Appendix H
Terrestrial ecology

Australian Industrial Energy

Port Kembla Gas Terminal

Biodiversity Development Assessment Report

November 2018

Executive summary

Australian Industrial Energy (AIE) proposes to develop the Port Kembla Gas Terminal (the project) in Port Kembla, New South Wales (NSW). The project involves the development of a liquified natural gas (LNG) import terminal including a Floating Storage and Regasification Unit (FSRU) moored at Berth 101 in the Inner Harbour, visiting LNG carriers, wharf offloading facilities and the installation of new pipeline to connect to the existing gas transmission network.

NSW currently imports more than 95 % of its natural gas requirements from Victoria, South Australia and Queensland. An import terminal would enable NSW to control and secure its own direct supplies. The project has the capacity to deliver in excess of 100 petajoules of natural gas per annum to NSW. This is equivalent to more than 70 % of the State's annual needs. Supply could be increased further to around 140–150 petajoules per annum through a slight increase in scheduled deliveries and pipeline upgrades.

The project consists of four key components:

- LNG carrier vessels — there are hundreds of these in operation worldwide transporting LNG from production facilities all around the world to demand centres;
- Floating Storage and Regasification Unit (FSRU) — a cape-class ocean-going vessel which would be moored at Berth 101 in Port Kembla. There are around 30 such vessels currently in operation around the world;
- Berth and wharf facilities – including landside offloading facilities to transfer natural gas from the FSRU into a natural gas pipeline located on shore; and
- Gas pipeline – a 6.3 kilometre Class 900 carbon steel high-pressure pipeline connection from the berth to the existing gas transmission network at Cringila.

The project has been declared critical state significant infrastructure in accordance with section 5.13 of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) and Schedule 5 of the *State Environmental Planning Policy* (SEPP) *State and Regional Development*.

An Environmental Impact Statement (EIS) is required to support the application for approval for determination by the NSW Minister for Planning. This Biodiversity Development Assessment Report (BDAR) has been prepared to support the EIS and to meet the requirements of the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Secretary's Environmental Assessment Requirements (SEARs).

The site is highly modified and disturbed, as much of it is located within land covered by the *State Environmental Planning Policy (Three Ports) 2013* (Three Port SEPP) and including part of the existing Port Kembla Coal Terminal, Grain Corp Terminal, BlueScope Steelworks and road reserves. The pipeline would be underbored beneath Gurungaty Waterway in the north-east and Allans Creek in the south. Both waterways flow through highly disturbed land, however the Allans Creek catchment includes natural areas of the Illawarra Escarpment. Allans Creek, Gurungaty Waterway and the Inner Harbour are mapped as key fish habitat under the *Fisheries Management Act 1994*(FM Act).

Native vegetation and original substrates have been almost entirely removed from the study area, with no remnant native vegetation or natural substrates occurring within the project site. Field surveys confirmed the presence of a single patch of native vegetation, comprising a small area of dense revegetation on modified/cleared lands at the approximate mid-point of the western alignment, within the project site. This vegetation has been assigned to Woollybutt – White Stringybark – Forest Red Gum grassy woodland (Plant Community Type 1326) based on

the species present and presence of similar vegetation in the area. It is not commensurate with a threatened ecological community.

The Port Kembla Key Population of the Green and Golden Bell Frog (*Litoria aurea*) occurs in the Port Kembla and southern Wollongong area. This species is listed as an endangered species under the *Biodiversity Conservation Act 2016* and a vulnerable species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Green and Golden Bell Frogs have also been found in unnatural habitats in the area including detention ponds and residential ponds, and can use disturbed habitats to disperse between breeding sites (DEC 2007).

However, the location of the project in a highly disturbed and modified industrial environment allows for avoidance of many actual and potential impacts as compared to a project in a predominantly greenfield location. Minimal native vegetation and associated habitat for threatened species is present. Potential impacts upon native vegetation and fauna habitat have been further avoided by the use of directional drilling instead of open trenching for the pipeline (in particular to avoid areas of Illawarra Lowlands Grassy Woodland and natural swamp areas that intersect the proposed alignment). Trenching will be used in previously disturbed areas only. The construction corridor has been reduced in some locations to minimise temporary impacts on potential Green and Golden Bell Frog habitat. Following construction, groundcover would be re-established, thus minimising impacts in the long-term.

Given the highly disturbed and modified nature of the study area, no suitable habitat for candidate species occurs within native vegetation within the project site. Dispersal habitat and artificial refuge habitat for the Green and Golden Bell Frog is assumed to be present based on recent records in the area, however this is not associated with any PCTs in the project site.

No biota impacted by the project were identified as being a candidate for Serious and Irreversible Impact (SAII) classification.

The project would result in the following impacts:

- Removal of 0.25 ha of planted native vegetation that is assigned PCT 1326 (Woollybutt – White Stringybark – Forest Red Gum grassy woodland) as the closest matching candidate PCT.
- Temporary short-term disturbance of the potential movement corridor for the Green and Golden Bell Frog during construction of the pipeline.
- Removal of four, small artificial detention ponds on the area on the existing coal terminal Berth 101 site that may be used on occasion by the Green and Golden Bell Frog but are unlikely to provide breeding habitat.
- Potential indirect impacts on adjoining vegetation associated with edge effects, light spill, noise and introduction of weeds and pathogens.
- Potential impacts on water quality from construction and operation.

At total of 3 ecosystem credits are required to offset residual impacts of the project upon potential threatened species habitat within vegetation zone 1 (1326_Moderate-good). No species credits are required to be calculated as offsets for the project.

To avoid and minimise potential impacts of the project on biodiversity, a series of mitigation and management measures have been identified, which would be implemented as part of the construction and operation environmental management plan for the site. In particular, a number of measures are recommended to minimise potential impacts on the Green and Golden Bell Frog, including pre-clearing surveys at detention basins to be removed, use of frog fencing, and management and inspection of the trench for any trapped individuals.

The project would not impact any threatened freshwater biota listed under the *Fisheries Management Act 1994*. There would be no direct impacts on key fish habitat or marine vegetation within Allans Creek or Gurungaty Waterway.

An assessment of significance pursuant to the EPBC Act significant impact guidelines 1.1 (DotE 2013) has been prepared for the Green and Golden Bell Frog (Appendix C). Given the temporary nature of the impacts on connectivity and avoidance of direct impacts on high quality areas of habitat, the project is unlikely to have a significant impact on this species. The project would have limited impacts on any other threatened or migratory biota listed under the EPBC Act and considered in this report. There would be negligible clearing of native vegetation, and no impacts on important habitat for migratory species. Referral of the project to the Commonwealth Minister for the Environment is therefore not required.

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Glossary of terms and acronyms

Term	Definition
AOBV	Areas of Outstanding Biodiversity Value.
BDAR	Biodiversity Development Assessment Report.
BSAR	Biodiversity Stewardship Assessment Report.
BC Act	*Biodiversity Conservation Act 2016*.
Biodiversity Assessment Method (BAM)	The methodology established under the BC Act to implement the aims of the BOS and provide a framework for the conservation of biodiversity values and the offsetting of development impacts. The BAM sets out: how biodiversity values will be assessed; prescribes requirements to avoid and minimise impacts; establishes rules for calculating the number and class of credits required for unavoidable impacts or that could be generated at stewardship sites; and determines the credit trading rules that will apply.
Biodiversity credit report	Specifies the number and type of biodiversity credits: required to offset the impacts of a development; to obtain a Biodiversity Certification Agreement; or that would be generated through conservation and management of a Stewardship site under a Stewardship Site agreement.
BCT	Biodiversity Conservation Trust.
Biodiversity credit	A unit of biodiversity value to measure specific development impacts or conservation gains in accordance with the BAM. Includes ecosystem credits and species credits.
Biodiversity offsets	Specific measures that are put in place to compensate for impacts on biodiversity values.
Biodiversity values	The composition, structure and function of ecosystems, including threatened species, populations and ecological communities, and their habitats.
BOS	Biodiversity Offset Scheme.
CEEC	Critically endangered ecological community.
DoEE	Department of the Environment and Energy.
DPI	Department of Primary Industries.
Ecosystem credit	A credit that relates to a vegetation type and the threatened species that are reliably predicted to occur in that vegetation type (as a habitat surrogate).
EEC	Endangered ecological community.
CEMP	Construction Environmental Management Plan.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999.*
FFMP	Flora and Fauna Management Plan.
IBRA	Interim Biogeographic Regionalisation for Australia.
MNES	Matters of National Environmental Significance.
LEP	Local Environmental Plan.

Term	Definition
LGA	Local Government Area.
Locality	The area within a 10 km radius of the study area.
Migratory Species	Species listed under listed under international agreements (I.e Ramsar, JAMBA and CAMBA convensions) to which Australia is a party.
OEH	Office of Environment and Heritage.
Project site	The area that would be directly impacted by construction and operation of the project.
PCT	Plant Community Type.
SAII	Serious and Irreversible Impacts.
SAII entity	Species and ecological communities that are likely to be the subject of serious and irreversible impacts (SAIIs)
SEPP	State Environmental Planning Policy.
Species Credit	A credit that relates to an individual threatened species that cannot be reliably predicted based on habitat surrogates. Threatened species that require species credits are identified in the Threatened Biodiversity Data Collection.
SIS	Species Impact Statement
Study area	The area that was subject to a site survey and assessed for direct or indirect impacts arising from construction and operation of the project.
TEC	Threatened ecological community.
Threatened biota	Threatened species, populations or ecological communities listed under the BC Act and/or the EPBC Act.

Scope and limitations

This report: has been prepared by GHD for Australian Industrial Energy and *may only be used and relied on by Australian Industrial Energy for the purpose agreed between GHD and the Australian Industrial Energy as set out in section 1.6 of this report.*

GHD otherwise disclaims responsibility to any person other than Australian Industrial Energy arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report. GHD has prepared this report on the basis of the project description, 'proposal site' polygon and other information provided by Australian Industrial Energy and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.8 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1. Introduction

1.1 Overview

Australian Industrial Energy (AIE) proposes to develop the Port Kembla Gas Terminal (the project) in Port Kembla, New South Wales (NSW). The project involves the development of a liquified natural gas (LNG) import terminal including a Floating Storage and Regasification Unit (FSRU) moored at Berth 101 in the Inner Harbour, visiting LNG carriers, wharf offloading facilities and the installation of new pipeline to connect to the existing gas transmission network.

NSW currently imports more than 95 % of its natural gas requirements from Victoria, South Australia and Queensland. An import terminal would enable NSW to control and secure its own direct supplies. The project has the capacity to deliver in excess of 100 petajoules of natural gas per annum to NSW. This is equivalent to more than 70 % of the State's annual needs. Supply could be increased further to around 140–150 petajoules per annum through a slight increase in scheduled deliveries and pipeline upgrades.

The project consists of four key components:

- LNG carrier vessels — there are hundreds of these in operation worldwide transporting LNG from production facilities all around the world to demand centres;
- Floating Storage and Regasification Unit (FSRU) — a cape-class ocean-going vessel which would be moored at Berth 101 in Port Kembla. There are around 30 such vessels currently in operation around the world;
- Berth and wharf facilities – including landside offloading facilities to transfer natural gas from the FSRU into a natural gas pipeline located on shore; and
- Gas pipeline – a Class 900 carbon steel high-pressure pipeline connection from the berth to the existing gas transmission network.

The project has been declared critical state significant infrastructure in accordance with section 5.13 of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) and Schedule 5 of the *State Environmental Planning Policy* (SEPP) *State and Regional Development*. An Environmental Impact Statement (EIS) is required to support the application for approval for determination by the NSW Minister for Planning.

This Biodiversity Development Assessment Report (BDAR) has been prepared to support the EIS and to meet the requirements of the NSW *Biodiversity Conservation Act 2016* (BC Act), the Secretary's Environmental Assessment Requirements (SEARs) and the specific requirements of the NSW Office of Environment and Heritage (OEH) (see Section 1.4). The purpose of the BDAR is to assess potential biodiversity impacts arising from the project with a particular focus on threatened biota listed under the BC Act and Matters of National Environmental Significance (MNES) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2 Project description

The project comprises the development of a LNG import terminal located within industrial land declared under the *State Environmental Planning Policy (Three Ports)*. The project incorporates four key components:

- Wharf facilities – construction of new berth and wharf facilities would involve establishment of a temporary construction compound, demolition of existing wharf facilities, and building of quay wall and topside facilities. In addition, a number of existing utilities used by

neighbouring tenants and/or the project will need to be realigned and reconnected prior to major construction disturbance. It is estimated that about 600,000 cubic metres of material would be excavated and dredged for the construction of berth and wharf facilities.

- Pipeline – an underground gas pipeline connection will be constructed from Berth 101 to the existing east coast gas transmission network at Cringila. The gas pipeline would be a DN450 carbon steel pipeline about 45 centimetres (18 inches) in diameter and 6.3 kilometres in length. The gas pipeline would be constructed progressively by a combination of trenching and horizontal directional drilling (HDD). HDD has also been adopted for key road, rail and waterway crossings and to avoid previously undisturbed areas of biodiversity and heritage value. A temporary right of way would be established along the length of the pipeline route to provide space for vehicles and stockpiles of topsoil, subsoil and vegetation. Temporary construction compounds may also established intermittently adjacent to the right of way for the laydown of segments of gas pipeline and other construction materials as necessary.
- Floating storage and regasification unit (FSRU) - a vessel which will be moored at berth 101 on the eastern side of the Inner Harbour at Port Kembla. Construction of the FSRU is under the operational control of the supplier and would occur outside of Australia. Therefore, the construction of the FSRU is not covered in this environmental impact assessment.
- LNG carriers (LNGCs) - At present it is envisaged that an LNG shipment will be required every two to three weeks during operation to provide for an annual supply of up to 100PJ of gas. Supply could be increased further to around 140 – 150 PJ per annum through a slight increase in LNG delivery schedules and pipeline upgrades.

It will take 10 - 12 months to complete construction and other works in order to start operations for the project and subject to the timing of approval processes, it is possible for the project to commence in early 2020.

1.3 Location and study area

The project is located in a predominantly industrial area at Port Kembla, in the Wollongong Local Government Area (see Figure 1-1). This figure shows the study area, proposed pipeline alignment and project areas summarised in Table 1-1. Impacts upon areas of high biodiversity constraint and key infrastructure have been avoided by the use of HDD. Remaining areas of the pipeline alignment are to be trenched within a 16 m wide construction footprint. Impacts of the project upon terrestrial biodiversity are restricted to above-ground works associated with trenching, HDD staging sites and berth footprint, hereafter referred to as the ‘project site’. Lengths of the proposed pipeline alignment where pipeline construction will be achieved via HDD would have no impact upon terrestrial biodiversity.

Port Kembla is a deep water harbour located in the Illawarra region, approximately three kilometres south of the Wollongong Central Business District and 80 kilometres south of Sydney. The port operates across two harbours, consisting of an Inner and Outer Harbour. Berth B101 is proposed for use as part of the project and is located between B102 and “the Cut” shipping channel providing access to the Inner Harbour.

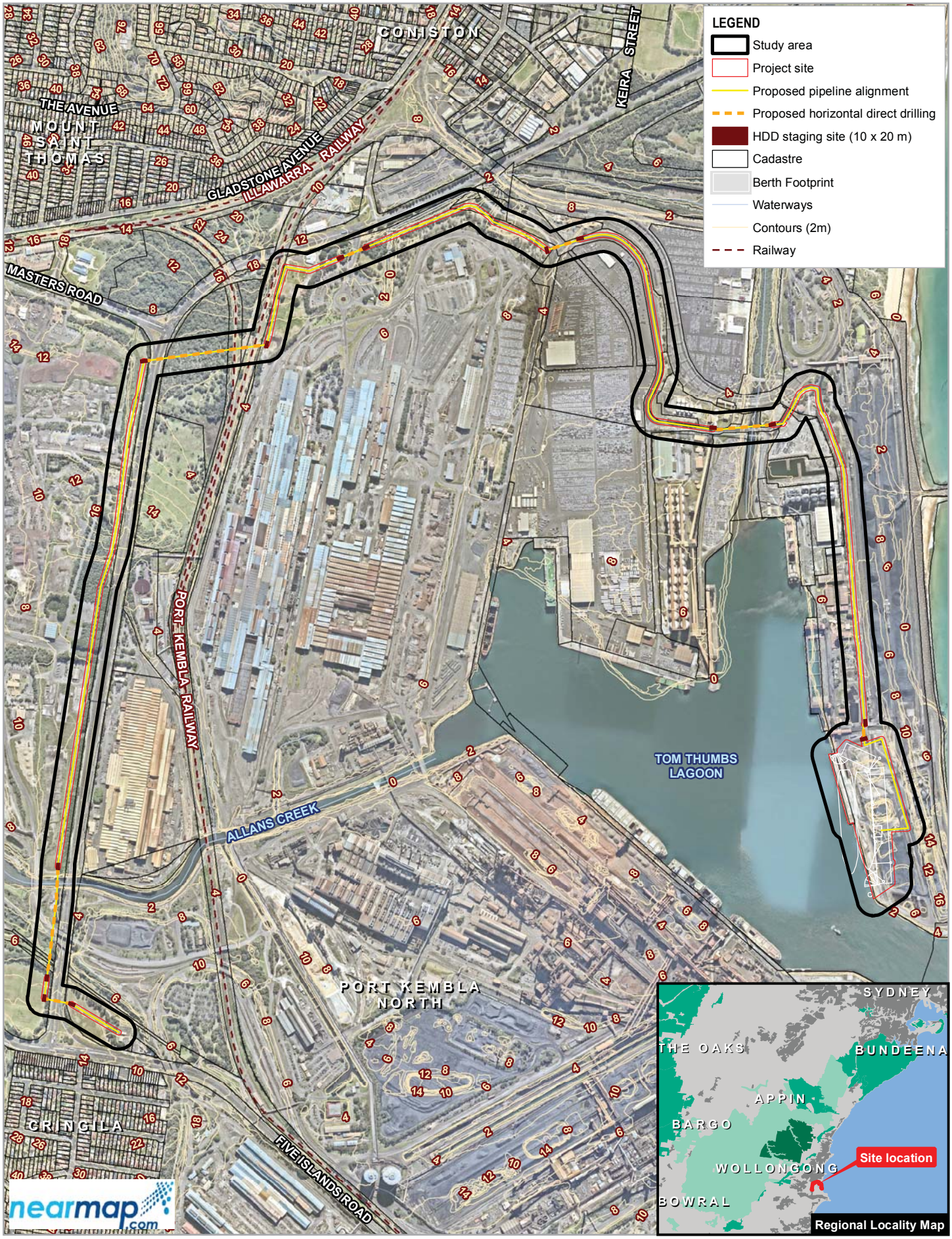
Two grain terminals operate on the northern side of the Inner Harbour along with bulk liquid facilities and a number of multi-purpose berths. BlueScope Steelworks operate five berths on the western side of the Inner Harbour and the Port Kembla Coal Terminal (PKCT) is a coal export facility located on the eastern side of the Inner Harbour operating from two berths. Wollongong Sewage Treatment Plant is located to the north of the coal export facility.

Springhill Road and Masters Roads are the two main vehicular traffic routes connecting Port Kembla to the regional road network including the M1 Princes Motorway. Tom Thumb, Springhill and Masters Roads all carry a high level of heavy vehicle traffic due to their direct link to and from Port Kembla. Tom Thumb Road services the existing port facilities.

The rail network within the port precinct consists of rail lines, sidings and loops. The Port Kembla rail network links to the Illawarra and Moss Vale-Unanderra rail line, managed by the NSW Government and ARTC respectively. The Illawarra Line is a shared passenger and freight rail line.

Table 1-1 Area of project site and study area

Project area	Surface Area (ha)
Project site (berth footprint, pipeline trenching and HDD staging sites)	14.55
Proposed HDD	0
Study area	74.09



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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Australian Industrial Energy
Port Kembla Gas Project
BDAR

Project Site

Project No. **21-27477**
Revision No. **-**
Date **23/10/2018**

FIGURE 1-1

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy; Inset map - Geoscience Australia. Created by: jrprice

1.4 Environmental assessment requirements

The EIS has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) which were provided on 10 August 2018 by the Department of Planning and Environment. Table 1-2 out the biodiversity assessment requirements of the SEARs.

Table 1-2 Secretary's environmental assessment requirements

Category	Secretary's Requirements	Where addressed in the BDAR
Biodiversity	An assessment that includes • the biodiversity values and the likely biodiversity impacts of the project • the impacts on the Green Golden Bell Frog, in accordance with the NSW *Biodiversity Conservation Act 2016*, the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR) • the impacts of the project on aquatic ecology, including impacts on key fish habitat and threatened species of fish;	Section 3 (Landcsape features) and 4 (Native vegetation) Section 5 (Conservation significance) Section 6 (Impact assessment)

1.5 Legislative context

1.5.1 Biodiversity Offset Scheme and Biodiversity Assessment Methodology

The BC Act, together with the *Biodiversity Conservation Regulations 2017*, provides a mechanism to address impacts on biodiversity from land clearing associated with development. Under this legislation, there are provisions for a Biodiversity Offsets Scheme (BOS), which includes a framework to avoid, minimise and offset impacts of development on biodiversity.

The aim of the BOS is to provide a transparent, consistent and scientifically based approach to biodiversity assessment and offsetting. It also allows for the establishment of biodiversity stewardship agreements, which are in-perpetuity agreements entered into by landholders, to secure offset sites and generate biodiversity credits, which can be used to offset impacts of development. The aim of the BOS is to ensure that the impacts of development, clearing or biodiversity certification will result in no net loss of biodiversity.

The Biodiversity Assessment Method (BAM) was established by OEH as a standard method to implement the aims of the BOS and to address the loss of biodiversity and threatened species. The scheme creates a market framework for the conservation of biodiversity values and the offsetting of development impacts. It also provides the mechanisms to offset impacts of development, clearing or biodiversity certification such that there is no loss of biodiversity values.

The BAM sets out how biodiversity values will be assessed, prescribes requirements to avoid and minimise impacts, establishes rules for calculating the number and class of credits required for unavoidable impacts, and determines the trading rules that will apply. The methodology includes a software package known as the Biodiversity Assessment Method Calculator (the credit calculator) which processes site survey and assessment data. The credit calculator specifies the type and extent of surveys required for a biodiversity assessment and then

processes survey data to calculate the number and type of biodiversity credits that are either required at a development site or will be generated at a stewardship site. The BAM must be applied by a person accredited under the BC Act.

The Biodiversity Conservation Trust Fund (BCTF) ensures that landowners have the funds needed to carry out the management actions required each year and provides a financial incentive to landowners to carry out those actions. The scheme is administered by OEH and ensures accountability and compliance through legislation, regular reporting requirements and financial measures. Under certain circumstances a developer may make a payment directly into the BCTF to offset the impacts of a proposed development in lieu of purchasing and retiring biodiversity credits. The BCT must then use funds in the BCTF to purchase and retire appropriate biodiversity credits.

The BOS and BAM have been addressed in accordance with the project SEARs through the preparation of this BDAR by accredited assessors.

1.5.2 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on 'matters of national environmental significance' undergo an assessment and approval process. Under the EPBC Act, an action includes a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Minister for the Environment. MNES relevant to this report include threatened species and ecological communities and migratory species. Note that pelagic species are covered in the Marine Ecology Assessment (GHD 2018a).

The EPBC Act has been considered in this assessment through:

- Desktop review to determine the listed biodiversity matters that are predicted to occur within the locality of the project and hence could occur, subject to the habitats present
- Targeted field surveys for listed threatened biota and migratory species
- Assessment of potential impacts on threatened and migratory biota, including assessments of significance where relevant
- Identification of suitable impact mitigation and environmental management measures for threatened and migratory biota, where required
- Identification of the need or otherwise for biodiversity offsets for impacts on listed biodiversity matters.

1.5.3 Fisheries Management Act 1994

The objects of the FM Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. It provides for the listing of threatened species, populations and ecological communities, listing of 'Key Threatening Processes', and the requirements or otherwise for the preparation of a Species Impact Statement (SIS).

One of the objectives of the FM Act is to 'conserve key fish habitats ' which includes aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. To assist in the protection of key fish habitats, DPI has produced the *Policy and guidelines for fish habitat conservation and management* (2013 update). This policy applies to the following developments, works or activities, each of which can impact on key fish habitat:

- Dredging or reclamation
- Impeding fish passage
- Damaging marine vegetation
- De-snagging.

This report assessed the potential impacts on freshwater fish and freshwater habitats associated with Allans Creek and Gurungaty Waterway. Potential impacts on marine habitats are assessed in the Marine Ecology Assessment (GHD 2018a).

1.6 Purpose of this report

The purpose of this assessment is to describe the biodiversity value of the study area, with particular emphasis on threatened ecological communities, populations and species listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and *Fisheries Management Act 1994* (FM Act), and Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessment has been prepared with reference to the NSW Biodiversity Assessment Method (BAM).

The specific objectives of this biodiversity assessment report are to:

- Outline the methods used in the biodiversity assessment.
- Describe the existing environment of the study area in terms of its biodiversity values, including flora and fauna species, vegetation communities and terrestrial and aquatic habitats.
- Describe the conservation significance of the study area in terms of threatened biota and their habitats and MNES that are known or predicted to occur.
- Provide a description of the project, including potential impacts on biodiversity values.
- Identify measures undertaken to avoid and minimise impact to biodiversity values.
- Present the data used to perform the BAM assessment and credit calculations for the project.
- Calculate the number and type of biodiversity credits using the BAM that would be required to offset impacts of the project.
- Consider impacts on freshwater fish habitat and key fish habitat associated with Allans Creek and Gurungaty Waterway
- Consider impacts on MNES with reference to the EPBC Act Significant Impact Guidelines 1.1 (DotE 2013) to help determine whether any additional assessment, approval or biodiversity offsets would be required under the EPBC Act.

1.7 Assumptions

This report has been prepared based on the project description, maps and plans provided by the proponent. A ‘project site’ polygon (i.e. surface disturbance footprint) was prepared by the proponent for the biodiversity assessment based on these inputs. It is assumed that the description and spatial data accurately represent the extent of direct impacts on terrestrial biodiversity values arising from the project and so these data have been used to calculate the extent of removal of vegetation and habitat arising from the project using GIS.

Potential impacts on the Green and Golden Bell Frog (*Litoria aurea*) have been assessed under 'prescribed biodiversity impacts'. No native vegetation associated with this species would be removed.

Marine mammals and wandering sea birds listed under the BC Act are not covered by the BAM. Threatened biota listed under the *Fisheries Management Act 1994* (FM) and MNES listed under the EPBC AC are also not covered by the BAM. Potential impacts on marine fauna have been assessed separately in the Marine Ecology Assessment (GHD 2018a). This report does however describe the freshwater aquatic habitats present and assess potential impacts on key fish habitat and terrestrial MNES.

2. Methods

2.1 Approach

This BDAR has been prepared to assess the impacts of the project on threatened biota and their habitats. The main components of the methodology for the biodiversity assessment include:

- Desktop assessment to describe the existing environment and landscape features of the study area and to identify the suite of threatened biota potentially affected by the project.
- Field survey in accordance with the BAM to describe the biodiversity values of the project site and surrounding study area and to determine the likelihood of threatened biota and their habitats occurring in the study area or being affected by the project.
- Determining reasonable actions to avoid and minimise impacts to biodiversity values.
- Completing calculations using the credit calculator to quantify the residual biodiversity impacts of the project and to determine the ecosystem and species credits that would need to be purchased and retired to offset these impacts.

2.2 Desktop assessment

2.2.1 Literature and database review

A desktop database review was undertaken to identify threatened flora and fauna species, populations and ecological communities (biota) listed under the BC Act, FM Act, and EPBC Act, that could be expected to occur in the locality, based on previous records, known distribution ranges, and habitats present. These were also used to obtain the necessary site location data to perform BAM calculations. Biodiversity resources pertaining to the study area and locality (i.e. within a 10 km radius of the site) that were reviewed prior to conducting field investigations included:

- The Australian Department of the Environment and Energy (DoEE) Protected Matters Search Tool (PMST), for MNES known or predicted to occur in the locality (DoEE, 2018a).
- DotE online species profiles and threats database (DoE, 2018b.)
- BioNet Atlas (licensed) records of threatened species, populations and communities listed under the BC Act that have been recorded within the locality of the project (OEH, 2018a).
- OEH threatened biota profiles for descriptions of the distribution and habitat requirements of threatened biota (OEH, 2018b).
- The NSW BioNet database to help identify PCTs that occur in the study area as required by the BAM (OEH, 2018c).
- Department of Primary Industries (DPI) freshwater threatened species distribution maps. For distribution of threatened aquatic species that may occur in the locality (DPI, 2018a).
- Groundwater Dependent Ecosystem Atlas (BOM 2018a).
- The *Ecological impact assessment for the Port Kembla Bulk Liquids Terminal* (Ecoplanning 2015).
- The list of candidate species credit-type species produced by the BAM Credit Calculator based on initial site context calculations.

- The *Illawarra escarpment and coastal plain native vegetation mapping* (NPWS 2002).
- Aerial photographs and satellite imagery of the study area and buffer area.

The threatened and migratory species identified in the desktop assessment are presented Appendix A. Following collation of database records and threatened species and community profiles, a 'likelihood of occurrence' assessment was prepared for threatened and migratory species and ecological communities with reference to the broad vegetation types and habitats contained within the study area. This was further refined following field surveys and verification of vegetation types and identification and assessment of habitat present within the study area. A likelihood of occurrence ranking was attributed to these biota based on this information.

2.3 Site survey

2.3.1 Survey effort and timing

Staged surveys of the study area were conducted with reference to the BAM and appropriate threatened species survey guidelines for targeted species. Site surveys included:

- Preliminary site walkover.
- Initial site stratification and vegetation mapping.
- Sampling of a vegetation integrity survey plot.
- Incidental threatened flora surveys.
- Fauna habitat assessment.
- Opportunistic fauna surveys.

Survey effort that has directly contributed to this BDAR is summarised in and is described in detail below.

Table 2-1 Survey effort associated with project impacts

Stage	Date	Survey Technique
Preliminary site walkover	4 July 2018	Fauna habitat assessment Opportunistic fauna sightings
Initial site stratification and vegetation mapping	22 August 2018	Vegetation mapping Fauna habitat assessment Opportunistic fauna sightings
BAM assessment survey	27 September 2018	Vegetation mapping Vegetation integrity survey plot

2.3.1 Vegetation mapping

Vegetation mapping completed by the New South Wales National Parks and Wildlife Service in 2002, and updated by Wollongong City Council in 2014 (NPWS 2002) was ground-truthed in the field via systematic walked transects across the entire study area and by walking the boundary of vegetation units. Necessary adjustments were made by hand on aerial photographs of the study area. The site was divided into relatively homogenous or discrete zones for assessment based on observed vegetation structure, species composition, soil type, landscape position and condition. Native vegetation was identified based on previous mapping and classification undertaken within the Illawarra region (NPWS 2002), investigation of local substrates and analysis of BAM plot data collected during field survey. Native vegetation was divided into vegetation zones which represented a distinct PCT and broad condition state.

2.3.2 Vegetation integrity survey plot

The site value was determined by assessing ten attributes used to assess function, composition and structure of vegetation within a 50 metre X 20 metre plot. These attributes were then assessed against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement (DECC, 2009). Attributes assessed within each plot are listed in Table 2-2. All flora species within a 20 metre X 20 metre quadrat nested within the 50 m X 20 m plot were identified according to the nomenclature of the Royal Botanic Gardens and Domain Trust (2017). Each species identified was allocated a growth form group and designated as either native, exotic or high threat exotic in accordance to the lists provided in the BAM calculator.

A single survey plot was located randomly within a single vegetation zone identified within the project site by walking a random distance into the vegetation zone and then locating the plot on a randomly generated compass bearing.

The plot was purposely not located near ecotones, tracks and their edges or other disturbed areas. The single vegetation zone was surveyed in accordance with the minimum number of plots required by Table 4 in the BAM (OEH 2017d) (refer to Table 2-3).

The location of the survey plots is shown on Figure 4-1.

Table 2-2 Site data collected within each plot

Attribute	Area assessed
Native plant species richness	20 X 20 metre plot
Percentage foliage cover for each species	20 X 20 metre plot
Estimated number of individuals for each species	20 X 20 metre plot
Number of large trees	50 X 20 metre plot
Tree regeneration (presence/absence)	50 X 20 metre plot
Tree stem size class	50 X 20 metre plot
Total length of fallen logs	50 X 20 metre plot
Litter cover	5 times 1 X 1 metre plot
High threat exotic vegetation cover	50 X 20 metre plot
Hollow bearing trees	50 X 20 metre plot

Table 2-3 Minimum plot survey requirements

Vegetation zone	Area (hectares) in impact area	Minimum plot number required	Number of plots surveyed
1. PCT 1326_Moderate-good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)	0.25	1	1 (plot ID 1)

The overall condition of vegetation was assessed through general observation and comparison against the PCT condition benchmark data as well as using parameters such as species diversity, history of disturbance, weed invasion and canopy health.

2.3.3 Groundwater dependent ecosystems

The NSW Groundwater Dependent Ecosystem (GDE) Policy defines GDEs as ecosystems, which have their species composition, and their natural ecological processes determined by

groundwater (DLWC 2002). The Policy defines groundwater as the water beneath the earth's surface that has filtered down to the zone where the earth or rocks are fully saturated (DLWC 2002). Ecosystems vary dramatically in the degree of dependency of groundwater, from having no apparent dependence through to being entirely dependent on it (DLWC 2002).

The Australian Government Atlas of Groundwater Dependent Ecosystems was used to identify any previously mapped GDEs that occur in or near the study area. This atlas identifies GDEs reliant on surface groundwater (rivers, springs and wetlands) and subsurface groundwater (vegetation). The Atlas was reviewed to ascertain whether any GDEs are likely to occur in the study area. A small number of terrestrial GDE's were identified. No acquatic GDE's were identified. All terrestrial GDE's will be avoided through the use of directional drilling under the relevant areas and so no impacts are anticipated.

2.3.4 Terrestrial fauna survey

The BAM identifies two classes of threatened fauna species:

- Predicted, or ecosystem credit species that can be reliably predicted to occur within the subject site based on the site location, PCT(s) present, patch size and other habitat criteria specified in the BAM and the threatened species data administered by OEH.
- Species credit entities, comprising threatened fauna species or specific habitat resources such as occupied breeding habitat that cannot be reliably predicted.

Under the BAM, targeted surveys are not required for ecosystem credit species.

Targeted surveys are required for 'candidate threatened species', comprising those species credit entities that could occur at a project site based on known species distributions and the habitat resources present. Section 6.4 of the BAM notes that a candidate species credit species will be considered unlikely to occur on the subject land if after carrying out a field assessment of the habitat constraints or microhabitats on the subject land, the assessor determines that the habitat is substantially degraded such that the species is unlikely to utilise the subject land (or specific vegetation zones). Given the negligible area of native vegetation at the project site, absence of habitat resources and general lack of connectivity, no targeted surveys for species credit species were conducted other than habitat assessments. Dispersal habitat for the Green and Golden Bell Frog (*Litoria aurea*) was assumed to be present based on recent records of the species in the area (OEH 2018a).

Fauna habitat assessment

Fauna habitat assessments were undertaken throughout the project site, including active searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as water bodies, food trees, the density of understorey vegetation, the composition of ground cover, the soil type, presence of hollow-bearing trees, leaf litter and ground debris were noted.

Habitat assessments included searches for resources of potential value to threatened fauna including:

- Wetlands, ponds drains that could provide habitat for frogs, particularly the Green and Golden Bell Frog.
- Trees with bird nests or other potential fauna roosts (with a particular focus on searching for raptor nests or hollows suitable for owls and large cockatoos).
- Rocky outcrop and ground debris.
- Distinctive scats or latrine sites, owl white wash and regurgitated pellets under roost sites.

- Tracks or animal remains.
- Evidence of activity such as feeding scars, scratches and diggings.
- Specific food trees and evidence of foraging.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. This included a conscious focus on suitable areas of habitat during surveys.

2.4 Survey conditions

The field surveys were undertaken over three days in winter and early spring. Conditions were cool to mild. Weather was overcast in during the July survey, but sunny on the other days. The BAM assessment survey on 27th September was preceded by a moderate amount of rain on the preceding day (18 mm), with below average rainfall prevailing for all of the preceding eight months of the year.

Bureau of Meteorology (BOM) records for the survey date are provided in Table 2-4. These records were taken at the Wollongong weather station (68131) located approximately 12 kilometres from the project site (BOM 2018a).

Table 2-4 Daily weather observations during the survey period

Date	Minimum temp (Deg Celsius)	Max temp (Deg Celsius)	Rainfall (mm)
4/07/2018	11.8	19.5	0
22/08/2018	11.2	15.3	0
27/09/2018	8.1	21.9	0

2.5 Geographical Information System (GIS) analysis

GIS analysis is an integral part of the BAM. GIS was used to:

- Plot the project site on a high resolution aerial photo base and to map survey effort, native vegetation, habitat resources and biodiversity values across the site.
- Confirm the relevant Interim Biogeographic Regionalisation for Australia (IBRA) bioregion, IBRA subregion and Mitchell Landscape for the site.

Additional GIS analysis was used to plot a 500 metre buffer area surrounding the site (as per the 'linear development' rules) in which site context components were calculated. Native vegetation cover, extent and connectivity were assessed using aerial photography (DECCW 2010). Air photo interpretation was used to identify and record distinct vegetation patches, determine the broad condition state of vegetation types and the location and extent of vegetated habitat corridors. The buffer area and GIS area calculations were used to calculate native vegetation cover and patch size.

2.6 BAM calculations

The project was assessed according to the methodology presented in the BAM (OEH, 2017d), and the *Biodiversity Assessment Methods Calculator Users Guide* (OEH 2017e). The credit calculator is a software application that is used to apply the BAM. Data is entered into the credit calculator based on information collected in the desktop assessment, site surveys and from using GIS mapping software.

The BAM credit calculations were performed by Kirsten Crosby and Daniel Whaite using credit calculator version 1.2.5.00.

The data and assumptions used to perform the BAM credit calculations are summarised in Section 5.

2.7 Staff qualifications

This BDAR was prepared by Kirsten Crosby (accredited assessor number BAAS17011) and Daniel Whaite (accredited assessor number BAAS17096) in accordance with the BAM, based on field surveys also completed by Kirsten Crosby, Daniel Whaite and Gary Leonard. A technical review of the report and credit calculations was undertaken by Ben Harrington (accredited assessor number BAAS17023). Staff qualifications are presented in Table 2-5.

Table 2-5 GHD ecology staff and qualifications

Name	Position / Project Role	Qualifications	Relevant Experience
Kirsten Crosby	Senior Ecologist (fauna)	BSc (Zoology), PhD BAM Assessor Accreditation (accredited assessor number BAAS17011)*	13+ years
Daniel Whaite	Senior Ecologist (botany)	BSc, MSc (Restoration Ecology) BAM Assessor Accreditation (accredited assessor number BAAS17096)*	18+ years
Gary Leonard	Botanist/arborist	Dip Hort, Dip Ed International Society of Arboriculture (membership no. 212238), Arboriculture Australia (membership no. 2173)	40+ years
Ben Harrington	Technical director - biodiversity (Technical review)	BSc, MSc (Physical Geography) BAM Assessor Accreditation (accredited assessor number BAAS17023)*	13+ years

*Refer to BCT (2018) list of accredited assessors.

3. Landscape features

The BAM requires the assessment of landscape features to help describe the biodiversity values of the proposed development area and assess the impacts of the project. Landscape features relevant to the BAM calculations are shown on Figure 3-1 are discussed below and summarised in Table 3-2.

3.1 Location and land uses

The study area is located at Port Kembla within land primarily covered by Three Port SEPP and within the Wollongong Local Government Area (LGA) (refer to Figure 1-1).

As described in Section 1.3, the site is highly modified and disturbed, as much of it is located within the existing Port Kembla Coal Terminal, NSW Ports, BlueScope Steelworks and road reserves. A small patch of modified native vegetation occurs in the site west of Springhill Road. Some larger fragmented patches of native vegetation occur east of Springhill Road, however these will be avoided through the use of HDD construction techniques.

3.2 Bioregion and IBRA subregion

The study area occurs mainly within the Illawarra IBRA (Interim Biogeographic Regionalisation for Australia) subregion of the Sydney Basin Bioregion (DSEWPaC 2011) (refer to Figure 3-1). The Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of about 3,624,008 hectares which includes about 4.53 % of NSW. The bioregion extends from north of Batemans Bay to Nelson Bay and West to Mudgee and includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems. The Illawarra subregion includes vegetated cliff faces on coastal escarpments and barrier systems.

3.3 NSW landscape region (Mitchell Landscapes)

The study area is mapped predominantly within the ‘Lake Illawarra Barrier’ Mitchell Landscape. Small portions in the north-west and west of the study area are mapped within the ‘Dapto-Wollongong Coastal Slopes’, ‘Kiama Coastal Slopes’ and ‘Lake Illawarra Alluvial Plains’ (refer to Figure 3-1) (DECC, 2008a). These landscapes are described in Table 3-1 based on information from (DECC 2008b). Based on the native vegetation and geomorphology of the study area. Lake Illawarra Alluvial Plains in the Mitchell Landscape where most of the impacts occur

Table 3-1 Mitchell Landscapes

Mitchell Landscape	Description (DECC 2008b)	Location (DECC 2008a)
Lake Illawarra Barrier	The landscape is substantially altered by urban and industrial development but would originally have a very similar structure and composition to the Seven Mile Barrier Landscape. General elevation 0 to 25m, local relief 5m. Eel grass (*Zostera capricorni*) on the lake floor, common reed (*Phragmites australis*) in fresh swamps and lakes margins, limited grey mangrove (*Avicennia marina*) and saltmarsh near lagoon mouths and in more open estuaries (DECC 2008b). Vegetation of the Seven Mile Barrier Landscape comprises coastal spinifex (*Spinifex hirsutus*), coast tea-tree (*Leptospermum laevigatum*), and coast wattle (*Acacia longifolia* ssp. *sophorae*) dominating a high, steep dune with little soil development. Across the lower, inner ridges a tall forest of blackbutt (*Eucalyptus pilularis*), southern mahogany (*Eucalyptus botryoides*), red bloodwood (*Corymbia gummifera*), old man banksia (*Banksia serrata*) smooth-barked apple (*Angophora costata*) with occasional macrozamia (*Macrozamia* sp.) and thick bracken (*Pteridium esculentum*) cover on soils with characteristic podsol profiles that increase in degree of development inland. The innermost ridge lies adjacent to extensive swamps and wetlands formed on organic rich quartz sands (DECC 2008b).	Port Kembla Coal Terminal, NSW Ports, Bluescope Steel
Dapto-Wollongong Coastal Slopes	Hilly forestland lying between the steep rubble slopes of the escarpment and valley floors or coastal barriers. A narrow landscape lying between the coast and the escarpment. Formed on Permian sandstone and shale with areas of interbedded basalt. Slopes range from 3 to 270 with thin stony soils on crests and upper slopes. Deeper well-structured red and red brown loam and clay loam with some areas of mellow texture-contrast soils of high fertility high and good water holding capacity on mid and lower slopes. Yellow solodic soils with bleached A2 horizons common on the lowest slopes and stream terraces. Open forest dominated by forest red gum (*Eucalyptus tereticornis*), yellow stringybark (*Eucalyptus muelleriana*), gully gum (*Eucalyptus smithii*), stringybark with rainforest elements along streamlines. Extensively cleared, former areas of coastal brush may be indicated by	North-west portion of the study area buffer, including land where native vegetation is present

Mitchell Landscape	Description (DECC 2008b)	Location (DECC 2008a)
	remnant cabbage-tree palms (*Livistona australis*) and Port Jackson figs (*Ficus rubiginosa*) (DECC 2008b).	
Lake Illawarra Alluvial Plains	Quaternary sand, silt and clay of the floodplain and alluvial fans of streams entering Lake Illawarra. General elevation 0 to 40m, local relief <10m. Soils differ with sediment type but are generally uniform sandy loam with high organic content, and humic podsols on some older dunes. Most of the plains are cleared but originally had forest red gum (*Eucalyptus tereticornis*), woollybutt (*Eucalyptus longifolia*), white stringybark (*Eucalyptus globoidea*), thin-leaved stringybark (*Eucalyptus eugenioides*), cabbage gum (*Eucalyptus amplifolia*) and extensive stands of swamp oak (*Casuarina glauca*), prickly paperbark (*Melaleuca styphelioides*) and decorative paperbark (*Melaleuca* sp.) on brackish wet ground near creeks. River oak (*Casuarina cunninhammiana*) on fresh water streams (DECC 2008b).	Western portion of the study area buffer, west of Springhill Road
Kiama Coastal Slopes	Comparable to the Dapto-Wollongong slopes but with higher relief, steep slopes and higher rainfall. Maximum elevation 250m, relief 160m. Well-structured red-brown loam with gradational profiles is widespread on the Gerringong volcanics of trachyte, latite and tuff. Sandstone is less common but tends to form steep slopes with texture-contrast soils marginal to the adjacent escarpment (DECC 2008b). Extensively cleared but originally had a wide distribution of rainforest elements; cabbage palm (*Livistona australis*), scentless rosewood (*Synoum glandulosum*), brush cherry (*Syzygium australe*), black apple (*Planchonella australis*), plum pine (*Podocarpus elatus*) amongst turpentine (*Syncarpia glomulifera*) and grey ironbark (*Eucalyptus paniculata*). River oak (*Casuarina cunninghamiana*) along the streams (DECC 2008b).	South-western portion of the study area buffer, near Five Islands Road

3.4 Climate

The site has a temperate climate. Based on data from the Port Kembla weather station the site has a mean annual rainfall of 1260.6 mm, with the highest rainfall tending to occur in February and March. The mean daily maximum temperature is 21.0 degrees Celcius and mean daily minimum temperature is 14.4 degrees Celsius (BOM, 2018b).

3.5 Soils and geology

3.5.1 Soil landscapes

The project is located entirely within lands identified as Disturbed Terrain, within which soils have been removed, greatly disturbed or buried. Landfill in areas of Disturbed Terrain may include soil, rock, building and waste material (Hazelton and Tille 1990).

Vegetated areas on BlueScope-owned land to the north of the steelworks and west of Springhill Road comprise revegetation upon substrates of dumped and formed steel slag (GHD 2018b).

3.5.2 Soil hazards

Port Kembla has a long history of industrial use, including land reclamation and filling, which has resulted in legacy contamination both within the land footprint and offshore areas. In addition to soil and sediment contamination, leaching of contamination from overlying fill materials and migration from up-gradient industrial sources, has resulted in contamination impact to groundwater beneath Port Kembla (GHD 2018b).

Inner Harbour seabed materials comprise soft silty clay. Previous investigations have identified the presence of contaminated sediments including heavy metals, tributyltin (TBT) and polycyclic aromatic hydrocarbons (PAH) at concentrations above the nominated sediment quality guidelines (GHD 2018b). Estuarine sediments within the harbour are mapped as high probability of being acid sulphate soils (GHD 2018c).

3.5.3 Areas of geological significance

There are no karst, caves, crevices, cliffs or other areas of geological significance located within the study area or buffer area surrounding the site.

3.6 Hydrology and key fish habitat

The project is located at Port Kembla south of Wollongong. The pipeline would run from a berth in the Inner Harbour (previously Tom Thumb Lagoon), where existing water quality has been impacted by historical and ongoing port operations. The pipeline would cross Gurungaty Waterway in the north-east and Allans Creek in the south. Both waterways flow through highly disturbed land, however the Allans Creek catchment includes natural areas of the Illawarra Escarpment. Allans Creek, Gurungaty Waterway and the Inner Harbour are mapped as key fish habitat by DPI (2007).

3.7 Wetlands

There are no Coastal Management SEPP wetlands or proximity area, nationally important wetlands or internationally important wetlands within the site or the buffer area. A small swamp is located between the rail corridor and Springhill Road in the ‘horse paddock’, located to the east of the project. Swamps are also located near Allans Creek further to the south. Various constructed sediment ponds are located around the Port Kembla Coal Terminal, Graincorp Terminal and Bluescope Steelworks. The Inner Harbour was previously Tom Thumb Lagoon, however much of the lagoon has been reclaimed for industrial use.

The Port Kembla Key Population of the Green and Golden Bell Frog occurs in the area and consists of four main sub-populations at wetlands in the following locations:

- North Port Kembla
- Boiler's Point
- Coomaditchy Lagoon
- Korrongulla Wetland (DEC 2007).

Green and Golden Bell Frogs have also been found in unnatural habitats in the area including detention ponds and residential ponds (DEC 2007).

3.8 Native vegetation extent and connectivity features

Within the 500 metre buffer area surrounding the centre line of the linear project site native vegetation comprises approximately 5.7 percent of the area. There is minimal connectivity with other areas of native vegetation due to the highly urbanised land surround the project site.

The project crosses two creeks (Allans Creek and Gurungaty Waterway) that flow into the Inner Harbour of Port Kembla.

3.9 Non-native vegetation

Vegetation throughout the majority of the project site has been classified as non-native vegetation (see Figure 4-1). Non-native vegetation at the project site comprises mixed landscape plantings of native and non-native over-storey, over mown groundcover dominated by exotic plant species. No naturally regenerating canopy species, hollow-bearing trees, nor fallen woody debris occur within areas of non-native vegetation.

Typically, native over-storey plantings comprise *Casuarina glauca* (Swamp Oak), *Eucalyptus tereticornis* (Forest Red Gum), *E. botryoides* (Bangalay), *Melaleuca linariifolia* (Flax-leaved Paperbark), *M. styphelioides* (Prickly-leaved Tea Tree), and two species not endemic to the region - *Ficus microcarpa* var. *hillii* (Hill's Weeping Fig – Queensland) and *Lophostemon confertus* (Brushbox – northern New South Wales / Queensland).

Exotic over-storey planting within the project site include *Harpephyllum caffrum* (Kaffir Plum), *Schinus molle* var. *areira* (Peppercorn tree), *Jacaranda mimosifolia* (Jacaranda), *Triadica sebifera* (Chinese Tallowwood), *Gleditsia triacanthos* (Honey Locust Bean), *Erythrina* x *sykesii* (Indian Coral Tree), *Cinnamomum camphora* (Camphor Laurel) and *Lagunaria patersonii* (Norfolk Island Hibiscus). A range of other planted over- and mid-storey species are also scattered throughout the project site as well as numerous invasive woody weed species (see Appendix B).

Common species within mown and predominantly exotic understorey include *Axonopus fissifolius* (Narrow-leaved Carpet Grass), *Bromus catharticus* (Prairie Grass), *Chloris gayana* (Rhodes Grass), *Cynodon dactylon* (Couch), *Ehrharta erecta* (Panic Veldtgrass), *Pennisetum clandestinum* (Kikuyu), *Paspalum dilatatum* (Paspalum) and *Sporobolus africanus* (Parramatta Grass). Isolated small patches of naturally established native grasses occur within the north of the project site, including *Bothriochloa decipiens* (Pitted Bluegrass), *Chloris truncata* (Windmill grass) and *Microlaena stipoides* (Weeping Grass).

Vegetation within the above-described areas is classified as 'non-native' because it is predominately composed of exotic plant species cover, provides limited habitat resources for native fauna, does not form a functioning or potentially self-sustaining ecosystem. No natural regeneration of overstorey species was observed and minimal recruitment of native undertsorey plants. These areas are managed as open recreational and operational land including through

period slashing, which would further limit any potential for the establishment of a functional native plant community. With the exception of an area of remnant woodland to the north of the western alignment, which will be under-bored and thus not impacted by the project, the Wollongong City Council 2014 update of NPWS (2002) native vegetation mapping classifies vegetation throughout the study area as 'Disturbed landscapes' – 'Weeds and Exotics', 'Cleared lands' or 'Modified lands'.

Indicative images of non-native vegetation within the project site are shown in Plate 1.

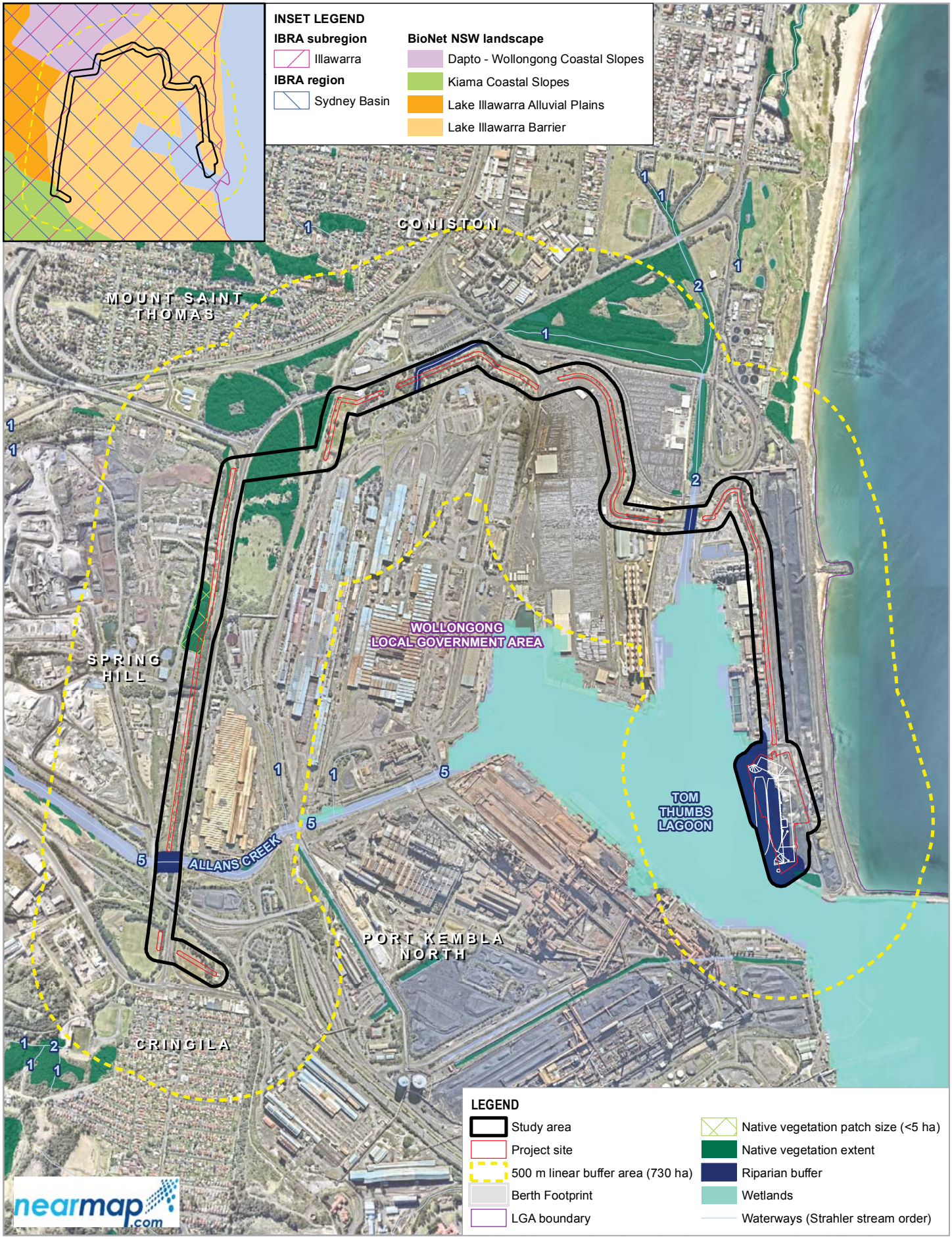
Plate 1 Non-native vegetation

3.10 Summary

A summary of landscape features is provided in Table 3-2.

Table 3-2 Summary of landscape features present within the study area

Landscape feature	Study area
Method applied for site context components	Linear development
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	Sydney Basin.
IBRA subregion	Illawarra
Mitchell landscapes	Lake Illawarra Alluvial Plains
% native vegetation extent within buffer area	5.7 percent.
Rivers, streams and estuaries	The project crosses two creeks (Allans Creek and Gurungaty Waterway) that flow into the Inner Harbour of Port Kembla.
Wetlands	None.
Connectivity features	The study area is located with the industrial complex at Port Kembla Harbour. It is surrounded by urban development of Wollongong and Port Kembla. There is minimal connectivity with large areas of native vegetation.
Areas of geological significance or soil hazard features	Soil landscapes for the study area and surrounding buffer area are highly modified, and are subject to contamination from various sources.
Other landscape features	Nil.



Paper Size ISO A4

0 400 800

Metres

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

N

GHD

Australian Industrial Energy
Port Kembla Gas Project
BDAR

Project No. **21-27477**
Revision No. **-**
Date **23/10/2018**

Site Location

FIGURE 3-1

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018 & 19/07/2018, date extracted 01/08/2018 & 12/10/2018) & sixmaps 2018 ; General topo - NSW LPI DTDB 2017, 2015 & 2015; IBRA, IBRA subregion, BioNet NSW Landscapes, wetlands, vegetation - OEH; Berth footprint - Australian Industrial Energy. Created by: jrprice

4. Native vegetation and habitat

4.1 Native vegetation cover

A total of 41.30 ha of native vegetation occurs within the 729.53 ha landscape buffer area (comprising 5.7% of the landscape buffer area).

A total of 0.25 ha of native vegetation occurs within the 14.55 ha project site (based on a 16 m wide construction corridor). This comprises 0.02% of the project site, and is entirely associated with a single, discrete patch of a single PCT (see Section 4.3 below). Native vegetation within the project site forms part of an approximately 2 ha patch.

4.2 Flora species

A total of 26 flora species from 18 families were recorded within native vegetation at the project site, comprising 13 native and 13 exotic species. The Asteraceae (daisies, 5 species, 1 native) and Poaceae (grasses, 4 species, 3 native) were the most diverse families recorded. A full list of flora species recorded within native vegetation is provided in Appendix B. Common species recorded are discussed below in relation to the vegetation zones occurring within the project site.

4.3 Native vegetation zones

Native vegetation and original substrates have been almost entirely removed from the study area, with no remnant native vegetation or natural substrates occurring within the project site.

Pre-European native vegetation within the study area is likely to have intergraded outwards from Tom Thumb lagoon, comprising Estuarine saltmarsh (PCT 1126) along intertidal lagoon shallows, grading to Coastal freshwater swamp forest (PCT 1232) fringing the lagoon edges. The coastal peninsular to the east of the study area is likely to have comprised Coastal foredune wattle scrub (PCT 772) along coastal foredunes, grading to Bangalay – Old-man Banksia open forest (PCT 659) inland. Inland flats is likely to have comprised Woollybutt – White Stringybark – Forest Red Gum grassy woodland (PCT 1326) with Forest Red Gum – Thin-leaved Stringybark grassy woodland (PCT) occurring on adjoining higher land (NPWS 2002). A small patch of Blackbutt – Turpentine – Bangalay moist open forest (PCT 694) / Woollybutt – White Stringybark – Forest Red Gum grassy woodland (PCT 1326) occurs within the north-west of the study area (NPWS 2002) (see Figure 4-1).

Field surveys confirmed the presence of a single patch of native vegetation, comprising a small area of dense revegetation on modified/cleared lands at the approximate mid-point of the western alignment, within the project site (see Figure 4-1). The vegetation is composed of a native canopy monoculture with a small number of bird-dispersed native species regenerating in the understorey, amongst dense exotic species cover. The patch of native vegetation has been assigned to a PCT based on the classification of surrounding remnant vegetation (NPWS 2002), and likely substrates and landscape position in the area prior to their excavation and redevelopment (see Table 4-1).

The closest matching candidate PCT that can be applied to the area of planted native vegetation may in appropriate condition states and landscape positions comprise an occurrence of a TEC (see Section 5.2.3).However, it should be noted that the vegetation zone at the project site does not comprise an occurrence of this threatened ecological community. This assessment is based primarily upon the absence of appropriate substrates, characteristic tree species and woodland structure. This is reflected in the BAM credit calculator where the single PCT entered is designated as ‘Not a TEC’ under the ‘Associated TEC’ field.

The vegetation zone at the project site is summarised in Table 4-1 . Species lists and plot data, including benchmark values for this PCT are provided in Appendix B.

Table 4-1 The vegetation zone in the project site

Zone no.	Vegetation zone	PCT ID[1]	PCT Common Name	Condition	Patch size (ha)	Area (ha)	VIS[2]	Conservation significance
1	1326_Moderate-good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)	1326	Woollybutt – White Stringybark – Forest Red Gum grassy woodland on coastal lowlands	Moderate-good	2	0.25	18.2	Does not comprise an occurrence of any listed TEC
Total area						**0.25**		

Notes: 1) the closest matching PCT has been assigned to planted native vegetation within cleared and modified lands

2) VIS = vegetation integrity score

Zone 1 – 1326_Moderate-Good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)	
PCT Common Name (OEH 2018b)	Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion
PCT Scientific Name (OEH 2018b)	*Eucalyptus globoidea , Eucalyptus longifolia , Eucalyptus tereticornis , Corymbia maculata / Glycine clandestina , Glycine tabacina , Leucopogon juniperinus , Melaleuca decora / Cheilanthes sieberi subsp. sieberi , Cymbopogon refractus , Dianella longifolia , Dichondra repens*
PCT ID	1326
Photo	 Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands at Plot 1
Survey effort	Plot 1

Zone 1 – 1326_Moderate-Good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)	
Conservation significance	Does not comprise an occurrence of any threatened ecological community under State or Commonwealth legislation. The closest matching PCT has been assigned to native vegetation within cleared and modified lands.
Patch size	2 ha (patch size class: <5 ha)
Vegetation Integrity Score	18.2
Condition	Moderate-good Vegetation zone comprises a weed infested semi-mature planted monoculture of native over-storey plants. A small number of bird-dispersed native species are beginning to establish within the revegetation area. Native species richness is very low, and substantially below the benchmark of the PCT assigned to this patch of native vegetation. Similarly, native species cover is zero or near-zero for all vegetation strata within the exception of tree cover, which is 35%. Litter cover is very high throughout the vegetation zone. Age distribution is uniform throughout the revegetation stand with the most mature trees at 10-20 cm DBH. Smaller suckering stems, as well as some germinating individuals, are also present. No fallen logs of >10 cm diameter are present.
Landscape position	Occurs on an artificially elevated landscape position, upon formed steel slag substrates on inland coast flats.
Structure	Closed low forest
Over-storey	Formed by a monoculture of planted Swamp Oak (*Casuarina glauca*).
Mid-storey	Native mid-storey cover absent.
Groundcover	Very sparse cover of bird-dispersed species amongst high cover of Casuarina needles. Species include *Cayratia clematidea* (Native Grape), *Eustrephus latifolius* (Wombat Berry) and *Pandorea pandorana* (Wonga Wonga Vine).
Exotic species	Mid-storey cover within the zone is dominated by the High Threat Exotic (HTE) species *Lantana camara* (Lantana). Additional HTE within the zone include *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Pennisetum clandestinum* (Kikuyu). *Morus alba* (White Mulberry) is also present in the zone.

4.4 Additional vegetation within the study area

An additional small area of native vegetation, comprising natural regeneration in a man-made drain was also recorded within the study area to the north of the western portion of the pipeline alignment. Native vegetation within the man-made drain is most closely aligned with PCT 1071 *Phragmites australis* & *Typha orientalis* on coastal freshwater wetlands, although native vegetation within the study area does not comprise an occurrence of a listed threatened ecological community. The project will not directly impact this vegetation (see Figure 4-1).

Paper Size ISO A4

0 100 200

Metres

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

N

GHD

Australian Industrial Energy
Port Kembla Gas Project
BDAR

Project No. **21-27477**
Revision No. **-**
Date **23/10/2018**

Vegetation and Habitat Resources

FIGURE 4-1a

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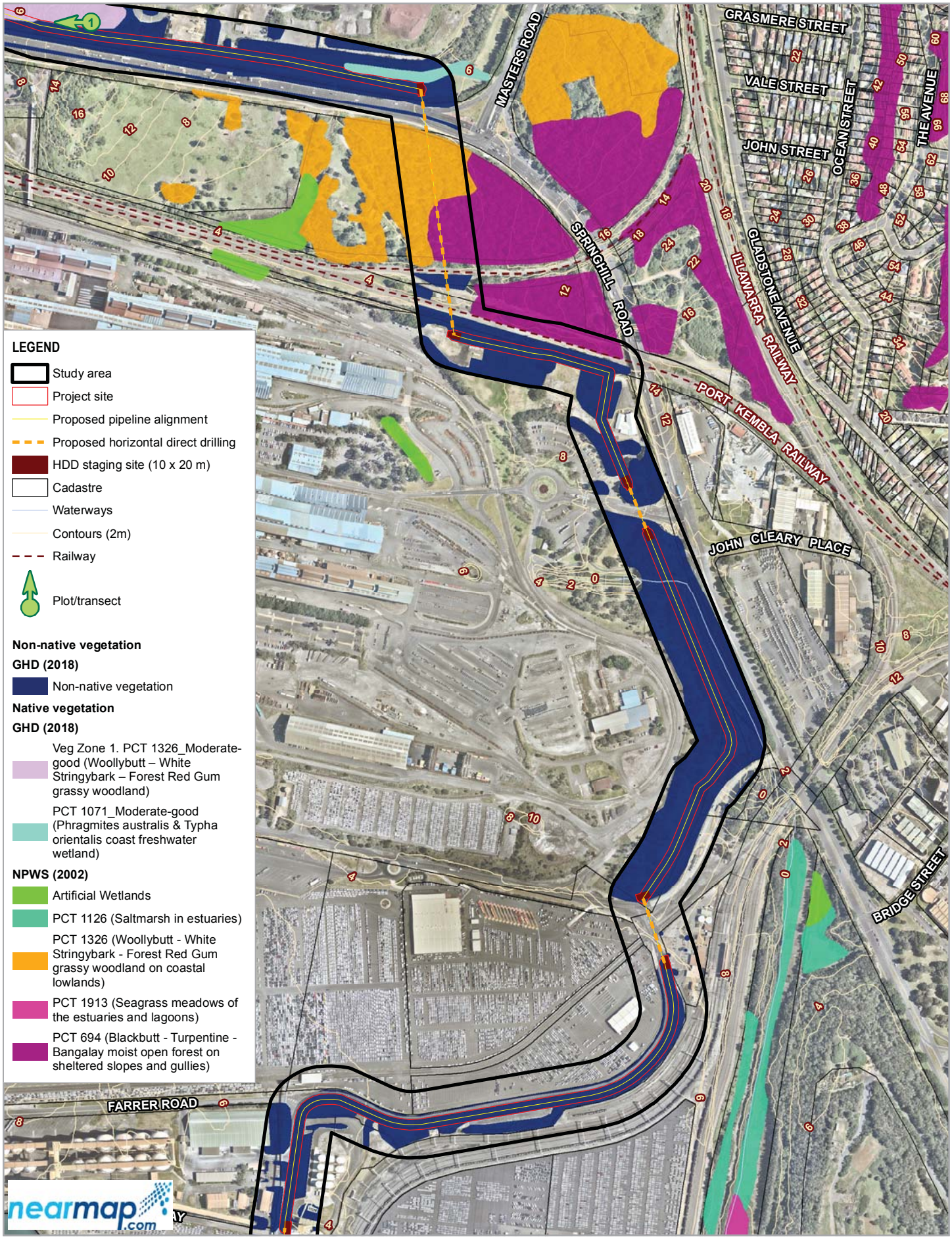
Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018 & 19/07/2018, date extracted 01/08/2018 & 12/10/2018) & sixmaps 2018 (); General topo - NSW LPI DTDB 2017, 2015 & 2015; Vegetation mapping - GHD & OEH (NPWS 2002, edited by WCC 2014); Berth footprint - Australian Industrial Energy. Created by: jrprice



LEGEND

- Study area
- Project site
- Proposed pipeline alignment
- Proposed horizontal direct drilling
- HDD staging site (10 x 20 m)
- Cadastre
- Waterways
- Contours (2m)
- Railway
- Plot/transect

Non-native vegetation

GHD (2018)

- Non-native 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)

NPWS (2002)

- Artificial Wetlands
- PCT 1126 (Saltmarsh in estuaries)
- PCT 1326 (Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands)
- 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

0 100 200

Metres

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

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GHD

Australian Industrial Energy
Port Kembla Gas Project
BDAR

Project No. **21-27477**
Revision No. **-**
Date **23/10/2018**

Vegetation and Habitat Resources

FIGURE 4-1b

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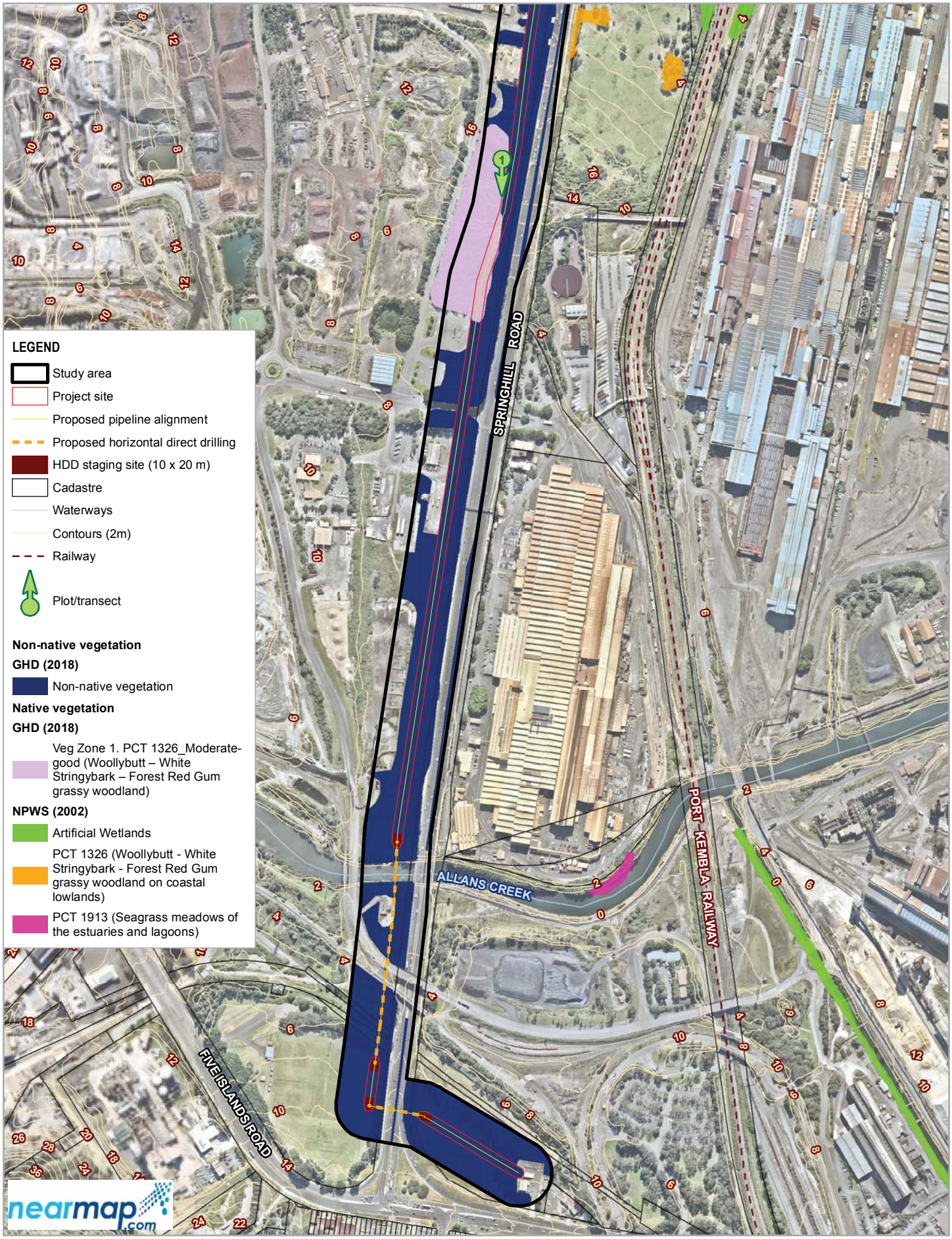
Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018 & 19/07/2018, date extracted 01/08/2018 & 12/10/2018) & sixmaps 2018 (); General topo - NSW LPI DTDB 2017, 2015 & 2015; Vegetation mapping - GHD & OEH (NPWS 2002, edited by WCC 2014); Berth footprint - Australian Industrial Energy. Created by: jrprice



LEGEND

- Study area
- Project site
- Proposed pipeline alignment
- Proposed horizontal direct drilling
- HDD staging site (10 x 20 m)
- Cadastre
- Waterways
- Contours (2m)
- Railway
- Plot/transect

Non-native vegetation

GHD (2018)

- Non-native vegetation

Native vegetation

GHD (2018)

- Veg Zone 1. PCT 1326_Moderate-good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)

NPWS (2002)

- Artificial Wetlands
- PCT 1326 (Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands)
- PCT 1913 (Seagrass meadows of the estuaries and lagoons)

Paper Size ISO A4

0 100 200

Metres

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

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GHD

Australian Industrial Energy
Port Kembla Gas Project
BDAR

Project No. **21-27477**
Revision No. **-**
Date **23/10/2018**

Vegetation and Habitat Resources

FIGURE 4-1c

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018 & 19/07/2018, date extracted 01/08/2018 & 12/10/2018) & sixmaps 2018 (); General topo - NSW LPI DTDB 2017, 2015 & 2015; Vegetation mapping - GHD & OEH (NPWS 2002, edited by WCC 2014); Berth footprint - Australian Industrial Energy. Created by: jrprice

4.5 Groundwater dependent ecosystems

The Groundwater Dependent Ecosystems Atlas (BOM 2018c) maps a number of potential terrestrial GDEs in the study area. These are outlined in Table 4-2. No aquatic GDEs are mapped in the study area.

Table 4-2 Potential Groundwater Dependent Ecosystems in the study area

Type of GDE	Location
Low potential GDE	The majority of Gurungaty Waterway and Allans Creek (to be underbored by the project)
Moderate potential GDE	Small vegetated areas along Gurungaty Waterway and Allans Creek (to be underbored by the project) Areas of native vegetation present at the northern end of Springhill Road (to be underbored by the project)
High potential GDE	Areas of native vegetation present at the northern end of Springhill Road (to be underbored by the project)

4.6 Habitat resources

4.6.1 Introduction

The following specific geographic and habitat features were identified within the project site and indicate the potential presence of threatened species that could contribute to the credit calculations:

- Semi-permanent/ephemeral wet areas.
- Land within one kilometre of wet areas/swamps.
- Land containing swamps.
- Swamp margins or creek edges.
- Land within 500 meters of swamps.

4.6.2 Fauna species

Field survey identified 25 fauna species in the project area and surrounds, comprising 23 bird species, one mammal species and one frog species (Appendix B). No threatened or migratory species were recorded.

4.6.3 Fauna habitats in the study area associated with native vegetation

Habitats for fauna associated with native vegetation are limited in the study area due to the history of industrial development at the site. A small patch of planted native vegetation dominated by Swamp Oak is located west of Springhill Road. A small drain with emergent vegetation is also located adjacent to Springhill Road. These are described below.

Table 4-3 Fauna habitats: Swamp oak revegetation

Swamp Oak revegetation	
Description	This area comprises a weed infested semi-mature, planted monoculture of Swamp Oak. A small number of bird-dispersed native species are beginning to establish within the revegetation area. No hollow-bearing trees are present.
Typical fauna species recorded	A small number of nectarivorous bird species were observed foraging within the planted trees and shrubs including the White-plumed Honeyeater (*Lichenostomus penicillatus*), Rainbow Lorikeet (*Trichoglossus haematodus*) and Red Wattlebird (*Anthochaera carunculata*). Insectivores including the Noisy Miner (*Manorina melanocephala*), Willie Wagtail (*Rhipidura leucophrys*) and Australian Magpie (*Cracticus tibicen*) were also observed.
Threatened fauna species recorded or likely to occur	No threatened species are likely to depend on the habitats present in this vegetation. Mobile threatened species such as woodland birds and microchiropteran bats may forage in these habitats on occasion while moving between better quality areas of habitat.
Migratory fauna species recorded	No migratory species are likely to depend on this habitat type. Species such as the Rufous Fantail or Satin Flycatcher could occur transiently while moving between better quality areas of habitat.
	

Table 4-4 Fauna habitats: Typha wetland

Typha wetland	
Description	There is a narrow drain with emergent, naturally regenerating Typha orientalis vegetation located near the intersection of Springhill Road and Masters Road. It runs alongside a mown lawn associated with the electricity easement and has high levels of weeds present. No large areas of open water are present.
Typical fauna species recorded	This drain is likely to provide habitat for common frog species such as the Common Eastern Froglet (Crinia signifera)
Threatened fauna species	This drain may provide habitat for the Green and Golden Bell Frog. Given its small size and location adjacent to a busy road, it is more likely to be used transiently as foraging or basking habitat by individuals moving between areas of better quality habitat. Given the absence of open water and nearby shelter, breeding is highly unlikely at this location.
Migratory fauna species	Migratory waders are unlikely to utilise this habitat frequently or for extended periods.
	

4.6.4 Habitat associated with non-native vegetation

Potential fauna habitats at the study area predominantly comprise areas of planted vegetation, mown lawns and areas of weeds. Constructed habitat features comprise sediment ponds.

Table 4-5 Fauna habitats: Planted trees and shrubs

Planted trees and shrubs	
Description	Planted trees and shrubs occur within parts of the study area. These include narrow linear plantings alongside the access road to the berth, planted trees in the northern portion of BlueScope Steel land, and planted figs along Springhill Road. No hollow-bearing trees were observed in this habitat type, although some small hollows may occur. Planted *Eucalyptus* and *Ficus* species provide foraging and shelter resources for a range of birds and mammalsof urban environments that are tolerant of regular disturbance from traffic and noise impacts. Foraging resources include seasonal nectar resources, seeds and insects. Woody debris is generally absent from this broad habitat type, however some leaf litter is present where canopy species are present. Fallen timber and leaf litter provides shelter substrate for small reptiles, snakes and small mammals.
Typical fauna species recorded	A small number of nectarivorous bird species were observed foraging within the planted trees and shrubs and included the White-plumed Honeyeater, Rainbow Lorikeet and Little Wattlebird. Insectivores including the Noisy Miner, Willie Wagtail and Australian Magpie were also observed.
Threatened fauna species recorded or likely to occur	The Grey-headed Flying-fox (*Pteropus poliocephalus*) is likely to forage in large Ficus individuals adjacent to Springhill Road and in planted eucalypts. No breeding camps are present. Other mobile threatened fauna such as woodland birds or microchiropteran bats could occur on occasion in this habitat type, but would not depend on the habitat for their survival in the locality.
Migratory fauna species recorded	No migratory species are likely to depend on this habitat type. Species such as the Rufous Fantail or Satin Flycatcher could occur transiently while moving between better areas of habitat.
Introduced species	Spotted Turtle-dove (*Streptopelia chinensis*)
Planted trees within Bluescope Steel land	

Table 4-6 Fauna habitats: Exotic scrub

Exotic scrub	
Description	Exotic scrub is present along the rail corridor. Exotic scrub is dominated by dense midstorey vegetation of variable structural complexity and include Lantana. These areas were once cleared, but have not been regularly maintained and have since become overgrown. Exotic scrub within the study area provide potential foraging habitat for a range of common bird and mammal species. Exotic scrub also provides good refuge habitat for many small insectivorous and nectarivorous birds.
Typical fauna species recorded	Small birds such as the Red-browed Finch (*Neochmia temporalis*), Superb Fairy-wren (*Malurus suberbus*) and New Holland Honeyeater (*Phylidonyris novaehollandiae*) were observed foraging within this habitat type. Native mammals including the Common Ring-tailed Possum (*Pseudocheirus peregrinus*) and small introduced mammals such as Black Rats (*Rattus rattus*) may den and forage in the dense midstorey of exotic scrub, although none were recorded.
Threatened fauna species	Exotic scrub is unlikely to provide suitable habitat for threatened fauna species.
Migratory fauna species recorded	No migratory species are likely to depend on this habitat type. Species such as the Rufous Fantail or Satin Flycatcher could occur transiently while moving between better quality areas of habitat.
Introduced species recorded	Common Myna (*Sturnus tristis*) Red-whiskered Bulbul (*Pycnonotus jocosus*)
Exotic scrub within the rail corridor	

Table 4-7 Fauna habitats: Exotic grassland

Exotic grassland	
Description	Exotic grassland is present within parts of Bluescope Steel and along Springhill Road and the rail corridor. Exotic grassland is interspersed with ballast, bare ground and other artificial substrate. These areas would have historically supported native vegetation but have been extensively modified by previous clearing and land reclamation. These areas are devoid of shrubs and trees. Exotic grassland contains few habitat resources of relevance to most native species due to its low structural and floristic diversity. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna species.
Typical fauna species recorded	Bird species commonly recorded in this habitat type include the Crested Pigeon (*Ocyphaps lophotes*), Welcome Swallow (*Hirundo neoxena*), Magpie-lark (*Grallina cyanoleuca*), and Willie Wagtail. These species are insectivorous and were observed foraging within mown portions of the grassland. Small, common lizards such as the Dark-flecked Garden Sunskink *(Lampropholis delicata*) are likely to occur in this habitat type, particularly in areas where shelter such as ballast or woody debris is present.
Threatened fauna species	No threatened species are likely to rely on this habitat. Microchiropteran bats such as the Eastern Bentwing Bat may forage above the grassland on occasion. There is potential for the Green and Golden Bell Frog to occur in these areas on rare occasions when moving between areas of better quality habitat.
Migratory fauna	No migratory fauna are likely to occur in these areas.
Introduced species	Spotted Turtle Dove
Mown lawns within Bluescope Steel land	

Table 4-8 Fauna habitats: hardstand and sediment ponds

Hardstand and sediment ponds	
Description	Areas of hardstand (roads, pavements, and berths) and constructed sediment ponds are located throughout the coal terminal and Bluescope Steel land. These areas provide limited habitat for fauna species.
Typical fauna species recorded	A tern (*Sternula sp.*) was observed resting on the edge of the berth. The Australian Raven (*Corvus coronoides*) was also observed foraging on the ground.
Threatened fauna species	Hardstand areas and artificial sediment ponds provided minimal habitat for threatened species. The Green and Golden Bell Frog has, however, been recorded in these habitats in the study area previously and this species is known to occur in highly disturbed environments including those with moderate surface water contamination. It is likely that the species would only use these habitats temporarily while moving between areas of better condition habitat.
Migratory fauna species	No migratory waders are likely to utilise artificial sediment ponds within the study area except on rare occasions.
Introduced species recorded	Rock Dove (*Columba livia*)
	

4.6.5 Connectivity

Native vegetation in the study area and surrounding buffer area is extensively fragmented by clearing for industrial development (see Figure 3-1 and Section 3.8). Limited connectivity for fauna movement is present in the study area. The main fauna corridor is located along Springhill Road, where planted trees provide habitat for birds. Areas of weedy vegetation are also present along the rail corridor and would provide habitat for birds, small mammals, reptiles and frogs.

Movement habitat of the key population of the Green and Golden Bell Frog at Port Kembla 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). This species may on occasion use disturbed habitats in the study area to move between other areas of habitat.

4.7 Aquatic habitat

Two highly disturbed aquatic habitats are present. These are described below.

Table 4-9 Fauna habitats: Aquatic habitat

Aquatic habitat	
Description	Allans Creek and Gurungaty Waterway are crossed by the pipeline alignment. The pipeline would be underbored beneath both creeks. Allans Creek, Gurungaty Waterway and the Inner Harbour are mapped as key fish habitat by DPI (2007). Allans Creek has modified banks along much of the reach within the study area. A number of pipelines are located alongside the creek. The creek is also crossed by various bridges. Limited riparian vegetation is present. A number of planted figs are located on the banks near Springhill Road. No emergent vegetation was observed. Gurungaty Waterway is also highly modified due to its location in an industrial area. It is crossed by various roads and rail lines before entering the Inner Harbour. It contains areas of saltmarsh and mangroves, which comprise 'marine vegetation' under the FM Act. These occur upstream of the project site and would not be directly impacted by the project.
Typical fauna species	Given their estuarine nature, a number of saltwater fish species are likely to occur in these creeks. Further detail is provided in the marine ecology report (GHD 2018).
Threatened species	Allans Creek and Gurungaty Waterway are unlikely to provide habitat for any threatened freshwater fish species (DPI 2018a).
Migratory fauna species	Migratory waders may occur on occasions along small areas of mudflats on Gurungaty Waterway and the remnant of Tom Thumb Lagoon.
Allans Creek within Bluescope Steel land	

Aquatic habitat	
Gurungaty Waterway upstream of the proposal site	

5. Conservation significance

5.1 Identification of threatened species under the BAM

5.1.1 Predicted threatened species

Based on the vegetation types and habitat resources present within the site, the BAM calculator generates a list of threatened fauna species that are predicted to utilise the study area. The list was refined based on the habitat assessment and field surveys conducted (see Appendix A). The suite of threatened species associated with ecosystem credits required for the study area are listed in Table 5-1. For each predicted threatened species, a sensitivity class rating and vegetation zones they are predicted to be associated with are also provided. The BAM does not require targeted surveys for predicted threatened species.

Table 5-1 Habitat for predicted threatened species

Common Name	Scientific Name	BC Act	EPBC Act	Sensitivity class1	Habitat present
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V		High	Yes – likely to forage above the project site site
Eastern Freetail-bat	*Mormopterus norfolkensis*	V		High	Yes – may forage on occasion at the project site
Flame Robin	*Petroica phoenicea*	V		Moderate	Yes – may forage on site on occasion
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V		Moderate	Yes – may forage on site on occasion
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V		High	Yes – may forage on site on occasion
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	High	Yes – may forage on occasion at the project site
Little Bentwing-bat	*Miniopterus australis*	V		High	Yes – may forage on occasion at the project site
Little Eagle	*Hieraaetus morphnoides*	V		Moderate	Yes – may forage on site on occasion
Little Lorikeet	*Glossopsitta pusilla*	V		High	Yes – may forage on site on occasion
Masked Owl	*Tyto novaehollandiae*	V		High	Yes – may forage on site on occasion
Powerful Owl	*Ninox strenua*	V		High	Yes – may forage on site on occasion

Common Name	Scientific Name	BC Act	EPBC Act	Sensitivity class1	Habitat present
Scarlet Robin	*Petroica boodang*	V		Moderate	Yes – may forage on site on occasion
Square-tailed Kite	*Lophoictinia isura*	V		Moderate	Yes – may forage on site on occasion
Varied Sittella	*Daphoenositta chrysoptera*	V		Moderate	Yes – may forage on site on occasion
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V		High	Yes – may forage on occasion at the project site

Key: V – vulnerable

5.1.2 Species credit species

Threatened species that cannot reliably be predicted to occur on a development site based on PCT, distribution and habitat criteria are identified by the Threatened Biodiversity Data Collection as 'species credit species'. In some circumstances, the particular habitat components of species assessed for ecosystem credit species, such as the breeding habitat of a cave roosting bat or forest owls, are also assessed for species credits. The credit calculator references geographic, vegetation and habitat data for the project footprint to generate a list of the species credit-type threatened species predicted to occur and requiring targeted survey. Searches of threatened species databases were also completed to determine any additional species to those generated by the credit calculator that are known or predicted to occur in the locality (refer to likelihood of occurrence table in Appendix A). These results were reviewed giving consideration to the relevant habitats available on site, to determine the candidate species credit species that may potentially occur onsite.

Given the highly disturbed and modified nature of the study area, no suitable habitat for candidate species credit species occurs within the project site (see Appendix A). Targeted threatened species surveys were not conducted. No species credit species were opportunistically recorded in the study area during the GHD surveys. Dispersal habitat and artificial refuge habitat for the Green and Golden Bell Frog is assumed to be present based on recent records in the area, however this is not associated with any PCTs in the project site (see Section 5.2.2 and Section 6.4). Potential impacts on this species are assessed as prescribed impacts (Section 6.4).

5.2 Threatened survey results

5.2.1 Threatened flora

No threatened flora species were recorded during surveys. Given the highly disturbed nature of the study area and especially the absence of natural soil profiles, no threatened flora species are likely to occur.

5.2.2 Threatened fauna

No threatened fauna were recorded during field surveys. The Port Kembla key population of the Green and Golden Bell Frog is known to be associated with unnatural habitats in the local area. Breeding habitat used on occasion by the key population includes domestic swimming pools, ponds, drainage depressions, culverts and possibly grassy swale areas (DEC 2007). Foraging habitat includes areas of native or introduced grasses, tussock vegetation and emergent sedges and reeds bordering water features (DEC 2007). Green and Golden Bell Frogs have previously been recorded in highly disturbed and modified habitats within the coal terminal, including artificial ponds. Further discussion regarding habitat for this species is provided in Section 6.4.

5.2.3 Threatened ecological communities

No threatened ecological communities occur within the project site or will be impacted by the project.

A single patch of native vegetation (vegetation zone 1), comprising a small area of planted native species within heavily modified and degraded land, has been assigned to PCT 1326 (Woollybutt – White Stringybark – Forest Red Gum grassy woodland on coastal lowlands) as the most likely PCT to have occurred in the area prior to clearance and development. PCT 1326 may in appropriate condition states and landscape positions comprise an occurrence Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion, which is listed as an endangered ecological community (EEC) under the BC Act, and the related critically endangered ecological

community (CEEC) listed under the EPBC Act. However, native vegetation within vegetation zone 1 does not comprise an occurrence of Illawarra Lowlands Grassy Woodland. This assessment is based primarily upon the absence of appropriate substrates, characteristic tree species and woodland structure.

A small patch of remnant PCT 694 (Blackbutt – Turpentine – Bangalay moist open forest) intergrading to PCT 1326 (Woollybutt – White Stringybark – Forest Red Gum grassy woodland) occurs within the north-west of the study area (NPWS 2002). This remnant patch of PCT 1326 comprises an occurrence of the TEC Illawarra Lowland Grassy Woodland, however, this vegetation will not be impacted by the project (see Section 6.2).

5.3 Matters of National Environmental Significance

5.3.1 Threatened biota

No threatened ecological communities or threatened flora species were recorded or are likely to occur within the project site.

The Grey-headed Flying-fox may forage in planted figs and eucalypts, but no breeding colony is present. The habitat present would make up a negligible area of foraging habitat for the local population.

The Green and Golden Bell Frog is known to occur in the area. It has been known to utilise artificial sediment ponds on occasion, and move through drainage depressions and cleared land. Further discussion regarding habitat for this species is provided in Section 6.4.

5.3.2 Migratory biota

Shorebirds

Chafer (1997) recorded a range of native fauna which utilise at the remnant of Tom Thumb Lagoon north of the project site, including 45 bird species, of which 9 are listed as migratory species under the EPBC Act (see Chafer 1997 and Woods 2006).

A critical consideration in assessing the significance of potential impacts on listed migratory shorebird species, according to the significant impact guidelines for migratory shorebird species (DEE 2017), is whether or not a proposed action is likely to affect 'important habitat'. Important habitat is defined separately for 36 of the migratory shorebird species and Latham's Snipe (*Gallinago hardwickii*). An area of 'important habitat' for the 36 migratory shorebird species is either:

- A site that is identified as internationally important
- A site that supports either:
  - at least 0.1 % of the flyway population of a single species, or
  - at least 2000 migratory shorebirds, or
  - at least 15 shorebird species.

Important habitat for Latham's Snipe is described as:

- areas that have previously been identified as internationally important for the species, or
- sites that support at least 18 individuals of the species

No mudflat or sandflats occur within the project site. Small areas of mudflats are located along Gurungaty Waterway upstream of the project site. No wetlands that would support at least 18 Latham's Snipe are present. As such, no important habitat for migratory shorebirds occurs in the project site.

Migratory terrestrial species

Referral guidelines have been published for 14 migratory terrestrial species, such as the Rufous Fantail and Satin Flycatcher (DoE 2015). Important habitat for these species generally relates to breeding habitat. Small areas of planted trees and exotic vegetation that occur in the project area are unlikely to support an ecologically significant proportion of any of these species, and no important breeding habitat is likely to be present.

6. Impact assessment

6.1 Introduction

The project would result in direct impacts on cleared and disturbed land, including a small area of planted native vegetation, within the 14.55 ha project site. Planted native vegetation within the project site is likely to provide marginal potential habitat for threatened species. No hollow-bearing trees suitable for use by breeding owls or cockatoos would be removed. No raptor nests would be removed. Construction would remove four detention ponds that could be used on occasion as a refuge by the Green and Golden Bell Frog, and trenching would temporarily impact a movement corridor for this species. Groundcover would be restored following construction of the project. Residual impacts on native vegetation are assessed in Section 6.5. Prescribed impacts, comprising impacts to non-native vegetation that comprises Green and Golden Bell Frog habitat are assessed in Section 6.4.

6.2 Avoidance of impacts

The location of the project in a highly disturbed and modified industrial site, allows for avoidance of many impacts as compared to a project in a predominantly greenfield location. Minimal native vegetation and associated habitat for threatened species is present. Potential impacts upon native vegetation and fauna habitat have further avoided by the use of directional drilling for the pipeline (in particular to avoid areas of Illawarra Lowlands Grassy Woodland and natural swamp areas that intersect the proposed alignment), with trenching being used in previously disturbed areas. The construction corridor has been reduced in some locations to minimise impacts on potential Green and Golden Bell Frog habitat. Following construction, groundcover would be re-established, minimising impacts in the long-term.

6.3 Minimisation of impacts

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, as well as site-specific measures, including the procedures outlined below.

The safeguards and management measures detailed in Table 6-1 would be used during the construction period to minimise the impacts of the project on the biodiversity of the study area. These safeguards and management measures would be incorporated into a CEMP to be implemented during construction.

No additional mitigation measures are proposed for the operation phase of the project. The project is expected to have minimal operational impacts.

Table 6-1 Safeguards and management measures

Impact	Safeguards and management measures	Timing	Responsibility
Loss of native vegetation and fauna habitat	• Staff will be inducted by an ecologist and informed of the limits of clearing, the areas of vegetation to be retained, Green and Golden Bell Frog habitat and characteristic features of the species for identification.	Construction	Construction contractor
Fauna protection	• A trained ecologist is to be present for construction activities that may impact frog habitat including dewatering / removal of detention basins and trenching 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 • The trench is to be covered at night to prevent fauna from falling in • 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	Construction	Construction contractor Project ecologist
Spread of weeds	• Priority weed control measures will be implemented as part of the CEMP to prevent their spread in the study area.	Pre-construction	Construction contractor
	• 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	Construction and operation	Construction contractor

Impact	Safeguards and management measures	Timing	Responsibility
	• Soil disturbance will be avoided as much as possible to minimise the potential for spreading weeds.		
Sedimentation	• 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 2008). The ESCP will include stockpiles, stormwater runoff, trees, site boundaries, site access and storage areas.	Pre-construction	Construction contractor
	• 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. • 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.	Construction	Construction contractor
Water quality, chemical and fuel impacts on flora and fauna	• 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)	Pre-construction	Construction contractor
	• 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	Construction	Construction contractor

Impact	Safeguards and management measures	Timing	Responsibility
	• 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	Construction	Construction contractor
	• 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.	Construction	Construction contractor
Pathogen spread and establishment	• Vehicle wash down facilities will be provided should evidence of pathogens or fungus such as Phytophthora or Chytrid be found.	Construction	Construction contractor

6.4 Prescribed impacts

Prescribed biodiversity impacts of relevance to the project area assessed below in accordance with section 9.2 of the BAM. These predominantly relate to impacts on potential habitat of the Green and Golden Bell Frog.

6.4.1 Impacts on habitat of threatened species or ecological communities associated with human made structures

Green and Golden Bell Frog habitat

The North Port Kembla sub-population of the Green and Golden Bell Frog extends, most likely, across much of the industrial lands in and around the Port Kembla Steelworks. The Green and Golden Bell Frogs are believed to utilise drainage features, rail easements, roads, culverts and other low lying features, with their associated vegetation, as habitat. The use of these habitat features may be transient, intermittent and dependent on suitable weather conditions (DEC 2007).

In 2008, 15 Green and Golden Bell Frogs were discovered in an outdoor storage area at the Port Kembla Coal Terminal (PKCT) (referred to as the “Spares Area”, on the north side of PKCT’s store building). Six individuals were subsequently transferred to the care of Symbio Wildlife Park as they were considered to be at risk of harm in the location they were found. Further surveys in 2009 and 2010 located more individuals around the settlement lagoon area at PKCT (PKCT HSEC 2011). A management plan was prepared for the species and included habitat construction at Greenhouse Park, north of the rail loop; installation of frog-proof fences to discourage frogs from entering PKCT, and discouraging use of stormwater basins by keeping them clear of vegetation and removing shelter habitat (PKCT HSEC 2011).

Surveys were conducted in 2015 at the National Terminals Site at north Port Kembla by BEC (2015) and Ecoplanning (2015b). The proposed gas pipeline crosses part of this site. No individuals were found during these surveys, however the sediment basin was considered to represent marginal habitat for the species (BEC 2015). A species polygon was mapped over the sediment basin to calculate offset obligations for the project in accordance with the Framework for Biodiversity Assessment (OEH 2014), with 1 species credit required for the removal of 0.09 ha of habitat (Ecoplanning 2015b).

A range of habitats have been established in order to protect and encourage the remaining Port Kembla Green and Golden Bell Frog population (see Goldingay 1996, Goldingay and Lewis 1999, Goldingay and Newell 2005 and van de Mortel and Goldingay 1995). Some of the constructed sites are monitored by volunteers over the summer breeding months (Jen Byrne pers. com. 2017), and the Bluescope Steel sites are regularly monitored by Gaia Research (Garry Daley pers. com. 2017).

Constructed habitat for Green and Golden Bell Frog is located to the north of the site in the south-east corner of Greenhouse Park. This habitat was constructed, in the event of individuals, which are occasionally observed at the inner harbour, moving northwards. No individuals of Green and Golden Bell Frog have been recorded at the Greenhouse Park habitat over the last five years (Gaby Kirwood, Jen Byrne, pers. com. 2017), and the numbers recorded in the inner harbour have also decreased significantly in recent years. However, Bluescope Steel noted that a number of individuals were observed in constructed habitat in March 2017, after there being no significant sightings of the species for about seven years at this location (BlueScope 2017).

Up to four small artificial detention ponds (~200m^2 in combined area) would be removed from the vicinity of Berth 101 (Figure 6-1). No emergent vegetation is present at these ponds. They are not within an area of high quality habitat for the species, however individuals have been

recorded near this location previously. Trenching would occur adjacent to another small detention pond at the northern end of the project site at Tom Thumb Road however there would be no direct impacts at this location. Sediment fencing and frog-proof fencing are proposed at these location to minimise the risk of indirect impacts (see Section 6.3).

Other human-made structures

The project would be underbored beneath Allans Creek and Gurungaty Waterway. There would be no impacts on potential roost habitat of the Southern Myotis.

6.4.2 Impacts on habitat associated with areas of non-native vegetation

Construction of the project could impact individual frogs that may be moving through the project site. These frogs could use roadside drains and artificial ponds as temporary refuges, and could also traverse mown lawns.

The project would have minimal impact on habitat for the species. The alignment and construction methods have been chosen to minimise impacts on better quality areas of potential Green and Golden Bell Frog habitat. In particular, the final alignment chosen avoids trenching within native vegetation in the centre of the site, including a swampy area within the 'horse paddock' east of Springhill Road and the rail corridor. This area would be underbored to avoid impacts on better quality Green and Golden Bell Frog habitat. Trenching and drilling sites would be subject to temporary disturbance only, with the trench covered and stabilised with groundcover vegetation following construction.

Trenching and drilling works would occur adjacent to a small drainage line at the northern end of Springhill Road. No construction works would occur within these locations. Sediment fencing and frog-proof fencing are proposed at these location to minimise the risk of indirect impacts (see Section 6.3).

The most appropriate habitat for Green and Golden Bell Frog in the area occurs on the north of Greenhouse Park where the three tributaries of Gurungaty Waterway separate, as well as within Wollongong Golf Course, where there are previous records of the species (OEH 2018a). This is located north of the project site (Figure 6-1). There are patches of tall reeds, grassy areas and shrubs for shelter, moreover the water is more fresh, in comparison with the water in the section of Gurungaty Waterway that runs through the study area. Mangrove habitat which follows a large section of Gurungaty Waterway north of the rail loop (and which is adjacent to the Greenhouse Park constructed habitat), does not provide appropriate habitat for Green and Golden Bell Frog (R. Goldingay, G. Dailey, pers. com. 2017).

Given the avoidance of impacts on better quality wetland areas, impacts on breeding habitat are highly unlikely to occur. The roadside drains and artificial ponds are highly unlikely to be used for breeding given their small size and highly modified nature. These areas may be used as temporary refuges by small numbers of individuals. It is possible that given the likely transient usage of these areas by the species that no individuals would be present at the time of construction. Pre-clearing surveys and monitoring of the trenches would further minimise the risk of impacts on the Green and Golden Bell Frog (see Section 6.3).

6.4.3 Impacts on connectivity and movement of threatened species

The project covers an area that is a potential movement corridor of the Green and Golden Bell Frog (Figure 6-1). Connections between the Tom Thumb Lagoon population to the north of the study area and other populations are exceedingly tenuous and would only be possible along rail easements, and creek and drainage lines (including Allan's Creek) in the vicinity of the BlueScope steelworks complex. Connectivity between the North Port Kembla population (to the

south of the study area) and the sub-populations further to the south is also likely to be tenuous (DEC 2007).

Up to four small artificial detention ponds would be removed from within an industrial area with no other vegetation present. The loss of these artificial ponds would have minimal impact on connectivity for the population.

Trenching and drilling works would temporarily impact areas of mown lawns, exotic vegetation and planted vegetation that may be used on occasion by the Green and Golden Bell Frog when moving between areas of better quality habitat. The potential Green and Golden Bell Frog movement corridors that would be affected would have little value to the key population of the species given the absence of native vegetation, limited shelter substrate and the risk of harm to frogs arising from existing industrial landuses. Following construction, the ground would be rehabilitated, and these areas could continue to be used by the species as a movement corridor and would have equivalent value to the current situation (see Section 6.3).

6.4.4 Impacts on water quality

Green and Golden Bell Frog habitat

Trenching and drilling works would temporarily impact areas of dispersal habitat for the Green and Golden Bell Frog when moving between areas of better quality habitat. There would be no direct impacts on the small drain with emergent Thypha. One detention basin in the northern portion of the project site is located immediately adjacent to the proposed trench but would be retained. Sediment fencing and frog-proof fencing are proposed at these location to minimise the risk of indirect impacts (see Section 6.3). No works would be conducted in or near any breeding sites, such as those to the north at Greenhouse Park and Wollongong Golf Club.

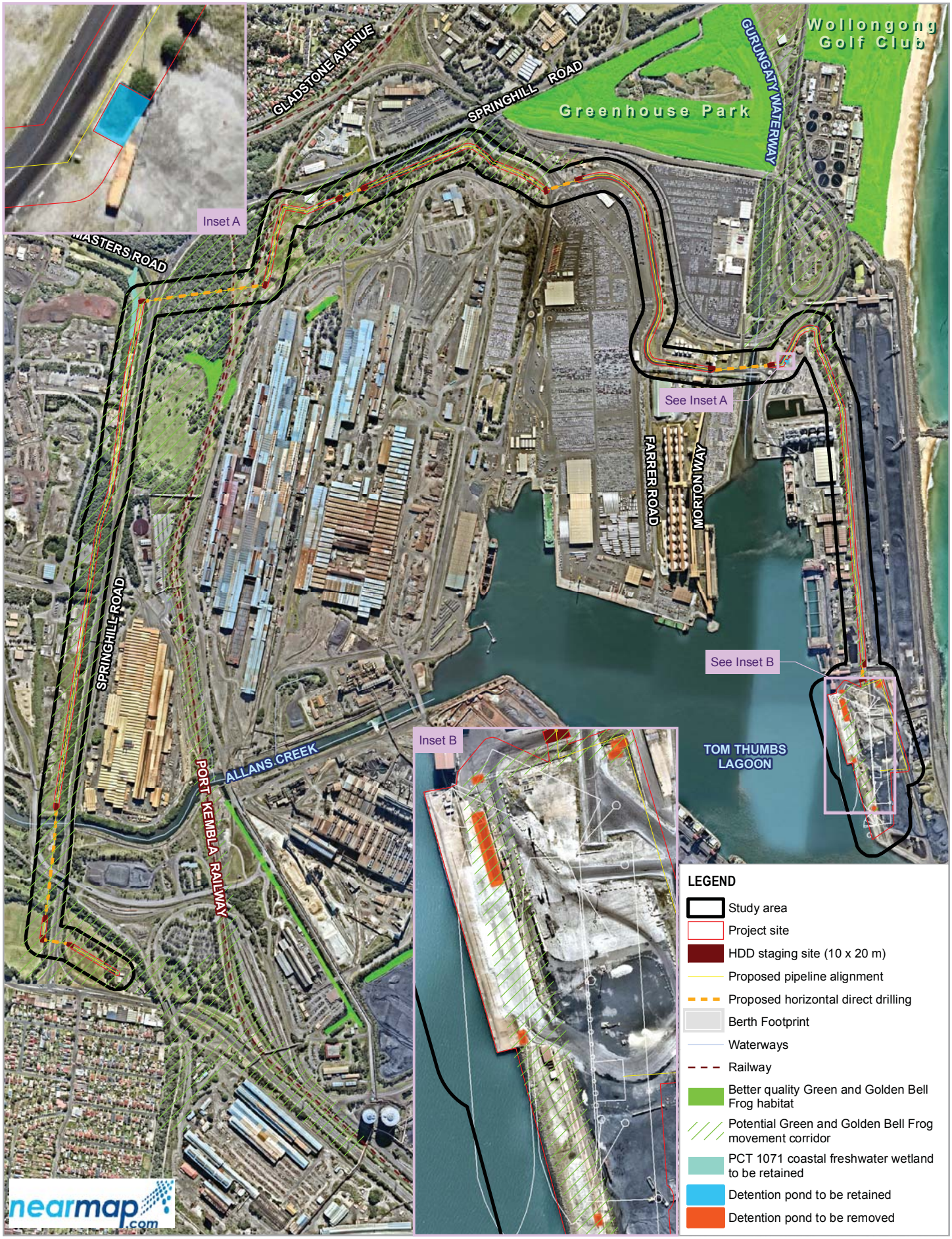
Water quality in the Inner Harbour

Disturbance of the seabed during the proposed dredging and reclamation activities have the potential to reduce water quality through generation of turbid plumes within both the Inner and Outer Harbours.. Resuspension of contaminated sediments resulting from dredging activities may lead to the release of pollutants into the water column. The release of contaminants within Port Kembla is likely to be localised and medium-term in nature, and any such species are likely to be present for only a few hours in most circumstances. The exposure to toxicants are considered to be short in duration while long-term toxic effects are considered unlikely (GHD 2018).

Construction and operation of the project also have the potential to unintentionally release solid wastes or chemicals into the harbour. The pollution of the immediate environment with the release of hazardous solid waste has the likely consequence of negatively affecting the health or flora and fauna within the area. The likelihood of spills is low. Mitigation measures are proposed to minimise the risk of spills and to manage spills in the event they occur (refer to GHD 2018).

The White-bellied Sea-eagle and Eastern Osprey would forage in the Inner and Outer Harbour on a regular basis, and can thus become exposed to pollutants released due to the resuspension of sediments during dredging activities. High-level contaminant exposure has been linked to various toxic effects including immune system depression, disease breakouts, reproductive effects and endocrine disruption (Vos et al. 2003). The Inner Harbour would likely be habitat for one breeding pair each of these species, and would make up a small proportion of their foraging range. As noted above, the duration of exposure to pollutants as a result of the project would be short-term, and long-term toxic effects are considered unlikely. In addition, any individuals that would forage in this area would already be subject to high levels of pollutants at

this location. Given these points, any changes to water quality in the Inner Harbour are unlikely to have a substantial impact on these species.



Paper Size ISO A4

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Metres

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

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Australian Industrial Energy
Port Kembla Gas Project
BDAR

Project No. **21-27477**
Revision No. **-**
Date **23/10/2018**

Green and Golden Bell Frog Habitat

FIGURE 6-1

Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Vegetation mapping - GHD & OEH (NPWS 2002, edited by WCC 2014); Berth footprint - Australian Industrial Energy. Created by: jrprice

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6.5 Residual impacts

6.5.1 Construction phase

Clearing of native vegetation

The project site contains cleared land comprising exotic grass species, planted native/exotic flora in varying states of maturity and environmental weeds. Only a single small area of native vegetation occurs within the project site and will be impacted by the project (see Section 3.9 and 4). Trenching for pipeline installation would mainly comprise a temporary disturbance of ground-cover species, and disturbed areas would be stabilised and revegetated following construction. Some removal of shrubs and trees would be required. For the purposes of this impact assessment, it is assumed that all vegetation within the project site will be removed in association with construction of the project.

The vegetation that would be removed provides habitat resources for common native fauna typical of fragmented urban bushland remnants and parks and gardens. Directional drilling is being used to avoid impacts on native vegetation present within the study area where possible. Drill sites and laydown areas would be located in predominantly cleared areas.

Direct impacts upon native vegetation that would occur as a result of the project are shown in Table 6-2.

Table 6-2 Proposed impacts within the project site

Zone no.	Vegetation zone	Conservation significance	VIS*	Area w/in project site (ha)
1	1326_Moderate-good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)	Does not comprise an occurrence of a listed TEC	18.2	0.25
n/a	Non-native vegetation	n/a	n/a	14.30
Total area (project site - trenching including HDD staging sites)				**14.55**

*VIS = vegetation integrity score

Removal of non-native vegetation

In addition to clearance of a 0.25 ha of native vegetation, 14.30 ha of non-native vegetation comprising planted native/exotic flora in varying states of maturity and environmental weeds will be removed within the remainder of the project site. The vegetation that would be removed provides limited potential habitat resources for native fauna species. No hollow-bearing trees would be removed that are likely to provide habitat for large forest owls, cockatoos or the Large-footed Myotis.

There would be no impacts on bridges that could provide roosting habitat for the Large-footed Myotis.

The project site includes potential habitat and movement corridors for the Green and Golden Bell Frog (see Figure 6-1).Small artificial detention ponds (~0.02 ha in total) will be removed from the proposed berth area which are potential temporary habitat for the threatened Green and Golden Bell Frog. No emergent vegetation is present, and no shelter habitat is present in or adjoining these ponds.

There would be temporary disturbance of the potential movement corridor for the species during construction. Following construction the ground surface would be stabilised and planted with groundcover, and could continue to be utilized by the species. Mitigation measures are recommended to minimise potential injury or mortality of Green and Golden Bell Frog individuals during removal of the artificial pond (see Table 6-1).

Fauna injury and mortality

As described above, the project site provides a variety of habitat resources for native fauna species, including foraging, roosting and shelter resources for threatened species as well as common native fauna. Groundcover vegetation, leaf litter and woody debris would provide shelter and foraging substrate for reptiles, frogs and invertebrates. Construction is likely to result in the injury or mortality of some individuals of these less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the subject site during clearing activities. Mitigation measures are recommended to minimise potential injury or mortality of native fauna and especially Green and Golden Bell Frog individuals, including pre-clearing surveys, use of frog-proof fencing near construction sites, and management of the trench (see Table 6-1).

Habitat fragmentation

The study area traverses mostly cleared or otherwise disturbed and/or modified land, with small patches of planted vegetation present. The project would mainly temporarily impact exotic species-dominated groundcover, with only some shrubs or trees removed. As a result, construction of the project is unlikely to directly isolate or fragment any areas of habitat. The majority of the vegetation in the study area comprises exotic groundcover plants that have very little value as fauna movement habitat. Fauna movement, pollination and seed fall of plants and other ecological processes would continue to occur through the study area. The vegetation that would be removed in the construction corridor would not comprise important shelter or movement habitat for most native fauna.

The majority of the project site is associated with the pipeline alignment and would not comprise any above-ground barriers to fauna movement.

As noted above, there may be temporary impacts on the movement corridor of the Green and Golden Bell Frog. A range of mitigation measures are recommended to minimise the risk of impacts on dispersing individuals (see Table 6-1).

Weed invasion and edge effects

‘Edge effects’ refers to increased noise and light or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation structure and condition, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna.

Weed invasion and edge effects are already present throughout the study area, given the location of the project within a heavily cleared industrial landscape. The potential for the project to exacerbate existing edge effects and weed invasion would be limited, given the extent of modification within the study area.

There is the some potential for additional impacts on native vegetation in the study area through dispersal of weed propagules on vehicles or equipment and through disturbance of vegetation and surface soil, which may provide increased opportunities for recruitment of new weed species.

Environmental safeguards, including weed control and minimising impacts on native vegetation are proposed in Table 6-1 to minimise the spread of weeds and edge effects.

Soil and water pollution

Construction of the project has the potential to result in sedimentation, pollution, contaminated runoff or erosion within the construction corridor and adjoining native vegetation and aquatic habitats, through soil disturbance and construction activities. Potential sources of soil and water pollution include:

- Soil disturbance during excavation and construction works.
- Inappropriate management of soil and material stockpiles.
- Hydrocarbon leaks or spills from vehicles or equipment used in construction.
- Increased sediment transfer and erosion potential in areas cleared of vegetation.

Mitigation measures to reduce the potential for such pollution are described in Table 6-1, and include minimising the disturbance area, construction staging, erosion and sediment control devices and rehabilitation or landscaping of disturbed areas.

Introduction of pests and pathogens

The project would not involve the transport of any animals or any other activities that are likely to directly contribute to the introduction of pest fauna species.

Construction activities have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) throughout the study area through vegetation disturbance and increased visitation. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can lead to the extinction of local populations once introduced into an area.

The potential for impacts associated with these pathogens is low, given the existing modified nature of the landscape, high visitation rates to the study area,limited intact native vegetation and habitats within the project site and impact mitigation measures including exclusion of access to retained native vegetation adjoining the project site.

Noise and vibration

The construction corridor is located near busy roads with relatively high traffic volumes, as well as industrial areas. Habitats adjacent to the project therefore already experience high noise, light and vibration disturbance. There would be additional temporary noise and vibration as a result of construction. Most of the species that are likely to nest or roost in the study area are common species typical of predominantly cleared landscapes and would be habituated to noise to a large extent. Most mobile species such as common birds would move out of the area during construction.

6.5.2 Operation phase

The project would include installation of underground services that would be located in an area that is already developed and includes similar infrastructure. The pipelines would require periodic maintenance, involving associated vehicle traffic and potential excavation to access the pipelines if required. Given the modified nature of the revised construction corridor and in the context of other day to day activities occurring in the study area, this would have a negligible impact on the natural environment.

The project would be undertaken on land which has been extensively modified by existing, approved developments. It contains a relatively small total area of vegetation, minimal habitat resources for native fauna and has limited value as a movement corridor. Impacts on native flora and fauna are substantially less than would be associated with an undisturbed ‘green field’

site. After construction, the disturbed construction corridor would be stabilised and revegetated and would contain environments equivalent to those currently present.

6.6 Impacts on aquatic habitats and key fish habitat

Impacts on freshwater aquatic habitats and key fish habitats are likely to be negligible. Construction may temporarily disturb small roadside drains and remove artificial ponds. The gas pipe will be underbored beneath Allan's Creek. There would be no direct impacts on key fish habitat within Allans Creek or Gurangaty Waterway. Indirect impacts from construction include soil and water pollution during trenching and directional drilling and are described above. Mitigation measures to reduce the potential for such pollution are described in Table 6-1. As there would be no removal of marine vegetation and no impacts on fish passage, offsets in accordance with DPI (2013) are not required.

Port Kembla is already a highly disturbed port. Introduced marine species accounted for 50 % of the coverage of the hard substrate assemblages within Port Kembla. Metals, total Polycyclic Aromatic hydrocarbons (PAH), dioxins and Tributyltin (TBT) have been recorded within sediments across the Inner Harbour. I. Elevated levels of pollutants such as metals have also been previously recorded in the water. Water temperatures within Port Kembla are generally higher than those measured offshore due to tidal flushing patterns and existing industrial thermal discharges (hot water discharge within Allan's Creek) to the Inner Harbour (GHD 2018a). The project has the potential to further impact key fish habitat within Port Kembla, including estuarine portions of Allans Creek and Gurangaty Waterway during construction and operation as a result of:

- Biofouling and benthic community disturbance
- Changes in water quality, such as through turbidity during construction and release of pollutants
- Articial light and noise emmissions
- Introduction and proliferation of aquatic pests
- Accidental release of solid waste, hydrocarbons and chemicals (GHD 2018a).

These impacts and associated mitigation measures are described in detail in the marine ecology report (GHD 2018a). Assessments of significance were prepared for marine fauna listed under the BC Act, EPBC Act and FM Act and are provided in GHD (2018a). The project was considered unlikely to have a signifant impact on any aquatic fauna.

6.7 Consideration of MNES

Potential impacts on the Green and Golden Bell Frog are discussed in Section 6.4 as prescribed impacts since the project would only affect habitat for the species associated with non-native vegetation. An assessment of significance is provided in Appendix C for this species. The project is unlikely to have a significant impact on this species given:

- There would be no impact on any good quality breeding habitat of the key population.
- The project has been designed and refined to avoid impacts on natural swamp areas that may represent breeding habitat and roadside drains with emergent vegetation that represent refuge habitat
- Direct impacts are limited to the removal of small artificial detention ponds from with the highly modified Coal Loading facility. The value of potential habitats to be removed is considered to be very low.

- Trenching works would only temporarily impact a movement corridor. The intensity and duration of trenching activities will be minor and short term.
- Mitigation measures are proposed to minimise impacts on dispersing individuals and any individuals that may occur in roadside drains or detention ponds
- Following construction the alignment would be rehabilitated.
- There would be no permanent fragmentation or isolation of habitat, and dispersal of the species would not be disrupted.

Given the results of the assessment of significance and the nature of the project, and with regards to the significant impact thresholds for the species (DEWHA 2009) a referral is not considered necessary.

No threatened ecological communities listed under the EPBC Act are present in the project site and no threatened flora species are likely to occur. The removal of a very small area of planted vegetation from within an industrial area is unlikely to impact habitat for any other threatened fauna species. No important habitat for migratory species is likely to be impacted. No other assessments of significance are considered necessary.

Given that the project is unlikely to result in any significant impacts on MNES, no offsets in accordance with DSEWPaC (2012) are necessary.

7. Offset requirements

7.1 Assessment of biodiversity impacts requiring offset

The construction phase of the project will result in the removal of 0.25 ha of PCT 1326 within a single vegetation zone that forms potential threatened species habitat (for predicted threatened species identified within Table 5-1) and has a vegetation integrity score of 18.2. In accordance with section 10.2.1.1 (b) of the BAM, offsets are required for impacts upon a vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits). The quantum of biodiversity credits required to offset residual impacts of the project is provided in Section 8.6.

No biota impacted by the project were identified as being a candidate Serious and Irreversible Impact (SAII) entity.

7.2 Assessment of biodiversity impacts not requiring offset

The construction phase of the project will result in the removal of 0.25 ha of PCT 1326 within a single vegetation zone that is not a TEC, and which has a vegetation integrity score of 18.2. In accordance with section 10.2.1.1 (c) of the BAM (2017), offsets are not required for impacts upon native vegetation that is not representative of a TEC or associated with threatened species habitat, where that vegetation zone has a vegetation integrity score of <20.

7.3 Areas not requiring assessment

The project site includes 14.30 ha of non-native vegetation, comprising exotic grass species, planted native/exotic flora in varying states of maturity and environmental weeds within previously cleared, degraded and modified lands.

In accordance with section 5.1.1.5 of the BAM, areas of non-native vegetation do not require assessment under Stage 2 of the BAM. The removal of non-native vegetation that comprises threatened species habitat has been assessed as a prescribed impact in accordance with section 9.2 of the BAM (see Section 6.4 above).

8. Credit calculations

8.1 Overview

The BDAR credit calculations were performed by Kirsten Crosby (assessor accreditation number BAAS17011) and Daniel Whaite (assessor accreditation number BAAS17096) using the BAM (2017) and BAM Calculator Version 1.2.5.00. BAM data utilised for this assessment is provided in Appendix B.

A summary of the data and assumptions used to generate the credit calculations is provided below.

8.2 Site context

A summary of site context and landscape feature data (see Section 3 and Figure 1-1) for credit calculations is provided in Table 8-1.

Table 8-1 Site context and landscape feature data summary

Site / Landscape feature	Proposed BSS
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	Sydney Basin
IBRA subregion	Illawarra
NSW landscape region	Lake Illawarra Barrier
% native vegetation cover within landscape assessment area	5.7% (41.30 ha within 729.53 ha landscape assessment area)
Rivers and streams	5th order stream (Allans Creek) and 2nd order stream (Gurungaty Waterway) draining to Tom Thumbs Lagoon at south-east boundary of study area.
Other landscape features	Nil

8.3 Site value

A summary of data entered into the BAM calculator for the vegetation zone within the project site is provided in Table 8-2 and Table 8-3. Vegetation zone composition, structure and function data for the plot sampled in the project site is provided in Appendix B.

The future vegetation integrity score has been calculated based on the assumption that all native vegetation and habitat resources in the vegetation zone would be removed (i.e. all future condition scores were reduced to zero).

Table 8-2 Plant Community Types (PCT) & ecological communities summary

Vegetation Formation	Vegetation Class	PCT	PCT % cleared	Associated TEC
Grassy Woodlands	Coastal Valley Grassy Woodlands	1326 - Woollybutt – White Stringybark – Forest Red Gum grassy woodland on coastal lowlands	95%	Not a TEC (the closest matching PCT has been assigned to native vegetation within cleared and modified lands).

Table 8-3 Vegetation zones summary (current and future vegetation integrity score)

Zone no.	Vegetation Zone name	Patch size (ha)	Area (ha)	Site condition scores	Composition condition score	Structure condition score	Function condition score	Current vegetation integrity score
1	1326_Moderate-good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)	2	0.25	Current	5.2	30.1	38.9	18.2
				Future	0	0	0	0
							Change in vegetation integrity score	**-18.2**

8.4 Habitat suitability

Data entered into the BAM calculator indicating suitability of habitat at the project site for predicted (ecosystem credit species) and candidate (species credit species) threatened species is provided in Table 8-4 and Table 8-5 respectively. Justifications are provided in Section 5.1 and Appendix A where threatened species have not been considered for further assessment under this BDAR.

Table 8-4 Predicted threatened species (Ecosystem credits)

Species	Habitat constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	National listing stats	Confirmed predicted species
Miniopterus schreibersii oceanensis Eastern Bentwing-bat	-	-	High	V		Yes
Mormopterus norfolkensis Eastern Freetail-bat	-	-	High	V		Yes
Petroica phoenicia Flame Robin	-	-	Moderate	V		Yes
Callocephalon fimbriatum Gang-gang Cockatoo	-	-	Moderate	V		Yes
Calyptorhynchus lathami Glossy Black-Cockatoo	-	-	High	V		Yes
Pteropus poliocephalus Grey-headed Flying-fox	-	-	High	V	V	Yes
Phascolarctos cinereus Koala	-	-	High	V	V	No
Miniopterus australis Little Bentwing-bat	-	-	High	V		Yes
Hieraaetus morphnoides Little Eagle	-	-	Moderate	V		Yes
Glossopsitta pusilla Little Lorikeet	-	-	High	V		Yes
Tyto novaehollandiae Masked Owl	-	-	High	V		Yes

Species	Habitat constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	National listing stats	Confirmed predicted species
Ninox strenua Powerful Owl	-	-	High	V		Yes
Petroica boodang Scarlet Robin	-	-	Moderate	V		Yes
Lophoictinia isura Square-tailed Kite	-	-	Moderate	V		Yes
Daphoenositta chrysoptera Varied Sittella	-	-	Moderate	V		Yes
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	-	-	High	V		Yes

8.5 Habitat survey

No targeted survey for candidate threatened species was required under this assessment (see Section 5).

8.6 Biodiversity credits

Biodiversity credits required for offset under the project, according to the BAM calculator, are shown in Table 8-5. At total of 3 ecosystem credits are required to offset residual impacts of the project upon potential threatened species habitat within vegetation zone 1 (1326_Moderate-good). In accordance with section 10.2.1.1 (b) of the BAM, offsets are required for impacts upon a vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits).

No species credits are required to be calculated as offsets for the project.

Table 8-5 Ecosystem credits for PCTs and threatened species habitat

Zone	Veg zone name	Veg integrity loss	Area	Sensitivity to gain class	Biodiversity risk weighting	Candidate SAII	Ecosystem credits
Woollybutt – White Stringybark – Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion							
1	1326_ Moderate-good	18.2	0.3ha	High	2.5	-	3
						Subtotal	3
						Total	**3**

9. Proposed conservation measures

9.1 Options to meet offset obligations

In accordance with the offset rules established by the *Biodiversity Conservation Regulation 2017* there are various means by which the offset obligations described in Section 7 and 8 can be met. These include:

- Retiring the appropriate credits purchased or generated from an established stewardship site.
- Monitory payment directly into the Biodiversity Conservation Fund,
- Funding an approved biodiversity action (note this mechanism is only available to actions listed in the ancillary rules for biodiversity conservation actions [OEH 2017b] and therefore is not relevant to this site).

9.2 Conservation measures proposed to offset impacts of development

The preferred approach to offset the residual impacts of the project is to secure and retire appropriate credits from stewardship site/s that fit within the trading rules of the BOS in accordance with the 'like-for-like' report generated by the BAM calculator (see 0). If the required credits are unavailable, credits would be sourced in accordance with the 'variation report' generated by the BAM calculator.

A payment to the Biodiversity Conservation Fund would only be considered if a suitable number and type of biodiversity credits cannot be secured from third parties.

10. Conclusion

Australian Industrial Energy (AIE) proposes to develop the Port Kembla Gas Terminal (the project). This Biodiversity Development Assessment Report (BDAR) has been prepared by GHD to identify the potential impacts of the project on biodiversity values within the project site. This assessment has been completed in accordance with the Biodiversity Assessment Method (BAM) and includes:

- Desktop assessment to describe the existing environment and landscape features of the project site and to identify the suite of threatened biota potentially affected by the project.
- Field survey to describe the biodiversity values of the project site and surrounding study area and to determine the likelihood of threatened biota and their habitats occurring in the project site or being affected by the project.
- BAM calculations using the BAM Calculator version 1.2.5.00 to quantify the biodiversity impacts of the project following implementation of measures to avoid and minimise impacts and to determine the biodiversity credits that would be required to be retired to offset the residual impacts of the project.

The project would result in the following impacts:

- Removal of 0.25 ha of planted native vegetation that is assigned PCT 1326 (Woollybutt – White Stringybark – Forest Red Gum grassy woodland) as the closest matching candidate PCT.
- Temporary disturbance of the potential movement corridor for the Green and Golden Bell Frog during construction of the pipeline.
- Removal of artificial detention ponds that may be used on occasion by the Green and Golden Bell Frog but are unlikely to provide breeding habitat.
- Potential indirect impacts on adjoining vegetation associated with edge effects, light spill, noise and introduction of weeds and pathogens.
- Potential impacts on water quality from construction and operation.

A discussion of prescribed biodiversity impacts has been provided, in particular for impacts on Green and Golden Bell Frog habitat not associated with native vegetation, connectivity for the species, and water quality impacts. An assessment of significance pursuant to the EPBC Act significant impact guidelines 1.1 (DotE 2013) has been prepared for the species. Given the temporary nature of the impacts on connectivity, avoidance of direct impacts on drains with emergent vegetation, location away from high quality areas of habitat, and removal of a small number of artificial detention ponds that are not within the main movement corridor for the species, the project is unlikely to have a significant impact on this species.

The project would have limited impacts on any other threatened or migratory biota listed under the EPBC Act. There would be negligible clearing of native vegetation, and no impacts on important habitat for migratory species. Referral of the project to the Commonwealth Minister for the Environment is unlikely to be required.

The project would not impact any threatened freshwater biota listed under the *Fisheries Management Act 1994*. There would be no direct impacts on key fish habitat or marine vegetation within Allans Creek or Gurungaty Waterway.

A BAM assessment and credit calculations have been performed in accordance with the methodology (OEH 2017a) and using credit calculator version 1.2.5.00. Credits required to be retired to offset the impacts of the project include:

- 3 ecosystem credits for impacts on PCT 1326 - Woollybutt – White Stringybark – Forest Red Gum grassy woodland.

The preferred approach to offset the residual impacts of the project is to secure and retire appropriate credits from stewardship sites that fit within the trading rules of the BOS in accordance with the 'like for like' report generated by the BAM calculator. If such credits are unavailable, credits would be sourced in accordance with the 'variation report' generated by the BAM calculator. A payment to the Biodiversity Conservation Trust would only be considered if a suitable number and type of biodiversity credits cannot be secured from third parties.

To avoid and minimise potential impacts of the project on biodiversity, a series of mitigation and management measures have been identified, which would be implemented as part of the construction and operation environmental management plan for the site.

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Appendix A – Likelihood of occurrence of threatened and migratory biota

Likelihood of occurrence of threatened flora species in the project site

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Acacia baueri subsp. *aspera*		V		1 record within 10km, last recorded 1999 (OEH 2018a)	Restricted to the Sydney region; Kings Tableland in the central Blue Mountains and with sporadic occurrences on the Woronora Plateau in the Royal National Park, Mt. Keira district and at Wedderburn, Woronora Plateau in the Flat Rock Junction and Stanwell Tops area of the Illawarra. Occurs in low, damp heathlands, often on exposed rocky outcrops over a wide range of climatic and topographical conditions (OEH 2012).	Nil. Suitable habitat absent from study area.
Acacia bynoeana	Bynoe's Wattle	E	V	Species or species' habitat may occur within 10km (DoEE 2018a)	Endemic to central eastern NSW, currently known from only 34 locations, many of only 1-5 plants. Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. Flowers September to March, and fruit matures in November.	Unlikely. Suitable heath / forest habitat absent from study area.
Allocasuarina glareicola		E	E	Species or species' habitat may occur within 10km (DoEE 2018a)	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Nil. Suitable habitat absent from study area.
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs from Central Coast NSW to southern Victoria. Mostly coastal but extends inland to Braidwood in southern NSW. In NSW grows in grassy dry sclerophyll woodland on clay loam or sandy soils, and less commonly in heathland on sandy loam soils (Duncan 2010).	Unlikely. Suitable intact / remnant habitat types absent from study area.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Chorizema parviflorum		EP; in Wollongong and Shell Harbour LGAs		Credit calculator	Recorded from between Austinmer and Albion Park in the local government areas of Wollongong and Shellharbour. All known sites occupy woodland or forest dominated by Forest Red Gum and/or Woollybutt. May occur on coastal heathland (OEH 2012).	Unlikely. Suitable woodland, forest, and coastal headland habitat absent from study area. Not recorded during site survey.
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with Large Tongue Orchid and the Bonnet Orchid. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	Unlikely. Suitable intact / remnant habitat types absent from study area.
Cynanchum elegans	White-flowered Wax Plant	E	E	47 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Occurs from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Most common near Kempsey. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and Melaleuca scrub. Soil and geology types are not limiting.	Unlikely. Suitable intact / remnant habitat types absent from study area. Not recorded during site survey.
Daphnandra johnsonii	Illawarra Socketwood	E	E	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Rainforest tree to 20 metres tall. Restricted to the Illawarra region where it has been recorded from the local government areas of Shoalhaven, Kiama, Shellharbour and Wollongong. Occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes.	Nil. Suitable habitat absent from study area. Not recorded during site survey.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Epacris purpurascens var. *purpurascens*		V		3 records within 10km (OEH 2018a)	Occurs from Gosford in the north, Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Grows in a range of sclerophyll forest, scrubs and swamps, most of which have a strong shale soil influence.	Nil. Suitable habitat absent from study area. Not recorded during site survey.
Genoplesium baueri	Yellow Gnat-orchid	E	E	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone	Unlikely. Suitable intact / remnant habitat types absent from study area.
Gentiana wingecarribiensis	Wingecarribee Gentian	CE	E	Species or species' habitat may occur within 10km (DoEE 2018a)	Known only from Hanging Rock Swamp and Wingecarribee Swamp in the Southern Highlands. Grows in bogs, in Sphagnum Moss humps and in sedge communities.	Nil. Suitable habitat absent from study area.
Gossia acmenoides	Gossia acmenoides population in the Sydney Basin Bioregion south of the Georges River	EP		2 records within 10km (OEH 2018a)	Known from Shellharbour, Wollongong and Kiama LGAs and encompasses all occurrences south of the Georges River. This population is the southern most occurrence of the species and is approximately 175 km from the nearest population to the north in the Hunter region of NSW. Found in subtropical and dry rainforest on the ranges and coastal plain of eastern Australia. Estimated less than 100 mature plants, through approximately 30 sites. Occurring often as a single individual or small group.	Nil. Suitable habitat absent from study area. Not recorded during site survey.
Haloragis exalata subsp. *exalata*	Wingless Raspwort	V	V	Species or species' habitat known to occur within 10km (DoEE 2018a)	Occurs in 4 widely scattered localities in eastern NSW, in the central coast, south coast and north-western slopes. Requires protected and shaded damp situations in riparian habitats.	Unlikely. Suitable intact / remnant riparian habitat absent from study area. Not recorded during site survey.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Lespedeza juncea subsp. *sericea*	Lespedeza juncea subsp. sericea in the Wollongong Local Government Area	EP		2 records within 10km (OEH 2018a)	Population occurs south of Dapto, disjunct from other (non-endangered) populations in Western Sydney, far South Coast and Southern Tablelands. Only known from one roadside population of approximately 200 plants, in open forest dominated by Forest Red Gum, Woollybutt and Melaleuca decora on Broughton Series sandstone.	Nil. Single known population located outside study area. Suitable woodland and forest habitat absent from study area. Not recorded during site survey.
Melaleuca biconvexa	Biconvex Paperbark	V	V	Species or species' habitat may occur within 10km (DoEE 2018a)	Scattered, disjunct populations in coastal areas from Jervis Bay to Port Macquarie, with most populations in the Gosford-Wyong areas. Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Nil. Prominent species not recorded during site survey.
Pelargonium sp. *Striatellum*	Omeo Stork's-bill	E	E	Species or species' habitat may occur within 10km (DoEE 2018a)	Omeo Storksbill Pelargonium sp. (G.W. Carr 10345), syn. P. striatellum, is a tufted perennial forb known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Nil. Study area outside known geographic range. Suitable habitat absent from study area.
Persoonia hirsuta	Hairy Geebung	E	E	1 record within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600m above sea level.	Unlikely. Suitable woodland, forest or heath habitat absent from study area. Not recorded during site survey.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Persoonia nutans	Nodding Geebung	E	E	1 record within 10km (OEH 2018a)	Occurs from Richmond to Macquarie Fields on the Cumberland Plain. Grows only on aeolian and alluvial sediments in sclerophyll forest and woodland vegetation communities. Largest populations occur in Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Unlikely. Suitable woodland and forest habitat absent from study area. Not recorded during site survey.
Pimelea curviflora var. *curviflora*	Pimelea curviflora var. curviflora	V	V	Credit calculator	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Unlikely. Suitable intact / remnant native vegetation habitat absent from study area. Not recorded during site survey.
Pimelea spicata	Spiked Rice-flower	E	E	1 record within 10km, last recorded 2005 (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (DEC 2005).	Unlikely. Suitable intact / remnant native vegetation habitat absent from study area. Not recorded during site survey.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Pterostylis gibbosa	Illawarra Greenhood	E	E	Species or species' habitat known to occur within 10km (DoEE 2018a)	Known from a small number of populations in the Illawarra, Nowra and Hunter regions. First collected in western Sydney. Only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. Grows in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum, Woollybutt and Melaleuca decora. Near Nowra, the species grows in an open forest of Spotted Gum, Forest Red Gum and Grey Ironbark. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark, Forest Red Gum and Black Cypress Pine.	Unlikely. Suitable woodland and forest habitat absent from study area. Not recorded during site survey.
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Species or species' habitat may occur within 10km (DoEE 2018a)	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Unlikely. Suitable intact / remnant habitat types absent from study area.
Pultenaea aristata	Prickly Bush-pea	V	V	31 records within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DoEE 2018a)	Restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Kiera above Wollongong (OEH 2012). Occurs in either dry sclerophyll woodland or wet heath on sandstone.	Nil. Study area outside known geographic range. Suitable habitat absent from study area. Not recorded during site survey.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Senna acclinis	Rainforest Cassia	E		1 record within 10km (OEH 2018a)	Coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland. Grows in or on the edges of subtropical and dry rainforest (OEH 2012).	Unlikely. Suitable habitat types absent from study area. Not recorded during site survey.
Solanum celatum		E		18 records within 10km (OEH 2018a)	Occurs from Wollongong to Nowra and inland to Bungonia. Grows in rainforest clearings, or in wet sclerophyll forests.	Unlikely. Suitable habitat types absent from study area. Not recorded during site survey.
Syzygium paniculatum	Magenta Lilly Pilly	E	V	3 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Occurs in narrow coastal strip from Bulahdelah to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.	Unlikely. Suitable remnant / habitat types absent from study area. Not recorded during site survey.
Thelymitra kangaloonica	Kangaloon Sun Orchid	CE	CE	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Only known from three locations near Robertson in the Southern Highlands. Grows in seasonally swampy sedgeland on grey silty clay loam at 600–700 m above sea level. Flowers in late October and early November.	Unlikely. Suitable intact / remnant habitat types absent from study area.
Thesium australe	Austral Toadflax	V	V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass.	Unlikely. Suitable intact / remnant habitat types absent from study area.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Xerochrysum palustre	Swamp Everlasting		V	Species or species' habitat may occur within 10km (DoEE 2018a)	In New South Wales it occurs as far north as the Southern Tablelands and ranges up to about 1300 m altitude. Swamp Everlasting grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils. Reproduction appears to be largely vegetative via an extensive rhizome system.	Unlikely. Suitable intact / remnant habitat types absent from study area.
Zieria granulata	Illawarra Zieria	E	E	7 records within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DoEE 2018a)	A tall bushy shrub that grows to 6 m. Restricted to the Illawarra region where it is recorded from a number of sites. The species primarily occupies the coastal lowlands between Oak Flats and Toolijooa. The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils, usually on Bumbo Latite. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas on Quaternary sediments.	Unlikely. Suitable intact / remnant habitat types absent from study area. Not recorded during site survey.

Key: CE – critically endangered, E – endangered, M – migratory, V – vulnerable.

Likelihood of occurrence of threatened fauna species within the project site

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Birds						
Botaurus poiciloptilus	Australasian Bittern	E	E	Species or species' habitat known to occur within 10km (DoEE 2018a)	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly *Typha* spp. and *Eleocharis* spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	Unlikely. No suitable wetland habitat present. Unlikely to use roadside drain. No local records.
Sternula nereis nereis	Australian Fairy Tern		V	Breeding likely to occur within 10km (DoEE 2018a)	Occurs along NSW coast. Inhabit offshore, estuarine or lake islands, wetlands, beaches and spits. Nests on coral shingle on continental islands or coral cays, on sandy islands and beaches inside estuaries and on open sandy beaches.	Nil. Does not breed in the area. No foraging habtiat present in the project site.
Rostratula australis	Australian Painted Snipe	E	E	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Unlikely. No suitable wetland habitat present. Unlikely to use roadside drain. No local records.
Ninox connivens	Barking Owl	V		1 record within 10km, last recorded 2003 (OEH 2018a)	Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts. Birds and mammals	Possible. May forage on site on occasion. No breeding habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
					important prey during breeding. Territories range from 30 to 200 hectares.	
Coracina lineata	Barred Cuckoo-shrike	V		1 record within 10km, last recorded 1998 (OEH 2018a)	Coastal eastern Australia from Cape York to the Manning River in NSW. Generally uncommon in their range, and are rare in NSW. Prefers rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses (OEH 2012).	Unlikely. Preferred habitat not present. Outside usual range.
Limosa lapponica baueri	Bar-tailed Godwit		V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Breeds in the north of Scandinavia, Russia and north-west Alaska. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	Nil. No mudflat or coastal lagoon habitat present in the project site.
Ixobrychus flavicollis	Black Bittern	V		6 records within 10km (OEH 2018a)	Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	Unlikely. No suitable wetland habitat present. Unlikely to use roadside drain.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V		1 record within 10km, last recorded 2004 (OEH 2018a)	Widespread in NSW, but rarely recorded east of Great Dividing Range except in Richmond and Clarence River areas and scattered sites in the Hunter, Central Coast and Illawarra regions. Mostly in upper levels of drier open forests /woodlands. Forage over home range of >5 ha. Tend to occur within largest woodland patches in the landscape. They forage for insects, nectar and honeydew. The nest is hidden by foliage high in the crown of a tree.	Unlikely. No suitable woodland or forest habitat present. Project site is highly disturbed industrial complex.
Ephippiorhynchus asiaticus	Black-necked Stork	E		1 record within 10km (OEH 2018a)	In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north-east. Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water.	Unlikely. No suitable wetland habitat present. Unlikely to use roadside drain or detention basins.
Oxyura australis	Blue-billed Duck	V		2 records within 10km (OEH 2018a)	Partly migratory, travels short distances between breeding swamps and over-wintering lakes. Young birds disperse in April-May from breeding swamps in inland NSW to Murray River system and coastal lakes. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Nests in Cumbungi over deep water or in trampled Lignum, sedges or spike-rushes. Completely aquatic, swimming along the edge of dense cover.	Unlikely. No suitable wetland habitat present. Unlikely to use roadside drain or detention basins.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Irediparra gallinacea	Comb-crested Jacana	V		BAM credit calculator. No local records	Occurs on freshwater wetlands in northern and eastern Australia, mainly in coastal and subcoastal regions, from the north-eastern Kimberley Division of Western Australia to Cape York Peninsula then south along the east coast to the Hunter region of NSW – some recorded in south-eastern NSW potentially in response to unfavourable conditions.	Unlikely. No suitable wetland habitat present. Unlikely to use roadside drain or detention basins.
Calidris ferruginea	Curlew Sandpiper	E	CE, M	1 record within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Nil. No mudflat or coastal lagoon habitat present in the project site.
Artamus cyanopterus	Dusky Woodswallow	V		5 records within 10km (OEH 2018a)	The Dusky Woodswallow is widespread from the coast to inland. It is typicaly recorded in woodlands and dry open sclerophyll forests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. The nest is an open shallow untidy cup frequently built in an open hollow, crevice or stump. Dusky Woodswallows prefer larger remnants over smaller remnants. Competitive exclusion by Noisy Miners (*Manorina melanocephala*) is a significant threat to this species.	Possible. May forage on occasion within planted trees.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Dasyornis brachypterus	Eastern Bristlebird	E	E	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs in three disjunct areas of south-eastern Australia. The Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Nil. No suitable heathy vegetation present.
Numenius madagascariensis	Eastern Curlew		CE, M	9 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Within Australia, the species has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Breeds in Russia and north-eastern China. Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms.	Nil. No mudflat or coastal lagoon habitat present in the project site.
Pandion cristatus	Eastern Osprey	V		15 records within 10km (OEH 2018a)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea, though there are a handful of records from inland areas.	Unlikely. Could forage in the Inner Harbour. No raptor nests present in the project site.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Stictonetta naevosa	Freckled Duck	V		1 record within 10km, last recorded 2003 (OEH 2018a)	Breeds in large, ephemeral swamps in the Murray-Darling, particularly along the Paroo and Lachlan Rivers and other Riverina rivers. In drier times moves to more permanent waters. Disperses during extensive inland droughts and may be found in coastal areas during such times. Prefers freshwater swamps/creeks with dense Cumbungi, Lignum or tea-tree. Nests in dense vegetation at or near water level.	Unlikely. No suitable wetland habitat present. Unlikely to use roadside drain.
Callocephalon fimbriatum	Gang-gang Cockatoo	V		24 records within 10km (OEH 2018a)	Inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. The Gang-Gang Cockatoo nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. The Gang-gang Cockatoo feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles.	Possible. May forage on site on occasion. No breeding habitat present.
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		6 records within 10km, last recorded 2005 (OEH 2018a)	Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts.	Possible. May forage on site on occasion. No breeding habitat present.
Calidris tenuirostris	Great Knot	V	CE, M	1 record within 10km, last recorded 2001 (OEH 2018a); Roosting known to occur within 10km (DoEE 2018a)	Breeds in northern hemisphere. In Australia, prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, mangroves, saltwork ponds, near-coastal swamps, saltlakes and non-tidal lagoons. Rarely occurs on inland lakes and swamps. Roosts in large groups in	Nil. No mudflat or coastal lagoon habitat present in the project site.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
					open areas, often at the water's edge or in shallow water close to feeding areas.	
Charadrius leschenaultii	Greater Sand-plover	V	V, M	2 records within 10km, last recorded 2003 (OEH 2018a); Roosting known to occur within 10km (DoEE 2018a)	Does not breed in Australia. In NSW, recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; forage on wet ground at low tide.	Nil. No mudflat or coastal lagoon habitat present in the project site.
Charadrius mongolus	Lesser Sand-plover	V	E, M	2 records within 10km, last recorded 2003 (OEH 2018a); Roosting known to occur within 10km (DoEE 2018a)	Does not breed in Australia. Found along the entire coast of Australia, most common in northern NSW, QLD and the Gulf of Carpentaria. Rarely recorded south of the Shoalhaven. In NSW almost entirely coastal, on beaches of sheltered bays, harbours and estuaries with large intertidal sand or mudflats, occasionally on sandy beaches, coral reefs and rock platforms.	Nil. No mudflat or coastal lagoon habitat present in the project site.
Hieraaetus morphnoides	Little Eagle	V		5 records within 10km (OEH 2018a)	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	Unlikely. No suitable woodland habitat present. Project site is highly disturbed industrial complex. No raptor nests present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Glossopsitta pusilla	Little Lorikeet	V		1 record within 10km (OEH 2018a)	Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts.	Possible. May forage on occasion within planted trees. No breeding habitat present.
Sternula albifrons	Little Tern	E	M	46 records within 10km (OEH 2018a)	In NSW occurs mainly north of Sydney, with smaller numbers south to VIC. Almost exclusively coastal, preferring sheltered environments; may occur several kilometres from the sea in harbours, inlets and rivers. Nests in low dunes or sandy beaches just above high tide mark near estuary mouths/ adjacent to coastal lakes and islands. Forage in shallow waters of estuaries, coastal lagoons and lakes, also along open coasts, less often at sea, and usually within 50 m of shore.	Unlikely. Could forage in the Inner Harbour and nest on the foreshore, however no habitat present in the project site.
Tyto novaehollandiae	Masked Owl	V		3 records within 10km (OEH 2018a)	Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.	Possible. May forage on site on occasion. No breeding habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit		CE, M	Species or species' habitat may occur within 10km (DoEE 2018a)	Has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Breeds in the north of Scandinavia, Russia and north-west Alaska. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	Nil. No mudflat or coastal lagoon habitat present in the project site.
Pachycephala olivacea	Olive Whistler	V		1 record within 10km, last recorded 1999 (OEH 2018a)	Occurs along the ranges of the east coast as two disjunct populations; in the beech forests of Barrington Tops and Macpherson Ranges in the north, and from Illawarra to Victoria and inland to the Snowy Mountains and Brindabella Ranges in the south. Inhabits wet forests above 500m asl, though may migrate to lower altitudes. Nests in the forks of shrubs and forage in trees/shrubs and on the ground for berries and insects.	Unlikely. No suitable woodland or forest habitat present. Project site is highly disturbed industrial complex.
Neophema chrysogaster	Orange-bellied Parrot	CE	CE	Species or species' habitat may occur within 10km (DoEE 2018a)	Breeds in Tasmania and migrates in winter to SE South Australia and southern Victoria. There are occasional reports from NSW, including Shellharbour, Maroubra and the Shoalhaven. In winter, usually found within 3 km of the coast in saltmarsh and strandline/ foredune vegetation. May also occur on golf-courses and other grassy areas, including improved pasture.	Unlikely. No saltmarsh present within project site. Rare visitor to NSW.
Haematopus longirostris	Pied Oystercatcher	E		8 records within 10km (OEH 2018a)	Scattered along NSW coast. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide. Nests mostly on coastal or estuarine beaches; occasionally saltmarsh or grassy areas.	Unlikely. May forage along Gurungaty Waterway on occasion.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Ninox strenua	Powerful Owl	V		30 records within 10km (OEH 2018a)	Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas.	Possible. May forage on site on occasion. No breeding habitat present.
Calidris canutus	Red Knot		E, M	Species or species' habitat known to occur within 10km (DoEE 2018a)	Breeds in northern hemisphere. Occurs in coastal areas around Australia, with important sites in VIC, SA, WA, NT and Qld. Mainly inhabits intertidal mudflats, sandflats and sandy beaches. Occasionally seen in terrestrial saline wetlands but rarely in freshwater wetlands. Forage in soft substrates in intertidal areas.	Nil. No mudflat or coastal lagoon habitat present in the project site.
Anthochaera phrygia	Regent Honeyeater	CE	CE	Species or species' habitat known to occur within 10km (DoEE 2018a)	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	Unlikely. May forage on rare occasions within planated trees. No breeding habitat present.
Ptilinopus regina	Rose-crowned Fruit-Dove	V		1 record within 10km (OEH 2018a)	Occurs from Newcastle north to Cape York, with vagrants occasionally as far south as Victoria. Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Thought to be locally nomadic in response to fruit availability.	Unlikely. No suitable woodland or forest habitat present. Project site is highly disturbed industrial complex.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Calidris alba	Sanderling	V	M	3 records within 10km (OEH 2018a)	Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes.	Nil. No mudflat or coastal lagoon habitat present in the project site.
Tyto tenebricosa	Sooty Owl	V		10 records within 10km (OEH 2018a)	Occurs in the coastal, escarpment and tablelands regions of NSW. More common in the north and absent from the western tablelands and further west. Inhabits tall, moist eucalypt forests and rainforests, and are strongly associated with sheltered gullies, particularly those with tall rainforest understorey. Roosts in tree hollows, amongst dense foliage in gullies or in caves, recesses or ledges of cliffs or banks. Nest in large (>40cm wide, 100cm deep) tree hollows in unlogged/unburnt gullies within 100m of streams or in caves.	Unlikely. No suitable forested habtiat present. No breeding habitat present.
Haematopus fuliginosus	Sooty Oystercatcher	V		30 records within 10km (OEH 2018a)	Evenly distributed along NSW coast, including offshore islands. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide. Breeds almost exclusively on offshore islands, and occasionally on isolated promontories.	Unlikely. Would forage along seawall outside the project site. No breeding habitat present.
Onychoprion fuscata	Sooty Tern	V		2 records within 10km (OEH 2018a)	Occurs over tropical and subtropical seas and islands around northern NSW. Occasionally seen along coastal NSW, especially after cyclones. Breeds in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	Nil. Does not breed in the area. No foraging habitat present in the project site.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Circus assimilis	Spotted Harrier	V		1 record within 10km (OEH 2018a)	Occurs throughout Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). Most commonly in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).	Unlikely. No suitable woodland habitat present. Project site is highly disturbed industrial complex. No raptor nests present.
Lophoictinia isura	Square-tailed Kite	V		7 records within 10km (OEH 2018a)	Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km^2.	Unlikely. No suitable woodland or forest habitat present. Project site is highly disturbed industrial complex. No raptor nests present.
Lathamus discolor	Swift Parrot	E	CE	11 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.	Unlikely. May forage on rare occasions within planated trees. No breeding habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Xenus cinereus	Terek Sandpiper	V	M	1 record within 10km, last recorded 2002 (OEH 2018a)	The two main sites for this species in NSW are the Richmond River and Hunter River estuaries. Inhabits coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks near mangroves, also observed on rocky pools and reefs and up to 10 km inland around brackish pools. Roost communally in mangroves or dead trees. Forages in open intertidal mudflats.	Nil. No mudflat or coastal lagoon habitat present in the project site.
Neophema pulchella	Turquoise Parrot	V		2 records within 10km (OEH 2018a)	Occurs from coast to inland slopes. In coastal area, most common between Hunter and Northern Rivers, and further south in S Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat. Nests in tree hollows, logs or posts from August to December.	Unlikely. No suitable woodland or forest habitat present. Project site is highly disturbed industrial complex.
Daphoenositta chrysoptera	Varied Sittella	V		1 record within 10km (OEH 2018a)	Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	Possible. May forage on occasion within planted trees.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	C	28 records within 10km (OEH 2018a)	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	Possible. Would forage in the Inner Harbour. No raptor nests present in the project site.
Epthianura albifrons	White-fronted Chat	V		BAM credit calculator. No local records	This species occurs from southern Queensland to Western Australia and down to Tasmania, mostly in temperate to arid climates and very rarely in sub-tropical areas. It is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands. Along the coast they are found in estuarine and marshy habitats with vegetation <1m tall, and in open grasslands and areas bordering wetlands. Inland, they are often observed in grassy plains, saltlakes and saltpans along waterway margins.	Possible. Could occur on rare occasions. No local records.
Mammals						
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Nil. No sandstone escarpment habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		25 records within 10km (OEH 2018a)	Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony.	Possible. Could forage in the project site on occasion. No breeding or roosting habitat present in the project site.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		9 records within 10km (OEH 2018a)	Occurs on southeast coast and ranges. Prefers tall (>20m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts in hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12km foraging movements recorded).	Unlikely. No large areas of forested habitat present. No suitable breeding habitat present.
Mormopterus norfolkensis	Eastern Freetail-bat	V		9 records within 10km (OEH 2018a)	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark.	Possible. Could forage in the project site on occasion. No suitable breeding habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Cercartetus nanus	Eastern Pygmy-possum	V		7 records within 10km (OEH 2018a)	Inhabits range of habitats from coastal heath and woodland though open and closed forests, subalpine heath and rainforest. Inhabits rainforest, sclerophyll forests and heath. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting subject sites in drier habitats. Diet mostly pollen and nectar from Banksia spp., Eucalyptus spp., Callistemon spp. and insects. Nests in hollows in trees, under the bark of Eucalypts, forks of tea-trees, abandoned bird nests and Xanthorrhoea bases.	Nil. No suitable woodland or forest habtiat present. No connectivity with areas of good quality habitat.
Kerivoula papuensis	Golden-tipped Bat	V		BAM credit calculator. No local records	Occurs along the NSW coast, with some records from escarpment areas. Inhabits moist, closed forest with high summer rainfall. Optimal sites are near the ecotone between wet and dry forest, in the vicinity of creeks with a westerly aspect, elevation 50-150 m, abundance of vines, high relief and slope and close spacing between stream channels . Roosts within rainforest, usually along creek lines. However individuals frequently forage in dry sclerophyll forests on upper slopes, generally within 2 km of the roost. Thought to have limited dispersal ability through cleared landscape .	Nil. No suitable moist forest present.
Scoteanax rueppellii	Greater Broad-nosed Bat	V		11 records within 10km (OEH 2018a)	Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable hollow trees.	Possible. Could forage in the project site on occasion. No suitable breeding habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Petauroides volans	Greater Glider		V	20 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Nil. No suitable woodland or forest habtiat present. No connectivity with areas of good quality habitat.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	45 records within 10km (OEH 2018a); Roosting known to occur within 10km (DoEE 2018a)	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	Likely. Would forage in figs and eucalypts in the project area and surrounds. No breeding camp present.
Phascolarctos cinereus	Koala	V	V	2 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	Nil. No suitable woodland or forest habtiat present. No connectivity with areas of good quality habitat.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	1 record within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Hoye and Schulz 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds (Churchill 2008). In southern Sydney appears to be largely restricted to the	Nil. No sandstone escarpment habitat present. No sutiable foraging habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
					interface between sandstone escarpments and fertile valleys.	
Miniopterus australis	Little Bentwing-bat	V		12 records within 10km (OEH 2018a)	Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats.	Possible. Could forage in the project site on occasion. No breeding or roosting habitat present in the project site.
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Restricted to east of the Great Dividing Range, with annual rainfall >760 mm. Inhabits coastal heath and dry and wet sclerophyll forests. Requires relatively thick ground cover and appears restricted to areas of light and sandy soil (Johnston 2008). Feeds on fungi, roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.	Nil. No suitable woodland or forest habtiat present. No connectivity with areas of good quality habitat.
Pseudomys novaehollandiae	New Holland Mouse		V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation	Nil. No heathy habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
					density, and high floristic diversity in regenerating heath.	
Isoodon obesulus	Southern Brown Bandicoot	E	E	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs mainly in 2 areas: Ku-ring-gai Chase and Garigal National Parks N of Sydney, and far SE NSW including Ben Boyd National Park, East Boyd State Forest, Nadgee Nature Reserve, Nadgee State Forest, South East Forest and Yambulla State Forest but also occurs between these areas. Inhabits scrubby vegetation, including heath, shrubland, and heathy forest and woodland. Often associated with well-drained soils and dry heathland communities, and prefers periodically burnt areas as this increases insect abundance.	Nil. No suitable heathy forest habitat present.
Myotis macropus	Southern Myotis	V		3 records within 10km (OEH 2018a)	Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008).	Possible. Could forage along Allans Creek and Gurungaty waterway on occasion. No suitable breeding habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Dasyurus maculatus	Spotted-tailed Quoll	V	E	1 record within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DoEE 2018a)	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.	Nil. No large areas of connected vegetation present. Project site is in an industrial site.
Petaurus australis	Yellow-bellied Glider	V		1 record within 10km (OEH 2018a)	Occurs along the east coast to the western slopes of the Great Dividing Range. Inhabits a variety of forest types but prefers tall mature eucalypt forest with high rainfall and rich soils. Relies on large hollow-bearing trees for shelter and nesting, with family groups of 2-6 typically denning together. In southern NSW its preferred habitat at low altitudes is moist gullies and creek flats in mature coastal forests. Mostly feeds on sap, nectar and honeydew.	Nil. No suitable woodland or forest habtiat present. No connectivity with areas of good quality habitat.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		3 records within 10km (OEH 2018a)	Migrates from tropics to SE Aus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings (Churchill 2008).	Possible. Could forage in the project site on occasion. No suitable breeding habitat present.
Reptiles						
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Nil. No sandstone habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Chelonia mydas	Green Turtle	V	V	5 records within 10km (OEH 2018a)	Usually found in tropical and sub-tropical waters, but also occurs off the NSW coast, usually on the north and central coast with occasional records from the south. Key nesting areas occur in Queensland, Northern Territory and Western Australian waters but there are scattered records of nesting along the NSW coast. Eggs are laid in nests dug in beaches.	Refer to Marine Ecology Report
Caretta caretta	Loggerhead Turtle	E	E	1 record within 10km (OEH 2018a)	In Australia, the Loggerhead Turtle occurs in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia. Nesting populations are known from southern Queensland and Western Australia. Loggerhead Turtles are carnivorous, feeding primarily on benthic invertebrates in habitat ranging from nearshore to 55 m.	Refer to Marine Ecology Report
Amphibians						
Heleioporus australiacus	Giant Burrowing Frog	V	V	44 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	Nil. No suitable sandstone habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Litoria aurea	Green and Golden Bell Frog	E	V	448 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DoEE 2018a)	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (Typha spp.) or spike rushes (Eleocharis spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. Gambusia holbrooki is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.	Assumed present based on recent records. Could use drains and detention ponds on occasion. May disperse through the area on occasion.
Litoria littlejohni	Littlejohn's Tree Frog	V	V	1 record within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs on plateaus and eastern slopes of the Great Dividing Range south from Watagan State Forest. Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops, hunting either in shrubs or on the ground.	Nil. No suitable forested stream habitat present.
Pseudophryne australis	Red-crowned Toadlet	V		14 records within 10km (OEH 2018a)	Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	Nil. No suitable sandstone habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Mixophyes balbus	Stuttering Frog	E	V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs along the east coast of Australia. Has undergone a massive range reduction particularly in the south of its range. Inhabits rainforest and wet, tall, open forest. Shelter in deep leaf litter and thick understorey vegetation on the forest floor. Feeds on insects and smaller frogs, breeding in streams during summer after heavy rain. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts.	Nil. No suitable forested stream habitat present.
Fish						
Prototroctes maraena	Australian Grayling		V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse et al 2008).	Nil. No suitable habitat present. Outside usual range.
Epinephelus daemelii	Black Rockcod		V	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Found in warm temperate/sub-tropical parts of south-western Pacific. Naturally occur along NSW Coastincl. Lord Howe Island. Adults generally found on rocky reefs. Juveniles found in coastal rock pools and around rocky shores in estuaries. (DPI 2013).	Refer to Marine Ecology Report

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Macquaria australasica	Macquarie Perch	V	E	Species or species' habitat known to occur within 10km (DoEE 2018a); Indicative distribution of the species is within 10km (DPI 2018)	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas.Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	Nil. No suitable habitat present. Does not occur in estuarine environments.
Maccullochella peelii	Murray Cod		V	Species or species' habitat may occur within 10km (DoEE 2018a)	Occurs throughout the Murray-Darling Basin. Can live in a wide range of habitats, from clear, rocky streams in the upper western slopes regions of New South Wales to the slow flowing, turbid rivers and billabongs of the western plains. Generally, they are found in waters up to 5m deep and in sheltered areas with cover from rocks, timber or overhanging banks. The presence of wood debris has been shown to be the primary factor determining Murray cod presence (Kearney and Kildea 2001).	Nil. No suitable habitat present. Does not occur in estuarine environments.

Key: CE – critically endangered, E – endangered, M – migratory, V – vulnerable.

Likelihood of occurrence of migratory fauna within the project site (not including pelagic species)

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Limosa lapponica	Bar-tailed Godwit		C,J,K	Species or species' habitat known to occur within 10km (DoEE 2018a)	Has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Breeds in the north of Scandinavia, Russia and north-west Alaska. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Monarcha melanopsis	Black-faced Monarch			Species or species' habitat known to occur within 10km (DoEE 2018a)	Found along the coast of eastern Australia, becoming less common further south. Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter.	Unlikely. No suitable moist forest habitat present.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Limosa limosa	Black-tailed Godwit		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Tringa nebularia	Common Greenshank		C,J,K	Species or species' habitat known to occur within 10km (DoEE 2018a)	Does not breed in Australia, but occurs in all types of wetlands. In NSW has been recorded in most coastal regions and is widespread west of the Great Dividing Range, particularly in the north-west, Macquarie Marshes and areas between the Lachlan and Murray Rivers and Darling River drainage basin. The Hunter River estuary is an internationally important site for the species. In coastal areas typically occurs in sheltered habitats with large mudflats and saltmarsh, mangroves or seagrass.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Actitis hypoleucos	Common Sandpiper		K	Species or species' habitat known to occur within 10km (DoEE 2018a)	Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Thalasseus bergii	Crested Tern		J	Breeding known to occur within 10km (DoEE 2018a)	Distributed around the Australian coast, including Tasmania. It occurs on ocean beaches, estuaries and coastal lagoons and occasionally on salt lakes. The species is known to rest on sand spits, low points and reefs along coastal beaches and inlets. It rarely flies far from shore out to sea or inland on bodies of fresh water.	Unlikely. Could forage in the Inner Harbour and nest on the foreshore, however no habitat present in the project site.
Calidris ferruginea	Curlew Sandpiper		C,J,K	Species or species' habitat known to occur within 10km (DoEE 2018a)	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Charadrius bicinctus	Double-banded Plover			Roosting known to occur within 10km (DoEE 2018a)	Found in both coastal and inland areas. During the non-breeding season, it is common in eastern and southern Australia. Breeds only in New Zealand. Found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Numenius madagascariensis	Eastern Curlew		C,J,K	Species or species' habitat known to occur within 10km (DoEE 2018a)	Within Australia, the species has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Breeds in Russia and north-eastern China. Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Apus pacificus	Fork-tailed Swift		C,J,K	Species or species' habitat likely to occur within 10km (DoEE 2018a)	Recorded in all regions of NSW. Non-breeding, and almost exclusively aerial while in Australia. Occurs over urban and rural areas as well as areas of native vegetation.	Possible. May forage high above the project site on occasion.
Calidris tenuirostris	Great Knot		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	Breeds in northern hemisphere. In Australia, prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, mangroves, saltwork ponds, near-coastal swamps, saltlakes and non-tidal lagoons. Rarely occurs on inland lakes and swamps. Roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding areas.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Charadrius leschenaultii	Greater Sand Plover		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	Does not breed in Australia. In NSW, recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; forage on wet ground at low tide.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Tringa brevipes	Grey-tailed Tattler		C,K	Roosting known to occur within 10km (DoEE 2018a)	Non-breeding visitor to Australia. In NSW occurs along the coast from the Queensland border south to Tilba Lake, and has been recorded as far south as Gippsland.In NSW it is recorded more frequently north of Sydney. Found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. Inland records are rare. Forages in shallow water in intertidal areas. Usually roosts in the branches of mangroves or rocks which may be partly submerged. Also rarely recorded in dense shrubs, on driftwood or sand dunes.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Gallinago hardwickii	Latham's Snipe		J,K	Roosting may occur within 10km (DoEE 2018a)	Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabit permanent and ephemeral wetlands up to 2000 m asl. Typically in open, freshwater wetlands with low, dense vegetation (incl. swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.	Unlikely. No suitable wetland habitat present. Unlikely to use roadside drain.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Charadrius mongolus	Lesser Sand Plover		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	Does not breed in Australia. Found along the entire coast of Australia, most common in northern NSW, QLD and the Gulf of Carpentaria. Rarely recorded south of the Shoalhaven. In NSW almost entirely coastal, on beaches of sheltered bays, harbours and estuaries with large intertidal sand or mudflats, occasionally on sandy beaches, coral reefs and rock platforms.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Numenius minutus	Little Curlew		C,J,K	Roosting likely to occur within 10km (DoEE 2018a)	Generally spend the non-breeding season in northern Australia. In NSW, most records are scattered east of the Great Dividing Range, from Casino, south to Greenwell Point with a few scattered records west of the Great Dividing Range. Recorded breeding in Siberia. Most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Sternula albifrons	Little Tern	E	C,J,K	Breeding known to occur within 10km (DoEE 2018a)	In NSW occurs mainly north of Sydney, with smaller numbers south to VIC. Almost exclusively coastal, preferring sheltered environments; may occur several kilometres from the sea in harbours, inlets and rivers . Nests in low dunes or sandy beaches just above high tide mark near estuary mouths/ adjacent to coastal lakes and islands. Forage in shallow waters of estuaries, coastal lagoons and lakes, also along open coasts, less often at sea, and usually within 50 m of shore.	Unlikely. Could forage in the Inner Harbour and nest on the foreshore, however no habitat present in the project site.
Tringa stagnatilis	Marsh Sandpiper		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	Breeds in N Hemisphere. Occurs in coastal and inland wetlands, including freshwater and estuarine habitats, throughout Australia. All regions of NSW but particularly central and south coasts and western slopes and plains. Sites of national importance in NSW include Parkes wetlands, Macquarie Marshes and Tullakool Evaporation Ponds.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Cuculus optatus	Oriental Cuckoo		C	Species or species' habitat may occur within 10km (DoEE 2018a)	This species migrates to northern and eastern Australia in the warmer months. Occurs south to the Shoalhaven area. Occurs in a range of habitats, including monsoon forest, rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves.	Unlikely. Rare visitor to NSW.
Pandion haliaetus	Osprey			Species or species' habitat known to occur within 10km (DoEE 2018a)	The Osprey is found around the Australian coast line, except for Victoria and Tasmania. They favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Ospreys feed on fish over clear, open water and breed from July to September in NSW. Nests are made high up in dead trees or in	Unlikely. Could forage in the Inner Harbour. No raptor nests present in the project site.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
					dead crowns of live trees, usually within one kilometre of the sea.	
Pluvialis fulva	Pacific Golden Plover		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	Breeds in the northern hemisphere. In Australia occurs mainly in coastal areas but also recorded inland. Important sites in NSW include the Hunter and Shoalhaven River estuaries. Usually occur on beaches, mudflats and sandflats in sheltered areas.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Calidris melanotos	Pectoral Sandpiper		J,K	Species or species' habitat known to occur within 10km (DoEE 2018a)	Widespread but scattered records across NSW, east of the divide and in the Riverina and Lower Western regions. Breeds in the northern hemisphere. In Australasia, prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually in coastal or near-coastal habitats, and prefers wetlands with open mudflats and low emergent or fringing vegetation such as grass or samphire.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Gallinago stenura	Pin-tailed Snipe		C,J,K	Roosting likely to occur within 10km (DoEE 2018a)	The species distribution within Australia is not well understood. There are confirmed records from NSW, south-west Western Australia, Pilbara and the Top End. In NSW a single banded bird was reported near West Wyalong. During non-breeding period the Pin-tailed Snipe occurs most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. The species is also found in drier, more open wetlands such as claypans in more arid parts of species' range. It is also commonly seen at sewage ponds; not	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
					normally in saline or inter-tidal wetlands (Higgins & Davies 1996).	
Calidris canutus	Red Knot		C,J,K	Species or species' habitat known to occur within 10km (DoEE 2018a)	Breeds in northern hemisphere. Occurs in coastal areas around Australia, with important sites in VIC, SA, WA, NT and Qld. Mainly inhabits intertidal mudflats, sandflats and sandy beaches. Occasionally seen in terrestrial saline wetlands but rarely in freshwater wetlands. Forage in soft substrates in intertidal areas.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Calidris ruficollis	Red-necked Stint		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	Distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. Breeds in Siberia and sporadically in north and west Alaska. In Australasia, mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Arenaria interpres	Ruddy Turnstone		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	Breeds in northern Hemisphere. In non-breeding season, widespread in most coastal regions of Australia with occasional inland records. Strongly prefers rocky shores or beaches with large seaweed deposits.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Rhipidura rufifrons	Rufous Fantail			Species or species' habitat known to occur within 10km (DoEE 2018a)	Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas (Birds Australia 2008).	Possible. Could occur in planted vegetation on occasion.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Calidris alba	Sanderling		C,J	Roosting known to occur within 10km (DoEE 2018a)	Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Myiagra cyanoleuca	Satin Flycatcher			Species or species' habitat likely to occur within 10km (DoEE 2018a)	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally not in rainforests.	Possible. Could occur in planted vegetation on occasion.
Calidris acuminata	Sharp-tailed Sandpiper		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	Spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Breeds in northern Siberia.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Monarcha trivirgatus	Spectacled Monarch			Species or species' habitat known to occur within 10km (DoEE 2018a)	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. Prefers thick understorey in rainforest, wet gullies and waterside vegetation as well as mangroves.	Unlikely. No suitable moist forest habtiat present.
Gallinago megala	Swinhoe's Snipe		C,J,K	Roosting likely to occur within 10km (DoEE 2018a)	Swinhoe's Snipe is recorded in north Australia, particularly the Kimberley region, from October–April. It is a non-breeding migrant to Australia and occurs at the edges of wetlands, such as wet paddy fields, swamps and freshwater streams. The species is also known to occur in grasslands, drier cultivated areas (including crops of rapeseed and wheat) and market gardens (Higgins & Davies 1996).	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.
Numenius phaeopus	Whimbrel		C,J,K	Roosting known to occur within 10km (DoEE 2018a)	A regular migrant to Australia and New Zealand, with a primarily coastal distribution. There are also scattered inland records in all regions. It is found in all states but is more common in the north. It is found along almost the entire coast of Queensland and NSW. Breeds in north and west Alaska, Eurasia and Iceland. Often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms.	Nil. No mudflat or coastal lagoon habitat present in the project site. Could occur in Gurungaty Waterway on rare occasions.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence
Hirundapus caudacutus	White-throated Needletail		K	Species or species' habitat known to occur within 10km (DoEE 2018a)	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	Possible. May forage high above the project site on occasion.
Motacilla flava	Yellow Wagtail		C,J,K	Species or species' habitat may occur within 10km (DoEE 2018a)	This species breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	Unlikely. Rare visitor to NSW.

Key: C – China-Australia Migratory Bird Agreement, J - Japan-Australia Migratory Bird Agreement, K – Republic of Korea-Australia Migratory Bird Agreement,

Potential candidate species credit species

Common Name	Habitat constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	National listing stats	Confirmed candidate species
Anthochaera phrygia Regent Honeyeater	-	-	High	CE	CE	No - no breeding habitat present
Burhinus grallarius Bush Stone-curlew	Fallen / standing dead timber including logs (N)	-	High	E	-	No – no suitable open woodland habitat with fallen timber present
Callocephalon fimbriatum Gang-gang Cockatoo	-	-	High	V	-	No – no hollow bearing trees with suitable large hollows present
Calyptorhynchus lathami Glossy Black-Cockatoo	-	-	High	V	-	No – no hollow bearing trees with suitable large hollows present
Cercartetus nanus Eastern Pygmy-possum	-	-	High	V	-	No – no large connected patch of myrtaceous woodland present
Chalinolobus dwyeri Large-eared Pied Bat	Cliffs (N) Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels (N)	-	Very High	V	V	No – no rocky areas containing caves, overhangs, escarpments, outcrops present. Site is over 2km from the Illawarra Escarpment

Common Name	Habitat constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	National listing stats	Confirmed candidate species
Chorizema parviflorum - endangered population *Chorizema parviflorum* Benth. in the Wollongong and Shellharbour Local Government Areas	-	Shellharbour ad Wollongong LGAs (Y)	High	E	-	No – suitable woodland, forest, and coastal headland habitat absent from study area. Not recorded during site survey.
Cynanchum elegans White-flowered Wax Plant	-	-	High	E	E	No – suitable intact / remnant habitat types absent from study area. Not recorded during site survey.
Haliaeetus leucogaster White-bellied Sea-Eagle	-	-	High	V	-	No – no raptor nests present in the project site
Haloragis exalata subsp. *exalata* Square Raspwort	-	-	Moderate	V	V	No – suitable intact / remnant riparian habitat absent from study area. Not recorded during site survey.
Hieraaetus morphnoides Little Eagle	-	-	Moderate	V	-	No – no raptor nests present in the project site
Lathamus discolor Swift Parrot	-	-	Moderate	E	CE	No – no foraging or breeding habitat present
Lespedeza juncea subsp. *sericea* - endangered population *Lespedeza juncea* subsp. *sericea* in the Wollongong Local Government Area	-	Wollongong LGA (Y)	High	E	-	No – single known population located outside study area. Suitable woodland and forest habitat absent from study area. Not recorded during site survey.
Lophoictinia isura Square-tailed Kite	-	-	Moderate	V	-	No – no raptor nests present in the project site

Common Name	Habitat constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	National listing stats	Confirmed candidate species
Miniopterus australis Little Bentwing-bat	-	-	Very High	V	-	No – no limestone caves present
Miniopterus schreibersii oceanensis Eastern Bentwing-bat	-	-	Very High	V	-	No – no limestone caves present
Myotis macropus Southern Myotis	Hollow bearing trees (N) Within 200 m of riparian zone/Other (Y) Bridges, caves or artificial structures within 200 m of riparian zone (Y)	-	High	V	-	No – project will not impact bridges (to be underbored). No hollow breaing trees present.
Ninox strenua Powerful Owl	-	-	High	V	-	No – no hollow bearing trees with suitable large hollows present
Phascolarctos cinereus Koala	-	-	High	V	V	No – no connected areas of woodland habitat present
Pimelea curviflora var. *curviflora*	-	-	High	V	V	No – suitable intact / remnant native vegetation habitat absent from study area. Not recorded during site survey.
Pteropus poliocephalus Grey-headed Flying-fox	-	-	High	V	V	No – no breeding camp present
Pterostylis gibbosa Illawarra Greenhood	-	-	Moderate	E	E	No – no suitable habitat present.

Common Name	Habitat constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	National listing stats	Confirmed candidate species
Tyto novaehollandiae Masked Owl	-	-	High	V	-	No – no hollow bearing trees with suitable large hollows present
Zieria granulata Illawarra Zieria	-	-	High	E	E	No – no suitable habitat present.

Appendix B – Survey results

Summary of vegetation integrity plot data

				Composition (species richness)							Structure (% cover)						Function													
Veg Zone	PCT	Condition	Plot	TG	SG	GG	FG	EG	OG	Total	TG	SG	GG	FG	EG	OG	Large trees	Hollow trees	Litter cover (%)	Fallen logs (m)	Tree DBH 5-10 (cm)	Tree DBH 10-20 (cm)	Tree DBH 20-30 (cm)	Tree DBH 30-50 (cm)	Tree DBH 50-80 (cm)	Tree regen	HTE cover (total)	Zone	Easting	Northing	Bearing
			Benchmark	**5**	**8**	**12**	**15**	**2**	**5**	**47**	**52**	**18**	**61**	**10**	**1**	**5**	**3**		**35**	**40**											
1	1326	Mod-good	1	1	0	0	0	0	2	3	35.0	0.0	0.0	0.0	0.0	0.2	0	0	91.0	0.0	Y	Y	N	N	N	Y	25.1	56	304684	6185746	180

*TG=Tree; SG=Shrub; GG=Grass and grass-like; FG=forb; EG=Fern; OG=Other; HTE=High Threat Exotic

Flora species recorded within native vegetation at the project site

Family	Scientific Name	Common Name	Exotic(*) / Native (0)	Cover (%)	Abundance
Plot 1					
Amaranthaceae	*Alternanthera pungens*	Khaki Weed	*	0.1	1
Asteraceae	*Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush	*	1	2
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*	0.2	5
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine	0	0.1	1
Casuarinaceae	*Casuarina glauca*	Swamp Oak	0	35	100
Moraceae	*Ficus microcarpa hillii*	-	0	0.5	2
Moraceae	*Morus alba*	White Mulberry	*	0.1	1
Poaceae	*Pennisetum setaceum*	Fountain Grass	*	4	3
Verbenaceae	*Lantana camara*	Lantana	*	20	100
Vitaceae	*Cayratia clematidea*	Native Grape	0	0.1	1

Flora species recorded within the study area

Family	Scientific Name	Common Name	Exotic(*) / Native (0)
Amaranthaceae	*Alternanthera pungens*	Khaki Weed	*
Apiaceae	*Hydrocotyle bonariensis*	Kurnell Curse	*
Apiaceae	*Foeniculum vulgare*	Fennel	*
Apocynaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush	*
Apocynaceae	*Araujia sericifera*	Moth Vine	*
Apocynaceae	*Nerium oleander*	Oleander	*
Asteraceae	*Ageratina adenophora*	Crofton Weed	*
Asteraceae	*Bidens pilosa*	Cobblers Pegs	*
Asteraceae	*Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush	*
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*
Asteraceae	*Gamochaeta coarctata*	-	*
Asteraceae	*Hypochaeris radicata*	Catsear	*
Asteraceae	*Senecio lautus*	Variable Groundsel	0
Asteraceae	*Ageratina riparia*	Mistflower	*
Asteraceae	*Baccharis halimifolia*	Groundsel Bush	*
Asteraceae	*Cirsium vulgare*	Spear Thistle	*
Asteraceae	*Conyza sumatrensis*	Tall fleabane	*
Asteraceae	*Cotula coronopifolia*	Water Buttons	*
Asteraceae	*Gazania rigens*	-	*
Asteraceae	*Senecio madagascariensis*	Fireweed	*
Asteraceae	*Soliva sessilis*	Bindyi	*
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	*
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine	0
Bignoniaceae	*Jacaranda mimosifolia*	Jacaranda	*
Caprifoliaceae	*Lonicera japonica*	Japanese Honeysuckle	*
Casuarinaceae	*Casuarina glauca*	Swamp Oak	0
Casuarinaceae	*Casuarina equisetifolia* subsp. *incana*	Coastal She-oak	0
Convolvulaceae	*Dichondra repens*	Kidney Weed	0
Convolvulaceae	*Ipomoea cairica*	Coastal Morning Glory	*
Convolvulaceae	*Ipomoea indica*	Morning Glory	*
Cyperaceae	*Cyperus brevifolius*	-	*
Cyperaceae	*Cyperus eragrostis*	Umbrella Sedge	*
Fabaceae (Faboideae)	*Trifolium repens*	White Clover	*
Fabaceae (Faboideae)	*Erythrina x sykesii*	Coral tree	*
Fabaceae (Faboideae)	*Psoralea pinnata*	African Scurf-pea	*
Fabaceae (Faboideae)	*Trifolium subterraneum*	Subterranean Clover	*
Fabaceae (Faboideae)	*Crotalaria agatiflora* subsp. *agatiflora*	-	*

Family	Scientific Name	Common Name	Exotic(*) / Native (0)
Fabaceae (Mimosoideae)	*Acacia longifolia*	Sydney Golden Wattle	0
Fabaceae (Mimosoideae)	*Acacia melanoxylon*	Blackwood	0
Fabaceae (Mimosoideae)	*Acacia saligna*	Golden Wreath Wattle	*
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	0
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	*
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*
Malvaceae	*Malva parviflora*	Small-flowered Mallow	*
Malvaceae	*Lagunaria patersonia*	Norfolk Island Hibiscus	0
Moraceae	*Ficus microcarpa hillii*	Hills Fig	0
Moraceae	*Morus alba*	White Mulberry	*
Myrtaceae	*Eucalyptus botryoides*	Bangalay	0
Myrtaceae	*Eucalyptus leucoxylon*	-	0
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	0
Myrtaceae	*Lophostemon confertus*	Brush Box	0
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark	0
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	0
Myrtaceae	*Agonis flexuosa*	-	*
Myrtaceae	*Callistemon viminalis*	Weeping Bottlebrush	0
Myrtaceae	*Corymbia citriodora*	Lemon-scented Gum	*
Myrtaceae	*Eucalyptus camaldulensis*	River Red Gum	0
Myrtaceae	*Eucalyptus elata*	River Peppermint	0
Myrtaceae	*Eucalyptus grandis*	Flooded Gum	0
Myrtaceae	*Eucalyptus microcorys*	Tallowwood	0
Myrtaceae	*Eucalyptus leucoxylon* subsp. *leucoxylon*	-	*
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark	0
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	*
Oleaceae	*Ligustrum lucidum*	Large-leaved Privet	*
Oleaceae	*Olea europaea* subsp. *cuspidata*	African Olive	*
Oxalidaceae	*Oxalis perennans*	-	0
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree	0
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn	0
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	*
Poaceae	*Bothriochloa decipiens* var. *decipiens*	Pitted Bluegrass	0
Poaceae	*Bromus catharticus*	Praire Grass	*
Poaceae	*Chloris gayana*	Rhodes Grass	*
Poaceae	*Chloris truncata*	Windmill Grass	0
Poaceae	*Cynodon dactylon*	Common Couch	0

Family	Scientific Name	Common Name	Exotic(*) / Native (0)
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*
Poaceae	*Entolasia stricta*	Wiry Panic	0
Poaceae	*Microlaena stipoides*	Weeping Grass	0
Poaceae	*Paspalum dilatatum*	Paspalum	*
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass	*
Poaceae	*Pennisetum setaceum*	Fountain Grass	*
Poaceae	*Poa affinis*	-	0
Poaceae	*Rytidosperma tenuius*	A Wallaby Grass	0
Poaceae	*Sporobolus africanus*	Parramatta Grass	*
Poaceae	*Aira cupaniana*	Silvery Hairgrass	*
Poaceae	*Avena fatua*	Wild Oats	*
Poaceae	*Digitaria ciliaris*	Summer Grass	*
Poaceae	*Eragrostis pilosa*	Soft Lovegrass	*
Poaceae	*Hyparrhenia hirta*	Coolatai Grass	*
Poaceae	*Melinis repens*	Red Natal Grass	*
Poaceae	*Setaria parviflora*	Pigeon Grass	*
Rosaceae	*Rubus fruticosus* sp. agg.	Blackberry complex	*
Rosaceae	*Rubus anglocandicans*	Blackberry	*
Typhaceae	*Typha orientalis*	Broad-leaved Cumbungi	0
Verbenaceae	*Lantana camara*	Lantana	*
Verbenaceae	*Verbena bonariensis*	Purpletop	*
Verbenaceae	*Verbena rigida* var. *rigida*	Veined Verbena	*
Vitaceae	*Cayratia clematidea*	Native Grape	0
Amaryllidaceae	*Clivia miniata*	-	*
Anacardiaceae	*Harpephyllum caffrum*	-	*
#N/A	*Schinus molle* var. *areira*	Pepper Tree	*
#N/A	*Cupressus torulosa*	-	*
Arecaceae	*Phoenix canariensis*	Canary Island Date Palm	*
Arecaceae	*Archontophoenix* spp.	Phoenix Palm	*
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	*
Basellaceae	*Anredera cordifolia*	Madeira Vine	*
Brassicaceae	*Hirschfeldia incana*	Buchan Weed	*
Chenopodiaceae	*Chenopodium album*	Fat Hen	*
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	0
Commelinaceae	*Tradescantia fluminensis*	Wandering Jew	*
Crassulaceae	*Crassula multicava*	-	*
Euphorbiaceae	*Ricinus communis*	Castor Oil Plant	*
Euphorbiaceae	*Triadica sebifera*	Chinese Tallowood	*
Fabaceae (Caesalpinioideae)	*Gleditsia triacanthos*	Honey Locust	*
Fabaceae (Caesalpinioideae)	*Senna pendula* var. *glabrata*	Cassia	*

Family	Scientific Name	Common Name	Exotic(*) / Native (0)
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*
Malaceae	*Cotoneaster pannosus*	Cotoneaster	*
Malaceae	*Pyracantha angustifolia*	Orange Firethorn	*
Davalliaceae	*Nephrolepis cordifolia*	Fishbone Fern	0
Ochnaceae	*Ochna serrulata*	Mickey Mouse Plant	*
Passifloraceae	*Passiflora edulis*	Common Passionfruit	*
Phytolaccaceae	*Phytolacca octandra*	Inkweed	*
Polygonaceae	*Rumex crispus*	Curled Dock	*
Polygonaceae	*Acetosa sagittata*	Rambling Dock	*
Proteaceae	*Grevillea robusta*	Silky Oak	0
Ranunculaceae	*Ranunculus repens*	Creeping Buttercup	*
Rubiaceae	*Coprosma repens*	Taupata	*
Solanaceae	*Cestrum parqui*	Green Cestrum	*
Solanaceae	*Solanum pseudocapsicum*	Madeira Winter Cherry	*
Solanaceae	*Solanum mauritianum*	Wild Tobacco Bush	*
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*
Ulmaceae	*Celtis occidentalis*	Hackberry	*
Myrsinaceae	*Anagallis* spp.	Scarlet Pimpernel	*

Fauna species recorded during site survey

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Observation Type
Cracticus tibicen	Australian Magpie				O
Corvus coronoides	Australian Raven				O
Coracina novaehollandiae	Black-faced Cuckoo-shrike				O
Sturnus tristis	Common Myna	*			O
Cracticus torquatus	Grey Butcherbird				O
Anthochaera chrysoptera	Little Wattlebird				O
Grallina cyanoleuca	Magpie-lark				O
Vanellus miles	Masked Lapwing				O
Phylidonyris novaehollandiae	New Holland Honeyeater				O
Manorina melanocephala	Noisy Miner				O
Trichoglossus haematodus	Rainbow Lorikeet				O
Neochmia temporalis	Red-browed Finch				O
Pycnonotus jocosus	Red-whiskered Bulbul	*			O
Columba livia	Rock Dove	*			O
Chroicocephalus novaehollandiae	Silver Gull				O
Pardalotus punctatus	Spotted Pardalote				W
Streptopelia chinensis	Spotted Turtle-dove	*			O
Malurus cyaneus	Superb Fairy-wren				O
Sterna sp.	Tern				O
Hirundo neoxena	Welcome Swallow				O
Ardea pacifica	White-necked Heron				O
Ptilotula penicillatus	White-plumed Honeyeater				O
Rhipidura leucophrys	Willie Wagtail				O
Oryctolagus cuniculus	Rabbit	*			P
Crinia signifera	Common Eastern Froglet				W

Key: * - exotic, O – observed, P – scats, W - heard

Appendix C – EPBC Act assessments of significance

The desktop assessment, field surveys and impact assessment have been used to identify MNES that are known or may occur at the project site and that have the potential to suffer a significant impact. An assessment of significance has been prepared using the *Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013) for the Green and Golden Bell Frog.

Green and Golden Bell Frog, a vulnerable species
According to the DoE (2013) 'significant impact criteria' for vulnerable species, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
Lead to a long-term decrease in the size of an important population of a species
Green and Golden Bell Frogs that occur in the area are part of the Port Kembla key population of the species, and are thus considered an important population. The North Port Kembla sub-population of the Green and Golden Bell Frog extends, most likely, across much of the industrial lands in and around the Port Kembla Steelworks. In 2008, 15 Green and Golden Bell Frogs were discovered in an outdoor storage area at the Port Kembla Coal Terminal. Further surveys in 2009 and 2010 located more individuals around the settlement lagoon area at the Port Kembla Coal Terminal. All frogs located in the terminal were relocated. Frog-proof fencing has been installed to minimise their incidence in this industrial site (PKCT HSEC 2011, BEC 2015). The most appropriate habitat for Green and Golden Bell Frog in the area occurs on the north of Greenhouse Park where the three tributaries of Gurungaty Waterway separate, as well as within Wollongong Golf Course, where there are previous records of the species (OEH 2018a). This is located north of the project site. The project will result in the removal of small detention ponds with no emergent vegetation at the proposed berth site that could be utilised on rare occasions by transient individuals. The value of potential habitats to be removed is considered to be very low, particularly given that the location of these ponds is at the far southern end of the wharf, and not in the movement corridor between populations at North Port Kembla (to the south of the project) and Wollongong (to the north of the project). Trenching of the pipeline would temporarily impact potential movement corridors for the species. The potential Green and Golden Bell Frog movement corridors that would be affected would have little value to the key population of the species given the absence of native vegetation, limited shelter substrate and the risk of harm to frogs arising from existing industrial landuses. No good quality wetland habitat would be removed. As such, the project is unlikely to result in a long-term decrease in the size of an important population of a species.
Reduce the area of occupancy of an important population
The project will result in the removal of small detention ponds (~200m^2) with no emergent vegetation located within a highly industrial site well away from areas of good quality habitat. The loss of this small area of habitat would not reduce the area of occupancy of the important population.
Fragment an existing important population into two or more populations
Connections between the Tom Thumb Lagoon population to the north of the study area and other populations are exceedingly tenuous and would only be possible along rail easements, and creek and drainage lines (including Allan's Creek) in the vicinity of the BlueScope steelworks complex. Connectivity between the North Port Kembla population (to the south of the study area) and the sub-populations further to the south is also likely to be tenuous (DEC 2007). Small artificial detention ponds with no emergent vegetation would be removed from within an industrial area. The loss of these artificial ponds would have minimal impact on connectivity for

Green and Golden Bell Frog, a vulnerable species
the population. The location of these ponds is at the far southern end of the wharf, and not in the main movement corridor between populations at North Port Kembla (to the south of the project) and Wollongong (to the north of the project), however individuals have been recorded in this area previously. Trenching and drilling works would temporarily impact areas of mown lawns, exotic vegetation and planted vegetation that may be used on occasion by the Green and Golden Bell Frog when moving between areas of better quality habitat. The potential Green and Golden Bell Frog movement corridors that would be affected would have little value to the key population of the species given the absence of native vegetation, limited shelter substrate and the risk of harm to frogs arising from existing industrial landuses. Following construction, the ground would be rehabilitated, and these areas could continue to be used by the species as a movement corridor.
Adversely affect habitat critical to the survival of a species
The Green and Golden Bell Frog inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (eg *Eleocharis* spp.). Optimum breeding habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available (OEH 2018b). Habitat critical to the survival of the key population would include breeding sites such as the remnant of Tom Thumb Lagoon, swamps in North Port Kembla, and Coomaditchy Lagoon. The artificial detention ponds to be removed are highly disturbed and would not provide habitat suitable for breeding. They are not in the main movement corridor between other areas of habitat. Trenching would temporarily impact a potential movement corridor. Disturbance of this corridor would be short-term only, and there would be no permanent fragmentation or isolation of habitat as a result of the project. Based on these points, the project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population
Given the avoidance of impacts on better quality swamp areas, impacts on breeding habitat are highly unlikely to occur. The roadside drains and artificial ponds are highly unlikely to be used for breeding given their small size and highly modified nature. These areas may be used as temporary refuges by small numbers of individuals. It is possible that given the likely transient usage of these areas by the species that no individuals would be present at the time of construction. Trenching and drilling works would temporarily impact areas of mown lawns, exotic vegetation and planted vegetation that may be used on occasion by the Green and Golden Bell Frog when moving between areas of better quality habitat. Following construction, the ground would be rehabilitated, and these areas could continue to be used by the species as a movement corridor.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The project would remove artificial detention ponds from the berth area and temporarily disturb a movement corridor that may only be used on rare occasions. Sediment fencing and frog-proof fencing are proposed to minimise the risk of indirect impacts during construction. The trench covered and stabilised with groundcover vegetation following construction. There would be no impact on any good quality breeding habitat of the key population.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Green and Golden Bell Frog, a vulnerable species
The project site is located in a highly modified industrial area. Large numbers of exotic species already occur. Introduction of new invasive species that may impact habitat for the Green and Golden Bell Frog is unlikely.
Introduce disease that may cause the species to decline
The project has the potential to spread Chytrid fungus in the project site through contaminated vehicles or equipment. This fungus is generally accepted to have spread throughout coastal NSW and so it is highly unlikely that the project would result in a novel introduction of the fungus. The persistence of the Key Population in the local area is probably attributable to salinity levels or another abiotic factor limiting the spread or virulence of the pathogen. The project is highly unlikely to affect these abiotic factors in any areas of important, occupied habitat (if at all).
Interfere substantially with the recovery of the species
The objectives of the recovery plan are initially to stabilise and prevent further decline of the species, and secondly to return the species to its former distribution, abundance and role in the ecosystem where-ever possible. The second part is highly dependent on the success of the initial objective (DEC 2015). Specific actions include: • preventing the further loss of GGBF habitat at key populations across the species range and where possible secure opportunities for increasing protection of habitat areas • ensure extant GGBF populations are managed to eliminate or attenuate the operation of factors that are known or discovered to be detrimentally affecting the species • implement habitat management initiatives. The project will result in the loss of poorer quality habitat associated with detention basins and the temporary disturbance of a potential movement corridor. These activities are unlikely to interfere in the recovery of the key population. Management measures are proposed to minimise the risk of indirect impacts as a result of the project. As such, the project would not interfere substantially with the recovery of the species.
Conclusion
The project is unlikely to have a significant impact on the Green and Golden Bell Frog as: • There would be no impact on any good quality breeding habitat of the key population. • The project has been designed and refined to avoid impacts on natural swamp areas that may represent breeding habitat and roadside drains with emergent vegetation that represent refuge habitat • Direct impacts are limited to the removal of small artificial detention ponds only from with the highly modified Coal Loading facility. The value of potential habitats to be removed is considered to be very low. • Trenching works would only temporarily impact a movement corridor. The intensity and duration of trenching activities will be minor and short term. • Mitigation measures are proposed to minimise impacts on dispersing individuals and any individuals that may occur in roadside drains or detention ponds • Following construction the alignment would be rehabilitated. • There would be no permanent fragmentation or isolation of habitat, and dispersal of the species would not be disrupted.

Appendix D – Biodiversity credit report

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00011775/BAAS17011/18/00011776	East Coast Gas Project	24/02/2018
Assessor Name	**Report Created**	**BAM Data version ***
Daniel Whaite	18/10/2018	3
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS17096		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAII	Ecosystem credits

BAM Credit Summary Report

Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion								
1	1326_Moderate-good	18.2	0.3	0.25	High Sensitivity to Potential Gain	2.50		3
							Subtotal	**3**
							Total	**3**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits

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