a level considered ALARP.
Leading Performance Criteria	Wells are design, construction, operated and maintained in accordance with Beach's Drilling & Completion Technical Standards, and Well Integrity Management Framework. Inspection schedule established to check appropriate control measures have been implemented. In the event of contamination, surface waters are tested and assessed against relevant water quality parameters.
Assessment Criteria	No uncontrolled flow to the surface (i.e. no free-flowing bores). No unauthorised discharge or escape of petroleum, processed substance, chemical, fuel or solid wastes to surface water and/or groundwater. Landholder complaints regarding impacts are documented and reasonable steps taken to resolve them can be demonstrated.
Potential Impact Event SW7	*Localised contamination of surface water (spills and leaks)*
Source/s	Chemicals, fuels or oils, wastes
Pathway/s	Spills and leaks (e.g. from transport activities, vehicles, other machinery)
Receptor/s	Surface water
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Uncertainty regarding the proximity of surface water resources to potential well sites. Uncertainty regarding the presence or absence of surface water as a result of rain. Uncertainty of the substance involved in the spill of leak.
Sensitivity to Change	High. The absence of surface water at the time of a spill or leak will prevent this impact from occurring. The type of substance involved will change the severity of this impact.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	See control measures listed in Table 5.4 (Soil) impact S2.
Procedural Controls	Uncontrolled release of hydrocarbons is avoided by controls outlined for SW1 in **Table 13**, and for PHS4 and PHS5 in **Table 9**.
Effectiveness of controls	High. Controls have been used at numerous well sites and proven to be effective.
Environmental Objective/s	Minimise disturbance to drainage patterns and avoid contamination of surface waters (OB-07).

Environmental Element	**Surface Water**		
Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon	Likelihood	Highly Unlikely
Extent	Depends on the surface water body. Confined if a pond or confined water source, but non-confined if the contamination is to a creek or stream, in which case contamination has the potential to cause downstream impacts which could be external to project boundaries.	Consequence	Moderate
Duration	Medium, but variable depending on the type of and amount of contaminant that enters the surface water.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Low
Severity	Variable depends on the level of contamination and importance of the impacted surface water body.		
Sensitivity of Receptor/s	Variable, depending on the type of surface water body. Larger streams or creeks, particularly if important to local communities are of high sensitivity and importance.		
Cumulative Impact Assessment	Yes. Surface water bodies can be also impacted by drainage pattern disturbance. Other activities external to the project (e.g. located upstream of the site) may also contribute to surface water impact.		
Likely Residual Impact Outcome	Implementation of control measures has reduced the possibility of spills and leaks and subsequent surface water contamination to a level considered ALARP.		
Leading Performance Criteria	Records of any disturbances to surface water quality have been kept. Inspection schedule established for hazardous substance and waste storage to check that appropriate control measures have been implemented. In the event of contamination, surface waters are tested and assessed against relevant water quality parameters.		
Assessment Criteria	No unauthorised discharge or escape of petroleum, processed substance, chemical, fuel or liquid or solid wastes to surface water. Landholder complaints regarding impacts are documented and reasonable steps taken to resolve them can be demonstrated.		

5.6 Air Quality/Greenhouse Gas

Potential impacts to air quality and greenhouse gas arise mainly from dust generation emissions from fuel burning.

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 14**.

Impacts of poor air quality on public health are discussed above in Section 5.1.

5.6.1 Dust generation

Generation of dust during site construction and use of unsealed roads and tracks can result in temporary and localised impacts to air quality. Dust generation will be minimised by restriction of speeds on unsealed roads and spraying of unsealed roads with water to moderate the potential for dust generation where required.

5.6.2 Greenhouse Gas Emissions

Emissions from fuel burning equipment, flaring and fugitive emissions from well operations have the potential to cause localised impacts to air quality and contribute to greenhouse gas emissions. Emissions of environmental significance (i.e. atmospheric pollutants and / or greenhouse gases) are:

- combustion by-products (e.g. oxides of nitrogen, carbon monoxide and sulphur dioxide)
- methane and organic carbon from fugitive sources
- flared hydrocarbons
- vented CO_2, H_2S, and CO.

Equipment will be operated and maintained appropriately in order to minimise emissions, and flaring during well production testing will be kept to the minimum length of time necessary to establish resource parameters. Fugitive emissions will be minimised by maintenance of well integrity and appropriate maintenance and operation of well heads and other surface infrastructure. Greenhouse gas emissions will be recorded and reported on in accordance with National Greenhouse and Energy Reporting Act requirements.

Table 14: Air Quality Impact Assessment

Environmental Element	**Air Quality**
Views of Affected Parties	Stakeholders have identified concern for the following values and impacts in previous consultation efforts, as summarised in Section 7: • Flaring • Reporting
Applicable Legislation	• Environmental Protection (Air Quality) Policy 2016 (SA) • National Greenhouse and Energy Reporting Act 2007
Applicable Standards	• NGER Scheme • National Pollutant Inventory
Site/Activity Specific Receptors	• Air quality • Climate greenhouse gas levels
Potential Impact Event AQ1	*Dust generation*
Source/s	Dust
Pathway/s	Vehicle movements (unsealed roads), earthworks.
Receptor/s	Air Quality
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Distance of unsealed roads surrounding project area. Rainfall volumes contributing to dust suppression around times of heavy vehicle

Environmental Element	Air Quality
	movements and earthworks.
Sensitivity to Change	High. Changes in rainfall volumes and distances of unsealed roads will greatly change the amount of dust produced.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Warning signage and traffic management measures installed where appropriate in the vicinity of well sites. If necessary, unsealed roads will be sprayed with water as required to minimise dust generation.
Procedural Controls	Equipment operated and maintained in accordance with manufacturer specifications. Control production and dispersion of dust on unsealed roads and drilling lease areas. Compliance with relevant speed restrictions on access roads and tracks.
Effectiveness of controls	High
Environmental Objective/s	Minimise reduction in air quality (OB-08).

Significance Assessment		Beach Risk Assessment	
Frequency	Common. Dust will be generation commonly throughout the project and lead to periods of lower air quality.	Likelihood	Unlikely
Extent	Non-confined. Reduction in air quality is likely to extend beyond the project boundaries, potentially into surrounding private or public land.	Consequence	Serious
Duration	Short to medium. Air quality is likely to stay reduced for weeks to months after dust generation, however permanent reduction is unlikely.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low to medium.		
Sensitivity of Receptor/s	Low. The quality of the air in the area is likely to recover.		
Cumulative Impact Assessment	Possible. Air quality will likely be impacted by other non-project sources of contaminants.		

Environmental Element	Air Quality		
Likely Residual Impact Outcome	Reduction of air quality is avoided by implementation of control measures to ALARP, however some impact is expected and cannot be avoided.		
Leading Performance Criteria	Stakeholder engagement and complaints reporting systems in place. Records are kept of any air quality complaints. Records of water use for dust suppression are kept.		
Assessment Criteria	Dust generation reduced by implementation of reasonable practical measures. Landholder / stakeholder complaints are documented and reasonable steps taken to resolve them can be demonstrated.		
Potential Impact Event C1	*Contribution to climate change through greenhouse gas emissions (including flaring)*		
Source/s	Combustion by-products (e.g. oxides of nitrogen, carbon monoxide and sulphur dioxide). Methane and organic carbon from fugitive sources. Flared hydrocarbons. Vented CO_2, H_2S, and CO.		
Pathway/s	Flaring for well testing Use of petrol or diesel machinery and vehicles, fugitive emissions.		
Receptor/s	Climate greenhouse gas levels		
Confirmation of Source – Pathway- Receptor	Yes		
Uncertainties and Assumptions	Uncertainty regarding volume of GHG emissions produced in future projects.		
Sensitivity to Change	Variable. Impact could change depending on .gas quality, fugitive emissions or flaring.		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	-		
Procedural Controls	Flaring during well production testing kept to minimum length of time necessary. Equipment options that are 'greener' (generate less greenhouse gas emissions) will be chosen when possible.		
Effectiveness of controls	Moderate		
Environmental Objective/s	Minimise atmospheric emissions (OB-09).		
Significance Assessment		Beach Risk Assessment	
Frequency	Common. Greenhouse gases will be produced through flaring on occasion, fugitive emissions and frequently through vehicles and other equipment and machinery to support	Likelihood	Likely

Environmental Element	Air Quality		
	construction and operations.		
Extent	Non-confined. Greenhouse gas emissions contribute to global atmospheric pollution and global climate change.	Consequence	Minor
Duration	Greenhouse gases remain as atmospheric pollution long-term and contribute to the long-term impacts of climate change.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low. The greenhouse gasses produced by project activities will contribute an insignificant component of Australian and global greenhouse gas emissions		
Sensitivity of Receptor/s	Medium. Climate is a sensitive environmental factor worldwide but within project context, emissions from project activities will have negligible impact.		
Cumulative Impact Assessment	Yes. Greenhouse gas emissions are cumulative over time and from a large range of contribution sources. Factors contributing to climate change can also be cumulative, for example the clearance of vegetation can exacerbate climate change effects.		
Likely Residual Impact Outcome	Contribution to climate change from greenhouse gas emissions from project activities		
Leading Performance Criteria	All facilities designed, constructed, operated and maintained in accordance with relevant standards and legislative requirements (e.g. *Environment Protection (Air Quality) Policy*). Equipment operated and maintained in accordance with manufacturer's specifications. Inspection schedule established to check appropriate control measures have been implemented. Flaring during production testing kept to minimum length of time necessary. Reporting of emissions in accordance with statutory requirements (e.g. NPI and NGER requirements).		
Assessment Criteria	Emissions minimised by implementation of reasonable practical measures during design and operation.		

5.7 Existing Land Use and Infrastructure

Potential impacts to existing land use and infrastructure local amenity arise from:

- Well site, access track and camp site construction and rehabilitation
- Access to contaminants by stock (e.g. from well control incidents, the drilling sump, spills or leaks, waste)
- Fire.

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 15**.

5.7.1 Well site, access track and camp site construction and rehabilitation

Construction, use and rehabilitation of the well site, access track and camp site have the potential to affect land use through disturbance to soil, groundwater and surface water within the footprint of the activity (as discussed in Sections 5.3, 5.4 and 5.5. The measures discussed in these previous sections will be implemented to ensure that these impacts are minimised and appropriate rehabilitation is undertaken.

Poor planning and execution of construction and rehabilitation activities also has the potential to impact land use beyond the activities' direct footprint, for example if well sites and access tracks are not sited to minimise the disruption to overall property access and management. Landholders will be consulted regarding the location, management and timing of proposed activities, with the aim of minimising disturbance. Ongoing liaison with landholders is carried out following drilling (and throughout the well's life if it is successful).

Appropriate access tracks to drill sites are chosen in consultation with landowners. Use of roads and tracks for drilling operations, particularly unsealed roads or farm tracks can also cause damage or degradation. Any deterioration of property tracks or infrastructure as a result of drilling-related traffic will be rectified. Previous experience in the Otway Basin has indicated that access tracks can generally be located so that they can be retained as all-weather access across the property and provide a long-term benefit to property operations.

Under the ER Act, landowners have rights to compensation. Compensation is payable where there is:

- deprivation or impairment of the use and enjoyment of the land
- damage to the land (not including damage that has or will be made good by the licensee)
- damage to, or disturbance of, any business or other activity lawfully conducted on the land
- consequential loss.

Compensation agreements are agreed and put into place before any activities are undertaken.

5.7.2 Disturbance from site activities (e.g. light, noise, presence of the drill rig, camp and personnel)

Drilling activities and transport moves have the potential to disturb and possibly injure stock. Consultation with landholders is undertaken to ensure that the location and timing of activities minimise the potential for impact. Measures in place to minimise impacts include speed limits, fencing of access tracks if required, positioning lighting to minimise light emanating from the site during drilling operations, avoidance of night transport moves as far as possible, and prompt removal of drill rigs and camps from site following the completion of operations.

The use of roads for drilling operations has the potential to increase disturbance to the landholders and local community. Traffic management measures will be implemented to reduce the magnitude of this impact as described in Section 5.1.1.

5.7.3 Access to contaminants by stock (e.g. from well control incidents, drilling sump, spills or leaks, waste)

The potential for stock to access contaminants and waste is limited. The well site and sump will be fenced, as discussed previously, and any contaminants from spills or leaks are likely to be confined to the area of the well lease and will be immediately cleaned up. Waste will be stored in covered bins before being transported off-site for disposal to an appropriately licenced facility.

5.7.4 Fire

Fire initiated by site activities (e.g. flaring, sparks from vehicles or equipment, cigarette butts) has the potential to significantly impact land use (e.g. via damage to pasture, forestry, crops and infrastructure). Measures discussed in Section 5.1.5 above will be in place to prevent fires including firebreaks, restriction of vehicles to tracks and cleared areas, maintenance of suitable fire-fighting equipment on site and liaison with the CFS.

Table 15: Existing land use, infrastructure and general amenity Impact Assessment

Environmental Element	**Existing land use and infrastructure**	
Views of Affected Parties	Stakeholders have identified concern for the following values and impacts in previous consultation efforts as summarised in Section 7: Stock accessing contaminants	
Applicable Legislation	*Planning, Development and Infrastructure Act 2016 (SA)*	
Applicable Standards	No applicable non-legislated standards.	
Site/Activity Specific Receptors	Existing land uses.	
Potential Impact Event LU1	*Disturbance to land use (including livestock)*	
Source/s	Fire, Noise, Light	
Pathway/s	Vehicles, machinery or other ignition sources	
Receptor/s	Local landholders, livestock	
Confirmation of Source – Pathway- Receptor		Yes
Uncertainties and Assumptions	Assume site produced noise disturbs livestock. The impact of light and noise on livestock may not be realised. Ignition source may not always be confirmed.	
Sensitivity to	High.	

Environmental Element	Existing land use and infrastructure
Change	Potential impact from fire could be small if fire contained or large if fire uncontained and impacting multiple properties.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Equipment operated and maintained in accordance with manufacturer specifications. Fire extinguishers etc. on site. Storage of flammable goods in accordance with regulations
Procedural Controls	Landholders, local councils, potentially affected residents and emergency services will be informed of significant activities such as rig mobilisation and demobilisation. Landholder is consulted regarding the location, management and timing of proposed activities. Ongoing landholder liaison during and following operations. Systems in place for logging stakeholder complaints to ensure that issues are addressed as appropriate. Liaise with CFS regarding operations to ensure fire concerns are addressed and any Fire and Emergency Services Act requirements are met (e.g. permits for 'hot work' on fire ban days if required).
Effectiveness of controls	High. Controls have been used on other projects.
Environmental Objective/s	Minimise disturbance to existing land users and infrastructure (OB-10).

Significance Assessment		Beach Risk Assessment	
Frequency	Fires from drill rigs are uncommon.	Likelihood	Unlikely
Extent	Generally confined to areas surrounding project site and access roads however fire could extend into surrounding community	Consequence	Serious
Duration	Noise and light emissions are short term for the duration of the activity. Impacts from fire on surrounding use could be medium to long-term, depending on the magnitude of the damage and the existing land use.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Variable. Depends on the magnitude of the fire and duration of activities being undertaken.		
Sensitivity of Receptor/s	Variable. Depends on the existing land use.		
Cumulative Impact Assessment	Unlikely for surrounding land to be damaged by fire on more than one occasion. Unlikely that other similar activities will occur in close proximity.		

Environmental Element	Existing land use and infrastructure
Likely Residual Impact Outcome	Noise and light disturbance to existing land uses is unavoidable but the implementation of control measures ensures it is reduced to ALARP. The potential for fires started from project activities and subsequent damage to existing land use is considered ALARP.
Leading Performance Criteria	Well sites have been chosen to reduce potential for noise and light impacts to surrounding properties. Consultation and notification of activities has been conducted and recorded. Consultation with CFS and local government regarding upcoming activities and proposed mitigations. Stakeholder engagement and complaints reporting systems in place.
Assessment Criteria	No adverse impact (outside agreed disturbance / compensation areas) on land use as a result of activities. Adverse impacts of accidental or unforeseen disturbance to infrastructure or land use resolved to the reasonable satisfaction of the landholder Timely consultation and notification of proposed activities with relevant landowners and stakeholders can be demonstrated Landholder / stakeholder complaints are documented and reasonable steps taken to resolve them can be demonstrated. No uncontrolled fires initiated as a result of drilling, completion and well production testing activities
Potential Impact Event LU2	*Damage to third party infrastructure*
Source/s	Vehicles
Pathway/s	Use of roads; movement of vehicles and heavy machinery
Receptor/s	Existing land use
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Assumption that project vehicles increase road use above standard levels. Uncertainty of original state of the roads to be used.
Sensitivity to Change	Medium to high. Roads could be damaged regardless of how much contribution is from the project. Some sites may involve significant increase to traffic volume and use of large trucks.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Vehicle speed limits to be observed. Any deterioration of property tracks or infrastructure as a result of drilling-related traffic is rectified. All gates left in the condition in which they were found (open / closed).
Procedural Controls	Driver behaviour and vehicle speed limits to be included in compulsory induction. Systems in place for logging stakeholder complaints to ensure that issues are addressed as

Environmental Element	Existing land use and infrastructure		
	appropriate. All required authorisations (e.g. local council, Department of Planning, Transport and Infrastructure, police) obtained where required for movement of rig along public roads, including joint inspections of roads before and after transport moves if necessary.		
Effectiveness of controls	High. Beach Energy and its contractors are highly aware of the need to respect existing land uses and third party property.		
Environmental Objective/s	Minimise disturbance to existing land users and infrastructure (OB-10).		
Significance Assessment		Beach Risk Assessment	
Frequency	Fairly common. Road degradation is a common occurrence that can be managed through maintenance.	Likelihood	Likely
Extent	Non-confined to project area. The extent of potential damage is variable.	Consequence	Moderate
Duration	Short term. Any degradation of roads contributed by project vehicle movement can be rectified by timely maintenance to reduce the duration of the impact.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low.		
Sensitivity of Receptor/s	Low.		
Cumulative Impact Assessment	Cumulative effects are possible from road use by parties external to the project		
Likely Residual Impact Outcome	The potential for third party infrastructure damage can be reduced but is still possible. Implementation of control measures ensures that impact is short-term and is considered ALARP.		
Leading Performance Criteria	Consultation and notification of activities has been conducted and recorded prior to activity commencement. Inspection of roads has been conducted and recorded. Consultation with local council regarding upcoming activities and proposed mitigations. Stakeholder engagement and complaints reporting systems in place.		
Assessment Criteria	No adverse impact (outside agreed disturbance / compensation areas) on land use as a result of activities Adverse impacts of accidental or unforeseen disturbance to infrastructure or land use resolved to the reasonable satisfaction of the stakeholder . Timely consultation and notification of proposed activities with relevant landowners and stakeholders can be demonstrated Landholder / stakeholder complaints are documented and reasonable steps taken to resolve them can be demonstrated		

5.8 Native Fauna

Potential impacts to native fauna arise from:

- Well site, access track and camp site construction and rehabilitation.
- Disturbance from site activities (e.g. light, noise, presence of the drill rig, camp and personnel).
- Use of roads and movement of heavy vehicles and machinery.
- Access to contaminants (e.g. from well control incidents, the drilling sump or spills and leaks) and waste.
- Fire.

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 16**.

5.8.1 Earthworks for well site, access track and camp site construction

Earthworks and clearing activities have the potential to damage native wildlife habitats (including wetland communities) and disturb or injure fauna.

Well sites are subject to environmental assessment in the planning process to ensure that any issues such as presence of rare or threatened species are identified and appropriate avoidance or mitigation strategies are developed. As discussed in Section 5.5, activities will also be carried out to ensure surface drainage patterns and water quality are maintained, which will avoid potential indirect impacts on fauna and fauna habitat.

5.8.2 Disturbance from site activities

Potential disturbance to native fauna from site activities (e.g. light, presence of the drill rig, camp and personnel) is short term, localised and generally of limited significance in the region given the existing land uses and extent of vegetation clearance and habitat modification. The environmental assessment undertaken during the planning process will identify whether there are specific issues at an individual well site (e.g. breeding of the Endangered Red-tailed Black-Cockatoo, or likely indirect impacts to adjacent conservation reserves) and develop measures to avoid or mitigate potential impacts. Relevant agencies (e.g. DEW, DCCEEW) would be consulted where required.

The presence of excavations on site (e.g. the drilling sump) also has the potential for localised impacts to native fauna. The presence of site personnel and the fencing of the drilling sump following drilling will generally preclude impacts to larger species. Well sites are likely to be located in areas where there is limited habitat value for smaller species and their presence on the well lease is unlikely, however excavations will be regularly checked for trapped fauna to minimise potential impacts.

Excessive noise production can have potential impacts on native fauna by causing stress, interfering with communication or causing hearing loss. Noise and vibration will be produced during well drilling operations, including from the increased vehicle movement associated with construction. Management measures to reduce noise and vibrations include:

- Use of heavy machinery and vehicle movements restricted to daylight hours where possible.

- Avoidance of heavy machinery or equipment usage when possible in the event of listed fauna observation on site.

5.8.3 Use of roads and movement of heavy vehicles and machinery

The movement of vehicles and machinery along existing roads and the access track has the potential to impact native fauna, principally through collisions. This is likely to be relatively insignificant due to the level of existing traffic, the short-term nature of the activities and the limited extent of significant fauna habitats. Transport procedures (e.g. speed restrictions, limitation of movements at night) will also reduce the potential level of impact.

5.8.4 Access to contaminants (e.g. from well control incidents, drilling sump, spills or leaks) and waste

The potential for native fauna to access contaminants and waste is limited. The well site and sump will be fenced, as discussed above, and any contaminants from spills or leaks are likely to be confined to the area of the well lease, and will be immediately cleaned up.

Potential impacts to native fauna can arise from the mismanagement of waste storage, including domestic waste, chemical or oil waste. Ingestion of waste material by native fauna can lead to injury, illness or fatality. Measure to prevent both the attraction and ability to access waste material by native fauna include:

- Covering bins with scavenger-proof lids.
- Regular disposal of waste off-site and avoidance of stockpiling.
- Correct storage and disposal of harmful substances (including chemical, fuel and oil waste products) as described in Section 5.3.2.
- Training of any site personnel to discourage feeding of native fauna.

Potential impacts to native fauna can arise from the mismanagement of waste storage, particularly from domestic waste from construction camps. Waste can attract both native fauna and pest species to site, altering behaviour, and can lead to broader ecosystem impacts, spread of diseases or injury or illness of native fauna.

5.8.5 Fire

Fire initiated by site activities (e.g. flaring, sparks from vehicles or equipment, cigarette butts) has the potential to impact fauna. The impact could be directly from injury or death from fire, or indirectly from destruction of fauna habitat. Measures will be in place to prevent fires including firebreaks, restriction of vehicles to tracks and cleared areas, maintenance of suitable fire-fighting equipment on site and liaison with the CFS. The flare tank or flare stack will be designed and located to avoid radiant heat impacting or burning trees.

Table 16: Native Fauna Impact Assessment

Environmental Element	Native Fauna
Views of Affected Parties	Stakeholders have identified concern for the following values and impacts in previous consultation efforts, as summarised in Section 7: • Habitat of red-tailed black cockatoos

Environmental Element	Native Fauna
	• Weed management and impact to native and honey bees • Noise impact to fauna Stakeholders have also expressed interest in observing monitoring plans.
Applicable Legislation	• *National Parks and Wildlife Act 1972 (SA)* • *Environmental Protection and Biodiversity Conservation Act 1999 (Cth)* • *Landscape (South Australia) Act 2019 (SA)* • *Fire and Emergency Services Act 2005 (SA)* • *Planning, Development and Infrastructure Act 2016 (SA)* • *Biosecurity Act 2015*
Applicable Standards	State and Commonwealth weeds of national significance AS 1940-2017: The storage and handling of flammable and combustible liquids
Site/Activity Specific Receptors	• Native fauna • Biodiversity • Fauna habitat
Potential Impact Event NF1	*Disturbance, injury or death of fauna – earthworks, weeds*
Source/s	Habitat clearance, introduction of pests and weeds via vehicles, import of supplies and materials, boots, introduction of feral animals/pests, noise emissions.
Pathway/s	Earthworks, vehicles, wind, storage handling and disposal of wastes
Receptor/s	Native fauna Fauna habitat
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Uncertainty of the presence of fauna habitat as the location of future drilling activities is not defined. Assumption that attracted pest species will further impact native fauna through competition for resources or habitat, or physical fights. Assume site produced noise disturbs native fauna. Severity of impact could change if native species sensitivity listings are reclassified. Severity of impact could change if weed or pest listing is reclassified.
Sensitivity to Change	Medium. This impact will be reduced if fauna habitat can be avoided. Not all attracted pest fauna will compete with native fauna for resources and habitat.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	All reasonable and practical endeavours taken to minimise the risks of introducing weeds, exotic pest fauna and pathogens into the tenement areas. Appropriate consultation regarding weeds or pathogens carried out with landholders and Landscape Board officers.

Environmental Element	Native Fauna
	Vehicles and equipment arriving at the site must be clean and free of soil and plant material. Paving materials will be sourced from licensed quarries. Sites and access tracks will be monitored on a regular basis for new weed species / infestations, and treated as necessary in accordance with requirements of the landholder, and if appropriate the Landscape Board. Vegetation is trimmed rather than removed where possible. Excavations (e.g. sump) checked regularly for trapped fauna. Native vegetation clearance avoided or minimised by locating well sites and access tracks appropriately. Sumps and well site are appropriately fenced to minimise fauna access.
Procedural Controls	Appropriately trained and experienced personnel have assessed or scouted proposed well site, access track and camp locations to identify and flag significant (or rare, vulnerable or endangered) species and communities (including wetland communities). Removal of large trees (including dead trees with hollows) is avoided. Areas of low-quality native vegetation are avoided unless there are no viable alternatives (e.g. use of adjacent cleared areas). Areas of high quality or significant remnant vegetation or Heritage Agreement Areas are avoided. Activities are not carried out in parks or reserves established under the National Parks and Wildlife Act. If well sites are in close proximity to a park or reserve established under the National Parks and Wildlife Act and indirect impacts are likely, consultation is undertaken with DEW to determine appropriate mitigation measures. If threatened species (e.g. Red-tailed Black-Cockatoos) are detected or likely to occur near the well site, specialist advice is sought regarding measures to mitigate potential impacts, particularly during breeding season. Undertake detailed assessments and EPBC Act referral (if required) if avoidance of species or habitats is not possible. Fauna mortality (if it occurs) to be captured by incident reporting system and advice from an ecologist if required. Biosecurity procedures implemented as agreed with landholders. All records of vehicle or equipment inspections and cleaning will be kept for auditing. Records of detection, monitoring or eradication of weeds or pathogens introduced by activities are kept and available for review. EPA's Waste Hierarchy model (avoid, reduce, reuse, recycle, recover, treat, dispose) should be complied with and waste management undertaken with regard to the *Environment Protection (Waste to Resources) Policy 2010*. Covered bins are provided for the collection and storage of wastes. All loads of rubbish are covered during transport to an approved waste facility. Waste streams are segregated on site and transported to appropriate facilities to maximise waste recovery, reuse and recycling. Production of waste is minimised by purchasing reusable, biodegradable or recyclable materials All waste disposal is at an EPA licensed facility. Hazardous wastes handled in accordance with relevant legislation and standards.

Environmental Element	Native Fauna		
	Licensed contractors used for waste transport. All wastewater is disposed in accordance with the *South Australian Public Health (Wastewater) Regulations 2013*. Sewage treatment units and septic tanks used at camp and drill rig ablutions. Septic tanks pumped out on an 'as required' basis by a licensed septic waste removal contractor and disposed of at a licensed facility. Any necessary approvals are obtained for use of wastewater disposal system. Well site is kept free of litter and rubbish.		
Effectiveness of controls	High.		
Environmental Objective/s	Minimise disturbance to native fauna and fauna habitat (OB-11).		
Significance Assessment		Beach Risk Assessment	
Frequency	Possible. Depends on the location of the site and spread of weeds, pests and plant pathogens	Likelihood	Possible
Extent	Removal of habitat confined to the clearance area however impact of weeds, pests and plant pathogens may extend beyond clearance area.	Consequence	Moderate
Duration	Variable. Short-term disturbance is possible during actual earthworks events; however the impact can be long-term if weed, pest or plant pathogen is not managed or eradicated or if contamination is not managed. See impact NV1 (**Table 17**) for impact to vegetation.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low to medium. Dependant on the species and listings of the fauna present and species of weed, pest or plant pathogen.		
Sensitivity of Receptor/s	Medium to high. Species that can be impacted can range in classification and could be State or Nationally listed species.		
Cumulative Impact Assessment	Yes. Other activities associated with agricultural activities could also result in noise emissions, fire or contamination from wastes and weeds, pests or plant pathogen impacts.		
Likely Residual Impact Outcome	Some impact to fauna from noise emissions from earthworks and other activities is expected in the short term, however the impact from weeds, pests or plant pathogens is generally avoidable. The impact is managed to a level considered ALARP by reducing the duration, extent and severity of the disturbance.		
Leading Performance Criteria	Locations of well sites chosen to reduce the potential for noise impacts to threatened/listed species. Noise production avoided or altered during important times or seasons for nearby threatened species. Flagging and boundary markers in place during clearing activities. Any threatened or listed species in area to be cleared have been identified in surveys from experienced personnel.		

Environmental Element	Native Fauna
	No earthworks have been conducted in parks and reserves established under the National Parks and Wildlife Act. Any injury or mortality of native fauna has been recorded and reported immediately. Records kept on weed management, detection and monitoring efforts, vehicle inspections. Consultation with landholders and Landscape Board conducted prior to construction. Existing weed species managed according to the Landscape Board plan. Inspection schedule established to check appropriate control measures have been implemented.
Assessment Criteria	No unauthorised clearing of native vegetation Any sites of rare, vulnerable or endangered species or threatened communities have been identified, flagged and subsequently avoided No rare, vulnerable or endangered flora removed without appropriate permits High quality or significant[9] remnant vegetation has not been cleared Activities are not carried out in parks or reserves established under the National Parks and Wildlife Act No significant adverse impacts on native fauna through any stage of construction, drilling or well production testing. No native fauna casualties that could have reasonably been prevented through the management measures. The presence of weeds, pest animals or pathogens is consistent with or better than pre-disturbance conditions and adjacent land or where this is not the case, a management plan is implemented promptly. Declared plants occurring as a result of regulated activities are reported and managed in accordance with the Landscape South Australia Act 2019 (Landscape Act) and applicable Landscape Board plans.
Potential Impact Event NF2	*Disturbance, injury or death of fauna (fire).*
Source/s	Weather, machinery, vehicles and personnel
Pathway/s	Fire
Receptor/s	Native fauna, State and Nationally listed fauna
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Assume some level of fauna impact will or may occur if there is a fire.
Sensitivity to Change	Low
Control Measures	
Type	*Description*
Elimination	-
Substitution	-

[9] Significant in this context includes listed plant species, listed communities or important fauna habitat

Environmental Element	Native Fauna		
Physical Controls	-		
Procedural Controls	Confinement of flammable sources, restrictions on certain procedures and ready access to suitable fire-fighting equipment. Liaise with CFS and local council regarding operations and Fire and Emergency Services Act requirements (e.g. permits for 'hot work' on fire ban days if required). Where necessary (e.g. in fire danger season), fire break constructed around well lease. Flare tank / stack located to ensure that radiant heat does not impact trees. Response to fire included in Emergency Response Plan. Ensure fire risk is included in the induction and all personnel are fully informed on the fire danger season and associated restrictions.		
Effectiveness of controls	High. Beach Energy have completed numerous wells without fire impacting fauna.		
Environmental Objective/s	Minimise disturbance to native fauna and fauna habitat (OB-11).		
Significance Assessment		Beach Risk Assessment	
Frequency	Unlikely. Event-based.	Likelihood	Unlikely
Extent	Non-confined to the project area, as fire may spread further.	Consequence	Minor
Duration	Short to medium. Depends on the severity of injury or disturbance to individuals or broader fauna populations.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Low
Severity	Variable. Low severity if the impact is only disturbance, however fauna deaths are a high severity impact		
Sensitivity of Receptor/s	Medium to high. Species that can be impacted can range in classification and could be State or Nationally listed species.		
Cumulative Impact Assessment	Yes. Fauna can be affected by other impacts such as spread of pests and weeds, vehicle strike, or noise and light disturbance simultaneously to fire. Cumulative impacts may also occur from follow-on effects of fires, for example a scarcity of food or habitat for impacted fauna.		
Likely Residual Impact Outcome	Controls have been implemented to reduce the possibility of fauna impacts from project-ignited fires to ALARP, by preventing the possibility of fires.		
Leading Performance Criteria	Fire breaks constructed if necessary in fire season. Regular review and/or update of the Emergency Response Plan.. Any fire-related fauna injuries or deaths are reported and recorded in the incident management system. Continued engagement with CFS.		
Assessment Criteria	No uncontrolled fires initiated as a result of drilling, completion and well production testing activities		

Environmental Element	**Native Fauna**		
Potential Impact Event NF3	*Disturbance, injury or death of fauna - vehicle strike*		
Source/s	Vehicles		
Pathway/s	Use of roads in and around project area; movement of vehicles and heavy machinery		
Receptor/s	Native fauna, State and Nationally listed fauna		
Confirmation of Source – Pathway- Receptor		Yes	
Uncertainties and Assumptions	Assume that vehicle collisions will or may kill or injure fauna. Assume that this impact will occur to some extent.		
Sensitivity to Change	Low		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls	Activities are not carried out in parks or reserves established under the National Parks and Wildlife Act. Transport trucks to be restricted to daylight hours as far as possible.		
Procedural Controls	Compliance with relevant speed restrictions on access roads and tracks. Warning signage and traffic management measures installed where appropriate in the vicinity of well sites. Driver behaviour and vehicle speed limits to be included in compulsory induction.		
Effectiveness of controls	Moderate. Vehicle strike cannot be eliminated despite implementation of controls but controls do minimise impact.		
Environmental Objective/s	Minimise disturbance to native fauna and fauna habitat (OB-11)		
Significance Assessment		Beach Risk Assessment	
Frequency	Low. Event-based.	Likelihood	Possible
Extent	Confined to the event.	Consequence	Minor
Duration	Short. Vehicle strike will be instantaneous and unlikely to have significant impacts to the wider population, unless a listed species is involved.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Low
Severity	Variable. Species that can be impacted range from pest species to State or Nationally listed species.		
Sensitivity of Receptor/s	Variable. Species that can be impacted range from pest species to State or Nationally listed species.		
Cumulative Impact Assessment	Potential. Repeat vehicle strike injuries or deaths of a listed species may have cumulative effects on the larger species population.		

Environmental Element	**Native Fauna**
Likely Residual Impact Outcome	Controls have been adopted to prevent the potential impact event from occurring. This potential impact is considered to be ALARP.
Leading Performance Criteria	Appropriate speed limits and signage have been established. Driver training has been conducted for workers.
Assessment Criteria	Activities are not carried out in parks or reserves established under the National Parks and Wildlife Act No significant adverse impacts on native fauna through any stage of construction, drilling or well production testing. No native fauna casualties that could have reasonably been prevented through the implementation of management measures.
Potential Impact Event NF4	*Disturbance, injury or death of native fauna - well control incidents*
Source/s	Access to contaminants (ingestion or contact).
Pathway/s	Well control incidents (e.g. blowout or kick).
Receptor/s	Native fauna, State and Nationally listed fauna
Confirmation of Source – Pathway- Receptor	Yes
Uncertainties and Assumptions	Assume that native fauna will or may be injured or killed. Uncertainty as this impact is dependent on well control incidents occurring.
Sensitivity to Change	Medium. This impact will be reduced if no native fauna are present at time of incident.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	-
Procedural Controls	See management measures for prevention of well control incidents for impact PHS5 in **Table 9**. Additional measure specific to preventing fauna injury or death include: Activities are not carried out in parks or reserves established under the National Parks and Wildlife Act. Important fauna habitat is avoided for well site locations.
Effectiveness of controls	High
Environmental Objective/s	Minimise disturbance to native fauna and fauna habitat (OB-11).

Significance Assessment		Beach Risk Assessment	
Frequency	Low. Event-based.	Likelihood	Highly Unlikely

Environmental Element	**Native Fauna**		
Extent	Confined to the well lease pad area. If fire is caused by well control incident, extent is no longer confined (see impact NF3).	Consequence	Minor
Duration	Short to medium. Depends on the severity of injury or disturbance to individuals or broader fauna populations.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Low
Severity	Variable. If fauna deaths are caused, the severity is high.		
Sensitivity of Receptor/s	Medium to high. Species that can be impacted can range in classification and could be State or Nationally listed species.		
Cumulative Impact Assessment	It is highly unlikely that multiple well control incidents would occur, and that the same fauna individuals would be impacted. Fauna can be impacted by other project impacts such as vehicle strike or vegetation clearance.		
Likely Residual Impact Outcome	The control measures outline reduce the chance of well control incidents to a level considered ALARP.		
Leading Performance Criteria	Wells designed, constructed, operated and maintained in accordance with Beach's Drilling and Completions Technical Standards and Well Integrity Framework. Inspection schedule established to check appropriate control measures have been implemented.		
Assessment Criteria	No well control incidents. Activities are not carried out in parks or reserves established under the *National Parks and Wildlife Act* No recorded significant adverse impacts on native fauna through any stage of construction, drilling or well production testing. No recorded native fauna casualties that could have reasonably been prevented through the management measures.		
Potential Impact Event NF5	*Disturbance, injury or death of native fauna - wastes, spills and leaks*		
Source/s	Access to contaminants (ingestion or contact), such as chemicals, fuels or oil wastes.		
Pathway/s	Spills and leaks of chemicals, fuels, oils.		
Receptor/s	Native fauna		
Confirmation of Source – Pathway-Receptor	Yes		
Uncertainties and Assumptions	Assume that native fauna will or may be injured or killed if they come in contact with or ingest contaminants or waste. Uncertainty as this impact is dependent on spills and leaks occurring. Uncertainty as this impact is dependent on types of contaminants and waste and accessibility of these to the native fauna. Assumption that native fauna will be present.		

Environmental Element	**Native Fauna**
Sensitivity to Change	Medium. This impact will be reduced pending the type of chemicals, fuels and wastes stored on site.
Control Measures	
Type	Description
Elimination	-
Substitution	-
Physical Controls	See management measures for prevention of spills and leaks for impact S2 in **Table 11**. Storage of fuels and chemicals to comply with Australian standard (AS1940). Fencing of well lease pad to prevent access by native fauna
Procedural Controls	EPA's Waste Hierarchy model (avoid, reduce, reuse, recycle, recover, treat, dispose) should be complied with and waste management undertaken with regard to the *Environment Protection (Waste to Resources) Policy 2010*. Covered bins are provided for the collection and storage of wastes. All loads of rubbish are covered during transport to an approved waste facility. Waste streams are segregated on site and transported to appropriate facilities to maximise waste recovery, reuse and recycling. Production of waste is minimised by purchasing reusable, biodegradable or recyclable materials where practical. All waste disposal is at an appropriately licensed facility. Hazardous wastes handled in accordance with relevant legislation and standards. Licensed contractors used for waste transport. All wastewater is disposed in accordance with the *South Australian Public Health (Wastewater) Regulations 2013*. Sewage treatment units and septic tanks used at camp and drill rig ablutions. Septic tanks pumped out on an 'as required' basis by a licensed septic waste removal contractor and disposed of at a licensed facility. Any necessary approvals are obtained for use of wastewater disposal system. Well site is kept free of litter and rubbish. Further controls for prevention and management of spills and leaks are found in impact S2 in **Table 11**.
Effectiveness of controls	High. Storage of wastes is in accordance with regulations.
Environmental Objective/s	Minimise disturbance to native fauna and fauna habitat (OB-11).

Significance Assessment		Beach Risk Assessment	
Frequency	Uncommon. Fauna access to hazardous materials and waste is unusual with the implementation of controls.	Likelihood	Highly Unlikely
Extent	Confined to the spill or leak or storage location.	Consequence	Minor

Environmental Element	Native Fauna		
Duration	Short-term. The potential spill or leak will be cleaned up and ongoing impacts to fauna will be avoided.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Low
Severity	Variable. Impact severity may be very low or high depending on the type of substance accessed, the volume ingested or contacted, and the type of fauna involved.		
Sensitivity of Receptor/s	Medium to high. Species that can be impacted can range in classification and could be State or Nationally listed species.		
Cumulative Impact Assessment	Unlikely that the same fauna individuals would access wastes, fuels, chemicals or oils on multiple occasions.		
Likely Residual Impact Outcome	Controls will prevent the possibility of fauna injury or death from wastes, spills or leaks to ALARP through prevention of and management of spill or leak events.		
Leading Performance Criteria	All fuel and oil storage facilities meet requirements of AS 1940-2017: The storage and handling of flammable and combustible liquids. All wastewater disposed of in accordance with the South Australian *Public Health (Wastewater) Regulations 2013* and where appropriate with regard to the EPA Septage Management Guideline (EPA 247/20). Inspection schedule established to check that appropriate control measures are in place for the management of wastes, chemicals, fuel and oil. Records of audit results are kept.		
Assessment Criteria	No recorded significant adverse impacts on native fauna through any stage of construction, drilling or well production testing that could have been reasonably been prevented through the implementation of management measures. Any escape of petroleum, processed substance, chemical or fuel is either immediately contained and removed for disposal at an appropriately licenced facility or assessed in accordance with NEPM[1] guidelines and remediated in a timely manner. All wastewater is disposed in accordance with regulatory requirements.		

5.9 Native Vegetation

Potential impacts to native vegetation arise from:

- Earthworks for well site, access track and camp site construction and rehabilitation
- Exposure to contaminants (e.g. from well control incidents, the drilling sump or spills and leaks) and waste
- Fire.

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 17**.

5.9.1 Earthworks for well site, access track and camp site construction

Earthworks and clearing activities have the potential to damage native vegetation and wildlife habitats (including wetland communities). In the onshore Otway Basin, a large proportion of the native vegetation has been cleared or heavily modified for agriculture and forestry. Consequently, the clearance of native vegetation for well sites, access tracks and camp sites can generally be avoided by locating well sites and access tracks in previously cleared or disturbed areas.

Well sites are subject to environmental assessment in the planning process to ensure that any issues such as native vegetation, presence of rare or threatened species or risk of introduction of weeds are identified and appropriate avoidance or mitigation strategies are developed. Large trees, high quality native vegetation and significant wetland areas will be avoided[10]. Low quality native vegetation will also be avoided unless there are no viable alternatives (e.g. use of adjacent cleared areas). Any native vegetation clearance would require approval and implementation of a 'significant environmental benefit', in accordance with the Native Vegetation Act and Native Vegetation Council guidelines. As discussed in Section 5.5, activities will also be carried out to ensure surface drainage patterns and water quality are maintained, which will avoid potential indirect impacts on native vegetation, particularly wetland communities.

5.9.2 Spills or leaks and waste management

Spills and leaks have the potential to cause damage to native vegetation directly and through the contamination of soil and water sources supporting vegetation. Spills and leaks may result from the improper storage and handling of fuel, oil and chemicals, runoff from higher risk areas (e.g. drill rig, generators), seepage from drilling sumps, waste storage and handling, and spills or leaks during well production testing activities. Management measures for spill and leak prevention are discussed above in Sections 5.3.2, 5.4.1 and 5.5.1.

5.9.3 Fire

Fire initiated by site activities (e.g. flaring, sparks from vehicles or equipment, cigarette butts) has the potential to impact large areas of vegetation. Measures will be in place to prevent fires including firebreaks, restriction of vehicles to tracks and cleared areas, maintenance of suitable fire-fighting equipment on site and liaison with the CFS. The flare will be designed and located to avoid radiant heat impacting or burning trees.

5.9.4 Weeds and Pathogens

The introduction of weeds or pathogens by vehicles and equipment (particularly earthmoving equipment) is a potentially significant impact to existing native vegetation, native fauna, biodiversity levels and sensitive ecosystems. Infestation of introduced weeds can result in the reduction of native plant populations as weeds compete with and displace these existing species.

A range of measures will be undertaken to manage the potential for the introduction or spread of weeds or pathogens, including:

[10] Site-specific assessment by an appropriately qualified specialist would be used to determine whether vegetation meets these parameters.

- consultation with landholders and Limestone Coast Landscape Board officers to identify any potential issues or specific management requirements
- ensuring that vehicles and equipment arriving at the site are clean and free of soil and plant material
- assessment of vehicles and equipment entering the region or moving between sites (especially from weed or pathogen infested areas into non-infested areas) for the risk of transporting weeds and pathogens and cleaning them down where appropriate
- using local earthworks contractors where possible rather than bringing in equipment from outside the region
- sourcing of paving materials from licensed quarries that are free of weeds
- monitoring sites and access tracks for new weed infestations, with treatment undertaken as necessary in accordance with requirements of the landholder, and if appropriate the Landscape Board

Table 17: Native Vegetation Impact Assessment

Environmental Element	**Native Vegetation**
Views of Affected Parties	Stakeholders have identified concern for the following values and impacts in previous consultation efforts as summarised in Section 7: • Large trees • Habitat of red-tailed black cockatoos • Weed management impact to bees and pollinators Stakeholders have also expressed interest in observing monitoring plans.
Applicable Legislation	• *Native Vegetation Act 1991 (SA)* • *National Parks and Wildlife Act 1972 (SA)* • *Biosecurity Act 2015* • *Environmental Protection and Biodiversity Conservation Act 1999 (Cth)* • *Landscape (South Australia) Act 2019 (SA)* • *Fire and Emergency Services Act 2005 (SA)* • *Planning, Development and Infrastructure Act 2016 (SA)*
Applicable Standards	State and Commonwealth weeds of national significance list AS 1940-2017: The storage and handling of flammable and combustible liquids
Site/Activity Specific Receptors	• Native vegetation • Habitat areas • Biodiversity
Potential Impact Event NV1	*Damage to native vegetation and wildlife habitats - earthworks*
Source/s	Vegetation clearance
Pathway/s	Earthworks

Environmental Element	**Native Vegetation**		
Receptor/s	Native vegetation, State and Nationally listed flora		
Confirmation of Source – Pathway- Receptor		Yes	
Uncertainties and Assumptions	Assumption that native vegetation is present in areas to be cleared. Uncertainty as this impact is dependant on construction of new facilities or expansion of existing facilities. Uncertainty regarding classifications or listings of any threatened species.		
Sensitivity to Change	Low. Changes to impact severity are possible if species classifications change.		
Control Measures			
Type	*Description*		
Elimination	Native vegetation avoided wherever possible.		
Substitution	-		
Physical Controls	Native vegetation clearance avoided or minimised by locating well sites and access tracks appropriately.		
Procedural Controls	Appropriately trained and experienced personnel have assessed or scouted proposed well site, access track and camp locations to identify and flag significant (or rare, vulnerable or endangered) species and communities (including wetland communities). Removal of large trees (including dead trees with hollows) is avoided. Areas of high quality or significant[8] remnant vegetation or Heritage Agreement Areas are avoided. Areas of low quality native vegetation are avoided unless there are no viable alternatives (e.g. use of adjacent cleared areas Well sites with native vegetation are rehabilitated in consultation with DEM, DEW and other relevant stakeholders.		
Effectiveness of controls	High.		
Environmental Objective/s	Minimise disturbance to native vegetation (including wetland communities) (OB-12). Ensure timely and effective rehabilitation of adversely affected land (OB-04).		
Significance Assessment		Beach Risk Assessment	
Frequency	Common.	Likelihood	Possible
Extent	Confined to earthworks site. Depends on the size on area needed in the earthworks and the presence of native vegetation.	Consequence	Minor
Duration	Medium to long-term. Some damaged or clearance of native vegetation can be rehabilitated successfully within short periods, however some clearance takes decades to recover depending on the species and ecosystems impacted.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Variable. Low to high, depending on the species of native vegetation present and the extent of the clearance.		

Environmental Element	Native Vegetation	
Sensitivity of Receptor/s	Variable. Depends on the classifications of any threatened or listed species that are impacted.	
Cumulative Impact Assessment	Other impacts possible from the project may affect native vegetation simultaneously to earthworks damage, such as fire, spread of weeds and pests, and spills and leaks.	
Likely Residual Impact Outcome	While this impact is unavoidable due to the requirement of clearing for project construction, the impact magnitude can be reduced by implementation of control measures to a level considered ALARP.	
Leading Performance Criteria	Inspection schedule established to check appropriate control measures have been implemented. Sites are selected to avoid disturbance to native vegetation. Flagging and boundary markers in place during clearing activities. Any sites of threatened or listed species in area to be cleared have been identified in surveys from experienced personnel and avoided where possible. No earthworks have been conducted in parks and reserves established under the National Parks and Wildlife Act. Vegetation is trimmed rather than cleared where possible.	
Assessment Criteria	No unauthorised clearing of native vegetation. Any sites of rare, vulnerable or endangered species or threatened communities have been identified, flagged and subsequently avoided. No rare, vulnerable or endangered flora removed without appropriate permits. High quality or significant[8] remnant vegetation has not been cleared. Activities are not carried out in parks or reserves established under the National Parks and Wildlife Act.	
Potential Impact Event NV2	*Damage to native vegetation and wildlife habitats - spills and leaks*	
Source/s	Vehicles, machinery, and transport	
Pathway/s	Spills or leaks of oil, fuels, chemicals and wastes	
Receptor/s	Native vegetation	
Confirmation of Source – Pathway- Receptor		Yes
Uncertainties and Assumptions	Assumption that some native vegetation will be impacted if this occurs. Severity of impact could change if native species sensitivity listings are reclassified.	
Sensitivity to Change	Low. Changes to impact severity are possible if species classifications change.	
Control Measures		
Type	*Description*	
Elimination	-	

Environmental Element	Native Vegetation		
Substitution	-		
Physical Controls	-		
Procedural Controls	Control measures described in S2 in **Table 11**.		
Effectiveness of controls	High		
Environmental Objective/s	Minimise disturbance to native vegetation (including wetland communities) (OB-12). Ensure timely and effective rehabilitation of adversely affected land (OB-04).		
Significance Assessment		Beach Risk Assessment	
Frequency	Possible.	Likelihood	Highly Unlikely
Extent	Confined to the spill or leak site.	Consequence	Minor
Duration	Short to medium-term, event-based. The duration of impact for a spill onto native vegetation will depend on the ability for that vegetation type to recover and on the substance type that was spilled and disturbance as a result of the clean up..	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Low
Severity	Variable. Depends on the substance spilled or leaked, and the sensitivity of the receiving environment.		
Sensitivity of Receptor/s	Variable. Depends on the classifications of any threatened or listed species that are impacted.		
Cumulative Impact Assessment	Other impacts possible from the project may effect native vegetation simultaneously to earthworks damage, such as fire, spread of weeds and pests, and earthworks.		
Likely Residual Impact Outcome	This potential for spills and leaks and subsequent damage to native vegetation can often be prevented through control measured to a level considered ALARP.		
Leading Performance Criteria	Inspection schedule established to check appropriate control measures have been implemented. Activities are not carried out in parks or reserves established under the National Parks and Wildlife Act.		
Assessment Criteria	In the event of a spill or leak, control measures were followed, and the incident was reported. Any escape of petroleum, processed substance, chemical or fuel to land is either immediately contained and removed for disposal at an appropriately licenced facility or assessed in accordance with NEPM[11] guidelines and remediated in a timely manner. Activities are not carried out in parks or reserves established under the National Parks and Wildlife Act.		

[11] *National Environment Protection (Assessment of Site Contamination) Measure (1999)* amended in 2013

Environmental Element	**Native Vegetation**
Potential Impact Event NV3	*Damage to native vegetation and wildlife habitats - fire*
Source/s	Dry and hot weather, machinery, vehicles and personnel
Pathway/s	Fire.
Receptor/s	Native vegetation
Confirmation of Source – Pathway-Receptor	Yes
Uncertainties and Assumptions	Assume that vegetation loss will or may occur if there is a fire. Uncertainty regarding classifications or listings of any threatened species.
Sensitivity to Change	Low. Changes to impact severity are possible if species classifications change
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Flare designed and located to ensure that radiant heat does not impact adjacent native vegetation. Where necessary (e.g. in fire danger season), fire break constructed around well lease. Confinement of flammable sources, restrictions on certain procedures and ready access to suitable fire-fighting equipment (e.g. fire unit consisting of trailer with water tank, pump and hoses in high fire danger season).
Procedural Controls	Liaise with CFS regarding operations to ensure fire concerns are addressed and any Fire and Emergency Services Act requirements are met (e.g. permits for 'hot work' on fire ban days if required). Response to fire included in Emergency Response Plan. Emergency response procedures included in staff training. Ensure fire risk is included in the induction and all personnel are fully informed on the fire danger season and associated restrictions.
Effectiveness of controls	High
Environmental Objective/s	Minimise disturbance to native vegetation (including wetland communities) (OB-12).

Significance Assessment		Beach Risk Assessment	
Frequency	Unlikely. Event-based.	Likelihood	Highly Unlikely

Environmental Element	**Native Vegetation**		
Extent	Non-confined to the project area, as fire may spread further.	Consequence	Serious
Duration	Medium to long. Depends on the extent of the fire and the type of vegetation impacted, including how well the species recovers from a fire event.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Variable. Low severity if the impact is small and restricted to non-listed or threatened species, however severity is able to increase to high if the extent and classifications of species impacted are higher.		
Sensitivity of Receptor/s	Variable. Depends on the classifications of any threatened or listed species that are impacted.		
Cumulative Impact Assessment	Other impacts possible from the project may affect native vegetation simultaneously to earthworks damage, such as earthworks, spread of weeds and pests, and spills and leaks.		
Likely Residual Impact Outcome	Controls have been implemented to reduce the possibility of native vegetation damage from project-ignited fires to ALARP, by preventing the possibility of fires and avoiding important vegetation areas.		
Leading Performance Criteria	Fire breaks constructed if necessary in fire season. Emergency Response Plan is reviewed regularly and updated when required. Engagement with the CFS. Appropriate permits in place at the commencement of activities. Any fire-related vegetation damage of threatened or listed species is recorded and reported immediately.		
Assessment Criteria	No uncontrolled fires initiated as a result of drilling, completion and well production testing activities		
Potential Impact Event NV4	*Loss of vegetation and habitat - weeds, pests and plant pathogens*		
Source/s	Introduction of pests and weeds via vehicles, import of supplies and materials, boots, flammable substances and introduction of heat sources.		
Pathway/s	Vehicles, creation of disturbed areas, wind.		
Receptor/s	Native vegetation		
Confirmation of Source – Pathway-Receptor	Yes		
Uncertainties and Assumptions	Assume some level of native flora loss will occur through competition with weeds or damage from pests. Severity of impact could change if native species sensitivity listings are reclassified. Severity of impact could change if weed or pest listing is reclassified.		

Environmental Element	**Native Vegetation**		
Sensitivity to Change	Medium		
Control Measures			
Type	*Description*		
Elimination	-		
Substitution	-		
Physical Controls			
Procedural Controls	All reasonable and practical endeavours taken to minimise the risks of introducing weeds, exotic pest fauna and pathogens into the tenement areas. Appropriate consultation regarding weeds or pathogens carried out with landholders and Landscape Board officers. Vehicles and equipment arriving at the site must be clean and free of soil and plant material. Vehicles and equipment entering the region or moving between sites (especially from weed or pathogen infested areas into non-infested areas) will be assessed for the risk of transporting weeds and pathogens and cleaned down where appropriate. Paving materials will be sourced from licensed quarries that are free of weeds. Sites and access tracks will be monitored on a regular basis for new weed species / infestations, and treated as necessary in accordance with requirements of the landholder, and if appropriate the Landscape Board. Correct storage of waste to avoid attraction of pests, including lids on all bins, regular removal from site, and avoiding stockpiling green waste for extended periods.		
Effectiveness of controls	High		
Environmental Objective/s	Minimise disturbance to native vegetation and native fauna (including wetland communities) (OB-12). Ensure timely and effective rehabilitation of adversely affected land (OB-04).		
Significance Assessment		Beach Risk Assessment	
Frequency	Occasional. Spread of weeds, pests and plant pathogens is known to occur on well sites.	Likelihood	Possible
Extent	Variable. May or may not be confined to site boundaries.	Consequence	Serious
Duration	Long term. Damage to native vegetation can be long lasting and take years to recover. Damage can be ongoing or permanent if weed, pest or plant pathogen is not managed or eradicated.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Variable. Low severity if the impact is small and restricted to non-listed or threatened species, however severity is able to increase to high if the extent and classifications of species impacted are higher.		

Environmental Element	Native Vegetation
Sensitivity of Receptor/s	Variable. Depends on the classifications of any threatened or listed species that are impacted.
Cumulative Impact Assessment	Other impacts possible from the project may effect native vegetation simultaneously to spread of weeds and pests such as earthworks, and spills and leaks.
Likely Residual Impact Outcome	Controls have been implemented to reduce the possibility of native vegetation damage from project-ignited fires and introduction of pests, weeds and plant pathogens to ALARP.
Leading Performance Criteria	Inspection schedule established to check appropriate control measures have been implemented. Records kept on weed management, detection and monitoring efforts, vehicle inspections. Consultation with landholders and Landscape Board conducted prior to construction. Existing weed species managed according to the Landscape Board plan.
Assessment Criteria	The presence of weeds, pest animals or pathogens is consistent with or better than pre-disturbance conditions and adjacent land or where this is not the case, a management plan is implemented promptly Declared plants occurring as a result of regulated activities are reported and managed in accordance with the *Landscape South Australia Act* 2019 (Landscape Act) and applicable Landscape Board plans.

5.10 General Amenity

Potential impacts regarding visual amenity arise mostly from:

- Earthworks for well site, access track and camp site construction and rehabilitation
- Disturbance from site activities (physical presence of drill rig and camp and personnel)
- Light emissions (rig lighting, flaring)

These potential impacts together with the control measures and environmental significance assessment are outlined in **Table 18**.

5.10.1 Earthworks for well site, access track and camp site construction and rehabilitation

Earthworks and clearing activities have the potential to reduce general amenity of the area, as viewed by landholders and local community. In the onshore Otway Basin, a large proportion of the native vegetation has been cleared or heavily modified for agriculture and forestry. Consequently, clearance needed for well sites and access tracks can generally be located in previously cleared or disturbed areas.

Landholders will be consulted regarding the location, management and timing of proposed activities, with the aim of minimising disturbance. Ongoing liaison with landholders is carried out following drilling (and throughout the well's life if it is successful). Appropriate access tracks to drill sites are chosen in consultation with landowners.

Under the ER Act, landowners have rights to compensation. Compensation is payable where there is deprivation or impairment of the use and enjoyment of the land.

Rehabilitation of disturbed land will be conducted promptly after activities cease. Rehabilitation will be conducted so that land contours, vegetation, and surface water channels are consistent with the surrounding landscape.

5.10.2 Disturbance from site activities (physical presence of drill rig and camp and personnel)

Potential disturbance to general amenity from site activities (e.g. presence of the drill rig, camp and personnel) is short term, localised and generally of limited significance in the region given the existing land uses and extent of vegetation clearance and habitat modification.

Landholders will be consulted regarding the location, management and timing of proposed activities, with the aim of minimising disturbance. Ongoing liaison with landholders is carried out following drilling (and throughout the well's life if it is successful).

5.10.3 Light emissions (rig lighting, flaring)

Potential disturbance to general amenity from light pollution from rig lighting and flaring is short term, localised and generally of limited significance in the region due to remote locations of sites.

Landholders will be consulted regarding the location, management and timing of proposed activities, with the aim of minimising disturbance. Ongoing liaison with landholders is carried out following drilling (and throughout the well's life if it is successful).

Table 18: General Amenity Impact Assessment

Environmental Element	**General Amenity**	
Views of Affected Parties	No significant stakeholder concerns have been identified.	
Applicable Legislation	• Planning, Development and Infrastructure Act 2016 (SA)	
Applicable Standards	AS 4282-1997 Control of the obtrusive effects of outdoor lighting	
Site/Activity Specific Receptors	• Local community • Landholders and users	
Potential Impact Event GA1	*General amenity impact - visual*	
Source/s	Drill rig and associated infrastructure	
Pathway/s	Observation from public roads and/or residences.	
Receptor/s	Local community Local landholders	
Confirmation of Source – Pathway- Receptor		Uncertain
Uncertainties and Assumptions	Assumption that drill rig and associated infrastructure is visible from public roads or private property. The proximity to public or private property is uncertain and will depend on the location of any future exploration activity.	
Sensitivity to Change	High. Proximity of receptors will greatly change the visual impact of project activities.	
Control Measures		
Type	*Description*	
Elimination	-	
Substitution	-	
Physical Controls	-	
Procedural Controls	Landholders consulted regarding location of proposed activities. Activities are restricted to agreed / defined areas. Drill rigs and camps removed from site promptly following completion of activities, particularly in visible locations. Well site is kept free of litter and rubbish.	
Effectiveness of controls	Medium	
Environmental Objective/s	Minimise the impact of operations on general amenity (OB-13). Ensure timely and effective rehabilitation of adversely affected land (OB-04).	
Significance Assessment		Beach Risk Assessment

Environmental Element	General Amenity		
Frequency	Common – the source and pathway will remain for the duration of the activity. The impact will be constrained to when the receptors are in the vicinity, which may change.	Likelihood	Unlikely
Extent	Confined – impact is confined to the locations that project activity is observable from.	Consequence	Minor
Duration	Low – the impact may occur for the duration of project activity. It will cease to occur upon activity completion.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Low
Severity	Low.		
Sensitivity of Receptor/s	Variable, depending on proximity of sensitive receptor.		
Cumulative Impact Assessment	Yes. Other visual impacts external to the project may be present in the area and visible to receptors.		
Likely Residual Impact Outcome	Visual disturbance can be minimised to a level consider ALARP but will occur.		
Leading Performance Criteria	Consultation with landholders. Stakeholder engagement and complaints reporting systems in place. Inspection schedule established to check appropriate control measures have been implemented. Activities remain in designated areas. Prompt removal of drill rigs and camps following activity completion.		
Assessment Criteria	Well site maintained in a clean and tidy condition. Restored well site contours and colour blend with the surroundings.		
Potential Impact Event GA2	*General amenity impact - noise emissions*		
Source/s	Physical presence of drill rig/ and camp and/or operating equipment (pipes etc).		
Pathway/s	Proximity to residences and public places		
Receptor/s	Local landholders Local community		
Confirmation of Source – Pathway-Receptor	Possible		
Uncertainties and Assumptions	Assumption that drill rig etc. Is audible to residences or public places.		
Sensitivity to Change	High. Proximity of receptors will greatly change the potential for noise impact as a result of project activities.		

Environmental Element	**General Amenity**		
Control Measures			
Type	*Description*		
Elimination	Locate drill rig and associated infrastructure away from residences and/or public places where possible. Undertake high noise emitting activities during daylight hours		
Substitution	-		
Physical Controls	Rig mobilisation and demobilisation to detour around town centres where possible Maintain equipment in accordance with manufacturers specifications i.e. exhaust systems Noise limitation where possible (i.e. particularly at night) to be included as part of induction procedures (e.g. noisy tubular / pipe handing, unnecessary use of horns, reversing of forklifts). Assessment of potential noise impacts from a site-specific activity will be undertaken as appropriate during design and planning stages with mitigation measures developed if required. Driver behaviour and vehicle speed limits to be included in compulsory induction. Well site and access track construction restricted to daylight hours. Transport trucks to be restricted to daylight hours as far as possible. Heavy truck drivers to be instructed not to use engine brake near dwellings.		
Procedural Controls	Landholders consulted regarding location of proposed activities. Other stakeholders (e.g. local council, industry associations) also consulted during operations.		
Effectiveness of controls	Medium		
Environmental Objective/s	Minimise the impact of operations on general amenity (OB-13).		
Significance Assessment		Beach Risk Assessment	
Frequency	Common – the source and pathway will remain for the duration of the project.	Likelihood	Possible
Extent	Confined – impact is confined to the locations that the drill rig is operating from.	Consequence	Minor
Duration	Low – the impact may occur for the duration of the project. Any long-term impacts after drilling operations are completed will cease.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low.		
Sensitivity of Receptor/s	Variable, depending on proximity of sensitive receptor		
Cumulative Impact Assessment	Yes. Other noise sources external to the project may be present in the area.		

Environmental Element	**General Amenity**
Likely Residual Impact Outcome	Noise emissions can be minimised to a level consider ALARP with implementation of appropriate controls.
Leading Performance Criteria	Consultation with landholders and local community prior to work. Stakeholder engagement and complaints reporting systems in place. High noise emitting activities planned to occur during daylight hours where possible.
Assessment Criteria	No complaints relating to noise emissions. Landholder / stakeholder complaints are documented and reasonable steps taken to resolve them can be demonstrated.
Potential Impact Event GA3	*General amenity impact - light pollution*
Source/s	Light emissions (rig lighting, flaring)
Pathway/s	Observation from public roads and/or residences.
Receptor/s	Local community Local landholders
Confirmation of Source – Pathway-Receptor	Uncertain
Uncertainties and Assumptions	Assumption that light emissions and flaring are visible from public or private property. Light emissions from a rig operating are considerably different compared to operations.
Sensitivity to Change	High. Proximity of receptors will greatly change the visual impact of project activities.
Control Measures	
Type	*Description*
Elimination	-
Substitution	-
Physical Controls	Any lighting required is positioned to minimise light emanating from the well site.
Procedural Controls	Landholders and relevant stakeholders (e.g. local council, industry associations) consulted regarding location of proposed activities. Activities are restricted to agreed / defined areas Flaring during well production testing kept to minimum length of time necessary.
Effectiveness of controls	Moderate
Environmental Objective/s	Minimise the impact of operations on general amenity (OB-13).

Significance Assessment		Beach Risk Assessment	
Frequency	Common – the source and pathway will remain for the duration of the project. The impact will be	Likelihood	Possible

Environmental Element	General Amenity		
	constrained to when the receptors are in the vicinity, which may change.		
Extent	Confined – impact is confined to the locations that project infrastructure is observable from.	Consequence	Minor
Duration	Low to medium – the impact may occur for the duration of the project.	Risk Outcome (see Appendix B for Beach Risk Assessment Matrix)	Medium
Severity	Low.		
Sensitivity of Receptor/s	Variable, depending on proximity of sensitive receptor.		
Cumulative Impact Assessment	Yes. Other visual impacts external to the project may be present in the area and visible to receptors.		
Likely Residual Impact Outcome	light disturbance can be minimised to a level consider ALARP but will occur.		
Leading Performance Criteria	Landholders, local councils, potentially affected residents and emergency services will be informed of significant activities such as rig mobilisation and demobilisation. Any lighting required has been positioned to minimise light emanating from the well site. Inspection schedule established to check appropriate control measures have been implemented. Stakeholder engagement and complaints reporting systems in place.		
Assessment Criteria	No complaints regarding light emissions or flaring from local community. Landholder / stakeholder complaints are documented and reasonable steps taken to resolve them can be demonstrated.		

6. Environmental Management Framework

Drilling, completion and well production testing activities will be undertaken in accordance with Beach Energy's Operations Excellence Management System (OEMS).

The OEMS is a key tool in the management of Beach Energy and associated contractors' environmental responsibilities, issues and risks. The OEMS also provides a framework for the coordinated and consistent management of environmental issues by ensuring the:

- establishment of an environmental policy (see http://www.beachenergy.com.au/)
- identification of environmental risks and legal and other requirements relevant to the operations
- setting of appropriate environmental objectives and targets
- delineation of responsibilities
- establishment of a structure and program to implement environmental policy and achieve objectives and targets, including the development of procedures or guidelines for specific activities and education and induction programs
- facilitation of planning, control monitoring, corrective action, auditing and review of activities to ensure that the requirements and aspirations of the environmental policy are achieved.

The Beach Operations Excellence Management System (OEMS) (**Figure 8**) is an integrated health, safety and environment (HSE) management system and includes all HSE management plans and procedures. The OEMS provides guidance on how Beach will meet the requirements of its Environment Policy) and has been developed using the principles of the IOGP Report 510.

The OEMS consists of 5 Management Standards (refer **Table 19**) that detail specific performance requirements to ensure the effective management of HSE risks and impacts. The Management Standards are complemented by asset and activity specific environmental management procedures and plans, including this EIR and accompanying SEO.

Key components of the OEMS are discussed in the following sections.

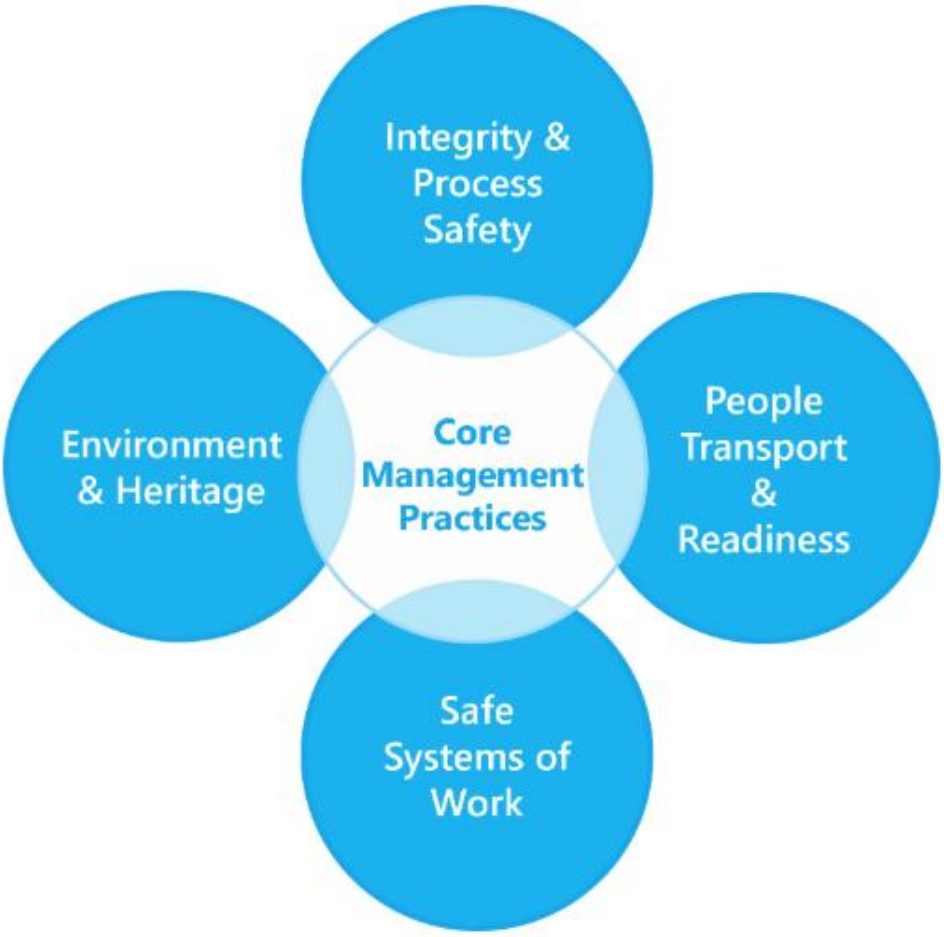

Figure 8: Beach OEMS Structure

Table 19: Beach OEMS Standards

OEMS Management Standards	
Standard 1: Core management practices	1.1 OEMS leadership
	1.2 Asset risk management
	1.3 Management of change
	1.4 Incident management
	1.5 Emergency management
	1.6 Assurance and improvement
Standard 2: Integrity and process safety	2.1 Well lifecycle management

OEMS Management Standards	
	2.2 Plant and pipeline lifecycle management
	2.3 Safety critical elements
	2.4 Pre-startup safety review (PSSR)
	2.5 Safe operating envelope
	2.6 Asset information
Standard 3: People, transport and readiness	3.1 Induction, training and competency
	3.2 Fitness for work
	3.3 Driving
	3.4 Aviation
Standard 4: Safe systems of work	4.1 Permit to work
	4.2 Hot work
	4.3 Energy isolation
	4.4 Confined space
	4.5 Working at height
	4.6 Lifting and load safety
	4.7 Electrical safety
	4.8 Excavation
	4.9 Occupational exposure
Standard 5: Environment and heritage	5.1 Environment permissions documents
	5.2 Cultural heritage
	5.3 Emissions monitoring and reporting

6.1 Environmental Objectives

Environmental objectives have been developed based on the information and issues identified in this document. These objectives have been designed to provide a clear guide for the management of environmental issues and are detailed in the accompanying Statement of Environmental Objectives.

6.2 Responsibilities

Beach aims to ensure that the organisation is equipped, structured, and supported to ensure a healthy, efficient, and successful company. Communications with internal and external bodies, including joint venture partners, is essential to delivering successful projects and operations. The leadership styles and actions demonstrated within Beach will influence the performance of all staff and contractors. Clear levels of authority are necessary to remove organisational ambiguity and to support effective decision making.

Beach's Executive Vice President – Onshore and Offshore Assets has the ultimate responsibility for ensuring that Beach has the appropriate organisation in place to comply with the commitments within the accompanying Statement of Environmental Objectives. However, the General Manager Drilling and Completions has the responsibility and delegated authority to ensure that adequate and appropriate resources are allocated to comply with OEMS and the Statement of Environmental Objectives.

Table 20: Roles and responsibilities for key roles for implementation of the SEO

Role	Responsibilities
Executive Vice President Onshore and Offshore Assets	• Responsible for HSE performance of all activities within Beach's assets. • Ensures policies and systems are in place to guide the company's environmental performance. • Ensures adequate resources are available for the safe operation of all facilities and operations. • Ensures that the OEMS continues to meet the evolving needs of the company.
General Manager Drilling and Completions :	• Compliance with the Environment Policy, regulatory and other requirements, and the SEO. • Personnel who have specific responsibilities pertaining to the implementation of the SEO know their responsibilities and are competent to fulfil their designated role. • Assurance processes as detailed in Section 6.7 are undertaken to confirm that control measures detailed in the SEO are effective in reducing the environmental risks of activities to ALARP and acceptable levels. • Incidents are managed and reported as per Section 6.9. • Leads the investigation and reporting of any environmental incidents. • Audits and inspections are undertaken in accordance with Section 6.7.
Beach Drilling Superintendent :	• Activities are carried out in accordance with regulatory requirements and the SEO. • Rig personnel are competent to fulfil their designated role. • HSE issues are communicated via systems such as the daily report and daily pre-start meetings. • Environmental incidents are managed and reported as per Section 6.8.
General Manager HSE	• Ensures this EIR and SEO is revised as required. • Reviews SEO audits. • Reviews and approves reportable incident reports to the regulators. • Reviews changes to operations for their environmental and regulatory implications.
Environmental Advisor	• Maintains ongoing communications with the General Manager Drilling and Completions regarding regulatory requirements and environmental management in general. • Prepares environmental inductions and training packages. • Monitors environmental performance against the SEO. • Undertakes audit and inspections as detailed in Section 6.7 to confirm that control measures detailed in the SEO are effective in reducing the environmental risks of activities to ALARP and acceptable levels. • Prepares and submits monthly recordable incident reports to the regulators. • Prepares reportable incident reports for submission to the regulators. • Supports the MoC process with regard to environmental issues. • Supports the investigation and reporting of any environmental incidents. • Prepares and submits reportable incident reports to the regulators. • Reviews changes to activities with the Head of Environment.
Senior Manager Community and Land (Onshore)	• Ensure that stakeholders (as defined in Section 7) have been consulted about the activities to enable the relevant person to make an informed assessment of the possible consequences of the activity on their functions, interests, or activities.

Role	Responsibilities
	• Ensure that any requests for updates about the activity that were identified during the EIR and SEO preparation consultation phase are implemented. • Maintains a record of stakeholder consultation including how any objection or claim relevant to the activities was assessed and communicated. • Reports stakeholder objections or claims to the General Manager Drilling and Completions and Environmental Advisor for assessment. • Keeps relevant persons informed of emergency events that may impact their functions, interests or activities.
First Nations Engagement Manager	• Managing cultural heritage policy and procedure reviews and other assurance activities for improving the effectiveness of the OEMS • Managing and recording consultation of stakeholders on cultural heritage management for activities undertaken in accordance with this EIR and accompanying SEO.
Employees and Contractors	• Carrying out work safely and without harm to themselves, others, equipment or the environment and in accordance with their training, operating procedures and work instructions described within the OEMS • Only complete tasks/activities that they have been instructed to do, and ensure they have the required competency and/or licence and experience to undertake the activity/task • Identifying and assessing hazards/risks associated with their work and ensuring suitable controls are in place before and during completion of the work • Enacting the Authority to Stop Work in the case of an immediate threat to the health or safety of any person • Reporting any hazards, unsafe acts or incidents observed in the workplace or deficiencies observed in work practice or procedures to their Supervisor • Participating in inductions, training and development activities and competency reviews as and when required

6.3 Environmental Management Procedure

All Beach employees and contractors are responsible for ensuring compliance with the Beach environmental permissioning documents (i.e. the SEO) which are embedded within the integrated OEMS along with any underlying procedures. The SEO and any procedures have been developed to set minimum operating standards to ensure Beach and its contractors comply with the relevant environmental legislation.

Beach conducts periodic environmental audits to assess the appropriateness of the HSE procedures to monitor performance to verify Beach is meeting its policies, legislative requirements and environmental objective commitments and whether procedures have been properly implemented and maintained.

6.4 Job Safety Analysis and 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. Beach 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.

Beach operates a single use, multi-purpose Permit to Work (PTW) system covering all areas of operations. The purpose of this PTW procedure is to summarise the Beach safety control mechanism designed to identify hazards, assess risks and to prevent accidents associated with task specific activities requiring a Permit prior to the work commencing.

6.5 Induction and Training

Prior to the start of field operations all field personnel will be required to undertake an environmental induction to ensure they understand their role in protecting the environment. This induction will be 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.

6.6 Emergency Response and Contingency Planning

In the course of normal operations, there is always the potential for environmental incidents and accidents to occur. To manage these incidents, emergency response plans will be developed to guide actions to be taken to minimise the impacts of accidents and incidents. Emergency response plans 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 they apply, and that there will be a rapid and effective response in the event of a real emergency occurring.

6.7 Environmental Monitoring and Audits

Monitoring and auditing of drilling operations will be undertaken to determine whether significant environmental risks are being managed, minimised and where reasonably possible, eliminated.

Monitoring and auditing undertaken will assess aspects such as:

- compliance with regulatory requirements (particularly the Statement of Environmental Objectives)
- visual impact of the operations
- impact upon land use
- cultural heritage management
- impact on flora and fauna
- integrity of bunding and containment systems
- site contamination
- site revegetation following program completion and any restoration
- contractor performance.

6.8 Incident Management, Recording and Corrective Actions

Beach 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 ER Act and associated regulations.

6.9 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 Beach.

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

7. Stakeholder Consultation

The South East region of South Australia is comprised of exceptionally fertile land accounting for three-quarters of the State's forests and one-third of its pastures. The high levels of employment within the agriculture, forestry and fishing industry reflects the economic importance of agricultural production within the region.

It is a requirement under the Regulations that information on consultation with relevant landowners, Aboriginal groups or representatives, government departments or agencies, or any other interested person or parties is outlined in an EIR.

Stakeholders in the Otway Basin region include landholders and the local community, native title groups, regulatory agencies, local councils, industry groups and environmental organisations.

Beach's long-term sustainability is contingent upon maintaining strong and meaningful relationships with the communities in which Beach operates. This ensures Beach creates a lasting legacy as an environmentally and socially responsible organisation across the regions in which it operates. Beach maintains a wide range of engagement with stakeholders in the region.

Beach's approach to supporting communities is guided by various policies, including the Aboriginal Engagement Policy, the Community and Stakeholder Engagement Policy as well as the Sponsorships and Donation Policy. Importantly, Beach aims to continue to engage stakeholders for the duration of its production activities to ensure that all potential concerns are identified and appropriately addressed.

7.1 Community Consultation

Beach has engaged with stakeholders in the South East since inception of operations. The methods of engagement include formal notification, direct discussions regarding specific activities and ongoing engagement regarding safe work practices near pipelines, general operational and land management matters.

Notwithstanding the mothballing of the KGPF, Beach maintains ongoing contact with key stakeholders in the region to gain an understanding of the issues of importance to the community and to ensure concerns are identified and appropriately addressed.

Regular and ongoing engagement with key stakeholders including local councils and landholders is an important element of our operations in the region through:

- Beach corporate website
- Engage Beach, Beach's online engagement platform
- Regular community and stakeholder information updates
- Meetings with landholders and key stakeholders
- Community partnerships and investments; and

Public notices in the local print press.

7.2 Formal ER Act Consultation Process

The previous revisions of the EIR and SEO were formally submitted to DEM after being updated to address the comments raised during stakeholder consultation in 2018. DEM, through concurrence with EPA and DEW, classified the regulated activities as low impact. Government agencies were subsequently formally consulted by DEM under the Petroleum and Geothermal Energy Act process in June 2019.

Consultation for this 5-year review of the EIR and SEO will be undertaken in accordance with a consultation plan developed in accordance with Sections 97 and 99 of the ER Act and the ER Regulations. Following this consultation the EIR and SEO will be updated to address comments received prior to resubmission to DEM for Government agency consultation. If required, further revision will be made to address these comments prior to resubmission to DEM for final acceptance.

A summary of the issues raised by stakeholder and government agencies in the formal consultation processes, along with Beach responses, will be provided in Appendix D and Appendix E. The EIR and SEO will be updated where relevant.

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9. Abbreviations and Glossary

Abbreviation / Term	Definition
AAR	Aboriginal Affairs and Reconciliation, Department of Premier and Cabinet (South Australia)
ABS	Australian Bureau of Statistics
ANZECC	Australian and New Zealand Environment and Conservation Council
aquitard	A bed of low permeability adjacent to an aquifer
AS 1940	Australian Standard AS 1940 Storage and Handling of Flammable and Combustible Liquids
BDBSA	Biological Databases of South Australia
blowout	An uncontrolled flow of reservoir fluids into the wellbore, and sometimes catastrophically to the surface. A blowout may consist of water, oil, gas or a mixture of these.
BoM	Bureau of Meteorology
bund	An earth, rock or concrete wall constructed to prevent the inflow or outflow of liquids.
casing	Large diameter steel rods that are screwed together to form a casing string, which is run into a core hole or well and cemented in place
casing annulus	Space between the casing and any piping, tubing or casing surrounding it
casing string	A series of casing rods screwed together
cement bond log	The output from an acoustic tool that is lowered down an oil or gas well to evaluate the integrity of the bond of the cement to the casing and formation
CFS	Country Fire Service
conventional gas	Natural gas trapped in underground structures in highly permeable sandstones
ºC	degrees Centigrade
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEM	Department for Energy and Mining
DEW	Department of Environment and Water (South Australia)
DMITRE	Department for Manufacturing, Innovation, Trade, Resources and Energy (formerly PIRSA) (now DEM)
DIT	Department for Infrastructure and Transport (formerly DPTI)
drill cuttings	Rock pieces dislodged by the drill bit as it cuts rock in the hole
drilling mud / drilling fluid	Fluids continuously circulated down the wellbore, to cool and lubricate the drill bit, lubricate the drill pipe, carry rock cuttings to the surface and control down hole pressure.
drill stem testing	A valved test tool is lowered down a well on the end of the drill string to a specific reservoir formation and the valve opened to admit formation fluids.
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (now DCCEEW)
EIR	Environmental Impact Report prepared in accordance with Section 97 of the South Australian *ER Act 2000* and Regulation 10
EPA	Environment Protection Authority (South Australia)

Abbreviation / Term	Definition
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
ephemeral	Existing for only a short time, often dependent upon climatic influences.
flaring	The burning of gas through a pipe (called a flare).
formation	The term for the primary unit in stratigraphy consisting of a succession of strata useful for mapping or description, which possesses certain distinctive lithologic and other features.
h	hour
ha	Hectares
HSE	Health, safety and environment
HSEMS	Health, Safety and Environment Management System
IBRA	Interim Biogeographical Regionalisation for Australia
ISO	International Standards Organisation
JSA	Job Safety Analysis
km	kilometre
km/h	kilometres per hour
LCM	Lost circulation material is a collective term for substances added to drilling fluids when drilling fluids are being lost to the formations downhole either due to natural or induced causes. Commonly used lost circulation materials include fibrous, flaky or granular substances (e.g. cedar, mica flakes, formica or ground marble)
LGA	Local Government Authority
lithology	Description of the physical characteristics of a rock such as colour, texture, grain size or composition
m	metre
mm	millimetre
m^2/day	square metres per day
m^3	cubic metre (=10^3 litres or one kilolitre)
mg/L	milligrams per litre
ML	megalitre (10^6 litres)
mud	See 'drilling mud'
MW	Megawatt
Native Vegetation Council	A council established under the *South Australian Native Vegetation Act 1991* to assess vegetation clearance applications.
NEPM	National Environmental Protection Measure
NGER Act	*National Greenhouse and Energy Reporting Act 2007* (Cth)
NGERS	National Greenhouse and Energy Reporting System
NPI	National Pollutant Inventory

Abbreviation / Term	Definition
NPW Act	*National Parks and Wildlife Act 1972* (South Australia)
Landscape Act	*Landscape South Australia Act 2019* (South Australia)
packer	A device that can be run into a wellbore with a smaller initial outside diameter that then expands externally to seal the wellbore.
PEL	Petroleum Exploration Licence
PPL	Petroleum Production Licence
PRL	Petroleum Retention Licence
perforating	The process of punching holes in the casing or liner of an oil or gas well to connect it to the reservoir
PHPA	Partially-hydrolysed polyacrylamide
PIRSA	Department of Primary Industries and Regions, South Australia
plug and abandon	To place a cement plug into a dry hole or non-economic well and abandon/decommission the well.
prescribed well	Water well prescribed under s.191 of the *Landscape South Australia Act 2019*
production testing	Tests in an oil or gas well to determine its flow capacity at specific conditions of reservoir and flowing pressures.
Ramsar wetland	A Wetland of International Importance listed under the Ramsar Convention (held in Ramsar, Iran 1971).
ripping	The use of machinery to rake or shallow plough soil to relieve compaction and aerate soil.
tubulars	A generic term pertaining to any type of oilfield pipe, such as drill pipe, drill collars, pup joints, casing, production tubing and pipeline.
SAHPD	South Australia Heritage Places Database
SANTS	South Australia Native Title Services
SBM	Synthetic Based Mud
SENRCC	South East Natural Resource Consultative Committee
separation tank	A cylindrical or spherical vessel used to separate oil, gas and water in the total fluid stream produced by a well.
SEO	Statement of Environmental Objectives
static gradients	Process of running a pressure gauge into the well while it is shut in (not flowing) and stopping at several depths to measure the pressure.
stratigraphy	The study of rock layers and layering (stratification)
suspended well	A suspended well is not currently used for assessment or production and has been shut in. It will either be returned to assessment or production or be decommissioned.
TCSA	Tertiary Confined Sand Aquifer
TLA	Tertiary Limestone Aquifer
unconventional gas	Natural gas that is trapped in lower permeability reservoirs, rather than on underground structures such as anticlines and highly permeable sandstones.

Abbreviation / Term	Definition
WBM	Water-Based Muds consist of water predominantly mixed with potassium chloride, bentonite clay and barite to control mud density. Other substances are added to gain the desired drilling properties to assist with drilling parameters and removing drilled cuttings from the hole.
well completion	A generic term used to describe the assembly of downhole tubulars and equipment required to enable safe and efficient production from an oil or gas well.
well head	The part of an oil or gas well which terminates at the surface, where oil or gas can be withdrawn.
WIS	Well Integrity Standards
wireline logging	A measuring instrument is raised up the well on a wireline to log or record rock properties and fluids.
workover	Repair or stimulation of an existing production well for the purpose of restoring, prolonging or enhancing the production of hydrocarbons.
zone	An interval or unit of rock differentiated from surrounding rocks on the basis of its fossil content or other features, such as faults or fractures. Often used to describe a layer of reservoir rock that contains oil or gas.

10. Document information and history

Document custodian group

Title	Name/s
Drilling and Completions	Brad Muir

Document history

Rev	Date	Changes made in first document	Reviewer/s	Consolidator	Approver
0	04/10/2013	Issued for submission	S Milne	S Milne	S Milne
1	12/11/2013	Finalised following agency consultation	B White	S Milne	S Milne
2	13/11/2013	Final DMITRE comments addressed	B White	S Milne	S Milne
3	26/11/2018	5 year review update – draft for internal review	S Milne	Z Bowen M Mackie	T Flowers
4	03/12/2018	Issued for public consultation	B White S Milne	R. Scullion	T Flowers
5	11/04/2019	Updated following receipt of public submissions	B White S Milne R. Scullion	R. Scullion	T Flowers
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7a	7/02/2025	Draft updated from 5-year review	D Browne		
7b	23/5/2025	Draft update for impact assessment process	D Browne		
7c	26/5/2025	Draft for Beach internal review.	C King	C King	
7d	11/6/2025	5-year review – EIA rework / internal review and reformat	Erias	C King	
7e	18/6/2025	5-year review – Beach SME review	C King, P Jones, L Johnson, C Nayda, C Green, N Wibbelmann, P Kokkoni, M Oliver	C King	
7f	21/7/2025	5-year review – final revision for Draft submission to DEM	C King, C Nayda, C Green	C King	C Green
7g	28/8/2025	5-year review – revision to address DEM review. Draft released for consultation.	C King	C King	B Muir

Appendix A Flora and Fauna Information

This appendix provides additional detail on the vegetation communities, threatened and migratory species and weeds that are summarised in Sections 4.5 of the EIR. The information in this appendix is derived largely from a draft report prepared for Beach by Coffey Environments in 2012.

A.1 Vegetation communities

Floristic communities mapped in areas of remnant native vegetation within Beach's licence areas include:

- Eucalyptus camaldulensis var. camaldulensis mid woodland over Leptospermum continentale shrubs over *Hypochaeris radicata, Hydrocotyle laxiflora, Ranunculus robertsonii, Schoenus apogon* forbs (most widespread association of the area).
- *Eucalyptus fasciculosa* low woodland over *Acacia longifolia ssp*. sophorae, *Banksia marginata* shrubs over *Xanthorrhoea caespitosa*.
- *Eucalyptus obliqua* mid woodland over *Acacia melanoxylon* shrubs over *Pteridium esculentum*, *Leucopogon parviflorus, Hypochaeris radicata*, *Hydrocotyle laxiflora* ferns.
- Emergent *Eucalyptus obliqua* trees over *Xanthorrhoea caespitosa*, *Leptospermum continentale* mid open shrubland over *Leucopogon virgatus var. virgatus*, *Astroloma conostephioides, Isopogon ceratophyllus, Hypolaena fastigiata, Epacris impressa, Tetratheca ciliata*.
- *Eucalyptus leucoxylon ssp*. mid open woodland over *Acacia pycnantha* shrubs over *Astroloma humifusum, Hibbertia australis, Kunzea pomifera, Danthonia sp*. shrubs.
- *Baumea juncea, Gahnia trifida* mid sedgeland.
- *Melaleuca brevifolia, Leptospermum continentale* mid shrubland over *Apodasmia brownii, Baumea juncea* sedges.
- *Melaleuca halmaturorum* tall shrubland over *Gahnia filum* sedges over *Comesperma volubile, Samolus repens*.
- *Cyperaceae* sp., *Gramineae* sp. mid sedgeland.
- Emergent *Eucalyptus* sp. trees over *Pteridium esculentum* mid closed fernland.

A.2 Details for Selected EPBC Act Listed Plant Species

A selection of the EPBC Act-listed flora species that have been recorded within the licence areas (based on BDBSA records) are discussed in further detail below. For the selected species, habitat requirements, key threats thought to have led to the species' decline, and key recovery actions are discussed. Not all listed species are discussed however the selected species provide examples of threats and recovery actions consistent with the other species.

Elegant Spider-orchid

The Elegant Spider-orchid (*Caladenia formosa*) occurs in western Victoria and south-eastern South Australia, and is now restricted to isolated public land forest blocks south of Edenhope and north of Cavendish, and adjoining properties in Victoria, in Mt Scott and Mt Monster Conservation Parks, and private properties in the

Naracoorte, Coonawarra and Kingston regions. The habitats *Caladenia formosa* typically occupy include damp-sands with herb-rich woodlands, with sedges, which may be seasonally inundated. Key threats to the species include disturbance (through timber harvesting, rabbit burrow ripping, horse riding and trail bikes), inappropriate fuel reduction burning in autumn, as well as weed invasion, and grazing from both native and exotic herbivores (Todd, 2000).

Bell-flower Hyacinth Orchid

In South Australia, the species *Dipodium campanulatum* is restricted to the south east of the state on an ancient shoreline extending parallel to 10–20 km from the Victorian border; from near Padthaway south to the Glenelg River and was once common around Naracoorte. The bell-flower hyacinth orchid is typically found on deep grey sands or limestone in stringybark (*Eucalyptus baxteri /arenacea*) woodland with an understorey of bracken fern (*Pteridium esculentum*), *Acacia* species (Bates 2011). Key threats to the species include clearing and fragmentation of existing habitat, trampling and grazing pressures, road side maintenance, competition from weed species and illegal picking by the public.

Trailing Hop-bush

There are 55 known populations of the Trailing Hop-bush (*Dodonaea procumbens*) across Victoria, New South Wales, and South Australia. Little is known about the species, and population occurrences and population estimates are not fully understood. In South Australia, there are populations near Port Lincoln, Clare and Burra in the Mid North, Kangaroo Island, and a small population on a roadside near Penola in the South East. Habitats within which the species has been recorded are often low-lying areas, typically wet in winter, of woodland, low open forests, heathlands and grasslands, on sands and clays. The South Australian populations have been recorded in *Eucalyptus camaldulensis*, *Eucalyptus fasciculosa* and *Eucalyptus leucoxylon* woodland, and in native grasslands of *Lepidosperma viscida, Themeda triandra, Austrodanthonia* sp., *Austrostipa* sp., and shrubs of *Acacia acinacea, Dodonaea viscosa*, and *Bursaria spinosa* (Carter, 2010).

Clover Glycine

The Clover Glycine (*Glycine latrobeana*) is distributed across south-eastern Australia, including south-eastern South Australia. The overall extent of occurrence is calculated at 351,350 km2, whilst the actual area of occupancy is estimated to be 131 km2. In South Australia, the species has been found on undulating plains, gentle west facing slopes and lower south facing river valley slopes. In the south-east, it has been recorded in *Eucalyptus baxteri* woodlands with *Banksia* species (Davies, 1986). Threats to *Glycine latrobeana* include small population size, inappropriate fire regimes, grazing by both native and introduced stock, habitat fragmentation, Phytophthora and weeds. Ensuring key populations and their habitat are identified and protected has been identified as a key objective of the species recovery plan (DEE, 2018a).

Spiral Sun Orchid

The Spiral sun orchid (*Thelymitra matthewsii*) is currently known to occur in Victoria, South Australia and New Zealand. Throughout its range the species is rare and of sporadic distribution. The species favours open forests and woodlands in well-drained sand and clay loams. It is a post-disturbance coloniser that is usually found in open areas around old quarries and gravel pits, on road verges, disused tracks and animal trails (Backhouse & Jeanes 1995). It has been recorded as growing on gravely soils in disturbed areas of low coastal forest (Bishop 1996), in swampy soils, on lateritic podsol on gently sloping plateaus or from sand

overlying limestone on undulating plains (Davies 1986, 1992). Current threats include disturbance to or destruction of plants and habitat, altered fire regimes, grazing/predation and weed invasion.

A.3 Details for Selected EPBC Act Listed Fauna Species

A selection of the EPBC Act-listed fauna species that have been recorded within the licence areas (based on BDBSA records) are discussed in further detail below. For the selected species, habitat requirements, key threats thought to have led the species' decline, and key recovery actions are discussed. Not all listed species are discussed however the selected species provide examples of threats and recovery actions consistent with the other species.

Australasian Bittern

The Australasian Bittern (*Botaurus poiciloptilus*) occurs in Australia, New Zealand and New Caledonia. Within South Australia, the species is confined to the south-east, ranging from north of the River Murray and west to southern Eyre Peninsula, with the greatest population densities within the licence areas at Bool Lagoon (Marchant and Higgens, 1990). The species occupies densely vegetated freshwater wetlands, and occasionally estuarine habitats. Key habitat preferences are wetlands with tall dense vegetation, allowing for foraging in still, shallow water. Vegetation communities often occupied by the species are dominated by sedges, rushes, and reeds (of the genera *Phragmites, Cyperus, Eleocharis, Juncus, Typha*). The key threat to *Botaurus poiciloptilus* is loss or alteration of suitable habitat through diversion of water from wetlands for irrigation, and the salinisation of swamps (Garnett and Crowley, 2000).

Red-tailed Black-cockatoo (South-eastern)

The Red-tailed Black-cockatoo (south-eastern) (*Calyptorhynchus banksii graptogyne*) has a restricted distribution, confined to the south-east South Australia and neighbouring areas in western Victoria. It is considered widespread, but rare within its range. Preferred habitats include *Eucalyptus arenacea* and *Eucalyptus baxteri* woodlands on plains, as well as *Eucalyptus camaldulensis*, *Eucalyptus leucoxylon* and *Allocasuarina luehmannii* woodlands (DEE, 2018b). A key habitat requirement is large hollows in eucalypt trees, preferably hollows of dead trees over live trees, with entrances facing upwards, preferably vertical or near vertical, higher than 6 m from the ground, with an entrance 15 – 50 cm in diameter (Hill and Burnard, 2001). Key threats to the species are food shortages (due to impact of fire on food, loss of feeding habitat, grazing impacts on foraging sites, fragmentation of foraging habitat), nest site availability, firewood harvesting, nest predators, and human interference with nests.

Southern Bell Frog

The distribution of the Southern Bell Frog (*Litoria raniformis*) covered sections of New South Wales, Victoria, Tasmania and South Australia. The species has undergone substantial declines in abundance, and has become locally extinct in many areas of its former range. In the south-east of South Australia, the species occurs at Bool and Hacks Lagoons, which are within the licence areas. In 2011 there was a notable population increase of *Litoria raniformis* at Bool Lagoon, Hacks Lagoon and Lake Ormerod (EBS, 2011). Preferred habitat typically includes emergent vegetation of *Typha* sp., *Phragmites* and *Eleocharis* sp., in or surrounding the edges of still or slow-moving lagoons, swamps, lakes, ponds and dams. Threats to the species include habitat loss and degradation, altered flooding regimes, disease, predation from introduced fish, and salinisation (DEE, 2018c).

Southern Brown Bandicoot (Eastern)

The Southern Brown Bandicoot (eastern) (*Isoodon obesulus obesulus*) is found in New South Wales, Victoria, and South Australia. The subspecies was once widely distributed along a broad coastal band from Eyre Peninsula in South Australia, through southern Victoria and south-eastern New South Wales to just north of Sydney. The current range has contracted, and the species is now patchily distributed in isolated populations throughout the former range (DSEWPC, 2011). In South Australia, the subspecies is found in the Mount Lofty Ranges, Kangaroo Island, and the south-east. There is little information on the habitats the subspecies utilises in the south-east, but in the Mount Lofty Ranges it inhabits eucalypt forests and woodlands with heath understoreys. Vegetation communities inhabited include *Eucalyptus obliqua*, *Eucalyptus fasciculosa*, *Leptospermum continentale*, *Leptospermum myrsinoides*, and *Banksia marginata*. Dense shrub understories, with at least 50% groundcover are preferred. Key threats are loss or habitat or modification, fragmentation, inappropriate fire regimes and extensive wildfires, and predation from introduced animals, as well as the isolation of the populations (DEE, 2018d).

Southern Bent-wing Bat

The Southern Bent-wing Bat (*Miniopterus schreibersii bassanii*) is found in wetland and river basins of in south-eastern South Australia and Victoria. The Naracoorte area is thought to be the species' most southern distribution in South Australia, with the key maternity cave located within Naracoorte Caves National Park. The species' preferred habitat is associated with the availability of foraging areas, and proximity to suitable roosting caves. Habitat loss, disturbance and modification are the key threats to the species (DEE, 2018e).

A.4 Details for Significant Migratory Species

The following section discusses a selection of the migratory species that have been recorded within the licence areas (based on BDBSA records). For the selected species, habitat requirements and key threats are discussed. Not all listed migratory species are discussed however the selected species provide examples consistent with the other species.

Fork Tailed Swift

In South Australia the Fork-tailed Swift (*Apus pacificus*) is widespread from the Victorian border west to the Spencer Gulf. It is also common in coastal parts of Eyre Peninsula as far west as Franklin Island, off Streaky Bay and to the north. There have been a few recently published records beyond these bounds, such as in Flinders Ranges and the Lake Eyre Drainage Basin from Billa Kallina Station, Lake Eyre South and Marree. Sightings have also been recorded north to Moorayepe and east to Innamincka and Moomba (Higgins 1999). In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. There are no significant threats to the Fork-tailed Swift in Australia. Potential threats include habitat destruction and predation by feral animals. Due to the wide range of the species the potential impacts are thought to be negligible (Birdlife International 2009).

Satin Flycatcher

The Satin Flycatcher (*Myiagra cyanoleuca*) are occasionally recorded, mostly in the lower south-east, occasionally as far north as Naracoorte (Blakers et al. 1984). They generally inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Populations of the Satin Flycatcher are said to have been

reduced by clearing and logging of forests in south-eastern Australia, mainly the loss of mature forests (Blakers et al. 1984).

Latham's Snipe

Latham's Snipe (*Gallinago hardwickii*) is a non-breeding visitor to south-eastern Australia and is a passage migrant through northern Australia (Higgins & Davies 1996). The species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia (including the Adelaide plains and Mount Lofty Ranges, and the Eyre Peninsula).

Historically, the greatest threats to Latham's Snipe in Australia have been a loss of habitat caused by the drainage and modification of wetlands, and excessive mortality due to hunting (Frith et al. 1977; Littler 1910; Naarding 1985). The current major threat to the species appears to be the ongoing loss of habitat. The wetland habitats occupied by Latham's Snipe are threatened by a variety of processes including pollution, drainage, diversion of water for storage or agriculture, development of land for urban or other purposes, and land management practices such as mowing of habitat during summer (Frith et al. 1977; Garnett & Crowley 2000; Naarding 1981 1985; Weston 1995). The habitat is also potentially threatened by vegetational replacement (Crowley & Garnett 1998; Garnett & Shephard 1997; Garnett & Crowley 2000). Collisions with vehicles could be a potential minor threat to some snipe, as birds are known to roost at times beside roadside puddles.

A.5 Introduced Species

Table A.5-1: Priority pest weeds and alert weeds identified by the Limestone Coast Landscape Board

Common name	Scientific name	Landscape Act status: Limestone Coast Landscape Board management aim
Bridal veil	*Asparagus declinatus*	Declared: eradicate from region
Golden dodder	*Cuscuta campestris*	Declared: eradicate from region
Blackberry	*Rubus fruticosus*	Declared: destroy infestations
Western Cape bridal creeper	*Asparagus asparagoides*	Declared: destroy infestations
Buffel grass	*Cenchrus ciliaris*	Declared: destroy infestations
Fountain grass	*Cenchrus setaceus*	Declared: destroy infestations
Innocent weed	*Cenchrus incertus / C. longispinus*	Declared: destroy infestations
Pampas grass	*Cortaderia spp*	Declared: destroy infestations
Silverleaf nightshade	*Solanum elaeagnifolium*	Declared: destroy infestations
Asparagus fern	*Asparagus scandens*	Declared: contain the spread
White weeping broom	*Retama raetam*	Declared: destroy infestations
African boxthorn	*Lycium ferocissium*	Declared: contain the spread
African feathergrass	*Pennisetum macrourum*	Declared: contain the spread
African lovegrass	*Eragrostis curvala*	Declared: contain the spread
Aleppo pine	*Pinus halepensis*	Declared: contain the spread
Bathurst burr	*Xanthium spinosum*	Declared: contain the spread
Boneseed ssp. *monilifera*	*Chrysanthemoides monilifera*	Declared: contain the spread
Caltrop	*Tribulus sp.*	Declared: contain the spread
Cape tulip	*Homeria sp.*	Declared: contain the spread
Creeping knapweed	*Rhaponticum repens*	Declared: contain the spread
Berry Heath	*Erica baccans*	Declared: contain the spread
Gorse	*Ulex europaeus*	Declared: contain the spread
Hoary cress	*Lepidium appelianum*	Declared: contain the spread
Madeira vine	*Andrera cordifolia*	Declared: contain the spread
Salvation jane	*Echium plantagineum*	Declared: contain the spread
Prickly pear	*Opuntia humifusa*	Declared: contain the spread
Three corner jack	*Emex australis*	Declared: contain the spread
Three horned bedstraw	*Galium tricornutum*	Declared: contain the spread
Variegated thistle	*Silybum marianum*	Declared: contain the spread
Apple of Sodom	*Calotropis procera*	Declared: protect key sites/assets from spread
Arum lily	*Zantedeschia aethiopica*	Declared: protect key sites/assets from spread

Common name	Scientific name	Landscape Act status: Limestone Coast Landscape Board management aim
Bladder campion	*Silene vulgaris*	Declared: protect key sites/assets from spread
Coastal tea tree	*Leptospermum laevigatum*	Declared: protect key sites/assets from spread
Cape broom	*Genista monspessulana*	Declared: protect key sites/assets from spread
Cutleaf mignonette	*Reseda lutea*	Declared: protect key sites/assets from spread
Yellow burweed	*Amsinckia calycina*	Declared: manage pest
English broom	*Cytisus scoparius*	Declared: protect key sites/assets from spread
Noogoora burr	*Xanthium strumarium*	Declared: protect key sites/assets from spread
Bluebell creeper	*Sollya heterophylla*	Declared: contain the spread
Dolichos pea	*Dipogon lignosus*	Declared: protect key sites/assets from spread
False caper	*Euphorbia terracina*	Declared: protect key sites/assets from spread
Field bindweed	*Convolvulus arvensis*	Declared: protect key sites/assets from spread
Ganzania	*Ganzania*	Declared: protect key sites/assets from spread
Horehound	*Marrubium vulgare*	Declared: protect key sites/assets from spread
Italian buckthorn	*Rhamnus alaternus*	Declared: protect key sites/assets from spread
Lincoln weed	*Diplotaxis tenuifolia*	Declared: protect key sites/assets from spread
Mirror bush	*Comprosma repens*	Declared: protect key sites/assets from spread
Musk weed	*Myagrum perfoliatum*	Declared: protect key sites/assets from spread
Olive	*Olea sp.*	Declared: protect key sites/assets from spread
Polygala	*Polygala myrtifolia*	Declared: protect key sites/assets from spread
Spiny Rush	*Juncus acutus*	Declared: protect key sites/assets from spread
Swamp oak	*Casuarina glauca*	Declared: protect key sites/assets from spread
Willow	*Salix spp.*	Declared: protect key sites/assets from spread
Bridal creeper	*Asparagus asparagoides*	Declared: manage pest
Desert ash	*Fraxinus angustifolia*	Declared: manage pest
Dog rose	*Rosa canina*	Declared: manage sites
Skeleton weed	*Chondrilla juncea*	Declared: manage sites
Sweet briar	*Rosa rubiginosa*	Declared: manage sites
Sweet pittosporum	*Pittosporum undulatum*	Declared: manage sites
Athel pine	*Tamarix aphylla*	Declared: monitor
Chilean dodder	*Cuscuta suaveolens*	Declared: monitor
Red dodder	*Cuscuta planifolia*	Declared: monitor
Wild artichoke	*Cynara cardunculus*	Declared: monitor

Common name	Scientific name	Landscape Act status: Limestone Coast Landscape Board management aim
Bulbil watsonia	*Watsonia meriana var. bulbillifera*	Declared: limited action
Alisma	*Alisma lanceolatum*	Declared: alert weed
Alkali sida	*Malvella leprosa*	Declared: alert weed
Alligator weed	*Alternanthera philoxeroides*	Declared: alert weed
Arrowhead	*Sagittaria montevidensis*	Declared: alert weed
Azzarola	*Crataegus sinaica*	Declared: monitor
Broadkernel espartillo	*Amelichloa brachychaeta*	Declared: alert weed
Broomrape	*Orobanche ramosa*	Declared: alert weed
Cabomba	*Cabomba caroliniana*	Declared: alert weed
Calomba daisy	*Oncosiphon suffruticosum*	Declared: alert weed
Cane needlegrass	*Nassella hyalina*	Declared: alert weed
Coolatia grass	*Hyparrhenia hirta*	Declared: contain the spread
Distichlis	*Distichlis spicata*	Declared: alert weed
Dune onion weed	*Trachyandra divaricata*	Declared: alert weed
Elodea	*Elodea canadensis*	Declared: alert weed
Eurasian watermilfoil	*Myriophyllum spicatum*	Declared: alert weed
Horsetail	*Equisetum hyemale*	Declared: alert weed
Hydrocotyle	*Hydrocotyle ranunculoides*	Declared: alert weed
Lagarosiphon	*Lagarosiphon major*	Declared: alert weed
Lantana	*Lantana camara*	Declared: alert weed
Leafy elodea	*Egeria densa*	Declared: alert weed
Mexican feathergrass	*Nassella tenuissima*	Declared: eradicate from the region
Nightstock	*Matthiola longipetala*	Declared: alert weed
Perennial thistle	*Cisium arvense*	Declared: alert weed
Plumerillo	*Jarava plumosa*	Declared: alert weed
Poison buttercup	*Ranunculus sceleratus*	Declared: alert weed
Poison Ivy	*Toxicodendron radicans*	Declared: alert weed
Primrose willow	*Ludwigia peruviana*	Declared: alert weed
Ragwort	*Senecio jacobaea*	Declared: alert weed
Rhus tree	*Toxicodendron succedaneum*	Declared: alert weed
Sagittaria	*Sagittaria graminea*	Declared: alert weed
Salvinia	*Salvinia molesta*	Declared: alert weed

Common name	Scientific name	Landscape Act status: Limestone Coast Landscape Board management aim
Senegal tea plant	*Gymnocoronis spilanthoides*	Declared: alert weed
Serrated tussock	*Nassella trichotoma*	Declared: alert weed
Texas needlegrass	*Nassella leucotricha*	Declared: destroy infestations
Tree Heath	*Erica arboria*	Declared: alert weed
Water caltrop	*Trapa natans*	Declared: alert weed
Water dropwart	*Oenanthe pimpinelloides*	Declared: alert weed
Water hyacinth	*Eichhornia crassipes*	Declared: alert weed
Water soldier	*Stratiotes aloides*	Declared: alert weed
Blue mustard	*Chorispora tenlla*	Declared: alert weed
Parrot's feather	*Myriophyllum aquaticum*	Declared: alert weed

Table A.5-2: Priority pest fauna identified by the Limestone Coast Landscape Board

Common name	Scientific name	Landscape Act status: Limestone Coast Landscape Board management aim
Wild dog / dingo	*Canis lupus/* ssp. *dingo*	Declared: eradicate from the region
Goat	*Capra hircus*	Declared: eradicate from the region
Chital deer	*Axis axis*	Declared: eradicate from the region
Rusa deer	*Cervus timorensis*	Declared: eradicate from the region
Sambar deer	*Cervus unicolour*	Declared: eradicate from the region
Red deer	*Cervus elaphus*	Declared: eradicate from the region
Wapiti deer	*Cervus canadensis*	Declared: eradicate from the region
Hog deer	*Axis porcinus*	Declared: eradicate from the region
Brown rat	*Rattus norvegicus*	Declared: contain the spread
Fallow deer	*Dama dam*	Declared: eradicate from the region
Feral pig	*Sus scrofa*	Declared: eradicate from the region
Rabbit	*Oryctolagus cuniculus*	Declared: contain the spread
Feral cat	*Felis catus*	Declared: manage pest
Fox	*Vulpes spp.*	Declared: manage pest
House mouse	*Mus musculus*	Declared: manage pest
Starling	*Sturnus spp.*	Declared: manage pest
Eurasian blackbird	*Turdus merula*	Declared: manage pest
Domestic pigeon	*Columba livia domestica*	Declared: manage pest
Hare	*Lepus europaeus occidentalis*	Declared: manage pest

Common name	Scientific name	Landscape Act status: Limestone Coast Landscape Board management aim
Asian black-spined toad	*Duttaphrynus melanostictus*	Declared: alert pest
Cane toad	*Rhinella marina*	Declared: alert pest
Corn snake	*Pantherophis guttatus*	Declared: alert pest
Common (Indian) myna	*Acridotheres tristis*	Declared: alert pest
House crow	*Corvus slendens*	Declared: alert pest
Indian ringneck parakeet	*Psittacula krameri*	Declared: alert pest
Laughing dove	*Spilopelia senegalensis*	Not declared: alert pest
Red-eared slider	*Trachemys scripta elegans*	Declared: alert pest
Red Whiskered bulbul	*Pycnonotus jocusus*	Declared: alert pest
Song thrush	*Turdus philomelos*	Not declared: alert pest
Tree sparrow	*Passer montanus*	Not declared: alert pest
Water buffalo	*Bubalus bubalis*	Not declared: alert pest

Appendix B Beach Risk Matrix

The risk assessment that is summarised in the impact assessment tables in Section 5 uses the Beach risk matrix definitions of likelihood and consequence.

CDN 14740489 Beach Risk Matrix

Risk Matrix

CONSEQUENCE	CONSEQUENCE CATEGORY					LIKELIHOOD					
	PEOPLE	ENVIRONMENT	REPUTATION	FINANCIAL[1]	LEGAL	A. Remote	B. Highly Unlikely	C. Unlikely	D. Possible	E. Likely	F. Almost Certain
	Impact to Beach or contracting personnel	Natural environment	Community safety, reputation/social licence. media, items of cultural significance.	Financial impact (e.g. due to loss of revenue, business interruption, asset loss etc.)	Breach of law, prosecution, civil action	<1% chance of occurring within the next year. Requires exceptional circumstances, unlikely event in the long-term future. Only occur as a 100-year event.	>1% chance of occurring within the next year. May occur but not anticipated. Could occur years to decades.	>5% chance of occurring within the next year. May occur but not for a while. Could occur within a few years.	>10% chance of occurring within the next year. May occur shortly but a distinct probability it won't. Could occur within months to years.	>50% chance of occurring within the next year. Balance of probability will occur. Could occur within weeks to months.	99% chance of occurring within the next year. Impact is occurring now. Could occur within days to weeks.
6 Catastrophic	Multiple fatalities >4 or severe irreversible disability to large group of people (>10)	Catastrophic offsite or onsite release or spill; long-term destruction of highly significant ecosystems; significant effects on endangered species or habitats; irreversible or very long-term impact	Multiple community fatalities; complete loss of social licence; prolonged negative national media; complete loss of items of cultural significance	>$500m	Prolonged and complex civil and/or regulatory litigation; potential jail terms and/or very high fines and/or damages claim	HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
5 Critical	1-3 fatalities or serious irreversible disability (>30%) to multiple persons (<10)	Significant offsite or onsite release or spill; eradication or impairment of the ecosystem; significant impact on highly valued species or habitats; widespread long-term impact	Community fatality; significant loss of social licence; negative national media for 2 or more days; significant damage to items of cultural significance	$100m-$500m	Civil and/or regulatory litigation; potential significant fines and/or damages claim	MEDIUM	MEDIUM	HIGH	HIGH	VERY HIGH	VERY HIGH
4 Major	Serious permanent injury/ illness or moderate irreversible disability (<30%) to one or more persons	Major offsite or onsite release or spill; very serious environmental effects, such as displacement of species and partial impairment of ecosystem; major impact on highly valued species or habitats; widespread medium and some long-term impact	Serious permanent injury to community member; major damage to social licence; negative national media; major damage to items of cultural significance	$10m-$100m	Civil and/or regulatory litigation; potential major fine and damages claim	MEDIUM	MEDIUM	MEDIUM	HIGH	HIGH	VERY HIGH
3 Serious	Serious reversible/ temporary injury/illness; Lost Time Injury >5 days or Alternate/Restricted Duties >1 month	Minor offsite or onsite release or spill; serious short-term effect to ecosystem functions; serious impact on valued species or habitats; moderate effects on biological or physical environment	Serious reversible injury to community member; serious damage to social licence; negative state media; serious damage to items of cultural significance	$1m-$10m	Serious potential breach of law; report and investigation by regulator; possible prosecution or regulatory notice (e.g. improvement notice or equivalent), or possible civil litigation and serious damages claim	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	HIGH
2 Moderate	Reversible temporary injury/ illness requiring Medical Treatment; Lost Time Injury ≤5 days or Alternate/Restricted Duties for ≤1 month	Event contained within site; short-term effects but not affecting ecosystem functions; some impact on valued species or habitats; minor short-term damage to biological and/or physical environment	Moderate injury to community member; moderate impact to social licence; negative local media; moderate damage to items of cultural significance	$100k-$1m	Potential breach of law or non-compliance; inquiry by a regulator leading to Low-level legal issues; possible civil litigation and moderate damages claim	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH
1 Minor	First Aid Injury/illness	Spill limited to release location; minor effects but not affecting ecosystem functions; no impact on valued species or habitats; low-level impacts on biological and physical environment	Minor injury to community member, public concern restricted to local complaints, minor damage to items of cultural significance	≤$100k	Minor potential breach of law; not reportable to a regulator; on the spot fine or technical non-compliance	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM

Appendix C Additional Information on Synthetic Based Muds

C.1 Introduction

This appendix provides additional information on additives used in synthetic based muds (SBM), based on additives that the main mud and chemical service providers may use for their fluid systems.
It is expected that the type and purpose of additives that may be used by different providers in the future are likely to be similar to those outlined in this document however new providers and new technologies are constantly being evaluated.

C.2 Additives

The following table lists typical SBM additives and examples of products that may be used by different service providers.

Table C2: SBM additives and examples of products used by different service providers

Additive	Purpose	Examples of supplier chemicals
Synthetic Base Oil	The base fluid used to transport drill cuttings to the surface, prevent well-control issues, preserve wellbore stability, and cool and lubricate the drill bit and drill string during drilling	Saraline 185V, Amodrill 1200, Escaid 110
Brine	Saline liquid usually used in synthetic muds to increase density and reduce water activity kin order to increase wellbore stability. Brines are preferred because they have higher densities than fresh water but lack solid particles that might damage producible formations. They will also inhibit hydratable clays.	Water, Calcium Chloride
Emulsifiers and wetting agents	An emulsifier lowers the interfacial tension between oil and water, which allows stable emulsions with small drops to be formed. Wetting agents lower the surface tension of a liquid and enable it to spread more quickly and easily.	Novatec P, Novatec S, Delta-mul, EZ MUL NT, Deeptreat
Fluid Loss additives	A group of mud additives specifically designed to lower the volume of filtrate that passes through a filter medium.	Novatec F, MAX-TROL, Carbotrol 375, Liquitone
Viscosifiers and Rheological Control	Mud rheology (elasticity, plasticity and viscosity) is measured on a continual basis while drilling and adjusted with additives or dilution to meet the needs of the operation to suspend and carry drill cuttings from the wellbore.	VG Supreme, Carbo-Gel, Versagel HT, Magmagel SE, Geltone II
Weighting agents	Also known as weighting material, a high-specific gravity and finely divided solid material used to increase density of a drilling fluid.	Newbar, Millbar, Barite, calcium carbonate, Mil-carb, Circal
Alkalinity control	Adding lime to drilling mud can assist in fluid loss, rheology, clay de-flocculation, stabilization and increase calcium solubility. An excess of lime in muds can neutralize acid gases and improve the safety of drilling a well with high H_2S zones	Lime
Bridging Agents	Sized inert solids that form bridges over rock permeability to enhance performance of fluid loss control additives	Baracarb, Omyacarb, Circal, Soltex, LC Lube

Additive	Purpose	Examples of supplier chemicals
Lost Circulation Material	A range of material added to the wellbore to combat or proactively prevent the loss of well fluid to permeable or faulted formations	Mix II, Kwikseal, Nutplug, Fracseal, Form-a-blok, Quickseal, Barafibre, Diaseal, Mil-Mica, Steelseal
Wellbore Cleaners	At the end of the drilling process, wellbore cleaners remove drilling fluid and other residues that would remain in the wellbore and	Deepclean, RX-03X, Prime 100, CFS-926

Additional details and Safety Data Sheets for the drilling fluid additives listed above are available at the following websites:

- Halliburton https://www.halliburton.com
- Schlumberger http://www.slb.com
- Baker Hughes https://www.bhge.com
- Newpark https://www.newpark.com

Appendix D Beach Response to Issues Raised During Stakeholder Consultation (XX 2025)

Appendix E Beach Responses to Government Agency Consultation (XX 2025)