Environmental Impact Report

Onshore Otway Basin Petroleum Production Operations

April 2024

Revision	Date	Reason for issue	Reviewer/s	Consolidator	Approver
Rev 3	06/03/2019	Updated following DEM comments	TF	RS/SM	TF
Rev 4	20/03/2019	Updated following EPA comments	TF	RS/BW/SM	TF
Rev 5	05/04/2024	Updated for 5-year review	ZB, MH, MP, TF	ERIAS	BB

Environmental Impact Report

Table of contents

Table of figures

List of tables

List of appendices

1 Introduction

Beach Energy Limited (Beach Energy) onshore Otway Basin production activities currently operate under the Otway Basin Petroleum Production Operations Statement of Environmental Objectives. This Statement of Environmental Objectives (SEO) and the associated Environmental Impact Report (EIR) were approved under the *Petroleum and Geothermal Energy Act 2000* (PGE Act) in April 2019, following the five-yearly review process under the Act.

Beach Energy holds a number of petroleum exploration, production and retention licences in the onshore Otway Basin in the Southeast of South Australia, which encompass various assets including the Katnook Gas Plant and associated infrastructure (Figure 1) located within Petroleum Production Licence 62 (PPL62).

This Environmental Impact Report (EIR) has been prepared under the PGE Act 2000 to cover current and proposed petroleum production and processing activities conducted by Beach Energy in the region. This document updates and supersedes the Environmental Impact Reports and associated Statements of Environmental Objectives (SEO) that have previously been developed to cover production and processing operations in the region:

- *Environmental Impact Report for the Production and Processing of Petroleum Products and Associated Activities at the Katnook and Ladbroke Grove Gas Plants, Otway Basin – South Australia* (Origin Energy 2002).
- *Environmental Impact Report. Adelaide Energy Pipelines (Jacaranda Ridge-2, Limestone Ridge-1, Haselgrove South-2 and Wynn-2* (Adelaide Energy 2009).
- *Addendum to Environmental Impact Report for the Production and Processing of Petroleum Products and Associated Activities at the Katnook and Ladbroke Grove Gas Plants. Otway Basin – South Australia. Five Year review of the Statement of Environmental Objectives.* (Adelaide Energy 2011a).

1.1 Background

Beach Energy has a long history of participation in exploration and development activities in the Otway Basin in the Limestone Coast region of south-east of South Australia, stretching back to the early 1960's, with more than 80 wells drilled by the petroleum industry since that time.

The Katnook Gas Plant was initially constructed by Origin Energy Resources Limited and commenced production in 1991. The gas plant supplied gas for over 20 years to industrial customers in the Limestone Coast region. In 2007 the gas plant and associated infrastructure was sold to Adelaide Energy Proprietary limited. Beach acquired Adelaide Energy in 2011 and subsequently stopped production at the plant due to limited gas supply from the well field. The Katnook Gas Plant was shut-in awaiting a new discovery of gas to support re-activating the plant.

Beach Energy drilled the Haselgrove-3 ST1 conventional gas exploration well in 2017. The Dombey-1 gas exploration well and Haselgrove4 appraisal well were subsequently drilled to further understand prospectivity in the region.

A redevelopment of the legacy Katnook Gas Plant (KGP) via the construction of Katnook Gas Processing Facility (KGPF) was completed and commissioned in February 2020, and mid year of the same year Beach Energy drilled Haselgrove 4DW1, a deviated well using the Haselgrove 4 well.

Haselgrove 3DW1 well was tied into the refurbished KGPF in 2020.

In September 2022, production operations at the Katnook facility were suspended and the facility and associated infrastructure were subsequently mothballed.

Beach Energy is undertaking ongoing subsurface assessments on the commerciality of drilling additional conventional wells in the region.

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

Beach Energy's currently holds one exploration licence, three production licences and four retention licences in the South Australian section of the Otway Basin, both in its own right and with co-ventures. The locations of Beach Energy's operations are shown in Figure 1.

1.3 About this Document

This document has been prepared to satisfy the requirements of an Environmental Impact Report (EIR) under the *PGE Act2000*. It has been prepared in accordance with current legislative requirements, in particular with Section 97 of the *PGE Act2000* and Regulation 10 of the *Petroleum and Geothermal Energy Regulations 2013*.

Previously published Environmental Impact Reports for the Otway Basin (Origin 2002; Adelaide Energy 2011a; Adelaide Energy 2009; Beach Energy 2013a) were used to provide background information for this EIR, including detailed background information on the environment of the Otway Basin and the environmental risks and consequences, gathered over more than 20 years of petroleum production operations in the Otway Basin.

1.3.1 Scope

This EIR addresses potential environmental risks and consequences associated with all Beach Energy's activities and operations at the Katnook Gas Plant site, associated wells and pipelines to the point of sale. It has been written to address both current and potential future petroleum production in the region of the Katnook plant and Beach's petroleum licence areas, in order to develop a SEO that will address reasonably foreseeable future activities over the lifetime of the facilities.

Beach Energy's activities that are specifically covered by this EIR include:

- petroleum production and processing operations at the Katnook Gas Plant site, including potential infrastructure refurbishment and improvement, and produced formation water disposal operations.
- well operations (after drilling has finished) including production completions and workovers, well integrity management, artificial lift and wellhead production equipment, gas well deliquification and downhole decommissioning[1] following production.
- field production / processing equipment construction, installation, operation, decommissioning and rehabilitation
- pipeline construction, operation and decommissioning

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

- construction depots and camps
- Construction, maintenance and rehabilitation of access tracks and pads.
- waste management
- end of life facility decommissioning / rehabilitation.

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

- well site and drilling access track construction
- drilling activities
- downhole decommissioning following drilling
- restoration of well sites and well access tracks directly following drilling
- seismic operations.

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: Drilling, Completion and Well Production Testing in the Otway Basin, South Australia* (Beach 2018).
- *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.

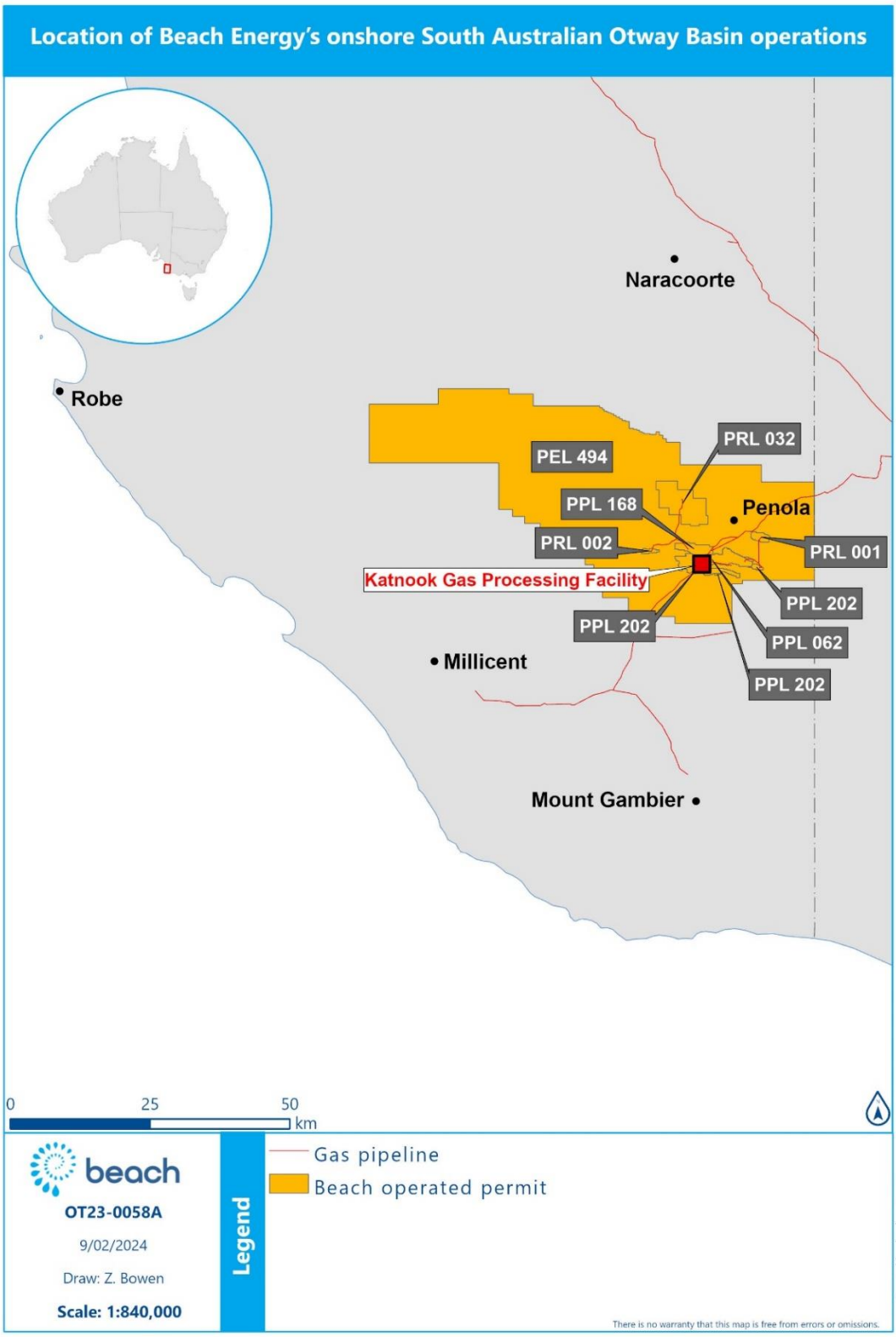

Figure 1: Location of Beach Energy's onshore South Australian Otway Basin operation

2 Legislative Framework

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

2.1 Petroleum and Geothermal Energy Act 2000

Petroleum production activities are governed by the PGE Act and the Petroleum and Geothermal Energy Regulations. This legislation is administered by the Department for Energy and Mining (DEM).

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.

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.

Statement of Environmental Objectives

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

Under Regulation 14 of the Petroleum and Geothermal Energy Regulations, an approved SEO must be reviewed at least once in every five years. Origin Energy originally developed the SEO for petroleum production and processing operations at the Katnook and Ladbroke Grove Gas Plants in 2004 (Origin Energy 2004). It was reviewed and updated by Adelaide Energy in 2011 (Adelaide Energy 2011b) after an extension of time was granted by the regulator, and similarly updated in 2019. A revised SEO has been prepared in parallel with this document.

Environmental Impact Report

Environmental Impact Report

In accordance with Section 97 of the Petroleum and Geothermal Energy Act, an EIR 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 Regulation 10 of the Petroleum and Geothermal Energy Regulations, the EIR must include:

- 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 use
- 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 events during the construction, operational and abandonment stages, atypical events, estimated frequency of events and the basis of predictions)
- an assessment of the potential consequences of these events on the environment (including size and scope, duration, cumulative effects (if any), the extent to which these consequences can be managed or addressed and proposed management actions)
- an explanation of the basis on which these consequences have been predicted
- a list of all owners of the relevant land
- information on consultation undertaken during preparation of the EIR.

Environmental Significance Assessment and SEO Consultation Requirements

The EIR is submitted to DEM and an Environmental Significance Assessment is undertaken in accordance with criteria established under Section 98 of the Act[2], to determine whether the activities described in the EIR are to be classified as 'low', 'medium' or 'high' impact. A corresponding SEO is prepared, reflecting the impacts and measures identified in the EIR or other assessments that may be required as determined by the classification.

[2] Criteria for classifying the level of environmental impact of regulated activities are published on the DEM website: http://energymining.sa.gov.au/petroleum/legislation_and_compliance/environmental_register

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

- **Low impact activities** do not require public consultation and are subjected to a process of internal government consultation and comment on the EIR and SEO prior to approval.
- **Medium impact activities** require a public consultation process for the EIR and proposed SEO, with comment sought for a period of at least 30 business days.
- **High impact activities** are required to undergo an environmental impact assessment under the provisions of the *Planning, Development and Infrastructure Act 2016*.

The level of impact of a particular activity is assessed on the basis of the predictability and manageability of the impacts on the environment. Where the environmental impacts are predictable and readily managed, the impact of the activity is considered low. Where the environmental impacts are less predictable and are difficult to manage, the impact of the activity is potentially high.

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

2.1.1 Activity Notification / Approval Process

Prior to commencing a regulated activity, Section 74(3) of the P&GE Act provides that:

- the Minister's prior written approval is required for activities requiring high level supervision (as per Regulation 19), and
- notice of activities requiring low level supervision is to be given at least 21 days in advance (as per Regulation 18).

In order to obtain written approval for activities requiring high level supervision, an application and notification of activities (in accordance with Regulation 20) must be submitted to the Minister at least 35 days prior to the commencement of activities.

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

Consequently, 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 approvals obtained in 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.

2.2 Other Legislation

A number of additional environmental approvals may be required under Commonwealth and South Australian legislation. These are outlined in Table 1. (Note that this is not a comprehensive list of all applicable legislation).

It must be noted that not all subsequent approvals are mandatory at the development (or construction) stage, as approvals may be required as circumstances arise (for example cultural artefact finds during construction or operation).

Table 1: Additional environmental legislation and approvals

Agency	Legislation	Issue
Commonwealth		
Department of Climate Change, Energy, the Environment and Water (DCCEEW)	*Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*	Assessment and approval required if activities will significantly impact matters of national environmental significance, including: • National Heritage Places • wetlands of international importance (Ramsar wetlands) • listed threatened species and communities • listed migratory species (for example JAMBA and CAMBA) • a water resource in relation to coal seam gas and large coal mining developments.
Attorney-General's Department	*Native Title Act 1993*	Intersection of registered Native Title claims
South Australia		
Department for Environment and Water (DEW)	*Heritage Places Act 1993*	Permission required if listed heritage places or related objects are to be destroyed / disturbed
DEW	*National Parks and Wildlife Act 1972*	'Taking' of protected plant and animal species
DEW	*Native Vegetation Act 1991*	Removal of native vegetation and achievement of significant environmental benefit (SEB)
DEW	*Crown Land Management Act 2009*	Provision for the disposal, management and conservation of Crown Land in South Australia.
DEW Limestone Coast Landscape Board	*Landscape South Australia Act 2019* (including associated Water Allocation Plans and Water Affecting Activities Control Policy)	• Management of pest plants and animals. • Water sourcing (e.g. from new bores) and licensing of water extraction. • Water affecting activities.
Attorney-General's Department – Aboriginal Affairs and Reconciliation	*Aboriginal Heritage Act 1988 (SA)* *Coroners Act 2003 (SA)*	Authorisation required if Aboriginal sites, objects or remains are to be damaged, disturbed or interfered with. Provides for the discovery of human skeletal remains.
Environment Protection Authority (EPA)	*Environment Protection Act 1993* (including all Environment Protection Policies (EPP) e.g. *Environment Protection (Water Quality) Policy 2015*)	General environmental duty to avoid causing environmental harm • Protection of water quality • Licensing of scheduled / prescribed activities e.g. • establishment of landfill site for waste disposal • transport of prescribed wastes or substances • producing listed wastes • storage or production of large volumes of petroleum (2,000 m^3 storage or 20 tonnes per hour production) • fuel burning at a rate of heat release exceeding 5 megawatts • injection of fluid containing antibiotic or chemical water treatments at a rate of more than 50 kL / day.

Agency	Legislation	Issue
Environment Protection Authority (EPA)	*Radiation Protection and Control Act 2021*	Control of activities related to radioactive substances and radiation apparatus, and for protecting the environment and the health and safety of people against the harmful effects of radiation.
Attorney-General's Department	*Native Title (South Australia) Act 1994*	Matters relating to traditional land rights in South Australia. The Act provides for the registration of native title rights, investigations on native title rights, claims and determinations of native title rights and compensation for acts affecting native title rights.
Safework SA	*Explosives Act 1936*	Regulates the manufacture, carriage, storage, import and purchase or explosives.
Safework SA	*Dangerous Substances Act*	Regulates the storage, handling and transport of dangerous substances
Safework SA	*Work Health and Safety Act 2012*	Identifies control measures to be applied to specific work activities and hazards.
Attorney-General's Department	*Planning, Development and Infrastructure Act 2016*	Regulates and facilitates development within the State of buildings, infrastructure, facilities and environments that will benefit the community.

Other legislation of particular relevance to the proposed activities includes:

- *Fire and Emergency Services Regulations 2021* – in relation to fire bans and hot work permits.
- *South Australian Public Health (Wastewater) Regulations 2013* – in relation approvals for waste water (sewage) disposal and the operation of septic tank systems.

EPBC Act

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

In regard to petroleum activities in the onshore Otway Basin, issues that potentially require approval under the EPBC Act are relatively limited and can generally be avoided by site selection and implementation of appropriate field procedures.

Beach Energy's will continue to review proposed activities against the EPBC Act matters and will submit a referral under the Act for specific activities if necessary.

Native Vegetation Act and Regulations

The South Australian *Native Vegetation Act (SANV Act)1991* and the *Native Vegetation Regulations 2017* apply to vegetation clearance for petroleum operations. Under Regulation 14 of the *Native Vegetation Regulations 2017*:

1. Clearance of native vegetation incidental to operations authorised under the PGE Act is permitted if it is undertaken in accordance with—

a. a management plan, approved by the Native Vegetation Council for implementation, that results in a significant environmental benefit; and

b. in the case of operations authorised under a Mining Act—a management plan under that Act; and

c. in the case of operations authorised under the *PGE Act2000*—a statement of environmental objectives under that Act.

2. Subregulation (1)(a) does not apply if the person undertaking the activities or operations (or a person acting on the person's behalf) has made a payment into the Native Vegetation Fund of an amount considered by the Council to be sufficient to achieve a significant environmental benefit in the manner contemplated by section 21(6) or (6a) of the *SANV Act*.

Guidelines have been developed to provide a framework for determining the significant environmental benefit (SEB) requirement or the amount for payment into the Native Vegetation Fund. These guidelines are administered by DEM, who have delegated authority to approve SEBs.

A requirement to achieve a SEB where required will be included in the accompanying SEO.

Environment Protection Act

The *Environment Protection Act (EP Act) 1993* imposes a general environmental duty not to undertake an activity that pollutes or might pollute the environment unless all reasonable and practicable measures have been taken to prevent or minimise any resulting environmental harm.

Environmental authorisations are required to undertake activities prescribed under the EP Act. Beach Energy holds a licence (number EPA23644) for the Katnook Gas Plant (Allotment 2 Argyle Rd Monbulla) that currently covers the following prescribed activities:

- 1(5)(b) Petroleum Production, Storage or Processing Works or Facilities
- 3(4) Activities Producing Listed Wastes.

The Environment Protection Act also imposes an obligation to report incidents causing or threatening serious or material harm, to the EPA where applicable, in accordance with Sections 83 and 83A of the EP Act.

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

3 Production Operations

This section provides a description of production operations and associated activities that are currently being or likely to be carried out by Beach Energy in the onshore Otway Basin in South Australia.

Production operations have been grouped under the following categories:

- production facility (Katnook Gas Processing Facility)
- well operations and well integrity management
- field production and processing
- gathering systems (pipelines)
- construction depots / camps
- access tracks and pads
- waste management
- decommissioning and rehabilitation.

Production-related operations can potentially be undertaken under a number of different types of licence under the P&GE Act 2000 including Petroleum Production Licence (PPL), Petroleum Retention Licence (PRL), Petroleum Exploration Licence (PEL) (e.g. extended production tests) and Pipeline Licence (PL). an overview of Beach's licence areas in the South Australian onshore Otway Basin are displayed in Figure 2. Beach Energy currently holds the following licences in the area:

- PPL 62 (100% Beach owned) covering the Katnook and Ladbroke Grove gas plants and the Katnook, Ladbroke Grove and Haselgrove fields
- PPL 168 (100%) (Redman field)
- PPL 202 (100%) (Haselgrove South and Ladbroke Grove South fields)
- PRL 1 (100%) (Wynn field)
- PRL 2 (100%) (Limestone Ridge field)
- PRL 32 (ex PEL 255) (70%)
- PL 19 (Jacaranda Ridge-2, Limestone Ridge-1, Wynn-2 and Haselgrove South-2 pipeline network)
- PEL 494 (70%)
- PEL 680 (70%).

The status of production wells in the Beach licence areas listed above is shown in Table 2.

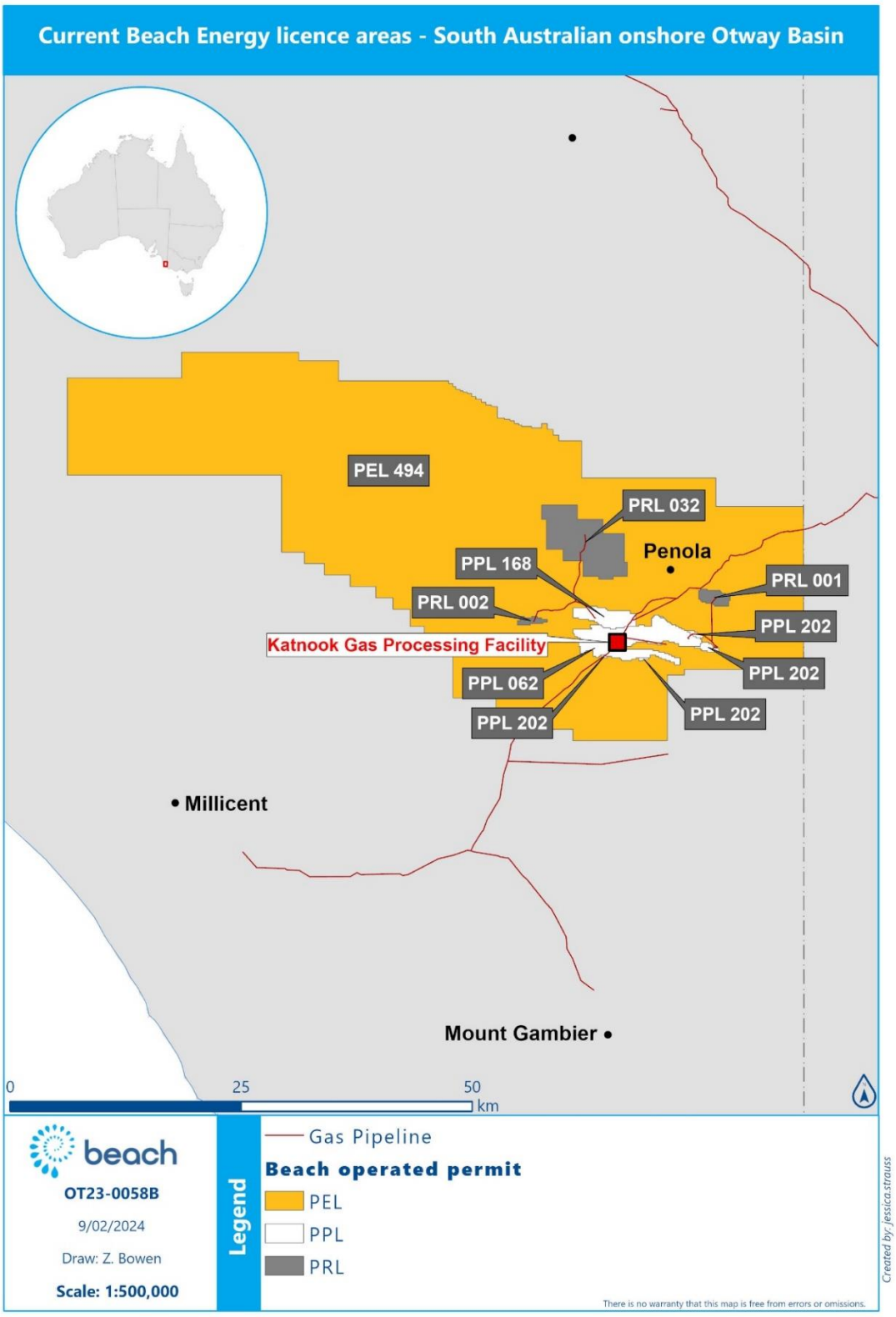

Figure 2: Beach Energy licence areas - onshore Otway Basin, South Australia

Table 2: Status of production wells in Beach Energy licence areas - South Australian onshore Otway Basin

Permit	Well	Status
PRL 32	Hollick-1	Shut-in
PRL 32	Jacaranda Ridge-2	Shut-in
PRL 32	Patrick-1	Shut-in
PPL 62	Haselgrove-1	Shut-in
PPL 62	Haselgrove-2	Shut-in
PPL 62	Haselgrove South-1 DW1	Shut-in
PPL 202	Haselgrove South-2	Shut-in
PPL 62	Haselgrove-3 ST1	Shut-in
PPL 62	Haselgrove-4 ST1	Shut-in
PPL 62	Katnook-1	Shut-in
PPL 62	Katnook-2	Plugged & abandoned
PPL 62	Katnook-3	Shut-in
PPL 62	Katnook-4	Plugged and suspended
PPL 62	Ladbroke Grove-1	Shut-in
PPL 62	Ladbroke Grove-2	Shut-in
PPL 62	Ladbroke Grove-3	Plugged & abandoned
PPL 168	Redman-1	Shut-in
PRL 1	Wynn-2	Shut-in
PRL 2	Limestone Ridge-1	Shut-in
PEL 494	Dombey-1	Cased and suspended
PEL 494 / 495	Bungaloo-1	Cased and suspended
PRL 13	Kilanoola-1	Shut-in

3.1 Katnook Production Facility

3.1.1 Infrastructure and Process

Gas production was first undertaken at Beach Energy's former Katnook Gas Plant (KGP), which is located on Argyle Rd approximately 10 km south-west of Penola. The Katnook Gas Plant occupies an area of approximately 3 hectares and commenced operating in 1991. The plant received natural gas from the Katnook, Haselgrove, Haselgrove South, Ladbroke Grove South, Redman, Wynn and Limestone Ridge fields and operated until 2011 when the wells were suspended. A gathering system (underground steel pipelines) collected gas from these fields for processing in the gas plant. These pipelines and the Katnook plant were mothballed in 2011 due to declining gas production.

The Katnook Gas Plant was demolished and replaced by the newly constructed 10 TJ/d Katnook Gas Processing Facility (KGPF) in 2020.

The Katnook Gas Processing Facility achieves sales gas specification through the following process:

- Removal of produced formation water by separation and storage in tanks
- Mercury removal
- hydrocarbon and water dew point control through a dew point control unit
- Injection of treatment chemicals to control hydrates, corrosion rates and remove H_2S.
- removal and stabilisation of condensate to storage via separation.

. The gas that is fed into the South East Pipeline System (SEPS), which supplies gas to the local region, is currently obtained via the South East South Australia (SESA) pipeline, owned by the APA Group, which runs from Poolaijelo in Victoria to Katnook.

The Ladbroke Grove Gas Plant is located directly adjacent to the Katnook Gas Plant at the Katnook site and commenced production and processing operations in 2000. Ladbroke Grove originally processed high CO_2 natural gas from the Ladbroke Grove gas field, however operations were suspended in December 2006, when the Ladbroke Grove power station which it supplied was converted to use gas from the SESA pipeline. Origin Energy's 86 MW Ladbroke Grove power station is located adjacent to the Katnook and Ladbroke Grove gas plants, and it provides peaking power from its gas-fired turbines during periods of high demand for electricity. Ladbroke Grove Gas plant was demolished as part of the construction of the new Katnook Gas Processing Facility in 2020.

The Katnook Gas Processing Facility and adjacent infrastructure is shown in Figure 3.

Figure 3: Katnook Gas Processing Facility and surrounding facilities

In 2017 Beach Energy drilled and subsequently tested a conventional gas reservoir at Haselgrove 3 ST-1. As part of the development of the Haselgrove 3 ST-1 well, Beach Energy constructed the new Katnook Gas Processing Facility (KGPF) to process up to 10 terajoules per day of gas.

The main processing equipment and processes for the Katnook gas processing facility includes: inlet separator, filter coalescer, hydrogen sulphide (H_2S) removal, mercury removal, dew point control, methanol hydrate suppression, dehydration and filtration. Processing by-product gas not suitable for sale will be flared to atmosphere via a vertical flaring system.

A pressure relief system is provided for both plant venting and emergency relief. During any process anomalies or emergency situation, gas in the plant can be sent directly to the flare.

Produced formation water (PFW) is stored in bunded tanks and transported off-site to an EPA licensed disposal location.

During gas processing, small quantities of gas are regularly flared to atmosphere as part of the routine operation. Depressurisation and other maintenance activities that vent or flare gas occur on an as-required basis.

Condensate produced with the gas is stored on-site before being transported at regular intervals by road tanker to a refinery for processing or disposal as waste if sales specifications are not met.

Bunds are provided for each area of hydrocarbon storage. These bunds will have closed drain valves and liquid potentially containing hydrocarbons is manually routed from the bunds to hydrocarbon separation sumps with separated water directed to the stormwater pond. There is a separate closed drain system which gathers regularly used process drains which are directed to self-contained sumps for removal via vacuum truck. Sumps have been constructed using corrosion resistant materials such as fibre reinforced plastic, and / or concrete and have level indication to indicate capacity and can be emptied via a vacuum truck. Bunds have been designed with an overflow capacity and can be directed to a stormwater pond if necessary.

Routine operational activities at the site typically involve two personnel, with the site staffed on an eight hours / day, five days / week basis. The plant is designed for remote and automated operation.

Gas is processed to meet sales gas quality specifications and is fed into the South East Pipeline System (SEPS) which supplies gas to the local region. The expected composition of sales gas processed at the facility is methane (91.2 mol%), ethane (2.8 mol%), propane (0.6 mol%), butane and residuals (0.2 mol%), carbon dioxide (4.7 mol%) and nitrogen (0.5 mol%).

A schematic of the processing infrastructure at the Katnook Gas Processing Facility is provided in Appendix B.

The refurbishment of the Katnook facility was designed to Australian standards, and incorporated appropriate Beach Energy and / or project design standards and specifications, with design to meet or exceed good industry practice. The Basis of Design for the refurbishment referenced all applicable codes, standards and regulations relevant to the construction.

The Ladbroke Grove gas plant equipment was also removed from the site as part of the decommissioning activities, in accordance with the practices outlined in Section 3.8.

3.1.2 Evaporation Ponds

Production and processing of conventional gas at the Katnook site generates relatively low volumes of produced formation water (PFW) from the targeted reservoirs. Produced formation water is one of the first by-products to be separated from the gas supply chain to the process facility. PFW disposal at the Katnook site has historically been to evaporation ponds. As noted above, PFW is now stored in bunded tanks and transported off-site to an EPA licensed disposal location.

One of the former KGP evaporation ponds was removed during the refurbishment of the site. The remaining pond has been retained to provide a reservoir for overflow of stormwater from bunds or sumps, and to provide additional water storage (e.g. for hydrotest water). The pond at Katnook has a holding capacity in the order of one megalitre.

The pond may be upgraded in future if the integrity of the liner is assessed as not being suitable for continued use. This may include the removal of the current liner (including sludge), followed by re-lining with a double membrane. Upgraded ponds, or new ponds, would be designed and constructed with regard to EPA Guideline *509/19 Wastewater lagoon construction*. The removed liner and sludge will be sent to an appropriate licensed facility for disposal. Additional groundwater monitoring bores may also be installed for leak detection and to monitor groundwater quality. Monitoring of pond water quality and freeboard is carried out regularly.

3.1.3 Condensate Handling

Condensate produced with the gas is stored on-site at the Katnook Gas Plant before being transported at regular intervals by road tanker to a refinery for processing or disposal as waste if sales specifications are not met. Safe transportation of the condensate from the facility to the delivery point is the prime responsibility of the transporters, under the *Dangerous Substances Act 1979* and the *Environment Protection Act 1993*. Suitably licensed, trained and experienced contractors are used to transport condensate.

3.1.4 Plant Amenities

The Katnook facility treats its domestic wastewater with an Envirocycle wastewater system that treats sewage and sullage in an underground tank constructed of concrete. A monitoring system is located within the unit. The unit at Katnook has a large redundancy built into the system to avoid overflow. The system is monitored and maintained on a quarterly rotation. During normal operations at the facility, there will be a small number of staff using the system and overflow is not anticipated. A high-level alarm is present on the system. Treated wastewater is periodically collected by tanker and transported to a licensed disposal facility or irrigated in accordance with appropriate approvals.

Beach Energy maintains a water licence (#9085) under the Water Allocation Plan (WAP) for use of groundwater resources for industrial purposes in the area surrounding the Katnook facility. Beach Energy is currently licensed to extract 110 ML per annum from the 3A Zone management area under the WAP.

Power is supplied through existing substations and powerlines at the facility location.

3.1.5 Fuel and Chemical Storage and Handling

A variety of fuels and chemicals are required for production operations and include fuel, lubes, oils, methanol, corrosion inhibitor and H_2S scavenger chemicals and solvents. 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 including AS 1940, EPA guideline 080/16 *Bunding and Spill Management* and the Australian Dangerous Goods Code. Typically fuel and chemicals are stored in approved tanks and / or containers in appropriately lined bunded areas or on bunded pallets.

3.2 Well Operations and Well Integrity Management

A range of activities related to the operation of wells may be carried out on well sites during the life of a production well. These include, but are not limited to, completions for production, workovers, installation and operation of artificial lift, wellhead production skids, gas well deliquification and ongoing well monitoring and integrity management. These are described in the following sections.

Well design and construction, and operation and decommissioning are undertaken in accordance with management systems that specify detailed requirements. Beach Energy maintains a Well Engineering and Construction Management System (WECS) which identifies the 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 abandonment). 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 Energy'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 WECS Standards and WIS, and are responsible for the application of these standards for all design work and operations that they undertake, supervise, report, verify or approve.

3.2.1 Completions and Workovers

Completion activities to prepare the well for production commence after the well has been drilled, cased and cemented and the wellhead installed. Completion activities generally commence soon after drilling but may be delayed for longer periods (e.g. if the well is cased and suspended for future production). Some examples of completion activities that may be undertaken include:

- cleaning out the casing of any fill, or to confirm wellbore access.
- perforating the casing to access the gas to be produced.
- setting packers downhole for the installation of tubing or plugs to isolate non-commercial reservoir zones.
- installation of wellhead valves to control the flow of hydrocarbons.
- cased hole logging and gradient / pressure surveys for evaluation of either wellbore construction elements or reservoir property evaluation with time.

Workover operations with a service rig may also be carried out on a well after the initial completion. They may include but not be limited to:

- repairing, replacing or installing artificial lift systems with either like-for-like repairs or upgrading to a different lift system as well parameters change with time.
- cleaning sand out of the well from debris / sand / backfill.
- isolation of zones, which may be required due to factors such as:
    - watered out zones.
    - non-commercial zones.
    - in preparation for final decommissioning by isolating formations.

    - well integrity purposes to reduce risks to as low as reasonably possible.

- zone changes in a multi-zone well that has the ability to open and close sleeves to access different formations or combinations of formations.
- repairing corrosion by replacement of equipment or engineered patches.
- deepening the wellbore to access previously un-accessed formations.
- fishing to recover objects from the wellbore and / or milling obstructions in the well.
- perforating / re-perforating new or existing zones to improve or increase production.

Some well interventions do not need a service rig and require either a smaller unit of slickline and / or wireline equipment to conduct various cased hole operations, such as perforating or setting a plug as mentioned above. In some instances. the use of a coiled tubing unit is necessary to enter a live wellbore under pressure to perform an operation similar to that of a service rig, but without having to fill the well full of fluid. Pumps and storage tanks are used for operations that need to circulate workover fluids in / out of the well.

3.2.2 Well Integrity Management

To assess and maintain the reliability of wells, Beach Energy has implemented a well integrity testing and monitoring program. The intent of this program is to maintain wells in a fit-for-purpose condition and to protect the environment and people.

The well integrity management process governs the operation and maintenance of wells throughout their lifecycle and includes routine visits to evaluate barrier integrity. Following inspection, the asset data is reviewed, and any wells identified with an elevated risk level undergo a detailed assessment. The outcomes of the risk assessment form the basis of an asset strategy plan, and integrity check frequencies may be modified and scheduled based on the level of risk assigned. Alternatively, the well analysis may generate recommendations to perform a well repair or suspension and / or decommissioning prioritisation. If a high-risk issue is identified, repair or decommissioning activities are to be undertaken as soon as practicable.

3.2.3 Wellhead Production Equipment

Gas wells typically have a wellhead production metering skid and a safety shutdown valve installed on the well lease, immediately downstream of the wellhead. Gas from the well passes through the wellhead production and metering skid before flowing into a gathering system (pipeline) for transport to Katnook.

A wellhead production metering skid may include any or all of the following equipment:

- auto controlled choke.
- pressure safety valve.
- over pressure protection systems.
- Emergency Shutdown (ESD) equipment.
- a meter run and flow recording device.
- corrosion inhibitor and other chemical injection facilities (e.g. methanol and H_2S scavenger).
- telemetry transmission which relays wellhead pressure, flow, temperature and choke position to remote control and monitoring locations.

Corrosion inhibitor may be added at the wellhead dependent on CO_2 content of the reservoirs. All well sites will be surrounded by security fencing which is kept locked. Signage will also be erected at all sites.

Plate 1: Typical well site

3.2.4 Gas Well Deliquification

As natural gas flows at a high rate to the surface of a producing well, a liquid mist is brought up with the gas, and begins to build up on the inner lining of the production conduit. The result of this water build-up within the well slows down the production rate. Once this water builds up at the bottom of the well, the pressure is severely reduced, slowing down production, or halting it altogether. As productivity declines in gas wells, they often require unloading of this reservoir fluid (primarily water) that has accumulated in the well and created a static column preventing it from flowing continuously. Deliquification typically involves unloading the liquids in the well's production tubing by expelling the gas via short-term controlled venting and flowing the liquids to a bunded tank. This allows the well to continue to flow for longer periods of time. When a well requires frequent unloading it may become a candidate for measures such as installation of a smaller diameter tubing or artificial lift depending upon the economics of the project and remaining reserves in place.

These measures may include:

- velocity string - small internal diameter (ID) tubing, which increases the velocity of the produced fluid moving up hole which can continuously unload the well.
- plunger lift, which uses bottom hole pressure to lift a plunger from downhole inside the tubing to the surface to push liquid out of the tubing.
- micro-strings, which are a small diameter tube used to inject foamers into a wellbore close to the perforations and help to reduce friction and unload water. Foamer / surfactant selection and dosage rate would be based on the type of the fluids to be foamed, downhole temperature and pressure, the environmental properties of the chemical and corrosivity of the foamer.

Where possible, the gas stream mix may be flared depending on the gas / fluid ratio, however often the stream is too wet to ignite. In these cases, unloading of wet gas streams to a bunded tank is performed in a controlled manner down a blowdown line, for a brief duration until optimum flowline pressure can be re-established, then the well is typically diverted back to inline flow.

Beach Energy may deliquify a production well based on production capability against flowline pressure.

3.3 Field Production and Processing

Gas produced at well sites typically flows to the Katnook facility via a system of pipelines for processing at the Katnook site.

However, during extended production tests that are conducted to evaluate new gas discoveries, gas wells that are not close to an existing gathering network may be flared to allow reservoir parameters and commerciality to be established. This is typically undertaken soon after drilling and is typically covered by the relevant drilling SEO. Additional equipment at the well site may be required for this process, including pipework and equipment for metering and gas sampling. A flare tank is generally used, however if a more extended production test is planned, gas may be transferred to a mobile, vertical flare.

Beach Energy is also considering the possibility of production and limited processing at the well site in some circumstances. This could involve water, hydrocarbon liquid and mercury removal, and compression of gas suitable for delivery to customers via compressed natural gas (CNG) road transport. Any equipment installed will be designed, installed and tested in accordance with Australian standards, incorporate appropriate Beach Energy and/or Project design standards and specifications, with design to meet or exceed good industry practice.

3.4 Gathering Systems (Pipelines)

A gathering system of underground steel pipelines collects gas from the Katnook, Haselgrove, Haselgrove South, Ladbroke Grove South, Redman, Wynn and Limestone Ridge fields (see Figure 4). These pipelines are currently suspended. Pipeline dimensions and lengths are summarised in Table 3.

Table 3: Existing Beach pipelines in the onshore Otway Basin

Name	Material	Diameter	Length
Ey Lane (Jacaranda Ridge-2) to Redman	Steel	100 mm	10 km
Limestone Ridge to Ey Lane Redman Interconnector	Steel	80 mm	4.8 km
Redman to Katnook Gas Plant	Steel	80 mm	3.5 km
Wynn pipeline	Steel	80 mm	4.8 km
Ladbroke Grove field to Ladbroke Grove Gas Plant	Steel	150 mm	3.4 km
Haselgrove South-2 to Haselgrove South-1	Steel	80 mm	4.0 km
Katnook-2 to Katnook Gas Plant (in-situ abandoned)	Steel	100 mm	0.9 km
Haselgrove South-1 to Haselgrove-3 tie-in	Steel	100 mm	7.0 km
Haselgrove-1 flowline	Steel	100 mm	1.1 km
Haselgrove-2 flowline	Steel	100 mm	0.5 km
Haselgrove- 3 tie in to Katnook Gas Plant	Steel	100 mm	6.2 km

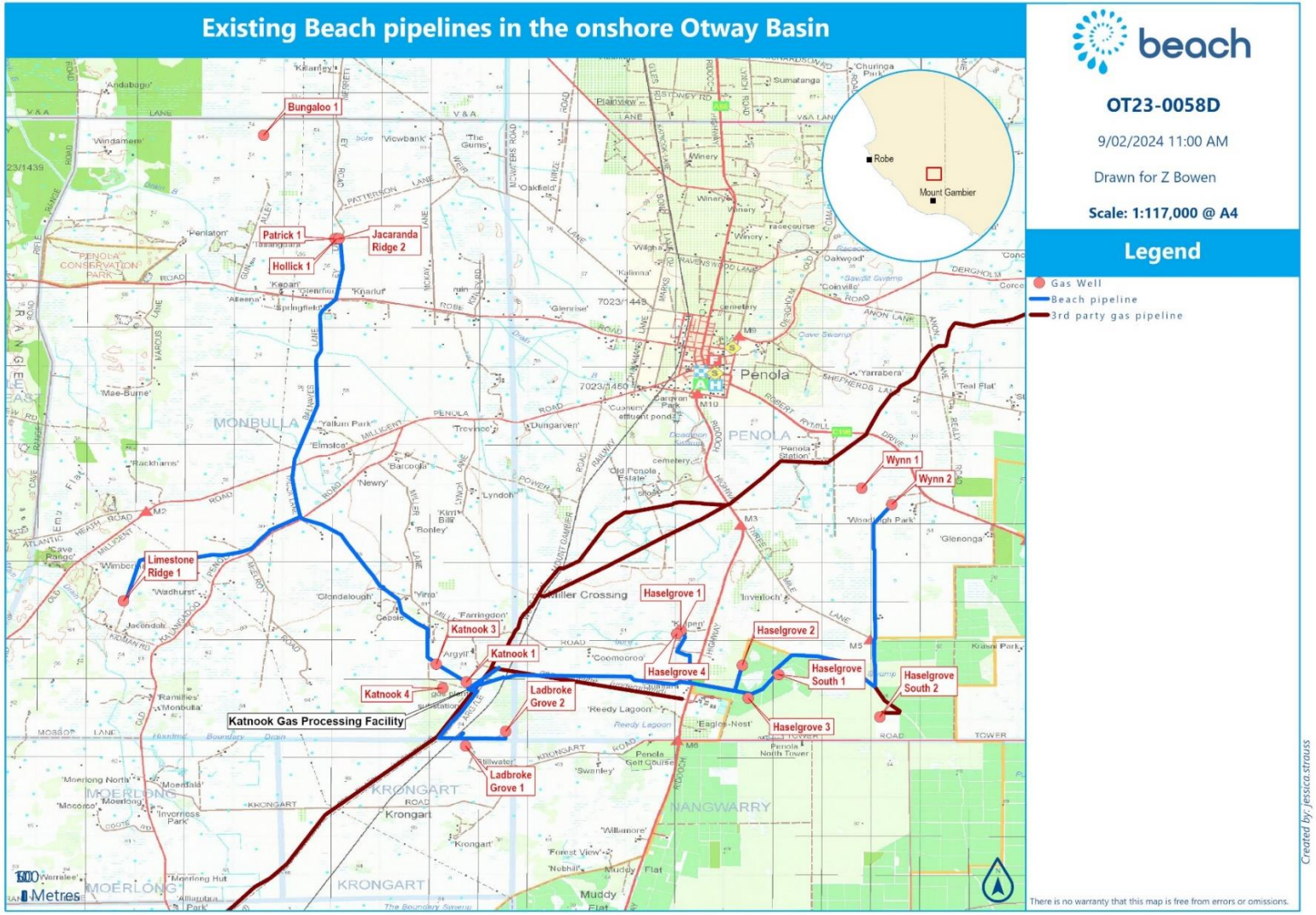

Figure 4: Existing Beach pipelines in the onshore Otway Basin, South Australia

Pipelines are typically constructed of steel and installed below ground, however, could also be constructed using buried stick glass reinforced epoxy (GRE) or spoolable composite pipe[3].

Optic fibre cable may be installed with buried pipelines, to improve operations and monitoring. In addition to underground pipelines from well site to facility, above-ground steel piping and control infrastructure is installed at well sites as noted in Section 3.2.3.

All pipeline design, construction, operation and decommissioning are undertaken in accordance with relevant Australian Standards (AS), in particular:

- AS 2885 Series - Pipelines – Gas and Liquid Petroleum.

3.4.1 Pipeline Construction

Pipelines are installed using standard construction practices which will be in accordance with the Australian Pipelines and Gas Association *Code of Environmental Practice – Onshore Pipelines* (APGA 2022). Pipeline construction will typically follow the sequence outlined in Table 4 with an example shown in Plate 4 (a, b, c).

Table 4: Typical pipeline construction sequence

Construction Activity	Description
Detailed Survey	Extensive consultation with land holders, and engineering, environmental and cultural heritage surveys are used both in route selection and to determine if any special construction techniques or mitigation measures are required. Once the preferred pipeline route has been determined, the centreline is surveyed, and engineering aspects are finalised. Markers (pegs) are placed to identify pipeline route and right-of-way (ROW).
Fencing	If required, construction gates are installed in fences.
Clear and Grade	Graders and bulldozers are used to clear the ROW of vegetation and topsoil ready for construction to commence. Vegetation and topsoil are stockpiled separately on the ROW. Topsoil is typically graded to a depth of 100 to 150 mm for a blade-width over the trench line, or the entire non-working side or the full ROW, depending on factors such as the soil type, terrain, construction requirements and weather conditions. The width of the ROW depends on the pipeline diameter, terrain and land use constraints but is typically in the order of 15 – 20 m. Additional width may be required in some areas to allow room for laydown of pipe and equipment and to allow trucks and vehicles to pass locations where construction is being carried out.
Trenching	After the route is cleared, a trench (approx. 1 m in depth but up to 2m deep where additional cover is required) is dug for the pipeline either by a trenching machine or excavator. Trench spoil is stockpiled on the ROW, usually on the non-working side.
Stringing	Steel pipe is trucked to the construction site and sections, each approximately 12 m long, are laid end-to-end next to the trench. Pipe sections are placed on sandbags that are raised on blocks or wood (timber skids), to protect the pipe from corrosion and coating damage. Stick GRE is transported to the construction site and sections, each approximately 9 m long, are laid end-to-end next to the trench. Spoolable composite pipe is supplied on large reels and is transported to locations along the alignment on a carousel located on a truck. Pipe is typically pulled off the carousel and placed directly in the trench as discussed under 'Lowering-in' below but alternatively may be laid out alongside the trench.

[3] The use of GRE or spoolable composite pipe would require that risk from external interference is demonstrated to be appropriately mitigated in accordance with Australian Standard AS 2885.

Construction Activity	Description
Bending	Where required, steel pipe sections are bent to match changes either in elevation or direction of the route. The natural roping radius of SGRE pipes is generally used for changes either in elevation or direction of the route. Bends in flexible spoolable pipe are kept within the limits of the minimum operating bend radius.
Welding / Joining	Steel pipe sections are welded together. SGRE pipelines do not need welding as pipe sections are joined together by screwing male-female ends together. Spoolable composite pipe joins typically use proprietary steel joiners.
X-raying	Pipes are inspected using x-ray equipment as per AS 2885.2.
Joint Coating	The area around the weld on steel pipes is wire-brushed or grit blasted and coated with a protective coating to reduce corrosion
Padding	Where required, padding machines are used to sift the excavated subsoil to remove coarse materials. To protect the pipe coating the remaining fine material is used to pad beneath and on top of the buried pipe. In some instances (e.g. very rocky soils) imported sand or foam pillows are used for padding.
Lowering-in	Sidebooms (bulldozers with cranes) or excavators are used to lower welded steel pipe into the trench. For SGRE the majority of the pipe will be installed using over the trench assembly machines. The pipe will be made up over the trench and as the machine is moved forward the pipe continuously lowered into the trench. Spoolable pipe is deployed from a hydraulically powered spooling fame and is typically pulled directly into the trench using mobile plant. Alternatively, the pipe may be rolled out alongside the trench and continuously lowered into the trench using excavators or sidebooms.
Backfilling	Trench spoil is returned to the trench and material compacted to minimise risk of subsidence of material over the pipe.
Pressure Testing	Pipeline integrity is verified using hydrostatic testing in accordance with AS 2885.5 - 2008. During hydrostatic testing the pipeline is capped with test manifolds, filled with water and pressurised up to 125% of maximum allowable operating pressure for a minimum of two hours. A 24-hour leak test then follows. Hydrotest water is sometimes treated with chemicals such as biocide, oxygen scavengers and corrosion inhibitors prior to testing. Providing it meets water quality guidelines and has landholder approval, hydrotest water may be discharged to the surrounding environment. If water does not meet quality guidelines it will be treated prior to disposal (e.g. by chemical neutralisation) or disposed in a pond at the Katnook Gas Plant or removed off-site for disposal at an approved / licensed facility.
Restoration and Rehabilitation	The easement is recontoured to match surrounding landform and erosion controls constructed where appropriate. Separately stockpiled topsoil is then respread evenly across the easement and any cleared vegetation placed across the easement, to assist in soil retention and provision of seed stock. Reseeding or revegetation of the easement, using appropriate species (i.e. crops/pasture or indigenous native species) is undertaken to restore vegetation cover.
Cathodic protection	Installation of cathodic protection system for steel pipelines including buried anode bed(s) and above ground test posts.
Signage	Information signs are erected along the easement as per AS 2885.1.

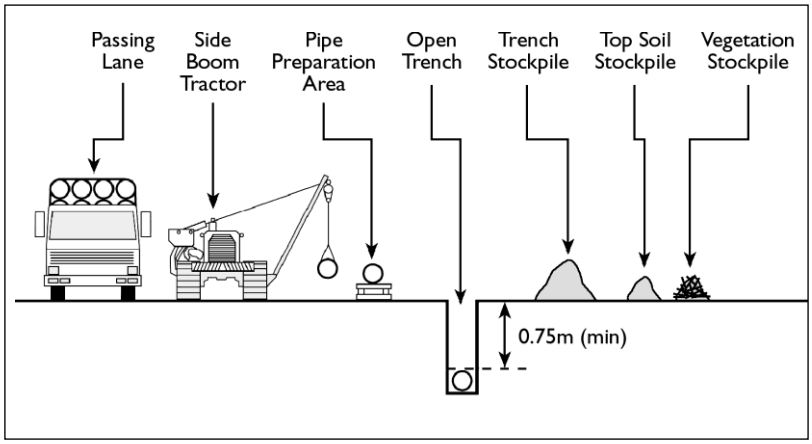

Figure 5: Typical construction of ROW layout for buried steel pipeline installation

Plate 2 (a): Pipeline construction examples for previous onshore Otway Basin pipelines

Plate 3 (b): Pipeline construction examples for previous onshore Otway Basin pipelines

Plate 4 (c): Pipeline construction examples for previous onshore Otway Basin pipelines

Road crossings will be carried out in accordance with AS 2885 and local council or Department of Infrastructure and Transport (DIT) requirements.

Bitumen roads are likely to be crossed by boring or horizontal directional drilling.

Boring is commonly used to install pipelines beneath infrastructure such as roads, railways, buried utilities and, in some circumstances, watercourse crossings. This is a low impact technique involving drilling short distances from below ground within an enlarged trench area, or bell hole, located inside the construction easement.

Horizontal directional drilling (HDD) is generally used to cross features such as major watercourses where standard open cut methods are not feasible. Mini-HDD rigs are commonly used for road crossings. The installation of the pipeline by HDD involves drilling a hole at a shallow angle beneath the surface through which the pipe is threaded. Drilling is conducted by a specially designed drill rig, operated by a specialist contractor. A variety of associated equipment and infrastructure is required.

The feasibility of using HDD can be limited by site conditions such as soil stability, slope, access, available workspace and the nature of subsurface rock. Horizontal directional drilling may reduce above ground impacts, however the technique can introduce additional environmental considerations such as drill site sediment control, waste management, noise and increased duration of construction and workforce numbers. To address these issues, site specific management procedures are generally prepared prior to drilling, particularly for long horizontal directional drills.

3.4.2 Pipeline Operation

Pipeline operation and maintenance is approached in a systematic manner over the life of the assets, in accordance with AS 2885. Inspection and monitoring of pipelines are carried out and operating procedures are followed to ensure that they are operated within their design capability. The Safety Management Study (SMS) and remaining life assessments are periodically reviewed, in accordance with AS 2885 requirements.

The pipeline easement is reinstated and restored as soon as possible after pipe laying, testing and backfill. This involves removal of all construction generated waste, re-contouring of the site, re-establishment of natural drainage lines, bank restoration (if necessary), topsoil respreading and replanting of any cleared vegetation. Following reinstatement and revegetation of the construction right-of-way, very little above-ground infrastructure will be visible. Above ground infrastructure along the pipelines is generally limited to marker posts to identify the location of the pipelines. Pipework and associated infrastructure will typically be present only at the start and end of the pipelines. Pipelines may also include a cathodic protection system which consist of buried anode beds and above ground test points located at intervals along the pipeline and connected to it by electrical cables. Cathodic protection test posts are usually located on fence lines to reduce impact to land use.

Environmental impact associated with operating gas pipelines is negligible and is generally associated with access and potential emissions (venting).

A routine operation and maintenance program is implemented, which includes leak detection surveys, cathodic protection surveys, aerial and / or ground patrols, repair or replacement of faulty pipe or other equipment, pigging and cleaning of the pipelines, in-line pipeline inspections, corrosion monitoring and remediation, and easement and lease area maintenance. Aerial or ground inspections include checking vegetation for discolouration which can be an indicator of a gas leak, detection of erosion, monitoring of rehabilitation success and detection of weed species.

Access to the easement is necessary to follow-up issues identified from inspections. Low level maintenance for erosion, subsidence and weeds may be necessary, particularly during the first 12 months following construction.

More significant maintenance activities, such as dig-ups to address coating defects, are not likely to be required regularly. However, all maintenance activities that may be required are conducted in accordance with the SEO.

Dig-ups involve the excavation of material from around the pipeline (typically referred to as a bell hole), to allow sufficient room for operations technicians to safely undertake any remedial works that may be required. The excavation of material would be undertaken in accordance with management conditions for construction (that is, topsoil will be stockpiled separately from trench spoil, and the site will be restored as soon as practical following completion of maintenance works).

Regular consultation is maintained with landowners whose properties are traversed by the pipeline as per Beach Energy Landholder Management Guidelines.

Environmental management of pipeline construction and operation is consistent with the guidance provided by the Australian Pipelines and Gas Association *Code of Environmental Practice – Onshore Pipelines* (APGA 2022), which has been incorporated in and expanded on in Beach Energy's environmental management procedures.

3.4.3 Pipeline Decommissioning

When they are no longer required, pipelines will be decommissioned in accordance with the legislative requirements and environmental practices of the day. Decommissioning of pipelines is addressed in more detail in Section 3.8.

3.5 Construction Depots / Camps

During potential upgrade works at the Katnook site facility or pipeline installation and well tie in, the construction workforce may consist of approximately 20 people, including project management personnel. In general, no more than 12-15 personnel are expected to be on a work-front site at any given time. Local contractors will be used where feasible (e.g. supply of plant and equipment, concreting, fencing). The workforce would be typically accommodated using existing local accommodation, however a construction camp may be established for some operations, depending on timing, workforce numbers and availability of accommodation.

Camps are typically established in existing areas of disturbance and for work at the Katnook Gas Plant, camp set up would most likely use the area previously established adjacent to the Katnook site. Depots and camps may be set up further afield for other activities (e.g. extended decommissioning operations).

A construction depot would typically be established for the duration of any significant construction activities and is likely to be established at or adjacent to the Katnook Gas Plant.

The construction depot would primarily be used for equipment storage, vehicle lay-down, site office and administration centre, training depot, and a rendezvous point for the crew each morning prior to commencing works. Equipment stored at the construction depot may include construction vehicles, diesel fuel and lubricants (minor storage), vehicle maintenance equipment, sandbags, sediment fencing, star droppers and wooden stakes, plant and equipment components, pipe wrapping materials and pipe.

Potable water for use at camps and operational sites may be obtained from commercial suppliers, landowners or appropriately licensed water bores.

3.6 Access Tracks and Pads

Short access tracks are typically constructed during drilling operations, from the public road to the well site, along an alignment approved by the landowner. In occasional circumstances, there may be a need to establish or modify tracks for production activities.

Access tracks are typically 4 m wide except on bends and at entry and exit points where the width is typically 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. Tracks are maintained for the life cycle of the asset before

appropriate rehabilitation in consultation with the landowner and appropriate authorities. If the landowner wishes to retain tracks, they may be handed over under a deed of transfer or similar.

Similarly, when a well becomes commercially viable, the drill pad is retained with an appropriate level of remediation to allow continuous safe and operational access to the wellhead while minimising the environmental impact of the pad to the surrounding area. Security fencing is erected to reduce access from livestock and native fauna and to restrict third party interference.

Pads may also occasionally need to be established or modified during production or decommissioning operations. As described in the Otway Drilling EIR (Beach 2013a), at most 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).

Pads are typically paved with gravel to a depth of approximately 30 cm and constructed so that any runoff from upslope of the pad is directed away from the pad.

If the grass is dry or operations are within the fire season, pads are generally surrounded by a 10 m wide ploughed firebreak.

3.7 Waste Management

Waste management is an important issue and Beach Energy incorporates appropriate waste management practices into the construction, operation and decommissioning phases of its developments.

Beach Energy is responsible for the management of all the wastes it generates and for its disposal in accordance with regulatory requirements and industry standards. Beach Energy follows the principles of the waste management hierarchy as far as possible (Avoid, Reduce, Reuse, Recycle, Recover, Treat, Dispose) and has put measures in place to prevent pollution by reducing the use of energy, water, material resources, and recycling waste where possible.

Waste from operations is generated from two main streams: operational waste and domestic waste (Table 5).

Table 5: Typical waste streams

Waste Type	Disposal
Operational Waste	
Gaseous waste	Flared or vented – gaseous hydrocarbons, CO_2, H_2S, CO Generator and vehicle emissions
Produced formation water	Collected in dedicated tanks for removal and disposal at licensed facility
Pig-receiver / slug catcher scale	Lime scale and sludge collected for transport off-site by a licensed regulated waste contractor to a licensed regulated waste facility for disposal
Contaminated soil / sludge	Soils contaminated with chemicals are to be managed as specified in the Safety Data Sheet (SDS) for the spilt chemical Contaminated soils are to be treated in situ or collected and treated at licensed facilities. Collected for transport off-site by a licensed regulated waste contractor to a licensed regulated waste facility for disposal Ultimate reuse or disposal of treated soil consistent with the principles of the National Environment Protection Measure for contaminated sites and relevant EPA guidelines

Waste Type	Disposal
Hydrotest water	Recycled for each hydrotest section Evaporation pond or to ground if consistent with ANZECC and EPA criteria and has landholder approval
Completions fluids (including water associated with deliquification)	Collected in lined pond or tanks for disposal in evaporation pond or to an appropriately licensed facility
Empty drums – plastic fuel, lubricant and chemical containers	Drums to be transported off-site by waste contractor for reuse, recycling or disposal
Chemical waste (including mercury removal adsorbents)	Stored in accordance with Australian Standards and EPA guidelines in bunded areas for transport off-site by a licensed regulated waste contractor to a licensed regulated waste facility for recycling or disposal
Used pond liner (e.g. HDPE)	Transported to a licensed recycling facility (where possible) or sent for disposal at an appropriately licensed facility
Metals – empty steel drums, bulk scrap steel, pipe, bolts, wire / cables, mini rings	Segregated (stored separately from other waste) metals from other wastes and stored for recycling
Timber pallets (skids)	Recycled where possible
Batteries	Collected for transport off-site by a licensed regulated waste contractor to a licensed regulated waste facility for treatment, recycling or disposal
Workshop waste – filters, rags, grease and lubricants	Recycle where possible and remainder for disposal to EPA licensed landfill Oil and lubricants to be collected and stored in bunded areas awaiting transport off-site by a licensed regulated waste contractor to a licensed regulated waste facility for treatment, recycling or disposal
Domestic waste	
Sewage and grey water	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. Sludge and residue collected by a licensed contractor as required and disposed of at an appropriately licensed facility
General wastes – food waste, food wrappers, plastic bags, packaging	Securely stored in covered bins for regular removal to licensed facility. Rubbish contained and controlled to minimise odours and maintain hygiene
Comingled recyclable material – paper and cardboard, timber pallets, plastics and aluminium cans	Segregated and placed in bins or skips for recycling
Stormwater	Collected in tank bunds and transferred to stormwater pond for evaporation

3.8 Decommissioning / Rehabilitation

When the gas plants, gathering infrastructure and wells have reached the end of their life, they will be decommissioned in accordance with the regulatory requirements and accepted environmental practices of the day. The key steps in decommissioning and rehabilitation are outlined below.

3.8.1 Facilities and Well Sites

Decommissioning of surface facilities and well sites involves the following:

- Wells are securely decommissioned (see Section 3.8.2 below).
- surface structures are removed, and re-used / recycled where appropriate.
- waste is removed, and recycled where appropriate.
- foundations are removed where appropriate or levelled and covered (the standard to which they will be restored will be defined as a result of stakeholder consultations)
- sites are assessed for potential contamination and treatment / remediation is undertaken if necessary.
- water wells or monitoring bores that are no longer required are decommissioned in accordance with *Landscape South Australia Act 2019* (LSA Act) requirements, with appropriate permits in place.
- disturbed areas are re-contoured to approximate pre-existing contours, natural drainage restored and compaction relieved (e.g. by scarification or ripping where appropriate) to promote rainwater infiltration and enhance seed capture and germination. Stockpiled topsoil is re-spread. Active re-seeding is undertaken where necessary.

Detailed plans would be developed in consultation with DEM and relevant stakeholders. This would include the appropriate removal and licensed disposal, in consultation with the EPA, of pressure equipment identified as having the presence of low-level mercury contaminated sludge.

3.8.2 Downhole Decommissioning Following Production

Once a well has reached the end of its productive life, a decision is made on whether to decommission4 the cased wellbore or leave it in a suspended state until it can be decommissioned.

Each well is evaluated individually to design the decommissioning program based on best industry practice to ensure two independent and verifiable barriers are in place. Decommissioning programs are submitted to DEM prior to implementation. The decommissioning program usually involves the following:

- all perforated hydrocarbon zones are isolated with cement plugs and / or mechanical plugs.
- bond logs, if conducted, are evaluated to ensure that the cement behind the production casing is adequate to avoid crossflow of 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 aquifers with other aquifers or hydrocarbon producing zones.
- pressure testing and / or negative inflow testing is performed on barrier envelopes / components where feasible.
- inhibited fluid is placed between barriers where applicable.

[4] Decommissioning of wells is equivalent to 'abandonment', which is the technical term used in the Petroleum and Geothermal Energy Regulations.

- final well decommissioning at the surface will involve a surface cement plug and cutting or removing the wellhead to below natural ground level.
- an abandonment plaque may be posted (generally on the nearest fence line).

Note: Surface rehabilitation of well sites and downhole decommissioning of wells directly following drilling are governed by the Otway Drilling SEO (Beach 2013b) and are not covered by this EIR or the accompanying SEO.

3.8.3 Pipelines

Pipeline decommissioning is undertaken in accordance with AS 2885.

Currently pipeline decommissioning procedures require the removal of all above ground infrastructure and the restoration of associated disturbed areas.

At the time of decommissioning, a decision will be made regarding the opportunities for future use of the below-ground pipelines. If no longer required, the pipelines will be cleaned (by pigging), purged of gas and allowed to gradually degrade in-situ. If it is considered that the pipelines may offer some future benefits, they will be filled with an inert material and the cathodic protection system maintained to prevent corrosion.

The key steps in decommissioning and rehabilitation are:

- all aboveground pipes and supports are assessed for the condition of the pipe for either salvage or for dismantling and re-use.
- all underground pipe work is cut-off (at a minimum depth of 750 mm below the natural surface or at pipeline depth), removed and blinded below the surface all aboveground signs and markers are removed.
- all pipeline protection systems are removed to allow the pipeline to degrade in-situ.
- pipelines may be filled with grout or another inert material prior to decommissioning where subsidence is a potential issue (e.g. under main roads) (Note: subsidence is not generally an issue with small diameter pipelines such as those that connect wells to the gas plant).
- monitoring and auditing of decommissioned pipelines is undertaken.
- all pipelines which are partially or wholly left in-situ are accurately mapped and recorded.
- records are prepared and submitted to the appropriate authority.

Detailed plans for decommissioning and rehabilitation would be prepared prior to the operations being undertaken. Plans would be developed in consultation with DEM and relevant stakeholders.

4 Existing Environment

This section provides an overview of the environment of the Limestone Coast region of lower south-east South Australia (defined by the LSA Act), with a focus on the region encompassed by Beach Energy's licence areas. Figure 6 shows the petroleum licences owned by Beach Energy in the region and shows surrounding towns, current infrastructure in place and conservation reserves.

4.1 Climate

The climate of the Limestone Coast 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 6.

Table 6: 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	21.1	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	7.0	5.5	5.2	5.4	6.4	7.3	8.9	10.2	8.1
Mean Rainfall (mm)	26.4	18.7	26.2	35.2	54.6	71.9	79.7	80.0	60.9	45.7	36.0	35.9	573.7
Median Rainfall (mm)	18.1	15.8	21.4	29.4	53.0	68.8	76.5	79.2	62.8	42.5	35.3	26.8	541.0
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 Energy 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 5.2°C in the cooler months to 11.8°C in the hottest months.

Average annual rainfall at Coonawarra is 573.7 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 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 33 km to the north of the production licence areas).

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 north of PEL 494 and 32 km north of the most northerly production licence area, 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).

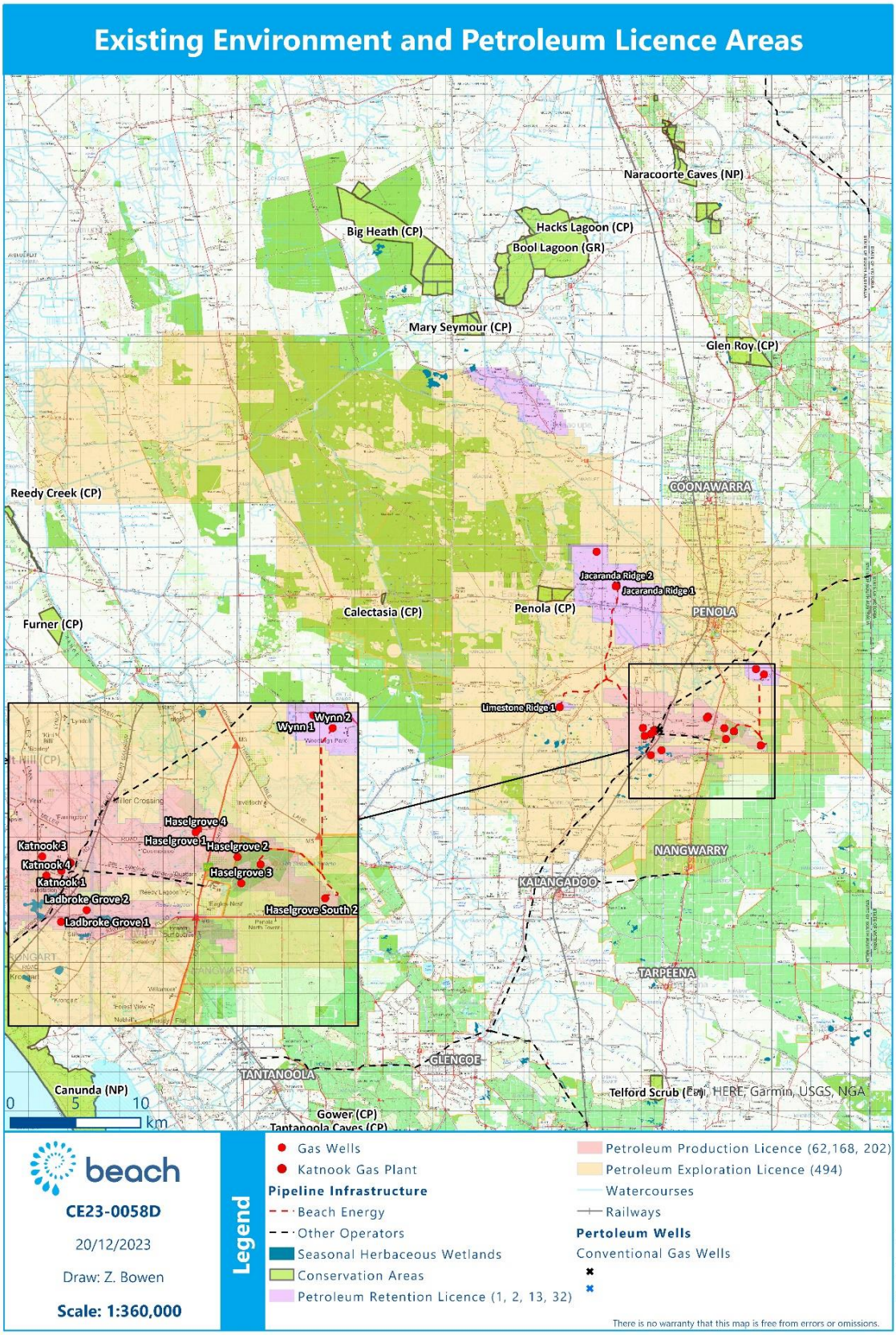

Figure 6: Existing environment and Petroleum Licence Areas

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 Paleozoic igneous rocks and metasediments of the Kanmantoo Fold Belt. Some 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.

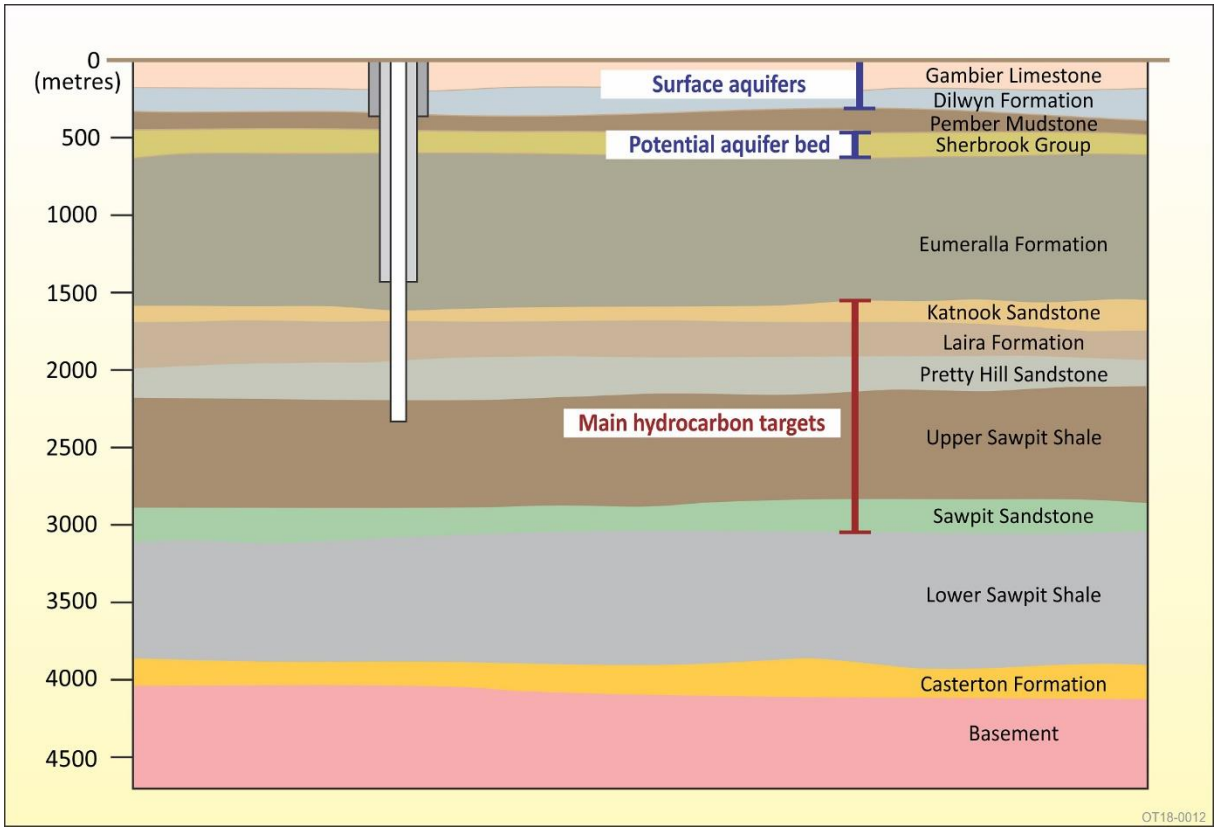

Figure 7: Indicative cross-section in the onshore Otway Basin, showing expected stratigraphy and targets

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 more shallow aquifers.

A period of structural geological activity occurred after the Katnook Sandstone was deposited about 125 million years ago. The surface was uplifted and eroded before this period of 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 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 conventional gas exploration are shown, along with the near-surface aquifers of the Gambier Limestone and Dilwyn Formation.

4.3 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, including the area around Katnook and the production licence area, 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).

4.4 Flora and Fauna

4.4.1 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. 1*999). A list of floristic communities mapped in areas of remnant native vegetation within Beach Energy's licence areas is provided in Appendix A.

At and near the Katnook site the vegetation is open redgum woodland interspersed with shrubs over sedgeland and grassland, which has been used for pasture.

4.4.2 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) 32 km north of the most northerly production licence area 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 (excluding vagrants and seabirds), 8% of the reptiles (excluding sea turtles), 4% of the frogs and 5% of the fish.

4.4.3 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 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. 1*999).

A search of the EPBC Act Protected Matters Database (DEE 2018) identified three nationally listed threatened ecological communities potentially present within the region (

Table 7).

Table 7: EPBC Act-listed threatened ecological communities potentially occurring in the region

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

Source: EPBC Act Protected Matters Database

A review of vegetation mapping indicated that there are potentially three occurrences of seasonal herbaceous wetlands within the production licence area. There are no mapped occurrences of the other two threatened ecological communities within the licence areas (NatureMaps 2018).

The Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains ecological community (referred to as Seasonal Herbaceous Wetlands or SHW) 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).

A seasonal herbaceous wetland is present approximately 150 m south of the Katnook site boundary. This has been fenced to control stock access, particularly when the wetland is filled.

4.4.4 Threatened Flora

The Limestone Coast 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 2018[5]) have been carried out. The initial extent covered all areas within PEL 494 with a 5 km buffer beyond the boundary of the licence area. The second extent covers all areas within the 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 the production and retention licence areas identified a total of 17 flora species listed as rare or threatened at State level; including, one endangered species, 12 rare species and one vulnerable species. There were no records of species listed under the EPBC Act recorded within areas covered by production or retention licences.

Eight plant species that are listed under the EPBC Act have been recorded within the exploration licence area (PEL 494) and these species are listed in Table 8.

Table 8: EPBC Act listed plant species recorded in PEL 494

Species	Common Name	Conservation Status	
		EPBC	SA
Caladenia formosa	Elegant spider-orchid	V	V
Caladenia fulva	Tawny spider-orchid	E	E
Dipodium campanulatum	Bell-Flower Hyacinth Orchid	E	V
Caladenia versicolor	Grampians spider-orchid	V	E
Dodonaea procumbens	Trailing hop-bush	V	V
Glycine latrobeana	Clover glycine	V	V
Thelymitra epipactoides	Metallic Sun-orchid	E	E
Thelymitra matthewsii	Spiral Sun-orchid	V	E

[5] This data has been sourced from the South Australian Department of Environment, Water and Natural Resources Biological Database of SA. Recordset number DEWNRBDBSA180307-1

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

Status: V: Vulnerable; R: Rare; E: Endangered

4.4.5 Threatened Fauna

A search of the BDBSA[6] 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. Further detail on these species is provided in. Appendix A.

A refined search of the production and retention licence areas identified a total of 11 fauna species listed as rare or threatened at State level including one endangered species, 8 rare species and two vulnerable species. There are 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[7] 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.

Nine 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 9. Further detail on these species is provided in Appendix A.

Table 9: EPBC Act listed fauna species recorded or potentially occurring in PEL 494

Species	Common Name	Conservation Status	
		EPBC	SA
Birds			
Botaurus poiciloptilus	Australasian Bittern	E	E
Calyptorhynchus banksii graptogyne	Red-tailed Black-cockatoo, south-eastern	E	E
Rostratula australis	Australian Painted Snipe	E	E
Amphibians			
Litoria raniformis	Southern Bell Frog	V	V
Mammals			
Isoodon obesulus	Southern Brown Bandicoot, eastern	E	V
Miniopterus orianae bassanii	Large Bent-wing Bat/ Southern Bent wing Bat	CE	E

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

4.4.6 Significant Migratory Species

The EPBC Act Protected Matters Report (DEE 2018) identified 13 migratory species listed under the EPBC Act as potentially occurring within the PEL 494 search area. The BDBSA search indicated that four of these species have been recorded in the area, as listed in Table 10.

[6] This data has been sourced from the South Australian Department of Environment, Water and Natural Resources Biological Database of SA. Recordset number DEWNRBDBSA180307-1

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

Table 10: Listed migratory species recorded in PEL 494

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 may occur within area
Myiagra cyanoleuca	Satin Flycatcher	Breeding likely to occur within area
Gallinago hardwickii	Latham's Snipe	Roosting known to occur within area

Source: BDBSA

4.4.7 Introduced Species

4.4.7.1 Weed Species

Sixty-four weed species declared under the Landscape South Australia Act 2019 have been identified for priority management by the Limestone Coast Landscape Board (Limestone Coast Landscape Board 2021b) with the aim to:

- eradicate the species from the region (three species)
- significantly reduce the extent of the species in the region (ten species)
- prevent the ongoing spread of the species in the region (21 species)
- protect key sites/assets by preventing the spread of species (22 species)
- reduce overall impact through targeted pest management (three species)
- reduce overall impact through targeted site management (four species)
- monitor for significant changes in species (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 (LSA Act) Region is provided in Appendix A.

4.4.7.2 Pest Fauna Species

Twenty key pest fauna species have been identified by the Limestone Coast Landscape Board for priority management in the region and all are declared under the *Landscape South Australia Act 2019*. The goal of the Board is to eradicate ten of the species from the region, prevent ongoing spread of two species in the region, protect key sites/assets by preventing 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 (LSA Act) Region is provided in Appendix A.

4.4.7.3 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).

4.5 Water Resources

4.5.1 Surface water

The Limestone Coast region has a low relief, with a general gradient toward the coast of 1: 1,600 and to the north less than 1: 5,000 (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).

4.5.2 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 2013).

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.

4.5.2.1 Tertiary Limestone Aquifer (unconfined)

The unconfined TLA is comprised mostly of Gambier Limestone with a water table depth varying from 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, largely as 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 salinity trigger value of 2% increase per year defined in the Water Allocation Plan (South East NRM Board 2013). 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 2013).

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 revealed a general increase in depth to water, ranging from 0.5 metres to greater than two metres (South East NRM Board 2013).

4.5.2.2 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).

4.5.2.3 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 2013). These aquifers are not used for irrigation, industrial or town water supplies due to their depth and generally high salinity (South East NRM Board 2013). The aquifers within these deeper formations are noted in the Lower Limestone Coast Water Allocation Plan (South East NRM Board 2013) as being of potential value as targets for petroleum and geothermal exploration and production.

4.5.2.4 Groundwater at the Katnook Site

The original groundwater monitoring well network at the Katnook facility was installed from 1995-2015 within and around the Katnook facility, prior to its acquisition by Beach Energy. Groundwater monitoring bores were drilled to a depth ranging from 4.2 m to 6 m. Groundwater depth has varied across the site since the installation of the monitoring bores. A gauging survey carried out in December 2018 measured the groundwater depths ranging

from 3.07 m to 3.62 m below the top of the casing (BTOC). The maximum recorded groundwater depth was 5.83 m (BTOC) recorded in 2008. Seasonal fluctuations in the groundwater levels were observed between 2014 and 2015 investigations, with some of the bores being observed as dry during the 2015 survey. During 2015 sampling of the groundwater bores, there were no contaminants of potential concern identified above applicable guidance values.

As part of the refurbishment of the Katnook facility, a review of the groundwater monitoring network was undertaken in 2019 and a number of the original monitoring wells were removed (Golder 2019). Three of the original groundwater monitoring wells were retained around the pond, with an additional 7 new well installed to monitor potential future groundwater impacts. Of these new wells, 6 are located adjacent to the site boundary and 1 has been established in the central portion of the site. One of the new monitoring wells (KAT-GW3) intersected a previously reported historical (2001) gas condensate contamination site.

All groundwater wells now present at the Katnook site have install depths between 5.5 m and 6 m (Golder 2019). Sampling has occurred biennially since 2019. Standing water levels (SWL) at each of the 10 bores has been found to vary up to 1.5 m due to seasonal water table fluctuations (WSP Golder 2023). The results of the October 2023 chemical analysis of the groundwater monitoring bores are provided in Table 11.

Table 11: Groundwater monitoring network October 2023 sampling results

Analyte	Concentration	Analyte	Concentration
Aluminium	< 0.01-0.03 mg/L	Nitrite	< 0.01 mg/L
Alkalinity as CaCO3 (Total)	319-811 mg/L	Nitrogen (Total)	0.1-44.1 mg/L
Arsenic	< 0.001-0.130 mg/L	pH	7.31-7.84
Barium	0.019-0.052 mg/L	Phosphorus	< 0.01-0.08 mg/L
Benzene	< 0.001-0.022 mg/L	Potassium	< 1-4 mg/L
Beryllium	< 0.001 mg/L	Selenium	< 0.01-0.02 mg/L
Boron	< 0.05-0.08 mg/L	Silicon	13.8-49.6 mg/L
Cadmium	< 0.0001 mg/L	Silver	< 0.001 mg/L
Calcium	41-139 mg/L	Sodium	58-892 mg/L
Chloride	39-951 mg/L	Strontium	0.243-1.12 mg/L
Chromium	< 0.001-0.002 mg/L	Sulphate	< 1-180 mg/L
Cobalt	< 0.001-0.006 mg/L	Thorium	< 0.001 mg/L
Copper	< 0.001-0.003 mg/L	Tin	< 0.001 mg/L
Cyanide (Free)	< 0.004 mg/L	Toluene	< 0.002-0.368 mg/L
Electrical Conductivity	759-5410 uS/cm	Total Anions	9.27-57.1 meq/L
Ethylbenzene	< 0.002-0.63 mg/L	Total Cations	9.34-54.4 meq/L
Fluoride	0.2-0.5 mg/L	Total Dissolved Solids	493-3520 mg/L
Hardness as CaCO3	195-806 mg/L	Total Organic Carbon	< 1-61 mg/L
Iron	< 0.05-6.59 mg/L	TRH C6 – C9	< 0.02-2.77 mg/L
Lead	< 0.001 mg/L	TRH C10 – C14	< 0.05-1.51 mg/L
Magnesium	18-104 mg/L	TRH C15 – C28	< 0.1-0.40 mg/L
Manganese	< 0.001 – 0.648 mg/L	TRH C29 – C36	< 0.05 mg/L
Mercury	< 0.0001 mg/L	Uranium	< 0.001-0.002 mg/L
Molybdenum	< 0.001-0.007 mg/L	Vanadium	< 0.01 mg/L

Analyte	Concentration	Analyte	Concentration
Naphthalene (PAH)	< 0.005-0.012 ug/L	Xylene (Total)	< 0.002-0.175 mg/L
Nickel	< 0.001 – 0.002 mg/L	Zinc	< 0.005– 0.007 mg/L
Nitrate	< 0.01-40.3 mg/L		

Source: WSP Golder 2023

Several of the groundwater monitoring bores show levels of metals, nutrients and inorganic compounds that exceed one or more of the accepted guideline thresholds (WSP Golder 2023), however this is consistent with historical results, and seasonal changes have been observed as a contributing factor for fluctuating results. No petroleum hydrocarbons have been detected in the monitoring bores with the exception of KAT-GW-2 which intersects the historical spill site. Concentrations of petroleum hydrocarbons identified in KAT-GW2 have declined since 2019 (WSP Golder 2023).

4.5.3 Water Use

The most significant user of groundwater in the Limestone Coast region (LSA Act) 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 Limestone Coast area.

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 2013).

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 2013).

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.

4.6 Land Use

4.6.1 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 further north of the Coonawarra region. 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 (120 km 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, part of the 'The Green Triangle', 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. While there are plantation zones within PEL 494, there only small areas of plantation forestry within the production licence areas, located at the south extent of the boundary (NatureMaps 2018).

Tourism is a large contributor to the local economy, with over 600,000 visitors to the Limestone Coast region per year, directly employing 2,700 people (South Australian Tourism Commission 2023). Key attractions include coastal resorts at Robe and Beachport, Naracoorte Caves and Tantanoola Caves, the Coonawarra, Wrattonbully, Padthaway and Mount Benson wine regions, Bool Lagoon and the Blue Lake (South Australian Tourism Commission 2023).

Since the 1960's approximately 80 oil and gas wells have been drilled in the region. Gas production has been undertaken at Beach Energy's legacy Katnook Gas Plant and the newer Katnook Gas Processing Facility, which has been fed by a network of pipelines from approximately 12 wells in surrounding gas fields. The Processing Plant feeds into the South East Pipeline System, which supplies gas to regional industries and the town of Mount Gambier. 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.

The Katnook Gas Plant is located approximately 10 km south of Penola, 10 km north west of Nangwarry, 14 km north east of Kalangadoo and 30 km east of Mount Burr. The closest residences to the Katnook Gas Plant are located approximately 1 km to the north and 2 km to the south-east.

4.6.2 Conservation Areas

The Limestone Coast 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). Nine reserves established under the National Parks and Wildlife Act are located in the vicinity of, within or overlap the licence areas:

- Big Heath Conservation Park (6km north of PEL 494)
- Bool Lagoon Game Reserve (5km north of PRL 13)
- Hacks Lagoon Conservation Park (12km north of PRL 13)
- Mary Seymour Conservation Park (2.5 km north of PRL 13)
- Glen Roy Conservation Park (14 km east of PRL 13)
- Penola Conservation Park (within PEL 494 and immediately to the west of PRL 32)
- Calectasia Conservation Park (within PEL 494)
- Reedy Creek Conservation Park (2km west of PEL 494)
- Furner Conservation Park (8km south west of PEL 494).

This EIR and the SEO do not cover activities in reserves established under the National Parks and Wildlife Act.

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 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 licence areas. This site is also covered by the EPBC Act.

4.7 Social Environment

The Limestone Coast (LSA Act) Region covers seven local government areas (LGAs), and the Beach Energy 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 3,166 (ABS 2022). Other population centres within and adjacent 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 12. Census data from 2021 for the two LGAs indicates that the population of 20,579 is distributed relatively evenly across the ages 0 to 64, 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 (ABS 2021).

Table 12: Population by Local Government Area

Local Government Area	Male	Female	Total
Wattle Range Council	6,012	5,877	11,889
Naracoorte Lucindale District Council	4,513	4,177	8,690

Source: Australian Bureau of Statistics Census Data 2021

The main industries of employment in the region are healthcare and social assistance, retail trade and agriculture, forestry and fishing (ABS 2021). The high levels of employment within the agriculture, forestry and fishing industry reflects the economic importance of agricultural production within the region.

4.8 Aboriginal Cultural Heritage

All of Beach Energy'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 Energy that the South East Aboriginal Focus Group will continue to manage heritage matters for Beach Energy's operational area.

The Aboriginal Affairs and Reconciliation Division (AARD) advised Beach Energy in March 2017 that the Register of Aboriginal Sites and Objects, does not contain any sites recorded with PPL 62, and one site (#7023 5304) directly south of PPL 62 beside the Riddoch Highway. Importantly this register is not comprehensive, nor does it capture undiscovered sites.

The South Australian Aboriginal Heritage Act 1988 protects Aboriginal sites, objects and remains (Aboriginal Heritage) in all areas of South Australia. Beach Energy complies with this legislation, by ensuring that all first or additional surface disturbance activities are assessed by the local Aboriginal group or other appropriate specialists as required before earthworks commence. Further, Beach Energy land access and cultural heritage procedures ensure that any sites identified are not disturbed during construction through compliance with Beach Energy inductions, pre-earthworks checklists, and field site identification pickets.

4.9 Non-Indigenous 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 46 State heritage places and 177 local heritage places (NatureMaps 2018). No heritage places are present within the 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 45 km north of the production licence area). There are three isolated heritage places located within 10 km of the boundary of the 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.

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 in close proximity to the licence areas, with the majority of the site located approximately 19 km north of PEL 494.

5 Environmental Impact Assessment

This section discusses potential environmental impacts associated with Beach Energy's onshore Otway Basin production operations. The discussion is supported by an environmental risk assessment.

Section 5.1 provides an overview of Beach Energy's Corporate Risk Management Framework. Sections 5.2 to 5.12 contain discussion of hazards and summaries of risk assessments and management strategies for Beach Energy's operations and activities in the Otway Basin. A summary of each risk assessment is provided in Table 16 This risk assessment table outlines:

- Environmental hazards associated with the operation or activity.
- The potential consequences of the hazard.
- An outline of key management measures.
- Likelihood of occurrence of these consequences, given the management measures in place.
- Potential severity of the consequence, give the management measures in place, and
- The resultant level of risk/impact.

5.1 Overview of Risk Assessment Process

Beach Energy uses its Corporate Risk Management Framework as per the Risk Management Standard to mitigate and manage risks for all its activities. The Corporate Risk Management Framework methodology is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018, Risk Management – Principles and Guidelines). The Risk Management Standard is part of Element 8 – Risk Management and Hazard Control, a component of the Beach OEMS.

Beach's Corporate Risk Management Framework requires the following steps to be implemented:

- Identify the activities and the potential impacts associated with them.
- Identify the sensitive environmental resources at risk within and adjacent to the wellsite.
- Identify the environmental consequences of each potential impact, corresponding to the maximum reasonable impact.
- Identify the likelihood (probability) of occurrence of each potential environmental impact (i.e., the probability of the event occurring).
- Identify applicable control measures, and
- Assign a level of risk to each potential environmental impact using a risk matrix.
- In accordance with this framework, all risks must provide for the elimination and minimisation, SFARP, of impacts from the operations[8].

[8] The risk assessment process may be iterative for some hazards. For example, the risk assessment may initially indicate that risks are unacceptably high, based on minimum or familiar management practices. In such cases, management practices are reviewed to identify additional management options to lower risk and / or improve environmental outcomes (e.g. elimination,

The level of risk for Beach Energy's production operations in the Otway Basin has been assessed based on the assumption that management measures that are discussed in this EIR will be in place. The risk assessment was carried out by Beach Energy environment personnel and relevant members of the Beach Energy Production team, based on knowledge of the existing environment, and experience with production operations in the Otway Basin undertaken by Beach Energy.

Beach Energy's risk matrix and definitions for consequences and likelihood are outlined below:

- six categories of consequence (Negligible to Critical) to describe the severity, scale and duration of potential impacts (Table 13).
- six categories of likelihood of potential environmental consequences occurring (Remote to Almost Certain). The likelihood refers to the probability of the particular consequences eventuating, rather than the probability of the hazard or event itself occurring (Table 14).
- a risk matrix to characterise the risk associated with each hazard as low, medium or high. Risks are generally considered acceptable if they fall into the low category without any further mitigation measures, and 'tolerable' if they fall into the medium risk category and are managed to reduce the risk to a level 'as low as reasonably practicable'. Risk reduction measures must be applied to reduce high risks to tolerable levels.

5.1.1 Definition of Consequences

To describe the severity, scale and duration of potential impacts, the six categories of consequence listed in the following table are used.

substitution, reduction, engineering controls and management controls). The risk is then re-assessed based on these additional management options. This EIR details the final or residual risk after management options have been applied.

Table 13: Consequence category

Risk Matrix

CONSEQUENCE	CONSEQUENCE CATEGORY				
	PEOPLE	ENVIRONMENT	REPUTATION	FINANCIAL	LEGAL
	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.)	E.G. Breach of law, prosecution, civil action
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	> AUD$500m	Prolonged and complex civil and/or regulatory litigation; potential jail terms and/or very high fines and/or damages claim
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	AUD$100m-$500m	Civil and/or regulatory litigation; potential significant fines and/or damages claim
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	AUD$10m-$100m	Civil and/or regulatory litigation; potential major fine and damages claim
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	AUD$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
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	AUD$100,000-$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
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	<AUD$100,000	Minor potential breach of law; not reportable to a regulator; on the spot fine or technical non-compliance

5.1.2 Definition of Likelihood

The likelihood of potential environmental consequences occurring is defined using the six categories shown in the following table. The likelihood refers to the probability of the particular consequence eventuating, rather than the probability of the hazard or event itself occurring.

Table 14: Likelihood categories

LIKELIHOOD					
A. Remote	B. Highly Unlikely	C. Unlikely	D. Possible	E. Likely	F. Almost Certain
<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

5.1.3 Characterisation of Risk

The risk associated with each hazard was characterised as low, medium, high, severe or extreme using the matrix below.

Table 15: Risk Matrix

Risk Matrix

CONSEQUENCE	CONSEQUENCE CATEGORY					LIKELIHOOD					
	PEOPLE	ENVIRONMENT	REPUTATION	FINANCIAL	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.)	E.G. 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	> AUD$500m	Prolonged and complex civil and/or regulatory litigation; potential jail terms and/or very high fines and/or damages claim	HIGH	HIGH	SEVERE	SEVERE	EXTREME	EXTREME
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	AUD$10m-$500m	Civil and/or regulatory litigation; potential significant fines and/or damages claim	MEDIUM	MEDIUM	HIGH	SEVERE	SEVERE	EXTREME
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	AUD$10m-$100m	Civil and/or regulatory litigation; potential major fine and damages claim	MEDIUM	MEDIUM	MEDIUM	HIGH	SEVERE	SEVERE
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	AUD$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	SEVERE
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	AUD$100,000-$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	<AUD$100,000	Minor potential breach of law; not reportable to a regulator; on the spot fine or technical non-compliance	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM

5.2 Soils and Shallow Groundwater

Potential impacts to soils and shallow groundwater arise mainly from:

- Earthworks associated with construction and rehabilitation activities.
- spills or leaks of fuel, chemicals, produced fluids, or hydrostatic test water.
- storage / disposal of produced formation water.
- loss of well integrity or well control incidents.
- explosion or fire at well sites and facilities.
- storage, handling and disposal of waste.

5.2.1 Earthworks, Construction and Rehabilitation Activities

Earthworks for construction and rehabilitation activities at operational sites or on pipeline easements and heavy vehicle movements have the potential for localised impacts to soil through inversion, compaction or increased erosion.

In order to minimise surface impacts and facilitate rehabilitation, landowners are consulted regarding the earthworks required, possible activity locations or pipeline routes and other relevant issues (see Section 5.6 for further discussion).

The soil types, general lack of defined drainage and relatively flat topography in the licence areas result in a relatively low risk of erosion or sedimentation. Other activities with similar (but more widespread) levels of soil disturbance also occur in the region without significant erosion issues, such as intermittent cultivation for pasture improvement, and ploughing in some sections of the forestry firebreaks.

Soil inversion and loss of topsoil can potentially reduce the regrowth of vegetation and / or the resumption of agricultural based land use activities following rehabilitation, and the effectiveness of pipeline easement restoration by limiting the amount of available nutrients, biomass and productivity. Topsoil is separated and stockpiled for use in rehabilitation, and paving materials are usually removed (unless the landowner requests that they are retained) and stockpiled topsoil re-spread over the site.

Shallow groundwater can potentially be intercepted by pipeline construction activities (e.g. trenching, horizontal directional drilling). Trenches are relatively shallow in relation to average groundwater depths (in the order of one to two metres) and open for a short period and impacts on groundwater resources are considered inconsequential. Horizontal directional drilling is undertaken in accordance with site specific management procedures which address aspects such as drilling mud management and cuttings disposal, to ensure that shallow groundwater resources are not adversely impacted.

Rehabilitation will be undertaken in accordance with industry standard criteria and 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.

5.2.2 Spills or Leaks

Improper storage and handling of fuel or chemicals could lead to a spill or leak and has the potential to result in minor localised contamination of soil or shallow groundwater. Fuel and chemicals will be stored in designated areas with appropriate secondary containment as required (e.g. lined, bunded areas or on self-bunded pallets).

Artificial lift systems may require a generator and associated fuel storage. Gas well skids may have storage and injection facilities for production chemicals such as corrosion inhibitor. Risk assessments are conducted to ensure that the design and installation of production equipment, including artificial lift equipment and wellhead skids, will conform to relevant industry and engineering standards and conventions and containment devices are installed to minimise potential consequences.

There is the potential for accidental spills / release of condensate or produced water as a result of pipe failure or leaks from equipment such as the inlet header, pipeline connection or plant valves. Other potential causes of spills or leaks include corrosion or material degradation (fatigue), mechanical damage, instrument / component failure or errors in design, construction and operation. Improper handling of produced water during completions and workovers or gas well deliquification could also result in a release to the environment. Cleaning of pressure vessels and changing filters at the gas plant can result in the release of sludge with elevated levels of mercury. There is also a potential for spills to occur during tanker loading activities.

The risks associated with leak or spill hazards are minimised through appropriate storage and containment and implementation of storage and handling procedures. A leak of produced fluids (e.g. from piping or equipment), would be expected to have a minor localised impact. Design and installation of piping and equipment in accordance with appropriate standards, integrity testing of piping and equipment, operation in accordance with design criteria and relevant standards, and ongoing monitoring and maintenance all minimise the risk of spills or leaks. Bunding and stormwater management proposed for the Katnook facility, including the use of appropriately designed and constructed sumps to capture stormwater runoff from infrastructure, will also reduce the level of risk.

Any spills will be immediately contained and cleaned up to minimise impact and any contaminated material removed off-site for appropriate treatment or disposal to a licensed facility. Larger scale spills that cannot be immediately contained and cleaned up 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).

5.2.3 Disposal of Hydrotest Water

Hydrostatic test (hydrotest) water will preferably be fresh but may contain low levels of corrosion inhibiting chemicals and biocides depending on the water source and total time required for the test. Inappropriate disposal of this water may result in localised soil contamination.

Disposal of hydrostatic test water which contains biocide or other chemicals will be into an existing lined evaporation pond (i.e. produced formation water facilities) or to tanks. Test water that is free of additives or meets relevant water quality guidelines (e.g. Environment Protection (Water Quality) Policy requirements and ANZECC guidelines) may, subject to landowner approval, be disposed of to land adjacent to the construction zone.

5.2.4 Produced Formation Water

One of the potential impacts associated with the operation of petroleum production facilities is the storage and treatment of produced formation water (PFW). PFW from the onshore Otway Basin is typically relatively fresh but can contain chemicals (both natural and added, e.g. methanol), residual hydrocarbons and some naturally occurring heavy metals.

The potential environmental consequences associated with a loss of containment of PFW could include:

- localised contamination of soil and shallow groundwater by any carried-over hydrocarbon or process chemicals (e.g. emulsion breakers, corrosion inhibitor or biocides used to prevent corrosion resulting from sulphur reducing bacteria) or naturally occurring metals

- localised contamination of soil and associated vegetation with salts and metals naturally occurring,

- increased soil salinity.

Potential contamination of soil and groundwater may result from leaks in separation or storage tanks or from damage to lining of evaporation ponds. Sub-surface movement of leaked PFW can potentially lead to upwelling of PFW.

Upgraded or new ponds for PFW disposal, if required, would be constructed using appropriate materials and suitable design criteria including adequate freeboard, depths, lining and bunding. Upgraded or new ponds would be designed and constructed in line with EPA Guideline 509/19 Wastewater lagoon construction. Additional monitoring bores would be installed around the facility and regular water quality monitoring and leak testing would be conducted. These measures reduce the likelihood of a significant leak occurring to a very low level. If a leak did occur, it could be reasonably be expected to result in (at most) low level, localised contamination.

A loss of containment of storage of PFW could potentially result in moderate consequences, however this is considered unlikely with appropriate control measures and management strategies in place. The use of appropriately bunded tanks to store PFW will further reduce the level of risk.

5.2.5 Loss of Well Integrity / Well Control Incidents

Well control and well integrity risks are managed by a range of measures that are discussed in Section 5.4.1.

5.2.6 Waste Management

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

The waste water treatment system used at Katnook to contain all wastewater (black water and grey water) will be monitored and maintained on a quarterly basis. An integrity test of the system will be planned to be undertaken by the maintenance contractor prior to reconnection to the new office unit being put in place. Treated waste water is periodically collected by tanker and transported to a licensed disposal facility or irrigated in accordance with appropriate approvals.

5.2.7 Risk Assessment

The level of risk has been assessed as low for many of these potential hazards (see Table 16). A medium risk is assigned for several hazards including well control incidents / loss of well integrity and PFW storage and disposal; although it is highly unlikely to occur, the consequence to shallow ground water is serious (see Table 16).

Note: Risks have been assessed taking into consideration the high importance of shallow ground water (the unconfined Tertiary Limestone Aquifer) in the region.

5.3 Surface Water

Potential impacts to surface water arise mainly from:

- earthworks associated with construction and rehabilitation activities
- spills or leaks of fuel, chemicals, produced fluids, hydrostatic test water
- storage / disposal of produced formation water
- loss of well integrity or well control incidents

- explosion or fire at well sites and facilities
- storage, handling and disposal of waste.

5.3.1 Earthworks, Construction and Rehabilitation Activities

Earthworks, construction and rehabilitation activities 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).

Pipelines, tracks and operational sites will be located and constructed to avoid significantly impacting surface drainage patterns or surface water features. Where necessary, temporary culverts will be installed on access tracks 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 LSA Act) are not undertaken unless relevant permits have been obtained. The presence of a pipeline construction easement and linear stockpiles of topsoil are unlikely to cause any more than minor and temporary disruption to natural overland flows. Sites will be rehabilitated to restore natural surface profiles and original drainage patterns.

The soil types, general lack of defined drainage and relatively flat topography in the licence areas result in a relatively low risk of sedimentation and turbidity due to low run-off volumes and velocities and the absence of significant drainage lines. Construction is timed where possible to take place in predominantly dry conditions, and the implementation of drainage controls, topsoil / spoil stockpile management and use of sediment and erosion control structures (e.g. near drains or surface water features) will protect surface water environments from potential sedimentation impacts.

If dewatering of the pipeline trench is required, appropriate disposal of trench water (e.g. away from surface water features) will protect surface water environments from potential sedimentation impacts.

5.3.2 Spills or Leaks

The principal risk to surface water typically results from the potential transport off-site of material from spills or leaks.

The measures discussed above in Section 5.2 will be implemented to ensure safe storage and handling of fuel and chemicals. Spill containment and clean-up equipment will be present on-site and any spills immediately cleaned up.

5.3.3 Flooding of Evaporation Ponds

Flooding of an evaporation pond can potentially result in impacts to surface water quality. Previous investigations into the likelihood of flooding at the Katnook site (Origin 2002) have indicated that the likelihood of significant inundation at the site is very low, and that the existing pond walls are well above any conceivable flood levels. Freeboard is maintained to prevent overtopping in the event of high rainfall. An inspection sump is located on the east side of the triangular pond that is expected to remain in place.

As outlined in Section 3.1.2, it is likely that one of the evaporation ponds may be removed at the Katnook site. If a decision is made to keep an existing pond, the integrity of the liner will be assessed to determine its suitability for continued use. The pond may also be upgraded if the integrity of the liner is assessed as not being suitable. The upgraded pond or any new pond if required would be designed and constructed with regard to EPA Guideline 509/19 Wastewater lagoon construction.

Additional monitoring bores would be installed around the facility and regular water quality monitoring and leak testing would be conducted. These measures reduce the likelihood of a significant leak occurring to a very low

level. If a leak did occur, it could be reasonably be expected to result in (at most) low level, localised contamination.

5.3.4 Loss of Well Integrity / Well Control Incidents

If gas or produced fluids were released from a loss of well integrity, impacts would be localised and contained within the immediate vicinity. Management measures outlined in 5.4.1 will be implemented to minimise the likelihood of this occurring.

Where appropriate, impervious well cellars are installed at wells. Containment devices are installed on gas well skids. Well control and well integrity risks are managed by a range of measures that are discussed in Section 5.4. Impact to surface water from well control or well integrity issues is considered unlikely.

5.3.5 Waste Management

Measures to ensure secure storage and handling of waste will be implemented as outlined in Section 5.2.6.

5.3.6 Risk Assessment

The level of risk has been assessed as low for most of these potential hazards (see Table 16). A medium risk is assigned for well integrity management and storage and disposal of PFW; although highly unlikely to occur, the consequence is serious (see Table 16).

5.4 Groundwater

Potential impacts to groundwater arise mainly from loss of well integrity / well control incidents.

Shallow groundwater can also be potentially impacted by surface activities including fuel and chemical storage and handling, PFW management and waste management. These are discussed in Section 5.2.

5.4.1 Loss of Well Integrity / Well Control Incidents

5.4.1.1 Well integrity

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.

Wells that will be completed for production are those that have already been cased and suspended and made safe following drilling operations (covered in the Beach Energy Otway Drilling EIR). Well integrity and completion for production will follow the same strict protocols for safety and environmental management. The risk is restricted to as low as reasonably possible by well design and construction and managed through operational monitoring and maintenance.

Measures undertaken to ensure well integrity include:

- comprehensive review of all available information is undertaken to identify all foreseeable well integrity risks that may arise during operations.
- well design and construction provides the mechanical integrity that reduces the risk to well integrity to as low as reasonably possible
- isolation of shallow aquifers behind multiple casing strings that are cemented as per the Beach Energy Otway Drilling SEO

- 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.
- ongoing well integrity monitoring
- accessible well integrity barriers undergo verification processes (including the well and wellhead) via a maintenance program as governed by the Beach Energy Well Integrity Management System.

Following a decision to decommission a well, a specific well decommissioning program is developed and implemented, as discussed in Section 3.8.2. Well decommissioning programs will be submitted to DEM.

5.4.1.2 Well control incident

A well control incident or uncontrolled release during production operations could result in a loss of containment of hydrocarbons, possible crossflow between aquifers or loss of aquifer pressure and possibly an explosion or fire. There are considerable safety measures to avoid an uncontrolled release and they are unlikely, particularly in areas such as the Otway Basin where reservoir pressures are understood and producing wells are declining in pressure. Safety measures to reduce the risk of a well control incident during production operations and intervention work include but are not limited to: well control equipment, certified valves, subsurface plugs, casing and tubing, engineered well fluids and cement and third-party emergency response specialists. Section 6.5 outlines the emergency response and contingency planning framework.

Risk assessments are applied at design and during the asset life to identify threats and controls to mitigate and manage risks.

5.4.2 Risk Assessment

The level of risk has been assessed as medium for well integrity management; although it is highly unlikely to occur, the consequence is serious (see Table 16).

5.5 Native Vegetation and Fauna

Potential impacts to native vegetation and fauna arise from:

- earthworks associated with construction and rehabilitation activities
- spills or leaks
- presence of personnel, lighting, general site activity and track use
- loss of well integrity or well control incidents
- explosion or fire at well sites and facilities
- storage, handling and disposal of waste.

5.5.1 Earthworks and Construction Activities

Earthworks and clearing activities have the potential to damage native vegetation and wildlife habitats (including wetland communities) and disturb or injure fauna. 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 facility and other construction activities can generally be avoided by locating sites in previously cleared or disturbed areas.

Operational sites and gathering system corridors 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[9]. 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 5.3, 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, fauna and particularly wetland communities.

5.5.2 Spills or Leaks

Spills of fuel, chemicals, produced fluids or hydrostatic test water have the potential to damage native vegetation. As discussed in Section 5.2, this risk will be minimised by appropriate storage, handling and spill response and design and installation, operation, testing and monitoring of piping and equipment in accordance with relevant standards and guidelines. As noted above, vegetation and habitats present are typically highly disturbed, which limits the potential for impact.

Similarly, if gas or produced fluids were released from a loss of well integrity, impacts would be localised and contained within the immediate vicinity of the facility or well lease. Well integrity management measures outlined in Section 5.4 will be implemented to minimise the likelihood of this occurring.

Access to fuel and chemicals and produced fluids presents a potential hazard for wildlife. Access to chemicals and fuel will be prevented by storing and handling them appropriately in designated areas and implementing immediate containment and clean-up if any spills occur. Stock-proof fencing will be erected around facilities and well leases to restrict access.

The potential for native fauna to access contaminants and waste is limited. Facilities and well sites 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. Waste will be stored in covered bins before being transported off-site for disposal at a licensed facility.

5.5.3 Presence of Personnel, Lighting, General Site Activity and Access Track Use

Potential disturbance to native fauna from production operations and site activities (e.g. light, noise, presence of personnel) is localised and generally of very limited impact in the region given the existing land uses and extent of historical vegetation clearance and habitat modification. The environmental assessment undertaken during the planning process will identify whether there are specific issues at some individual sites (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 or the Commonwealth Department of the Environment and Energy) would be consulted where required.

The presence of excavations and pipeline trenches during construction activities also has the potential for localised impacts to native fauna. The presence of site personnel and the fencing of facilities and well leases will generally preclude impacts to larger species at these sites. These sites are also likely to have been located in areas where there is limited habitat value for smaller species and their presence on the well lease is unlikely. Pipeline trenches and any other excavations will be regularly checked for trapped fauna to minimise potential impacts.

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

The movement of vehicles and machinery along existing roads and access tracks has the potential to impact native fauna, principally through collisions. This is likely to be relatively insignificant due to the level of existing traffic 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.

5.5.4 Waste Management

Measures to ensure secure storage and handling of waste will be implemented as outlined in Section 5.2.6. Covered bins will be used to prevent native fauna and pest animals accessing or spreading waste.

5.5.5 Explosion or Fire at Well Sites and Facilities

An explosion associated with production well or processing facilities would have a short-term impact on air quality. Impacts would be expected to be relatively localised, and unlikely to result in significant impacts to sensitive receptors. A fire 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. Where used, flare stacks will be located to avoid radiant heat impacting or burning trees.

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 outlined above will be in place.

Management measures relevant to explosion or fire are discussed further in Section 5.10.

5.5.6 Risk Assessment

The level of risk has been assessed as low for these potential hazards (see Table 16).

5.6 Land Use

Potential impacts to land use arise from:

- construction and rehabilitation activities
- disturbance from site production activities (e.g. light, noise, presence of personnel)
- access to contaminants by stock (e.g. from well control incidents, pond, spills or leaks, waste)
- fire.

5.6.1 Construction and Rehabilitation Activities

Construction and rehabilitation activities 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 5.2 to 5.5). The measures discussed in these previous sections will be implemented to ensure that these potential impacts are minimised.

Poor planning and execution of construction and rehabilitation activities also has the potential to impact land use beyond the activities' direct footprint, if the activities are not conducted 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 throughout the life of a producing well or pipeline and deterioration of property tracks or infrastructure as a result of production operations traffic is rectified.

5.6.1.1 Pipelines

Pipeline construction can cause temporary disruption to land use and localised impacts can be summarised as:

- impeded property access
- short-term reduction in availability of cropping land/pastures
- potential introduction or spread of agricultural weeds or diseases
- reduction in long-term productivity due to soil compaction, inversion or contamination
- temporary replacement of permanent fences with access gates
- short term disturbance to stock associated with noise and human activity
- potential injury to, or mortality of, stock in the open trench
- risk of fire associated with welding and the use of vehicles and machinery in paddocks.

These impacts can be successfully managed to avoid significant impact. They are generally temporary in nature and cease once the construction phase has been completed and the easement has been rehabilitated.

Operation of pipelines will generally not impact existing land use, as the pipelines are buried and the construction corridor is rehabilitated to as near as practicable to the pre-construction state. Existing land use activities will generally not be restricted over the pipelines except for those that will potentially cause harm to the pipeline or the public (for example, water bore installation, blasting, fence post installation, deep ripping in areas where it has not been specifically approved and planned for, and planting of trees).

5.6.1.2 Weeds and pathogens

The introduction of weeds or pathogens by vehicles and equipment (particularly earthmoving equipment) is a potentially significant impact to land use. A range of measures are undertaken to manage the potential for the introduction or spread of weeds or pathogens, including:

- 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 sites 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 Limestone Coast Landscape Board.

Under the Petroleum and Geothermal Energy 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.

5.6.2 Disturbance from Site Activities

Production activities and transport movements have the potential to disturb 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 sites during production operations, and avoidance of night transport moves as far as possible.

5.6.3 Access to Contaminants by Stock

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

5.6.4 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 5.5.5 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.

5.6.5 Risk Assessment

The level of risk has been assessed as low for these potential hazards.

5.7 Air Quality

Potential impacts to air quality can arise from generation of dust during site construction activities and wheel-generated dust from heavy and light vehicle movements on unsealed surfaces.

There is one sensitive receptor located approximately 1km north of the Katnook Plant, which is 500 m to the west of Argyle Road. There is a residence directly off Millers Lane, approximately 2 km from the facility, however there is a section of sealed road running past this property.

Construction activities are not expected to generate significant quantities of dust, based on the relatively limited ground disturbance footprint and short-term, construction period.

Levels of heavy and light vehicle traffic associated with construction activities will be minor, with contracted personnel transported to site via a shuttle bus to limit the number of small vehicles on the road and therefore reducing dust generating activities. Routine operational activities at the site typically involve two personnel on site on a daily basis, reducing the traffic to and from the facility.

The activities associated with the facility and use of unsealed access tracks that may generate low level impacts from dust are small scale, temporary and localized in nature.

Dust generation will be minimised by spraying of unsealed access tracks with water during construction activities and by restriction of speeds on unsealed access tracks to moderate the potential for dust generation where required. Given the lack of receptors and the temporary nature of construction activities that may lead to dust generation, these measures and criteria are considered appropriate.

Operation of gas production facilities can produce atmospheric emissions via fugitive, flare, combustion and venting sources and 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
- vented gas
- flared hydrocarbons
- vented CO_2, H_2S, and CO.

All facilities will be designed, constructed, operated and maintained in accordance with relevant standards (e.g. AS 3000, AS 1940, AS 2885, AS 4041, ASME/ANSI B31.3, AS 1200, AS 3788, hazardous area compliance to AS 60079 series) and legislative requirements. Assessments will be undertaken where appropriate during design and operation to confirm compliance with legislative requirements, particularly the *Environment Protection (Air Quality) Policy 2016*.

Plant and equipment will be operated and maintained appropriately in order to minimise emissions. Flaring during production testing will be kept to the minimum length of time necessary to establish resource parameters. Flaring or venting for other purposes such as deliquification of production wells is generally short term in nature and the gas flared or vented is negligible.

Fugitive emissions will be minimised by maintenance of well integrity (as discussed in Section 5.4) and appropriate maintenance and operation of wellheads, pipelines and other surface infrastructure.

Adequate buffer distances will be maintained between the well site and residences and systems will be in place for logging stakeholder complaints to ensure that issues are addressed as appropriate.

Beach Energy reports emissions in accordance with statutory requirements such as the National Pollutant Inventory (NPI) and National Greenhouse and Energy Reporting Act 2007 (NGER).

5.7.1 Risk Assessment

The level of risk has been assessed as low for these potential hazards.

5.8 Noise

Potential noise impacts may arise from construction and rehabilitation activities, production activities at the Katnook site or well sites and flaring.

5.8.1.1 Construction and rehabilitation

Construction activities resulting in noise with an adverse impact on amenity are generally restricted by the *Environment Protection (Noise) Policy 2007* to between 7 am and 7 pm, Monday to Saturday. Although this restriction does not apply to construction activities where development authorisation is not required under the *Planning, Development and Infrastructure Act 2016*, noise-generating activities will generally be scheduled within these times, but may be on a 7 day per week basis.

Construction near residences (e.g. pipeline construction) will be scheduled in accordance with EPA guidance for normal construction working hours as far as practicable. Local residents will be consulted if unavoidable out-of-hours work is required near residences.

Given the distances of nearby residences from the Katnook site, construction noise from the site is unlikely to adversely impact amenity.

5.8.1.2 Operation

Operation of equipment such as compressors or generators and activities such as venting or flaring can result in an increase in background noise levels, which may result in disturbance to wildlife, stock or the local community. The presence of personnel and site activities also has the potential to disturb stock or wildlife, depending on the location.

The Environment Protection (Noise) Policy 2007 establishes goal noise levels to be achieved at noise receivers (residences), based on the Development Plan locality in which the noise source and the noise receivers are located, and the land use that these localities principally promote.

All facilities will be designed, constructed, operated and maintained in accordance with relevant standards (refer to 5.7) and legislative requirements. Assessments will be undertaken as appropriate during design and operation (e.g. following identification of new plant and equipment for the Katnook site) to confirm compliance with the Environment Protection (Noise) Policy 2007.

Adequate buffer distances will be maintained between the operational sites and residences and systems will be in place for logging stakeholder complaints to ensure that issues are addressed as appropriate.

Given the distances of nearby residences from the Katnook site, the history of successful operation and the presence of a gas-fired power station adjacent to the site, operational noise from appropriately designed and operated plant and equipment at the site is unlikely to adversely impact amenity.

5.8.2 Risk Assessment

The level of risk has been assessed as low for these potential hazards.

5.9 Visual Amenity

The presence of facilities and associated infrastructure can potentially impact visual amenity.

The existing Katnook site (and associated wells) are relatively isolated, and generally not visible from main roads or other commonly accessed viewpoints. Any future modifications at the Katnook site would not be expected to have a significant visual impact, given the presence of the existing plant and the adjacent Ladbroke Grove power station. The potential for impact is also mitigated by the distances to nearest residences, main roads or other commonly accessed viewpoints, and the screening provided by the numerous large trees in the surrounding landscape. The flare stack is expected to be lower than the trees in the landscape and its visibility is expected to be low unless it is activated during an emergency scenario.

The current Haselgrove 3 ST1 well site is located within a previously cleared forestry area and is obscured from view from most directions by the surrounding forestry areas. Any infrastructure installed at the site would not be inconsistent with the adjacent food processing and storage facility and is likely to be obscured from view from the Riddoch Highway as the surrounding pine plantation matures.

Careful location of any new infrastructure can reduce potential impact to visual amenity and measures such as screening plantings can also be undertaken to minimise visual impact where appropriate.

Buried pipelines, by their very nature, have a low level of impact on visual amenity. Generally this is restricted to short term disturbances associated with construction earthworks and localised impacts associated with the presence of marker signs and above ground facilities.

5.9.1 Risk Assessment

The level of risk has been assessed as low for these potential hazards.

5.10 Public Safety and Risk

Potential risks to public safety arise mainly from the inherent risk of explosion or fire due to the nature of petroleum production operations. However, this risk is reduced to As Low As Reasonably Practical (ALARP) by compliance with relevant standards and implementation of various management measures to minimise the risk, as summarised in Table 16.

Standards of particular relevance to facility design, construction and operation include:

- AS 1940 – The storage and handling of flammable and combustible liquids
- AS/NZS 1200 – Pressure equipment
- AS/NZS 3788 – Pressure equipment – In-service inspection
- AS 2885 – Pipelines – gas and liquid petroleum
- AS/NZS 3000 – Electrical installations
- AS 4041 – Pressure piping
- AS/NZS 60079 – Explosive atmospheres intrinsically safe electrical systems

Process critical shutdowns / fail safes are generally hard wired and regularly function tested. Risk assessments are applied at design and during the life of the asset to identify threats and controls to mitigate risks. Asset integrity and maintenance is managed to ensure compliance with regulations and scheduled maintenance and safety checks on control systems and monitoring are performed in a traceable manner.

Fire and explosion are also possible hazards associated with pipeline operation. A fire or explosion along a pipeline can pose a danger to personnel, contractors and possibly the public and can potentially produce significant amounts of atmospheric emissions. The potential for explosion or fire associated with gas pipelines is considered low as all gas pipelines are designed, installed and operated in compliance with AS 2885 (i.e. with appropriate design features and management measures including wall thickness, depth of burial, pipeline marker signs, cathodic protection, shutdown valves and monitoring, testing, maintenance and inspection procedures).

The use of roads can result in an increased road hazard to local road users. Impacts of road use are relatively limited and short term, with peak traffic movements occurring during transport of materials (e.g. plant or pipeline materials) to site. Landholders, local councils, potentially affected residents and police will be informed of any significant activities, which will detour around town centres where possible. Warning signs and traffic management measures will be installed where appropriate near construction sites. All necessary transport-related permits will be obtained. Transport moves will be restricted to daylight hours as far as possible.

5.10.1 Risk Assessment

The level of risk to public safety has been assessed as low for many of the potential hazards identified. A medium risk is assigned for the use of roads, explosion or fire at facilities, well sites or pipelines and explosion or fire

during decommissioning; although these events have a remote or highly unlikely possibility of occurring, the consequence is serious to major.

5.11 Cultural Heritage

Potential impacts to cultural heritage arise predominantly from earthworks and excavations 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. Heritage registers and the Heritage Branch, DEW will be consulted regarding the location of non-indigenous 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.

5.11.1 Risk Assessment

The level of risk to cultural heritage has been assessed as low.

5.12 Economic Impact

Many of the identified environmental risks have potential for negative economic impact on landholders and other stakeholders. Application of the measures discussed above to minimise the environmental risk also minimises the economic risk.

There are a number of potential economic benefits for landholders, the community and the State, including:

- provision of enhanced gas supply to the region, which currently relies on gas imported from Victoria via the SEA Gas pipeline.
- potential for utilisation of local food, fuel and accommodation which has direct benefit to business owners and benefits the regional economy.
- potential for engagement of local contractors for activities such as facility construction, earthworks and fencing.
- potential enhancements or increased maintenance to infrastructure such as roads, dependent on success and ongoing activity.
- well access tracks are often of use to landholders as all-weather access tracks and may save construction costs to the landholder and enhance property management.
- potential for royalties to be paid if exploration and appraisal are successful and project economics are favourable, which benefits the State.

The supply of gas from the Katnook facility to the region is considered a supplementary supply above the current gas supply generated by both Beach Energy and other operators. It is not considered a credible risk to the security of supply if there was a failure of delivery from the Katnook production operations. In the event of future discoveries that may be tied into the Katnook facility, Beach Energy will reassess the implications in relation to the security of supply.

5.13 Environmental Risk Assessment Summary

As discussed above, Beach Energy has undertaken an environmental risk assessment of production operations in the onshore Otway Basin. This section summarises the process and results of the assessment.

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

The risk assessment process involves:

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

The level of risk for Beach Energy's production operations in the onshore Otway Basin have been assessed based on the assumption that the management measures discussed in this EIR will be in place. The risk assessment was carried out by JBS&G, Beach Energy environment personnel and relevant members of the Beach Energy Production team, based on knowledge of the existing environment, and experience with production operations in the Otway Basin undertaken by Beach Energy as well as other companies (e.g. Adelaide Energy and Origin Energy) and experience with production operations in other areas of Australia.

Risks are generally considered acceptable if they fall into the low category without any further mitigation measures, and 'tolerable' if they fall into the medium risk category and are managed to reduce the risk to a level 'as low as reasonably practicable'. Risk reduction measures must be applied to reduce high risks to tolerable levels.

The following table summarises the results of the risk assessment and management measures identified for operations. The table presents the final or residual risk after management measures have been applied. The tables also provide a cross-reference to the relevant SEO objectives for each hazard.

Risk events in the table have been grouped under the following headings:

- Production facility operations.
- Well operations and well integrity management.
- Construction and rehabilitation activities (e.g. pipelines, access tracks and pads, Katnook site works).
- Pipeline operations.
- Use of roads.
- Waste management.
- Decommissioning of infrastructure.

Table 16: Environmental risk assessment summary

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
Production facility operations						
Physical presence of plant, personnel and temporary depot/camp	Visual impact	1, 3	Site activities planned and undertaken to minimise disturbance to landowners and adjacent landholders	Minor	Highly Unlikely	Low
	Disturbance to native fauna		Landowners and relevant stakeholders (e.g. local council, industry associations) consulted regarding nature, location and management of proposed activities.	Minor	Highly Unlikely	Low
	Disturbance to stock		Activities are restricted to agreed / defined areas Temporary facilities removed from site promptly following completion of activities, particularly in visible locations	Minor	Highly Unlikely	Low
	Disturbance to land use		High standard of 'housekeeping' is maintained to minimise visual impact	Minor	Highly Unlikely	Low
	Disturbance to local community		Measures such as screening plantings undertaken to minimise visual impact where appropriate **Note**: The Katnook site is 1-2 km from nearest neighbours and not visible from main roads.	Minor	Highly Unlikely	Low
Emissions of methane and organic carbon Venting of CO_2, H_2S, and CO Venting of gas Combustion emissions (e.g. engines, compressors, flaring for production testing at well sites)	Localised reduction in air quality Release of greenhouse gases	8	All facilities designed, constructed, operated and maintained in accordance with relevant standards (e.g. AS 3000, AS 1940, AS 2885, AS 4041, ASME/ANSI B31.3, AS 1200, AS 3788, hazardous area compliance to AS 60079 series) and legislative requirements (e.g. Environment Protection (Air Quality) Policy) Assessments undertaken as appropriate during design and operation to confirm compliance with legislative requirements Plant and equipment operated and maintained in accordance with manufacturer's specifications Safety, testing, maintenance and inspection procedures implemented Risk assessments applied at design and during the asset life to identify threats and controls to mitigate risks Continual review and improvement of operations Facilities are routinely inspected for signs of leaks and / or loss of containment Venting activities are managed and minimised with preference to flare rather than vent where feasible Consideration of weather conditions (e.g. wind direction) prior to commencing planned venting activities Flaring activities are actively managed and reduced to operational necessity	Moderate	Highly Unlikely	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
			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)			
Noise emissions	Disturbance to native fauna Disturbance to stock Disturbance to local community	1	All facilities designed, constructed, operated and maintained in accordance with relevant standards (refer to listing under *Air Quality* above) and legislative requirements (e.g. Environment Protection (Noise) Policy) Assessments undertaken as appropriate during design and operation to confirm compliance with legislative requirements Plant and equipment operated and maintained in accordance with manufacturer specifications Transport trucks are restricted to daylight hours as far as possible. Heavy truck drivers to be instructed not to use engine brake near dwellings Systems in place for logging stakeholder complaints to ensure that issues are addressed as appropriate Adequate buffer maintained between sites and residences	Minor	Unlikely	Low
Explosion or fire at the production facility	Danger to health and safety of personnel, contractors and possibly the public	7, 6, 8, 1	All facilities are designed, constructed, operated and maintained in accordance with relevant standards (refer to listing under Air Quality above) Safety, testing, maintenance and inspection procedures implemented	Major	Remote	Medium
	Contamination of soil, shallow groundwater and / or surface water		Risk assessments applied at design and during the asset life to identify threats and controls to mitigate risks Establishment of appropriate emergency / spill response procedures for explosion or fire	Serious	Remote	Low
	Atmospheric pollution		Emergency response procedures included in staff training Erection of signage and, where required, fencing to delineate restricted / hazardous areas	Serious	Remote	Low
	Burning of vegetation and habitat		Personnel trained to supervise and instruct individuals entering area to conduct work Appropriate fire fighting equipment at all facilities	Serious	Remote	Low
	Injury to or loss of native fauna		Safe work permits must be obtained to ensure only individuals with proper clearance can conduct works Smoking only in designated areas located away from equipment or activity	Serious	Remote	Low
	Disruption to land use (e.g. grazing)		Appropriate firebreaks are maintained	Serious	Remote	Low
	Access to contaminants by stock and wildlife		Liaison undertaken 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)	Moderate	Remote	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
Spills or leaks associated with chemical and fuel storage and handling, cleaning of pressure vessels and changing filters, condensate load-out	Localised contamination of soil, shallow groundwater and / or surface water Access to contaminants by stock and wildlife Damage to vegetation and habitat	6	Implementation of appropriate chemical and fuel storage and handling procedures (e.g. bunding and signage) in accordance with relevant standards and guidelines, including AS 1940, EPA guideline *080/16 Bunding and Spill Management* and the Australian Dangerous Goods Code (ADG) Hazardous materials stored, used and disposed of in accordance with relevant legislation on dangerous substances Establish appropriate emergency / spill response procedures for spills or leaks to soil and water Periodic review and exercise of response equipment and procedures to ensure preparedness Appropriate spill containment and clean-up equipment located on-site Personnel are trained in the use of spill response equipment Spills or leaks are immediately reported and clean up actions initiated Affected areas fenced if threat is posed to stock or wildlife Any 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 (e.g. release of fluid to land outside fenced areas, or any volume to water) is consistent with the National Environment Protection (Assessment of Site Contamination) Measure and relevant SA EPA guidelines Maintain a register of spills and / or leaks and implement corrective actions based on analysis of spill events Site stormwater managed to avoid off-site impacts <u>Production testing / flaring</u> Production tanks to be located in lined bunded areas in accordance with relevant standards and guidelines, including AS 1940, EPA guideline *080/16 Bunding and Spill Management*. Production testing lines and tanks to be inspected prior to use. Personnel remain on-site during production testing. Separator tank used during production testing to separate any produced liquids from gas before gas is sent to a vertical flare. <u>Condensate Tanker Load-out</u> Tanker load-out in lined area, with appropriate bunding to contain spills	Moderate	Highly Unlikely	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
			Construction and operation of filling systems, storage tanks and the tankers in accordance with AS 1940 Spill kit/s located at the load-out Hoses with dry-break couplings Personnel attendance at all times during tanker filling			
Loss of containment (pipe rupture, reliefs, fittings or leaks from plant and other sources)	Danger to health and safety of personnel, contractors and possibly the public	7, 6, 8	All facilities designed, constructed, operated and maintained in accordance with relevant standards (see *Air Quality* in this table (above)) Safety, testing, maintenance and inspection procedures implemented	Minor	Highly Unlikely	Low
	Localised contamination of soil, shallow groundwater and / or surface water		Risk assessments applied at design and during the asset life to identify threats and controls to mitigate risks Strategies to mitigate potential threats including high use of corrosion resistant materials, design approach and maintenance systems Construction and operation of filling systems, storage tanks and tankers in accordance with AS 1940	Minor	Highly Unlikely	Low
	Localised reduction in air quality			Minor	Highly Unlikely	Low
	Release of greenhouse gases		Use of steel piping and fittings where possible Appropriate areas (e.g. storage tanks) bunded and lined to contain spills in accordance with relevant standards and guidelines including AS 1940, EPA guideline 080/16 *Bunding and Spill Management* Process critical shutdowns / fail safes generally hard wired and regularly function tested Level control / overfill protection on tanks **Note**: Condensate / water production is relatively low and leaks / ruptures would result primarily in gaseous emissions, discussed in *Air Quality* above.	Moderate	Highly Unlikely	Low
	Access to contaminants by stock and wildlife			Minor	Highly Unlikely	Low
	Damage to vegetation and habitat			Minor	Highly Unlikely	Low
Storage and disposal of PFW	Contamination of soil, groundwater and / or surface water	6	PFW at the Katnook site will be stored in appropriately bunded tanks and transported off site for disposal at an EPA licence facility. Alternatively, upgraded or new ponds may be used in the future if required.	Serious	Highly Unlikely	Medium
	Access to contaminants by stock and wildlife Death of adjacent vegetation Injury to or death of wildlife		Upgraded or new pond constructed using appropriate materials and suitable design criteria including adequate freeboard, depths, leak detection systems, lining and bunding Upgraded or new pond designed and constructed with regard to EPA Guideline *509/19 Wastewater lagoon construction* Ensure adequate freeboard is maintained on pond. Tanks (where used) have appropriate overflow prevention and containment systems Install monitoring bores and conduct regular water quality monitoring Monitor and audit evaporation pond water quality regularly	Moderate	Highly Unlikely	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
			Minimise use of process chemicals (e.g. biocides, emulsion breakers) and use biodegradable or UV degradable chemicals where available Evaporation pond is within the fenced facility area to prevent wildlife and stock access Maintain a register of spills and / or leaks and remediate Record fauna entrapment or deaths if they occur and implement appropriate preventative measures if required			
Unauthorised access by third parties	Injury / danger to health and safety of employees, contractors and third parties	7	"No Entry" signs warning of dangers associated with production operations placed at the entry to the site. Necessary measures (e.g. security fencing, signage) taken to prevent the public accessing facilities, well sites or waste relating to the sites. All facilities designed, constructed, operated and maintained in accordance with relevant standards (see *Air Quality* in this table (above))	Moderate	Remote	Low
Access and activity of personnel outside designated facility area / work areas	Damage to vegetation and habitat Disturbance to land use	3, 1, 9	Training and induction of all personnel and visitors includes information on restricted areas and activities Vehicle access restricted to designated roads and areas Erection of fencing and signage to delineate restricted areas	Minor	Highly Unlikely	Low
	Damage to cultural heritage sites			Moderate	Remote	Low
Well operations and well integrity management						
Loss of well control during completions and workovers (resulting in uncontrolled release of gas to surface)	Localised contamination of soil, shallow groundwater and / or surface water	6, 7, 8	Wells designed, constructed, operated and maintained in accordance with Beach Energy's Well Engineering and Construction Management System (WECS) Standards and Well Integrity Standards (WIS) Periodic well integrity processes in place for whole of life well monitoring and management Workover / completion program in place, designed, verified and approved via Beach Energy's WECS Standards and WIS Periodic review of management systems as required based on learnings and changes to Australian and international leading practice Fit for purpose equipment used Competent site personnel and contractors on-site at all times Blowout preventers (BOP) installed where appropriate Regular BOP drills, testing, certification, and maintenance	Moderate	Highly Unlikely	Low
	Access to contaminants by stock and wildlife Damage to vegetation and habitat			Moderate	Highly Unlikely	Low
	Danger to health and safety of personnel, contractors and possibly the public			Serious	Remote	Low
	Generation of greenhouse gas emissions, localised reduction in air quality			Moderate	Highly Unlikely	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
			Continuous observation during operations to mitigate loss of well control events e.g. trip tanks / gas detection Personnel are trained in the use of spill response equipment Implementation of appropriate emergency / spill response procedures Emergency response procedures included in staff training Safety equipment on-site such as portable gas detection meters carried by field personnel and contractors Restricted access to site			
Explosion or fire at the well site during completions and workovers	Localised contamination of soil, shallow groundwater and / or surface water	6, 7, 8	Fit for purpose equipment used Approved workover / completion program Safety, testing, maintenance and inspection procedures are implemented Establishment of appropriate emergency / spill response procedures for explosion or fire Emergency response procedures included in staff training Safety equipment on-site such as portable gas detection meters carried by field personnel and contractors Personnel are trained in the use of spill response equipment Erection of signage and, where required, fencing to delineate restricted / hazardous areas Personnel are trained to supervise and instruct individuals entering lease to conduct work Appropriate fire fighting equipment maintained on-site Safe work permits must be obtained to ensure only individuals with proper clearance can conduct work on a lease Smoking only in designated areas located away from equipment or activity Restricted access to site	Serious	Remote	Low
	Danger to health and safety of personnel, contractors and possibly the public			Major	Highly Unlikely	Medium
	Generation of greenhouse gas emissions, localised reduction in air quality			Moderate	Highly Unlikely	Low
	Burning of vegetation and habitat			Moderate	Highly Unlikely	Low
	Injury to or loss of native fauna			Moderate	Highly Unlikely	Low
Spills or leaks associated with chemical and fuel storage and handling during completions and workovers	Localised contamination of soil, shallow groundwater and / or surface water Access to contaminants by stock and wildlife Damage to vegetation and habitat	6	See *Production facility operations* section for controls related to spills or leaks	Moderate	Highly Unlikely	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
Handling of formation water during completions and workovers	Localised contamination of soil, shallow groundwater and / or surface water Access to contaminants by stock and wildlife Loss of vegetation and fauna habitat	6	Tanks used for on-site storage of fluids generated during completions and workover activities	Minor	Highly Unlikely	Low
Well integrity management – cement failure	Communication between formations that are typically hydraulically isolated; or to surface Contamination of aquifers	6	Periodic well integrity processes in place for whole of life well monitoring and management Appropriate controls implemented during initial drilling of wells (under the Drilling SEO) including: Cement slurry and pumping schedule design Casing centralisation program QA / QC during cement job execution Cement bond logs run where appropriate Remedial cementing undertaken where logs indicate an unacceptable risk Competent site personnel and contractors on-site at all times	Serious	Highly Unlikely	Medium
Well integrity management – down hole production equipment failure (e.g. casing, packer, seal assembly)	Communication between formations that are typically hydraulically isolated	6, 7, 8	Appropriate controls implemented during casing installation (under the Drilling SEO) including casing design, running procedures, pressure testing and casing certification All wells designed, constructed, maintained and abandoned in such a manner that it can be demonstrated that at all stages in the well lifecycle, there will be two verified well barriers between a hydrocarbon or water zone and the surface, as per the WECS and WIS. Competent site personnel and contractors on-site at all times New wellhead and production equipment installed on all new wells Downhole production equipment and wellhead equipment designed to meet pressure, temperature, operational stresses and loads. Pressure testing, either inflow (negative test) or positive testing to be performed on barrier envelopes / components where feasible Inhibited static packer fluid, where applicable Monitoring programs implemented (e.g. through well logs, pressure measurements / testing and, or corrosion monitoring programs) to aid in the assessment of wellbore barrier conditions	Moderate	Highly Unlikely	Low
	Contamination of aquifers			Serious	Highly Unlikely	Medium
	Contamination of soil, shallow groundwater and / or surface water			Serious	Highly Unlikely	Medium
	Danger to health and safety of personnel, contractors and possibly the public			Serious	Remote	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
	Access to contaminants by stock and wildlife		Where monitoring identifies potential issues, working within Beach Energy Management Systems, risk assessment undertaken to identify hazards / scenarios and propose recommendations and mitigation controls where appropriate to reduce or monitor risk	Minor	Highly Unlikely	Low
	Damage to vegetation and habitat		Casing annulus pressures are routinely checked and reported, if accessible Downhole decommissioning following production	Minor	Highly Unlikely	Low
	Generation of greenhouse gas emissions, localised reduction in air quality		Well decommissioning program to be submitted to DEM prior to implementation Downhole decommissioning carried out to meet worst case expected loads and downhole environmental conditions	Minor	Highly Unlikely	Low
	Loss of reserves and reservoir pressure		Appropriate barrier controls 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 for barrier installation and testing submitted and retained	Moderate	Highly Unlikely	Low
Spills and leaks from artificial lift and wellhead production equipment	Localised contamination of soil, shallow groundwater and / or surface water Access to contaminants by stock and wildlife Damage to vegetation and habitat Generation of greenhouse gas emissions, localised reduction in air quality	6, 8	Equipment is fit for purpose and installed in accordance with relevant standards Safety, testing, maintenance and inspection procedures are implemented Safe work permits must be obtained to ensure only individuals with proper clearance can conduct work on a lease Where appropriate, impervious well cellars are installed at wells Containment devices are installed on gas well skids See *Production facility operations* section for controls related to spills or leaks	Minor	Highly Unlikely	Low
Handling of formation water during gas well deliquification	Localised contamination of soil, shallow groundwater and / or surface water Danger to health and safety of personnel, contractors and potentially the public Impacts to stock and / or wildlife Ignition of bushfires Damage to vegetation and habitat	6, 7, 3	Tanks used for on-site storage of water generated during gas well unloading Gas / fluid stream may be flared rather than vented to minimise emissions where possible. This will depend upon fluid ratio in the stream Wells that are frequently unloaded are reviewed to evaluate whether measures to minimise unloading are appropriate (e.g. installation of small ID tubing or artificial lift installation) Unloading undertaken only when prevailing environmental conditions (e.g. wind speed and direction) are suitable	Moderate	Highly Unlikely	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
Construction and rehabilitation activities (e.g. pipelines, access tracks and pads, Katnook site works)						
Construction and rehabilitation activities	Impacts to soil (e.g. erosion, inversion, compaction) Visual impact	2, 1	Landowners consulted regarding earthworks required, location of proposed activities and general information to minimise surface damage and to facilitate rehabilitation Soil removed during construction stockpiled on-site and returned to its original stratigraphic level upon restoration where appropriate (i.e. may not be appropriate for long-term sites such as Katnook) Separate storage of topsoil, subsoil and clays undertaken to assist in regeneration of vegetation, pasture or crops. Restoration of temporary sites 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 areas of compacted soil are ripped (after removal of any imported fill) and before the returning of stockpiled topsoil. Soil profile and contours are reinstated following completion of operations.	Minor	Highly Unlikely	Low
Construction and rehabilitation activities (continued)	Disturbance to natural drainage patterns Sedimentation of surface waters Localised change to shallow groundwater quality and flows	5	Sites, tracks and pipelines 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. Landowners or infrastructure owners consulted regarding requirements for crossings of artificial drainage channels. Appropriate measures implemented where required (e.g. culverts). Sediment and erosion control measures (e.g. sediment fences) installed where necessary (e.g. if in close proximity to drains or surface water features). Pipeline trench water disposed to land consistent with relevant guidelines (e.g. *Environment Protection (Water Quality) Policy 2015* requirements and ANZECC guidelines). Discharged water not allowed to flow beyond the intended receiving area or into any watercourses or areas where it may enter surface water unless it has been appropriately assessed. Any area artificially elevated via pad or access track construction is lowered to original ground level by removal of paving material unless otherwise instructed by the landowner. Original drainage patterns will be restored. If pipeline alignments require watercourse crossings, undertake in dry conditions where possible and complete within the shortest period practicable. If crossing flowing	Moderate	Highly Unlikely	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
			watercourses, locate stockpiles (e.g. excavated bank material) and HDD sites (if HDD used) in bunded areas away from watercourse banks. Relevant permits (e.g. for water affecting activities under the LSA Act) obtained where required. HDD undertaken in accordance with site specific management procedures. Trench plugs installed where necessary to prevent longitudinal water flow within the backfilled trench.			
Construction and rehabilitation activities (continued)	Introduction and spread of weeds or pathogens	4	All reasonable and practical endeavours undertaken 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 Limestone Coast 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. Biosecurity procedures implemented as agreed with landholders. All records of vehicle or equipment inspections and cleaning will be kept for auditing. Paving materials are sourced from licensed quarries that are free of weeds. Operational sites 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 Limestone Coast Landscape Board. Records of detection, monitoring or eradication of weeds or pathogens introduced by activities are kept and available for review.	Moderate	Highly Unlikely	Low
Construction and rehabilitation activities (continued)	Damage to native vegetation and wildlife habitats Disturbance to native fauna	3	Appropriately trained and experienced personnel have assessed or scouted proposed routes or locations to identify and flag significant (or rare, vulnerable or endangered) species and communities (including wetland communities). Native vegetation clearance avoided or minimised by locating sites, tracks or pipelines appropriately. Vegetation (e.g. trees on or adjacent to pipeline easements) is trimmed rather than removed where possible 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).	Moderate	Highly Unlikely	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
			Areas of high quality or significant10 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 sites 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. Minimise hazard to fauna by leaving trenched areas open for as little time as possible Utilise trench plugs and fauna ladders to facilitate movement of fauna out of and across trench Regularly inspect open trenches and excavations to detect and release trapped fauna If threatened species (e.g. Red-tailed Black-Cockatoos) are detected or likely to occur near the 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. Sites with native vegetation are rehabilitated in consultation with DEM, DEW and other relevant stakeholders.			
Construction and rehabilitation activities (continued)	Damage to infrastructure Disturbance to stock Disturbance to land use Dust generation Noise generation	1	Landholders are consulted regarding the location, management and timing of proposed activities. Ongoing landholder liaison during and following operations. Activities are restricted to agreed / defined areas. All gates left in the condition in which they were found (open / closed). Construction near residences is scheduled in accordance with EPA recommendations for normal construction working hours as far as practicable Local residents will be consulted if unavoidable out-of-hours work is required near residences All vehicles and equipment conform to appropriate noise control standards. Systems in place for logging stakeholder complaints to ensure that issues are addressed as appropriate. Compliance with Part 10 of the PGE Act(Notice of Entry requirements).	Minor	Unlikely	Low

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

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
			In the case of a decommissioned site, the entire area will be restored to original land surface topography with no irregularities likely to cause injury to stock. Unless otherwise agreed with the landowner During rehabilitation, imported materials are removed from site and soil profiles and contours restored unless otherwise agreed with the landowner. If necessary, unsealed roads will be sprayed with water as required to minimise dust generation.			
Construction and rehabilitation activities (continued)	Damage to cultural heritage sites	9	Cultural heritage inspection of proposed activity areas undertaken with the relevant Aboriginal heritage group. Known sites identified and protected from operations (e.g. using temporary flagging). Cultural heritage issues covered in inductions. Key personnel (e.g. supervisors, machinery operators) receive appropriate cultural heritage training. Procedure in place for the appropriate response to any sites discovered during activities. Records of sites forwarded to the Aboriginal Heritage Branch in compliance with the Aboriginal Heritage Act. Records relating to sites of cultural heritage significance kept and available for audit. Heritage site registers and Heritage Branch, DEW, consulted regarding the location of non-indigenous heritage sites where appropriate.	Moderate	Highly Unlikely	Low
Spills or leaks associated with chemical and fuel storage and handling	Contamination of soil, shallow groundwater and / or surface water Access to contaminants by stock and wildlife Loss of vegetation and fauna habitat	6	Implement appropriate refuelling procedures (e.g. use of drip trays and avoidance of refuelling in proximity to watercourses or water bodies) See *Production facility operations* section for controls related to spills or leaks	Moderate	Highly Unlikely	Low
Ignition of fire in construction areas	Disturbance to cultural heritage sites Loss of vegetation and fauna habitat Release of particulate emissions to the atmosphere Disruption to land use (e.g. grazing and recreation)	9, 3, 8, 1	See *Production facility operations* section for controls relating to fire prevention.	Serious	Remote	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
Accidental release of hydrotest water	Contamination of soil, shallow groundwater and / or surface water Access to contaminants by stock and wildlife Loss of or damage to vegetation and fauna habitat as a result of soil or water contamination Soil erosion / scouring	6, 2	Use of biocides and toxic chemicals are kept to a minimum and if biocides are necessary UV-degradable or biodegradable biocides shall be used where practicable Assessment of hydrotest water prior to disposal to land is undertaken to ensure that its quality is consistent with relevant guidelines (e.g. ANZECC and EPA) for the disposal site. Discharged water not allowed to flow beyond the intended receiving area or into any watercourses or areas where it may enter surface water Landholder approval obtained prior to disposal of hydrotest water to land Disposal of hydrostatic test water into existing lined and fenced pond, or to bunded tanks for off-site treatment or disposal at an approved facility where disposal to land is not appropriate Use of aerators / spray bars, geotextile etc. to prevent soil erosion at discharge point where uncontaminated hydrotest water is released to land	Minor	Highly Unlikely	Low
Pipeline operations						
Explosion or fire along a pipeline	Localised contamination of soil, shallow groundwater and / or surface water Atmospheric pollution Damage to vegetation and fauna habitat Disruption to land use (e.g. grazing)	6, 8, 3, 1, 7	All pipelines are designed, constructed, operated and maintained in accordance with relevant standards[11] including installation of appropriate warning signage and appropriate external interference protection measures Separation distances and exclusion zones are maintained Pipeline proximity fire breaks are cleared and maintained Safety, testing, maintenance and inspection procedures are implemented Refer to *Production facility operations* section for additional controls relating to fire prevention	Moderate	Highly Unlikely	Low
	Danger to health and safety of personnel, contractors and possibly the public			Major	Remote	Medium
Spill or leak associated with pipeline failure	Localised contamination of soil, shallow groundwater and / or surface water Damage to vegetation and habitat	6, 7	All pipelines are designed, constructed, operated and maintained in accordance with relevant standards[11] including installation of appropriate warning signage and appropriate external interference protection measures Safety, testing, maintenance and inspection procedures are implemented	Moderate	Highly Unlikely	Low

[11] Relevant standards include AS 2885, AS 2832.1 and associated documentation/processes including Safety Management Study, Pipeline Integrity Management Plan, Pipeline Management System and Remaining Life Review

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
	Disruption to land use (e.g. grazing) Access to contaminants by stock and wildlife		Export lines and high pressure flowlines associated with well equipment have pressure monitoring / shutdown in case of leak Establishment of appropriate emergency / spill response procedures for spills or leaks to soil and water			
	Danger to health and safety of personnel, contractors and possibly the public		Personnel are trained in the use of spill response equipment Spill response equipment maintained on-site Immediate clean-up and remediation of spills to minimise contamination to soil / water Fencing of contaminated areas if threat is posed to stock or wildlife Maintain a register of spills and / or leaks and implement corrective actions based on analysis of spill events Periodic review and exercise of response equipment and procedures to ensure preparedness	Moderate	Highly Unlikely	Low
Pipeline inspection and maintenance activities	Disturbance to land use Introduction and spread of weeds or pathogens	1, 4	See *Construction and Rehabilitation* section for relevant controls	Minor	Highly Unlikely	Low
Use of roads						
Use of roads; movement of vehicles and heavy machinery	Injury or death of stock or fauna Dust generation Noise generation Damage to third party infrastructure Disturbance to local community	1, 3	Control production and dispersion of dust on unsealed roads and tracks. Compliance with relevant speed restrictions on access roads and tracks. Warning signage and traffic management measures installed where appropriate. If necessary, unsealed roads will be sprayed with water as required to minimise dust generation. Driver behaviour and vehicle speed limits to be included in compulsory induction.	Minor	Highly Unlikely	Low
	Road hazard / disturbance to local road users		Vehicle speed limits to be observed. Landholders, local councils, potentially affected residents and emergency services will be informed of significant transport movements. All required authorisations (e.g. local council, DIT, police) obtained where required for movement of oversize loads along public roads, including joint inspections of roads before and after transport moves if necessary. Significant transport movements to detour around town centres where possible. Any deterioration of property tracks or infrastructure as a result of activities is rectified.	Serious	Highly Unlikely	Medium
Waste management						

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
Storage, handling and disposal of waste	Localised contamination of soil, surface water and groundwater Damage to vegetation and habitat Attraction of scavenging animals (native / pest species) and access to contaminants by stock and wildlife Litter / loss of visual amenity	6, 1	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. Monitoring and maintenance of the wastewater system at the Katnook facility undertaken on a quarterly basis Treated wastewater is periodically collected by tanker and transported to a licensed disposal facility or irrigated in accordance with appropriate approvals. Any necessary approvals are obtained for use of wastewater system. Well site is kept free of litter and rubbish.	Minor	Unlikely	Low
Decommissioning of infrastructure						
Loss of containment of gas or condensate (pipeline failure / pigging during decommissioning or leaks from facility equipment)	Localised contamination of soil, shallow groundwater and / or surface water Disruption to land use (e.g. grazing) Atmospheric pollution Access to contaminants by stock and wildlife Loss of vegetation and fauna habitat	6, 8, 7, 10	Decommissioning programs planned to avoid or minimise hazardous situations, with controls in place to address risks Pipeline decommissioning programs planned to take into account pipeline condition and location and minimise risk of rupture or leak See *Production facility operations* section for controls related to spills or leaks	Moderate	Highly Unlikely	Low

Risk Event / Hazard	Potential Environmental Impacts	SEO Obj	Key Management Measures	Consequence	Likelihood	Residual Risk
	Danger to health and safety of personnel, contractors and possibly the public			Serious	Remote	Low
Handling and disposal of hazardous materials (e.g. low level mercury contaminated sludge, VOCs, BTEX, H_2S)	Localised contamination of soil, shallow groundwater and / or surface water Danger to health and safety of personnel, contractors and possibly the public	6, 7, 10	Identify associated risks prior to work commencing and develop specific safety and health procedures including PPE Carry work out on hardstand areas where possible Appropriate spill response procedures and containment measures in place Work performed by accredited contractor.	Moderate	Highly Unlikely	Low
Accidental release of hydrotest water or water used for flushing pipelines	Contamination of soil, shallow groundwater and / or surface water Access to contaminants by stock and wildlife Loss of vegetation and fauna habitat as a result of soil or water contamination	6	See *Construction and Rehabilitation* section for controls related to hydrotest water	Minor	Highly Unlikely	Low
Explosion or fire	Danger to health and safety of personnel, contractors and possibly the public	7, 6, 8, 1, 10	Decommissioning programs planned to avoid or minimise hazardous situations, with controls in place to address risks Risk assessments undertaken in line with industry best practice Hazardous area assessment and compliance with AS 3000 Earthing maintained as appropriate to prevent static charges where residual hydrocarbons may be present See *Production facility operations* section for additional controls relating to fire prevention	Major	Highly Unlikely	Medium
	Contamination of soil, shallow groundwater and / or surface water			Moderate	Highly Unlikely	Low
	Atmospheric pollution			Moderate	Highly Unlikely	Low
	Damage to vegetation and fauna habitat			Moderate	Highly Unlikely	Low
	Disruption to land use (e.g. grazing and recreation)			Moderate	Highly Unlikely	Low

6 Environmental Management Framework

Production activities will be undertaken in accordance with Beach Energy's Operations Excellence Management System (OEMS) and Production Operations Safety Manual.

Operations Excellence Management System

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.

KGPF HSE Management Plan

The Katnook HSE Management Plan (KGPF HSEMP) (CDN/ID 18528220) is the reference manual for Beach Energy Site Supervisors and Production Operators controlling well production operations of the processing plant and onshore wells. This document does not replace sound production practices and should reflect industry best practice.

The purpose of the plan is to:

- illustrate the guidelines, procedures and controls required during production of gas wells.
- provide sufficient information to ensure that production operations are conducted with environmentally and safety orientated procedures.
- provide a guide for relevant personnel on the procedures to be followed to ensure that a consistent, thorough and uniform approach is adopted to facilitate delivery of hydrocarbon product to point of sale.
- provide sufficient information to allow a Production Supervisor to supervise and monitor production operation control standards and reporting.
- provide sufficient information to allow the Production operator to operate, monitor and report on production operations.

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

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.

6.1 Responsibilities

Environmental management and compliance will be the responsibility of all personnel and contractors. The indicative organisation and responsibilities for personnel overseeing environmental management are detailed in Table 17. The exact nature and title of these roles may vary and positions may be amalgamated or the responsibilities shared under a modified arrangement.

Responsibility for control of all activities is delegated from the Chief Operating Officer to the General Manager Operations for each asset. The Facilities Manager and/or Operations Superintendent for each asset has the responsibility for ensuring that all work carried out is undertaken in accordance with all relevant procedures, systems and standards. The training of all personnel will ensure that each individual is aware of their environmental responsibility.

Table 17: Indicative roles and responsibilities

Role	Responsibility
Managing Director	• HSE performance of all activities across Beach Energy • Appropriate HSE policies are in place and HSE management system in place to deliver these policies in practice • Appropriate resources are in place to implement the OEMS.
Chief Operating Officer	• HSE performance of all activities across Beach Energy • Ensuring a system is in place for the ongoing identification and control of HSE risks • Developing HSE Improvement Action Plan and ensuring all sites/activities have one • Ensuring systems are in place to define requirements for personnel (including contractors) HSE competencies to carry out their work • Ensuring managers and supervisors understand, accept and carry out their responsibilities in safety and health matters and that they are trained and instructed to undertake these responsibilities • Ensuring processes are in place for interpreting and communicating relevant legislative requirements and industry standards and any changes thereto, and compliance with these obligations i.e. Annual Safety Report, • Safety Case/Safety Management Plans, Environmental Management Plans where these documents exist due to regulatory requirements • Monitor safety performance through review of lead and lag Key Performance Indicators (KPIs) and actions are taken to improve safety performance and correct any identified deficiencies.

Group Executive HSE & Risk	• Providing technical support to the Managing Director and the General Managers for each asset on OEMS and HSE issues • Ensuring a system is in place for the ongoing identification and control of HSE risks • Ensuring systems are in place to define requirements for personnel (including contractors) HSE competencies to carry out their work • Ensuring managers and supervisors understand, accept and carry out their responsibilities in safety and health matters and that they are trained and instructed to undertake these responsibilities • Development and update of the OEMS and supporting documentation within • Monitors safety performance through review of lead and lag Key Performance Indicators (KPIs) and actions are taken to improve safety performance and correct any identified deficiencies.
Head of Technical Assurance	• Providing assurance that the onshore and offshore facilities have been designed and constructed to meet the requirements of the relevant OEMS applicable performance standards • Delivery of Safety Case/Safety Management Plans and regulatory reports where these documents exist due to regulatory requirements • Oversight of verification of safety critical controls within site Safety Cases/ EMPs via the Integrity Verification program. • Developing, monitoring, periodic review and update of the relevant Asset Integrity Management Plans • Ensuring assurance activities are undertaken in accordance with performance standards for safety critical elements
Head of Environment	• Emissions monitoring, reporting and reduction opportunity identification • Waste Management – liquid and solid management strategies including recycling • Rehabilitation – strategy development, on-ground implementation and monitoring • Energy Efficiency – facility monitoring, reporting and opportunity identification • Native title – stakeholder management strategies • Regulatory Compliance – monitoring, reporting (internal and external) and advocacy with regulators • Water Management – modelling, monitoring, strategy development and advocacy with regulators • Climate Change – policy and strategy development, carbon emissions reduction project identification
Head of Health & Safety	• Providing technical support to the Chief Operating Officer and the General Managers for each asset on OEMS and HSE issues • Supporting the identification and management of HSE risks across production operations • Assisting to uniformly implement the OEMS across Beach Energy facilities
Head of Corporate Risk	• Developing assurance plan and implementation of assurance activities that monitor overall compliance with the OEMS elements

General Manager - Engineering and Technical Services	• Managing implementation of Asset Integrity Management Plans • Managing inspections, maintenance and testing programs for plant, equipment and associated control systems to ensure continued reporting • Ensuring systems are in-place to maintain plant and equipment operations strictly within their designed operating envelope • Ensuring personnel inspecting, maintaining and testing equipment are competent to do so • Maintaining systems to control the quality and suitability of maintenance consumables and replacement parts • Maintaining systems to retain records of all scheduled programs for maintenance, inspection, testing and calibration of facilities, plant, equipment and machinery • Ensuring all engineering and maintenance contracts are in accordance with the relevant OEMS standards • Ensuring appropriate HSE reviews are undertaken for any new equipment or any planned modifications or changes in the design or operation of existing plant and equipment • Maintaining as built drawings and documentation of the facilities, plant and equipment. • Implementation and verification of safety critical controls within site Safety Cases/EMPs. • Execution of stay-in-business projects and planned modifications to the design or operation of existing plant and equipment, ensuring appropriate HSE reviews are undertaken in accordance with Management of Change processes
General Manager Operations	• HSE performance of all activities across their asset • Responsible Person on behalf of the Person Conducting Business Undertaking (PCBU) for the development, implementation and compliance with the asset's Safety Cases/ EMPs. • Ensuring the Facilities Manager and Operations Superintendent has the required skills and can fulfil their duties as the "Accountable Person" for managing HSE performance at each site • Ensuring that, for every site and activity in their area of responsibility: • appropriate systems exist for monitoring existing and identifying new HSE risks • key controls are identified • appropriate risk treatment plans are implemented • Ensuring that regional and site level emergency response plans are in place and regularly tested • Implementing and ensuring compliance with systems which define the HSE competencies for personnel (including contractors) to carry out their work • Ensuring assurance activities are undertaken in accordance with performance standards for safety critical elements • Maintaining relationship and reporting relevant requirements under the Safety Cases/ EMPs and HSE legislation.

Facilities Manager / Operations Superintendent	• Day to day management of the asset in line with the Safety Case/ /EMP and the OEMS • NZ - Compliance with all "Permitted Operations" as described in the Safety Case Performance Standards for each Safety Critical Element • Ensuring appropriate and effective OEMS procedures, work instructions and support documents exist for their site or activity • Providing supervision and processes to ensure that the OEMS is implemented correctly on site • Ensuring compliance with all relevant procedures, systems and standards; • Appointing competent personnel to manage day-to-day HSE matters and associated compliance risks • Ensuring appropriate risk management is undertaken for their site or activity in accordance with relevant procedures • Ensuring that appropriate reporting, verification, authorisation and escalation occurs within their area of responsibility for the review and actioning of all incidents, defects, hazards, inadequacies of procedures • Ensuring that processes are implemented to ensure that all employees and contractors (members of the workforce) in their area of responsibility are appropriately inducted, hold the required competencies and licences to undertake their assigned work.
Senior Environmental Advisor **Senior HSE Advisor**	• Providing technical support to the General Managers, Facilities Manager and Superintendent for each asset on OEMS and HSE issues • Assisting with the development, revision and effective implementation of HSE procedures and tools necessary for efficient functioning of the OEMS • Supporting the identification and management of HSE risks across production operations • Assisting to uniformly implement the OEMS across Beach Energy facilities • Managing HSE audits and other assurance activities for improving the effectiveness of the OEMS. • Managing and recording consultation of stakeholders on HSE management of production operations.
First Nations Engagement Manager	• Providing technical support to the General Managers, Facilities Manager and Superintendent for each asset on OEMS and HSE issues • Assisting with the development, revision and effective implementation of HSE procedures and tools necessary for efficient functioning of the OEMS • Supporting the identification and management of HSE risks across production operations • Assisting to uniformly implement the OEMS across Beach Energy facilities • 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 of production operations.

Employees and Contractors (Members of the Workforce)	• 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 or Facilities Manager/Operations Superintendent • Participating in training and development activities and competency reviews as and when required

6.2 Environmental Management Standard

All Beach Energy employees and contractors are responsible for ensuring compliance with

the BSTD 10.1 - Beach Energy Environmental Management Standard and associated environmental legislation. The Environmental Management Standard is comprised of a number of levels of documentation (including plans and procedures) that form the framework for the management of the environment in which Beach Energy operates. The standard covers all activities undertaken by Beach Energy in Australia including exploration, drilling, well operations, and production.

Beach Energy conducts periodic environmental audits to assess the appropriateness of the Standard to meeting Beach' Energy s policies, legislative requirements and environmental objective commitments and whether the procedures have been properly implemented and maintained.

6.3 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 Energy 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 Energy operates a single use, multi-purpose Permit to Work (PTW) system covering all areas of operations in the region. The purpose of this PTW procedure is to summarise the Beach Energy 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.

6.4 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. Beach Energy field personnel and contractors receive periodic, in-field environmental training. Beach Energy also utilises knowledge sharing bulletins to communicate specific environmental issues.

A record of induction and attendees will be maintained.

6.5 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 are 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 (e.g. every 2 years in accordance with regulations) 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.

6.5.1 Spill Response

Spill response procedures are captured under Beach Energy's emergency response plan, which requires spills to be contained, reported, cleaned-up and the cause investigated and corrective and / or preventative action implemented.

Minor spills in lined bunded areas are generally treated in situ in accordance with EPA guidelines. Initial clean-up of spills outside of bunded areas usually involves removal of hydrocarbon contaminated soil to licenced waste facility.

Assessment of potentially contaminated sites where spills have occurred is undertaken in accordance with the National Environment Protection Measure for contaminated sites. Site remediation (where required) is undertaken in line with relevant EPA guidelines.

6.6 Environmental Monitoring and Audits

Ongoing monitoring and auditing of production operations are undertaken to determine whether significant environmental risks are being managed, minimised and where reasonably possible, eliminated.

Monitoring programs are designed to assess:

- compliance with regulatory requirements (particularly the Statement of Environmental Objectives)
- integrity of bunding and containment systems
- integrity of pond and pond liner
- site contamination
- groundwater quality
- site revegetation following completion and any restoration.
- potential future problems.

6.7 Incident Management, Recording and Corrective Actions

Beach Energy and its contractors have a system in place to record environmental incidents, near misses and hazards, track the implementation and close out of corrective actions, and allow analysis of such incidents to

identify areas requiring improvement. The system also provides a mechanism for recording 'reportable' incidents, as defined under the PGE Act and associated regulations.

6.8 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 Energy.

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

The National Pollutant Inventory (NPI) is an internet-based database on emissions and transfer of substances (see Section 5.7). Several of Beach Energy's production facilities exceed NPI reporting thresholds and the resultant emissions are reported at http://www.npi.gov.au/.

Where applicable, incidents causing or threatening serious or material environmental harm under the *Environmental Protection Act 1993* must be reported to the EPA in accordance with Section 83 of the Act.

As noted in Section 2.2, the Environmental Protection Act and its reporting obligation do not apply to:

- petroleum exploration activity undertaken under the PGE Act .
- wastes produced in the course of an activity (not being a prescribed activity of environmental significance) authorised by a licence under the PGE Act when produced and disposed of to land within the area of the licence.

7 Stakeholder Consultation

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 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 PGE Regulations that information on consultation with relevant landowners, First Nations People or representatives, government departments or agencies, or any other interested person or parties is outlined in an EIR.

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

Beach Energy is committed to maintaining effective communication and good relations with all stakeholders. Beach Energy maintains ongoing contact with key stakeholders, landholders and other directly affected parties in relation to all aspects of its operations in the Otway Basin. Issues raised to date have been integrated into this report.

Beach Energy aims to continue to engage stakeholders for the duration of its exploration and production activities to ensure that all potential concerns are identified and appropriately addressed.

7.1 Overview of Consultation

Petroleum production operations have been conducted in the Otway Basin for over 20 years. Consequently, key stakeholders in the region, particularly landowners, are aware of and understand the relevant issues associated with petroleum production operations in the region.

Beach Energy undertakes active ongoing liaison with landowners in the Otway Basin. This includes formal notification and direct discussions regarding specific proposed activities such as well drilling, fracture stimulation, pipeline and facility construction, road construction and maintenance and site rehabilitation, as well as less formal liaison regarding working safely near pipelines, general operational and land management matters.

7.2 Stakeholder Consultation on the EIR and SEO (2003 – 2019)

In August 2018 Beach Energy held 'drop-in' community consultation sessions at the Wattle Range Council offices in Penola and Millicent. The aim of these sessions was to provide the local community an opportunity to meet with Beach Energy to discuss future development plans for the Penola region. A multi-discipline team of Beach Energy employees attended the sessions to answer questions on exploration and production activities.

There was an extensive media campaign undertaken to communicate the consultation activities Beach Energy was undertaking as part of the update to the Production and Drilling EIR and SEO. This media coverage extended across print media, in particular The Border Watch, The Pennant (Penola), The South Eastern (Millicent) and The Naracoorte Herald, as well as local ABC South East Radio, which combined have an audience catchment of approximately 56,000 people extending from Padthaway in the mid south-east to Port MacDonnell on the Limestone Coast coastline.

To ensure any direct or indirect parties living outside the catchment area of the Limestone Coast were also informed, Beach Energy advertised the consultation events across regional South Australia via the ABC Statewide Regional radio broadcast and in The Stock Journal weekly print publication. The advertisements in the print publications were run in the two weeks leading into the consultation events with a number of publications running follow up stories on the success of the respective events in Penola and Millicent.

Due to the high level of interest in Beach Energy's activities in the region at the time, Beach Energy decided to make the draft EIR and accompanying SEO publicly available on its website for all stakeholders to review who were directly and indirectly impacted by Beach Energy's production operations. Beach Energy informed stakeholders who attended the public meetings and used local ABC radio to inform the draft documents would be available for review on its website over a four-week period. Hard copies of the documents were provided to stakeholders upon request.

The EIR and the accompanying SEO were then updated where relevant. In addition to comments on issues relevant to the scope of the EIR and SEO, Beach also received comments expressing general opposition to fossil fuels, general opinions on an issue, or comments which require consideration by the regulator rather than Beach.

The Department for Energy and Mining and the Department for Environment and Water provided initial comments on the draft documents and these were addressed in the EIR and the accompanying SEO.

The EIR and SEO were formally submitted to DEM after being updated to address the comments raised and underwent a formal period of consultation under the PGE Act 2000. The SEO was gazetted in April 2019.

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

- Website
- Online engagement platform
- Regular stakeholder information updates (latest version issued February 2024)
- Regular meetings with landholders and key stakeholders
- Community partnerships.

7.3 EIR and SEO Assessment and Consultation (2024)

Beach Energy have a consultation program in place and undertake regular engagement with stakeholders, landholders and the community located in the Otway Basin region. Through our ongoing community engagement program in the Otway Basin, stakeholders are aware of issues associated with petroleum production in the Otway Basin and the current non-operational status of the Katnook gas facility. Notwithstanding, Beach will formally consult with key stakeholders and landholders during the current review and revision of this EIR and SEO.

The basis of Beach Energy's stakeholder consultation will be:

- to ensure stakeholders are kept informed of our operations in the area
- to ensure that Beach Energy has an understanding of issues of importance to the community when it comes to our operations
- so the community has relevant contact details for key personnel in Beach Energy
- to ensure landholders are aware of specific issues regarding the safety of working near our assets.

Our engagement tools include:

- Beach Website

- Beach online engagement platform (https://engage.beachenergy.com.au/otway-basin-south-australia)
- Regular community and stakeholder information updates (https://hdp-au-prod-app-beach-engage-files.s3.ap-southeast-2.amazonaws.com/5517/0857/9015/SA_Otway_Info-Sheet_February_2024.pdf)
- Regular meetings with landholders and key stakeholders
- Community partnerships and investment
- Public notices in the local print press

A summary of written responses will be incorporated into the final revised EIR.

Revision 5 of the EIR and Revision 4 of the SEO will be submitted to DEM for review after stakeholder engagement has been completed in May 2024.

[TO BE UPDATED FOLLOWING DEM CONSULTATION RESPONSES]

DEM undertook additional consultation on the SEO and EIR with the following government agencies:

- Department for Environment and Water (DEW)
- Aboriginal Affairs and Reconciliation (AAR)
- Limestone Coast Landscape Board
- Environment Protection Authority (EPA)
- SA Health

A summary of consultation comments and responses is provided in Appendix C.

8 References

ABS 2021. 2021 Census data and analysis. Accessed 17 January 2024 at http://www.abs.gov.au/websitedbs/censushome.nsf/home/2016 Australian Bureau of Statistics. Canberra, ACT.

ABS. 2022. Region summary: Penola. Estimated resident population. Website accessed on 17 January 2024 at: https://dbr.abs.gov.au/region.html?lyr=sa2&rgn=407021156. Australian Bureau of Statistics. Canberra, ACT.

Adelaide Energy 2009. *Environmental Impact Report: Adelaide Energy Pipelines (Jacaranda Ridge-2, Limestone Ridge-1, Haselgrove South-2 and Wynn-2).* June 2009. Adelaide Energy, Adelaide SA.

Adelaide Energy 2011a. *Addendum to the Environmental Impact Report for the Production and Processing of Petroleum Products and Associated Activities at the Katnook and Ladbroke Grove Gas Plants, Otway Basin – South Australia. Five Year Review of the Statement of Environmental Objectives*. April 2011. Adelaide Energy, Adelaide SA

Adelaide Energy 2011b. *Statement of Environmental Objectives for the Production and Processing of Petroleum Products and Associated Activities at the Katnook and Ladbroke Grove Gas Plants, Otway Basin – South Australia.* April 2011. Origin Energy Resources Ltd.

APA 2016. *South East South Australia Gas Pipeline (PL16) Statement of Environmental Objectives (Operations)*. September 2016. APA Group.

APGA 2020. *Code of Environmental Practice – Onshore Pipelines*. Australian Pipelines and Gas Association, Kingston ACT.

Backhouse, G.N. & J.A. Jeanes 1995. The Orchids of Victoria. Carlton: Miegunyah Press, Melbourne University Press.

Bates R.J. 2011. South Australia's Native Orchids. E-book. Native Society of South Australia Inc., Adelaide.

Beach 2013a. *Environmental Impact Report: Drilling, Completion and Initial Production Testing in the Otway Basin, South Australia*. November 2013. Beach Energy, Adelaide SA.

Beach 2018. *Statement of Environmental Objectives: Drilling, Completion and Well Production Testing in the Otway Basin, South Australia*. November 2018. Beach Energy, Adelaide SA.

Beach 2021. *Statement of Environmental Objectives for Geophysical Activities in the Otway Basin, South Australia.* April 2021. Beach Energy, Adelaide SA.

Binks, B. 2000. Profile of the South East Irrigation Industry, South East Catchment Water Management Board, South Australia, September 2000.

BirdLife International 2009. Apus pacificus In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. Apus pacificus. IUCN Red List

Bishop, A. 1996. Field Guide to Orchids of New South Wales and Victoria. Sydney, NSW: University of New South Wales Press.

Blakers, M., S.J.J.F. Davies & P.N. Reilly 1984. *The Atlas of Australian Birds*. Melbourne, Victoria: Melbourne University Press.

BOM 2024. Climate Data Online. Accessed in March 2018 at http://www.bom.gov.au/climate/data/. Bureau of Meteorology, Australia.

Brown, K., Harrington, G., and Lawson, J. 2006. Review of groundwater resource condition and management principles for the Tertiary Limestone Aquifer in the South East of South Australia. South Australia. Department of Water, Land and Biodiversity Conservation. DWLBC Report 2006/2.

Brown, K., Love, A., and Harrington G. 2001. Vertical groundwater recharge to the Tertiary confined sand aquifer, South East, South Australia, Department of Water Resources South Australia, Report Book DWR 2001/002 (unpublished).

Carter, O. 2010. National Recovery Plan for Trailing Hop-bush *Dodonaea procumbens*. Department of Sustainability and Environment, Melbourne, Victoria.

Croft. T.S., Carruthers, S., Possingham, H., Inns, B. 1999. Biodiversity Plan for the South East of South Australia. Department for Environment, Heritage and Aboriginal Affairs, Adelaide, SA.

Crowley, G.M. & S.T. Garnett 1998. Vegetation change in the grasslands and grassy woodlands of central Cape York Peninsula. *Pacific Conservation Biology*. 4:132-148.

Davies, R.J.P. 1986. Threatened Plant Species of the Mt Lofty Ranges and Kangaroo Island Regions of South Australia. Conservation Council of South Australia.

Davies, R.J.P. 1992. Threatened Plants of the Murray Mallee, Mt Lofty Range and Kangaroo Island Region of South Australia. Conservation Council of South Australia.

DEE 2018. EPBC Act Protected Matters Search Tool – online database http://www.environment.gov.au/epbc/pmst/index.html. Department of the Environment and Energy, Canberra. Searched March 2018.

DEE 2018a. Species Profile and Threats Database: *Glycine latrobeana* – Clover Glycine, Purple Glycine. Accessed on May 2018 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=13910. Department of the Environment and Energy, Canberra.

DEE 2018b. Species Profile and Threats Database: *Calyptorhynchus banksii graptogyne* — Red-tailed Black-Cockatoo (south-eastern). Accessed on May 2018 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25982. Department of the Environment and Energy, Canberra.

DEE 2018c. Species Profile and Threats Database: *Litoria raniformis* — Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog. Accessed on May 2018 at http://www.environment.gov.au/cgibin/ sprat/public/publicspecies.pl?taxon_id=1828. Department of the Environment and Energy, Canberra.

DEE 2018d. Species Profile and Threats Database: *Isoodon obesulus obesulus* – Southern Brown Bandicoot (Eastern). Accessed on May 2018 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=68050. Department of the Environment and Energy, Canberra.

DEE 2018e. Species Profile and Threats Database: *Miniopterus schreibersii bassanii* — Southern Bent-wing Bat. Accessed on May 2018 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=76606. Department of the Environment and Energy, Canberra.

DEW 2018. Biological Databases of SA. Department of Environment and Water. Recordset number DEWNRBDBSA180307-1

Dickson, C.R., Farrington, L & Bachmann M. 2014. Survey and description of the Seasonal Herbaceous Wetlands (freshwater) of the Temperate Lowland Plains in the South East of South Australia. Nature Glenelg Trust.

DSEWPC 2009. Australia's 15 National Biodiversity Hotspots. A WWW publication accessed on 25 June 2012 at http://www.environment.gov.au/biodiversity/hotspots/nationalhotspots. Html#hotspot6.

DSEWPC 2011. *Environment Protection and Biodiversity Conservation Act 1999* referral guidelines for the endangered southern brown bandicoot (eastern) *Isoodon obesulus*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

EBS 2011. Case Study: Southern Bell Frog Surveys. http://www.ebsecology.com.au/documents/StateGovernment- SouthernBellFrogSurveys_000.pdf

Frith, H.J., F.H.J. Crome & B.K. Brown 1977. Aspects of the Biology of the Japanese Snipe *Gallinago hardwickii*. *Australian Journal of Ecology*. 2:341-368

Garnett, S.T. & G.M. Crowley 2000. *The Action Plan for Australian Birds 2000*. Canberra, ACT: Environment Australia and Birds Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/action/birds2000/index.html.

Garnett, S.T., & S. Shephard 1997. Cape York Peninsula, Australia, as a stopover site for Latham's Snipe *Gallinago hardwickii*. *Stilt*. 30:54-55.

Golder. 2019. Baseline Groundwater Monitoring Report, Katnook Gas Facility. Prepared by Golder Associates Pty Ltd for Beach Energy Limited, Adelaide SA.

Gravestock, D.I., Hill, A.J. and Morton, J.G.G. 1986. A review of the structure, geology and hydrocarbon potential of the Otway. Basin in South Australia. South Australia. Department of Mines and Energy. Report Book, 86/77.

Higgins, P.J. & S.J.J.F. Davies, eds 1996. *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three – Snipe to Pigeons*. Melbourne, Victoria: Oxford University Press

Higgins, P.J. (ed.) 1999. Handbook of Australian, New Zealand and Antarctic Birds. Volume Four – Parrots to Dollarbird. Melbourne: Oxford University Press.

Hill, R., Burnard, T. 2001. Habitat Management Plan for the South-eastern Red-tailed Black- Cockatoo. Red-tailed Black-Cockatoo Recovery Team. Birds Australia, Melbourne, Victoria.

Kopsen, E. and Scholefield, T. 1990. Prospectivity of the Otway Supergroup in the central and western Otway Basin. APEA Journal, 30:263-279.

Littler, F.M. 1910. *A Handbook of the Birds of Tasmania and its Dependencies*. Launceston: Published privately.

Love, A., Herczeg, A., Armstrong, D., Stadter, F., and Mazor, E. 1993. Groundwater flow regime within the Gambier Embayment of the Otway Basin, Australia: evidence from hydraulics and hydrochemistry, Journal of Hydrology, 143:297–338.

Love, A., Herczeg, A., Leaney, F., Stadter, M., Dighton, J., and Armstrong, D. 1994. Groundwater residence time and palaeohydrology in the Otway Basin, South Australia: 2H, 18O and 14C data, Journal of Hydrology, 153:157–187.

Marchant, S., Higgens. P.J. 1990. Handbook of Australian, New Zealand and Antarctic Birds. Volume One – Ratites to Ducks. Oxford University Press, Melbourne, Victoria.

Naarding, J.A. 1981. Latham's Snipe *(Gallinago hardwickii)* in Tasmania. *Wildlife Division Technical Report*. 81/2. Tasmania: National Parks and Wildlife Service.

Naarding, J.A. 1985. Latham's Snipe *(Gallinago hardwickii)* in Australia and Japan. *Wildlife Division Technical Report*. 85/2. Tasmania: National Parks and Wildlife Service.

NatureMaps 2018. Online search tool –Accessed at http://www.naturemaps.sa.gov.au/. Department of Environment, Water and Natural Resources, South Australia.

Origin Energy 2002. *Environmental Impact Report for the Production and Processing of Petroleum Products and Associated Activities at the Katnook and Ladbroke Grove Gas Plants, Otway Basin – South Australia.* September 2002. Origin Energy Resources Ltd.

Origin Energy 2004. *Statement of Environmental Objectives for the Production and Processing of Petroleum Products and Associated Activities at the Katnook and Ladbroke Grove Gas Plants, Otway Basin – South Australia.* December 2004. Origin Energy Resources Ltd.

Paydar, Z., Chen, Y., Xevi, E., and Buettikofer, H. 2009. Current understanding of the water cycle in the Limestone Coast region. Cooperative Research Centre for Irrigation Futures. Technical Report No. 03/09.

PIRSA. 2017. Forestry in South Australia brochure. Government of South Australia. Primary Industries and Regions SA.

SENRCC. 2003. South East Natural Resource Management Plan, A plan for the integrated management of natural resources in the South East, Consultation Report. South East Natural Resource Consultative Committee

South Australian Tourism Commission. 2023. Regional Profile – Limestone Coast. Website access January 2024 at: https://tourism.sa.gov.au/regions/limestone-coast

South East NRM Board 2010. Natural Resource Management Plan, Part One: Regional Description. South East Natural Resource Management Board, Government of South Australia.

South East NRM Board 2013. Water Allocation Plan for the Lower Limestone Coast Prescribed Wells Area. Prepared by the South East Natural Resources Management Board, March 2013. Amended June 2019.

Limestone Coast Landscape Board. 2021a. Limestone Coast Region Landscape Plan 2021-2026. Government of South Australia.

Limestone Coast Landscape Board. 2021b. Pest plant and animal strategy for the Limestone Coast Landscape Board 2021-2026. Government of South Australia.

Todd 2000. Recovery Plan for Twelve Threatened Spider-orchid *Caladenia* taxa (Orchidaceae: Caladeniinae) of Victoria and South Australia 2000 – 2004. Department of Natural Resources and Environment, Melbourne, Victoria.

Threatened Species Scientific Committee (TSSC) 2012. Approved Conservation Advice for the Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains

Weston, M.A. 1995. Snipers band together in the suburbs. *Geo*. 17:18-19.

WSP Golder. 2023. Annual 2023 Groundwater Monitoring Report, Katnook Gas Facility. Prepared by WSP Golder Associates Pty Ltd for Beach Energy Limited. Adelaide, SA.

9 Abbreviations and Glossary

AAL	Associated Activities Licence
ADG Code	Australian Dangerous Goods Code
ALARP	As Low as Reasonably Practical
ANZECC	Australia and New Zealand Environment and Conservation Council
APGA	Australian Pipelines and Gas Association
aquitard	A bed of low permeability adjacent to an aquifer
AS	Australian Standard
BCP	Business Continuity Pan
BDBSA	Biological Databases of South Australia
biocide	Chemical compound that can kill living organisms (typically targeted at microorganisms)
BoM	Bureau of Meteorology
BTEX	Benzene, toluene, ethylbenzene, xylene
BTOC	Below Top of Casing
casing annulus	Space between the casing and any piping, tubing or casing surrounding it
casing string	A long section of connected oilfield pipe that is lowered into a wellbore and cemented into place
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
CEM	Crisis Emergency Management
CEO	Chief Executive Officer
CMP	Crisis Emergency Plan
CMT	Crisis Management Team
coiled tubing	A long, continuous length of pipe wound on a spool. The pipe is straightened prior to pushing into a wellbore and rewound to coil the pipe back onto the transport and storage spool
conventional gas	Natural gas trapped in underground structures in highly permeable sandstones
CO_2	carbon dioxide
CxP	Crisis Communication Plan
DEE	Department of the Environment and Energy
DEM	Department for Energy and Mining
DMITRE	Department of Manufacturing, Innovation, Trade, Resources and Energy (now DEM)
DEWNR	Department of Environment, Water and Natural Resources (now DEW)
DEW	Department for Environment and Water
DIT	Department of Infrastructure and Transport
EIR	Environmental Impact Report prepared in accordance with Section 97 of the *Petroleum and Geothermal Energy Act 2000* and Regulation 10
EMP	Emergency Management Plan
EMS	Environmental Management System
EMT	Emergency Management Team

EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERT	Emergency Response Team
EPT	Extended production testing
GRE	glass reinforced epoxy
ha	Hectare
H_2S	hydrogen sulphide
HDD	horizontal directional drilling
HDPE	high density polyethylene
hydrotest	hydrostatic testing
Inhibition fluid	An inhibition fluid used to prevent, arrest or slow down a process. A corrosion inhibitor is a chemical additive used in treatments to protect iron and steel components in the wellbore. This protection must remain effective under the anticipated pressure and temperature environment for the duration of the treatment.
ISO	International Standards Organisation
JSA	Job Safety Analysis
kL	kilolitre (1,000 litres)
km	Kilometre
km^2	square kilometres
mg/L	milligrams per litre
ML	megalitre (1,000,000 litres)
modular processing skid	Gas processing equipment arranged on transportable structural steel frames to maximise the level of assembly completed at the factory.
LCPA	Limestone Coast Protection Alliance
LSA Act	*Landscape South Australia Act 2019*
NGER	*National Greenhouse and Energy Reporting Act 2007* (Cth)
NPI	National Pollutant Inventory
NPWS	National Parks and Wildlife Service
PEL	Petroleum Exploration Licence
PIMP	Pipeline Integrity Management Plan
PFW	produced formation water
PGE Act	*Petroleum and Geothermal Energy Act 2000*
perforating	The process of punching holes in the casing or liner of an oil or gas well to connect it to the reservoir
permeability	A measure of the ease of flow of fluids through a rock
pigging	use of pipeline inspection gauges or 'pigs' to perform various maintenance operations on a pipeline, including cleaning and inspecting the pipeline
PMS	Pipeline Management System
PPL	Petroleum Production Licence
PRL	Petroleum Retention Licence
psi	pounds per square inch (a unit of pressure)
PSV	pressure safety valve

PTW	Permit to Work
QA/QC	Quality Assurance / Quality Control
Ramsar wetland	A Wetland of International Importance listed under the Ramsar Convention (held in Ramsar, Iran 1971).
ROW	Right-of-way (pipelines)
ripping	The use of machinery to rake or plough soil to relieve compaction and aerate soil.
SDS	Safety Data Sheet
SEB	Significant environmental benefit
SEO	Statement of Environmental Objectives prepared in accordance with the *Petroleum and Geothermal Energy Act 2000*
SEPS	South East Pipeline System
Shut-in	To shut in a well is to close off a well so that it cannot produce.
slugcatcher	the unit in which slugs (a quantity of gas or liquid) at the outlet of pipelines are collected or caught
SMS	Safety Management Study
stratigraphy	The study of rock layers and layering (stratification)
VOCs	Volatile organic compounds
WECS	Well Engineering and Construction Management System
Well barrier	A well barrier is an independent and verified barrier preventing reservoir fluid from flowing unintentionally from the formation, into another formation or to surface.
WIS	Well Integrity Standards
wellhead	The part of an oil or gas well which terminates at the surface, where oil or gas can be withdrawn.
wireline unit	The equipment used to lower a wire or cable into an oil or gas well to conduct operations in the well
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

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 Section 4.4 of the EIR. The information in this appendix is derived largely from a Biological Databases of South Australia (BSBDA) database search carried out in 2018 (DEW 2018).

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 Limestone Coast region. 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 km^2, whilst the actual area of occupancy is estimated to be 131 km^2. 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 favors 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).

Large Bent-wing Bat / 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 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 A1: Priority pest weeds and alert weeds identified by the Limestone Coast Landscape Board (2021b).

Common name	Scientific name	Status and management action
Bridal veil	*Asparagus declinatus*	Declared: eradicate from region
Golden dodder	*Cuscuta campestris*	Declared: eradicate from region
Mexican feathergrass	*Nassella tenuissima*	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	*Pennisetum setaceum*	Declared: destroy infestations
Innocent weed	*Cenchrus incertus / C. longispinus*	Declared: destroy infestations
Khaki weed	*Tagetes minuta*	Declared: destroy infestations
Pampas grass	*Cortaderia* spp	Declared: destroy infestations
Silverleaf nightshade	*Solanum elaeagnifolium*	Declared: destroy infestations
Texas needlegrass	*Nasella leucotricha*	Declared: destroy infestations
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 curvula*	Declared: contain the spread
Aleppo pine	*Pinus halepensis*	Declared: contain the spread
Asparagus fern	*Asparagus scandens*	Declared: destroy infestations
Bathurst burr	*Xanthium spinosum*	Declared: contain the spread
Bluebell creeper	*Billardiera heterophylla*	Declared: contain the spread
Boneseed	*Chrysanthemoides monilifera* ssp. *monilifera*	Declared: cDeclared: contain the spreadontain the spread
Caltrop	*Tribulus* sp.	Declared: contain the spread
Cape tulip (1 & 2 leaf)	*Homeria* sp.	Declared: contain the spread
Coolatai grass	*Hyparrhenia hirta*	Declared: contain the spread
Creeping knapweed	*Rhaponticum repens*	Declared: contain the spread
Berry Heath (Erica)	*Erica baccans*	Declared: contain the spread
Gorse	*Ulex europaeus*	Declared: contain the spread
Hoary cress	*Lepidium appelianum*	Declared: contain the spread
Madeira vine	*Andredera sp.*	Declared: contain the spread
Prickly pear	*Opuntia*	Declared: contain the spread
Salvation jane	*Echium plantagineum*	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

Common name	Scientific name	Status and management action
Apple of Sodom	*Calotropis procera*	Declared: prevent spread to key sites/assets
Arum Lily	*Zantedeschia sp.*	Declared: prevent spread to key sites/assets
Bladder campion	*Silene vulgaris*	Declared: prevent spread to key sites/assets
Coastal tea tree	*Leptospermum laevigatum*	Declared: prevent spread to key sites/assets
Cape broom	*Genista monspessulana*	Declared: prevent spread to key sites/assets
Cutleaf mignonette	*Ruseda lutea*	Declared: prevent spread to key sites/assets
Dolichos pea	*Dipogon lignosus*	Declared: prevent spread to key sites/assets
English broom	*Cytisus scoparius*	Declared: prevent spread to key sites/assets
False caper	*Euphorbia terracina*	Declared: prevent spread to key sites/assets
Field bindweed	*Convolvulvus arvensis*	Declared: prevent spread to key sites/assets
African daisies	Gazania	Declared: prevent spread to key sites/assets
Horehound	*Marrubium vulgare*	Declared: prevent spread to key sites/assets
Italian buckthorn	*Rhamnus alaternus*	Declared: prevent spread to key sites/assets
Lincoln weed	*Diplotaxis tenuifolia*	Declared: prevent spread to key sites/assets
Mirror bush	*Coprosma sp.*	Declared: prevent spread to key sites/assets
Muskweed	*Myagrum perfoliatum*	Declared: prevent spread to key sites/assets
Noogoora burr	*Xanthium occidentale*	Declared: prevent spread to key sites/assets
Olive	*Olea eurapaea*	Declared: prevent spread to key sites/assets
Milkwort	*Polygala*	Declared: prevent spread to key sites/assets
Spiny Rush	*Juncus acutus*	Declared: prevent spread to key sites/assets
Swamp Oak	*Casuarina glauca/Casuarine obesa*	Declared: prevent spread to key sites/assets
Willow sp.	*Salix sp.*	Declared: prevent spread to key sites/assets
Bridal creeper	*Asparagus asparagoides*	Declared: targeted management
Desert ash	*Fraxinus angustifolia*	Declared: targeted management
Yellow burweed	*Amsinckia calycina*	Declared: targeted management
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 planiflora*	Declared: monitor
Hawthorn: May / Azarola	*Crataegus sinaica / Cateugus monogyna*	Declared: monitor
Wild artichoke	*Cynara cardunculus*	Declared: monitor
Bulbi Watsonia	*Watsonia meriana var. bulbillifera*	Declared: limited action
Alisma	*Alisma*	Declared: alert species
Alkali sida	*Malvella leprosa*	Declared: alert species

Common name	Scientific name	Status and management action
Alligator weed	*Alternanthera philoxeroides*	Declared: alert species
Arrowhead	*Syngonium podophyllum*	Declared: alert species
Blue mustard	*Chorispora tenella*	Declared: alert species
Broadkernel espartilo	*Amelichloa caudata*	Declared: alert species
Broomrape	*Orobanche sp.*	Declared: alert species
Cabomba	*Cabomba*	Declared: alert species
Calomba daisy	*Oncosiphon suffruticosum*	Declared: alert species
Cane needlegrass	*Nassella hyalina*	Declared: alert species
Distichlis	*Distichlis spicata*	Declared: alert species
Dune onion weed	*Trachyandra divaricata*	Declared: alert species
Elodea	*Elodea*	Declared: alert species
Eurasiona watermilfoil	*Myriophyllum spicatum*	Declared: alert species
Horsetail	*Equisetum sp.*	Declared: alert species
Water pennyworts	*Hydrocotyle*	Declared: alert species
Oxygen weed	*Lagarosiphon*	Declared: alert species
Lantana	*Lantana sp.*	Declared: alert species
Leafy elodea	*Egeria densa*	Declared: alert species
Nightstock	*Matthiola longipetala*	Declared: alert species
Parrot's feather	*Myriophyllum aquaticum*	Declared: alert species
Perrenial thistle	*Cirsium aervense*	Declared: alert species
Plumerillo	*Jarava plumosa*	Declared: alert species
Poison buttercup	*Ranunculus sceleratus*	Declared: alert species
Poison Ivy	*Toxicodendron radicans*	Declared: alert species
Primrose willow	*Ludwigia sp.*	Declared: alert species
Ragwort	*Jacobaea vulgaris*	Declared: alert species
Rhus tree	*Toxicodendron succedaneum*	Declared: alert species
Sagittaria	*Sagittaria platyphylla*	Declared: alert species
Salvinia	*Salvinia molesta*	Declared: alert species
Senegal tea plant	*Gymnocoronis spilanthoides*	Declared: alert species
Serrated tussock	*Nassella trichotoma*	Declared: alert species
Tree Heath	*Erica arborea*	Declared: alert species
Water caltrop	*Trapa sp.*	Declared: alert species
Water dropwort	*Oenanthe crocata*	Declared: alert species
Water hyacinth	*Eichhornia crassipes*	Declared: alert species
Water soldier	*Stratiotes sp.*	Declared: alert species

Table A2: Priority pest fauna identified by the Limestone Coast Landscape Board (2021b).

Common name	Scientific name	Status and management action
Wild dog / dingo	*Canis lupus/* ssp. *dingo*	Declared: eradicate
Feral pig	*Sus scrofa*	Declared: eradicate
Goat	*Capra hircus*	Declared: eradicate
Chital deer	*Axis axis*	Declared: eradicate
Rusa deer	*Cervus timorensis*	Declared: eradicate
Sambar deer	*Cervus unicolour*	Declared: eradicate
Hog deer	*Axis porcinus*	Declared: eradicate
Red deer	*Cervus elaphus*	Declared: eradicate
Wapiti deer	*Cervus canadensis*	Declared: eradicate
Fallow deer	*Dama dam*	Declared: eradicate
Brown rat	*Rattus norvegicus*	Declared: prevent ongoing spread
Rabbit	*Oryctolagus cuniculus*	Declared: prevent ongoing spread
Black rat	*Rattus rattus*	Declared: prevent spread to key sites / assets
Feral cat	*Felis catus*	Declared: targeted management
Fox	*Canidae*	Declared: targeted management
House mouse	*Mus musculus*	Declared: targeted management
Starling	*Sturnidae*	Declared: targeted management
Eurasian blackbird	*Turdus merula*	Declared: targeted management
Domestic pigeon	*Columba livia domestica*	Declared: targeted management
Hare	*Lepus sp.*	Declared: targeted management
Asian black spined toad	*Duttaphrynus melanostictus*	Declared: alert species
Cane toad	*Rhinella marina*	Declared: alert species
Corn snake	*Phantherophis guttatus*	Declared: alert species
Common (Indian) myna	*Acridotheres tristis*	Declared: alert species
House crow	*Corvis splendens*	Declared: alert species
Indian ringneck parakeet	*Psittacula krameri*	Declared: alert species
Laughing dove	*Spilopelia senegalensis*	Declared: alert species
Red-eared slider	*Trachemys scripta elegans*	Declared: alert species
Red Whiskered bulbul	*Pycnonotus jocosus*	Declared: alert species
Song thrush	*Turdus philomelos*	Declared: alert species
Tree sparrow	*Passer montanus*	Declared: alert species
Water buffalo	*Bubalus bubalis*	Declared: alert species

Appendix B Schematic Drawing of the Katnook Processing Infrastructure