



# Eastern Gas Pipeline Modification 2

Modification report

November 2021



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# 1. Introduction

## 1.1 Overview

Jemena proposes to modify its existing infrastructure approval for the Eastern Gas Pipeline to incorporate a segment of the gas pipeline proposed by Australian Industrial Energy (AIE) as part of the approved Port Kembla Gas Terminal. The segment to be incorporated extends from the western boundary of the corridor of Springhill Road southward to a connection point on the proposed Port Kembla Lateral Looping of the Eastern Gas Pipeline. The modification is required to allow this segment of the gas pipeline to be constructed and operated under a modified infrastructure approval for the Eastern Gas Pipeline under the *Environmental Planning and Assessment Act 1979* (SSI-9973). The proposed modification would also involve minor changes to the alignment as well as the addition of a short lateral section of the pipeline at the southern end of the modification (the Cringila Lateral).

The Eastern Gas Pipeline is a major infrastructure asset supplying natural gas to the eastern market spanning between gas fields in the Gippsland Basin through to New South Wales and the Australian Capital Territory. The Port Kembla Gas Terminal involves the development of a liquefied natural gas import terminal at Port Kembla with the goal to provide a simple, flexible solution to the state's gas supply challenge. The proposed modification would represent a critical link between Port Kembla Gas Terminal and the Eastern Gas Pipeline to get the gas to market.

The proposed modification and its relationship to the other projects is described further in section 3.

## 1.2 Purpose and structure

The purpose of this report is to provide environmental assessment of the proposed modification in support of a request for a Minister's approval under section 5.25 of the *Environmental Planning and Assessment Act 1979*.

Prior to the preparation of this modification report a scoping report was prepared and submitted to the Department of Planning, Industry and Environment (DPIE), which set out the relevant environmental matters and their appropriate level of assessment. Subsequent correspondence from DPIE confirmed that the scoping report was appropriate noting that prior surveys could only be relied upon where the disturbance areas of the gas pipeline proposed by AIE and the proposed modification were the same.

This modification report has been prepared in accordance with the scoping report, subsequent correspondence from DPIE and the *State significant infrastructure guidelines – preparing a modification report* (DPIE 2021).

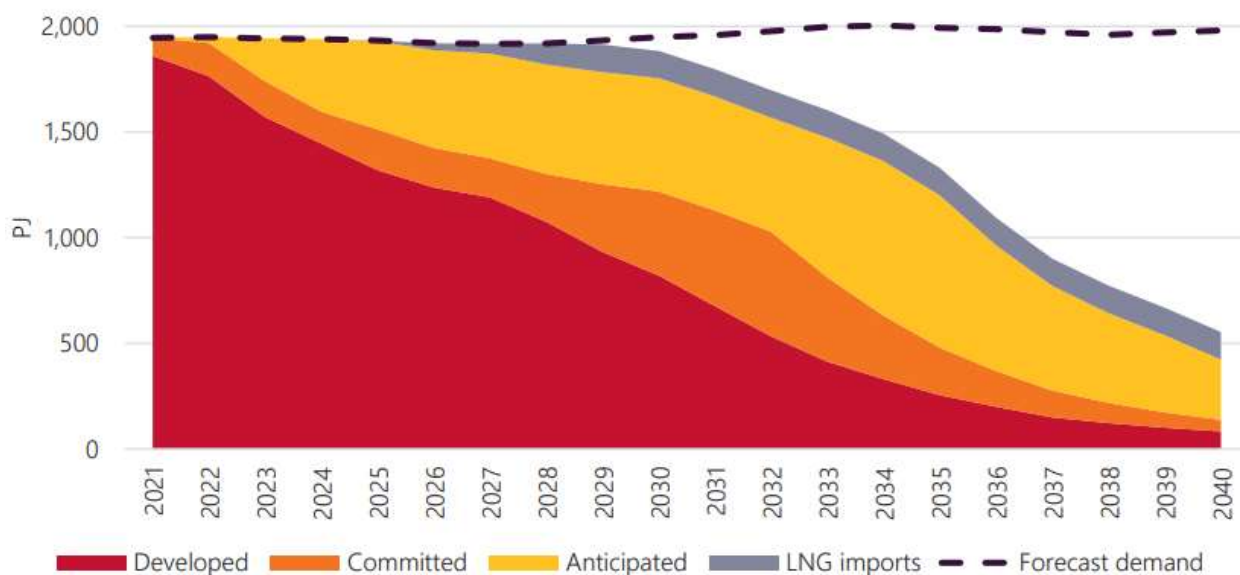
The structure and content of this report is as follows:

- Section 2 – explanation of strategic context
- Section 3 – description of proposed modification
- Section 4 – explanation of relevant statutory context
- Section 5 – summary of community engagement to date
- Section 6 – environmental assessment of proposed modification
- Section 7 – assessment of consistency with conditions and measures
- Section 8 – justification and conclusion including summary of key findings.

## 2. Strategic context

NSW is the only mainland eastern state that does not have its own material local gas supplies and relies on Queensland, Victoria and South Australia for more than 95 per cent of its gas needs. This means NSW is widely exposed to supply and/or price disruptions from other states while the requirement to transport natural gas over large distances via on-shore transmission networks puts gas consumers at an immediate financial disadvantage. According to reports by the Australian Competition and Consumer Commission, consumers in NSW may pay as much as an additional \$3.50 per gigajoule (GJ) in gas transportation costs due to these constraints.

Forecasts from a range of market analysts including the Australian Energy Market Operator (AEMO) have noted the east coast gas market is becoming increasingly reliant on undeveloped, contingent or prospective sources of gas supply to meet forecast demand as shown in Figure 2-1. These sources of gas supply may never be realized. Furthermore, existing gas producers in the north are expected to continue to focus on export markets while gas producers in the south continue to experience increasing extraction costs and declining production volumes.



Source: AEMO (2021)

Figure 2-1 Projected gas demand

The Port Kembla Gas Terminal is being developed by AIE to help address this strategic need and is predicted to deliver in the order of 100 petajoules of gas per annum or greater. The product gas would be delivered to market through Jemena's Eastern Gas Pipeline, a major infrastructure asset supplying natural gas to the eastern market and spanning between gas fields in the Gippsland Basin through to New South Wales and the Australian Capital Territory. The proposed modification would represent a critical link between AIE's Port Kembla Gas Terminal and the Eastern Gas Pipeline and would therefore be essential in addressing the strategic need for gas supply in NSW.

## 3. Proposed modification

### 3.1 Approved infrastructure

The Eastern Gas Pipeline is an existing major gas pipeline operated by Jemena in accordance with its licence under the *Pipelines Act 1967* (Licence No. 26) and its associated infrastructure approval as State significant infrastructure under the *Environmental Planning and Assessment Act 1979* (SSI-9973).

The Port Kembla Lateral is a section of the Eastern Gas Pipeline that branches off from the main pipeline route and runs from Kembla Grange to Cringila. An application to modify the infrastructure approval to loop the Port Kembla Lateral was made and was determined in October 2020 (SSI-9973-Mod-1). This modification was necessary to increase the capacity of the pipeline for the delivery of gas from Port Kembla Gas Terminal.

Port Kembla Gas Terminal is a gas import terminal proposed by AIE that would receive liquefied natural gas (LNG), process the LNG including regasification, and transport the gas via a gas pipeline from the import terminal a connection point with the Eastern Gas Pipeline. The Port Kembla Gas Terminal consists of four key components:

- LNG carrier vessels — to transport LNG from production facilities to Port Kembla
- Floating Storage and Regasification Unit (FSRU) — a vessel moored at Berth 101 to process the gas
- Berth and wharf facilities — including landside offloading facilities to transfer natural gas from the FSRU
- Gas pipeline — a high-pressure pipeline connecting the FSRU at Berth 101 to the Eastern Gas Pipeline.

Port Kembla Gas Terminal is approved under the *Environmental Planning and Assessment Act 1979* (SSI-9471).

### 3.2 Proposed modification

#### 3.2.1 Overview

For the purpose of the proposed modification, the gas pipeline from Port Kembla Gas Terminal has been divided into two sections: the section from the terminal up to and including the crossing of Springhill Road (Segment 1.1) and the section following the road crossing to a connection point with the proposed Port Kembla Lateral Looping.

The proposed modification would incorporate Segment 1.2 into the infrastructure approval for the Eastern Gas Pipeline (SSI-9973). The modification would also involve minor changes to the alignment of the gas pipeline as well as the addition of the Cringila Lateral in the vicinity of the connection point with the proposed Port Kembla Lateral Looping. The primary purpose of the Cringila Lateral would be to supply nitrogen into the mainline gas pipeline. The Cringila Lateral would include some minor nitrogen inlet infrastructure including a limit valve, blowdown vent, other minor pipework and valving and provision for a crawler pig for future maintenance. A belowground isolation valve would be incorporated at its connection with the Port Kembla Lateral Looping.

Jemena is also seeking to align some of the operational parameters of the pipeline with the conditions of its existing pipeline licence and infrastructure approval — specifically the nominal operating pressure. The existing infrastructure approval for the Eastern Gas Pipeline, modified to incorporate the proposed Port Kembla Lateral Looping, sets the maximum operating pressure at 16.55 MPa, whereas the infrastructure approval for Port Kembla Gas Terminal sets the operating pressure at 12 MPa. Accordingly, to align the proposed modification with the existing approval, the proposed modification has been assessed at a pressure of 16.55 MPa.

#### 3.2.2 Design

The design of the gas pipeline would essentially be consistent with the description in the environmental impact statement and response to submissions for Port Kembla Gas Terminal. Segment 1.2, subject to the proposed modification, would be approximately 2.5 kilometres. The Cringila Lateral would be approximately 200 metres.

The gas pipeline, including Cringila Lateral, would nominally have a diameter of about 45 centimetres and be composed of carbon steel. It would comply with the requirements of Australian Standard AS 2885.

The alignment of the gas pipeline, including Cringila Lateral, is shown in Figure 3-1.

### 3.2.3 Construction

The gas pipeline, including Cringila Lateral, would be constructed by applying standard construction methods including a combination of open trenching and trenchless methods. The majority would be constructed by open trenching with horizontal directional drilling employed in a few areas to avoid impacts to roads and waterways.

The depth of trenching is expected to be up to about 2 metres with some deeper excavations for entry and exit pits required to support horizontal directional drilling. The construction right of way would be up to about 25 metres. Some additional areas would also be required for construction activities including laydown and pipe stringing.

The construction footprint, including the right of way and additional areas, is shown in Figure 3-1. It should be noted the extended area in the north is an envelope for pipe stringing and is unlikely to be utilised in its entirety.

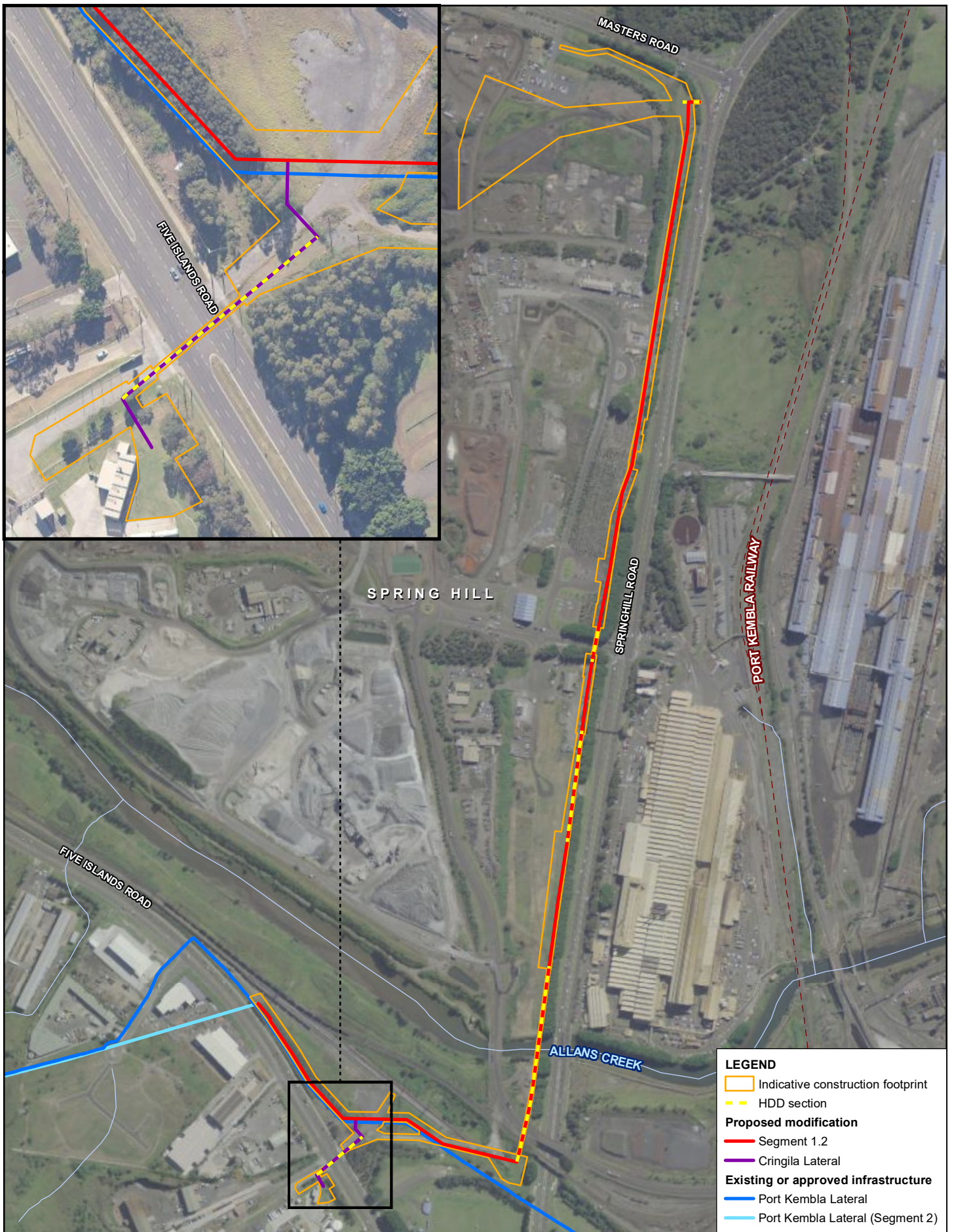
The construction is expected to occur progressively over the course of about 9 months with the majority of works carried out during standard construction hours of Monday to Friday, 7 am to 6 pm and Saturday, 8 am to 1 pm. Some out of hours works may be required for activities requiring continuous operation such as horizontal directional drilling. These activities and their potential impacts are discussed further in section 6.

### 3.2.4 Operation

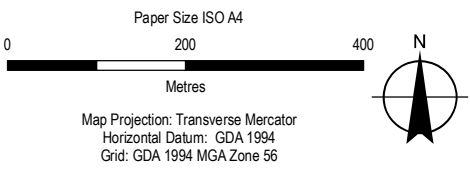
The pipelines would be operated in accordance with all relevant industry standards and codes of practice as well as Jemena's existing pipeline licence, environmental management systems and plans in place for the Eastern Gas Pipeline, amended as necessary to adhere to any conditions of approval attached to this proposed modification.

### 3.2.5 Alternatives

The current design of the pipeline was arrived at through an assessment of a number of alternatives and further refinements developed through the design and environmental assessment of the Port Kembla Gas Terminal. The design as it stands is optimised to avoid significant environmental impacts whilst meeting operational needs.



LEGEND	
	Indicative construction footprint
	HDD section
Proposed modification	
	Segment 1.2
	Cringila Lateral
Existing or approved infrastructure	
	Port Kembla Lateral
	Port Kembla Lateral (Segment 2)



Jemena  
Eastern Gas Pipeline - Modification 2

Project No. 12547160  
Revision No. A  
Date 23 Sep 2021

Proposed modification

FIGURE 3-1

N:\AU\Sydney\Projects\21112547160\GIS\Maps\Deliverables\ModReport\12547160\_MOD001\_ProjectOverview.mxd Data source: Aerial imagery - SIXmaps 2021; General topo - NSW LPI DTDB 2017 & 2015; Cadastre - NSW LPI DCDB 2021; Project components - Jemena. Created by: jpric  
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## 4. Statutory context

### 4.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal law regulating development in NSW. It establishes a regime for the making of development applications, assessment of their environmental impacts, and the determination of those applications. It also allows for the making of environmental planning instruments such as the state environmental planning policies and local environmental plans discussed below.

Part 5, division 5.2 of the EP&A Act provides for declaration, assessment and approval of State significant infrastructure (SSI). The process for environmental assessment and approval of SSI is set out as follows:

- Application for approval of the Minister to carry out development
- Preparation of environmental assessment requirements
- Preparation of an environmental impact statement
- Public exhibition of the environmental impact statement
- Response to submission received during public exhibition
- Preparation of Planning Secretary's assessment report
- Determination by Minister regarding the development.

The Eastern Gas Pipeline was approved under now-repealed provisions and has since been redesignated as SSI under part 5, division 5.2 of the EP&A Act. A modification is now being sought under section 5.25 of the EP&A Act.

Section 5.22(2) of the EP&A Act provides that environmental planning instruments do not apply to, or in respect of, State significant infrastructure. The consistency with some key instruments is nonetheless discussed below.

#### 4.1.1 State Environmental Planning Policy (Three Ports) 2013

*State Environmental Planning Policy (Three Ports) 2013* sets out the planning regime that applies to land at Port Botany, Port of Newcastle and Port Kembla to ensure these locations are preserved for port-related uses.

The proposed modification is on land zoned IN3 Heavy Industrial. The land use table for IN3 Heavy Industrial is reproduced below in Table 4-1. The land use table specifies that port facilities are permissible with consent. The definition of port facilities includes utilities and services. The gas pipeline is therefore permissible with consent.

Table 4-1 IN3 Heavy Industrial

Item	Development
Permitted without consent	Environmental protection works
Permitted with consent	Depots, Food and drink premises, Freight transport facilities, Heavy industries, Port facilities, Roads, Transport depots, Warehouse or distribution centres, Waste or resource management facilities
Prohibited	Any development not specified as permitted without consent or permitted with consent

## 4.1.2 State Environmental Planning Policy (Infrastructure) 2007

*State Environmental Planning Policy (Infrastructure) 2007* aims to facilitate the effective delivery of infrastructure across the state. It establishes development controls and permissibility for a range of types of infrastructure.

Part 3, division 12A deals with development for the purpose of a pipeline. It states that development for the purpose of a pipeline may be carried out by any person without consent on any land if the pipeline is subject to a licence under the *Pipelines Act 1967* or a licence or authorisation under the *Gas Supply Act 1996*.

As discussed in section 4.2.1, the Eastern Gas Pipeline has been granted Licence No. 26 under the *Pipelines Act 1967* and a variation of the licence would be sought to integrate the proposed modification into the licence. Accordingly, the proposed modification could be carried out without consent under the policy.

## 4.1.3 Wollongong Local Environmental Plan 2009

The *Wollongong Local Environmental Plan 2009* sets out the environmental planning provisions that are administered by Wollongong City Council within the Wollongong local government area.

The proposed modification is on land zoned IN3 Heavy Industrial and SP2 Infrastructure. The land use tables for IN3 Heavy Industrial and SP2 Infrastructure are reproduced below in Table 4-2 and Table 4-3.

While the land use table for IN3 Heavy Industrial does not specify gas pipelines as being permitted without consent or permitted with consent, the gas pipeline would be ancillary to the Port Kembla Gas Terminal, which would classify as heavy industries and accordingly the gas pipeline would be permissible with consent. While the land use table for SP2 Infrastructure does not specify gas pipelines as permitted without consent or permitted with consent, it could nonetheless be carried out under *State Environmental Planning Policy (Infrastructure) 2007*.

Table 4-2 IN3 Heavy Industrial

Permission	Land use
Permitted without consent	Building identification signs; Business identification signs
Permitted with consent	Advertising structures; Boat building and repair facilities; Depots; Freight transport facilities; General industries; Hazardous storage establishments; Heavy industrial storage establishments; Heavy industries; Helipads; Industrial retail outlets; Kiosks; Light industries; Offensive storage establishments; Oyster aquaculture; Recreation areas; Recreation facilities (indoor); Roads; Rural industries; Service stations; Storage premises; Take away food and drink premises; Tank-based aquaculture; Transport depots; Truck depots; Vehicle body repair workshops; Vehicle repair stations; Warehouse or distribution centres; Water supply systems
Prohibited	Pond-based aquaculture; Any other development not specified above

Table 4-3 SP2 Infrastructure

Permission	Land use
Permitted without consent	Building identification signs
Permitted with consent	Aquaculture; The purpose shown on the Land Zoning Map, including any development that is ordinarily incidental or ancillary to development for that purpose [SP2 Road]; Advertising structures; Business identification signs; Centre-based childcare facilities; Community facilities; Recreation areas; Recreation facilities (indoor); Recreation facilities (major); Recreation facilities (outdoor); Respite day care centres; Roads
Prohibited	Any development not specified in item 2 or 3

## 4.2 Other NSW Legislation

### 4.2.1 Pipelines Act 1967

The *Pipelines Act 1967* establishes a licensing regime for pipelines within NSW. Section 18 of the Act provides that a licensee may apply for a variation to a licence. The Eastern Gas Pipeline has been granted Licence No. 26 under the Act. A variation of Licence No. 26 would be sought to amend it to include the proposed modification.

### 4.2.2 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) aims to maintain a healthy, productive and resilient environment consistent with the principals of ecologically sustainable development and in particular conserve biodiversity.

Part 4 of the BC Act provides for the listing of threatened species and threatened ecological communities, part 6 provides for a biodiversity offsets scheme and part 7 provides for biodiversity assessment and approvals under the EP&A Act including the preparation of biodiversity development assessment reports (BDAR) and includes a test to determine whether a proposed development will significantly affect threatened species or ecological communities.

As discussed in section 6, the proposed modification would be largely consistent with the assessment in the environmental impact statement and response to submissions for Port Kembla Gas Terminal. A BDAR was produced as part of the environmental impact statement and an additional assessment has been prepared.

AIE has recently made payments into the Biodiversity Conservation Fund under section 6.30(1) of the BC Act to retire biodiversity credits and meet offset obligations for impacts associated with the Port Kembla Gas Terminal including native vegetation and habitat values disturbed by construction of Segment 1.2 of the gas pipeline.

### 4.2.3 Fisheries Management Act 1994

The objectives of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fisheries resources of NSW for the benefit of present and future generations. Part 7 of the FM Act requires a permit for a number of activities, including dredging and reclamation work, causing harm to marine vegetation and blockage of passage of fish. The proposed modification will not involve activities that would trigger a need for a permit under the FM Act and it is noted that under section 5.23(1)(b) of the EP&A Act such permits are not required for SSI.

### 4.2.4 Heritage Act 1977

The *Heritage Act 1977* regulates all aspects of the conservation of heritage places and items. Items of state heritage significance are listed on the State heritage register under the Act. Under Part 4 of the Act, approval must be obtained for works that have the potential to interfere with an item listed on the State heritage register. It should be noted that under section 5.23(1)(c) of the EP&A Act a permit to interfere with an item is not required and as stated in section 6, the proposed modification would not impact an item of state heritage significance.

### 4.2.5 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the protection of Aboriginal objects and places. An Aboriginal object includes any deposit, object or material relating to habitation of an area. An Aboriginal place means an area which has been declared by the Minister administering the Act as a place of special significance.

It is an offence under section 86 of the NPW Act to harm an Aboriginal object. Section 87 of the NPW Act provides a number of defences which include that the harm was carried out under an Aboriginal heritage impact permit (AHIP). It should be noted that section 5.23(1)(2) of the EP&A Act provides this that permit is not required and as stated in section 6, the proposed modification would not directly impact an Aboriginal object or place.

## 4.2.6 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) aims to protect, restore and enhance the quality of the environment. It prescribes offences mainly regarding pollution of the environment and establishes a regime of environment protection licences for the carrying out of prescribed scheduled activities. It also establishes general environmental duties regarding disposal of waste (section 115), leaks or spills (section 116), emissions to air (section 117), water pollution (section 120) and land pollution (section 142A). The modification is not expected to involve scheduled activities and accordingly an environment protection licence is not expected to be required.

## 4.2.7 Roads Act 1993

The *Roads Act 1993* regulates the carrying out of activities on public roads. It establishes the roads authority based on the class of road including Transport for NSW for classified roads and the relevant local council for local roads. Section 138 of the *Roads Act 1993* requires that a person must not carry out work in, on or over a public road without the prior approval of the roads authority. Approval would be required for the proposed modification.

## 4.2.8 Water Management Act 2000

The *Water Management Act 2000* (WM Act) regulates the extraction and use of water, construction works such as dams and weirs, and the carrying out of activities in or near water sources. Water sources are defined very broadly and include any river, lake, estuary or place where water occurs on or below the ground, and coastal waters.

The WM Act includes approval requirements for water use, water management work and certain controlled activities. It should be noted that under section 5.23(g) of the EP&A Act these permits are not required.

Although the WM Act contains a number of provisions concerning aquifer interference activities, a system of approvals is not set out and therefore these provisions are generally given effect through the EP&A Act and the *NSW Aquifer Interference Policy*. Exemptions can be applied for minor dewatering associated with trench excavation if likely to intersect the groundwater table. Section 21 and Schedule 4, Clause 7 of the *Water Management (General) Regulation 2018* provide that any person lawfully engaged in an aquifer interference activity carried out in connection with an authorised project may take up to 3 megalitres of water in a year.

The proposed modification is not expected to require any additional approval under the WM Act.

## 4.3 Commonwealth legislation

### 4.3.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the principal Commonwealth environment law. It protects nine matters of national environmental significance, specifically:

- world heritage properties
- national heritage places
- wetlands of international importance
- listed threatened species and ecological communities
- migratory species under international agreements
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)
- a water resource, in relation to coal seam gas or coal mining.

An action that is likely to have a significant impact on a matter of national environmental significance must be referred to the Minister administering the EPBC Act. It is considered that a referral is not required.

## 5. Community engagement

A significant amount of stakeholder engagement has been carried out for the Port Kembla Gas Terminal to date including the exhibition of the environmental impact statement, the response to submissions, and numerous briefings, community meetings and consultation materials produced throughout the assessment process.

Likewise, Jemena has carried out significant stakeholder engagement in the region as part of the Eastern Gas Pipeline and the more recent application to modify the infrastructure approval to loop the Port Kembla Lateral.

Jemena has and will continue to engage with relevant stakeholders including landholders, interest groups and other community bodies, and authorities throughout the modification assessment process and post-determination.

# 6. Environmental assessment

## 6.1 Overview

As stated in section 1.2, prior to the preparation of this modification report a scoping report was prepared and submitted to DPIE, which set out the relevant environmental matters and their appropriate level of assessment. The scoping report identified noise, heritage, biodiversity and hazard and risk as key matters for assessment report. They are assessed in sections 6.2, 6.3, 6.4, and 6.5. Other matters are assessed in section 6.7.

The site of the proposed modification is situated within the Illawarra region about 80 kilometres south of Sydney. The main regional centre is Wollongong about 3 kilometres to the north. Other major features of the region include the Illawarra Escarpment about 5 kilometres to the west and Lake Illawarra about 3 kilometres to the south. Major transport infrastructure near the proposed modification includes Princes Motorway and the South Coast Rail Line. The site also intersects the waterway Allans Creek which flows into the Inner Harbour of Port Kembla.

The site and surrounds of the proposed modification include parts of the localities of Port Kembla, Spring Hill, Cringila and Unanderra. Port Kembla is a deep-water harbour hosting a range of port and industrial uses including import, export and storage for commodities including vehicles, grain, coal, dry bulk, bulk liquid and general cargo. The parts of Spring Hill, Cringila and Unanderra where the proposed modification is situated are characterised by a mix of commercial and industrial uses with some residential and/or open space areas in Mount St Thomas about 300 metres to the north and Cringila about 300 metres to the south of the site of the proposed modification.

Some environmental mapping of the site of the proposal modification is provided in Appendix E.

## 6.2 Noise

A noise update report has been prepared for the proposed modification and is provided as Appendix A and summarised below. Any other minor matters as identified in the scoping report are assessed in section 6.7.

The assessment adopted noise catchment areas consistent with the prior assessment, incorporating the nearest residences to the north at Mount St Thomas within noise catchment area 1 (NCA1) and to the south at Cringila within noise catchment area (NCA2). The assessment utilised background noise monitoring collected as part of the prior assessment to determine the noise management level (NML) appropriate to the identified receivers.

Table 6-1 Background noise monitoring

Location	Rating background level $L_{a90}$			Ambient level $L_{Aeq}$		
	Day	Evening	Night	Day	Evening	Night
Location 1	39	40	39	52	60	50
Location 2	43	42	45	51	49	50

Consistent with the prior assessment, the potential for noise and vibration impacts would occur during construction and principally in two main activities being trenching and other construction works along the length of the pipeline, and the carrying out of horizontal directional drilling including establishment of pits at both ends of the drill span. Consistent with the prior assessment, sound power levels of 116 dBA and 110 dBA were adopted respectively.

Noise modelling was undertaken to quantify the predicted noise levels at the nearest receptors for these activities. In general the predicted noise levels remained consistent with the prior assessment with some transitory exceedances of the relevant NML expected at a number of residential and industrial receptors.

The predicted noise levels at the assessed receptors are shown in Table 6-2.

Table 6-2 Predicted noise levels

Receiver ID	Receiver type	NCA	NML		Noise prediction	
			Std. hours	Night works	CS1.1	CS1.4
R001	Residential	NCA1	53	47	51	37
R005	Residential	NCA1	53	47	51	40
R007	Active recreation	NCA1	65	-	60	46
R008	Industrial	NCA1	75	-	82	51
R009	Residential	NCA1	53	47	55	45
R013	Residential	NCA1	53	47	55	47
R016	Residential	NCA1	53	47	53	47
R019	Residential	NCA1	53	47	53	46
R044	Industrial	NCA2	75	-	69	45
R045	Industrial	NCA2	75	-	69	60
R047	Industrial	NCA2	75	-	60	52
R053	Residential	NCA2	49	44	47	40
R056	Residential	NCA2	49	44	47	40
R064	Residential	NCA2	49	44	49	42
R065	Residential	NCA2	49	44	52	45
R067	Residential	NCA2	49	44	48	41
R068	Industrial	NCA2	75	-	50	43
R072	Residential	NCA2	49	44	42	33

As discussed in section 3, some out of hours works may be required for activities requiring continuous operation such as horizontal directional drilling. An approval for out of hours work was previously sought for Port Kembla Gas Terminal, which was approved by DPIE, and which included horizontal directional drilling (GHD 2020). The related assessment had recommended the use of noise barriers for conducting these activities and accordingly this recommendation has been carried forward in the mitigation measures for the proposed modification. It is further noted that the conditions of approval for the Port Kembla Lateral Looping require an out of hours work protocol to be integrated in the construction environmental management plan. That out of hours work protocol likewise applies to the proposed modification. The management plan approach is described further in section 7.

The mitigation measures set out in the prior assessment were therefore considered to remain appropriate for the proposed modification and no additional measures would be necessary. These measures are listed in section 7.

## 6.3 Heritage

A heritage update report has been prepared for the proposed modification and is provided as Appendix B and summarised below. Any other minor matters as identified in the scoping report are assessed in section 6.7.

The assessment considered both Aboriginal and historic heritage values. The Aboriginal heritage component involved an updated search of the Aboriginal Heritage Information Management System (AHIMS) to identify any Aboriginal sites in the vicinity of the proposed modification and confirm that no new sites had been recorded since the prior assessment. The historic heritage component involved a review of all relevant local, state and national heritage registers. Both components involved a review of archaeological potential based on prior assessments.

The assessment identified one Aboriginal site on the AHIMS in the vicinity of the site of the proposed modification, being an open camp site on the eastern side of Springhill Road, while no historic heritage items were identified. Areas of archaeological potential were considered to occur on both sides of Springhill Road with regard to both

Aboriginal and historic heritage. The identified Aboriginal and historic heritage values or areas of risk, all of which were identified in the prior assessment and avoided, would likewise be avoided by the proposed modification.

Mapping of known heritage values in and around the site of the proposed modification is in Appendix B.

The mitigation measures set out in the prior assessment were therefore considered to remain appropriate for the proposed modification and no additional measures would be necessary. These measures are listed in section 7.

## 6.4 Biodiversity

A biodiversity update report has been prepared for the proposed modification and is provided as Appendix C and summarised below. Any other minor matters as identified in the scoping report are assessed in section 6.7.

A biodiversity development assessment report (BDAR) was prepared as part of the prior assessment which comprehensively assessed the impacts of the Port Kembla Gas Terminal and included detailed biodiversity surveys of the gas pipeline, assessment of impacts of its construction, and estimation of offset obligations. Payments have subsequently been made to the Biodiversity Conservation Fund to retire those obligations.

The assessment of the proposed modification involved a review of the BDAR, carrying out of some minor supplementary surveys in additional impact areas, and reappraisal of impacts on biodiversity values. The survey effort to date, including the prior assessment and supplementary surveys, is summarised in Table 6-3.

*Table 6-3 Survey effort*

Date	Approximate location	Survey techniques
4 July 2018	Springhill Road	Fauna habitat assessment Opportunistic fauna sightings
22 August 2018	Springhill Road, Bluescope	Vegetation mapping Fauna habitat assessment Opportunistic fauna sightings
27 September 2018	Springhill Road	Vegetation mapping Vegetation integrity survey plot
14 September 2021	Masters Road, Springhill Road, Five Islands Road	Vegetation mapping Fauna habitat assessment

The additional surveys in the north, near the intersection of Masters Road and Springhill Road, identified some planted native vegetation including forest red gum, spotted gum, blackbutt and swamp oak. A variety of potentially self-recruited native vegetation was also present including scrambling lily, sweet pittosporum, coffee bush and golden wattle. A number of minor drainage lines were also observed that were vegetated with bulrush and multiple invasive species. The vegetation in the stringing area for the crossing of Springhill Road predominantly consisted of exotic ground cover, however some naturally recruited native vegetation was present. Additional surveys in the south, near Five Islands Road, identified some planted native vegetation including spotted gum, prickly-leaved paperbark, swamp oak and Hill's weeping fig, and in some areas a mid-storey invasive species such as lantana.

Mapping of known biodiversity values in and around the site of the proposed modification is in Appendix B.

The assessment found the potential impacts of the proposed modification would be largely confined to some limited additional clearing of planted vegetation at the northern end, near the intersection of Masters Road and Springhill Road, and southern end, in the vicinity of Five Islands Road. The vegetation was assessed as having negligible habitat value for fauna including threatened species such as grey-headed flying fox and swift parrot.

It also found that the pipe stringing area in the north would potentially impact a small additional area of native vegetation and a drainage line. These areas were assessed to be marginal habitat for green and golden bell frog.

The assessment concluded potential impacts of the proposed modification on biodiversity values would be minimal, a separate BDAR would not be necessary, and that existing offset arrangements were satisfactory.

The mitigation measures set out in the prior assessment were therefore considered to remain appropriate for the proposed modification and no additional measures would be necessary. These measures are listed in section 7.

## 6.5 Hazard and risk

A final hazard analysis been that considers the integrated operations of gas pipeline infrastructure including the proposed modification and Port Kembla Lateral Looping and is provided as Appendix D and summarised below.

The assessment considered the risk posed by the proposed modification to people and property and was carried out in accordance with *Hazardous Industry Planning Advisory Paper No 6 Hazard Analysis* (DPIE 2011a) and *Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning* (DPIE 2011b). It involved the identification of potentially hazardous incidents that could occur, an analysis of the likelihood of them occurring and their consequences if they were to occur, and an assessment against the predefined risk criteria.

The identified potentially hazardous incidents derived from a loss of containment of gas due to faults occurring in the gas pipeline across a range of severities between a small leak and a full rupture and the subsequent ignition of the gas. The likelihood of these hazardous incidents occurring was determined based on empirical pipeline failure rate data and correlative ignition probability based on the physical properties of the gas and the release rate. The consequences of these hazardous incidents was based on predefined heat radiation thresholds at which harm to people or property would be expected to occur in accordance with the above departmental guidelines.

The assessment concluded that the risk posed by the proposed modification complied with the criteria set out in *Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning*. The risk exposure contours that were produced as part of the assessment are provided in the final hazard analysis in Appendix D.

## 6.6 Cumulative impacts

As discussed above, the proposed modification would be largely consistent with the assessment in the environmental impact statement and response to submissions for Port Kembla Gas Terminal. The cumulative impact assessment carried out as part of the environmental impact statement (GHD 2018) found that the majority of potential cumulative impacts related to the operation of the gas terminal, rather than gas pipeline, and that the potential for any cumulative impact to be significant was low. This remains the case for the proposed modification.

## 6.7 Other matters

As stated in section 1.2, prior to the preparation of this modification report a scoping report was prepared and submitted to DPIE, which set out the relevant environmental matters and their appropriate level of assessment. The matters identified in this section were assessed as being scoping matters, having been assessed at a high level in the scoping report and requiring no further assessment. These other matters are nonetheless considered in this modification report and an updated table summarising that assessment is provided as Table 6-4. As with the key matters discussed above, the potential impacts are consistent with the prior assessment and the mitigation measures set out in that prior assessment remain appropriate to avoid, mitigate and manage any impacts.

Table 6-4 Matters and impacts

Issue	Sub issue	Discussion
Amenity	Acoustic	Refer to section 6.2
	Visual	The construction of the project and the presence of equipment, vehicles and machinery would have the potential to create temporary visual impacts at visual receivers such as nearby residences, roads, and open space. The construction of the project would occur progressively and impacts would be temporary and significantly mitigated by the separation distance to residential areas. As construction progresses the disturbed areas would be progressively restored to similar to their prior condition. Once operating, the infrastructure would be mainly situated below ground.
	Odour	The project is not expected to generate odour during operation. While natural gas and nitrogen are odourless, additional odorous chemicals are included in the product gas as a safety precaution to detect leaks. While odour could be generated in the event of a leak, this would be rare, would be remedied as soon as practicable after a leak is detected, and is generally not expected to occur.
Access	Access to property	Construction activities around roads and properties would have the potential to temporarily affect access. Impacts would be limited in extent and duration. Any disturbed areas would be restored to prior condition and accordingly the project would not be expected to have lasting impacts on access.
	Utilities	Construction activities would have potential to cause temporary disruption or relocation of utilities. Impacts to utilities would be avoided as far as reasonably practicable through design refinement and construction methodology. At the completion of construction activities and any required restoration activities, the project would not be expected to have any lasting impacts on existing utilities.
	Road and rail network	The project would generally follow the road corridor of Springhill Road and Five Islands Road and would also cross Five Islands Road at one location and a number of smaller access ways. It would also cross beneath a rail bridge of an off-branch of the South Coast Rail Line at Springhill Road. As shown in Figure 3-1 impacts to the road and rail network would be avoided by directional drilling. Construction would generate additional traffic including some light and heavy vehicles. The volume of traffic would be limited and not be expected to significantly affect safety or efficiency of the roads.
	Offsite parking	The construction corridor and any suitable nearby areas will be utilised for construction vehicle parking. The project is not expected to require the use of any public parking facilities.
Built environment	Public domain	The construction of the project would have the potential to temporarily affect some public domain areas adjacent to Centenary Park at Cringila. The potential impacts would include the direct impacts of construction, associated amenity impacts as discussed above, and potential disruption of access. These impacts would be temporary and following construction and restoration activities the project would not be expected to have any lasting impact on the public domain, including Centenary Park.

Issue	Sub issue	Discussion
	Public infrastructure	See utilities, road and rail network and public domain above. Impacts to other public infrastructure are not anticipated.
	Other built assets	See utilities, road and rail network and public domain above. Impacts to other built assets are not anticipated.
Heritage	Natural	The project does not intersect any known natural heritage items.
	Cultural	The project does not intersect any known non-Aboriginal cultural heritage items.
	Aboriginal cultural	Refer to section 6.3
	Built	The project does not intersect any known built heritage items.
Community	Health	The project is not expected to present a significant risk to public health.
	Safety	The project is not expected to present a significant risk to public safety.
	Services and facilities	See utilities, road and rail network and public domain above. Other impacts to other services and facilities are not currently anticipated to be impacted.
	Cohesion, capital and resilience	The project would have limited impacts and would not be expected to significantly affect social cohesion, capital and resilience in the region — consistent with the prior assessment.
	Housing	Construction of the project will require a relatively small workforce that may require temporary accommodation in the region. The workforce will therefore have the potential to temporarily affect availability of housing or other forms of accommodation in the unlikely event such accommodation is required during construction however such impacts, if any, would be very limited if they did occur.
Economic	Natural resource use	Construction of the project would involve the use of resources embodied in construction materials such as steel. Operation of the project would require a supply of natural gas from the gas terminal and nitrogen for injection. The potential impacts on natural resource use would be negligible.
	Waste	Construction would have the potential to generate waste materials including waste excavated material, waste cleared material, and general construction/demolition waste. Operation would generate negligible waste. All waste would be collected by suitably licensed waste contractors.
	Livelihood	The construction and operation of the project would generate a number of temporary and permanent jobs. The gas pipeline would support the operation of Port Kembla Gas Terminal, as discussed in section 2, which would supply gas and support thousands of jobs across the region and NSW.
	Opportunity cost	The project is not expected to significantly impact the environment or preclude other developments.
Air	Particulate matter	Construction activities, particularly earthworks, would have the potential to generate dust which could then affect air quality at any nearby sensitive receivers such as residences including those to the north and south. The operation of machinery during construction would also have the potential to generate emissions from exhaust however these would be negligible. The operation of the project is not expected to result in any material particulate matter emissions to air.

Issue	Sub issue	Discussion
	Gases	The project would involve the reticulation of natural gas from Port Kembla Gas Terminal to the Eastern Gas Pipeline and as such there is potential for losses of gas to occur from the gas pipeline in the unusual event of a leak or rupture. The day-to-day operation of the project would not involve such releases of gas and any such releases would be remedied if detected as soon as practicable.
	Atmospheric emissions	Construction activities, equipment and vehicles could be potential sources of atmospheric emissions however these emissions would be negligible. As discussed above, there is potential for losses of gas to occur however the day-to-day operation of the pipeline would not involve such releases.
Biodiversity	Native vegetation	Refer to section 6.4
	Native fauna	Refer to section 6.4
Land	Stability/structure	The project would be on relatively flat terrain and involve relatively limited excavation meaning risks to surrounding land stability and/or structure are minor. Disturbed areas would be restored.
	Soil chemistry	The project would involve excavation, stockpiling and backfilling of soil with the potential to affect soil chemistry, fertility and profile. The project is largely situated on disturbed land and would not affect areas with high soil values such as agricultural areas and impacts would be negligible.
	Capability	As above with regard to soil chemistry, the project is largely situated on disturbed land and would not affect areas with high land capability and accordingly impacts would be negligible.
	Topography	The project would be on relatively flat terrain and involve relatively limited excavation meaning risks to surrounding land stability and/or structure are minor. Disturbed areas would be restored.
	Contamination	The project, particularly during construction, has the potential to encounter contaminated material primarily due to current and past industrial land uses in and adjacent to the site. The contamination assessment carried out as part of the environmental impact statement for the Port Kembla Gas Terminal (GHD 2018) identified a number of areas of environmental concern along the alignment including fill materials, spilled fuels, oils or other liquids, and building and demolition materials.
	Acid sulfate soils	The project would involve relatively limited excavation which is not expected to encounter acid sulfate soils. A potential exception would be the area surrounding Allans Creek which has a high probability of acid sulfate soil being present (NSW Government 2021). It is planned that horizontal directional drilling would be carried out at the crossing of the creek and therefore potential to generate waste acid sulfate soil is minimal. Its management is discussed below in section 7.
Water	Water quality	The site of the proposed modification intersects Allans Creek which flows into the Inner Harbour of Port Kembla. The existing water quality within Allans Creek is expected to be relatively poor given it drains surrounding industrial areas and is understood to receive industrial discharges particularly around Port Kembla. In any case, the project is not expected to have any material impact on water quality in Allans Creek as it would be constructed by horizontal directional drill. Impacts on water quality more generally, due to erosion and sedimentation or accidental leaks and spills, would be readily avoided, mitigated and managed through the measures discussed below in section 7.
	Water availability	The construction of the project would involve the use of water for activities such as dust suppression. The volumes of water required would be very limited and would not limit availability.

Issue	Sub issue	Discussion
	Hydrological flows	As discussed above, the site of the proposed modification would intersect Allans Creek however construction at this location would be carried out by horizontal directional drilling and as a result no impacts are expected. Impacts on hydrology and topography more generally would be negligible.
Hazards and risks	Coastal hazards	The site of the proposed modification is partly within the coastal environment area however its construction and operation would not materially interact with any coastal hazards.
	Flood waters	As discussed above, the project would not affect hydrological flows, including flood waters.
	Bushfire	The construction of the project would potentially involve hot works that could lead to fire ignition. The risk of causing a fire is very low as the site of the proposed modification is largely cleared.
	Undermining	Some horizontal directional drilling would be carried out during construction. Given the small volume of drilling and the nature of the overlying land uses undermining impacts are very unlikely.
	Steep slopes	The project would be on relatively flat terrain with few if any steep slopes. The steepest landform would be the banks of Allans Creek, which would be avoided by horizontal directional drilling.
	Industrial hazard	Refer to section 6.5

# 7. Consistency assessment

## 7.1 Approval conditions

With reference to section 1, the proposed modification is to modify the infrastructure approval for the Eastern Gas Pipeline (SSI-9973) and accounting for the modification for the Port Kembla Lateral Looping (SSI-9973-Mod-1). The approval conditions of the modification of the Port Kembla Lateral Looping are most relevant and include:

- hazard management plans, including:
  - construction safety study
  - hazard and operability study
  - final hazard analysis
  - emergency plan
  - pipeline management plan
- construction traffic management plan
- conditions to protect amenity (noise and air)
- conditions to minimise impact to soil and water
- conditions to minimise interaction with contamination
- conditions to deal with generated waste appropriately
- conditions to avoid any impacts to any heritage values
- conditions to adhere to assessed impacts to biodiversity
- a construction environmental management plan, addressing:
  - noise
  - air quality
  - biodiversity
  - soil and water
  - traffic management
  - waste management

Accordingly, it is considered that the proposed modification and the mitigation measures carried forward would be readily integrated into the infrastructure approval, and requisite management plans, for the Eastern Gas Pipeline.

## 7.2 Mitigation measures

*State significant infrastructure guidelines – preparing a modification report* (DPIE 2021) recommends that an updated mitigation measures table is provided with the modification report. The relevant parts of the mitigation measures table from the environmental impact statement for Port Kembla Gas Terminal are shown in Table 7-1. The omitted mitigation measures principally concern the operation of the gas terminal or dredging and disposal.

Table 7-1 Mitigation measures

ID	Issue	Measure
PN1–PN15	Port Navigation	NA
H1	Safety	Hazard identification and design assurance process safety activities such as HAZID, HAZOP and LOPA shall continue in the detailed design phase to ensure that the health and safety risk is reduced to As Low As Reasonably Practicable (ALARP). Major Accident Hazard events and the associated safeguards will be further defined to allow the development of performance standards for safety critical systems and elements
H2	Safety	NA
H3	Fire safety	NA
C01–C03	Contamination	NA
C04	Contamination	Preparation of an ASSMP by a consultant experienced in the identification and management of ASS. This will also include appropriate management and/or treatment of ASS. The ASSMP will be developed in line with the requirements of the Acid Sulphate Soils Management Advisory Committee Guidelines (ASSMAC, August 1998 and as updated). The ASSMP will be prepared to identify, manage and treat the ASS encountered during excavation to minimize the production of acid leachate.
C05	Contamination	Preparation and implementation of a construction environmental management plan (CEMP) to include an unexpected finds protocol (UFP) to effectively manage the potential contamination issues identified from both a human health and environmental perspective. This would include the assessment of materials to be disturbed across the site to inform appropriate management strategies.
C06	Contamination	Assessment and classification of all material to be disposed of offsite as per NSW EPA (2014) Waste Classification Guidelines, Part 1: Classifying Waste and Part 4: Acid Sulfate Soils prior to off-site disposal.
C07	Contamination	If the proposed pipeline alignment is likely to intersect groundwater, assessment of groundwater quality in those sections should also be carried out to inform construction management of potential contamination issues.
C08	Contamination	NA
W01	Water	NA
W02	Water	The proposed pipeline between the terminal and the existing east coast gas transmission network at Cringila has been designed such that the pipeline will be below existing ground levels.
W03–W04	Water	NA
W05	Water	Preparation of a Construction Environmental Management Plan (CEMP) ... to provide a framework for the environmental management of construction activities to minimise the environmental risks to a level that is as low as practically possible for this project.
W06–W09	Water	NA
W10	Water	A site specific erosion and sediment control plan (ESCP) will be prepared as part of the CEMP to provide control of all land based excavation and stockpiling requirements. All erosion and sediment control measures shall be designed, implemented and maintained in accordance with 'Managing Urban Stormwater: Soil and Construction Volume 1' (Landcom 2004) ('the Blue Book').

ID	Issue	Measure
W11	Water	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and Environment Protection Authority).
W12	Water	An emergency spill kit will be kept on site at all times. All staff will be made aware of the location of the spill kit and trained in its use.
W13	Water	Machinery will be checked daily to ensure there is no oil, fuel or other liquids leaking from the machinery. All staff will be appropriately trained through toolbox talks for the minimisation and management of accidental spills.
W14–W15	Water	NA
W16	Water	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and Environment Protection Authority). An emergency spill kit will be kept on site. All staff will be made aware of the location of the spill kit and trained in its use.
ME01–ME12	Marine ecology	NA
TB1	Terrestrial ecology	NA
TB2	Terrestrial ecology	Staff will be inducted and informed of the limits of clearing and the areas of vegetation to be retained.
TB3	Terrestrial ecology	A trained ecologist is to be present for construction activities that may impact frog habitat which includes dewatering / removal of detention basins and trenching immediately adjacent to Typha drainage line (west of Springhill Road) Temporary frog-proof fencing should be installed around drill sites, road side drains and detention ponds near the project site to be retained to prevent frogs from being injured or killed by equipment An inspection is to be conducted each morning to check the trench for frogs Any frogs identified will only be handled by an ecologist or wildlife rescue representative Any Green and Golden Bell Frogs or other resident frogs are to be handled in accordance with the Chytrid fungus hygiene protocols (DECC 2008c) and released into the most appropriate nearby habitat area
TB4	Terrestrial ecology	Priority weed control measures will be implemented as part of the CEMP to prevent their spread in the study area.
TB5	Terrestrial ecology	Declared priority weeds will be managed according to requirements of the NSW Biosecurity Act 2015 Soil material and stripped groundcover vegetation with the potential to contain priority weeds will not be removed from the project site Soil disturbance will be avoided as much as possible to minimise the potential for spreading weeds.
TB6	Terrestrial ecology	A site specific erosion and sediment control plan will be prepared as part of the CEMP. All erosion and sediment control measures shall be designed, implemented and maintained in accordance with relevant sections of 'Managing Urban Stormwater: Soil and Construction Volume 1' (Landcom 2004) ('the Blue Book') (particularly section 2.2) and 'Managing Urban Stormwater: Soil and Construction Volume 2A – Installation of Services' (DECC 2008b). The erosion and sediment control plan will include stockpiles, stormwater runoff, trees, site boundaries, site access and storage areas.
TB7	Terrestrial ecology	Areas disturbed during the works will be rehabilitated, including stabilising disturbed soils to resist erosion and weed invasion via establishment of with a suitable turf species such as a native Couch or repaving roads and sealed surfaces.

ID	Issue	Measure
		Stabilisation activities will be carried out progressively to limit the time disturbed areas are exposed to erosion processes Activities with a risk of soil erosion such as earthworks will not be undertaken immediately before or during high rainfall or wind events.
TB8	Terrestrial ecology	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers)
TB9	Terrestrial ecology	An emergency spill kit will be kept on site at all times. All staff will be made aware of the location of the spill kit and trained in its use
TB10	Terrestrial ecology	Any herbicides used for weed control will be applied to the manufacturer's specifications and as outlined in the manufacturer's Material Safety Data Sheet
TB11	Terrestrial ecology	Machinery will be checked daily to ensure there is no oil, fuel or other liquids leaking from the machinery. All staff will be appropriately trained through toolbox talks for the minimisation and management of accidental spills.
TB12	Terrestrial ecology	Vehicle wash down would be carried out should evidence of pathogens or fungus such as Phytophthora or Chytrid be found.
H1	Heritage	The construction workforce would be given a heritage induction and supporting material to be able to identify materials of potential heritage value and how to respond.
H2	Heritage	A protocol to be followed in the event of an unexpected find would be developed and would include clear lines of communication and stop work procedures to be followed.
T1	Traffic	A Construction Traffic Management Plan be prepared prior to the commencement of works with site induction for construction personnel being undertaken to outline the requirements of the CTMP. The aim of the CTMP is to maintain the safety of all workers and road users within the vicinity site including but not limited to: <ul style="list-style-type: none"> <li>• site access routes</li> <li>• construction parking arrangement</li> <li>• traffic management</li> <li>• pedestrian and bicycle rider management roadside hazards.</li> </ul>
T2	Traffic	A traffic control plan would be developed in accordance with the NSW Roads and Maritime Services Traffic control at work sites and AS1742.3 – Traffic control devices for works on roads.
T3	Traffic	Traffic management planning would seek to minimise traffic movements where possible during the morning and afternoon peak hours.
T4	Traffic	Construction workers would be encouraged to car pool or utilise public transport where practicable.
NV1	Noise	Provide site inductions to all employees, contractors and subcontractors. The induction must at least include: <ul style="list-style-type: none"> <li>• All relevant project specific and standard noise and vibration mitigation measures</li> <li>• Relevant licence and approval conditions</li> <li>• Permissible hours of work</li> <li>• Any limitations on noise generating activities with special audible characteristics</li> <li>• Location of nearest sensitive receivers</li> </ul>

ID	Issue	Measure
		<ul style="list-style-type: none"> <li>• Construction employee parking areas</li> <li>• Designated loading/unloading areas and procedures</li> <li>• Site opening/closing times (including deliveries)</li> <li>• Environmental incident procedures.</li> </ul>
NV2	Noise	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.
NV3	Noise	<p>Notify the affected receivers detailing the construction activities, time periods over which they would occur and the duration of works.</p> <p>Provide contact details to the affected receivers. If noise complaints are received, they should be recorded and attended noise monitoring should be conducted to assess compliance with the predicted construction noise levels.</p>
NV4	Noise	Quieter construction methods should be used where feasible.
NV5	Noise	Minimise pipeline construction activities near sensitive receivers during more sensitive time periods (evening, night).
NV6	Noise	Turn off equipment after use.
NV7	Noise	<p>No swearing or unnecessary shouting or loud stereos/radios on site.</p> <p>No dropping of materials from height, throwing of metal items and slamming of doors. No excessive revving of plant and vehicle engines.</p> <p>Controlled release of compressed air.</p>
NV8	Noise	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
NV9	Noise	<p>Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided.</p> <p>The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down.</p> <p>Noise-emitting plant to be directed away from sensitive receivers.</p>
NV10	Noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles.
NV11	Noise	<p>Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers.</p> <p>Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers.</p> <p>Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.</p>
NV12	Noise	Where possible reduce noise from mobile plant through additional fittings including residential grade mufflers.
NV13	Noise	Where practicable, pre-fabricate and/or prepare materials off-site to reduce noise with special audible characteristics occurring on site. Materials can then be delivered to site for installation.
NV14	Noise	Stationary noise sources, such as pumps, should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436:1981 lists materials suitable for shielding
NV15	Noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when siting plant.

ID	Issue	Measure
NV16–NV17	Noise	NA
NV18	Noise	Install noise barriers between stationary plant such as generators, water treatment, desander and horizontal directional drill and noise sensitive receivers. Barriers may be plywood hoarding or construction blanket installed on temporary fencing.
AQ1	Air	Water material prior to it being loaded for on-site haulage, where appropriate.
AQ2	Air	Aim to minimise the size of storage piles where possible.
AQ3	Air	Limit cleared areas of land and clear only when necessary to reduce fugitive dust emissions.
AQ4	Air	Control on-site traffic by designating specific routes for haulage and access and limiting vehicle speeds to below 25 km/hr.
AQ5	Air	All trucks hauling material will be covered on the way to the site and maintain a reasonable amount of vertical space between the top of the load and top of the trailer.
AQ6	Air	Operations conducted in areas of low moisture content material should be suspended during high wind speed events or water sprays should be used.
LV1	Visual	NA
LV2	Visual	Where possible, locate the gas pipeline alignment and associated easement away from the existing established buffer tree planting along Springhill Road, to avoid unnecessary tree removal and ensure the functional integrity of the existing environmental and visual buffers as outlined in the Port Kembla Development Code.  Obtain arboricultural advice regarding the opportunity to retain existing mature vegetation and investigate design solutions to achieve this.
LV3	Visual	NA
LV4	Visual	Temporary boardings, barriers, traffic management and signage would be removed when no longer required.
LV5	Visual	Materials and machinery would be stored neatly during construction works.
LV6	Visual	Roads providing access to the site and work areas would be maintained free of dust and mud as far as reasonably practicable.
LV7	Visual	Ensure temporary lighting required during the construction period is sited and designed to avoid light spill into the surrounding area.
S1	Social	A contracting and procurement strategy focusing on maximising local content will be prepared to support local employment and business opportunities during construction.
S2	Social	Stakeholder engagement would be carried out prior to and during construction with key stakeholders and the community to provide information about the project activities and provide a feedback mechanism for residents.
W1	Waste	Develop and implement a waste management plan for construction that integrates all statutory requirements for waste in NSW and includes: <ul style="list-style-type: none"> <li>• systems to sort and track the actual types and quantities of waste generated</li> <li>• measures for separating waste based on classification of management options including colour coded bins</li> </ul> options for offsite reuse, reprocessing, recycling and energy recovery of waste

ID	Issue	Measure
W2	Waste	<p>Develop and implement a waste management plan for operation that integrates all statutory requirements for waste in NSW, including under MARPOL, and includes:</p> <ul style="list-style-type: none"> <li>• systems to sort and track the actual types and quantities of waste generated</li> <li>• measures for separating waste based on classification of management options including colour coded bins</li> <li>• options for offsite reuse, reprocessing, recycling and energy recovery of waste</li> </ul>
G1	Greenhouse gas	All plant and equipment used during the construction works shall be regularly maintained to comply with the relevant exhaust emission guidelines
G2	Greenhouse gas	Sustainable procurement practices will be adopted where feasible.
G3	Greenhouse gas	<p>The following measures will be considered by contractor(s):</p> <ul style="list-style-type: none"> <li>• Construction materials sourced locally where possible</li> <li>• Construction materials that have minimal embodied energy be selected</li> <li>• Use of PVC plastic minimised</li> <li>• Construction materials that are low maintenance and durable</li> <li>• Plant and equipment will be switched off when not in constant use and not left idling</li> <li>• Plant and equipment brought onsite will be regularly serviced and energy efficient vehicles or equipment will be selected where available</li> <li>• Any plant and equipment that is not working efficiently (i.e. emitting excessive smoke) will be removed from site and replaced as soon as possible</li> <li>• Construction works will be planned to ensure minimal movement of plant and equipment, including barges.</li> </ul>
G4–G6	Greenhouse gas	NA
G7	Greenhouse gas	The equipment will be maintained appropriately to minimise the risk of unintended leaks and unnecessary venting.
G8	Greenhouse gas	NA

## **8. Justification and conclusion**

The proposed modification, being the construction and operation of Segment 1.2 of the gas pipeline, is integral to the connection from the approved Port Kembla Gas Terminal to the broader gas network operated by Jemena. By servicing the import terminal the proposed modification will improve gas security and will support thousands of jobs across the region and NSW. The environmental and social impacts of the project and particularly Segment 1.2 of the gas pipeline, being the subject of this modification, are limited and readily avoided, mitigated and managed.

## 9. References

Australian Energy Market Operator (AEMO) 2021, Gas Statement of Opportunities, [https://aemo.com.au/-/media/files/gas/national\\_planning\\_and\\_forecasting/gsoo/2021/2021-gas-statement-of-opportunities.pdf?la=en](https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2021/2021-gas-statement-of-opportunities.pdf?la=en)

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# Appendices

# **Appendix A**

**Noise update report**

# Noise update report

## 1. Introduction

### 1.1 Project modification

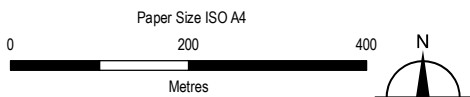
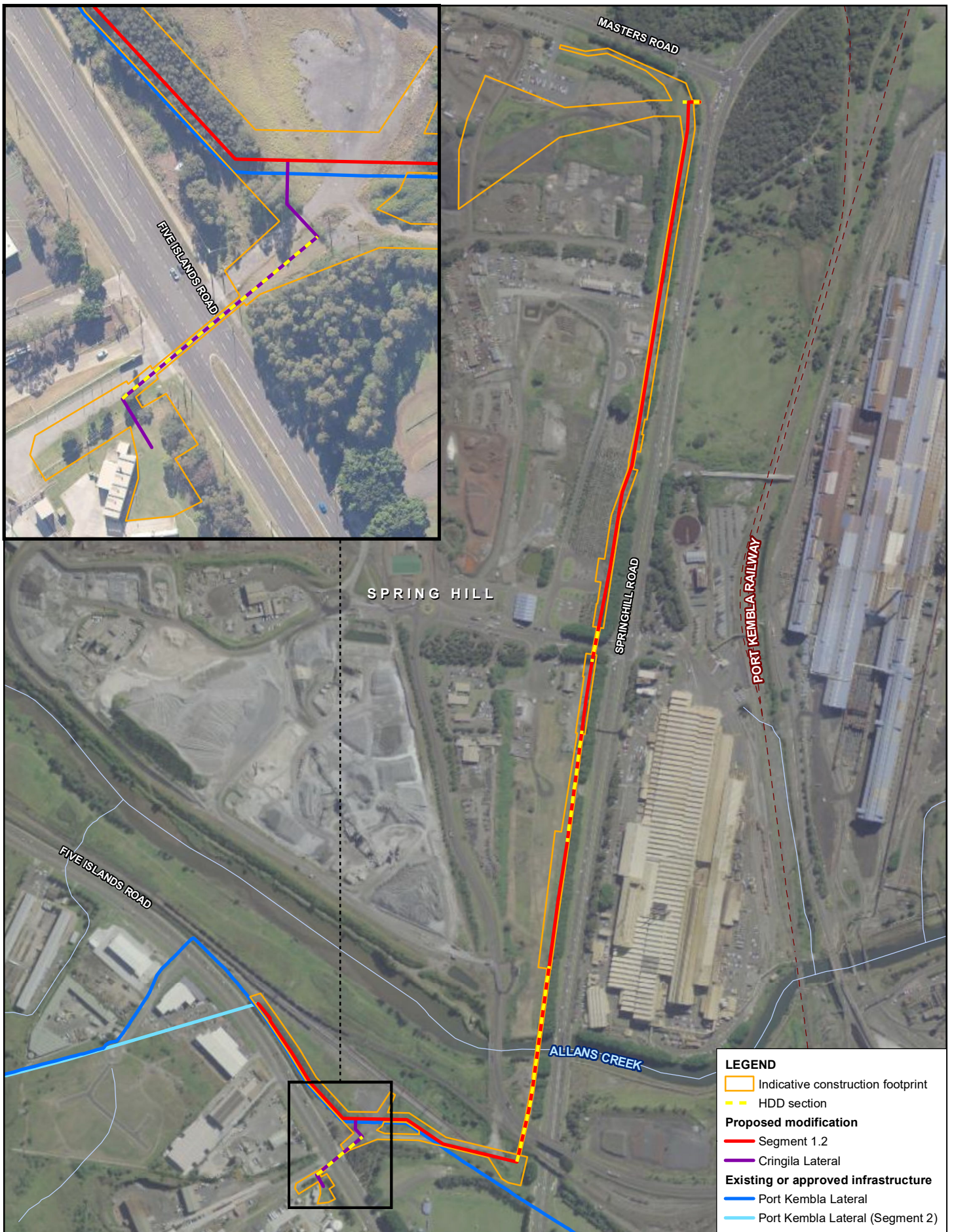
Jemena proposes to modify its existing infrastructure approval for the Eastern Gas Pipeline to incorporate a segment of the gas pipeline proposed by AIE as part of the approved Port Kembla Gas Terminal. The segment to be incorporated extends from the western boundary of the corridor of Springhill Road southward to a connection point on the proposed Port Kembla Lateral Looping of the Eastern Gas Pipeline. The modification is required to allow this segment of the gas pipeline to be constructed and operated under a modified infrastructure approval for the Eastern Gas Pipeline under the *Environmental Planning and Assessment Act 1979* (SSI-9973). The proposed modification would also involve minor changes to the alignment as well as the addition of a short lateral pipeline at the southern end of the modification (the Cringila Lateral), which would also connect to the Eastern Gas Pipeline.

GHD undertook a Noise and Vibration Impact Assessment for the Port Kembla Gas Terminal in 2018 and while the proposed modification would involve some minor changes to the gas pipeline alignment, the construction process and general location would be very similar to that which was approved under the Port Kembla Gas Terminal. As such, it is considered unlikely that the proposed modification would involve additional noise and vibration impacts or that additional mitigation measures would be necessary.

### 1.2 Purpose

The purpose of this report is to assess potential construction noise impacts associated with the proposed modification (see Figure 1 below) and identify reasonable and feasible mitigation measures where required. The following tasks have been undertaken:

- Noise levels for the construction of the pipeline have been modelled at the nearest receivers to the modification.
- A comparison of the predicted noise levels to the findings of the EIS has been undertaken.
- Mitigation measures have been provided for sufficiency.



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Jemena  
Eastern Gas Pipeline - Modification 2

Project No. 12547160  
Revision No. A  
Date 23 Sep 2021

Proposed modification

FIGURE 1

## 2. Methodology

Noise modelling was undertaken for the two worst case construction scenarios involved in the modification and noise levels assessed to the nearest receivers to the modification. The results of the noise modelling have been compared with the noise modelling results from the original EIS assessment undertaken in 2018, it is noted that the pipeline alignment was updated in the Submissions Report (GHD, 2019).

The scenarios assessed are as follows and activity sound power levels (SWLs) are consistent with the original EIS assessment:

- Construction works along trenched construction footprint during standard hours (CS1.1 Site establishment) – SWL 116 dBA.
- Construction works at the HDD launch/retrieval pits during standard hours and during the night period (CS1.4 Directional Drilling works) – SWL 110 dBA.

Noise modelling was undertaken using SoundPlan Version 8.2. SoundPlan is a computer program for the calculation, assessment and prognosis of noise exposure. SoundPlan calculates environmental noise propagation according to *ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'*. Modelling parameters and assumptions have remained consistent with the original assessment model.

## 3. Existing environment

Port Kembla is an industrial hub characterised by industrial or infrastructure use. The proposed modification site lies adjacent to Spring Hill Road and crosses Five Islands Road. The closest residential receivers to the proposed modification would be to the north at Mount St. Thomas in Noise Catchment Area 1 (NCA1) and to the south at Cringila (NCA2), noting that these residential areas would be have a separation distance from the works of approximately 300 metres with sub-arterial roads (including Masters Road and Five Islands Road) in the intervening space.

Springhill Road is one of the main vehicular traffic routes connecting Port Kembla to regional road network including the M1 Princes Highway. Five Islands Road also runs parallel to the Port Kembla branch of the South Coast railway. Similarly, Five Islands Road is a major six-lane road and run parallel to the Unanderra main railway line.

Background noise monitoring at two residential locations in Port Kembla was undertaken in 2018 as part of the assessment of potential noise and vibration impacts in the EIS. The results of the monitoring are summarised in Table 1.

Noise Management Levels (NMLs) were developed from the background noise monitoring for the original assessment and remain consistent for this modification in accordance with the Interim Construction Noise Guideline (DEC 2009). The NMLs used in this assessment are shown in Table 2.

*Table 1 Background noise levels collected during the Port Kembla Gas Terminal EIS*

Location	Rating background level $L_{a90}$			Ambient level $L_{Aeq}$		
	Day	Evening	Night	Day	Evening	Night
Location 1	39	40	39	52	60	50
Location 2	43	42	45	51	49	50

## 4. Impact assessment

Results of the noise modelling described above are presented in Table 2 alongside results for the same scenarios from the original EIS assessment and the change in predicted noise levels. The southern end of the pipeline alignment was updated during the response to submissions phase, the alignment shown in

Figure 1, is similar to this updated alignment. However, no noise modelling was undertaken during this phase and as such the change in noise levels presented are from the original EIS noise model. Noise levels presented for the modification are likely to be similar to those for the alignment presented in the Submissions Report (GHD, 2019)

The results show that for works along the trenched construction footprint (CS1.1), noise levels at the receivers nearest the updated alignment in NCA1 are anticipated to increase. At the industrial receiver R008 this increase is up to 27 dB and is predicted to receive noise levels above the NML while in use. Note should be made that this assumes worst-case construction activities are occurring at the nearest distance between the works and the receiver. For the majority of the time, noise levels will be significantly less as construction works move away from this receiver.

Industrial receivers R044 and R045 are also predicted to receive noise levels higher than previously modelled, however, these noise levels are predicted to remain below the NML. Receivers where the separation distance to the alignment is now greater (i.e. residences in NCA2) noise levels are predicted to reduce, in some cases below the NML.

For directional drilling works (CS1.4) noise levels are predicted to remain consistent with the original EIS assessment for receivers in NCA1 and reduce for receivers in NCA2. Industrial receiver R045 is predicted to experience noise levels up to 14 dB greater than originally assessed, however the received noise level is below the NML.

The nearest residential receivers are over 300 metres from the construction footprint and are not expected to receive vibration levels above the structural damage or human comfort levels. The nearest industrial receiver (R008) is approximately 25 metres from the construction footprint and is therefore not expected to receive vibration levels above the threshold for structural damage, however may experience levels above the human comfort levels.

**Table 2** Predicted  $L_{Aeq(15min)}$  noise levels, dBA

Receiver ID	Receiver type	NCA	NML		EIS assessment, dBA		Modified alignment, dBA		Change in noise level, dB	
			Std. hours	Night works	CS1.1	CS1.4	CS1.1	CS1.4	CS1.1	CS1.4
R001	Residential	NCA1	53	47	44	37	51	37	7	0
R005	Residential	NCA1	53	47	45	39	51	40	6	1
R007	Active recreation	NCA1	65	-	51	45	60	46	9	1
R008	Industrial	NCA1	75	-	56	50	82	51	26	1
R009	Residential	NCA1	53	47	50	44	55	45	5	1
R013	Residential	NCA1	53	47	51	45	55	47	4	2
R016	Residential	NCA1	53	47	51	45	53	47	2	2
R019	Residential	NCA1	53	47	51	45	53	46	2	1
R044	Industrial	NCA2	75	-	49	43	69	45	20	2
R045	Industrial	NCA2	75	-	55	46	69	60	14	14
R047	Industrial	NCA2	75	-	55	48	60	52	5	4
R053	Residential	NCA2	49	44	51	43	47	40	-4	-3
R056	Residential	NCA2	49	44	49	43	47	40	-2	-3
R064	Residential	NCA2	49	44	55	49	49	42	-6	-7
R065	Residential	NCA2	49	44	66	52	52	45	-14	-7
R067	Residential	NCA2	49	44	54	45	48	41	-6	-4
R068	Industrial	NCA2	75	-	62	49	50	43	-12	-6

Receiver ID	Receiver type	NCA	NML		EIS assessment, dBA		Modified alignment, dBA		Change in noise level, dB	
			Std. hours	Night works	CS1.1	CS1.4	CS1.1	CS1.4	CS1.1	CS1.4
R072	Residential	NCA2	49	44	45	35	42	33	-3	-2

## 5. Conclusion

The noise modelling results indicate that noise levels are anticipated to increase for some industrial receivers as a result of the modification. However, noise levels are also anticipated to decrease for residential receivers in NCA2.

Noise mitigation measures for construction airborne noise from the original EIS assessment are provided in Appendix A for reference.

Industrial receiver R008 is predicted to receive noise levels higher than originally predicted that would be above the noise management level. The industrial receiver at R008 (Masters Road) should be notified prior to the works as recommended in the EIS noise assessment mitigation measures.

While increases in the received noise levels are predicted for R044 and R045 they are not anticipated to be above the NML and no additional mitigation is required for these receivers.

Predicted noise levels at all other receivers closest to the alignment in NCA1 are predicted to marginally increase from the original assessment for trenching works and remain consistent for directional drilling works. Receivers within NCA2 are predicted to receive noise levels lower than those predicted in the original assessment for both trenching and directional drilling works.

Mitigation measures provided in the original EIS assessment should be maintained and are considered adequate to manage and minimise impacts.

# Appendix A

## **Mitigation measures**

ID	Measure
NV1	<p>Provide site inductions to all employees, contractors and subcontractors. The induction must at least include:</p> <ul style="list-style-type: none"> <li>– all relevant project specific and standard noise and vibration mitigation measures</li> <li>– relevant licence and approval conditions</li> <li>– permissible hours of work</li> <li>– any limitations on noise generating activities with special audible characteristics</li> <li>– location of nearest sensitive receivers</li> <li>– construction employee parking areas</li> <li>– designated loading/unloading areas and procedures</li> <li>– site opening/closing times (including deliveries)</li> <li>– environmental incident procedures.</li> </ul>
NV2	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.
NV3	<p>Notify the affected receivers detailing the construction activities, time periods over which they would occur and the duration of works.</p> <p>Provide contact details to the affected receivers. If noise complaints are received, they should be recorded and attended noise monitoring should be conducted to assess compliance with the predicted construction noise levels.</p>
NV4	Quieter construction methods should be used where feasible.
NV5	Minimise pipeline construction activities near sensitive receivers during more sensitive time periods (evening, night).
NV6	Turn off equipment after use.
NV7	<p>No swearing or unnecessary shouting or loud stereos/radios on site.</p> <p>No dropping of materials from height, throwing of metal items and slamming of doors. No excessive revving of plant and vehicle engines.</p> <p>Controlled release of compressed air.</p>
NV8	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
NV9	<p>Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided.</p> <p>The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down.</p> <p>Noise-emitting plant to be directed away from sensitive receivers.</p>
NV10	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles.
NV11	<p>Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers.</p> <p>Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.</p>
NV12	Where possible reduce noise from mobile plant through additional fittings including residential grade mufflers.
NV13	Where practicable, pre-fabricate and/or prepare materials off-site to reduce noise with special audible characteristics occurring on site. Materials can then be delivered to site for installation.
NV14	Stationary noise sources, such as pumps, should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436:1981 lists materials suitable for shielding.
NV15	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when siting plant.
NV16–NV17	NA
NV18	Install noise barriers between stationary plant such as generators, water treatment, desander and horizontal directional drill and noise sensitive receivers. Barriers may be plywood hoarding or construction blanket installed on temporary fencing.

# **Appendix B**

**Heritage update report**

# Heritage update report

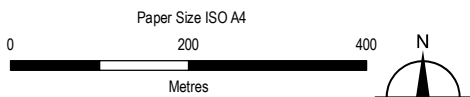
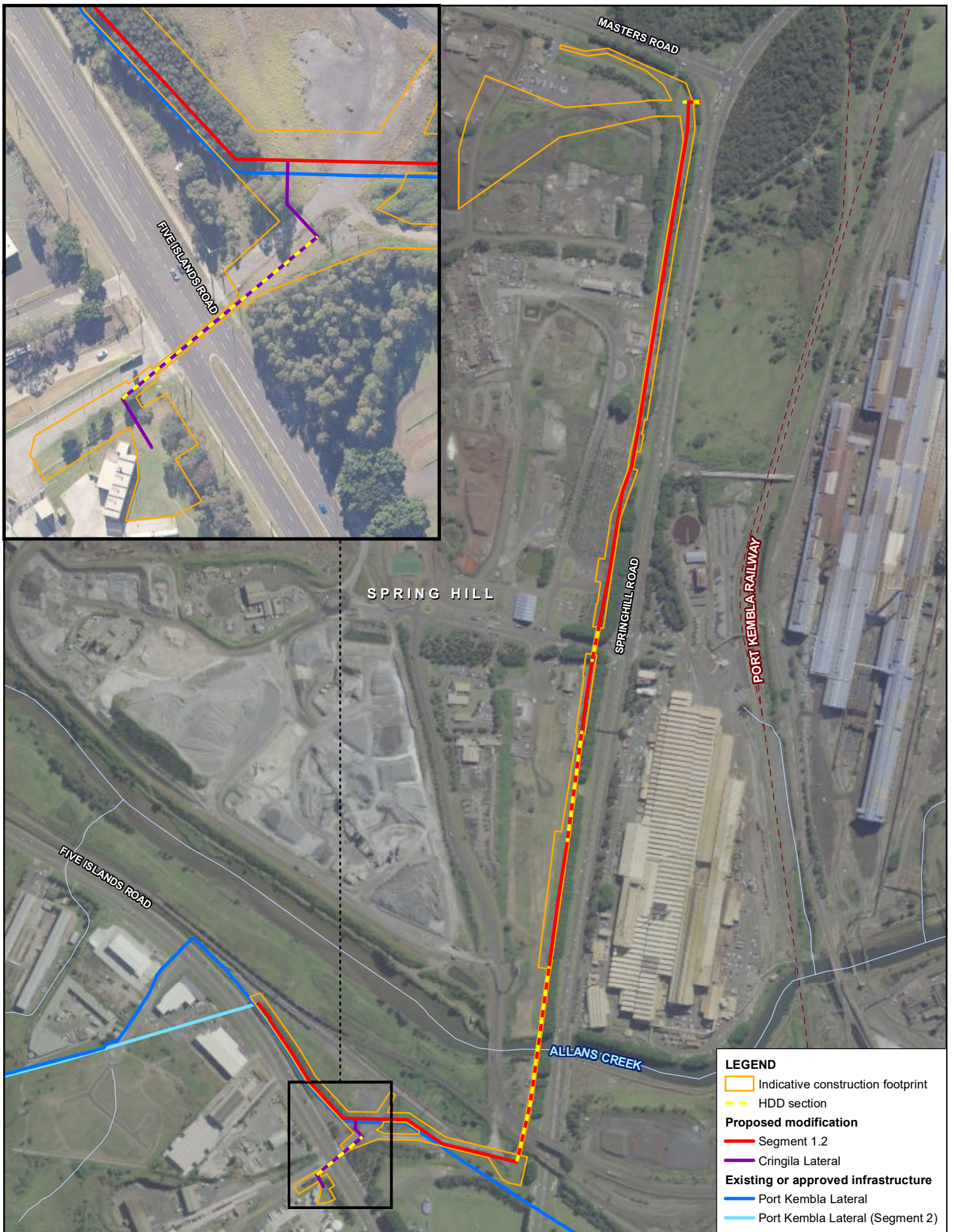
## 1. Introduction

### 1.1 Project modification

Jemena proposes to modify its existing infrastructure approval for the Eastern Gas Pipeline to incorporate a segment of the gas pipeline proposed by AIE as part of the approved Port Kembla Gas Terminal. The segment to be incorporated extends from the western boundary of the corridor of Springhill Road southward to a connection point on the proposed Port Kembla Lateral Looping of the Eastern Gas Pipeline. The modification is required to allow this segment of the gas pipeline to be constructed and operated under a modified infrastructure approval for the Eastern Gas Pipeline under the *Environmental Planning and Assessment Act 1979* (SSI-9973). The proposed modification would also involve minor changes to the alignment as well as the addition of a short lateral pipeline at the southern end of the modification (the Cringila Lateral), which would also connect to the Eastern Gas Pipeline.

### 1.2 Purpose

This report has been prepared by GHD Pty Ltd (GHD) for Jemena to provide information on Aboriginal and non-Aboriginal heritage considerations for the proposed modification to the existing Eastern Gas Pipeline Approval. In 2018, GHD completed a Historic Heritage Assessment (HHA) (GHD 2018a) and an Aboriginal Heritage Due Diligence Assessment (AHDDA) (GHD 2018b) for the proposed Port Kembla Gas Terminal (the project) in New South Wales (NSW). Both reports were prepared in accordance with the Secretary's environmental assessment requirements (SEARs) and provide information and advice on historic and Aboriginal heritage considerations for the proposed works.



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Jemena  
Eastern Gas Pipeline - Modification 2

Project No. 12547160  
Revision No. A  
Date 23 Sep 2021

Proposed modification

FIGURE 1

## **2. Aboriginal Heritage**

The 2018 (GHD) AHDDA report was prepared in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (OEH 2010).

### **2.1 Consultation**

The 2018 (GHD) AHDDA report was prepared in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (OEH 2010). At the time, to inform the AHDDA, consultation was undertaken with the Illawarra Local Aboriginal Land Council (ILALC). Consultation was also undertaken with OEH, with an initial project brief and post visual inspection meeting to discuss Aboriginal heritage risks.

No further consultation for the proposed modification has been undertaken given the minor variation of the proposed works.

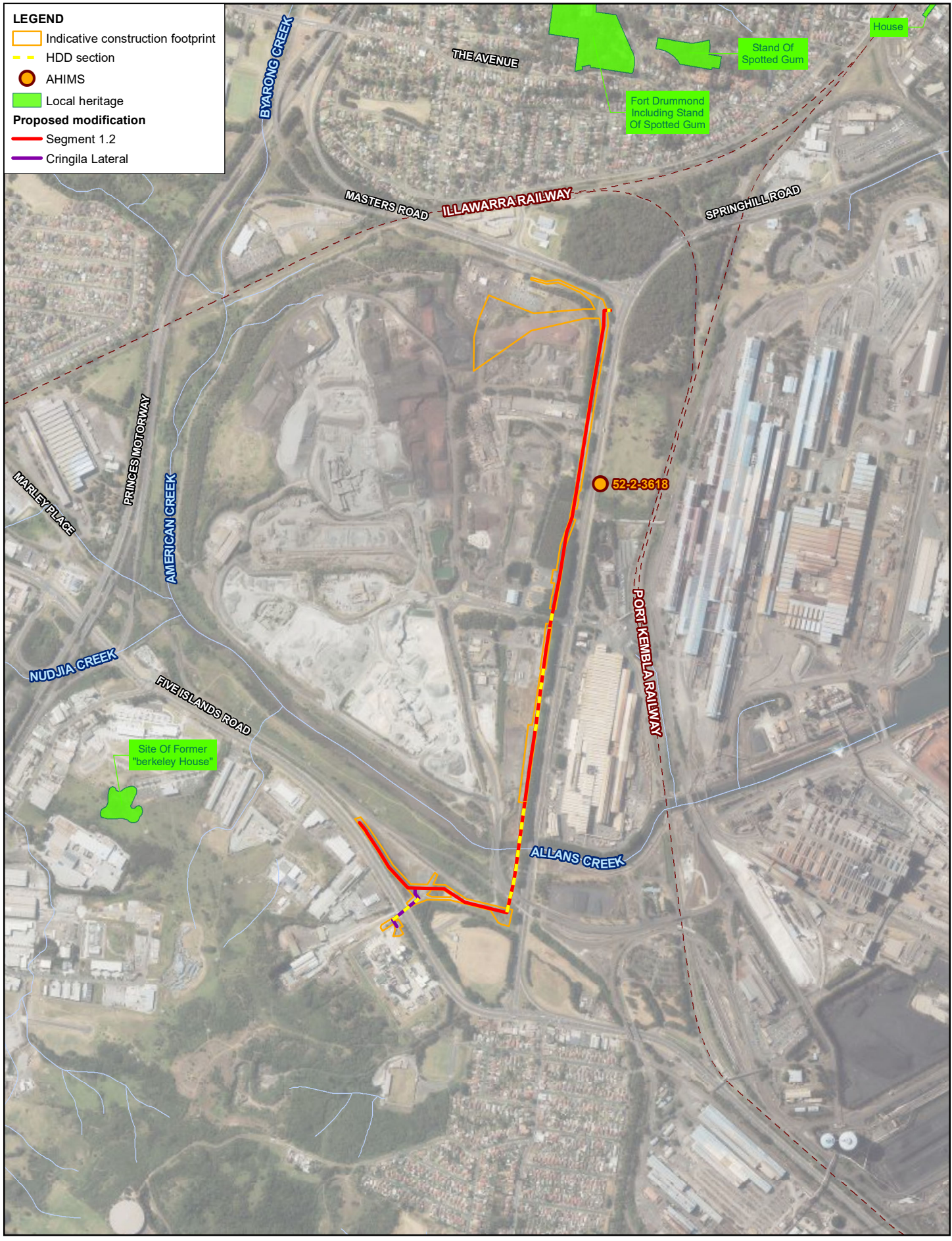
### **2.2 AHIMS Data**

An extensive search of AHIMS was undertaken on the 27 July 2018. There was only one Aboriginal site on AHIMS within the study area, BSS-OS-1 (52-2-3618). This Aboriginal place is an open camp site recorded in 2008 and consists of two flaked stone artefacts located on the crest of a ridgeline in a disturbed context. AHIMS coordinates for 52-2-3618 place the site on the western side of Springhill Road, 100 metres to the south. However, these coordinates may be in error as the site card description and mapping indicates that the site is located on the eastern side of Springhill Road, north of Spring Hill (refer to Figure 2). An updated search of AHIMS undertaken on 27 September 2021 did not identify any recorded Aboriginal places within or close to the proposed modification. Further to this, no new Aboriginal cultural heritage assessments have been completed within or close to the current study area that could provide additional information on the conditions within the current study area.

### **2.3 Archaeological Potential and Risk**

The 2018 AHDDA (GHD) identified pockets of archaeological potential along areas located on Spring Hill, and to the east and west of Springhill Road. The proposed gas pipeline route has been designed to avoid impacts to areas of potential for Aboriginal cultural material and no significant impacts are anticipated to either tangible or intangible heritage values.

Given the extent of previous ground disturbances, particularly near Five Island Road and within the existing industrial property in the north, it is highly unlikely that any Aboriginal cultural material has survived.



**LEGEND**

- Indicative construction footprint
- HDD section
- AHIMS
- Local heritage

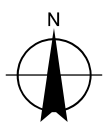
**Proposed modification**

- Segment 1.2
- Cringila Lateral

Paper Size ISO A4

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Metres

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Jemena  
Eastern Gas Pipeline - Modification 2

Project No. 12547160  
Revision No. A  
Date 23 Sep 2021

Heritage values

FIGURE 2

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© 2021. Whilst every care has been taken to prepare this map, GHD (and SIXmaps 2021, NSW Department of Lands, Jemena, NSW Department of Planning, Industry, and Environment) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

### 3. Historic Heritage

The 2018 (GHD) HHA report was prepared in accordance with SEARS that were issued for the original project on the 10 August 2018. The HHA also took into consideration the following heritage guidelines provided in Attachment 1 of the SEARS:

- *Australia ICOMOS Charter for Places of Cultural Significance, The Burra Charter* (ICOMOS, 2013)
- *NSW Heritage Manual* (Heritage Office and Department of Urban Affairs and Planning, 1994)
- *Assessing Heritage Significance* (NSW Heritage Office, 2001)
- *Statements of Heritage Impact* (Heritage Office and Department of Urban Affairs and Planning, 2002).

#### 3.1 Heritage listings

The 2018 (GHD) HHA report included searches of the EPBC protected matters tool, Australian National Shipwreck Database (ANSDB), State Heritage Register (SHR), Section 170 registers, the Three Ports State Environmental Planning Policy (SEPP) and Local Environmental Plans (LEPs). These searches did not identify any listed heritage values within the study area.

Updated searches of the EPBC protected matters tool, ANSDB, SHR, Section 170 registers, the Three Ports SEPP and LEPs was undertaken on 22 September 2021. No listed heritage values were identified within the study area (refer to Figure 2).

Further to this, no new historical heritage assessments have been completed within or close to the current study area that could provide additional information on the conditions within the current study area.

#### 3.2 Archaeological Potential and Risk

The 2018 HHA (GHD) identified pockets of less disturbed land with potential for historical heritage features and archaeological deposits are located on Spring Hill to the east and west of Springhill Road. Industrial moveable heritage items are also on display in the study area as part of the Inside Industry Visitor Centre on Bluescope Steel land.

The proposed works avoid areas of potential historical heritage values and items of moveable heritage identified in the 2018 HHA (GHD), and no impacts are anticipated.

### 4. Conclusion

The proposed gas pipeline route and proposed modification have been designed to avoid impacts to areas of potential for Aboriginal and non-Aboriginal cultural heritage and no significant impacts are anticipated to either tangible or intangible heritage values. The proposed pipeline modification will avoid areas of potential for Aboriginal and non-Aboriginal heritage features and/or archaeological deposits.

No further Aboriginal or non-Aboriginal cultural heritage assessment is required. Accordingly, the mitigation measures identified in the original assessment continue to be appropriate to the proposed modification, being:

- The construction workforce would be given a heritage induction and supporting guidelines to be able to identify materials of potential heritage value and how to respond.
- A protocol to be followed in the event of an unexpected find would be developed and would include clear lines of communication and stop work procedures to be followed.

# **Appendix C**

**Biodiversity update report**

# Biodiversity update report

## 1. Introduction

### 1.1 Project modification

Jemena proposes to modify its existing infrastructure approval for the Eastern Gas Pipeline to incorporate a segment of the gas pipeline proposed by AIE as part of the approved Port Kembla Gas Terminal. The segment to be incorporated extends from the western boundary of the corridor of Springhill Road southward to a connection point on the proposed Port Kembla Lateral Looping of the Eastern Gas Pipeline. The modification is required to allow this segment of the gas pipeline to be constructed and operated under a modified infrastructure approval for the Eastern Gas Pipeline under the *Environmental Planning and Assessment Act 1979* (SSI-9973). The proposed modification would also involve minor changes to the alignment as well as the addition of a short lateral pipeline at the southern end of the modification (the Cringila Lateral), which would also connect to the Eastern Gas Pipeline.

A biodiversity development assessment report (BDAR) was prepared in accordance with the *Biodiversity Conservation Act 2016* (BC Act) and the Biodiversity Assessment Method (BAM) (OEH 2017) for the Port Kembla Gas Terminal Environmental Impact Statement (EIS). Field surveys were conducted by GHD ecologists over three days between July to September 2018, and included vegetation mapping, vegetation integrity plots and fauna habitat assessments in Segment 1.2 along Springhill Road, the pipe stringing parallel to Masters Road, and the connection from Springhill Road to Five Islands Road. AIE has recently made payments into the Biodiversity Conservation Fund under section 6.30(1) of the BC Act to retire biodiversity credits and meet offset obligations for impacts associated with the Port Kembla Gas Terminal, including native vegetation and habitat values disturbed by construction of Segment 1.2 of the gas pipeline proposed to be included under the Eastern Gas Pipeline project as part of this modification.

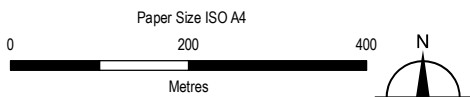
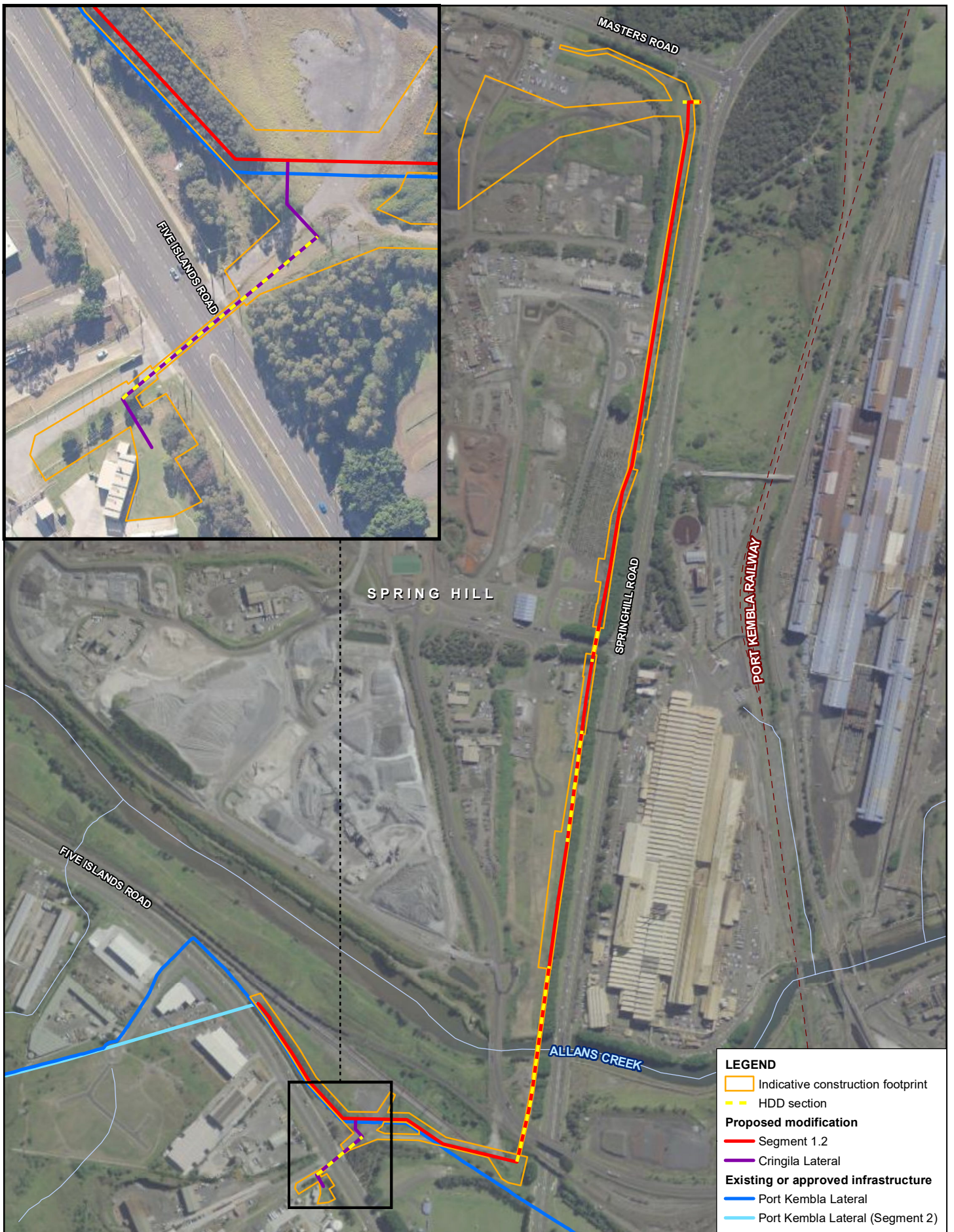
Field surveys have also been conducted by GHD ecologists in the Bluescope land at the northern end of Segment 1.2, west of the intersection of Masters Road and Springhill Road on 6 February 2020. This included vegetation mapping and fauna surveys in the area where pipe stringing will occur for this modification. Field surveys were conducted on 17 January 2020 by Biosis (2020) for the Port Kembla Lateral Looping project, and included vegetation mapping and fauna surveys near Five Islands Road (Section 2). Further surveys were conducted by GHD on 14 September 2021 at the northern and southern sections of Segment 1.2 to assess biodiversity values in areas of the proposed modification not previously assessed.

### 1.2 Purpose

Under Part 7, Division 4 of the BC Act, a further BDAR is not required to be submitted if the authority or person determining the application for modification (or determining the environmental assessment requirements for the application) is satisfied the modification will not increase impacts on biodiversity.

The purpose of this memorandum is to:

- outline the field survey methods
- describe biodiversity values within the proposed modification areas that have not previously been assessed
- assess potential impacts of the proposed modification on threatened biota listed under the BC Act and the EPBC Act
- confirm that the modification will not increase the impact on biodiversity values.



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56



Jemena  
Eastern Gas Pipeline - Modification 2

Project No. 12547160  
Revision No. A  
Date 23 Sep 2021

Proposed modification

FIGURE 1

## 2. Methodology

### 2.1 Desktop assessment

A desktop review of existing information was undertaken, involving review of the following:

- Port Kembla Gas Terminal Biodiversity Development Assessment Report (GHD 2019)
- previous vegetation mapping, including regional vegetation mapping (OEH 2002) and mapping by Biosis (2020)
- BAM important habitat maps for threatened species (DPIE 2021).

### 2.2 Field surveys

As noted in section 0, field surveys have previously been conducted in the vicinity of the proposed modification for various projects. A brief survey in the proposed modification area was conducted on 14 September 2021 by two GHD ecologists, focussing on the disturbance footprint for new components of the proposal (i.e. near the intersection of Masters Road and Springhill Road, the Cringilla lateral, and other components near Five Islands Road). A summary of relevant field surveys is presented in Table 1.

Table 1 Survey effort

Date	Location	Survey techniques
4 July 2018	Springhill Road	Fauna habitat assessment Opportunistic fauna sightings
22 August 2018	Springhill Road, Bluescope	Vegetation mapping Fauna habitat assessment Opportunistic fauna sightings
27 September 2018	Springhill Road	Vegetation mapping Vegetation integrity survey plot
14 September 2021	Masters Road/ Springhill Road Five Islands Road area	Vegetation mapping Fauna habitat assessment

## 3. Existing environment

### 3.1 Vegetation

#### 3.1.1 Five Islands Road

The proposed modification area is located on either side of Five Islands Road, approximately 300 metres south of Allans Creek and 450 metres west of the Springhill Road intersection.

On the north-eastern side of Five Islands Road, the proposed alignment extends alongside a sealed driveway, then across the road to a sealed drive and eastwards to a grassed and planted area (see Figure 2). A 10 metre wide section of mown grassland occurs on the eastern side of the driveway. A large triangular patch of planted vegetation occurs between the mown grassland and Centenary Park (Photo 1). The trees are mostly Spotted Gum (*Corymbia maculata*), with some Prickly-leaved Paperbark (*Melaleuca styphelioides*) and Hill's Weeping Fig (*Ficus microcarpa* var. *hillii*). The trees appear to be of similar age (approximately 30 years old). A dense mid-storey of invasive species occurs along the vegetation edges and extends into some sections of the patch. Species include Lantana (*Lantana camara*), Cotoneaster (*Cotoneaster pannosus*), African Olive (*Olea europaea* subsp. *cuspidata*) and Broad-leaved Privet (*Ligustrum lucidum*). The groundcover is mostly bare, or lightly covered with leaf litter.

To the north of the driveway, there are scattered lines of planted trees (Photo 2). It is apparent that the trees on the western side are a more recent planting, compared with the eastern patch. Common tree species include Spotted Gum (*Corymbia maculata*), Swamp Oak (*Casuarina glauca*), Norfolk Island

Hibiscus (*Lagunaria patersonii*) and Hill's Weeping Fig (*Ficus microcarpa* var. *hillii*). The trees are growing within occasionally mown grassland. There is a section of mown grassland, varying between 3 to 10 metres between the edge of this patch and the driveway.



**Photo 1: View of mown grassland and triangular vegetation**    **Photo 2: View of northern vegetation patch from driveway patch from driveway**

Vegetation on the western side of Five Islands Road consists of planted trees and shrubs in groups and narrow lines, either with a mulched surface or mown grass. Alongside the access to BOC Gas there is a line of planted Swamp Mahogany (*Eucalyptus robusta*). A line of planted trees and shrubs is located close to the footpath along Five Islands Road, as well as groups of trees on the slopes above the footpath (Photo 3). Exotic species include Chinese Elm (*Ulmus parvifolia*) and Sycamore (*Acer pseudoplatanus*). Trees indigenous to Wollongong local government area (LGA) include *Eucalyptus robusta*, Water Gum (*Tristaniopsis laurina*) and Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*). Australian tree species (not indigenous to the LGA) include Yellow Gum (*Eucalyptus leucoxylon* subsp. *megalocarpa*), Weeping Bottlebrush (*Callistemon viminalis*) and Robin Redbreast-bush (*Melaleuca laterita*).



**Photo 3: View from Five Islands Road, looking towards entrance to BOC Gas**

While Biosis (2020) assigned planted vegetation at Five Islands Road to native plant community types (PCTs), this area was not mapped as a vegetation zone and Biosis (2020) noted that no offsets were required as the vegetation is not contiguous with remnant naturally occurring vegetation, supports negligible habitat for threatened species, and is located in a predominantly industrial area. Planted vegetation is assessed in accordance with Appendix D of the BAM 2020 (DPIE 2020). Given that the planted vegetation near Five Islands Roads lacks connectivity to any naturally occurring PCTs, has not been planted for rehabilitation or a conservation obligation or to provide habitat for threatened species, and appears to be

planted for screening purposes, the vegetation is not considered a PCT and ecosystem credits are not required to be calculated. Given the lack of suitable microhabitat values (such as hollow-bearing trees, stick nests, waterbodies or roost camps), this planted vegetation does not support habitat for any species credit species, and no species credits are required.

### 3.1.2 Masters Road

Two pipe stringing areas are identified at the northern end of Segment 1.2 near the intersection of Masters Road and Springhill Road (see Figure 1). The section alongside Masters Road was assessed as part of the Port Kembla Gas Terminal BDAR. The stringing area and compound within SCE Group land has not been previously assessed.

A small floodway occurs south of Masters Road and west of Springhill Road. A narrow line of planted trees follows the Masters Road footpath and a band of planted trees occurs on a constructed batter, upslope of the floodway. Groundcover vegetation is sparse and in most areas there is a thick mulch topdressing. The floodway mostly consists of Kikuyu (*Cenchrus clandestinus*).

Planted tree species along Masters Road and on the batter include the following species which are indigenous to Wollongong LGA: Forest Red Gum (*Eucalyptus tereticornis*), Blackbutt (*Eucalyptus pilularis*), Swamp Oak (*Casuarina glauca*) and Spotted Gum (*Corymbia maculata*). Australian species (not indigenous to the LGA) include Brush Box (*Lophostemon confertus*) and Hill's Weeping Fig (*Ficus microcarpa* var. *hillii*). Indigenous species which may have self-recruited include: *Geitonoplesium cymosum*, *Pittosporum undulatum*, *Breynia oblongifolia* and *Acacia longifolia* subsp. *longifolia*.

Nearer the corner of the two roads a more defined drainage line is present. *Typha orientalis* has formed dense thickets in the drainage line, in association with invasive exotic species including *Lantana camara*, *Phoenix canariensis* and other species. Exotic species which appear to have self-recruited include *Asparagus aethiopicus*, *Asparagus asparagoides*, *Asparagus plumosus*, *Cinnamomum camphora*, *Ligustrum lucidum*, *Ligustrum sinense*, *Araujia sericifera*, *Clivia miniata*, *Lantana camara*, *Rubus anglocandicans*, *Lonicera japonica* and *Thunbergia alata*. For the purposes of the BDAR for the Port Kembla Gas Terminal, this drainage line was mapped as PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetland (see Figure 2).

The vegetation within the compound site and stringing area within SCE Group land mostly consists of a dense cover of grasses, forbs and woody weeds. Most grass and forb species are exotic, although some self-recruited indigenous species also occur.

No threatened flora species are likely to occur are likely to occur in planted and exotic vegetation at the northern end of Segment 1.2.



Photo 4: Vegetation on the Masters Road batter; Swamp Oak and Spotted Gum are the most common species



Photo 5: Line of planted Hill's Weeping Figs adjacent to Masters Road



Photo 6: Drainage line vegetation in middle-ground; Road batter vegetation in background

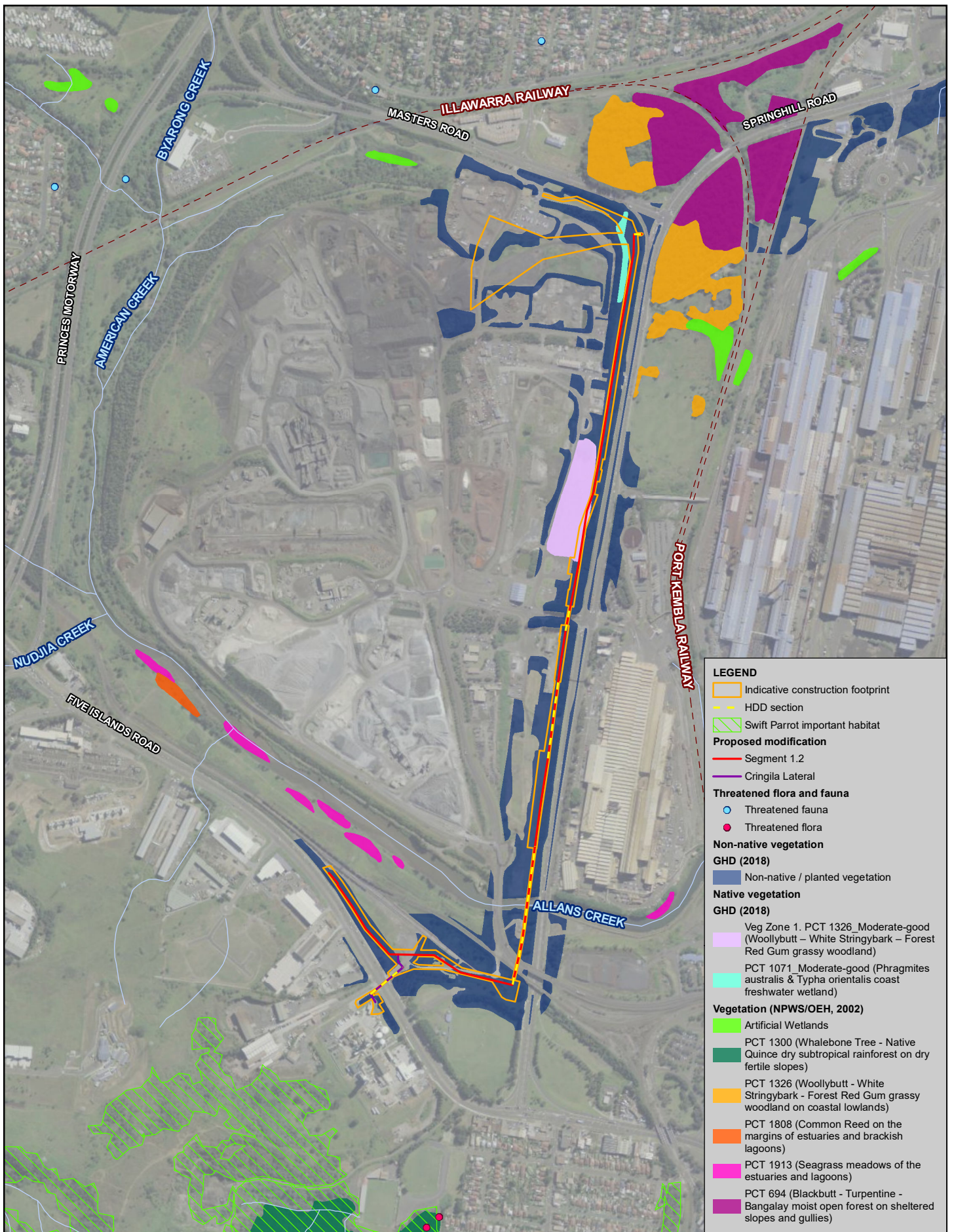
### 3.2 Fauna species and habitats

Planted *Eucalyptus* and other species in the modification area provide foraging and shelter resources for a range of birds typical of urban environments that are tolerant of regular disturbance from traffic and noise impacts. Foraging resources include seasonal nectar resources, seeds and insects. A small number of nectarivorous bird species were observed foraging within the planted trees and shrubs and included the Rainbow Lorikeet (*Trichoglossus moluccanus*) and Little Wattlebird (*Anthochaera chrysoptera*). Insectivores including the Noisy Miner (*Manorina melanocephala*), Willie Wagtail (*Rhipidura leucophrys*) and Australian Magpie (*Cracticus tibicen*) were also observed. Small birds including the Superb Fairy-wren (*Malurus cyaneus*) occur in Lantana thickets.

Woody debris is generally absent from this broad habitat type, however there is some leaf litter where canopy species are present. Fallen timber and leaf litter provides shelter substrate for small reptiles, snakes and small mammals.

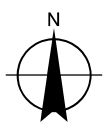
The areas of planted vegetation are unlikely to provide important habitat for threatened species. Some mobile species such as birds and bats may occur on occasion when food is available. The Grey-headed Flying-fox (*Pteropus poliocephalus*) is likely to forage in planted eucalypts when flowering, however no roost camps are present. Swift Parrot (*Lathamus discolor*) could forage on occasion in flowering planted Spotted Gums, however the proposed modification area is outside the areas of mapped important habitat (DPIE 2021). Small, isolated patches of planted vegetation are not likely to provide habitat for those species that require larger tracts of interconnected vegetation to support movement and foraging needs.

Drainage lines likely provide habitat for common species of frogs, reptiles and small birds. The threatened Green and Golden Bell Frog (*Litoria aurea*) is known to occur in the Port Kembla area. Movement habitat of this key population is generally typified by wet areas such as creek lines, drains, periodically damp areas, connecting or partially connecting vegetation, easements, laneways and even open areas that do not restrict movement (DEC 2007). Given the distance of the small drainage line from the main areas of this key population at the Port Kembla Coal Terminal and to the south at Coomaditchy Lagoon, and presence of barriers such as rail lines and roads, it is highly unlikely that this species would reside in this small drainage line, although there is a possibility this species may disperse through this area on rare occasions.



- LEGEND**
- Indicative construction footprint
  - HDD section
  - Swift Parrot important habitat
- Proposed modification**
- Segment 1.2
  - Cringila Lateral
- Threatened flora and fauna**
- Threatened fauna
  - Threatened flora
- Non-native vegetation**
- GHD (2018)**
- Non-native / planted vegetation
- Native vegetation**
- GHD (2018)**
- Veg Zone 1. PCT 1326\_Moderate-good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)
  - PCT 1071\_Moderate-good (Phragmites australis & Typha orientalis coast freshwater wetland)
- Vegetation (NPWS/OEH, 2002)**
- Artificial Wetlands
  - PCT 1300 (Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes)
  - PCT 1326 (Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands)
  - PCT 1808 (Common Reed on the margins of estuaries and brackish lagoons)
  - PCT 1913 (Seagrass meadows of the estuaries and lagoons)
  - PCT 694 (Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies)

Paper Size ISO A4  
 0 200 400  
 Metres  
 Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 56



Jemena  
 Eastern Gas Pipeline - Modification 2

Project No. 12547160  
 Revision No. A  
 Date 24 Sep 2021

**Biodiversity values**

**FIGURE 2**

N:\AU\Sydney\Projects\2112547160\GIS\Maps\Deliverables\ModReport\12547160\_MOD005\_Biodiversity.mxd Data source: Aerial imagery - SIXmaps 2021; General topo - NSW LPI DTDB 2017 & 2015; Cadastre - NSW LPI DCDB 2021; Project components - Jemena; Biodiversity data - OEH, Jemena, Biosis; Swift Parrot habitat - DPIE 2021.  
 © 2021. Whilst every care has been taken to prepare this map, GHD (and SIXmaps 2021, NSW Department of Lands, Jemena, NSW Department of Planning, Industry, and Environment, OEH) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason. Created by: price

## 4. Potential impacts

The majority of the impacts associated with Segment 1.2 were assessed in the Port Kembla Gas Terminal BDAR. These included clearing of planted vegetation along Springhill Road and parts of the Five Islands Road area, and pipe stringing parallel to Masters Road and across the drainage line.

There will be only minor additional impacts in the two modification areas at either end of Segment 1.2. The proposed modification would predominantly impact cleared and disturbed land near Masters Road and near Five Islands Road. Small areas of planted vegetation at Masters Road and Five Islands Road would be removed. No good quality habitat for threatened fauna species would be impacted. The vegetation to be impacted would provide a negligible area of foraging habitat for mobile threatened fauna such as the Grey-headed Flying-fox and Swift Parrot.

Stringing of the pipeline would temporarily impact a small, additional area of native vegetation along the drainage line near the intersection of Masters Road and Springhill Road. Marginal dispersal habitat for the Green and Golden Bell Frog may be temporarily impacted during stringing of the pipes. Mitigation measures including construction matting, sediment fencing and frog-proof fencing are proposed at this location to minimise the risk of indirect impacts. Drainage line vegetation would recover following construction.

As noted in section 3.1, planted vegetation is not representative of a vegetation zone that requires biodiversity offsets.

## 5. Conclusion

Potential impacts of the proposed modification on biodiversity values would be minimal. The majority of the impacts associated with Segment 1.2 were assessed in the Port Kembla Gas Terminal BDAR. AIE has recently made payments into the Biodiversity Conservation Fund under section 6.30(1) of the BC Act to retire biodiversity credits and meet offset obligations for impacts associated with the Port Kembla Gas Terminal, including impacts on potential breeding habitat for the Green and Golden Bell Frog. Offsets were also calculated in the Port Kembla Lateral Looping BDAR for impacts on PCT 781 Coastal Freshwater Wetlands, PCT 838 Forest Red Gum – Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion (Biosis 2020).

The modification would predominantly impact cleared and disturbed land and would result in removal of small areas of planted vegetation that have not been identified in this report or Biosis (2020) as requiring offsets. These areas do not provide areas of important habitat for threatened species. Temporary impacts on marginal dispersal habitat for the Green and Golden Bell Frog would be managed as recommended in the Port Kembla Gas Terminal BDAR. Given there are likely to be only very minor additional impacts on biodiversity values, the preparation of a separate BDAR and calculation of additional offsets is not considered necessary for the proposed modification.

A Construction Environmental Management Plan (CEMP) would be required for the construction phase of the project. The CEMP would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants. Mitigation measures from the original EIS assessment are provided in Appendix A for reference. No additional mitigation measures compared to the original assessment are proposed for the construction of operation phase of the proposed modification.

## 6. References

Biosis (2020). Port Kembla Lateral Looping Project Biodiversity Development Assessment Report. Report prepared for Jemena.

DEC (2007). The Green and Golden Bell Frog Key population at Port Kembla. Management Plan. Department of Environment and Conservation.

DPIE (2020). Hygiene guidelines for wildlife: Protocols to protect priority biodiversity areas in NSW from *Phytophthora cinnamomi*, myrtle rust, amphibian chytrid fungus and invasive plants. Department of Planning, Industry and Environment.

DPIE (2021). BAM important areas viewer. Department of Planning, Industry and Environment.

GHD (2019). Port Kembla Gas Terminal Biodiversity Assessment Development Report. Report prepared for AIE.

NPWS (2002). The Illawarra escarpment and coastal plain native vegetation mapping. National Parks and Wildlife Service.

OEH (2017). Biodiversity Assessment Methodology 2017. Published by: Office of Environment and Heritage for the NSW Government.

# Appendix A

## **Mitigation measures**

ID	Measure
TB1	NA
TB2	Staff will be inducted and informed of the limits of clearing and the areas of vegetation to be retained.
TB3	<p>A trained ecologist is to be present for construction activities that may impact frog habitat which includes dewatering / removal of detention basins and trenching immediately adjacent to Typha drainage line (west of Springhill Road).</p> <p>Temporary frog-proof fencing should be installed around drill sites, road side drains and detention ponds near the project site to be retained to prevent frogs from being injured or killed by equipment. An inspection is to be conducted each morning to check the trench for frogs.</p> <p>Any frogs identified will only be handled by an ecologist or wildlife rescue representative.</p> <p>Any Green and Golden Bell Frogs or other resident frogs are to be handled in accordance with the Chytrid fungus hygiene protocols (DECC 2008c) and released into the most appropriate nearby habitat area.</p>
TB4	Priority weed control measures will be implemented as part of the CEMP to prevent their spread in the study area.
TB5	<p>Declared priority weeds will be managed according to requirements of the NSW Biosecurity Act 2015.</p> <p>Soil material and stripped groundcover vegetation with the potential to contain priority weeds will not be removed from the project site.</p> <p>Soil disturbance will be avoided as much as possible to minimise the potential for spreading weeds.</p>
TB6	A site specific erosion and sediment control plan will be prepared as part of the CEMP. All erosion and sediment control measures shall be designed, implemented and maintained in accordance with relevant sections of 'Managing Urban Stormwater: Soil and Construction Volume 1' (Landcom 2004) ('the Blue Book') (particularly section 2.2) and 'Managing Urban Stormwater: Soil and Construction Volume 2A – Installation of Services' (DECC 2008b). The erosion and sediment control plan will include stockpiles, stormwater runoff, trees, site boundaries, site access and storage areas.
TB7	<p>Areas disturbed during the works will be rehabilitated, including stabilising disturbed soils to resist erosion and weed invasion via establishment of with a suitable turf species such as a native Couch or repaving roads and sealed surfaces.</p> <p>Stabilisation activities will be carried out progressively to limit the time disturbed areas are exposed to erosion processes.</p> <p>Activities with a risk of soil erosion such as earthworks will not be undertaken immediately before or during high rainfall or wind events.</p>
TB8	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers).
TB9	An emergency spill kit will be kept on site at all times. All staff will be made aware of the location of the spill kit and trained in its use.
TB10	Any herbicides used for weed control will be applied to the manufacturer's specifications and as outlined in the manufacturer's Material Safety Data Sheet.
TB11	Machinery will be checked daily to ensure there is no oil, fuel or other liquids leaking from the machinery. All staff will be appropriately trained through toolbox talks for the minimisation and management of accidental spills.
TB12	Vehicle wash down facilities will be provided should evidence of pathogens or fungus such as Phytophthora or Chytrid be found.

# Appendix D

Final hazard analysis



## Document Cover Sheet

 <b>Worley</b> energy   chemicals   resources L12, 141 Walker Street North Sydney NSW 2060	Supplier PO/Contract No:	4600009256
	Supplier Item Description:	
	Equipment/Tag No:	

Project Name:	Port Kembla Gas Terminal to Eastern Gas Pipeline		
Supplier Document Title:	Final Hazard Analysis		
Supplier Document No:	411010-00484-SR-REP-0001	Supplier Rev No:	0
Jemena Document No:	GAS-599-RP-RM-001	Jemena Rev No:	0
			Total No of Pages (incl cover page) <b>41</b>

### Document Revision History:

Rev	Issue Date	Key Reason for Issue (as above table)	Approved By/ Signature	Company Name	Notes (if not applicable N/A)
A	27/09/21	Issued for Review		Worley	
0	21/10.21	Issued for Use		Worley	

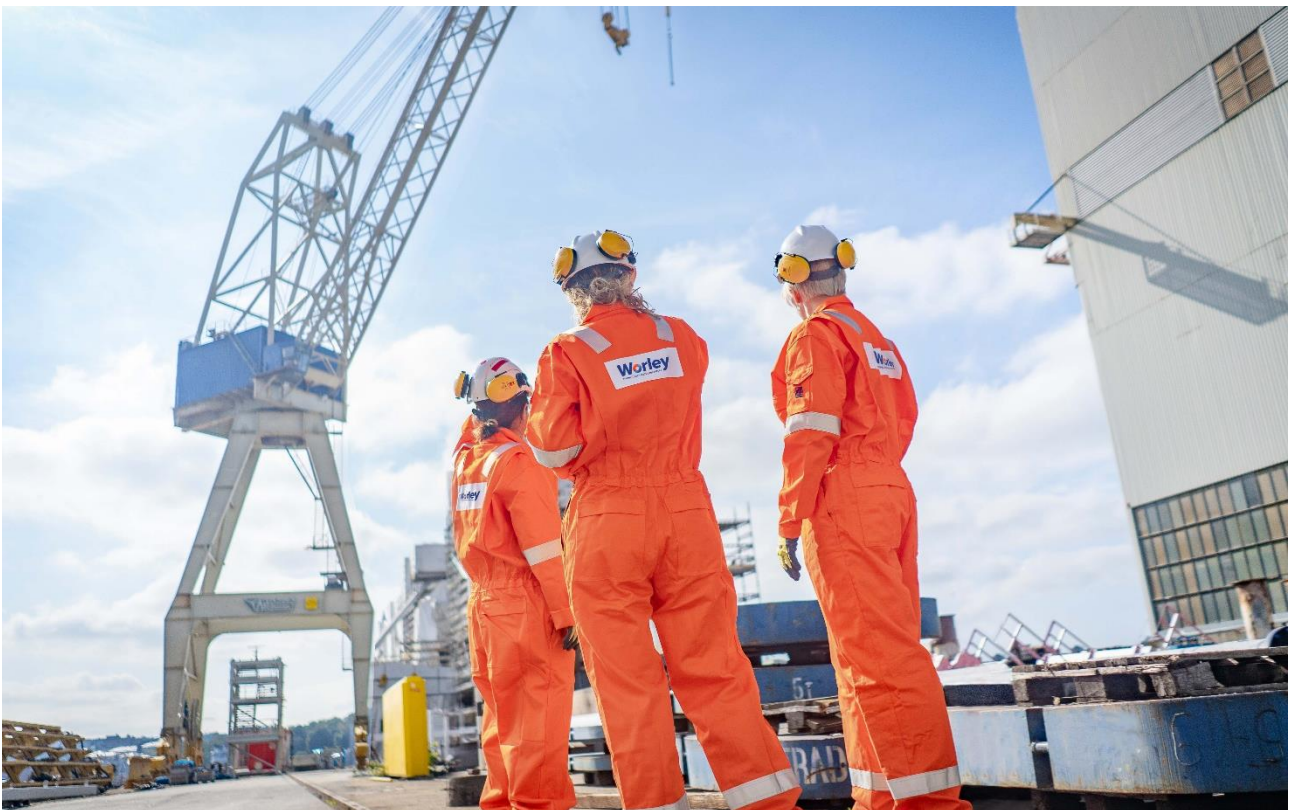
### Key Reason for Issue:

IFR- Issued for Review	IFI- Issued for Information	IFU- Issued for Use
IFP- Issued for Purchase	IFC- Issued for Construction	AB- As Built

JEMENA

# Port Kembla Gas Terminal to Eastern Gas Pipeline

## Final Hazard Analysis



Document no. Rev 0: 411010-00484-SR-REP-0001  
21 October 2021

**Jemena Document No. GAS-599-RP-RM-001**

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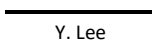











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***Worley is committed to providing the proposed Services to you in a timely and professional manner. Worley is also committed to ensuring the health and safety of everyone, including our people and our customers. In some cases, the COVID-19 pandemic has caused us to modify our working practices. Worley employees and collaborators may therefore provide some or all of the proposed Services from offices within their homes. In addition, the ability to travel for attendance to business meetings or site may be affected.***

***Worley will take reasonable steps to mitigate any delays associated with the measures necessary to keep everyone safe and comply with all government regulations and proclamations regarding the COVID-19 pandemic. Customers will be informed if there is any foreseeable impact on providing the proposed Services.***

**PROJECT 411010-00484-SR-REP-0001 - Port Kembla Gas Terminal to Eastern Gas Pipeline - Final Hazard Analysis**

Rev	Description	Originator	Reviewer	Worley Approver	Revision Date	Customer Approver	Approval Date
Rev A	Issued for Review	 Y. Lee	T. Millen	F. Losty	21 September 2021		
Rev 0	Issued for Use	 Y. Lee	T. Millen	F. Losty	21 October 2021		
							
							

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## 1. Executive Summary

---

Jemena is currently planning to upgrade capacity between Port Kembla and the Eastern Gas Pipeline through construction of a new ~11.5km pipeline (Port Kembla Pipeline, PKP) from Port Kembla, through to a new meter station (Kembla Grange Meter Station, KGMS) in the vicinity of Jemena's existing MLB/Lateral Offtake facility. Sections of the PKP will run parallel to the existing Port Kembla Lateral (PKL).

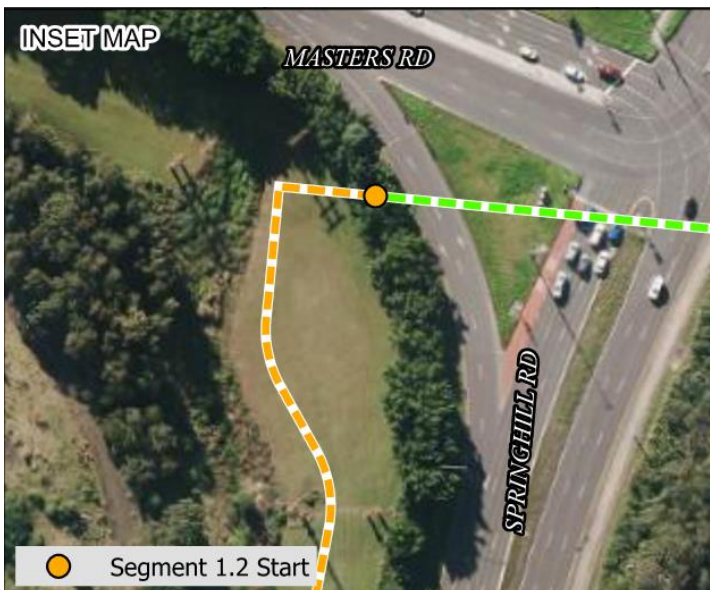
The pipeline will have a nominal diameter of 450mm, and is designed for future operation up to a Maximum Allowable Operating Pressure (MAOP) of 16.55MPa.

As part of the approvals process for the PKP, Jemena was required to complete a Level 2 (Semi Quantitative) Preliminary Hazard Analysis (PHA). The Department of Planning, Industry & Environment (DPIE) guideline "Multi-Level Risk Assessment" requires that incidents that have potential significant consequences beyond the site boundary must be quantified and demonstrated to be below the appropriate criteria. The study [1] demonstrated that life safety risk consequences associated with the PKP and the KGMS were within the tolerable limits specified by HIPAP-4 [2]. As part of the process, Jemena are required to submit a Final Hazard Analysis (FHA) at least one month prior to commencement of construction.

Since the submission of the PHA, there have been a number of changes to the overall project, in terms of transfer of pipeline ownership, and modifications to both the Cringila nitrogen facility and the KGMS.

The first 4.3 km of the pipeline (Segment 1.1) will be owned and operated by the Australian Industrial Energy (AIE), with the transfer of ownership between AIE and Jemena located near the intersection of Masters Road and Springhill Road.

Figure 1-1: AIE to Jemena Interface



Segment 1.2 will be owned and operated by Jemena, and runs approximately 2.5km from the AIE/Jemena interface to Cringila, where nitrogen is injected as required to meet Wobbe index specification. Whilst located within BOC property, the nitrogen facility will be part of Jemena pipeline license PL26.

Pipeline Segment 2 runs approximately 5.5 km from Cringila to Kembla Grange, where gas is metered and enters the Eastern Gas Pipeline via a hot tap connection.

The FHA has been completed as a Quantitative Risk Assessment (QRA), considering the following Jemena owned and operated scope:

- Pipeline Segment 1.2, from the AIE/Jemena interface to Cringila
- Pipeline Segment 2, from Cringila to the Kembla Grange Meter Station
- Kembla Grange Meter Station

Location specific individual risk (LSIR) contours for the entire pipeline length, inclusive of the facilities is shown in Figure 1-2, with magnified views for Kembla Grange and Cringila in Figure 1-3 and Figure 1-4 respectively.

The results of the QRA modelling undertaken indicate that risk exposure associated with the PKP and the associated KGMS will be below the fatality risk criteria specified in HIPAP-4, with no risks recorded above 5E-05 per annum (limit for commercially developed land), and no risk above 5E-07 per annum (sensitive land use) impacting on residential areas. Due to the application of a higher probability of ignition model, the Cringila injection facility shows a slightly higher risk than the KGMS, with a localized area showing risk in excess of 5E-06 per annum.

Note along the pipeline length, risk was measured to be <5E-07 per annum, and risk contours of 3E-07 per annum have therefore been recorded to show risk in these locations.

Figure 1-2: Location Specific Individual Risk Contours

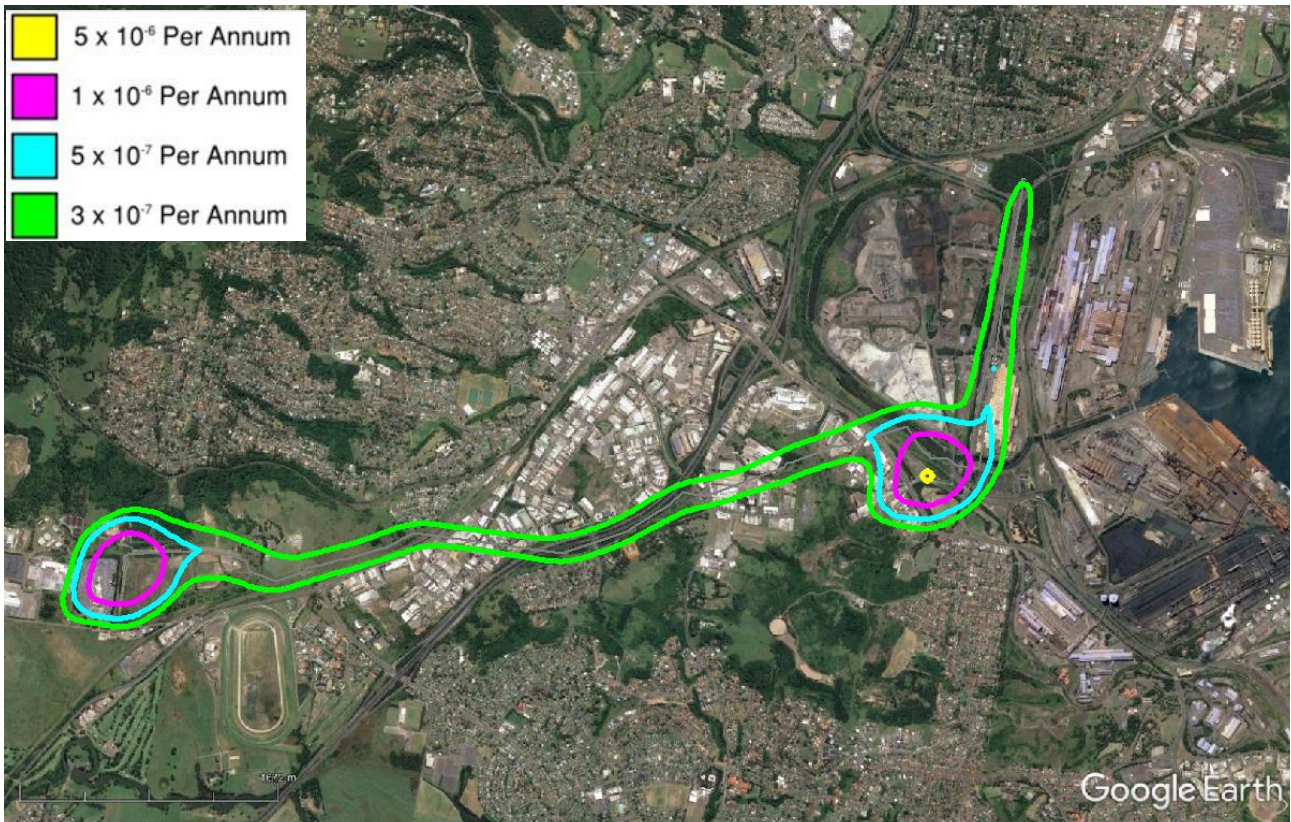


Figure 1-3: Location Specific Individual Risk Contours – KGMS

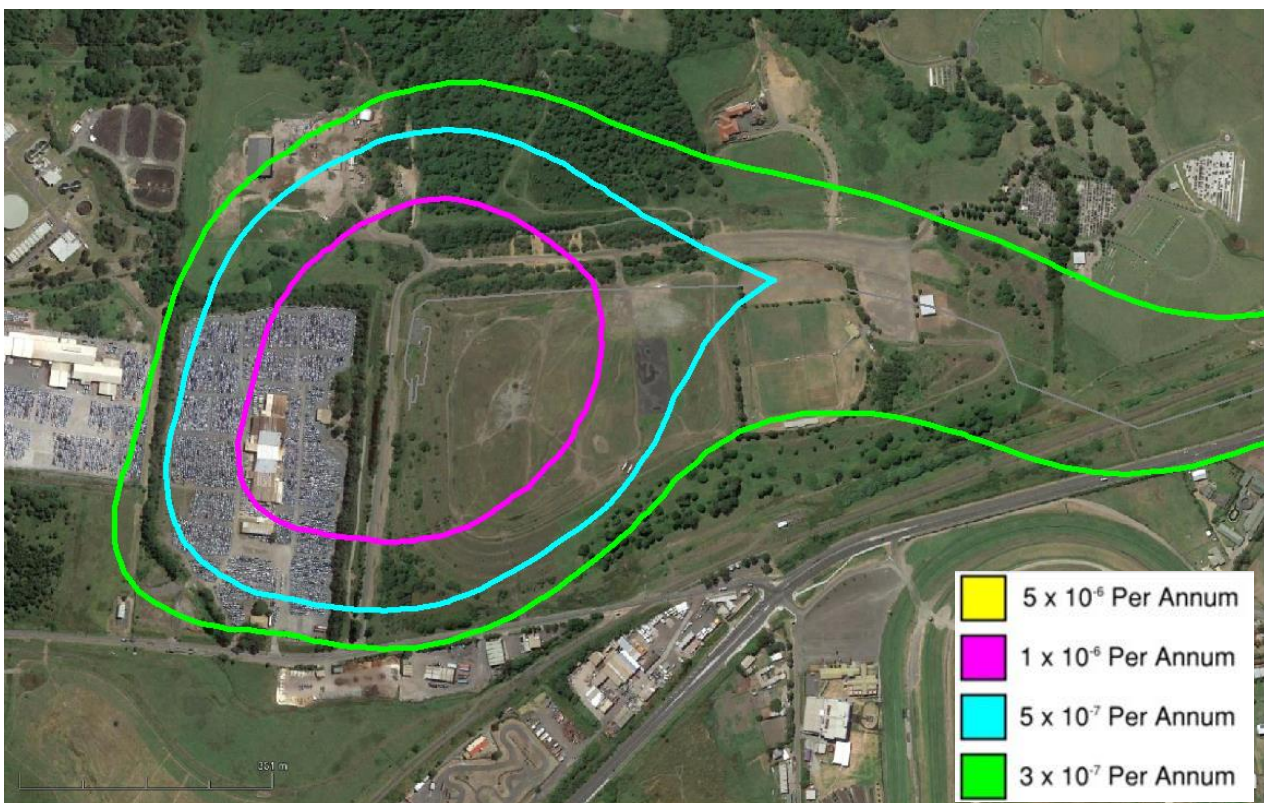
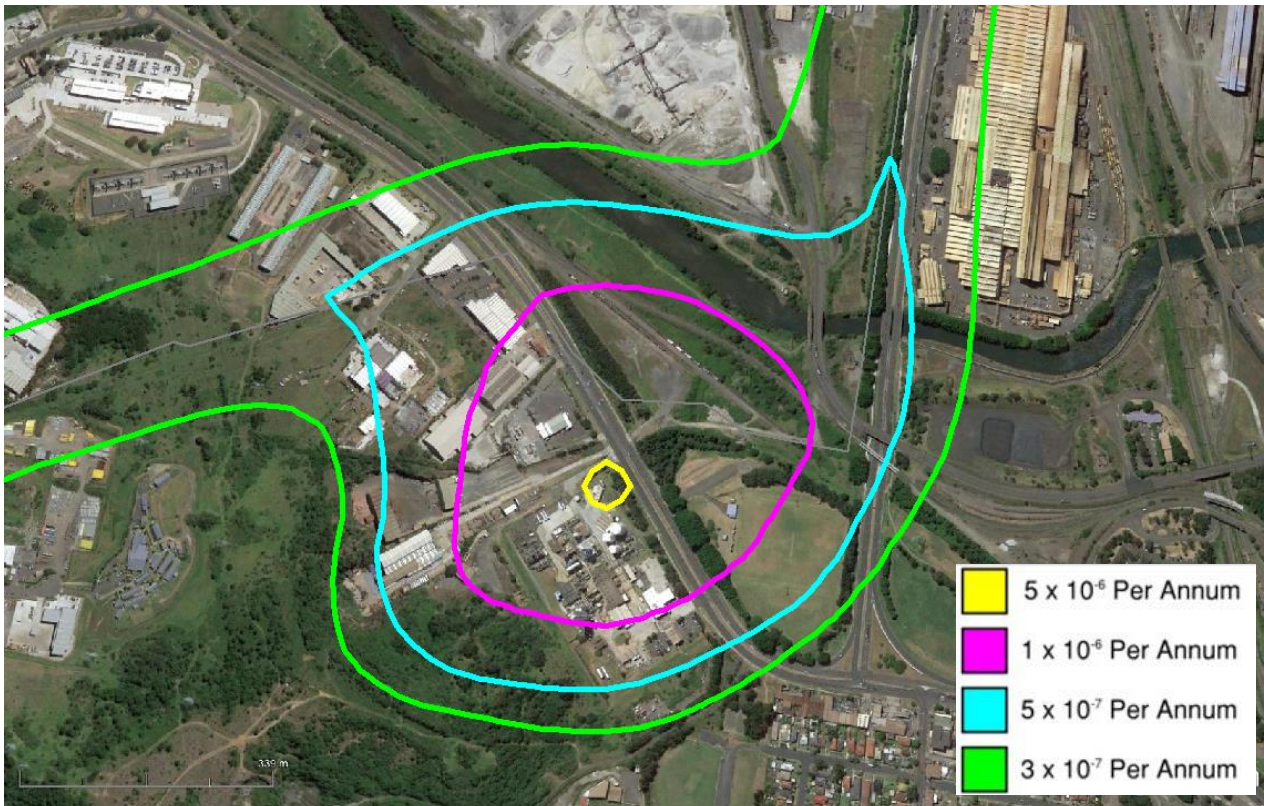


Figure 1-4: Location Specific Individual Risk Contours – Cringila Nitrogen Facility



In addition to production of Location Specific Individual Risk (LSIR) contours, the FHA has considered injury and property damage/accident propagation risk, defined by radiant heat impacts of 4.7, and 23kW/m<sup>2</sup>.

Note, results were not generated at this level for the specified HIPAP-4 criterion of 5E-05 per annum (or, fifty in a million per year), and as an alternative, the HIPAP LSIR frequency criteria were applied, as shown in Figure 1-5 and Figure 1-6.

Figure 1-5: Injury Risk (Exposure to 4.7kW/m<sup>2</sup>)

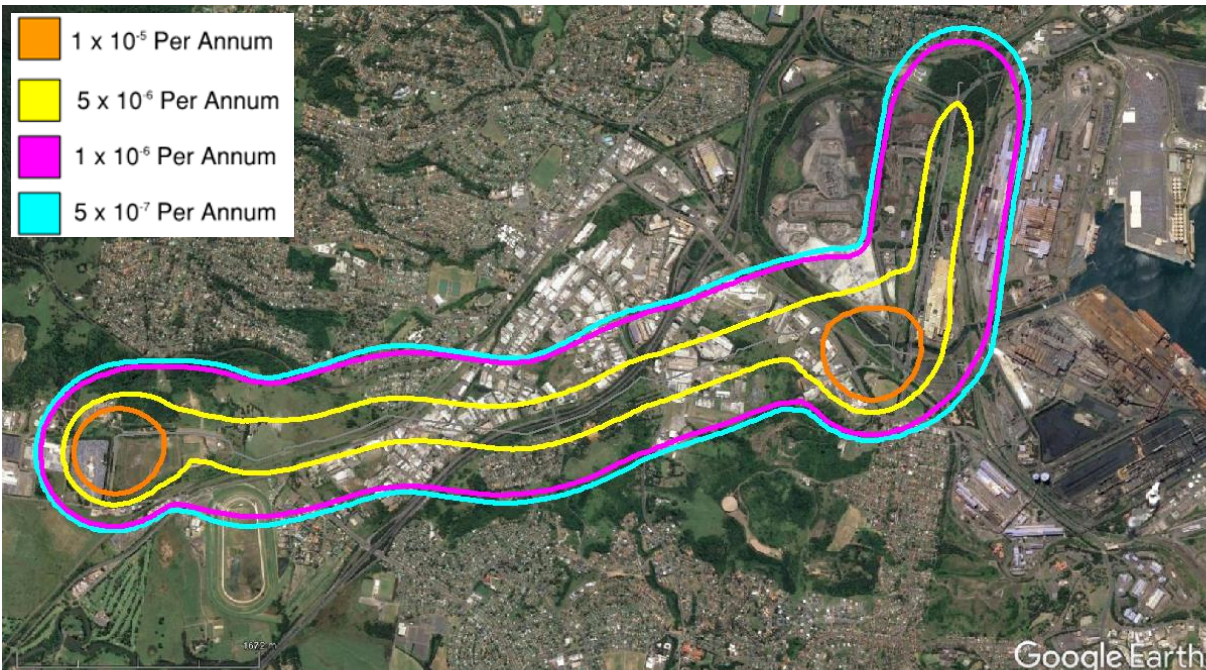
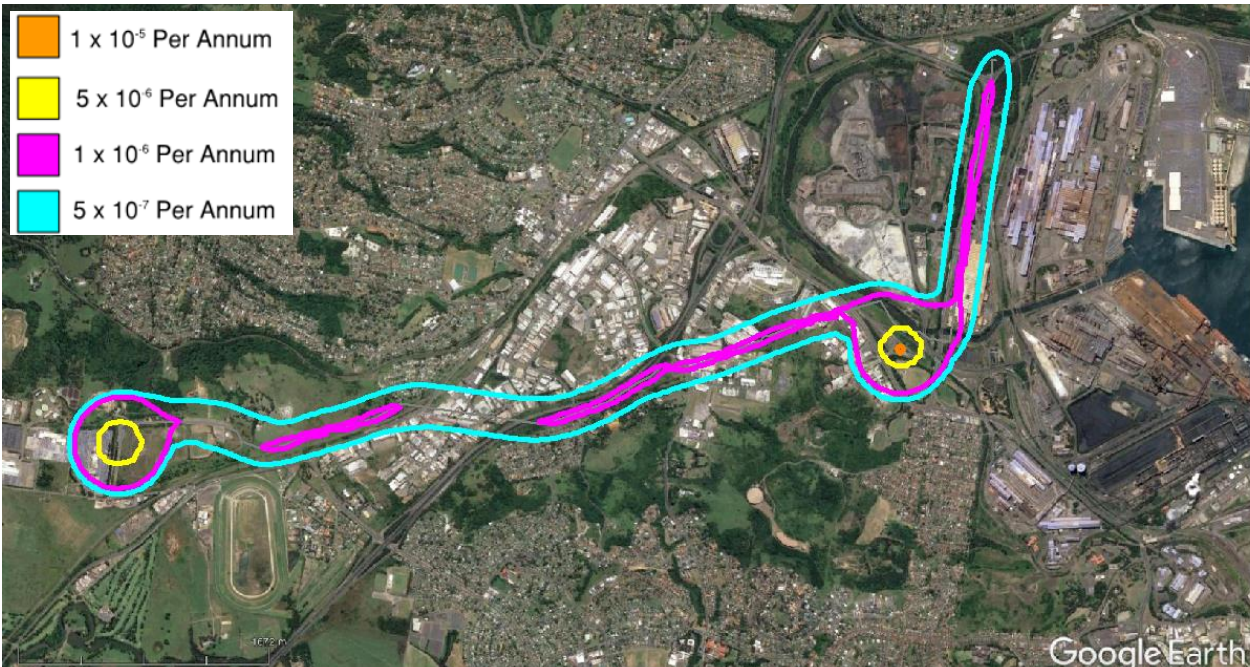


Figure 1-6: Property Damage & Escalation Risk (Exposure to 23kW/m<sup>2</sup>)



## 2. Introduction

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Jemena is currently planning to upgrade capacity between Port Kembla and the Eastern Gas Pipeline through construction of a new ~11.5km pipeline (Port Kembla Pipeline, PKP) from Port Kembla, through to a new meter station (Kembla Grange Meter Station, KGMS) in the vicinity of Jemena's existing MLB/Lateral Offtake facility. Sections of the PKP will run parallel to the existing Port Kembla Lateral (PKL).

The pipeline will have a nominal diameter of 450mm, and is designed for future operation up to a Maximum Allowable Operating Pressure (MAOP) of 16.55MPa.

As part of the approvals process for the PKP, Jemena was required to complete a Level 2 (Semi Quantitative) Preliminary Hazard Analysis (PHA). The Department of Planning, Industry & Environment (DPIE) guideline "Multi-Level Risk Assessment" requires that incidents that have potential significant consequences beyond the site boundary must be quantified and demonstrated to be below the appropriate criteria. The study [1] demonstrated that life safety risk consequences associated with the PKP and the KGMS were within the tolerable limits specified by HIPAP-4 [2]. As part of the process, Jemena are required to submit a Final Hazard Analysis (FHA) at least one month prior to commencement of construction.

This Quantitative Risk Assessment (QRA) is intended to satisfy the requirements of the FHA.

### 2.1 Objectives

The objectives of the QRA study are to assess the level of risk posed by Jemena Port Kembla Pipeline and Kembla Grange Meter Station on surrounding land, and compare the level of risk with nominated tolerability criteria. Specific risk metrics to be reported include:

- Location Specific Individual Risk (LSIR)
- Risk of Injury
- Risk of property damage

The QRA is to be consistent with the requirements of Hazardous Industry Planning Advisory (HIPAP) Paper No. 6 – Guidelines for Hazard Analysis (DPE, 2011) [3].

### 2.2 Scope

The scope of this QRA includes:

- Pipeline Segment 1.2, from the AIE/Jemena interface to Cringila
- Pipeline Segment 2, from Cringila to the Kembla Grange Meter Station
- Kembla Grange Meter Station

Note that for full context, elements of the Australian Industrial Energy (AIE) project scope (FSRU, pipeline to Segment 1.1) are briefly described within this report but are not the subject of the QRA.

## 2.3 Acronyms

The acronyms used throughout the study are listed in Table 2-1.

Table 2-1: Acronyms

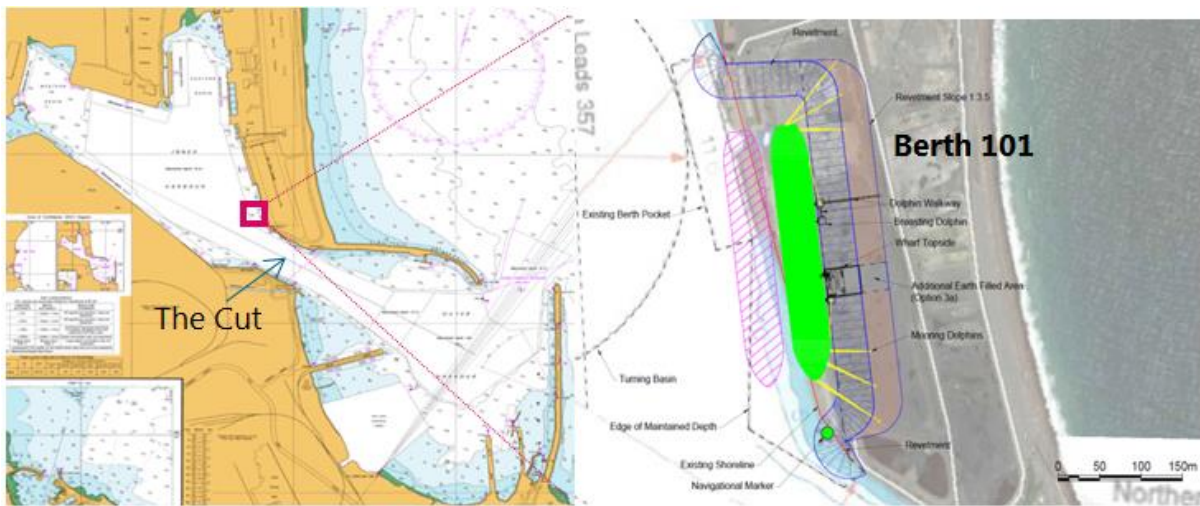
Abbreviation	Definition
AEMO	Australian Energy Market Operator
AIE	Australian Industrial Energy
AS	Australian Standard
BOD	Basis of Design
DPIE	Department of Planning, Industry & Environment
EGP	Eastern Gas Pipeline
FHA	Final Hazard Analysis
FSRU	Floating Storage and Regasification Unit
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HCRD	Hydrocarbon Release Database
HIPAP	Hazardous Industry Planning Advisory Paper
IOGP	International Association of Oil and Gas Producers
KGMS	Kembla Grange Meter Station
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier
LSIR	Location Specific Individual Risk
MAOP	Maximum Allowable Operating Pressure
MLV	Mainline Valve
NSW	New South Wales
P&ID	Piping and Instrumentation Diagram
PHA	Preliminary Hazard Analysis
PKGP	Port Kembla Gas Project
PKGT	Port Kembla Gas Terminal
PKL	Port Kembla Lateral
PKP	Port Kembla Pipeline
QRA	Quantitative Risk Assessment
SMS	Safety Management Study
UK HSE	United Kingdom Health & Safety Executive
UKOOA	United Kingdom Offshore Operators Association
VCE	Vapour Cloud Explosion

### 3. System Description

#### 3.1 LNG Terminal Overall Description

The PKGT is planned to be developed at Port Kembla and will include a Floating Storage and Regasification Unit (FSRU) moored to an existing berth in the inner harbour (see Figure 3-1). LNG carriers (LNGC) will moor in a side-by-side configuration to offload the LNG to the FSRU where it will be regasified and sent to shore via marine loading arms and aboveground station piping and connected to an onshore pipeline that will tie-in to the existing Eastern Gas Pipeline (EGP) at Kembla Grange.

Figure 3-1 PKCT Berth 101 layout

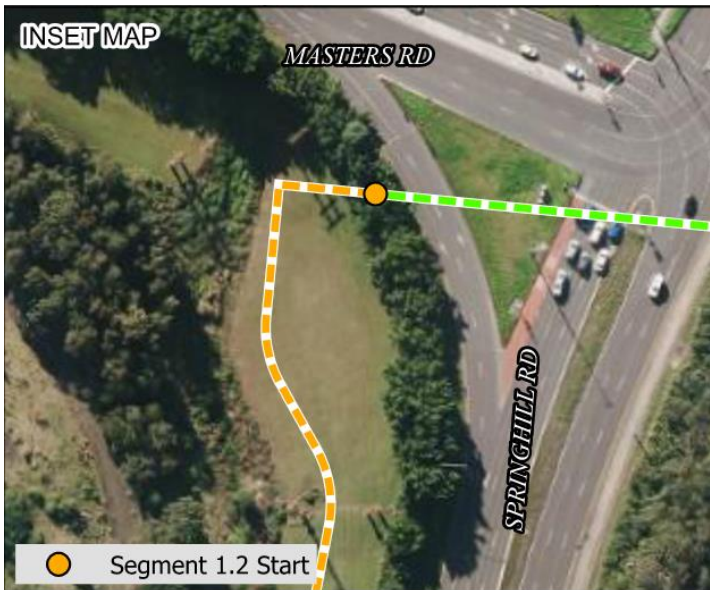


#### 3.2 Onshore Pipeline

The onshore pipeline will run approximately 12.3km pipeline from Port Kembla, through to a meter station (KGMS) in the vicinity of Jemena’s existing Kembla Grange mainline valve (MLV)/Lateral Offtake facility.

The first 4.3 km of pipeline (Segment 1.1) will be owned and operated by AIE, with the transfer of ownership between AIE and Jemena located near the intersection of Masters Road and Springhill Road (refer Figure 3-2).

Figure 3-2: AIE to Jemena Interface



Segment 1.2 will be owned and operated by Jemena, and runs approximately 2.5km from the AIE/Jemena interface to Cringila, where nitrogen is injected as required to meet Wobbe index specification. Whilst located within BOC property, the nitrogen facility will be part of Jemena pipeline license PL26.

Pipeline Segment 2 runs approximately 5.5km from Cringila to Kembla Grange, where gas is metered and enters the Eastern Gas Pipeline via a hot tap connection.

Surrounding area of the proposed PKP route is a combination of industrial, residential and rural. A Safety Management Study (SMS) was carried out for the pipeline in line with the requirements of AS 2885.1 [4] and it was agreed in the workshop that based on the usage of land adjacent to the pipeline the overall location class along the pipeline length is Residential (T1), with secondary location class industrial (I) [5].

### 3.3 Cringila Lateral

The Cringila Lateral is located within the BOC fenceline, however is owned and operated by Jemena, and is considered to be part of the pipeline under PL26.

Gaseous nitrogen is delivered via a 150mm line from BOC, and injected into a 450mm lateral which connects into the main pipeline via a barred tee, at the intersection between pipeline Segments 1.2 and 2. The layout of the Cringila nitrogen injection facility is shown in Figure 3-3, and an aerial view of the location in Figure 3-4.

Figure 3-3: Cringila Lateral

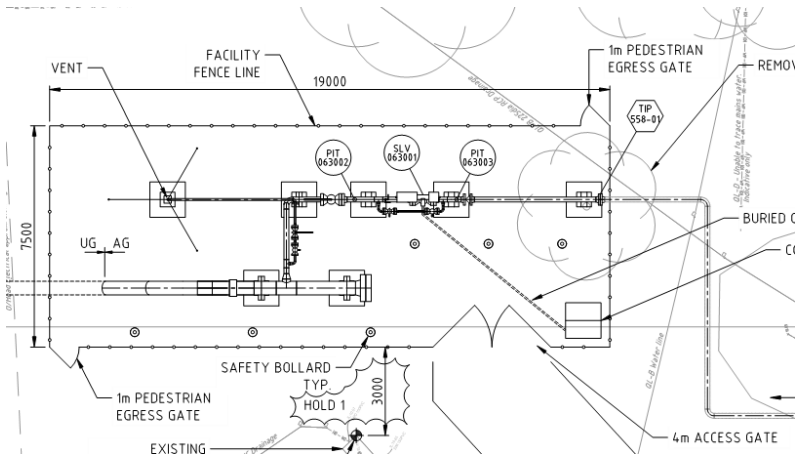


Figure 3-4: Cringila Lateral – Aerial View



The nitrogen facility is protected against reverse gas flow via the following means:

- A check valve immediately upstream of the barred tee.
- A reduced bore isolation valve, with operating stem accessible from the surface, upstream of the check valve.
- A manual block valve, check valve, and actuated shutdown valve on the 150mm nitrogen line.

As a conservative measure, the QRA has considered the Cringila nitrogen injection facility as potentially containing flammable gas, up to the BOC tie in point.

### 3.4 Kembla Grange Tie-in Facility

The PKP comes above ground to the south of Jemena’s existing Kembla Grange MLV/Lateral Offtake facility and tie-in to the EGP. The tie-in facility at Kembla Grange includes a gas custody transfer meter, pigging facility and an actuated shutdown valve to segregate the PKGT from the EGP during an emergency.

Figure 3-5 shows the Kembla Grange facility layout, and Figure 3-6 provides an aerial view of the location.

Figure 3-5: KGMS Facility Layout

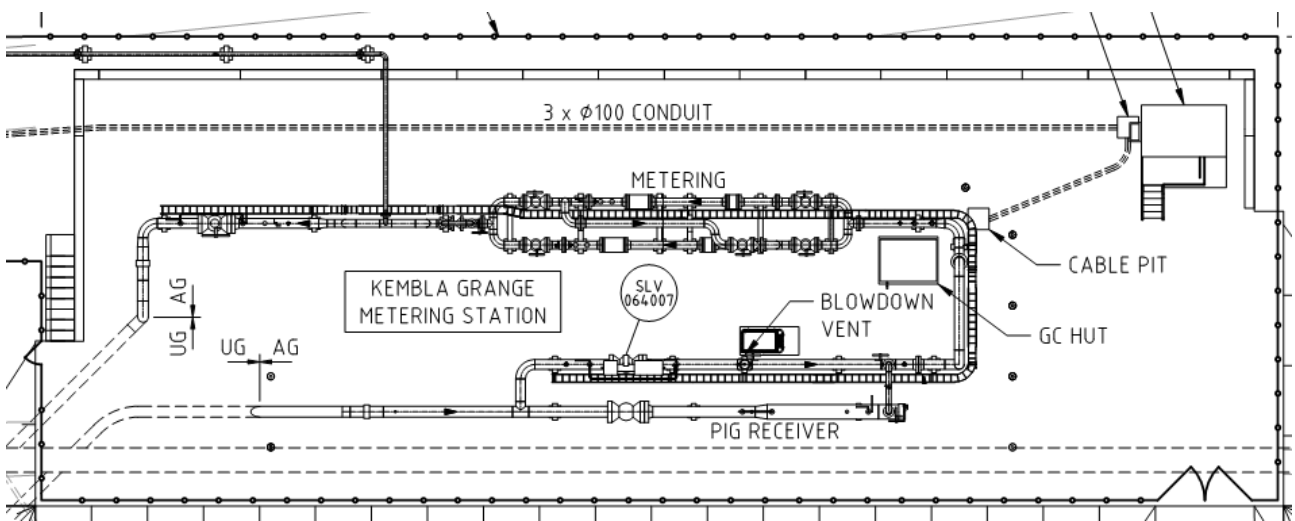
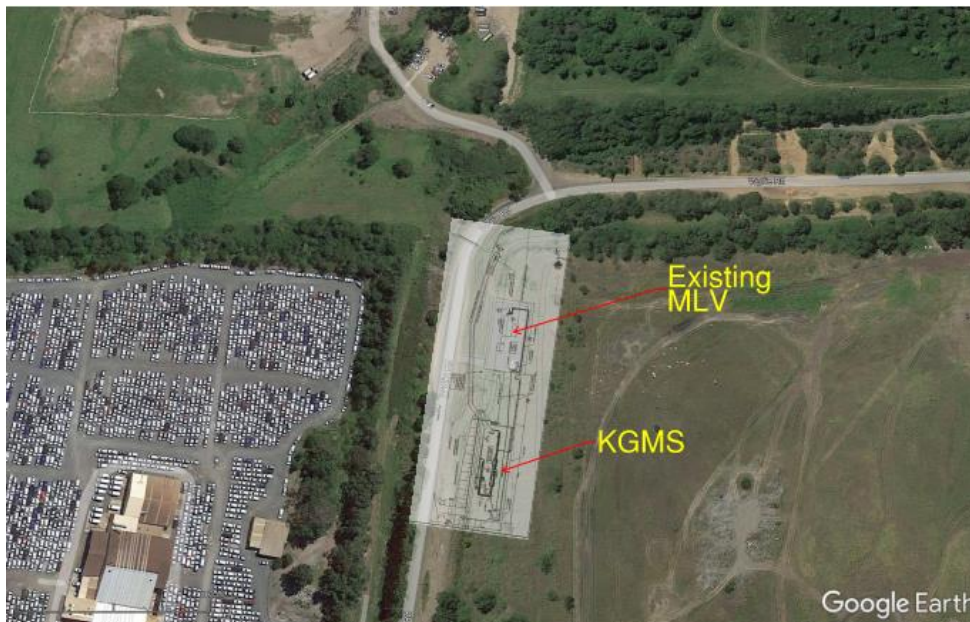


Figure 3-6: KGMS - Aerial View

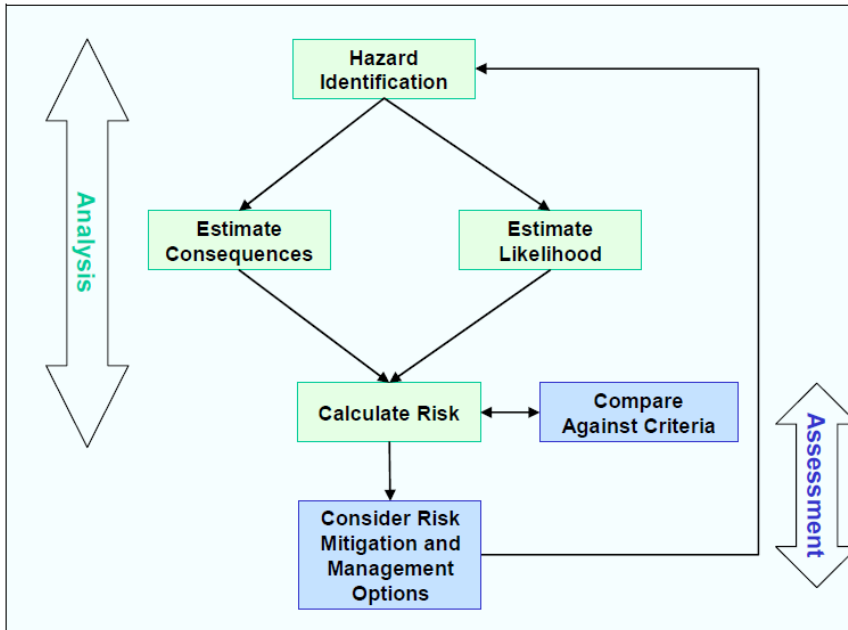


The KGMS is mainly surrounded by rural area. There is an industrial development to the west (predominantly a car yard), and public sporting facilities to the east (Sir Ian McLennan Oval).

## 4. Methodology

The QRA study has been carried out in accordance with the NSW HIPAP 6 guidelines for hazard and risk assessments [3]. The methodology is outlined in Figure 4-1 below.

Figure 4-1: Hazard Analysis Methodology



The methodology includes the following steps:

- Identification of Hazards (Section 5) – Review of possible accidents and the associated impacts that may occur based on previous accident experience or judgement where necessary.
- Consequences and Impact Analysis (Section 6) – Define the characteristic of the identified possible accidents.
- Frequency Analysis (Section 7) – Define the probability of the identified possible consequences.
- Risk Analysis (Section 8 and Section 9) – Define the acceptable risk levels and compare against the determined Location Specific Individual Risk contours.

## 5. Hazard Identification

A number of studies have been undertaken which have identified potential hazards associated with the new pipeline and tie-in facility, including:

- HAZID and HAZOP
- Pipeline Safety Management Study

The studies have identified a number of hazard causes which may lead to loss of containment events, including overpressurisation of the system, brittle failure, corrosion, and third-party impacts.

### 5.1 Loss of Containment Consequences

The only available hazardous material within the scope of this study is natural gas.

Natural gas is known to be a clean source of methane with very few contaminants. The natural gas composition used in this study is as presented in Table 5-1 and is calculated using composition of Rich LNG reported in Port Kembla BOD [6] adjusted with Nitrogen to achieve the AEMO Wobbe Index limitation of 51.9 MJ/Sm<sup>3</sup>.

Table 5-1: Natural Gas Composition

Component	NG Composition [mol%]
Methane	79.83
Ethane	12.38
Propane	4.44
n-Butane	0.98
n-Pentane	0.02
Nitrogen	2.34

Natural gas will form a flammable mixture on release, with a lower flammable limit of approximately 4%. Should releases rapidly ignite, a jet fire will form, which is highly directional and will generate significant levels of radiant heat due to efficient burning.

Delayed ignition will result in a flash fire, and if sufficient congestion is present, a vapour cloud explosion (VCE). VCEs occur due to rapid combustion of flammable gas which generates pressure effects due to the acceleration of the flame front by congestion or confinement. As both pipeline and Kembla Grange tie-in facility are located in open areas and the degree of confinement and congestion is very low, explosion is not considered a credible scenario in this study.

The composition of the re-gasified LNG is such that toxic impacts are not considered to be credible. It is noted that significant releases of nitrogen from the lateral connection may pose an asphyxiation risk, however this is considered a lesser risk than flammable gas release. As the QRA is conservatively assuming natural gas may be present at this location, the effects of nitrogen release are not considered.

## 5.2 Escalation Potential

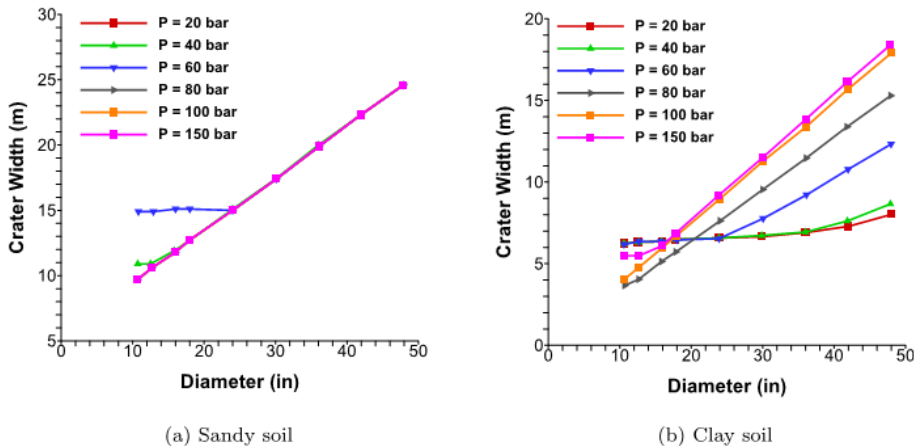
A specific query was raised by DPIE relating to the separation distance between the looping pipeline and the existing pipeline, when they are in proximity in the same corridor.

Guidance with respect to spacing has been taken from “Underground parallel pipelines domino effect: An analysis based on pipeline crater models and historical accidents”, published in the Journal of Loss Prevention in the Process Industries [7]. The concept is that inter-pipeline escalation can occur when a crater forms, exposing the adjacent pipeline to direct flame impingement following a release event.

The potential crater dimensions are based on the pipeline pressure, diameter and the soil type. For an 18” (DN450) pipeline in sandy soil, and operating at up to 150 barg, the total crater width (centred on the pipeline) is approximately 13m, and in clay soil the crater width is approximately half of this (refer to Figure 5-1). The new pipeline alignment is such that the separation from the existing pipeline exceeds these separation distances for the vast majority of the common route. There is one location (approximately 20m in length) where the separation is reduced due to physical constraints, however these constraints also make it highly improbable that any third party excavation with the potential for pipeline impact could occur in this area. The risk of inter-pipeline escalation was not identified as a specific threat within SMS reviews, and the pipeline has been designed as “no rupture”.

Based on this data, the risk of inter-pipeline escalation has been excluded from this analysis.

Figure 5-1 Pipeline Crater Width



## 6. Consequence Modelling Assumptions and Inputs

DNV Safeti version 8.4 was used to model the possible identified consequences from releases of hazardous inventories and resulting risk contours.

The following section describes the assumptions, inputs and scenario development for the modelling undertaken.

### 6.1 Release Scenarios

The release cases modelled in this study are summarised in Table 6-1 below. All releases have been modelled at a pressure of 16,550 kPag, and temperature of 10°C.

Table 6-1: Hazardous Inventories

Scenario ID	Scenario
1	Natural Gas pipeline Segment 1.2
2	Natural Gas pipeline Segment 2
3	Kembla Grange - Above ground to SLV 064007, and pig trap isolation
4	Kembla Grange - Metering to hot tap valve assembly
5	Kembla Grange - Pig receiver
6	MLV-1 Tie-in to Kembla Grange Meter Station
7	Cringila Lateral Injection

All releases have been modelled at initial process conditions until depleted, with the exception of very large releases which are modelled based on the release rate at 30 seconds after release. Isolation is provided at both the Kembla Grange facility and at Port Kembla, however the effects of pipeline isolation have been ignored in the consequence modelling.

### 6.2 Hole Size Distribution

The hole size distributions used in the PHA were consistent with those used in the AIE PKGP Preliminary Hazard Analysis. For the FHA, distribution for above ground facilities has been refined as follows:

- Representative hole sizes have been modelled based on the geometric mean of the range. Per IOGP document 434-01 [8], holes over a given range are best represented by the geometric mean.
- The previous study modelled all releases <rupture as a maximum 100mm hole size. An additional release case has been included between the 100mm, and full bore (450mm) release cases.

The hole size distribution applied for the above ground facilities is provided in Table 6-2.

Table 6-2: Leak Size at Kembla Grange Facility

Range (mm)	Representative Hole Size (mm)
1-10	3
10-25	16
25-50	35
50-100	71
100-450	212
Full Bore	450

For the pipeline, the release sizes are consistent with the previous study, as derived from IOGP 434-04 [9], and presented in Table 6-3.

Table 6-3: Leak Size – Pipeline

Leak Description	Diameter (mm)	Representative Hole Size(mm)
Small	<20	20
Medium	20-80	50
Large	>80	100
Catastrophic	Full Bore Rupture	450

### 6.3 Leak Direction and Elevation

Three different release orientations were modelled. Directional probabilities are as follows:

- 50% for horizontal;
- 25% for vertical (up); and
- 25% for vertical (down).

A leak from the pipeline is assumed to have following orientation probabilities:

- 20% for vertical (up); and
- 80% for vertical (45° diagonal).

Releases from the Kembla Grange tie-in facility were modelled at an elevation of 1m, and releases from the buried pipeline at an elevation of 0m. All risk impacts have been measured at a height of 1.65m above ground level.

### 6.4 Environmental Conditions

Environmental conditions and wind direction probabilities used in the consequence modelling are taken from the PKGP PHA [10] and summarised in Table 6-4 and Table 6-5 as follows.

Table 6-4: Weather Parameters

Weather ID	Wind Speed (m/s)	Pasquil Stability	Air Temperature (°C)	Relative Humidity (%)	Ground Temperature (°C)
Calm	1	F	5	68	17
Average	5	D	25	68	21
Windy	10	D	40	68	25

Table 6-5: Weather Probability Distribution

Weather ID	N	NE	E	SE	S	SW	W	NW	Occurrence
Calm – 1F	2.59%	5.80%	2.86%	3.49%	2.77%	3.83%	2.41%	1.55%	25.28%
Average – 5D	5.24%	12.64%	3.52%	5.86%	10.68%	7.53%	6.22%	2.47%	54.15%
Windy – 10D	0.78%	4.20%	0.72%	1.30%	5.49%	2.54%	4.64%	0.90%	20.57%

## 7. Frequency Analysis

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### 7.1 Release Frequency

Release frequency has been estimated based on a parts count using issued Piping and Instrumentation Drawings (P&IDs), and application of failure rates premised on historical data using correlations provided in OGP 434-01 (Process Release Frequencies) [8] published by the International Association of Oil and Gas Producers.

The release frequencies within the reference are based on historical data sourced from the United Kingdom Health and Safety Executive (UK HSE) Hydrocarbon Release Database (HCRD) which is considered to be the standard source of release frequencies for offshore QRA, and represents a large, high quality collection of release experience. It is acknowledged within the document that the data may be applied for onshore installations, due to an absence of comparable datasets for such installations, with consideration of scaling factors to represent the change in application. Whilst no scaling factors have been applied, the following is noted with respect to the database failure rates, which make application in this context conservative:

- Offshore industry has a range of additional risk contributors not relevant in this application, including a saline marine environment, higher overall facility congestion, increased potential for lifting in close proximity to live equipment, and stresses imposed by facility movement.
- The failure data does not consider the nature of the process fluid. Higher failure rates would be expected to be associated with sour service, or where the stream includes the presence of sand (causing erosion) or water (causing corrosion). In this instance, the service is dry, clean methane gas, and as such failure rates will be significantly lower.
- Failure data is expected to be significantly skewed by aged assets.

The most recent (September 2019) publication of IOGP 434-01 notes that the number of incidents recorded in the HCRD have been steadily decreasing, and it may be appropriate to base the frequency on more recent data on the assumption that this is more representative of what will occur in the future. For this reason, failure rates are presented based on the last 10 years of recordings, as well as over the entire reporting period, with a recommendation to use the former.

The failure rates in IOGP 434-01 are correlated by a model which estimates the probability of a release of size “d” mm or larger, based on the following equation:

$F(d) = Cd^m + B$ , where:

- $F(d)$  = frequency of a hole, d mm in diameter or smaller
- C, m and B are parameters for the equipment type, dependent on the equipment size, D

Note that the parts count does not include an estimation of pipe lengths at the facility. Per DNV Report “Technical Report Offshore QRA – Standardised Hydrocarbon Leak Frequencies” section 2.3.3 notes that application of failure rate per unit length of piping results in a very high contribution compared to other equipment, and this is believed to be through an under estimation of overall exposure data. The reference recommends a parts count be completed for all other components, and leaks attributable to pipework defined such that they represent 25% of the release total. This approach has been adopted within this QRA.

The pig receiver 557-E-018001 and associated piping are only in use during pigging operation which is assumed to be a maximum of once every 5 years, and online for a maximum of 80 hours when in use.

The P&IDs used in the parts count are listed in Table 7-1. Release frequencies for each release scenario are summarised in Appendix A.

Table 7-1: Reference P&IDs

Drawing Number	Title	Revision
GAS-556-DW-PD-001	Port Kembla Pipeline Nitrogen Injection Connection	C
GAS-557-DW-PD-001	Kembla Grange Meter Station Pig Receiver	G
GAS-557-DW-PD-002	Kembla Grange Meter Station Metering	F
GAS-557-DW-PD-003	Kembla Grange Meter Station EGP Hot Tap Tie-In	F
GAS-557-DW-PD-004	Kembla Grange Meter Station Remote Actuated MLV & DN200 Sales Tap	C
GAS-558-DW-PD-001	BOC Lateral Inlet Facility BOC Nitrogen Injection	B

IOPG Pipeline failure rate data [9] has been used for the release frequency calculation of the pipeline within this QRA, which correlates release frequency based on pipeline wall thickness. For a pipeline between 17 and 23 inches in diameter, a release frequency of 0.091 per 1000km per year is provided, with no consideration of wall thickness. The distribution of hole sizes for pipeline releases is provided in Table 7-2. Note that APGA maintains a failure database, with failure rates in Australia approximately one order of magnitude lower than overseas failure rates. As such, application of the IOPG data may be considered conservative in this context.

Table 7-2: Pipeline Release Hole Size Distribution

Leak Description	% of Release Cases
Small	70
Medium	15
Large	5
Catastrophic	10

## 7.2 Ignition Probability

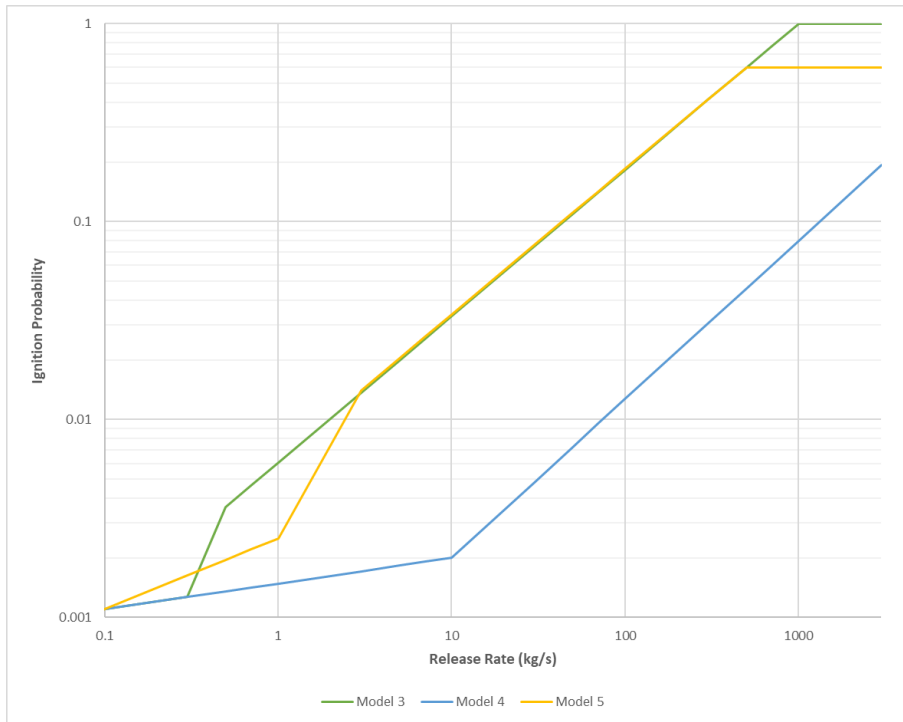
Given a release, the probability of ignition is dependent on a range of factors including:

- Release rate;
- Material state (liquid or gas);
- Material physical properties (flash point, density, flammability limits); and
- Ignition sources present (hot work, uncertified / old equipment, energy sources).

There are a range of correlations available for applying an ignition probability to a release, and most are based on the release rate and state. The ignition probabilities utilised in this QRA are based on the United Kingdom Offshore Operators Association (UKOOA) ignition correlations [11] which take into account the factors above as well as the nature of the surrounding area with respect to potential ignition sources.

The ignition probabilities in this QRA are determined using the UKOOA ignition correlation no. 4 (Pipe Gas LPG Rural) for the releases at Kembla Grange facility and correlation no. 3 (Pipe Gas LPG Industrial) for release from the buried pipeline, and correlation no. 5 (Small plant gas/LPG) for the Cringila facility. Ignition probability as a function of release rate for each model is shown in Figure 7-1, with ignition probabilities for each release scenario summarised in Appendix B.

Figure 7-1: UKOOA Ignition Models



For each ignited event, the proportion of immediate (rapid) to delayed ignition events influences the event outcome (specifically, the probability of a jet or flash fire forming).

Table 2.13 of the IP Research Report [11] (OIR 12 data ignition outcome distribution by media) suggests that 29% of ignited gas releases will result in a jet fire (immediate ignition event), with the remaining 61% flash fires and explosions. This is backed up by Table 2.15 (Plant ignition timings distribution) which suggests that 36% of ignition events occur within 30 seconds of release (media independent). As a base case, it is assumed that 30% of ignition events are immediate, with the balance delayed ignition.

### 7.3 Fatality Probability

For jet fires, it is assumed that fatality occurs as a result of exposure to a radiant heat. Table 7-3 provides typical effects of radiant heat exposure, as source from HIPAP 4 [2].

Table 7-3: Radiant Heat Consequences

Radiation (kW/m <sup>2</sup> )	Effect – People
2.1	Minimum level to cause pain after 1 minute

Radiation (kW/m <sup>2</sup> )	Effect – People
4.7	Pain in 15-20 seconds, Injury after 30 seconds exposure (second degree burns minimum)
12.6	Significant chance of fatality with extended exposure High chance of injury
23	Likely fatality with extended exposure Chance of fatality with instantaneous exposure
35	Significant chance of fatality

Within the QRA, fatality due to exposure to radiant heat is premised on the following Probit equation for personnel located outdoors:

$$\text{Probit} = -36.38 + 2.56 \ln (t \cdot q^{4/3}), \text{ where}$$

- t = exposure time, in seconds
- q = radiant heat load, in W/m<sup>2</sup>

OGP Report 434-14.1 (Vulnerability of humans) [12] notes in Table 2.2 that exposure above 12.5 kW/m<sup>2</sup> has a significant chance of fatality for medium duration exposure, and Table 2.3 notes at this level extreme pain within 20 seconds, and 100% chance of fatality when exposed to 35 kW/m<sup>2</sup>.

Based on these definitions, a maximum exposure time of 20 seconds to radiant heat has been specified, which correlates to approximately 7% chance of fatality at 12.5 kW/m<sup>2</sup>, and 98% chance of fatality at exposure of 35 kW/m<sup>2</sup>.

For flash fires, fatality is assumed to occur when persons are engulfed within the fire event, which is defined by the extent of the flammable cloud.

## 8. Risk Criteria

Risk criteria has been derived from Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 “Risk Criteria for Land Use Safety Planning” [2]. The following measures of risk have been utilised, and are summarised below:

- Location Specific Individual Risk
- Injury Risk
- Risk of Property Damage and Accident Propagation

### 8.1 Location Specific Individual Risk

Location Specific Individual Risk (LSIR) is the level of risk which would be experienced by a person in a particular location, for a full calendar year. LSIR criteria has been sourced from the NSW Department of Urban Affairs and HIPAP No. 4 as follows:

Table 8-1: HIPAP-4 LSIR Criteria

Land Use	Suggested Criteria (risk in a million per year)
Hospitals, schools, child-care facilities, old age housing	0.5
Residential, hotels, motels, tourist resorts	1
Commercial developments including retail centres, offices and entertainment centres	5
Sporting complexes and active open space	10
Industrial	50

### 8.2 Injury Risk

HIPAP-4 notes that society are concerned about risk of injury as well as risk of death, and proposes a heat radiation injury risk criterion of  $4.7 \text{ kW/m}^2$ , noting that this should not be exceeded in residential and sensitive use areas at a frequency of more than 50 chances in a million per year.

For explosion overpressure, HIPAP-4 proposes an injury overpressure criterion of 7 kPa not be exceeded at a frequency of more than 50 chances in a million per year, however explosions have not been considered as a credible outcome within this study.

It is noted that the specified injury criteria do not include consideration of flash fire events. As a conservative measure, injury risk within the QRA is estimated with no consideration for the 30% to 70% split between immediate and delayed ignition, with the total ignition probability as determined by the UKOOA model attributed to immediate ignition, and hence producing radiant heat jet fire impacts.

### 8.3 Risk of Property Damage and Accident Propagation

HIPAP-4 further notes that the siting of a hazardous installation must account for the potential of an accident at the installation causing damage to buildings and propagating to neighbouring industrial operations.

HIPAP-4 notes that heat radiation levels of  $23 \text{ kW/m}^2$  as the result of fire incidents at a hazardous plant may affect a neighbouring installation to the extent that unprotected steel can suffer thermal stress that may cause structural failure. This may trigger a hazardous event unless protection measures are adopted.

The suggested HIPAP-4 criterion for radiant heat property damage is  $23 \text{ kW/m}^2$  noting that this should not be exceeded at neighbouring potentially hazardous installations or at land zoned to accommodate such installations should not at a frequency of more than 50 chances in a million per year.

As above, this assessment has been undertaken with no consideration for the 30% to 70% split between immediate and delayed ignition, with the total ignition probability as determined by the UKOOA model attributed to immediate ignition, and hence producing radiant heat jet fire impacts.

## 9. Risk Results

Impact distances for jet fires and flash fires for each weather case are presented in Appendix C.

### 9.1 Location Specific Individual Risk

Location specific individual risk (LSIR) contours for the entire pipeline length, inclusive of the facilities is show in Figure 9-1, with magnified views for Kembla Grange and Cringila in Figure 9-2 and Figure 9-3 respectively.

The results of the QRA modelling undertaken indicate that risk exposure associated with the PKP and the associated KGMS will be below the fatality risk criteria specified in HIPAP-4, with no risks recorded above  $5E-05$  per annum (limit for commercially developed land), and no risk above  $5E-07$  per annum (sensitive land use) impacting on residential areas. Due to the application of a higher probability of ignition model, the Cringila injection facility shows a slightly higher risk than the KGMS, with a localized area showing risk in excess of  $5E-06$  per annum.

Note along the pipeline length, risk was measured to be  $<5E-07$  per annum, and risk contours of  $3E-07$  per annum have therefore been recorded to show risk in these locations.

Figure 9-1: Location Specific Individual Risk Contours

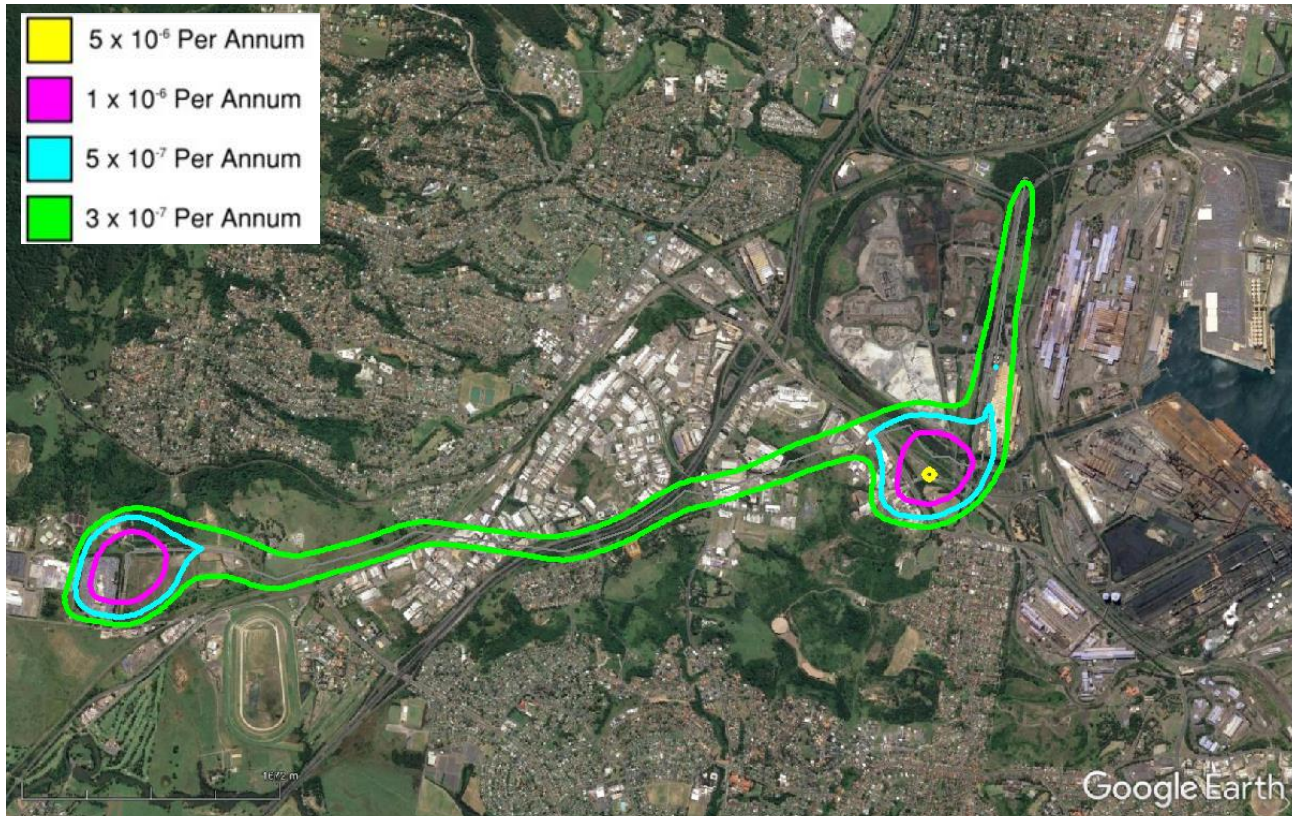


Figure 9-2: Location Specific Individual Risk Contours – Kembla Grange

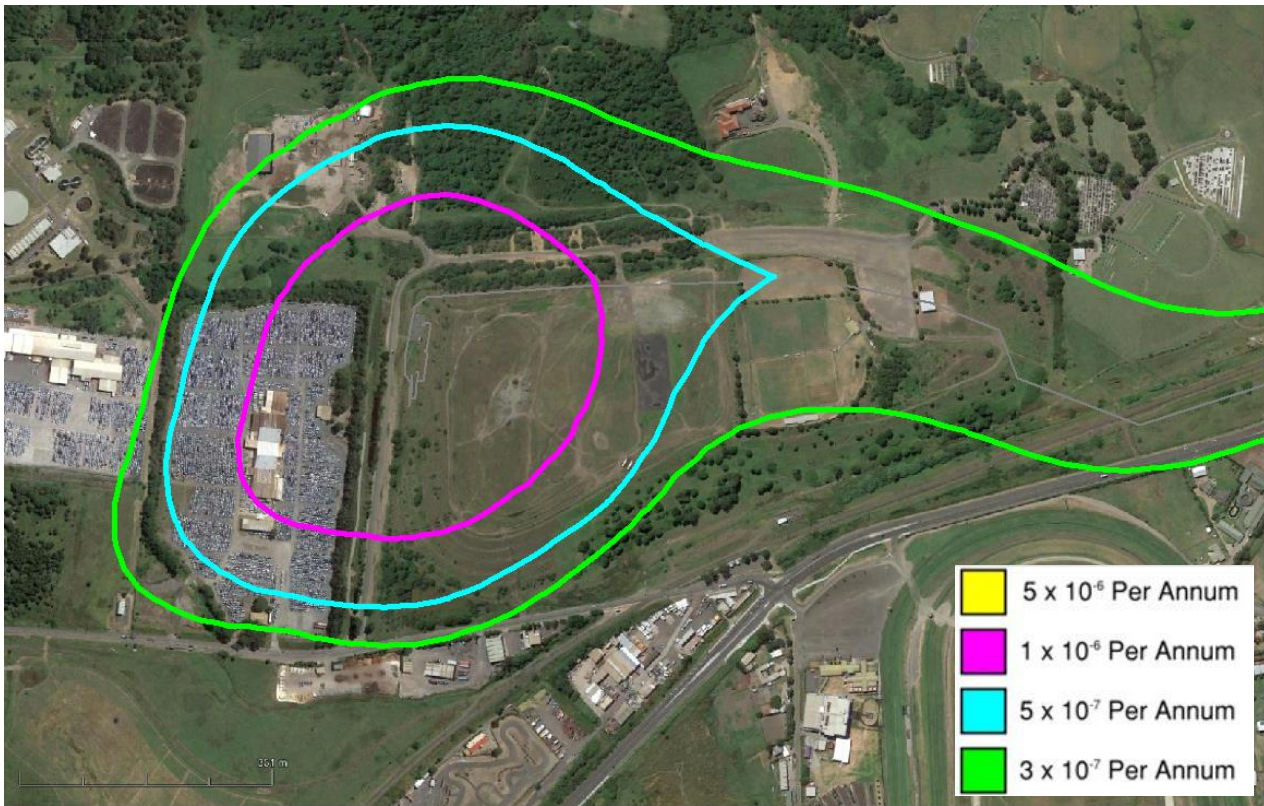
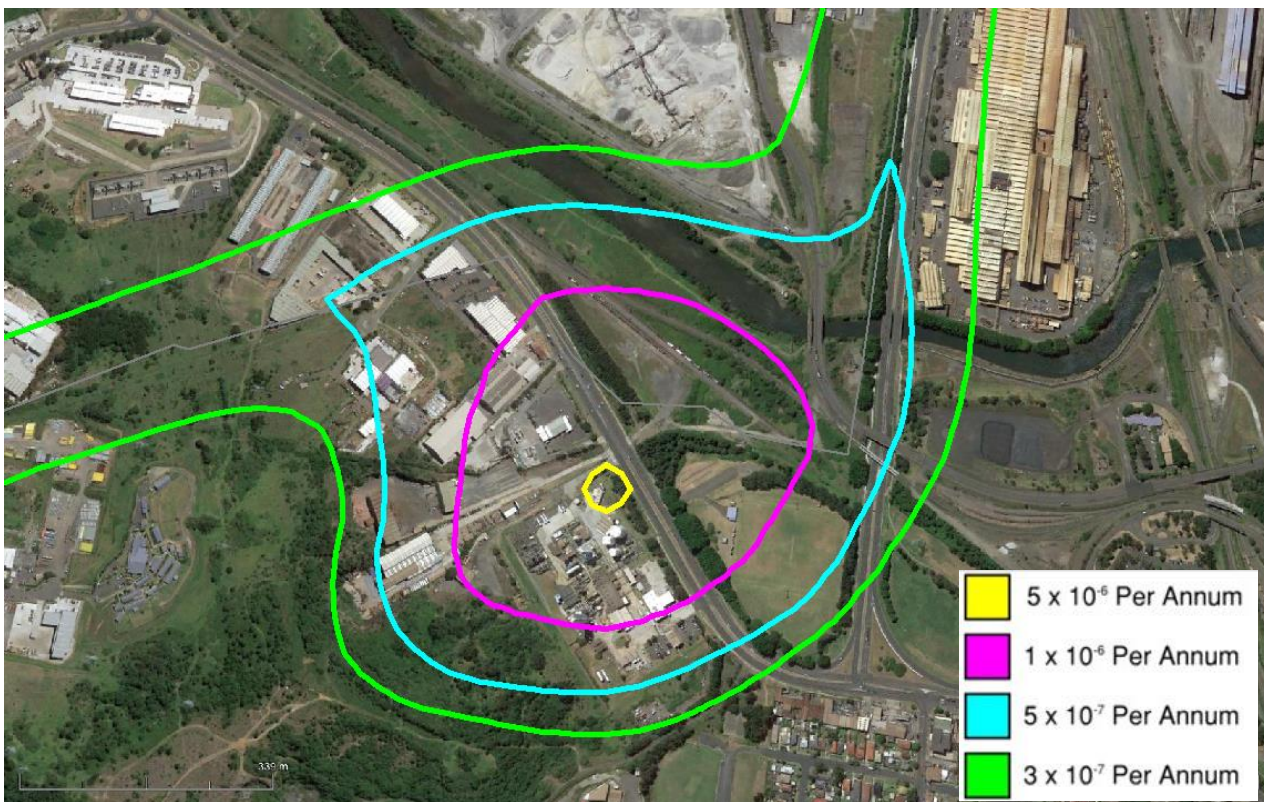


Figure 9-3: Location Specific Individual Risk Contours – Cringila Nitrogen Facility



## 9.2 Injury and Escalation Risk

In addition to production of Location Specific Individual Risk (LSIR) contours, the FHA has considered injury and property damage/accident propagation risk, defined by radiant heat impacts of 4.7, and 23kW/m<sup>2</sup>.

Note, results were not generated at this level for the specified HIPAP-4 criterion of 5E-05 per annum (or, fifty in a million per year), and as an alternative, the HIPAP LSIR frequency criteria were applied, as shown in Figure 9-4 and Figure 9-5.

Figure 9-4: Injury Risk (Exposure to 4.7kW/m<sup>2</sup>)

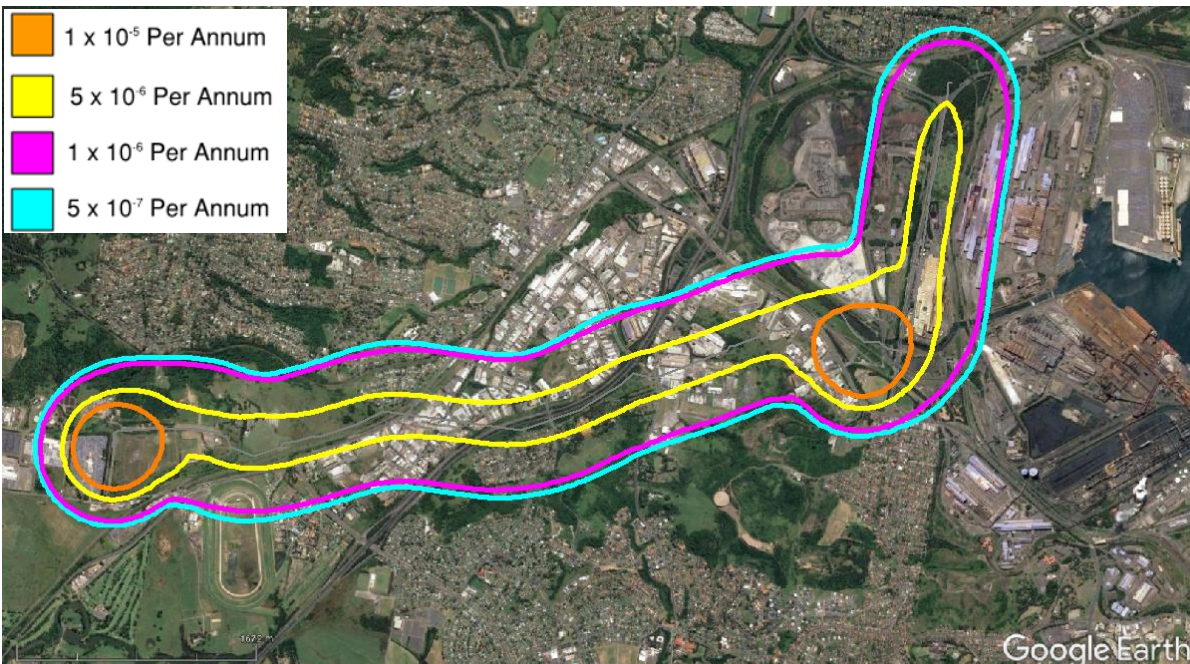
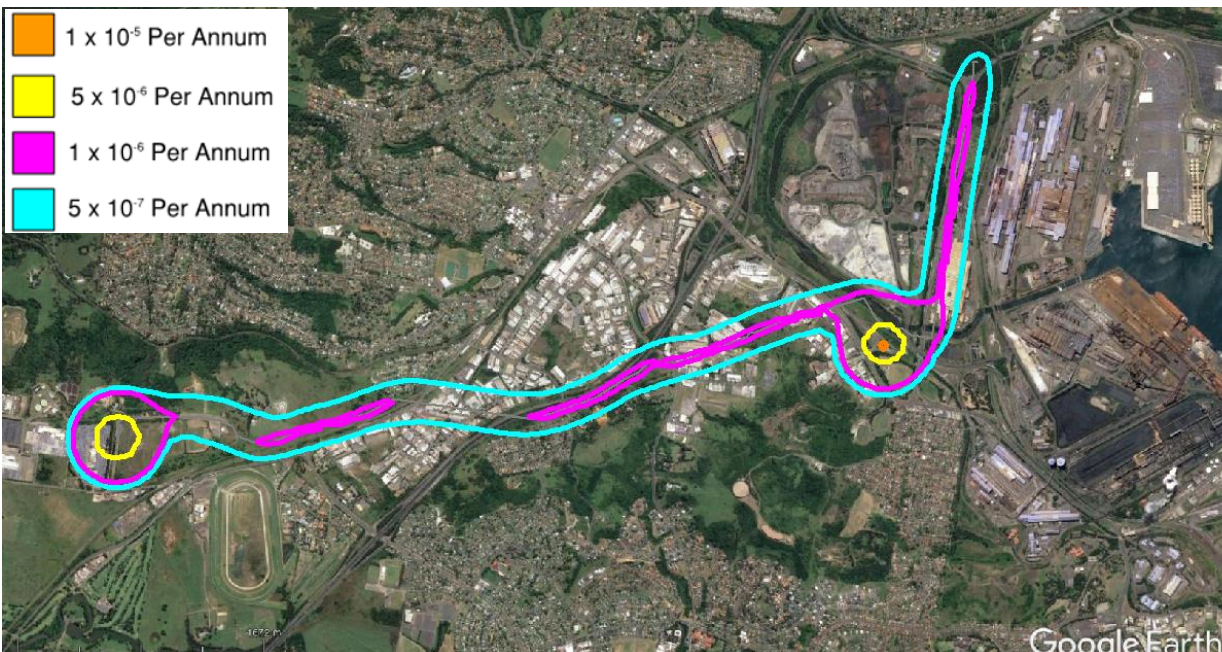


Figure 9-5: Property Damage & Escalation Risk (Exposure to 23kW/m<sup>2</sup>)



## 10. Conclusion

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The results of the QRA modelling undertaken indicate that risk exposure associated with the PKP and the associated KGMS will be below the fatality risk criteria specified in HIPAP-4.

## 11. References

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1. 411010-00071-SR-REP-0002, Port Kembla Lateral Looping NGP2 Pipeline FEED, Rev C, October 2020
2. Hazardous Industry Planning Advisory Paper (HIPAP) No. 4, Risk Criteria for Land Use Safety Planning, January 2011
3. Hazardous Industry Planning Advisory Paper (HIPAP) No. 6- Hazard Analysis, January 2011
4. AS2885.1, Pipelines – Gas and Liquid Petroleum – Part 1: Design and Construction, 2012
5. 401010-00071-SR-REP-0001, Port Kembla Lateral Looping PKL Pipeline FEED, Pipeline Safety Management Study Workshop, Rev 0
6. 401010-01496-PM-BOD-0001, Port Kembla Gas Project Basis of Design, Rev 0
7. Underground parallel pipelines domino effect: An analysis based on pipeline crater models and historical accidents, Journal of Loss Prevention in the Process Industries, Vol. 43, September 2016
8. OGP Risk Assessment Data Directory, Process Release Frequencies, Report No 434-01, September 2019
9. OGP Risk Assessment Data Directory, Riser and Pipeline Frequencies, Report No 434-04, September 2019
10. Port Kembla Gas Project, Preliminary Hazard Analysis, 401010-01496-SR-REP-0002, Rev 0
11. IP Research Report, Ignition Probability Review, Model Development and Look-Up Correlations, January 2006
12. OGP Risk Assessment Data Directory, Vulnerability of Humans, Report 434-14.1, March 2010

## **Appendix A. Parts Count**

### Section 3: Kembla Grange - Above ground to SLV 064007, and pig trap isolation

Component	Diameter	Count	Hole Size (mm)					
			1-10	10-25	25-50	50-100	100-450	450
INST	40	2	3.44E-04	2.95E-05	2.42E-05	0.00E+00	0.00E+00	0.00E+00
MANVALVE	25	1	2.24E-05	3.24E-06	4.54E-06	0.00E+00	0.00E+00	0.00E+00
FLANGE	50	2	1.27E-05	1.29E-06	5.16E-07	7.50E-07	0.00E+00	0.00E+00
MANVALVE	50	2	4.60E-05	6.29E-06	2.87E-06	5.35E-06	0.00E+00	0.00E+00
ACTVALVE	400	1	1.14E-04	1.01E-05	3.83E-06	2.12E-06	2.74E-06	0.00E+00
MANVALVE	450	1	6.05E-05	9.15E-06	4.37E-06	2.96E-06	3.53E-06	3.00E-06
FLANGE	450	2	5.05E-05	3.22E-06	1.05E-06	5.19E-07	3.95E-07	3.64E-06
PIPE			2.17E-04	2.09E-05	1.38E-05	3.90E-06	2.22E-06	2.21E-06
<b>TOTAL</b>			<b>8.67E-04</b>	<b>8.38E-05</b>	<b>5.52E-05</b>	<b>1.56E-05</b>	<b>8.89E-06</b>	<b>8.85E-06</b>

### Section 4: Kembla Grange - Metering to hot tap valve assembly

Component	Diameter	Count	Hole Size (mm)					
			1-10	10-25	25-50	50-100	100-450	450
INST	40	3	5.16E-04	4.42E-05	3.63E-05	0.00E+00	0.00E+00	0.00E+00
INST	50	1	1.72E-04	1.47E-05	5.48E-06	6.62E-06	0.00E+00	0.00E+00
MANVALVE	15	1	2.21E-05	8.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MANVALVE	20	4	8.91E-05	3.16E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MANVALVE	25	7	1.57E-04	2.27E-05	3.18E-05	0.00E+00	0.00E+00	0.00E+00
MANVALVE	40	6	1.37E-04	1.91E-05	2.57E-05	0.00E+00	0.00E+00	0.00E+00
FLANGE	40	5	2.98E-05	3.04E-06	2.84E-06	0.00E+00	0.00E+00	0.00E+00
FLANGE	50	4	2.53E-05	2.58E-06	1.03E-06	1.50E-06	0.00E+00	0.00E+00
MANVALVE	50	5	1.15E-04	1.57E-05	7.18E-06	1.34E-05	0.00E+00	0.00E+00
FLANGE	150	3	3.02E-05	3.03E-06	1.20E-06	6.97E-07	1.94E-06	0.00E+00
MANVALVE	150	1	2.51E-05	2.72E-06	1.12E-06	6.66E-07	9.84E-07	0.00E+00
FLANGE	200	5	6.13E-05	5.86E-06	2.29E-06	1.30E-06	4.37E-06	0.00E+00
MANVALVE	200	2	6.06E-05	6.64E-06	2.74E-06	1.64E-06	2.54E-06	0.00E+00
FLANGE	300	24	4.16E-04	3.39E-05	1.23E-05	6.62E-06	3.22E-05	0.00E+00
MANVALVE	300	6	2.62E-04	3.26E-05	1.43E-05	8.99E-06	1.62E-05	0.00E+00
FLANGE	400	4	9.03E-05	6.26E-06	2.12E-06	1.07E-06	7.17E-06	0.00E+00
MANVALVE	400	2	1.11E-04	1.57E-05	7.29E-06	4.81E-06	9.93E-06	0.00E+00
FLANGE	450	1	2.52E-05	1.61E-06	5.27E-07	2.60E-07	1.98E-07	1.82E-06
PIPE			7.36E-04	8.43E-05	4.88E-05	1.42E-05	2.18E-05	0.00E+00
<b>TOTAL</b>			<b>3.08E-03</b>	<b>3.54E-04</b>	<b>2.03E-04</b>	<b>6.17E-05</b>	<b>9.74E-05</b>	<b>1.82E-06</b>

### Section 5: Kembla Grange - Pig receiver

Component	Diameter	Count	Hole Size (mm)					
			1-10	10-25	25-50	50-100	100-450	450
MANVALVE	25	1	2.24E-05	3.24E-06	4.54E-06	0.00E+00	0.00E+00	0.00E+00
INST	40	3	5.16E-04	4.42E-05	3.63E-05	0.00E+00	0.00E+00	0.00E+00
FLANGE	50	5	3.16E-05	3.22E-06	1.29E-06	1.88E-06	0.00E+00	0.00E+00
MANVALVE	50	3	6.90E-05	9.44E-06	4.31E-06	8.03E-06	0.00E+00	0.00E+00
FLANGE	200	1	1.23E-05	1.17E-06	4.57E-07	2.60E-07	8.73E-07	0.00E+00
MANVALVE	200	1	3.03E-05	3.32E-06	1.37E-06	8.21E-07	1.27E-06	0.00E+00
PIGTRAP	450	1	2.20E-03	2.75E-04	1.21E-04	7.61E-05	8.19E-05	4.73E-05
FLANGE	450	1	2.52E-05	1.61E-06	5.27E-07	2.60E-07	1.98E-07	1.82E-06
PIPE			9.69E-04	1.14E-04	5.65E-05	2.91E-05	2.81E-05	1.64E-05
<b>TOTAL</b>			<b>3.87E-03</b>	<b>4.55E-04</b>	<b>2.26E-04</b>	<b>1.16E-04</b>	<b>1.12E-04</b>	<b>6.55E-05</b>

### Section 6: MLV-1 Tie-in to Kembla Grange Meter Station

Component	Diameter	Count	Hole Size (mm)					
			1-10	10-25	25-50	50-100	100-450	450
INST	40	2	3.44E-04	2.95E-05	2.42E-05	0.00E+00	0.00E+00	0.00E+00
MANVALVE	20	1	2.23E-05	7.89E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FLANGE	40	1	5.96E-06	6.07E-07	5.67E-07	0.00E+00	0.00E+00	0.00E+00
FLANGE	150	10	1.01E-04	1.01E-05	4.01E-06	2.32E-06	6.45E-06	0.00E+00
ACTVALVE	150	1	1.17E-04	1.27E-05	5.20E-06	3.09E-06	4.79E-06	0.00E+00
MANVALVE	150	3	7.52E-05	8.15E-06	3.35E-06	2.00E-06	2.95E-06	0.00E+00
PIPE			2.22E-04	2.30E-05	1.24E-05	2.47E-06	4.73E-06	0.00E+00
<b>TOTAL</b>			<b>8.88E-04</b>	<b>9.18E-05</b>	<b>4.98E-05</b>	<b>9.89E-06</b>	<b>1.89E-05</b>	<b>0.00E+00</b>

### Section 7: BOC Nitrogen Injection

Component	Diameter	Count	Hole Size (mm)					
			1-10	10-25	25-50	50-100	100-450	450
INST	40	2	3.44E-04	2.95E-05	2.42E-05	0.00E+00	0.00E+00	0.00E+00
MANVALVE	20	1	2.23E-05	7.89E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FLANGE	50	2	1.27E-05	1.29E-06	5.16E-07	7.50E-07	0.00E+00	0.00E+00
MANVALVE	50	3	6.90E-05	9.44E-06	4.31E-06	8.03E-06	0.00E+00	0.00E+00
FLANGE	150	6	6.04E-05	6.05E-06	2.41E-06	1.39E-06	3.87E-06	0.00E+00
MANVALVE	150	2	5.01E-05	5.43E-06	2.23E-06	1.33E-06	1.97E-06	0.00E+00
ACTVALVE	150	1	1.17E-04	1.27E-05	5.20E-06	3.09E-06	4.79E-06	0.00E+00
FLANGE	450	2	5.05E-05	3.22E-06	1.05E-06	5.19E-07	3.95E-07	3.64E-06
PIPE			2.42E-04	2.52E-05	1.33E-05	5.04E-06	3.67E-06	1.21E-06
<b>TOTAL</b>			<b>9.69E-04</b>	<b>1.01E-04</b>	<b>5.32E-05</b>	<b>2.02E-05</b>	<b>1.47E-05</b>	<b>4.85E-06</b>

## **Appendix B. Summary of Release Scenarios**

**Above Ground Facilities:**

No.		Hole Size (mm)	Temp	Pressure (barg)	Release Rate (kg/s)	Release Frequency	Ignition Probability	Fire Frequency
3	Pipeline- A/G point at Kembla to SLV-064007	3	10	165.5	0.27	8.67E-04	1.25E-03	1.08E-06
		16	10	165.5	7.62	8.38E-05	1.93E-03	1.62E-07
		35	10	165.5	36.44	5.52E-05	5.63E-03	3.11E-07
		71	10	165.5	149.90	1.56E-05	1.75E-02	2.73E-07
		212	10	165.5	879.30	8.89E-06	7.22E-02	6.42E-07
		431.6	10	165.5	1285.00	8.85E-06	9.78E-02	8.66E-07
4	Metering to U/G point to hot tap valve assembly	3	10	165.5	0.27	3.08E-03	1.25E-03	3.85E-06
		16	10	165.5	7.62	3.54E-04	1.93E-03	6.84E-07
		35	10	165.5	36.44	2.03E-04	5.63E-03	1.14E-06
		71	10	165.5	149.90	6.17E-05	1.75E-02	1.08E-06
		212	10	165.5	879.30	9.74E-05	7.22E-02	7.03E-06
		431.6	10	165.5	1285.00	1.82E-06	9.78E-02	1.78E-07
5	Pig Receiver	3	10	165.5	0.27	3.87E-03	1.25E-03	4.84E-06
		16	10	165.5	7.62	4.55E-04	1.93E-03	8.79E-07
		35	10	165.5	36.44	2.26E-04	5.63E-03	1.27E-06
		71	10	165.5	149.90	1.16E-04	1.75E-02	2.04E-06
		212	10	165.5	879.30	1.12E-04	7.22E-02	8.10E-06
		431.6	10	165.5	1285.00	6.55E-05	9.78E-02	6.40E-06
6	Kembla Grange MLV	3	10	165.5	0.27	8.88E-04	1.25E-03	1.11E-06
		16	10	165.5	7.62	9.18E-05	1.93E-03	1.77E-07
		35	10	165.5	36.44	4.98E-05	5.63E-03	2.80E-07
		71	10	165.5	149.90	9.89E-06	1.75E-02	1.73E-07
		150	10	165.5	648.10	1.89E-05	5.65E-02	1.07E-06
		431.6	10	165.5	1285.00	1.82E-06	9.78E-02	1.78E-07
7	BOC Nitrogen Injection	3	10	165.5	0.27	9.69E-04	1.56E-03	1.51E-06
		16	10	165.5	7.62	1.01E-04	2.78E-02	2.79E-06
		35	10	165.5	36.44	5.32E-05	8.77E-02	4.67E-06
		71	10	165.5	149.90	2.02E-05	2.48E-01	5.00E-06
		212	10	165.5	1436.00	1.47E-05	6.00E-01	8.82E-06
		431.6	10	165.5	2502.00	4.85E-06	6.00E-01	2.91E-06

**Pipeline:**

No.		Hole Size (mm)	Temp	Pressure (barg)	Release Rate (kg/s)	Ignition Probability
1	NG Pipeline Segment 1.2	20	10	165.5	11.90	3.77E-02
		50	10	165.5	74.36	1.46E-01
		100	10	165.5	297.40	4.08E-01
		431.6	10	165.5	2483.00	1.00E+00
2	NG Pipeline Segment 2	20	10	165.5	11.90	3.77E-02
		50	10	165.5	74.36	1.46E-01
		100	10	165.5	297.40	4.08E-01
		431.6	10	165.5	2295.00	1.00E+00

## **Appendix C. Jet Fire & Flash Fire Impacts**

### Above Ground Facilities:

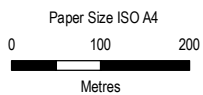
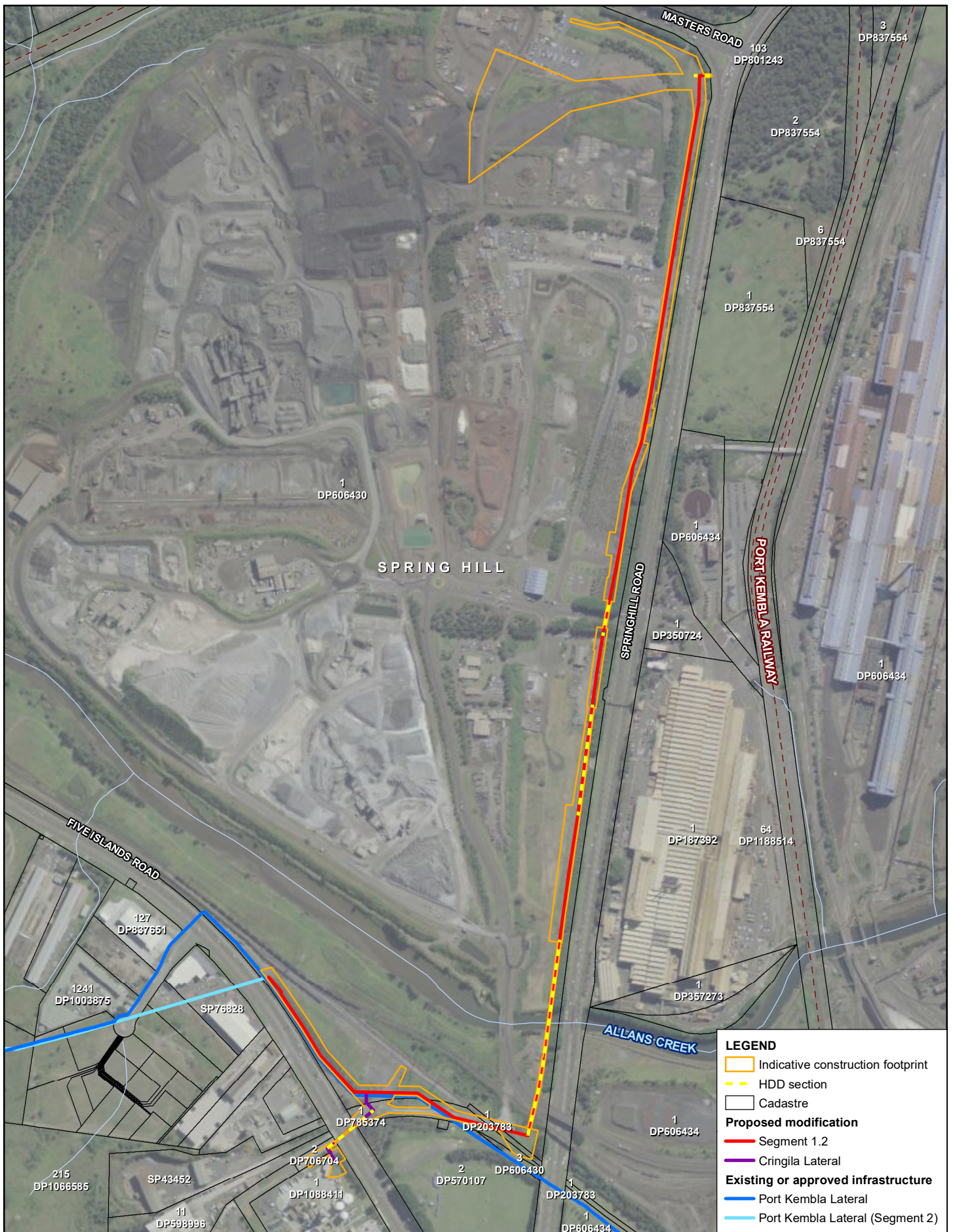
Section	Hole Size (mm)	Distance to LFL (m)			Distance to LFL (m)			Impact Distance to 4.7 kW/m <sup>2</sup> (m)			Impact Distance to 12.6 kW/m <sup>2</sup> (m)			Impact Distance to 23 kW/m <sup>2</sup> (m)		
		Horizontal			Down			Horizontal			Horizontal			Horizontal		
		1/F	5/D	10/D	1/F	5/D	10/D	1/F	5/D	10/D	1/F	5/D	10/D	1/F	5/D	10/D
Kembla Grange - Above ground to SLV 064007, and pig trap isolation	3	n/a	n/a	n/a	n/a	n/a	n/a	12	9	9	10	7	7	9	7	6
	16	n/a	n/a	n/a	n/a	n/a	n/a	53	43	40	45	35	32	42	32	29
	35	n/a	n/a	n/a	48	43	52	108	87	82	91	70	65	83	63	58
	71	31	30	30	100	103	122	205	164	155	171	132	123	156	118	109
	212	113	111	116	247	285	317	521	500	482	384	378	385	329	321	342
	431.6	142	139	145	308	354	417	662	641	623	501	483	490	429	414	431
Kembla Grange - Metering to hot tap valve assembly	3	n/a	n/a	n/a	n/a	n/a	n/a	12	9	9	10	7	7	9	7	6
	16	n/a	n/a	n/a	n/a	n/a	n/a	53	43	40	45	35	32	42	32	29
	35	n/a	n/a	n/a	48	43	52	108	87	82	91	70	65	83	63	58
	71	31	30	30	100	103	122	205	164	155	171	132	123	156	118	109
	212	113	111	116	247	285	317	521	500	482	384	378	385	329	321	342
	431.6	142	139	145	308	354	417	662	641	623	501	483	490	429	414	431
Kembla Grange - Pig receiver	3	n/a	n/a	n/a	n/a	n/a	n/a	12	9	9	10	7	7	9	7	6
	16	n/a	n/a	n/a	n/a	n/a	n/a	53	43	40	45	35	32	42	32	29
	35	n/a	n/a	n/a	48	43	52	108	87	82	91	70	65	83	63	58
	71	31	30	30	100	103	122	205	164	155	171	132	123	156	118	109
	212	113	111	116	247	285	317	521	500	482	384	378	385	329	321	342
	431.6	142	139	145	308	354	417	662	641	623	501	483	490	429	414	431
MLV-1 Tie-in to Kembla Grange Meter Station	3	n/a	n/a	n/a	n/a	n/a	n/a	12	9	9	10	7	7	9	7	6
	16	n/a	n/a	n/a	n/a	n/a	n/a	53	43	40	45	35	32	42	32	29
	35	n/a	n/a	n/a	48	43	52	108	87	82	91	70	65	83	63	58
	71	31	30	30	100	103	122	205	164	155	171	132	123	156	118	109
	150	87	85	88	204	230	255	423	403	390	308	306	314	265	262	281
	431.6	142	139	145	308	354	417	662	641	623	501	483	490	429	414	431
BOC Nitrogen Injection	3	n/a	n/a	n/a	n/a	n/a	n/a	12	9	9	10	7	7	9	7	6
	16	n/a	n/a	n/a	n/a	n/a	n/a	53	43	40	45	35	32	42	32	29
	35	n/a	n/a	n/a	48	43	52	108	87	82	91	70	65	83	63	58
	71	31	30	30	100	103	122	205	164	155	171	132	123	156	118	109
	212	114	112	116	247	286	318	523	502	484	385	379	387	330	322	344
	431.6	142	139	146	309	356	418	664	643	625	502	484	491	430	415	432

**Pipeline:**

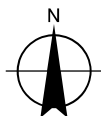
Section	Hole Size (mm)	Distance to LFL (m)			Distance to LFL (m)			Impact Distance to 4.7 kW/m <sup>2</sup> (m)			Impact Distance to 12.6 kW/m <sup>2</sup> (m)			Impact Distance to 23 kW/m <sup>2</sup> (m)		
		Angled			Vertical			Angled			Angled			Angled		
		1/F	5/D	10/D	1/F	5/D	10/D	1/F	5/D	10/D	1/F	5/D	10/D	1/F	5/D	10/D
NG Pipeline Segment 1.2	20	2.6	2.4	2.6	0.3	0.4	0.4	48	45	44	32	31	32	16	25	26
	50	3.1	2.7	2.8	0.4	0.5	0.6	113	104	100	76	70	70	41	57	55
	100	3.5	3.1	3.2	1.0	0.7	0.8	216	187	175	146	124	119	90	99	96
	431.6	n/a	5.1	5.2	n/a	2.0	2.0	572	509	480	363	347	328	n/a	259	255
NG Pipeline Segment 2	20	2.6	2.4	2.6	0.3	0.4	0.4	48	45	44	32	31	32	16	25	26
	50	3.1	2.7	2.8	0.4	0.5	0.6	113	104	100	76	70	70	41	57	55
	100	3.5	3.1	3.2	1.0	0.7	0.8	216	187	175	146	124	119	90	99	96
	431.6	n/a	5.1	5.2	n/a	2.0	2.0	571	508	478	362	346	327	n/a	259	254

# Appendix E

## Mapping



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56

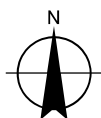
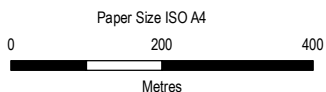
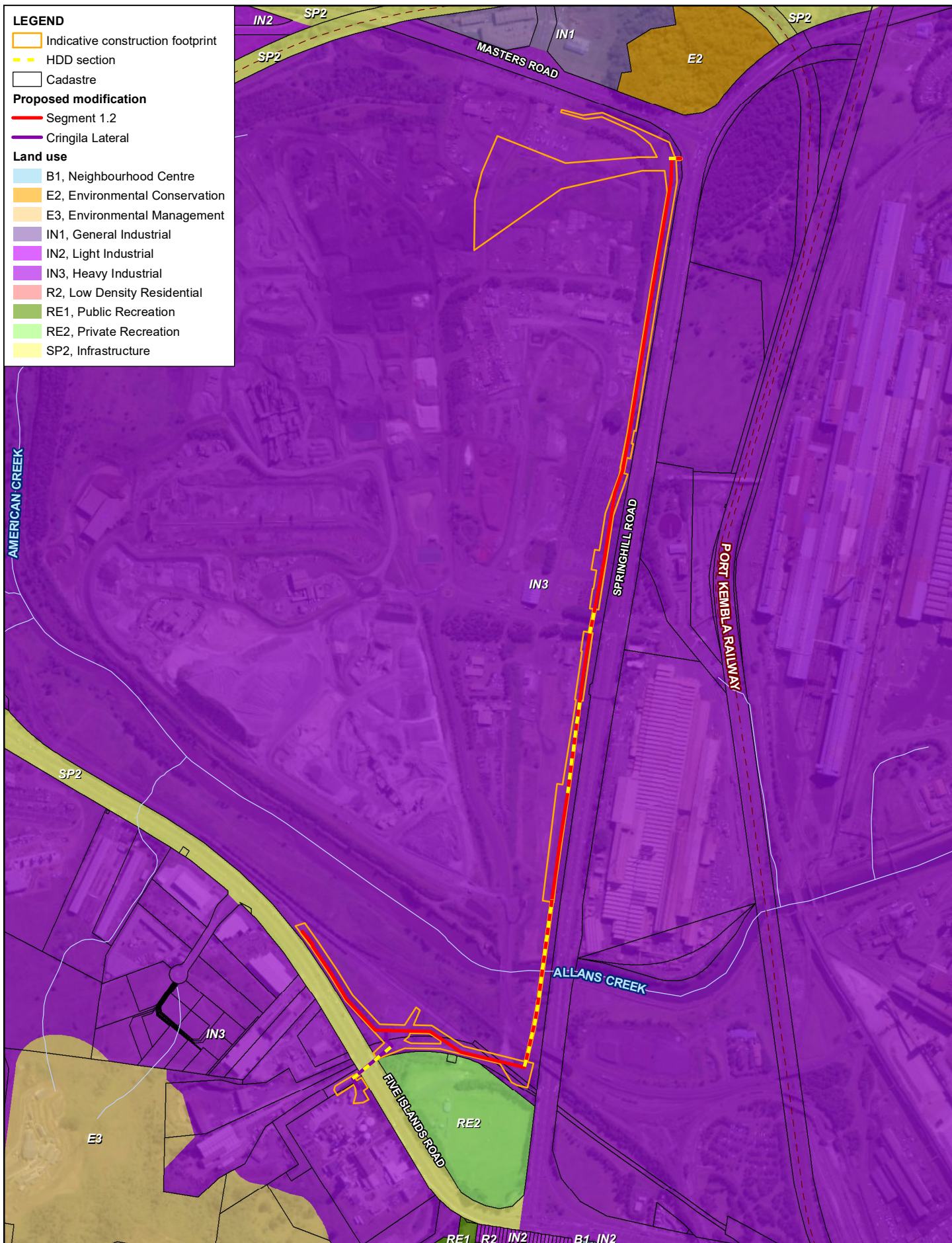


Jemena  
Eastern Gas Pipeline - Modification 2

Project No. 12547160  
Revision No. A  
Date 23 Sep 2021

Project layout

FIGURE B-1



Jemena  
Eastern Gas Pipeline - Modification 2

Project No. 12547160  
Revision No. A  
Date 23 Sep 2021

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56

Land zoning of land area

FIGURE B-2

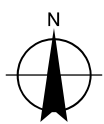
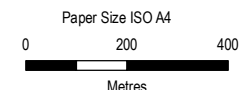


**LEGEND**

- Indicative construction footprint
- HDD section
- AHIMS
- Local heritage

**Proposed modification**

- Segment 1.2
- Cringila Lateral



**Jemena**  
**Eastern Gas Pipeline - Modification 2**

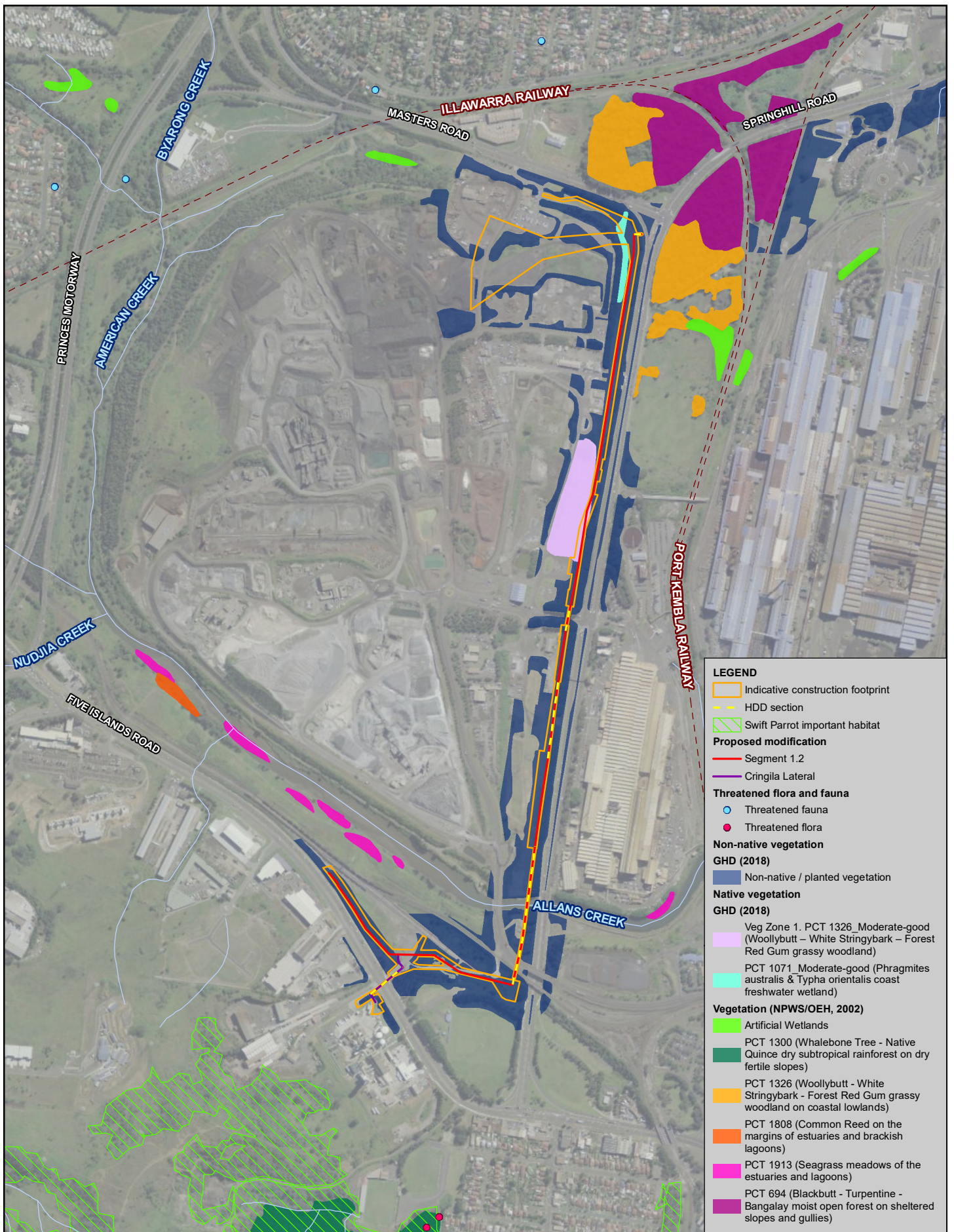
Project No. 12547160  
Revision No. A  
Date 23 Sep 2021

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 56

**Heritage values**

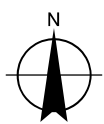
**FIGURE B-3**

N:\AU\Sydney\Projects\2112547160\GIS\Maps\Deliverables\ModReport\12547160\_MOD004\_Heritage.mxd Data source: Aerial imagery - SIXmaps 2021; General topo - NSW LPI DTDB 2017 & 2015; Cadastre - NSW LPI DCDB 2021; Project components - Jemena; Heritage - NSW DPE 2020 & OEH. Created by: jpric  
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- LEGEND**
- Indicative construction footprint
  - HDD section
  - Swift Parrot important habitat
- Proposed modification**
- Segment 1.2
  - Cringila Lateral
- Threatened flora and fauna**
- Threatened fauna
  - Threatened flora
- Non-native vegetation**
- GHD (2018)**
- Non-native / planted vegetation
- Native vegetation**
- GHD (2018)**
- Veg Zone 1. PCT 1326\_Moderate-good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)
  - PCT 1071\_Moderate-good (Phragmites australis & Typha orientalis coast freshwater wetland)
- Vegetation (NPWS/OEH, 2002)**
- Artificial Wetlands
  - PCT 1300 (Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes)
  - PCT 1326 (Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands)
  - PCT 1808 (Common Reed on the margins of estuaries and brackish lagoons)
  - PCT 1913 (Seagrass meadows of the estuaries and lagoons)
  - PCT 694 (Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies)

Paper Size ISO A4  
 0 200 400  
 Metres  
 Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 56



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 Date 24 Sep 2021

Biodiversity values

FIGURE B-4

N:\AU\Sydney\Projects\2112547160\GIS\Maps\Deliverables\ModReport\12547160\_MOD005\_Biodiversity.mxd Data source: Aerial imagery - SIXmaps 2021; General topo - NSW LPI DTDB 2017 & 2015; Cadastre - NSW LPI DCDB 2021; Project components - Jemena; Biodiversity data - OEH, Jemena, Biosis; Swift Parrot habitat - DPIE 2021.  
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**Document status**

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
0	0	M Goodall	K Rosen		K Rosen		25/11/21

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