Inland Rail - Gowrie to Kagaru

Geotechnical Investigations | Matters of National Environmental Significance Assessment Report

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Prepared for Australian Rail Track Corporation | 23 July 2018

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Inland Rail - Gowrie to Kagaru – Geotechnical Investigations

Final

Report B180146RP1 | Prepared for Australian Rail Track Corporation | 23 July 2018

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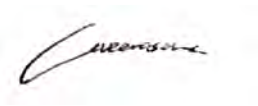
Signature		Signature	
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1 Introduction

1.1 Background

The Australian Government has committed to delivering the Inland Rail Programme which is a once-in-a-generation project connecting regional Australia to domestic and international markets. It is a 1,700 km freight rail network from Melbourne to Brisbane which will offer less than 24 hour freight time between the two cities with 90% reliability. Inland Rail Programme is divided into 13 distinct projects with one in Victoria, seven in New South Wales (NSW) and five in Queensland (Qld). They will be assessed, approved, procured and constructed separately.

In May 2017 the Federal government announced a long-term investment in Inland Rail, funding a combination of an $8.4 billion equity investment in Australian Rail Track Corporation (ARTC) and a Public Private Partnership (PPP) for delivery of the three most complex elements of Inland Rail from Gowrie to Kagaru (G2K) in Qld. The value for money provided by the PPP is generated through the sharing or transfer of risk to the private sector. Studies have shown that geotechnical risk is one such risk area that is transferred to the private partner of the PPP and that the more thorough the pre-award Geotechnical Investigation (GI) the less geotechnical contingency the private partner will need to build into their price.

ARTC will contract a Geotechnical Service Provider to undertake a program of detailed geotechnical investigations to inform the PPP bid phase and detailed design of the G2K section of the Inland Rail project. The geotechnical investigations will collect suitable data on surface and sub-surface conditions. Therefore it is imperative the geotechnical investigations are completed in coming months to ensure delays to the Inland Rail project are avoided.

The G2K section of Inland Rail is split into three projects as shown in Figure 1.1:

- Gowrie to Helidon;
- Helidon to Calvert; and
- Calvert to Kagaru.

Each G2K section will be assessed and approved independently under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) as State Significant Projects by the Qld Coordinator-General. The sections have also been declared 'controlled actions' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) with the Commonwealth matters being assessed under a bilateral agreement. The approvals process is in its early stages, and ARTC has commenced some initial environmental studies. The geotechnical investigations will be assessed and approved separately to the Inland Rail projects.

1.2 Purpose of this report

This report focuses solely on the PPP detailed geotechnical investigations for G2K, and the potential for significant impacts to occur to matters of national environmental significance (MNES).

The Commonwealth EPBC Act aims to protect MNES including:

- world heritage properties;
- national heritage places;

- Ramsar wetlands of international importance;
- nationally threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- a water resource, in relation to coal seam gas development and large coal mining development.

If an action will, or is likely to, have a significant impact on any MNES, it is deemed to be a 'controlled action' and requires approval from the Commonwealth Minister for the Environment or the Minister's delegate. To determine whether a proposed action will or is likely to be a controlled action, a Referral of Proposed Action (referral) can be submitted to the Commonwealth Department of the Environment and Energy (DoEE) for assessment.

Where a referral is submitted to the DoEE, a determination will be made by the Minister (or Minister's delegate) as to whether the proposed action is a 'controlled action' and requires assessment and approval under the EPBC Act. The Minister may also decide it is not a controlled action but is to be undertaken in accordance with the manner specified, referred to as 'Not Controlled Action - Particular Manner', or the proposed action is not a controlled action with no further requirements.

The MNES identified with potential to be impacted by the geotechnical investigations include:

- listed threatened species;
- listed threatened ecological communities; and
- migratory species.

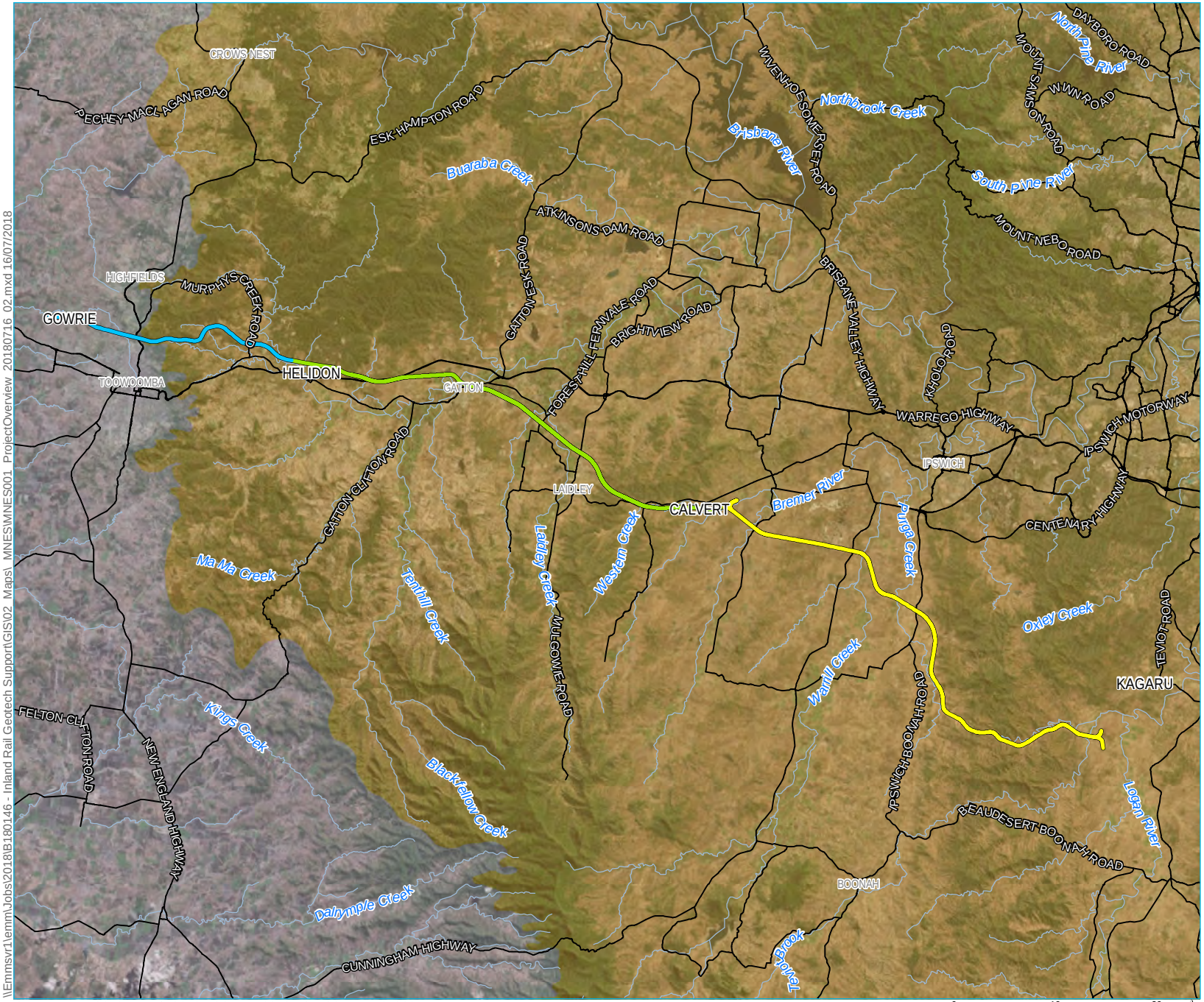
This MNES assessment report has been prepared to support a referral to DoEE under the EPBC Act for geotechnical investigations for G2K focussing on nationally threatened species, ecological communities and migratory species.

The purpose of this EPBC Act assessment is to:

- identify the threatened species, ecological communities and migratory species listed under the EPBC Act that have potential to occur in the proposed action area, and be impacted by geotechnical investigations;
- evaluate the potential for significant impacts to occur to the identified threatened species, ecological communities and migratory species identified as 'known' or 'likely' to occur applying the *EPBC Act Significant Impact Guidelines* (DoEE 2013);
- outline appropriate avoidance, mitigation and management measures to ensure impacts to the identified threatened species, ecological communities and migratory species are avoided and reduced to the greatest extent possible; and

- provide a conclusion as to whether Exploratory Works are likely to have a significant impact to the identified threatened species, ecological communities and migratory species.

This assessment has been undertaken in accordance with applicable guidelines including the *'Matters of National Environmental Significance – Significant Impact Guidelines 1.1'* (DoEE 2013), '*EPBC Act referral guidelines for the vulnerable koala'* (DoEE 2014), '*Draft referral guidelines for the nationally listed Brigalow Belt reptiles*' (DoEE 2011) and '*Significant Impact Guidelines 1.2 – Actions on, or impacting upon Commonwealth land and Actions by Commonwealth Agencies*' (DoEE 2013).



KEY

- Gowrie to Helidon (G2H) baseline alignment
- Helidon to Calvert (H2C) alignment
- Calvert to Kagaru (C2K) alignment
- Main road
- Named watercourse

IBRA region

- Brigalow Belt South bioregion
- South Eastern Queensland bioregion

Source: EMM (2018); ARTC (2018); QSpatial (2018); GA (2015); DES (2007)

0 10 20 km

GDA 1994 MGA Zone 56

N

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Inland Rail - Gowrie to Kagaru

Geotechnical Investigations
Gowrie to Kagaru
Figure 1.1

EMM

1.3 The proponent

ARTC is the proponent for the G2K Project and geotechnical investigations. ARTC is an Australian Government owned corporation and current operator of the Australian freight network. ARTC has been tasked with delivery of the Inland Rail Programme. ARTC was established in 1998 after the privatisation of the national rail network and Commonwealth and State Government agreement to form a 'one-stop' shop for all operators wanting access to the standardised interstate rail network.

ARTC currently manage and maintain approximately 8500 km of rail network across Victoria, New South Wales, South Australia, Western Australia and Queensland. Over the past five years alone ARTC have delivered an almost $3bn capital programme works to modernise the east coast freight rail lines and other projects to enhance the national rail network offering to customers. The Inland Rail Programme is an integral component of the future enhancement of the national rail network.

The company is an integral part of the transport supply chain and a major contributor to the economic development of Australia. It services all the major capitals, markets, regional freight centres and import/export ports in Australia. Its network is used to move a range of commodities including general freight, coal, iron ore, and other bulk minerals and agricultural products.

ARTC operate under various licences and all of their activities are implemented in accordance with corporate policies and procedures including ARTC's Environmental Policy and Environmental Management System.

2 Project Description

In May 2017 the Federal government announced a long-term investment in Inland Rail, funding a combination of an $8.4 billion equity investment in ARTC and a PPP for delivery of the three most complex elements of Inland Rail from G2K in Qld. The value for money provided by the PPP is generated through the sharing or transfer of risk to the private sector. Studies have shown that geotechnical risk is one such risk area that is transferred to the private partner of the PPP and that the more thorough the pre-award Geotechnical Investigation the less geotechnical contingency the private partner will need to build into their price.

ARTC will contract a Geotechnical Service Provider to undertake a program of detailed geotechnical investigations to inform the PPP bid phase and detailed design of the G2K section of the Inland Rail project. The geotechnical investigations will collect suitable data on surface and sub-surface conditions.

A description of G2K and the proposed geotechnical investigations is provided below.

2.1 Inland Rail Gowrie to Kagaru

ARTC are currently finalising the rail corridor for the G2K alignment. There are currently two alignment options being evaluated which are:

- Baseline;
- Option 1 (3216) – baseline alignment with a small deviation to the north of baseline on foothills of Toowoomba range and another small deviation to north of baseline east of Murphys Creek Road.

The two options are illustrated in Figure 2.1 and both options have been evaluated as part of this MNES assessment. Currently Option 1 (3216) is the preferred rail alignment primarily due to construction requirements requiring an increase in the height of the tunnel portals, requiring alignment adjustment to maintain the grades up the hill. Final alignments will be confirmed during the EIS phase for each project.

The G2K project is approximately 127 km in total length commencing at Gowrie west of Toowoomba and finishing at Kagaru, south-west of Jimboomba. G2H is approximately 26 km in length, the H2C project approximately 47 km in length, and the C2K project approximately 54 km in length. All projects consist of a proposed single line, dual gauge track, utilising sections of the existing rail network and new greenfield corridors. They also include construction of tracks and track formation, new culverts and bridges, a tunnel and ventilation infrastructure, construction of new crossing loops, rationalisation of level crossings with some grade separations of the local road network.

For further detailed project descriptions of G2H, H2C and C2K please refer to the initial advice statements (IAS) that can be found on the Qld Coordinator General website at http://www.statedevelopment.qld.gov.au/assessments-and-approvals/current-eis-projects.html.

2.2 Geotechnical Investigations

The geotechnical investigations will include up to approximately 1,313 individual investigation sites that follow the rail alignment. They consist of:

- soil surveys from test pits;

- soil sampling by auger hole;
- rock sampling from boreholes;
- seismic surveys; and
- geological mapping.

Facilitative access tracks will also be required to gain access to investigation sites. Access tracks will preference utilising existing access tracks and cleared areas. In some borehole locations due to the depth of drilling required and larger machinery needed, and where there may be constraints such as steep slopes and dense vegetation, new access tracks may need to be established up to 5 m in width.

Geotechnical investigations will involve the mobilisation of vehicles or machinery, with the majority being accessed by 4WD. A 4WD vehicle can gain access to seismic surveys (SS), geological mapping (GM) sites, and auger holes (AH) with a 4WD ute mounted drill rig. For test pits a small tracked excavator will be used and for boreholes (BH) a larger drill rig will be required.

A more detailed description of the geotechnical investigation sites, related activities and the nature of their disturbance is summarised below. The descriptions show that the geotechnical investigations are of low impact, due to their temporary nature and that most sites can be located in cleared areas. There is also a high degree of flexibility with where investigation sites and access tracks are placed to move them away from identified areas of high biodiversity value and avoid the need to clear woody vegetation.

2.2.1 Access tracks

Access tracks will be 3 m in width and provide entry to geotechnical investigation sites. ARTC will prioritise the use of existing access tracks, and where these are not available establish a new track across existing cleared areas to avoid the need for any vegetation clearing. Where there is an exception is for borehole investigation sites that require a larger drill rig, the access tracks will need to be up to 5 m in width in locations that may be limited by steep, rugged, uneven, soft, and or heavily vegetated land. This is to provide safe access for drilling, trenching and ancillary machinery.

Establishment of new access tracks shall ensure protection against erosion and siltation of waterways. Some access tracks may be maintained for construction access, but the majority will be rehabilitated when no longer required to pre-disturbance land use.

Access tracks may need to cross ephemeral waterways in some locations. Degraded and cleared areas will be targeted for crossings. A preferential path will be designed to avoid established riparian vegetation. This will be ratified by field investigation prior to access occurring. No work will be permitted when drainage lines are active. Below bed rock spall crossings will be incorporated with Certified Professional in Erosion and Sediment Control (CPESC) certified erosion and sediment controls. Where disturbance to riparian areas has occurred, invasive species will be removed and revegetation will occur with local native species. Fauna spotter catchers will also be present during all works. Barriers will be erected around the disturbance to prevent damage from livestock until revegetation is established.

The crossing will monitored and maintained during the Geotech program in accordance with erosion and sediment control (ESC) guidelines. Upon completion of the geotechnical investigations at that location the crossing will be rehabilitated in consultation with the landowner.

2.2.2 Soil sampling test pits

Test pits and trenches shall be excavated by machinery (e.g. rubber tyred back hoe or small tracked excavator) to the required depth to enable visual examination, logging, in-situ testing and sampling from outside the pit or trench as required. Upon completion, test pits will be backfilled as soon as possible, and the excavation shall be reinstated to match the existing surrounding surface as far as practicable. Test pits will be backfilled with excavated spoil, in the general order the material was removed, and be compacted in layers of 300 mm to 500 mm (maximum) using the machine bucket. The excavation will be left with a slightly raised or mounded surface as a precaution against subsidence. Typically, a trench pit will be completed within a day. Where test pits or trenches are required to be left open for a period, safety fencing and all necessary lighting and signage determined by a specific risk assessment for that site, will be installed. Precautions will be taken to protect the pits and trenches from the adverse effects of weather during this period. The estimated disturbance area for each test pit is 0.8 m^2.

2.2.3 Auger hole (soil) sampling

Auger holes will be used where sampling is only required to a shallower depth. They will be drilled using a mobile rig mounted on a four wheel drive light vehicle or small truck. They are usually drilled to a depth of 2 to 25 m below ground level, with a diameter of 75-100 mm to allow for soil and rock sampling from the auger hole as required. As the rig is mounted on a vehicle the disturbance area required is very minor, estimated at 0.2 m^2.

2.2.4 Borehole (rock) sampling

Boreholes will be used where sampling is needed at much deeper depths and rock is encountered. They will be drilled using a truck or track mounted drill rig. They are usually drilled to a depth of 10 to 250 m deep, with a diameter of 100 mm. Deeper holes may also require a support vehicle carrying drill rods, compressors or pumps. Borehole rigs require a relatively flat drilling platform or pad, and the size is dependent on the terrain and the depth of the hole. Deeper holes may require a disturbance area of 100 m^2 to allow for a safe working platform.

Water is usually necessary as a lubricant during the drilling process. Water will be provided under an agreement with a local supplier, and will not be drawn from the site unless specific arrangements have been made with the landholder. Water used for the drilling process is usually contained in a purpose-built tank and recirculated as required until the hole is complete. Following the completion of drilling the water in the tank includes clay and silt in solution and settles over time, after which the water is discharged to land. Where water is required, the volumes are typically between 450 and 900 litres per day.

The borehole will be backfilled on completion using an appropriate method for the location that complies with relevant legislation, plans and guidelines. Drill pads will be rehabilitated as soon as practicable and reinstated to match the previous ground surface. Restoration will occur to natural conditions to pre-disturbance land use.

During the drilling process, the most consistent disturbance will be the sound of an idling diesel engine, occasional louder engine noises, and infrequent hammering noises if rock is encountered. No night time work will be required and work will only occur over a short duration.

2.3 Site Context

The majority of G2K and proposed geotechnical investigation sites are located within the South East Queensland Bioregion, with a small portion west of the Toowoomba Range in the Brigalow Belt Bioregion (refer Figure 1.1).

Large portions of the land where geotechnical investigation sites are proposed are within agricultural areas historically cleared of native vegetation and have been highly disturbed for cropping and grazing. This includes areas on the Darling Downs near Gowrie, Lockyer Creek and areas near Forest Hill and Laidley.

The largest patches of native remnant vegetation where geotechnical investigations are proposed is the Toowoomba Range escarpment and foothills, and Little Liverpool Range. The Toowoomba Range is part of the Great Dividing Range and supports a large intact area of remnant vegetation with potential to provide fauna habitats and is a state significant ecological corridor. The Little Liverpool Range is a mountain range of the Scenic Rim.

The topography from Helidon gently slopes down towards Gatton, remaining relatively flat up to Forest Hill. Ebenezer (east of Calvert) is characterised by predominantly rural and rural-residential land uses, with a considerable amount of remnant vegetation. The area south of Purga towards Peak Crossing contains a mixture of land uses, including a number of rural-residential properties and agricultural estates, poultry farms, Purga Quarry, Gibb Brothers farming operations, and the township of Peak Crossing. Washpool is characterised by predominantly vegetated mountainous areas in the east and rural land uses in the west. The Purga Nature Reserve is also located in this region. Throughout the Woolooman area and the Teviot Range (Flinders Peak Conversation Park), terrain is of a rugged nature.

KEY

- Gowrie to Helidon (G2H) baseline alignment
- Option 3216 alignment
- Helidon to Calvert (H2C) alignment
- Main road
- Named watercourse

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Source: EMM (2018); ARTC (2018); QSpatial (2018); GA (2015)

0 2.5 5 km

GDA 1994 MGA Zone 56

N

G2K alignment options

Geotechnical Investigations
Gowrie to Kagaru
Figure 2.1

EMM

3 Legislative Context

For the Inland Rail G2K projects each section will be assessed and approved independently under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) as State Significant Projects by the Qld Coordinator-General. The sections have also been referred and declared 'controlled actions' under the EPBC Act with the Commonwealth matters being assessed under the bilateral agreement. The assessment and approval processes for Inland Rail will occur separately to the proposed geotechnical investigations that are addressed in this report.

The proposed geotechnical investigations are required to comply with various Qld Acts and Regulations in relation to how works are undertaken and the management of environmental values and impacts. Depending on where investigation sites are located, the nature of proposed works, and the biodiversity values that may be impacted will determine whether an approval or notification is required.

A summary of applicable legislation and potential approval requirements is summarised in Table 3.1.

ARTC is currently undertaking the required assessments and will ensure all Qld and Commonwealth legislative requirements are met for the proposed geotechnical investigations. These requirements will also be outlined in contractual documentation with the company who is engaged to undertake the geotechnical investigations and reflected in applicable documentation including an Environmental Management Plan. The G2K Geotechnical Investigation Environmental Management Plan is provided in Appendix D.

Table 3.1 Applicable legislation to geotechnical investigations

Act/Regulation	Responsible/Administering Authority	Approval/Permit	Applicability
Environment Protection & Biodiversity Conservation Act 1999 (Commonwealth)	DoEE	EPBC Act referral to the DoEE for determination on whether the proposal is a 'controlled action'	Potential impacts to MNES including threatened species and threatened ecological communities
Vegetation Management Act 1999 (Qld)	Department of Natural Resources, Mines and Energy (DNRME) and Department of Infrastructure, Local Government and Planning (DILGP)	Operational works permit for clearing remnant and high value regrowth native vegetation. Permit is granted under *Planning Act 2016*.	Depending on the extent of vegetation clearing required a permit may be necessary. If clearing is within the allowable exemptions under VM Act for geotechnical investigations no permit is required.
Planning Act 2016 (Qld)	DILGP	Operational works permit for clearing remnant and high value regrowth native vegetation. Permit is granted under *Planning Act 2016*.	Depending on the extent of vegetation clearing required a permit may be necessary. If clearing is within the allowable exemptions under VM Act for geotechnical investigations no permit is required.
Nature Conservation Act 1992 (Qld)	Department of Environment and Science (DES)	Where geotechnical investigations require disturbance in an area mapped as 'high risk' a protected plant survey is required to be undertaken. If no EVNT species are identified within the 100 m survey buffer a Protected Plant Exemption Notification can be submitted. If an EVNT species is recorded within the 100 m survey buffer a clearing application is to be submitted. If an animal breeding place, such as a nest or tree hollow, (including those used by an endangered, vulnerable, least concern or special least concern fauna species) may be disturbed as a result of proposed geotechnical investigations a Species Management Program (SMP) will need to be prepared and approved.	Protected plant surveys are currently underway and surveys for G2H are completed. Remaining sections are also nearly complete. To date one EVNT flora species has been recorded in C2K for *Melaleuca irbyana*. The endangered species have been recorded within the 100 m survey buffer therefore a clearing application under NC Act will be submitted. At present it is expected notification exemptions can be lodged for G2H and H2C. No flora species listed under EPBC Act have been found. There is potential for animal breeding places to be present within areas required for geotechnical investigations. If vegetation clearing is required and an animal breeding place cannot be avoided an approved Species Management Program (SMP) will be required. ARTC will be submitting a breeding place SMP which covers geotechnical activities for G2K to Department of Environment and Science (DES) for approval.
Fisheries Act 1994 (Qld)	Department of Agriculture and Fisheries (DAF)	Development permit for Operational Works that is raising or constructing a waterway barrier	There are a number of waterways in the area of proposed geotechnical investigations mapped as low, medium or high risk under the Fisheries Act. Requirement for permit

Table 3.1 Applicable legislation to geotechnical investigations

Act/Regulation	Responsible/Administering Authority	Approval/Permit	Applicability
			to be confirmed depending on the design and nature of creek crossings. It is likely all waterway crossings will comply with the self-assessable code for temporary works. Impacts to waterways will be avoided and no work will be permitted when drainage lines are active.
Water Act 2000 (Qld)	DNRME and DILGP	Riverine Protection Permit may be required for clearing or damage to watercourse vegetation, excavation or placing fill in a watercourse, lake or spring.	No permit is required if the works comply with exemption requirements. It is not anticipated geotechnical investigations will require any works or clearing within a watercourse under *Water Act 2000*. These are larger watercourses containing permanent water.
Biosecurity Act 2014 (Qld)	DAF	Approvals and permits may be required under this Act if there is movement of restricted matter including invasive animals or plants. Movement of soil and other plant material that has potential to carry Fire Ants is also regulated and may require a Biosecurity Instrument Permit.	Parts of H2C and all of C2K are within biosecurity zones for Fire Ant. A Biosecurity Instrument Permit may be required if the codes cannot be met for the management and movement of soil and other carriers such as mulch/hay/turf.
Environmental Protection Act 1994 (Qld)	DES	Disposal of contaminated material from a site listed on the Environment Management Register (EMR) or Contaminated Land Register (CLR) and/or making a material change of use of premises if all or part of the premises is on the EMR or CLR	The likelihood of an approval being required will be dependent on the nature of contaminants present within the material to be disposed.
*Transport Infrastructure Act 1994 (*Qld)	Department of Transport and Main Roads (DTMR)	Road corridor permit for works within a State Controlled Road (s50) Access to State Controlled Road (s62/66)	Geotechnical investigations may be needed on state controlled road corridors therefore permit will need to be obtained from DTMR.

4 Desktop Assessment of MNES

4.1 Desktop searches

Background research and desktop assessments have been completed to provide an understanding of the broader environmental values, landscape features and biodiversity attributes in the study area. The study area is defined by the G2K baseline alignment with a 5 km buffer. Desktop searches have been completed for the two alignment options.

A detailed desktop assessment was completed evaluating a range of information sources to gather information on the biodiversity values across the study area and identify those MNES considered to have potential to occur. Information sources reviewed are summarised below:

- Department of the Environment and Energy (DoEE) Protected Matter Search Tool (PMST) (refer Appendix A) to determine whether matters protected by the EPBC Act are likely to occur in the study area;
- QLD Department of Environment and Science (DES) Wildlife Online to access a recorded list of wildlife in the study area;
- QLD Department of Natural Resources and Mines (DNRM) Regional Ecosystems (RE) mapping of both remnant and high value regrowth (HVR) to determine the vegetation communities and extents that occur in the study area;
- Atlas of Living (ALA) biodiversity database to access geographic records of flora and fauna species that occur in the study area;
- eBird database to access geographic records of birds and migratory birds that occur in the study area;
- QLD DES to determine essential habitat areas in the study area;
- Findings of ecology surveys, including targeted threatened flora species surveys, that have been completed for Inland Rail to inform the geotechnical investigations or EIS.

4.1.1 Toowoomba Second Range Crossing

The Toowoomba Second Range Crossing (TSRC), constructed by Nexus, is a 41 km road bypass north of Toowoomba, QLD. This project is in the vicinity of the G2H study area, and passes through the Toowoomba Range in some areas close to proposed geotechnical investigation sites. Survey findings from this project, including during construction phase, have been taken into consideration. Two threatened species recorded were the vulnerable Collared Delma (*Delma torquata*) and Koala (*Phascolarctos cinereus*) under EPBC Act.

Nexus with approval of DoEE and DES undertook a translocation program for Collared Delma. Intensive investigations were undertaken to identify Collared Delma microhabitat along the project corridor, with specimens collected by ecologists and moved to a soft release area. Collared Delma were collected from areas of proposed impact and moved to one of four translocation areas located within offset properties adjacent to the approved works area. Under the Australian Government's EPBC Act, all translocated Collared Delma will be monitored over a two-year period and key findings adapted into future environmental management plans. This information will also be used to enhance our understanding of

this little understood reptile (Nexus, 2017). Records of where Collared Delma have been captured have been mapped and taken into consideration as part of the impact assessments in Section 7.

4.2 Desktop results

4.2.1 Desktop ecological communities

To identify threatened ecological communities (TECs) with potential to occur in the study area, the following background research was undertaken:

- a review of RE vegetation mapping (DNRM 2018); and
- a search of the PMST (Appendix A) to identify the potential for TECs to occur within 5 km of the baseline alignment.

A list of TECs considered having potential to occur within the survey area based on the results of the background research is provided in Table 4.1. The REs associated with each TEC are also listed.

Table 4.1 Desktop results for TECs

Threatened Ecological Community	EPBC Act status[1]	Associated REs
Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	E	11.3.3, 11.3.15, 11.3.16, 11.3.28, 11.3.37
Lowland Rainforest of Subtropical Australia	CE	12.3.1, 12.5.13, 12.8.3, 12.8.4, 12.8.13, 12.11.1, 12.11.10, 12.12.1, 12.12.16
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	11.3.23, 11.8.2a, 11.8.8, 11.9.9a, 12.8.16, 13.3.4, 13.3.1, 13.11.3, 13.11.4, 13.11.8, 13.12.8, 13.12.9
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	CE	11.3.21, 11.3.24
Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland	CE	12.9-10.11, 12.3.18
Weeping Myall Woodlands	E	11.3.2, 11.3.28, 11.9.3a
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	E	11.11.18, 11.3.11, 11.11.18, 11.4.1, 11.5.15, 11.8.13, 11.9.4, 11.2.3, 11.8.3, 11.8.6, 11.9.8

1. *EPBC Act status: CE- critically endangered, E – endangered, VU – vulnerable*

4.2.2 Desktop flora species

To identify threatened flora species occurring in the study area, the following background research was undertaken:

- a search of the PMST (Appendix A) to identify threatened flora species with potential to occur within 5 km of the G2K baseline alignment;

- a search of the Wildlife Online to identify threatened flora species listed under the EPBC Act (and NC Act) previously recorded within 5 km of the G2K baseline alignment; and
- a search of ALA to identify records of threatened flora within 5km of the G2K baseline alignment.

A list of threatened flora species considered to have potential to occur within the study area based on background research is provided in Table 4.2.

Table 4.2 Threatened flora species with potential to occur within the survey area

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Species recorded within 5km on Wildlife Online
Arthraxon hispidus	Hairy-joint Grass	VU	V	✗
Bertya ernestiana	-	VU	V	✗
Bosistoa transversa	Three-leaved Bosistoa	VU	LC	✗
Bothriochloa bunyensis	Satin-top Grass	VU	V	✗
Bulbophyllum globuliforme	Miniature Moss-orchid	VU	NT	✗
Clematis fawcettii	Stream Clematis	VU	V	✗
Cupaniopsis tomentella	Boonah Tuckeroo	VU	V	✓
Cycas ophiolitica	-	EN	E	✗
Dichanthium queenslandicum	King Blue-grass	EN	E	✗
Dichanthium setosum	Bluegrass	VU	LC	✗
Grevillea quadricauda	-	VU	V	✗
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	VU	V	✗
Lepidium peregrinum	Wandering Pepper-cress	EN	LC	✗
Macadamia integrifolia	Macadamia Nut	VU	V	✗
Macadamia tetraphylla	Rough-shelled Bush Nut	VU	V	✗
Notelaea ipsviciensis	Cooneana Olive	CE	E	✗
Notelaea lloydii	Lloyd's Olive	VU	V	✓
Paspalidium grandispiculatum	-	VU	V	✗
Phebalium distans	Mt Berryman Phebalium	CE	E	✗
Picris evae	Hawkweed	VU	V	✗
Planchonella eerwah	Shiny-leaved Condoo	EN	E	✓
Rhaponticum australe	Austral Cornflower	VU	V	✗
Samadera bidwillii	Quassia	VU	V	✗
Sarcochilus hartmannii	Waxy Sarcochilus	VU	V	✗
Sarcochilus weinthalii	Blotched Sarcochilus	VU	E	✗
Sophora fraseri	-	VU	V	✗
Thesium australe	Austral Toadflax	VU	V	✗

1. *EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable*
2. *NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened, LC – least concern*

4.2.3 Desktop fauna species

To identify threatened fauna species occurring in the study area, the following background research was undertaken:

- a search of the PMST (Appendix A) to identify threatened fauna species with potential to occur within 5 km of the G2K baseline alignment;
- a search of the Wildlife Online to identify threatened flora species listed under the EPBC Act (and NC Act) previously recorded within 5 km of the G2K baseline alignment; and
- a search of ALA to identify records of threatened fauna in 5km of the baseline alignment.

A list of threatened fauna species considered to have potential to occur within the study area is provided in Table 4.3.

Table 4.3 Threatened fauna species with potential to occur in survey area

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Species recorded within 5km on Wildlife Online
Birds				
Anthochaera phrygia	Regent Honeyeater	CE	E	✓
Botaurus poiciloptilus	Australasian Bittern	EN	-	✗
Calidris ferruginea	Curlew Sandpiper	CE, M	E	✓
Grantiella picta	Painted Honeyeater	VU	V	✗
Lathamus discolor	Swift Parrot	CE, M	E	✓
Numenius madagascariensis	Eastern Curlew	CE, M	E	✓
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	EN	E	✓
Dasyornis brachypterus	Eastern Bristlebird	EN	E	✗
Erythrotriorchis radiatus	Red Goshawk	VU	E	✓
Geophaps scripta scripta	Squatter Pigeon (southern)	VU	V	✗
Poephila cincta cincta	Southern Black-throated Finch	EN	E	✗
Turnix melanogaster	Black-breasted Button-quail	VU	V	✓
Esacus magnirostris	Beach Stone-curlew	M	V	✓
Charadrius leschenaultii	Greater Sand Plover	VU, M	V	✓
Charadrius mongolus	Lesser Sand Plover	EN	E	✓
Limosa lapponica baueri	Bar-tailed Godwit (Western Alaskan)	VU	V	✓
Rostratula australis	Australian Painted Snipe	EN	V	✓
Small terrestrial mammals				
Potorous tridactylus tridactylus	Long-nosed Potoroo	VU	V	✗
Pseudomys novaehollandiae	New Holland Mouse	VU	V	✗

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Species recorded within 5km on Wildlife Online
Large terrestrial mammals				
Dasyurus maculatus maculatus	Spot-tailed Quoll	EN	V	✓
Dasyurus hallucatus	Northern Quoll	EN	-	✗
Petrogale penicillata	Brush-tailed Rock-wallaby	VU	V	✓
Arboreal mammals				
Petauroides volans	Greater Glider	VU	V	✗
Phascolarctos cinereus	Koala	VU	V	✓
Bats				
Nyctophilus corbeni	Corben's Long-eared Bat	VU	V	✗
Chalinolobus dwyeri	Large-eared Pied Bat	VU	V	✗
Pteropus poliocephalus	Grey-headed Flying-fox	VU	-	✗
Fish				
Maccullochella mariensis	Mary River Cod	EN	-	✗
Maccullochella peelii	Murray Cod	VU	-	✗
Neoceratodus forsteri	Australian Lungfish	VU	-	✗
Reptiles				
Anomalopus mackayi	Five-clawed Worm-skink	VU	E	✗
Furina dunmalli	Dunmall's Snake	VU	V	✗
Saiphos reticulatus	Three-toed Snake-tooth Skink	VU	-	✗
Tympanocryptis condaminensis	Condamine Earless Dragon	EN	E	✗
Delma torquata	Collared Delma	VU	V	✓
Egernia rugosa	Yakka Skink	VU	V	✗
Insects				
Argynnis hyperbius inconstans	Australian Fritillary	CE	E	✗
Phyllodes imperialis smithersi	Pink Underwing Moth	EN	-	✗

1. *EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, M – marine*
2. *NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened*

4.2.4 Desktop migratory species

To identify a list of candidate migratory species for further consideration and assessment, the following background research was undertaken:

- a search of the PMST (Appendix A) to identify threatened migratory species with potential to occur within 5 km of the G2K baseline alignment;
- a search of the Wildlife Online to identify threatened flora species listed under the EPBC Act (and NC Act) previously recorded within 5 km of the G2K baseline alignment; and
- a search of eBird to identify records of threatened migratory species within 5km of baseline alignment.

A list of migratory species considered to have potential to occur within the study area is provided in Table 4.4.

Table 4.4 Migratory species with potential to occur within the survey area

Scientific name	Common Name	Migratory status[1]	Species recorded within 5km on Wildlife Online
Actitis hypoleucos	Common Sandpiper	Mi, M	×
Apus pacificus	Fork-tailed Swift	Mi, M	×
Cuculus optatus	Oriental Cuckoo	Mi	×
Monarcha melanopsis	Black-faced Monarch	Mi, M	×
Symposiachrus trivirgatus	Spectacled Monarch	Mi, M	×
Calidris acuminata	Sharp-tailed Sandpiper	Mi, M	×
Calidris ferruginea	Curlew Sandpiper	CE, Mi, M	✓
Calidris melanotos	Pectoral Sandpiper	Mi, M	×
Calidris ruficollis	Red-necked Stint	Mi, M	×
Gallinago hardwickii	Latham's Snipe	Mi, M	×
Pandion haliaetus	Osprey	Mi, M	×
Tringa nebularia	Common Greenshank	Mi, M	×
Tringa stagnatilis	Marsh Sandpiper	Mi, M	×
Hirundapus caudacutus	White-throated Needletail	Mi, M	×
Motacilla flava	Yellow Wagtail	Mi, M	×
Myiagra cyanoleuca	Satin Flycatcher	Mi, M	×
Numenius madagascariensis	Eastern Curlew	CE, Mi, M	✓
Rhipidura rufifrons	Rufous Fantail	Mi, M	×

1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory, M – marine

4.3 Regional ecosystems

To assist with the likelihood of occurrence of threatened TECs, flora and fauna species, an assessment of regional ecosystems (REs) occurring in the study area that are intersected by the alignment options and proposed geotechnical investigation sites was completed. These are summarised in Table 4.5.

REs were taken from the Qld Government regulated vegetation mapping v10.1 (DES 2018).

Table 4.5 Regional Ecosystems

Regional Ecosystem	Description	EPBC Act status[1]	VM Act status[2]
12.3.3	*Eucalyptus tereticornis* woodland on Quaternary alluvium	-	E
12.3.3d	*Eucalyptus moluccana* woodland. Other frequently occurring species include *Eucalyptus tereticornis, E. crebra, E. siderophloia, Corymbia citriodora subsp. variegata, Angophora leiocarpa* and *C. intermedia*. Occurs on margins of Quaternary alluvial plains often adjacent sedimentary geologies. May also occur on stranded Pleistocene river terraces. Floodplain (other than floodplain wetlands).	-	E
12.3.7	*Eucalyptus tereticornis*, *Casuarina cunninghamiana* subsp. *cunninghamiana* +/- *Melaleuca spp*. fringing woodland	-	LC
12.3.18	*Melaleuca irbyana* low open forest or thicket. Emergent *Eucalyptus moluccana, E. crebra, E. tereticornis or Corymbia citriodora subsp. variegata* may be present. Occurs on Quaternary alluvial plains where drainage of soils is impeded	CE - Swamp tea-tree TEC	E
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	-	LC
11.8.5	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks	-	LC
12.8.9	*Lophostemon confertus* open forest on Cainozoic igneous rocks	-	LC
12.8.14	*Eucalyptus eugenioides, E. biturbinata, E. melliodora +/- E. tereticornis*, *Corymbia intermedia* woodland on Cainozoic igneous rocks	-	LC
12.8.17	*Eucalyptus melanophloia +/- E. crebra, E. tereticornis, Corymbia tessellaris* woodland on Cainozoic igneous rocks	-	LC
12.8.21	Semi-evergreen vine thicket with *Brachychiton rupestris o*n Cainozoic igneous rocks. Usually southern half of bioregion	-	E
12.9-10.2	*Corymbia citriodora* subsp. *variegata* +/- *Eucalyptus crebra* open forest on sedimentary rocks	-	LC
12.9-10.3	*Eucalyptus moluccana* open forest on sedimentary rocks	-	OC
12.9-10.7	*Eucalyptus crebra +/- E. tereticornis*, *Corymbia tessellaris*, *Angophora spp., E. melanophloia* woodland on sedimentary rocks	-	OC
12.9-10.11	*Melaleuca irbyana* low open forest or thicket. Emergent *Eucalyptus moluccana, E. crebra, E. tereticornis or Corymbia citriodora subsp. variegata* may be present. Occurs on Mesozoic sediments where drainage of soils is impeded	CE - Swamp tea-tree TEC	E
12.9-10.15	Semi-evergreen vine thicket with Narrow-leaved Bottle Trees on sedimentary rocks		E
12.9-10.17a	*Lophostemon confertus* or *L. suaveolens* dominated open forest usually with emergent Eucalyptus and/or Corymbia species. Occurs in gullies and southern slopes on Cainozoic and Mesozoic sediments.	-	LC

Notes: *1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable*

2. NC Act status: CE – critically endangered, E – endangered, OC – of concern, LC – least concern

5 Field Surveys

The following sections summarise field ecology surveys that have been completed for the geotechnical investigation sites, as well as to support EIS for the G2K projects. These surveys have been commissioned by ARTC to support an understanding of the biodiversity values that occur in the area of the proposed alignment, including MNES.

5.1.1 Protected plant surveys

Areas of the G2K alignment intersect areas of 'high risk trigger mapping' under the NC Act. Targeted threatened flora surveys adopting the required survey methods under the *Protected Plant Survey Guidelines* (DEHP 2014) have been completed. Main methodology adopted for these surveys is a timed meander survey as defined in Section 6.2.2 of the Flora Survey Guidelines (DEHP 2014) to identify and locate potentially occurring EVNT flora species within the clearing impact area. The timed meander survey methodology involved traversing the vegetation community in a random manner and recording any EVNT flora species or potential flora species occurring in the area. The survey ceased once no new flora species had been recorded for a period of 30 minutes, or the entire survey area was covered.

Protected plant surveys commenced in March 2018 and are still underway as land access is permitted. No threatened flora species listed under EPBC Act have been recorded to date. *Melaleuca irbyana* individuals (listed as endangered under NC Act) have been recorded in the C2K section. Individuals recorded were predominantly found as individual trees or clumps of individuals (often suckering regrowth) that didn't meet the TEC requirements.

In the C2K section in an area south of Paynes Road, Ebenezer during protected plant surveys two remnant patches were confirmed as RE12.3.18. The patches were then confirmed by a suitably qualified person to meet the requirements for the Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland TEC. The location of the TEC patches are shown in Appendix E.

5.1.2 Terrestrial ecology surveys for EIS

ARTC has commenced ecology surveys for the G2K EIS studies and preliminary findings have been considered as part of this geotechnical investigations MNES assessment report.

Terrestrial field investigations were undertaken during the month of September 2017 by three teams, with each team specifically focusing on one of the two sections of the G2K alignment (i.e. G2H, H2C and C2K). Fauna survey techniques included habitat values assessment, motion cameras, Anabat, and analysis of scat and scratches. Scats were sent to the Queensland Museum to confirm identifications made in the field. Field investigations resulted in obtaining a baseline dataset of the existing flora and fauna species within each alignment, including conservation significant species (flora and fauna listed as critically endangered, endangered, vulnerable or near-threatened) and TECs under the provisions of the NC Act and/or the EPBC Act. In addition, the identification of traces (ie scats, tracks and other indirect evidence) left by conservation significant fauna species and their potential habitat was assessed.

Key findings were:

- multiple specimens of *Melaleuca irbyana* (Endangered – NC Act) were recorded within the C2K alignment;

- multiple locations identified as suitable habitat for *Thesium australe* (Vulnerable – NC Act and EPBC Act), *Rhaponticum australe* (Vulnerable – NC Act and EPBC Act) and *Picris evae* (Vulnerable – NC Act and EPBC Act) were identified within the G2H and H2C alignments;

- evidence of Koala (Vulnerable – NC Act and EPBC Act) (ie diagnostic scratches on trees and the presence of scats under preferred food trees) were identified across the entire G2K alignment where preferred habitat was present;

- direct observations of Koalas were made within the eastern portion of the G2H alignment;

- known populations of the Collared Delma (Vulnerable – NC Act and EPBC Act) occur adjacent to the Toowoomba Second Range Crossing project. This area is contained within the G2H portion of the alignment;

- multiple species considered to be migratory (eg Satin Flycatcher and Spectacled Monarch) were identified throughout the G2K alignment;

Swift Parrots were identified on 21 June 2018 as an incidental observation during targeted flora surveys. Four individuals were observed foraging on Grey Box (*Eucalyptus moluccana*) trees in area of Ebenezer, on a property located on Rosewood Warrill View Road. The location is shown in habitat mapping provided in Appendix E.

The above findings have been taken into consideration as part of the MNES impact assessments in this report.

6 Candidate species and communities

Following the assessment of desktop review results and field survey results, 20 MNES (including threatened communities, flora and fauna species and migratory species) have been identified as known or likely to occur in the study area. The study area encompasses a 5 km buffer from the alignment.

The MNES identified in the desktop searches were categorised based on their potential to occur in the study area. Four categories were used to define the likelihood of occurrence:

1. Known – confirmed sighting of the species during ARTC commissioned field surveys, and/or confirmed presence from other field assessments within the proposed investigation areas;

2. Likely – suitable habitat occurs within the study area, and recent desktop records (since 2000) are present in the study area;

3. Potential – suitable habitat occurs within the study area, the study area is within the known distribution of the protected matter, but there are no recent desktop records within the study area; and

4. Unlikely - no suitable habitat or records occur in the study area, and the study area is outside the protected matter's known distribution.

The likelihood of occurrence assessments for all MNES identified in the desktop searches is provided in Appendix B. Communities and species considered as candidate ecological communities (which are known or likely to occur) are summarised in Section 6.1.

6.1 List of candidate ecological communities

One TEC has been identified as a candidate community for further assessment. The other six desktop TECs are not considered as likely to occur (Appendix B). The candidate TEC is listed in Table 6.1.

Table 6.1 Candidate TEC

Threatened Ecological Community	EPBC Act status[1]	NC Act status	Rationale and location
Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland	CE	-	Known - the TEC was confirmed in the field in area of proposed geotechnical investigations in the Ebenezer area (as shown in Appendix E). Targeted flora surveys undertaken in the study area have confirmed the presence of individual *M. irbyana* within the C2K section, south of Rosewood and Ebenezer. There is potential for surrounding areas in C2K to support the Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland TEC. Associated REs with TEC include; RE12.9-10.11 and RE12.3.18.

Notes: 1.EPBC Act status: CE- critically endangered

6.2 List of candidate flora species

A likelihood of occurrence assessment was completed for the 27 flora species (Appendix B). As a result, this assessment determined that four threatened flora species are likely to occur in the study area, and therefore be considered candidate flora species for the purposes of this referral. Habitat mapping for these flora species is provided in Appendix E and habitat criteria are provided in Table 6.2.

Candidate flora species identified as known or likely to occur are listed in Table 6.2.

Table 6.2 Candidate flora species

Scientific name	Common Name	EPBC[1] Act status	NC Act[2] status	Rationale and location	REs associated with suitable habitat along study area
Grevillea quadricauda	-	VU	V	Likely - Desktop review confirmed records of the species within the study area of G2H section in Lockyer National Park. Suitable potential habitat is present within the study area along creek lines.	12.8.14, 12.8.17, 12.9-10.2, 12.3.7, 12.9-10.17a, 12.9-10.2, 12.9-10.7, 12.3.3d, 12.3.3, 12.9-10.3, 11.3.25 in riparian zones
Paspalidium grandispiculatum	-	VU	V	Likely - Desktop review confirmed records of the species within the study area of G2H section in Lockyer National Park. Suitable mixed eucalypt forest habitat is present within the study area.	12.8.14, 12.8.17, 12.9-10.2, 12.3.7, 12.9-10.17a, 12.9-10.2, 12.9-10.7, 12.3.3d, 12.3.3, 12.9-10.3, 11.3.25
Picris evae	Hawkweed	VU	V	Likely - Desktop review confirmed records of the species north and south of the G2H section in Toowoomba. Field surveys confirmed that suitable open eucalypt woodland habitat is present within the study area.	12.8.14, 12.8.17, 12.9-10.2, 12.3.7, 12.9-10.17a, 12.9-10.2, 12.9-10.7, 12.3.3d, 12.3.3, 12.9-10.3, 11.3.25
Thesium australe	Austral Toadflax	VU	V	Likely - Desktop review confirmed records of the species within the study area of G2H section in the Toowoomba Range. Field surveys confirmed that suitable habitat is present within the study area.	12.3.7, 12.9-10.7, 12.3.3d, 12.3.3, 12.8.14, 12.8.17, 11.3.25

Notes: *1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable*

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

6.3 List of candidate fauna species

A likelihood of occurrence assessment was completed for the 38 fauna species (Appendix B). As a result, this assessment determined that nine threatened fauna species are known or likely to occur in the study area, and therefore be considered candidate fauna species for the purposes of this referral. Habitat mapping for these fauna species is provided in Appendix E and habitat criteria are provided in Table 6.3.

Candidate fauna species are listed in Table 6.3.

Table 6.3 Candidate fauna species

Scientific name	Common Name	EPBC[1] Act status	NC[2] Act status	Rationale and location	REs associated with suitable habitat along study area
Turnix melano gaster	Black-breasted Button-quail	VU	V	Likely - Desktop review confirmed records of the species in the study area of G2H section near Gowrie Junction and Toowoomba Range, and the C2K section in Flinders Peak Conservation Park. Platelets were observed during targeted protected plant surveys on foothills of Toowoomba range.	12.8.21, 12.9-10.15 (remnant and high value regrowth (HVR))
Lathamus discolor	Swift Parrot	CE, M	E	Known - The species was recorded during field surveys in *Eucalyptus moluccana* woodland in C2K.	12.3.3d 12.3.7, 12.9-10.7, 12.3.3d, 12.3.3, 12.8.14, 12.8.17, 11.3.25 (remnant and HVR)
Rostratula australis	Australian Painted Snipe	EN	V	Likely - Desktop review confirmed known records of these species between the G2H and H2C sections, mainly near Helidon Spa and Laidley Heights. Suitable wetland habitat is available in within the study area.	Wetlands mapped by DES in G2H and H2C
Dasyurus maculatus maculatus	Spot-tailed Quoll (southern subspecies)	EN	V	Likely - Desktop review confirmed records of the species within the G2H section in the Little Liverpool Range area. Field surveys confirmed potential habitat with hollows and rocky outcrops for dens within the Toowoomba Range.	12.9-10.2, 12.9-10.7, 12.9-10.15, 12.8.21, 12.8.17, 12.8.14, 12.8.9 (remnant vegetation)
Petauroides volans	Greater Glider	VU	V	Likely - Desktop review confirmed records of the species within the G2H section. The species is restricted to areas with remnant eucalypt forests with abundant hollows.	12.3.7, 12.9-10.2, 12.9-10.17a, 12.9-10.7, 12.3.3d, 12.3.3, 12.9-10.3, 12.8.14, 12.8.17, 11.8.5, 11.3.25 (remnant vegetation)
Phascolarctos cinereus	Koala	VU	V	Known - Desktop review confirmed records of the species between the G2H and H2C sections. The species was confirmed during field surveys. Essential habitat areas include Lockyer National Park, Lockyer Creek, land north east of Placid Hills, Gatton National Park, eastern slopes of Little Liverpool Range and eastern slopes of Toowoomba Range.	12.8.14, 12.8.17, 12.9-10.2, 12.3.7, 12.9-10.17a, 12.9-10.2, 12.9-10.7, 12.3.3d, 12.3.3, 12.9-10.3, 11.3.25 (remnant and HVR)
Pteropus poliocephalus	Grey-headed Flying-fox	VU	-	Likely - Desktop review confirmed records of the species within the study area, mainly in Toowoomba Range, Laidley and Flinders peak Conservation Park. Habitat is seasonal, depending on the availability of nectar in eucalypt, melaleuca and banksia trees.	12.8.14, 12.8.17, 12.9-10.2, 12.3.7, 12.9-10.17a, 12.9-10.2, 12.9-10.7, 12.3.3d, 12.3.3, 12.9-10.3, 11.3.25, 11.8.5 (remnant and HVR)

Scientific name	Common Name	EPBC[1] Act status	NC[2] Act status	Rationale and location	REs associated with suitable habitat along study area
Delma torquata	Collared Delma	VU	V	Likely - Desktop review confirmed records of the species in the G2H section in the Toowoomba Range. Field surveys confirmed suitable habitat containing eucalypt woodland with rocky outcrops is available. Field surveys from the TSCR project confirmed the presence of this species in Toowoomba Range.	12.9-10.2, 12.9-10.7, 12.9-10.15, 12.8.21, 12.8.17, 12.8.14, 12.8.9 (remnant and HVR) Plus areas within 1km of confirmed records.
Neocera todus forsteri	Australian Lungfish	VU	-	Likely – Desktop review confirmed records of the species in the H2C section in Lockyer Creek, north of Gatton. This species is limited to watercourses.	Not applicable

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, M - marine

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

6.4 List of candidate migratory species

A likelihood of occurrence assessment was completed for the 18 migratory species (Appendix B). Six migratory species were assessed as known or likely to occur in study area. Candidate migratory species are listed in Table 6.4 including habitat criteria. Habitat mapping is provided in Appendix E.

Table 6.4 Candidate migratory species

Scientific name	Common Name	EPBC[1] Act status	NC Act[2] status	Rationale and location	REs associated with suitable habitat along study area
Monarcha melanopsis	Black-faced Monarch	Mi, M	-	Likely - Desktop review confirmed records of the species within the G2H section along the Toowoomba Range and Flinders Peak Conservation Park. Suitable habitat is available within the G2H and C2K sections.	12.8.21, 12.9-10.15 (remnant and HVR)
Gallinago hardwickii	Latham's Snipe	Mi, M	-	Likely - Desktop review confirmed known records of these species between the G2H and H2C sections, mainly near Gowrie Junction, Helidon Spa and Laidley Heights. Suitable wetland habitat is available in within the study area.	Wetlands in G2H and H2C mapped by DES
Hirundapus caudacutus	White-throated Needletail	Mi, M	-	Likely - Desktop review confirmed records of these species within the study area, mainly in Toowoomba Range, Helidon, Laidley Heights and Peak Crossing. The species is almost exclusively aerial.	-
Rhipidura rufifrons	Rufous Fantail	Mi, M	-	Likely - Desktop review confirmed known records of these species within the study area, mainly concentrated around Toowoomba and Rosewood, and a record found in Flinders Peak Conservation Area. Suitable dry sclerophyll forest habitat (for when the species is on passage) is present within the study area.	12.8.14, 12.8.17, 12.8.21 (remnant and HVR)

Scientific name	Common Name	EPBC[1] Act status	NC Act[2] status	Rationale and location	REs associated with suitable habitat along study area
Myiagra cyanoleuca	Satin flycatcher	Mi	-	Known – recorded during ecology surveys for ARTC	12.8.14, 12.8.17, 12.9-10.2, 12.3.7, 12.9-10.17a, 12.9-10.2, 12.9-10.7, 12.3.3d, 12.3.3, 12.9-10.3, 11.3.25 (remnant and HVR)
Symposiachrus trivirgatus	Spectacled Monarch	Mi	-	Known – recorded during ecology surveys for ARTC	-

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory, M - marine

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

7 Impact assessment and mitigation

This section discusses the potential direct and indirect impacts on threatened communities and species identified as 'known' or 'likely' to occur within the study area based on the outcomes of the desktop assessment and field surveys outlined above. The impact assessment has considered the various types of geotechnical investigations that will be required and their potential to impact MNES.

In summary a large proportion of the proposed geotechnical investigations will not require vegetation clearing or disturbance to native flora and fauna species habitats. Many areas are within lands that have been previously cleared and highly disturbed due to grazing and agricultural purposes. There is also flexibility in where sites are located thereby allowing ARTC to target existing cleared areas and avoid native vegetation, including individual trees. A number of geotechnical investigation types either have no requirement for ground disturbance such as geological mapping, or very minor disturbance such as seismic surveys undertaken by using a hand held probe, and auger holes as the machine is mounted on a 4WD vehicle and they can gain access through existing cleared areas and avoid any native vegetation. Where the largest potential exists for impacts to occur are the borehole locations as they require a larger drilling pad as well as require access for larger drill rigs. Therefore an access track may need to be cleared (particularly where they are proposed in remnant vegetation or on slopes) as well as clearing to level a drilling pad. Access tracks can be up to 5 m wide to borehole locations.

The following sections assess what the direct and indirect impacts could be to MNES and the avoidance and mitigation measures that will be put in place.

7.1 Potential direct and indirect impacts

The main direct impacts of the geotechnical investigations will be associated with clearing of native vegetation and loss of species habitat. Other direct impacts may include:

- loss of breeding and/or foraging habitat for threatened fauna species including hollow-bearing trees;
- loss of habitat for threatened flora species;
- fragmentation of flora and fauna habitats;
- clearing of individual threatened flora species;
- direct impacts from clearing of vegetation on fauna species;
- direct impacts from vehicles/machinery on sedentary species that may reside under logs, leaf litter; and
- disturbance to riparian areas and drainage lines where access tracks are required to go across these waterways with larger machinery for boreholes.

The geotechnical investigations also have potential to result in indirect impacts. These include:

- increase in noise, vibration and dust levels;
- sediment runoff and/or contaminant runoff into adjacent watercourses; and
- increase the spread of weeds which can reduce habitat quality.

7.2 Measures to avoid, minimise and mitigate impacts

ARTC have undertaken significant steps to avoid, minimise and mitigate impacts. A key focus for the planning and implementation of geotechnical investigations will be to locate sites in existing cleared areas, maximise the use of existing access tracks, and avoid areas of biodiversity value including remnant and regrowth native vegetation, riparian areas, protected plants and watercourses.

Measures undertaken to avoid, minimise and mitigate impacts are outlined below for each type of geotechnical investigation activity.

7.2.1 Test pit soil sampling

Trench pits will be excavated by machine (e.g. a rubber tyred back hoe, or small tracked excavator). The pits will be dug to the required depth to allow a visual examination of the soil, logging, in-situ testing and sampling from the pit as required. Maximum depth of test pits is most commonly 2 m below ground level, with a width of approximately 600 mm. The area of disturbance includes the pit and the spoil pile, and does not usually exceed 0.8 m^2.

The excavator will gain access to the site using existing cleared tracks and manoeuvre around any existing native vegetation. The area of the trench will also be located in existing cleared/disturbed areas and away from watercourses to avoid any environmental impacts.

While the test pits are in action, a suitably qualified fauna spotter catcher will assess the pits daily for any fauna entrapments. Pits will be backfilled on completion, and the excavation will be reinstated to match the existing ground surface. Test pits will be backfilled with excavated soil in the general order it was removed, and be compacted using the machine bucket. The excavation will be left with a slightly mounded profile to allow for settling. Test pits are usually completed within a day, however if a test pit is required to be left open for a longer period of time, safety precautions such as fencing and signage will be installed.

7.2.2 Auger hole soil sampling

Auger holes will be drilled using a mobile rig mounted on a four wheel drive light vehicle or small truck. They are usually drilled to a depth of 2 to 25 m below ground level, with a diameter of 75-100 mm to allow for soil and rock sampling from the auger hole as required. The area of disturbance is limited to the auger hole and drill cuttings, which is approximately 0.2 m^2.

The vehicle will gain access to the site using existing cleared tracks and manoeuvre around any existing native vegetation. The area of the drill hole will also be located in existing cleared/disturbed areas and away from watercourses to avoid any environmental impacts.

The auger hole will be backfilled on completion using soil and rock cuttings from the drilling process and any surplus material will be mounded over the hole. Shallow auger holes are often completed within an hour, and deeper auger holes taking up to one day.

7.2.3 Borehole rock sampling

Boreholes will be drilled using a truck or track mounted drill rig. They are usually drilled to a depth of 10 to 250 m deep, with a diameter of 100 mm. Deeper holes may also require a support vehicle carrying drill rods, compressors or pumps. Borehole rigs require a relatively flat drilling platform or pad, and the size is dependent on the terrain and the depth of the hole. Deeper holes may require a pad up to 100 m^2 to allow for a safe working area.

Water is usually necessary as a lubricant during the drilling process. Water will be provided under an agreement with a local supplier, and will not be drawn from the site unless specific arrangements have been made with the landholder. Water used for the drilling process is usually contained in a purpose-built tank and recirculated as required until the hole is complete. Following the completion of drilling the water in the tank includes clay and silt in solution and settles over time, after which the water is discharged to land. Where water is required, the volumes are typically between 450 and 900 litres per day.

The borehole will be backfilled on completion using an appropriate method for the location that complies with relevant legislation, plans and guidelines. Drill pads will be rehabilitated as soon as practicable and reinstated to match the previous ground surface.

For a number of borehole locations the machinery and vehicles will be able to utilise existing access tracks and cleared areas to gain entry to the drilling site. In areas of more dense vegetation, and areas on steeper slopes such as the Toowoomba range and foothills, 5 m wide access tracks will need to be established, and a drilling pad of approximately 100 m^2.

The following mitigation measures will be implemented for all investigation sites:

- access tracks will be targeted to use existing tracks and cleared areas to avoid any disturbance to native vegetation and habitats. Where new access tracks may be required they will be placed to avoid areas of high biodiversity value including mature, hollow bearing trees, riparian vegetation and watercourses;

- establishment of new access tracks shall ensure protection against erosion and sedimentation of waterways. Some access tracks may be maintained for construction access, but the majority will be rehabilitated when no longer required to pre-disturbance land use;

- access tracks may need to cross minor ephemeral waterways in some locations. Degraded and cleared areas will be targeted for crossings. A preferential path will be designed to avoid established riparian vegetation. This will be ratified by field investigation prior to access occurring. No work will be permitted when drainage lines are active. Below bed rock spall crossings will be incorporated with CPESC certified erosion and sediment controls. Where disturbance to riparian areas has occurred, invasive species will be removed and revegetation will occur with local native species. Fauna spotter catchers will also be present during all works. Barriers will be erected around the disturbance to prevent damage from livestock until revegetation is established;

- prior to any disturbance or vegetation clearing a fauna spotter catcher will check the area for any fauna and breeding places. No-go areas will be clearly marked to ensure clearing stays within the agreed areas;

- during clearing the fauna spotter catcher will spot for wildlife (including Koalas), relocate species where appropriate (such as reptiles found under logs/leaf litter) in accordance with best practice guidelines, and ensure impacts to fauna are minimised;

- if Koalas are observed the tree they are in, and adjacent trees will not be disturbed. The Koala will be left to move out of the area on its own accord and ARTC will ensure a safe corridor is retained for its movement from the site; and

- a suitably qualified ecologist will also be engaged to undertake a pre-clearance ecology survey prior to any disturbance of confirmed impact areas. This will include a survey to check for the presence of listed flora species, identification of weeds including those of higher risk that may require control prior to disturbance, and any other biodiversity values that should be avoided and impacts managed such as fauna breeding places. This survey will be undertaken closer to the time the investigation site will be established to ensure findings reflect current conditions at the site.

7.2.4 Access tracks

Borehole locations will require access tracks up to 5 m in width in areas that are constrained due to steep, rugged, uneven, soft, and or heavily vegetated land. Construction of access tracks will provide safe access for drilling, trenching and ancillary machinery. Access tracks to other investigation sites will be up to 3 m in width and will be used by 4WD or small excavator therefore there is a greater ability to avoid trees and other native vegetation.

All access tracks will preferentially be located on existing access tracks and tracks that are located on previously cleared or disturbed land will be used when possible. Where existing tracks are not available, access tracks will be micro-sited to avoid and minimise impacts on vegetation. Removal of any threatened flora species will be avoided, as will the removal of large hollow-bearing trees. Some tracks may be maintained for rail construction access. All others will be rehabilitated to natural conditions when no longer required to pre-disturbance land use. Development of access tracks in close proximity to waterways shall ensure protection against erosion and sedimentation of water courses. Erosion and sediment control measures will be implemented in accordance with an approved Erosion and Sediment Control Plan and EMP for the geotechnical investigations.

7.3 Significant impact assessments

For the candidate MNES communities and species summarised in Section 6, an assessment has been completed to determine if the proposed geotechnical investigations are likely to have a significant impact on each MNES. These impact assessments have applied the *Matters of National Environmental Significance – Significant Impact Guidelines 1.1* have been applied (DoEE, 2013). The Koala assessment has been undertaken with specific reference to *EPBC Act referral guidelines for the vulnerable koala* (DoEE, 2014) and consideration of the *Draft referral guidelines for the nationally listed Brigalow Belt reptiles* (DoEE, 2011) for Collared Delma.

A significant impact is defined as “an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts” (DoEE, 2013d).

Consideration has been given to all threatened species and communities and migratory species with potential to occur within the survey area, with reference to DoEE (2013d). Significant impact assessments have been completed for 17 species considered to have potential to be impacted by the geotechnical investigations following the process outlined in this assessment report:

- *Grevillea quadricauda;*
- *Paspalidium grandispiculatum;*
- Hawkweed (*Picris evae*);
- Austral Toadflax (*Thesium australe*);

- Black-breasted Button-quail (*Turnix meglanogaster*);
- Swift Parrot (*Lathamus discolour*);
- Australian Painted Snipe (*Rostratula australis*);
- Spotted-tailed Quoll (*Dasyurus maculates*);
- Greater Glider (*Petauroides volans*);
- Koala (*Phascolarctos cinereus*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Collared Delma (*Delma torquarta*);
- Australian Lungfish (*Neoceratodus forsteri*);
- Black-faced Monarch (*Monarcha melanopsis*);
- Latham's Snipe (*Gallinago hardwickii*);
- White-throated Needletail (*Hirundapus caudacutus*); and
- Rufous Fantail (*Rhipidura rufifrons*).

The impact assessments concluded that the geotechnical investigations will not have a significant impact on any MNES species or the Swamp tea-tree TEC. Each investigation site requires minor areas of disturbance, with flexibility to generally avoid native vegetation and habitats. Mitigation measures that will be implemented will also reduce residual impacts to species and associated habitats to be very minor. No impacts to the TEC are anticipated by ensuring no investigation sites or access tracks are placed in the TEC patches and measures are taken to manage any indirect impacts.

Each investigation site will be closely managed and monitored. Mitigation meaures including use of suitably qualified ecologists and fauna spotter catchers will ensure that any protected matters with potential to occur in an area are surveyed for, identified, and specific measures implemented to ensure impacts are avoided and minimised prior to, and during the works.

Further detail for each MNES and avoidance and mitigation measures to be implemented are provided in Appendix C.

8 Conclusion

This report provides information on geotechnical investigations proposed for G2K, and assessment of the potential for significant impacts to occur to threatened communities or species listed under the EPBC Act. The geotechnical investigations will include up to approximately 1,313 investigation sites that follow the rail alignment. The investigations will result in minor impacts to native vegetation and habitats as a large proportion of the investigation sites and access tracks occur in existing cleared and disturbed areas. Each investigation site will require small areas of disturbance, and there is flexibility in where the drilling sites are located to minimise impacts. Where vegetation clearing is required the impact will be of a temporary nature and rehabilitation will occur post completion (where these areas are not required for the Inland Rail project). The temporary mature of investigation relates to the fact that cleared and/or disturbed areas will only be for a short duration (period of a few days) until rehabilitation can be commenced. For the areas that will be required for construction of the Inland Rail project these impacts are addressed through the EIS phase and separate approvals by the Qld Coordinator General and DoEE.

A combination of a desktop assessment and consideration of field survey results along the alignment has been undertaken to identify the biodiversity values within the study area and those MNES considered as known or likely to occur. For those MNES identified as known or likely, significant impact assessments were completed taking into consideration their habitat types, distribution, potential for impacts to occur and mitigation measures. Significant impact assessments found that no MNES would experience a significant impact based on the nature of the geotechnical investigations and mitigation and management measures that would be put in place.

The design of geotechnical investigations has seen significant effort expended on avoiding and minimising impacts to native vegetation and key biodiversity features. A key focus being to locate sites in existing cleared areas, maximise the use of existing access tracks, and avoid areas of biodiversity value including threatened species habitats. Where clearing of habitat cannot be avoided, a number of mitigation measures will be implemented including; fauna spotters, erosion and sediment control, reinstatement of microhabitats (such as leaf litter, logs, rocks), restricting work to daytime operations and rehabilitation.

In summary the geotechnical investigations are not expected to have a significant, residual impact on MNES based on implementation of the mitigation and management measures outlined.

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Appendix A

Desktop searches

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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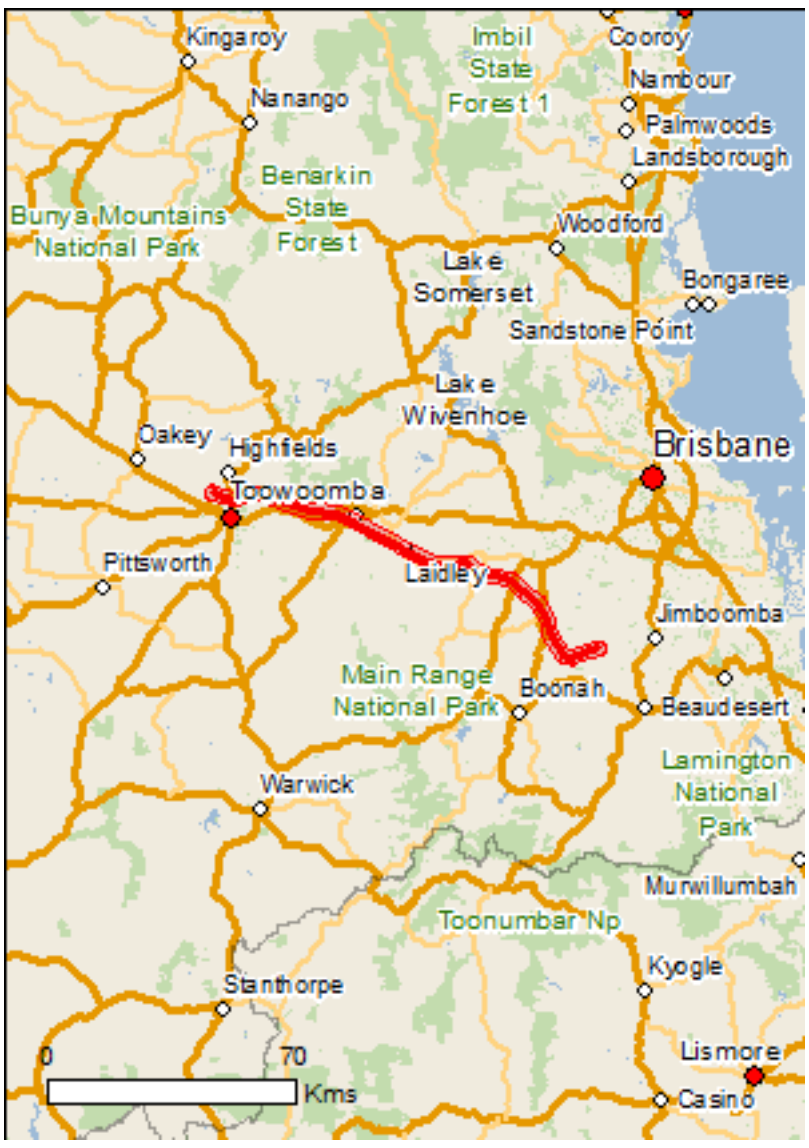

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Coordinates

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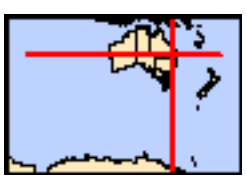

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	5
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	61
Listed Migratory Species:	18

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	26
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	6
Regional Forest Agreements:	None
Invasive Species:	44
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Banrock station wetland complex	1300 - 1400km
Moreton bay	40 - 50km upstream
Narran lake nature reserve	400 - 500km upstream
Riverland	1200 - 1300km
The coorong, and lakes alexandrina and albert wetland	1400 - 1500km

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
Swamp Tea-tree (Melaleuca irbyana) Forest of South-east Queensland	Critically Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Cyclopsitta diophthalma_coxeni Coxen's Fig-Parrot [59714]	Endangered	Species or species habitat may occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Geophaps scripta scripta		
Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta		
Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor		
Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Poephila cincta cincta		
Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Turnix melanogaster		
Black-breasted Button-quail [923]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Maccullochella mariensis		
Mary River Cod [83806]	Endangered	Translocated population known to occur within area
Maccullochella peelii		
Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Neoceratodus forsteri		
Australian Lungfish, Queensland Lungfish [67620]	Vulnerable	Species or species habitat known to occur within area
Insects		
Argynnis hyperbius inconstans		
Australian Fritillary [88056]	Critically Endangered	Species or species habitat may occur within area
Phyllodes imperialis smithersi		
Pink Underwing Moth [86084]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus hallucatus		
Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Arthraxon hispidus		
Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area
Bertya ernestiana		
a shrub [78349]	Vulnerable	Species or species habitat may occur within area
Bosistoa transversa		
Three-leaved Bosistoa, Yellow Satinheart [16091]	Vulnerable	Species or species habitat likely to occur within area
Bothriochloa bunyensis		
Satin-top Grass [15961]	Vulnerable	Species or species habitat known to occur within area
Bulbophyllum globuliforme		
Miniature Moss-orchid, Hoop Pine Orchid [6649]	Vulnerable	Species or species habitat likely to occur within area
Clematis fawcettii		
Stream Clematis [4311]	Vulnerable	Species or species habitat likely to occur within area
Cupaniopsis tomentella		
Boonah Tuckeroo [3322]	Vulnerable	Species or species habitat likely to occur within area
Cycas ophiolitica		
[55797]	Endangered	Species or species habitat may occur within area
Dichanthium queenslandicum		
King Blue-grass [5481]	Endangered	Species or species habitat may occur within area
Dichanthium setosum		
bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Grevillea quadricauda		
[64651]	Vulnerable	Species or species habitat likely to occur within area
Haloragis exalata subsp. velutina		
Tall Velvet Sea-berry [16839]	Vulnerable	Species or species habitat may occur within area
Lepidium peregrinum		
Wandering Pepper-cress [14035]	Endangered	Species or species habitat likely to occur within area
Macadamia integrifolia		
Macadamia Nut, Queensland Nut Tree, Smooth-shelled Macadamia, Bush Nut, Nut Oak [7326]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Macadamia tetraphylla Rough-shelled Bush Nut, Macadamia Nut, Rough-shelled Macadamia, Rough-leaved Queensland Nut [6581]	Vulnerable	Species or species habitat may occur within area
Notelaea ipsviciensis Cooneana Olive [81858]	Critically Endangered	Species or species habitat may occur within area
Notelaea lloydii Lloyd's Olive [15002]	Vulnerable	Species or species habitat likely to occur within area
Paspalidium grandispiculatum a grass [10838]	Vulnerable	Species or species habitat likely to occur within area
Phebalium distans Mt Berryman Phebalium [81869]	Critically Endangered	Species or species habitat may occur within area
Picris evae Hawkweed [10839]	Vulnerable	Species or species habitat likely to occur within area
Planchonella eerwah Shiny-leaved Condoo, Black Plum, Wild Apple [17340]	Endangered	Species or species habitat likely to occur within area
Rhaponticum australe Austral Cornflower, Native Thistle [22647]	Vulnerable	Species or species habitat likely to occur within area
Samadera bidwillii Quassia [29708]	Vulnerable	Species or species habitat likely to occur within area
Sarcochilus hartmannii Waxy Sarcochilus, Blue Knob Orchid [4124]	Vulnerable	Species or species habitat likely to occur within area
Sarcochilus weinthalii Blotched Sarcochilus, Weinthals Sarcanth [12673]	Vulnerable	Species or species habitat likely to occur within area
Sophora fraseri [8836]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat known to occur within area
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat known to occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Saiphos reticulatus Three-toed Snake-tooth Skink [88328]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Tympanocryptis condaminensis		
Condamine Earless Dragon [87888]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus		
Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat likely to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Species or species habitat known to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pandion haliaetus		
Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Defence - TOOWOOMBA RIFLE RANGE

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat likely to occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis		
Cattle Egret [59542]		Breeding likely to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Bowman Park Koala	QLD
Gatton	QLD
Gum Tips	QLD
Koala Crossing	QLD
Lockyer	QLD
Lockyer	QLD

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus africanus Climbing Asparagus, Climbing Asparagus Fern [66907]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Reptiles		

Name	Status	Type of Presence
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-27.8531 152.883047,-27.87370334 152.8160221,-27.86994977 152.7933133,-27.81599518 152.7565715,-27.79077101 152.7541196,-27.7484824 152.7275594,-27.72744365 152.6939183,-27.69896535 152.6623364,-27.69131216 152.6145073,-27.68094458 152.5725473,-27.66141562 152.548509,-27.66378578 152.5147787,-27.66447633 152.4744097,-27.65795846 152.4492856,-27.55015 152.220967,-27.54493737 152.156414,-27.530331 152.093192,-27.507244 152.026175,-27.51932024 151.9618235,-27.51263797 151.9323947,-27.50422425 151.9048768

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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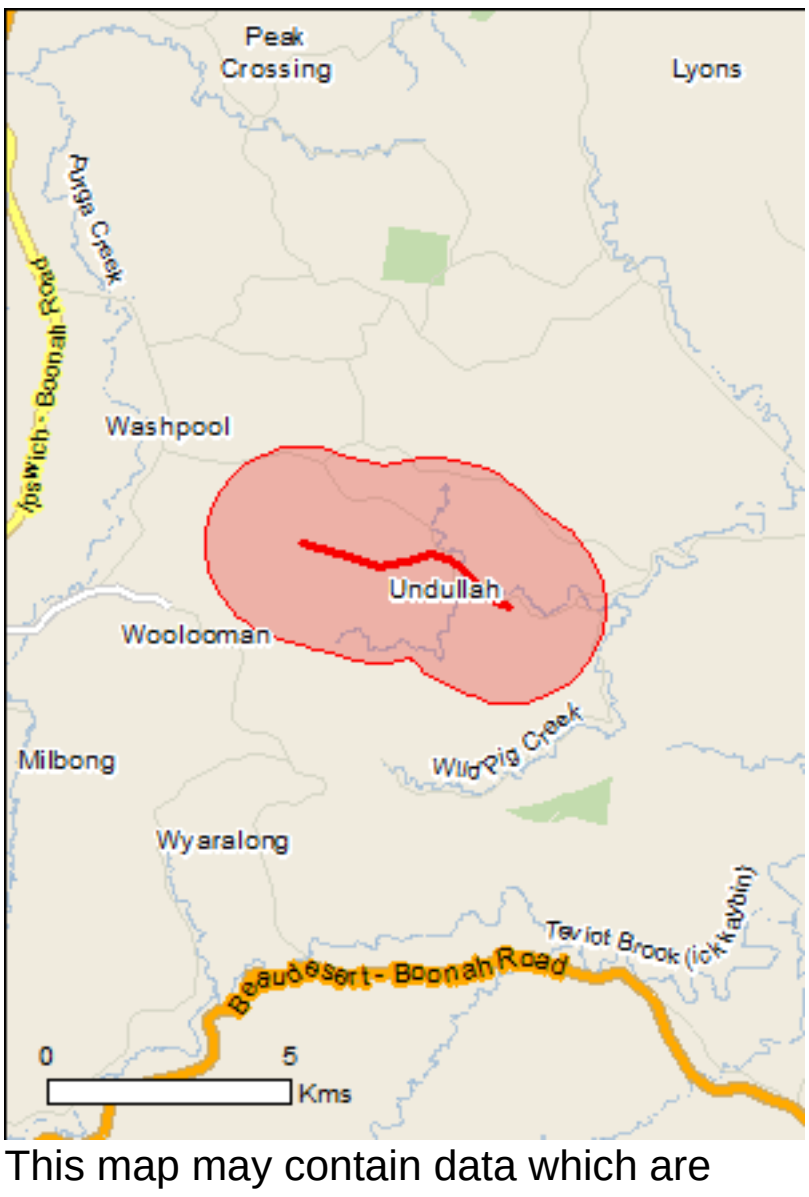
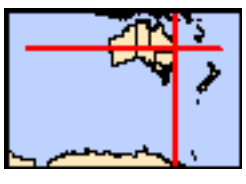


This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 2.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	35
Listed Migratory Species:	16

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	23
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	30
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Moreton bay	40 - 50km upstream

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Cyclopsitta diophthalma coxeni Coxen's Fig-Parrot [59714]	Endangered	Species or species habitat may occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat likely to occur within area
Insects		
Phyllodes imperialis smithersi Pink Underwing Moth [86084]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area
Bosistoa transversa Three-leaved Bosistoa, Yellow Satinheart [16091]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat may occur within area
Macadamia integrifolia Macadamia Nut, Queensland Nut Tree, Smooth-shelled Macadamia, Bush Nut, Nut Oak [7326]	Vulnerable	Species or species habitat may occur within area
Macadamia tetraphylla Rough-shelled Bush Nut, Macadamia Nut, Rough-shelled Macadamia, Rough-leaved Queensland Nut [6581]	Vulnerable	Species or species habitat may occur within area
Notelaea ipsviciensis Cooneana Olive [81858]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Notelaea lloydii		
Lloyd's Olive [15002]	Vulnerable	Species or species habitat likely to occur within area
Planchonella eerwah		
Shiny-leaved Condoo, Black Plum, Wild Apple [17340]	Endangered	Species or species habitat likely to occur within area
Samadera bidwillii		
Quassia [29708]	Vulnerable	Species or species habitat may occur within area
Sophora fraseri		
[8836]	Vulnerable	Species or species habitat may occur within area
Thesium australe		
Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Delma torquata		
Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli		
Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Saiphos reticulatus		
Three-toed Snake-tooth Skink [88328]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat likely to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus		
Spectacled Monarch [610]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		

Name	Threatened	Type of Presence
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-27.857617 152.790082,-27.858528 152.793172,-27.859438 152.796605,-27.860045 152.800039,-27.861259 152.804159,-27.860045 152.811025,-27.859438 152.813772,-27.860045 152.816862,-27.861563 152.819265,-27.86308 152.820981,-27.864598 152.823041,-27.866116 152.823728,-27.867026 152.825788,-27.867937 152.828191,-27.867937 152.828191

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

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-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B

Likelihood of Occurrence

Table A.1 Likelihood of occurrence assessment – threatened ecological communities

Threatened Ecological Community	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	-	Likely	Unlikely	White Box-Yellow Box-Blakely's Red Gum Grassy Woodlands occurs from Queensland to South Australia, with the predicted distribution of the community including the northern end of the survey area at Talbingo. The community occurs as a grassy woodland or derived grassland community dominated by White Box (*Eucalyptus albens*), Yellow Box (*E.melliodora*) or Blakely's Red Gum (*E.blakelyi*) in the east of the community's range, or Grey Box (*E. microcarpa* or *E. moluccana*) in the Nandewar bioregion (DECCW 2010a, DEH 2006). The REs associated with this TEC do not intersect the study area.
Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	EN	-	Potential	Unlikely	The Coolibah – Black Box Woodlands were once widespread on the inland floodplains of northern New South Wales and southern Queensland that are associated with the Darling River system and the southern part of the Fitzroy River system. This eucalypt woodland is found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands and stream levees. The main tree species in the canopy of the woodland are Coolibah (*Eucalyptus coolabah subsp. coolabah*) and/ or Black Box (*Eucalyptus largiflorens*) (DSEWPC, 2011). The REs associated with this TEC do not intersect the study area.
Lowland Rainforest of Subtropical Australia	CE	-	Potential	Potential	The Lowland Rainforest of Subtropical Australia ecological community primarily occurs from Maryborough in Queensland to the Clarence River (near Grafton) in New South Wales. The ecological community is generally a moderately tall (≥20 m) to tall (≥30 m) closed forest (canopy cover ≥70%). Lowland rainforest mostly occupies areas on highly fertile basaltic and alluvial soils. These areas have been heavily cleared as they are the most suitable for agricultural use (DEE, 2011b). No known areas of the TEC occur in the study area, and REs associated with this TEC do not intersect the study area. The TEC has been assessed as potential to occur as the study area is within its known distribution and there is potential for vegetation communities to not be accurately reflected in RE mapping.

Threatened Ecological Community	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	CE	-	Likely	Unlikely	The Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland are native grasslands typically composed of perennial native grasses. They are found on soils that are fine textured (often cracking clays) derived from either basalt or alluvium on flat to low slopes (< 1 degree). A tree canopy is usually absent, but when present, comprises ≤10% projective foliage cover. The REs associated with this TEC do not intersect the study area and there are no known areas of the TEC occurring in the study area.
Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland	CE	-	Likely	Known	The Swamp Tea-tree (Melaleuca irybana) Forest of South-east Queensland ecological community is generally low open forest dominated by dense thickets of Swamp Tea-tree, usually growing to about 8–12 m high. This ecological community may also have an emergent layer that typically includes Narrow-leaved Ironbark (*Eucalyptus crebra*), Silverleaved Ironbark (*E. melanophloia*), Grey Box (*E. moluccana*) or Forest Red Gum (*E. tereticornis*). This ecological community is unique to south-east Queensland, where it occurs on plains and low hills in the Moreton Basin in an arc from west to south of Brisbane, mainly in the Morton Vale and Lockrose areas, Calvert to Harrisville areas, and North Maclean and Jimboomba areas (DEE, 2008j). This TEC was identified in the C2K section and is known to occur near Woodlands, Calvert and Harrisville in the study area. *M. irbyana* was identified in the C2K section.
Weeping Myall Woodlands	EN	-	Likely	Unlikely	The Weeping Myall Woodlands ecological community occurs on the inland alluvial plains west of the Great Dividing Range in NSW and Queensland. It occurs in a range from open woodlands to woodlands, generally 4-12 m high, in which Weeping Myall (*Acacia pendula*) trees are the sole or dominant overstorey species. Other common names for Weeping Myall include Myall, Boree, Balaar, Nilyah, Bastard Gidgee, and Silver Leaf Boree (DEE, 2018uu). The REs associated with this TEC do not intersect the study area. There have been no confirmed records of the TEC in study area.

Threatened Ecological Community	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	EN	-	-	Unlikely	Semi-evergreen vine thicket (SEVT) is considered an extreme form of dry seasonal subtropical rainforest (McDonald 1996). It is generally characterised by the prominence of trees with microphyll sized leaves (i.e. leaves usually 2.5–7.6 cm long), the presence of Bottle Trees (*Brachychiton* spp.) as emergents from the vegetation, and the thickets occurring in areas with a subtropical, seasonally dry climate on soils of high to medium fertility. The REs associated with this TEC do not intersect the study area. It occurs only within the Brigalow Belt bioregion and these areas within the study area are highly disturbed and not likely to support the TEC.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

A.1 Likelihood of occurrence assessment – threatened flora

Table 8.2 Likelihood of occurrence assessment – threatened flora

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Arthraxon hispidus	Hairy-joint Grass	VU	V	Potential	Potential	Hairy-joint Grass is a slender tufted creeping grass that roots at the nodes. It is found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps, as well as woodland. In south-east Queensland, Hairy-joint Grass has also been recorded growing around freshwater springs on coastal foreshore dunes, in shaded small gullies, on creek banks, and on sandy alluvium in creek beds in open forests, and also with bog mosses in mound springs. The species has been recorded from scattered locations throughout Queensland and on the northern tablelands and north coast of NSW (DEEa, 2008). Desktop review confirmed records of the species in the wider area in Toowoomba. While some suitable habitat may occur in form of seepages within pasture grasses and creeklines there are no records within close proximity to the study area. Therefore it has been classified as potential to occur.
Bertya ernestiana	-	VU	V	Potential	Unlikely	*Bertya ernestiana* is a branched shrub growing to 1.5 m in height. The species grows in heath or open eucalypt forest with a heath understorey. This species has been recorded growing with tea tree (*Leptospermum spp*.), *Gynura spp*., *Keraudrenia spp*. and *Plectranthus suaveolens*. It occurs on skeletal sandy loam soils derived from rhyolite on steep rocky slopes, rock pavements and in mountain gorges. This species occurs at two sites in Mt Barney National Park. The population at Mt May supports approximately 50 plants while the population at Mt Ernest is estimated to support a few hundred plants (DEE, 2011). Desktop review did not confirm records of the species within the study area and the survey area is outside the very restricted distribution of the species.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Bosistoa transversa	Three-leaved Bosistoa	VU	-	Likely	Unlikely	Three-leaved Bosistoa is a small to medium-sized crooked tree that grows to 22 m high. The species grows in lowland subtropical rainforest up to 300 m above sea level. At Mt Warning NP, NSW, Three-leaved Bosistoa is recorded as growing in a rainforest transect along Wollumbin Creek, associated with Ferny-leaf Bosistoa (*Bosistoa pentacocca*). At Natural Bridge-Springbrook NP, Queensland, Three-leaved Bosistoa grows on reddish loam over basalt rock on a very steep slope in complex notophyll vine forest with emergent Brush Box (*Lophostemon confertus*). At Triuna NP, west of Woombye, Queensland, Three-leaved Bosistoa grows in complex notophyll vine forest, on brown loamy soils on a hillside with Brush Poison Tree (*Excoecaria dallachyana*) and Hauer (*Dissiliaria baloghioides*). At Buderim, Queensland, Three-leaved Bosistoa has been found in remnant vine forest pockets within highly disturbed and weed infested habitats on a site with varying slope, from relatively flat to a steep scree slope. The species appears to occur only in areas that have experienced minimal disturbance (DEE, 2018a). Desktop review did not confirm records of the species within the study area and the survey area is outside the known distribution of the species.
Bothriochloa bunyensis	Satin-top Grass	VU	V	Known	Potential	Satin-top Grass is an erect ascending perennial to 60 cm tall without lateral branches. Satin-top Grass is endemic to south-east Queensland where populations occur on Bunya Mountains north of Dalby, near Toowoomba, Crows Nest and the Main Range (Mt Mistake Plateau). Satin-top Grass occurs on relatively fertile krasnozem (dark brown) soils derived from basalt on upper slopes and hill crests at altitudes of 600–1100 m, in grassland or woodland with a grassy understorey. This species has a range of approximately 140 km^2 (DEE, 2008b). Desktop review confirmed two records of the species within the study area. However, majority of the populations are located on the Bunya Mountains. The study area is outside the known distribution for the species.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Bulbophyllum globuliforme	Miniature Moss-orchid	VU	NT	Likely	Unlikely	Miniature Moss-orchid is a tiny rhizomatous orchid that grows on the bark of trees, forming a dense mat. The species grows only on Hoop Pines (*Araucaria cunninghamii*), colonising the upper branches of mature trees in upland rainforest (Harrison, 2002; DECC, 2005a). It is conserved in Noosa National Park, Lamington National Park and Bunya Mountains National Park. The distribution of this species overlaps with the following EPBC Act-listed threatened ecological communities - Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions, and Brigalow (*Acacia harpophylla* dominant and co-dominant) (DEE, 2008c). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Clematis fawcettii	Stream Clematis	VU	V	Likely	Potential	Stream Clematis is a weak climber with stems 1–2 m long. Stream Clematis prefers canopy gaps on loam soils derived from basalt and mixed volcanic rocks usually near streams. Associated vegetation communities include dry rainforest, complex notophyll vineforest (warm and cool subtropical rainforest), on the margins of semi-evergreen vine thickets and, at one site, in eucalypt open forest with scattered vine forest species. This species is conserved within the Richmond Range National Park (NP), Toonumbar NP, Lamington NP, Main Range NP and Mt Barney NP (DEE, 2008d). Desktop review confirmed records of the species in the wider area in Toowoomba. However, suitable potential habitat is not present within the study area.
Cupaniopsis tomentella	Boonah Tuckeroo	VU	V	Likely	Unlikely	Boonah Tuckeroo is a tree to 10 m tall. It grows in vine thickets predominantly on fertile clay soils. These areas have been extensively cleared for agriculture and close settlement over the last 150 years, and the only seven known occurrences are confined to small isolated remnants on scree slopes and roadsides. Boonah Tuckeroo is known only from an area between Boonah and Ipswich in south-eastern Queensland. The distribution of this species overlaps with the following EPBC Act-listed threatened ecological communities - Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions, and Brigalow (*Acacia harpophylla* dominant and co-dominant) (DEE, 2008e). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Cycas ophiolitica	-	EN	E	Potential	Unlikely	*Cycas ophiolitica* is a small to medium sized cycad. The species grows on hills and slopes in sparse, grassy open forest at altitude ranges from 80–400 m above sea level. Although this species reaches its best development on red clay soils near Marlborough, it is more frequently found on shallow, stony, infertile soils, which are developed on sandstone and serpentinite, and is associated with species such as *Corymbia dallachiana, C. erythrophloia, C. xanthope* and *Eucalyptus fibrosa.* It is endemic to Queensland, occurring from Marlborough to Rockhampton in central-eastern Queensland, occurring in woodland or open eucalypt woodlands (DEE 2018b). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Dichanthium queenslandicum	King Blue-grass	EN	E	Potential	Unlikely	King Blue-grass is a perennial, tufted, erect grass to 80 cm tall. It occurs on black cracking clay in tussock grasslands mainly in association with other species of blue grasses (*Dichanthium* spp. and *Bothriochloa* spp.) but also with other grasses restricted to this soil type. It is mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, open downs) on undulating plains. It occurs from Brisbane to Townsville, with a likely habitat north of Toowoomba (DEE, 2018c). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Dichanthium setosum	Bluegrass	VU	-	Likely	Potential	Bluegrass is an erect perennial which grows to 1 m in height. It is associated with heavy basaltic black soils and red-brown loams with clay subsoil. It is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. It is often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched. The species may tolerate or benefit from disturbance. In Queensland the species has been reported from the Leichhardt, Morton, North Kennedy and Port Curtis regions (Henderson 1997). This species occurs in the Mistake Range, in Main Range National Park, and possibly on Glen Rock Regional Park, adjacent to the national park (DEE, 2018d). Desktop review confirmed records of the species in the wider area in Toowoomba. However, suitable cracking clay habitat is not present within the study area.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Grevillea quadricauda	-	VU	V	Likely	Likely	*Grevillea quadricauda* is a bushy shrub with yellow-green foliage, growing to 2 m in height and spread. It grows in gravely loam, in the understorey of dry eucalypt forest, usually along or near creeks. The species occurs near Toowoomba in south-east Queensland (OEH, 2018a). Desktop review confirmed records of the species within the study area. Suitable potential habitat is present along creek lines.
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	VU	V	Potential	Unlikely	Tall Velvet Sea-berry is a small, erect shrub growing to 1.5 m high. It has been recorded from eucalypt forests, from rainforest margins and grasslands from 500 m to 1000 m altitude. The species has been recorded growing on brown heavy clay (Carnarvon National Park), shallow rock loam (Bunya Mountains National Park), and basaltic soils. Associated species include *Eucalyptus tereticornis*, *Angophora subvelutina*, *Acacia irrorata*. The species occurs in the grassland balds (*Poa* and *Themeda*) of the Bunya Mountain National Park, and it was formerly known from swamp vegetation near Hamilton beside the Brisbane River at low elevation (DES, 2018a). Desktop review did not confirm records of the species within the study area. Suitable heavy clay habitat is not present within the study area.
Lepidium peregrinum	Wandering Pepper-cress	EN	-	Likely	Potential	Wandering Pepper-cress is a perennial herb to sub-shrub 10–80 cm tall. This species was most abundant in the tussock grassland fringe of the riparian open forest (*Poa sp*. - *Lomandra longifolia* - *Paspalum dilatatum*), with some plants scrambling to a height of 2 m in thickets of Hymenanthera. It also occurred in shade under shrubs close to the creek bank. It occurs from the Bunya Mountains, south-east Queensland, to near Tenterfield, in northern New South Wales. Populations have been discovered at Picnic Point Toowoomba and Highfields Falls near Toowoomba (DEE, 2014a). Desktop review confirmed records of the species within the study area. However, suitable riparian forest habitat does not occur in the study area.
Macadamia integrifolia	Macadamia Nut	VU	V	Likely	Unlikely	The Macadamia Nut is a medium-sized tree which can grow to approximately 20 m in height. It grows in remnant rainforest (Gross 1995; Stanley & Ross 1986), preferring partially open areas such as rainforest edges. It prefers to grow in mild frost-free areas with a reasonably high rainfall. This species is known from Mt Bauple, north of Gympie, to Currumbin Valley in the Gold Coast hinterland (DEE, 2018e). Desktop review did not confirm records of the species within the study area. Planted specimens are possible.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Macadamia tetraphylla	Rough-shelled Bush Nut	VU	V	Potential	Unlikely	Rough-shelled Bush Nut is a small to medium sized tree. It is a rare species that generally occurs in subtropical rainforest and complex notophyll vineforest, at the margins of these forests and in mixed sclerophyll forest. It occurs in restricted habitat, growing on moderate to steep hillslopes on alluvial soils at well-drained sites. Records from Queensland include Wyangan Creek, Mudgeeraba; Upper Tallebudgera-Mount Cougal, partly within Springbrook National Park; Natural Bridge, Springbrook National Park; Montville-Maleny, Nicoll Scrub National Park; Lower Bellbird, Lamington National Park; and from freehold properties at Numinbah Valley/Cave Creek, Camp Bornhoffen, Numinbah Valley, Beechmont and Mudgeerabah (DEE, 2018f). Desktop review did not confirm records of the species within the study area. Planted specimens are possible.
Notelaea ipsviciensis	Cooneana Olive	CE	E	Potential	Unlikely	Cooneana Olive is a small multi-stemmed evergreen shrub growing to 1–2 m in height. The Cooneana Olive grows as an understorey plant in open woodlands, and is primarily associated with eucalypt-dominated dry sclerophyll communities situated on poor, sandstone-based soils. It is known from only three closely clustered sub-populations in the Ipswich area of southern Queensland. Total extent of occurrence is less than 2 km^2, and total number of specimens is 17 (all mature) (DEE, 2008f). Desktop review did not confirm records of the species within the study area. The species is restricted to north-east Ipswich.
Notelaea lloydii	Lloyd's Olive	VU	V	Likely	Potential	Lloyd's Olive is a multi-stemmed shrub to 4 m. It commonly occurs in open eucalypt forest, often near the margins of vine thickets, vine forests and softwood scrub at altitudes between 80 and 480 m. It is usually found on stony, shallow and rocky soils derived from sandstone or acid volcanic rocks, often on steep slopes, or near drainage lines. It is endemic to south-east Queensland between Mt Brisbane, near Somerset Dam, to just south of Beaudesert and as far west as Mt Berryman near Laidley, a range of approximately 120 km (DEE, 2008g). Desktop review confirmed records of the species in the wider area in Ipswich. However, suitable potential habitat is not present within the study area.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Paspalidium grandispiculatum	-	VU	V	Likely	Likely	*Paspalidium grandispiculatum* is a perennial, tufted grass. It occurs in mixed Eucalyptus forest, mixed open forest, and native pasture occurring as a result of land clearing for agriculture. One population occurs in the Crows Nest Falls National Park, the remaining known populations occur in either state forest or on private land in Queensland. *Paspalidium grandispiculatum* occurs in south-east Queensland in a band from Canungra to Kingaroy, over a range of approximately 100 km (DEE, 2008h). Desktop review confirmed records of the species within the study area in Lockyer National Park. Suitable potential habitat is present within the study area.
Phebalium distans	Mt Berryman Phebalium	CE	E	Potential	Unlikely	Mt Berryman Phebalium is a small tree growing to 8 m tall. It is found in semi-evergreen vine thicket on red volcanic soils, or in communities adjacent to this vegetation type. Vegetation associations in which Mt Berryman Phebalium occur include microphyll to notophyll vine forest with or without *Araucaria cunninghamii* and low microphyll vine forest and semi-evergreen vine thicket with or without *Araucaria cunninghamii* which can be divided further into regional ecosystems depending on substrate, geography and associated vegetation species. It is part of the 'Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions' Ecological Community. Populations are known from near Mt Berryman, Kingaroy (Mt Jones Plateau and surrounds) and Mt Walla (Coalston Lakes) (DEE, 2018g). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Picris evae	Hawkweed	VU	V	Likely	Likely	Hawkweed, is an erect annual herb growing 1.3–1.7 m high. Hawkweed occurs in Eucalyptus open woodland with a grassy understorey composed of *Dichanthium spp.* Collections have been made along roadsides and in cultivated areas, such as paddocks. This species also occurs at 30 sites in the Darling Downs and Moreton pastoral districts in south-east Queensland (DEE, 2008i). Desktop review confirmed records of the species within the study area. Field surveys confirmed that suitable potential habitat is present within the study area, however; no living species were observed.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Planchonella eerwah	Shiny-leaved Condoo	EN	E	Likely	Unlikely	The Shiny-leaved Condoo is a tree growing up to 40 m high. The species grows in subtropical rainforest, dry rainforest and Hoop Pine (*Araucaria cunninghamii*) vine scrub. All known areas in which the Shiny-leaved Condoo occurs are warm and subtropical with an annual rainfall of between 650–1000 mm. It is endemic to Queensland and restricted to three locations – Nambour-Maleny district, Beenleigh-Ormeau-Pimpama district, and Ipswich-Beaudesert district (DEE, 2018h). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Rhaponticum australe	Austral Cornflower	VU	V	Likely	Potential	The Austral Cornflower is an erect, herbaceous perennial that grows up to 60 cm high. It usually grows on heavy black or red-brown clay, or clay loams derived from basalt. Populations are often confined to roadsides and cultivation headlands. Locations where the species occurs range in altitude up to 480 m above sea level. The current distribution of the Austral Cornflower extends from Allora (north of Warwick) to Callide (north-west of Biloela), Queensland (DEE, 2018i). Desktop review confirmed a record of the species within the study area. However, suitable clay habitat is not present within the study area.
Samadera bidwillii	Quassia	VU	V	Likely	Unlikely	Quassia is a small shrub or tree that grows to about 6 m in height. Quassia commonly occurs in lowland rainforest or on rainforest margins (Hewson 1985), but it can also be found in other forest types, such as open forest and woodland (QDNR 2001). Quassia is commonly found in areas adjacent to both temporary and permanent watercourses. It is endemic to Queensland and is currently known to occur in several localities between Scawfell Island, near Mackay, and Goomboorian, north of Gympie (DEE, 2018j). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Sarcochilus hartmannii	Waxy Sarcochilus	VU	V	Likely	Unlikely	Hartman's Sarcochilus is an epiphytic orchid. Favours cliff faces on steep narrow ridges supporting eucalypt forest and clefts in volcanic rock from 500 to 1,000 m in altitude. Also found occasionally at the bases of fibrous trunks of trees, including cycads and grass-trees. The species distribution is from the Richmond River in northern NSW to Gympie in south-east Queensland (OEH, 2018b). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Sarcochilus weinthalii	Blotched Sarcochilus	VU	E	Likely	Potential	Blotched sarcochilus is an orchid that grows on rainforest trees. It occurs in rainforest, dry rainforest and drier scrub of sub-coastal ranges and associated foothills inland from the coast at altitudes of 400–700 m above sea level. The species occurs north of the Richmond River to the Bunya Mountains and the Gallangowan area. The distribution of this species is associated with the 'Lowland Rainforest of Subtropical Australia' EPBC Act-listed threatened ecological community (DEE, 2014b). Desktop review confirmed a record of the species within the study area. However, suitable potential habitat is not present within the study area.
Sophora fraseri	-	VU	V	Potential	Unlikely	*Sophora fraseri* is a softly pubescent, sparsely branched leguminous shrub 1–2 m high. It grows in moist habitats, often in hilly terrain at altitudes from 60–660 m on shallow soils along rainforest margins in eucalypt forests or in large canopy gaps in closed forest communities. In south-east Queensland, it is widespread but not common. It is conserved in Lamington National Park (NP) and Mount Mistake NP. The distribution of this species overlaps with three EPBC Act-listed threatened ecological communities - Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions, Brigalow (Acacia harpophylla dominant and co-dominant), and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Thesium australe	Austral Toadflax	VU	V	Likely	Likely	Austral Toadflax is a hairless, yellowish-green perennial herb. It is semi-parasitic on roots of a range of grass species. It occurs in subtropical, temperate and subalpine climates over a wide range of altitudes. Collections since the 1990s have been made from Kumbia, Glen Rock Regional Park, Carnarvon National Park, Crows Nest, Clifton, Warwick, Greenmount, Cambooya, Dalby, the Bunya Mountains, Blackbutt and Imbil (DEE, 2018k). Desktop review confirmed records of the species within the study area. Field surveys confirmed that suitable habitat is present within the study area, however; no living species were observed.

Notes: *1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable*

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

Table A.2 Likelihood of occurrence assessment – threatened fauna (birds)

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Anthochaera phrygia	Regent Honeyeater	CE	E	Potential	Potential	The Regent Honeyeater is a striking, predominantly black and yellow bird. Endemic to mainland south-eastern Australia, the species has a patchy distribution from south-east Queensland, through NSW and the ACT into central Victoria. Records are widely distributed across this range, but the species is only found regularly at a few localities in NSW and Victoria. Most records of regent honeyeaters come from box-ironbark eucalypt associations, where the species seems to prefer more fertile sites with higher soil water content. Other forest types regularly utilised by the Regent Honeyeater include wet lowland coastal forest dominated by Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum-Ironbark associations and riverine woodlands (DEE, 2015a) Desktop review did not confirm records of the species within the study area. The species may fly over the survey area depending on seasonality.
Botaurus poiciloptilus	Australasian Bittern	EN	-	Known	Potential	The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds or cutting grass growing over a muddy or peaty substrate (DES, 2018a). Desktop review did not confirm records of the species within the study area. The species may utilise wetland habitats in the area.
Calidris ferruginea	Curlew Sandpiper	CE, Mi, M	E	Known	Potential	The Curlew Sandpiper is a small, slim sandpiper. Inland, the species mainly occur around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. In Queensland, scattered records occur in the Gulf of Carpentaria, with widespread records along the coast south of Cairns. There are sparsely scattered records inland (DEE, 2018l). Desktop review confirmed a record of the species within the study area. However, suitable wet habitat is not present within the study area.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Grantiella picta	Painted Honeyeater	VU	V	Known	Potential	The Painted Honeyeater has black upperparts, white underparts, black spots on its flanks and yellow edges to the flight and tail feathers. The species has a specialist diet mainly consisting of mistletoe fruits, but also includes nectar. The species inhabits mistletoes in a variety of vegetation types, including eucalypt forests/woodlands, riparian woodlands, box-ironbark-yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, callitris, and trees on farmland or gardens. In Queensland, the species regularly occurs west of the Great Dividing Range (Whitmore and Eller 1982). However, non-breeding individuals have been recorded occasionally from coastal areas along the eastern seaboard (Rowland, 2012). Desktop review confirmed records of the species within the study area. Suitable mistletoe habitat is sparse within the study area.
Lathamus discolor	Swift Parrot	CE, M	E	Known	Known	The Swift Parrot is a small fast-flying, nectarivorous parrot which occurs in eucalypt forests in south eastern Australia. The species breeds in Tasmania and migrate to mainland Australia in autumn. During winter the parrots disperse across a broad landscape, foraging on nectar and lerps in eucalypt forests, particularly inland box-ironbark and grassy woodlands, and Coastal Swamp Mahogany (*E. robusta*) and Spotted Gum (*Corymbia maculata*) woodland when in flower. Birds have been recorded in southern Queensland (DEHP, 2017a). The species was recorded during field surveys in *E. moluccana* woodland.
Numenius madagascariensis	Eastern Curlew	CE, Mi, M	E	Potential	Unlikely	The Eastern Curlew is the largest migratory shorebird in the world, migrating to Australia during the northern hemisphere winter. In Australia, the species has a primarily coastal distribution, inhabiting sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (DEHP, 2017b). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	EN	E	Potential	Unlikely	Coxen's Fig-Parrot is a small parrot that measures approximately 13 to 16 cm in length. The adults are predominantly bright green. It occurs in rainforest habitats including subtropical rainforest, dry rainforest, littoral and developing littoral rainforest, and vine forest. The fig-parrot was, in the past, probably most abundant in lowland subtropical rainforest. Coxen's Fig-Parrot is estimated to occur in four subpopulations: greater Bundaberg region, Maleny/Imbil/Kin Kin Creek area, the Qld/NSW border area (Lamington National Park, Whian Whian State Forest, Alstonville plateau), and the upper Hastings River catchment. This estimate is considered to be of low reliability (DEE, 2018m). Desktop review did not confirm records of the species within the study area. This species is one of Australia's rarest and least known birds.
Dasyornis brachypterus	Eastern Bristlebird	EN	E	Potential	Potential	Eastern Bristlebirds are medium-sized, long-tailed, brown and rufous birds. The species is restricted to three geographically separate areas along eastern Australia. In Queensland, most sightings have within been localised pockets of open eucalypt forest in close proximity to denser vegetation along creek lines and rainforest (DEHP, 2013a). Desktop review did not confirm known records of the species in the study area. However, suitable potential habitat is present within the study area.
Erythrotriorchis radiatus	Red Goshawk	VU	E	Known	Unlikely	The Red Goshawk is a large, swift and powerful rufous-brown hawk, growing to a length of 45–60 cm, with a wingspan of 100–135 cm. It occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia. Riverine forests are also used frequently. The vegetation types include eucalypt woodland, open forest, tall open forest, gallery rainforest, swamp sclerophyll forest, and rainforest margins. Historical records suggests that the species is extinct in the SEQ region.
Geophaps scripta scripta	Squatter Pigeon (southern)	VU	V	Known	Potential	The Squatter Pigeon (southern) is a medium-sized, ground-dwelling pigeon that measures approximately 30 cm in length and weighs about 190-250 g. Its habitat is generally defined as open-forests to sparse, open-woodlands and scrub that are mostly dominated in the overstorey by *Eucalyptus, Corymbia, Acacia* or *Callitris* species, remnant, regrowth or partly modified vegetation communities, and within 3 km of water bodies. The Squatter Pigeon (southern) occurs in 12 conservation reserves or state/resource reserves in Queensland (DEE, 2018n). Desktop review did not confirm records of the species in the study area. Lantana has invaded most of the suitable habitat for this species.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Poephila cincta cincta	Southern Black-throated Finch	EN	E	Potential	Unlikely	The Black-throated Finch is a sleek but thickset grass-finch, which measures approximately 12 cm in length, and weighs approximately 15 g. The species occurs mainly in grassy, open woodlands and forests, typically dominated by *Eucalyptus*, *Corymbia* and *Melaleuca*, and occasionally in tussock grasslands or other habitats (for example freshwater wetlands), often along or near watercourses, or in the vicinity of water. In south-eastern Queensland, it was formerly recorded in open forest on ridges, on grassy hillsides, and on 'mountain flats (DEE, 2018o). Desktop review did not confirm records of the species within the study area. The species has not been recorded in SEQ since the mid-1900s.
Turnix melanogaster	Black-breasted Button-quail	VU	V	Likely	Likely	The Black-breasted Button-quail is a large, plump, pale-eyed button-quail. The Black-breasted Button-quail is restricted to rainforests and forests, mostly in areas with 770-1200 mm rainfall per annum. They prefer drier low closed forests, particularly semi-evergreen vine thicket, low microphyll vine forest, araucarian microphyll vine forest and araucarian notophyll vine forest. They may also be found in low, dense acacia thickets and, in littoral area, in vegetation behind sand dunes. In south-eastern Queensland, they are recorded on rare occasions in open eucalypt forest. In Queensland prior to about 1900, this species was probably fairly widespread in the Dawson and Fitzroy River catchments, but these populations have declined dramatically since then (DEE, 2018p). Desktop review confirmed records of the species in the study area. Suitable potential habitat is present within the study area.
Esacus magnirostris	Beach Stone-curlew	M	V	-	Unlikely	The Beach Stone-curlew is a large, heavy-set wader (up to 56 cm in body length, and with a wingspan of up to 1.1 m), with a large-headed appearance, emphasised by its massive bill, strong legs and a short tail. Beach Stone-curlews are found exclusively along the coast, on a wide range of beaches, islands, reefs and in estuaries, and may often be seen at the edges of or near mangroves. They forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. In Queensland, the species are uncommon on beaches in the south of the state but numbers gradually increase northward (DEHP, 2013b). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Charadrius leschenaultii	Greater Sand Plover	VU, M	V	-	Unlikely	The Greater Sand Plover is a medium-sized (length: 22–25 cm; weight 75–100 g) brown-and-white plover. In the non-breeding grounds in Australasia, the species is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons (DEE, 2018q). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Charadrius mongolus	Lesser Sand Plover	EN	E	-	Unlikely	The Lesser Sand Plover is a small to medium-sized grey-brown and white plover. In non-breeding grounds in Australia, this species usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops (DEE, 2018r). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Limosa lapponica baueri	Bar-tailed Godwit (Western Alaskan)	VU	V	-	Unlikely	The bird has a length around 37–39 cm, a wingspan of 62–75 cm and a weight between 250–450 g. The species is found mainly in coastal habitats, and often found around beds of seagrass (DEE, 2018s). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Rostratula australis	Australian Painted Snipe	EN	V	Likely	Likely	The Australian Painted Snipe is a stocky wading bird, endemic to Australia and has been recorded at wetlands in all states and territories. The species inhabits shallow ephemeral and permanent freshwater (occasionally brackish) wetlands (DEE, 2018t). Desktop review confirmed records of the species within the study area. Suitable wetland habitat is present within the study area.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, M – marine, Mi - migratory

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

Table A.3 Likelihood of occurrence assessment – threatened fauna (mammals)

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Small terrestrial mammals						
Potorous tridactylus tridactylus	Long-nosed Potoroo	VU	V	Potential	Potential	The Long-nosed Potoroo (SE Mainland) is a medium sized marsupial of the order Diprotodontia. It is sparsely distributed along the coast and Great Dividing Range of south-east Queensland through NSW. It can be found in wet eucalypt forests to coastal heaths and scrubs. There is limited information about the species habitat in Queensland and NSW (DEE, 2018u). Desktop review confirmed records of the species in the wider area in Toowoomba. However, suitable wet forest habitat is not present within the study area.
Pseudomys novaehollandiae	New Holland Mouse	VU	V	Likely	Unlikely	A small, burrowing native rodent, the New Holland Mouse is similar in size and appearance to the introduced House Mouse. The New Holland Mouse has been found from coastal areas and up to 100 km inland on sandstone country. Across the species' range, the New Holland Mouse is known to inhabit open heathland, open woodland with a heath understorey, and vegetated sand dunes (DEE, 2018v). Desktop review did not confirm records of the species in the study area. The study area lacks suitable heathy habitat for the species.
Large terrestrial mammals						
Dasyurus maculatus maculatus	Spot-tailed Quoll (southern subspecies)	EN	V	Potential	Likely	The Spotted-tailed Quoll is one of Australia's largest extant marsupial carnivores, and has a distinctive spotted appearance. The species is primarily forest-dependent , and occupies a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, coastal heathland, scrub and dunes, woodland, heathy woodland, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas. The species has been recorded on coastal ranges and the Great Dividing Range from the QLD-NSW border, north of Gladstone, and in the Dalby region (DEHP, 2018a). Desktop review confirmed records of the species within the study area. Field surveys confirmed potential habitat with hollows within the study area. However, the species has experienced significant declines from the region.
Dasyurus hallucatus	Northern Quoll	EN	-	Likely	Unlikely	The Northern Quoll is the smallest of the four Australian quoll species. It occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. In Queensland, Northern Quolls are more likely to be present in high relief areas that have shallower soils, greater cover of boulders, less fire impact and were closer to permanent water (DEE, 2018w). Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.

Petrogale penicillata	Brush-tailed Rock-wallaby	VU	V	Likely	Potential	The Brush-tailed Rock-wallaby is brown above, tending to be rufous on the rump and grey on the shoulders. This species prefers rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes, cliffs, gorges and isolated rock stacks. The species are closely associated with dense arboreal cover, especially fig trees. No recent surveys have been published from Queensland, and this species is considered to be declining and vulnerable (DEE, 2018x). Desktop review did not confirm records of the species in the study area. Potential rocky habitat is present along the escarpment.
Arboreal mammals						
Petauroides volans	Greater Glider	VU	V	Known	Likely	The Greater Glider is the largest gliding possum in Australia. The species is distributed across eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevation range from sea level to 1200 m above sea level. The species is restricted to eucalypt forests and woodlands, typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The species distribution may be patchy even in suitable habitat (TSSC, 2016a). Desktop review confirmed records of the species within and nearby the study area. The species is restricted to areas with large hollows.
Phascolarctos cinereus	Koala	VU	V	Known	Known	The Koala is a tree-dwelling, medium-sized marsupial, distributed from Cairns to South Australia, however, the listed population does not include Victoria or South Australia. Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus Eucalyptus. The distribution of Koalas is also affected by altitude, with the species limited to below 800 m ASL. The listed species range extends from north-eastern Queensland to the Victorian border (DEE, 2018y). Desktop review confirmed records of the species within the study area. The species was confirmed during field surveys.
Bats						
Nyctophilus corbeni	Corben's Long-eared Bat	VU	V	Potential	Unlikely	The Corben's Long-eared Bat is a relatively large solid member of the Vespertilionidae family, with a broad, robust skull. The species is found from southern central Queensland, through central western NSW into north-western Victoria and eastern South Australia, where it is patchily distributed, with most of its range in the Murray Darling Basin. The species is uncommon within this distribution and is rarely recorded. The species inhabits a wide range of inland woodland vegetation types, including box/ironbark/cypress pine woodlands, Buloke woodlands, Brigalow woodland, Belah woodland, smooth-barked apple woodland, river red gum forest, black box woodland, and various types of tree mallee (TSSC 2015a). Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.

Chalinolobus dwyeri	Large-eared Pied Bat	VU	V	Likely	Potential	The Large-eared Pied Bat is a medium-sized insectivorous bat measuring a total length of approximately 100 mm and weighing 7–12 grams. The species has been recorded in rainforest and moist eucalypt forest habitats at high elevations. Large-eared Pied Bats are likely to shelter within their roosts in caves, sandstone overhangs, tunnels and culverts. Records exist from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, NSW in the south (DEE, 2018z). Desktop review confirmed records of the species within the study area. While potential roosting habitat may occur in the Toowoomba Range, suitable wet forest habitat is not present within the study area.
Pteropus poliocephalus	Grey-headed Flying-fox	VU	-	Roosting known	Likely	The Grey-headed Flying-fox is a large, endemic megachiropteran bat occurring in south-eastern Australia. The species distribution extends from Bundaberg in Queensland to Melbourne in Victoria, and from the coast inland to the western slopes of NNSW. The Grey-headed Flying-fox feeds on nectar and pollen from flowers of canopy trees and fleshy fruits from rainforest trees and vines, with regional preferences shown (DEE, 2018aa). Desktop review confirmed records of the species within the study area. Habitat is seasonal, depending on the availability of nectar.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

TableA.4 Likelihood of occurrence assessment – threatened fauna (reptiles)

Scientific name	Common Name	EPBC Act status	NC Act status	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Reptiles						
Anomalopus mackayi	Five-clawed Worm-skink	VU	E	Known	Unlikely	The Five-clawed Worm-skink is a burrowing skink which is characterised by three fingers and two toes and grows up to 27 cm long. It is known to occur in both remnant and non-remnant woodlands and grasslands. In areas modified by agriculture and other human activities, the species has been found sheltering under artificial materials lying flat on the ground. In south-eastern Queensland, the species' known distribution is on the upper Condamine River Floodplain from Warwick in the south to the Jimbour region in the north and bordered by the western edge of the granite belt (DEE, 2018bb). Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.
Furina dunmalli	Dunmall's Snake	VU	V	Potential	Unlikely	Dunmall's Snake is a venomous snake that belongs to the Elapidae family. Dunmall's Snake has been found in a broad range of habitats, including Forests and woodlands on black alluvial cracking clay and clay loams dominated by Brigalow (*Acacia harpophylla*), other Wattles, and Various Blue Spotted Gum (*Corymbia citriodora*), Ironbark (*Eucalyptus crebra* and *E. melanophloia*), White Cypress Pine (*Callitris glaucophylla*) and Bulloak open forest and woodland associations on sandstone derived soils. Dunmall's Snake occurs primarily in the Brigalow Belt region in the south-eastern interior of Queensland. Records indicate sites at elevations between 200–500 m above sea level (DEE, 2018cc). Desktop review did not confirm records of the species in the study area. Suitable cracking clay habitat is not present within the study area.
Saiphos reticulatus	Three-toed Snake-tooth Skink	VU	-	Potential	Unlikely	The Three-toed Snake-tooth Skink has reduced limbs, each with three digits. It has been found in loose, well mulched friable soil, in and under rotting logs, in forest litter, under fallen hoop pine bark and under decomposing cane mulch. In Queensland, the Three-toed Snake-tooth Skink has a disjunct north-south distribution, with the species absent from apparently suitable habitat in the D'Aguilar Ranges (DEE, 2018dd). Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.

TableA.4 Likelihood of occurrence assessment – threatened fauna (reptiles)

Scientific name	Common Name	EPBC Act status	NC Act status	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Tympanocryptis condaminensis	Condamine Earless Dragon	EN	E	Likely	Unlikely	The Condamine earless dragon is a small, spiny earless dragon lizard that grows to around 12cm. It has been recorded in the eastern Darling Downs area, and survives in intensively cropped areas. The species has been found sheltering under surface rocks or in rocky outcrops, and occurs in grasslands on black cracking clays of the Condamine River floodplain (DEHP, 2017c). Desktop review did not confirm records of the species in the study area. Suitable cracking clay habitat is not present within the study area.
Delma torquata	Collared Delma	VU	V	Known	Known	The Collared Delma is endemic to Queensland and is the smallest member of the family Pygopodidae. It normally inhabits eucalypt-dominated woodlands and open-forests with rocky outcrops. Large concentrations of records are from the western suburbs of Brisbane (DEE, 2018ee). Desktop review confirmed records of the species adjacent to the study area in the Toowoomba Range. Field surveys confirmed suitable potential habitat for this species, and field surveys from other projects confirmed sightings of the species.
Egernia rugosa	Yakka Skink	VU	V	Potential	Unlikely	The Yakka Skink is a pale fawn reptile growing to 40 cm. It is known to occur in open dry sclerophyll forest, woodland and scrub. The core habitat of this species is within the Mulga Lands and Brigalow Belt South Bioregions (DEE, 2018ff). Particularly in areas where ironbarks are common, with fallen logs or surface rocks. Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.

Notes: *1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable*

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

Table A.5 Likelihood of occurrence assessment – threatened fauna (invertebrates)

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Invertebrates						
Argynnis hyperbius inconstans	Australian Fritillary	CE	E	Potential	Unlikely	The Australian Fritillary is an orange butterfly that is restricted to open, swampy, coastal areas where the larval food plant, *Viola betonicifolia*, grows in Melaleuca wetlands. It has been recorded in south-eastern Queensland between Gympie and Port Macquarie in New South Wales (DEHP, 2018b). Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.
Phyllodes imperialis smithersi	Pink Underwing Moth	EN	-	Potential	Unlikely	The Pink Underwing Moth is a striking moth with leaf-shaped grey-brown forewings marked with white. The Pink Underwing Moth is found below the altitude of 600 m in undisturbed, subtropical rainforest on rich volcanic soils and fertile alluvium. It occurs in association with the vine *Carronia multisepalea*, a collapsed shrub that provides the food and habitat the moth requires in order to breed. It is distributed from Kin Kin Creek south-east of Gympie in Queensland, to Bellingen in northern NSW (DEE, 2018gg). Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

Table A.6 Likelihood of occurrence assessment – threatened fauna (fish)

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Fish			**FM Act status**			
Maccullochella mariensis	Mary River Cod	EN	-	Known (translocated population)	Unlikely	The Mary River Cod is a golden-yellow to green to dark brown fish. It is restricted to the Mary River catchment and stocked in some SEQ impoundments. It prefers areas of low flow, resides around undercut banks and fallen timber (DAF, 2018a). Desktop review did not confirm records of the species within the study area and the study area is outside the known distribution of the species.
Maccullochella peelii	Murray Cod	VU	-	Potential	Unlikely	The Murray Cod was formerly widespread and abundant in the lower and mid-altitude reaches of the Murray-Darling Basin but now has a patchy distribution and abundance across its historic range .The species has been found in diverse habitats including flowing and standing waters, small, clear, rocky streams on the inland slopes and uplands of the Great Dividing Range, large, turbid, meandering slow-flowing rivers, creeks, anabranches, and lakes and larger billabongs of the inland plains of the Murray Darling Basin (DAF, 2018b). Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.
Neoceratodus forsteri	Australian Lungfish	VU	-	Known	Likely	The Australian Lungfish has a stout, elongate body with an eel-like tail. It is native to Mary and Burnett River systems in freshwater (DEE, 2018ww). Its distribution is limited to SEQ. Desktop review confirmed a record of the species along Lockyer Creek. Suitable habitat is available within the study area.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

Table A.7 Likelihood of occurrence assessment – threatened fauna (migratory)

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Migratory species						
Actitis hypoleucos	Common Sandpiper	Mi, M	-	Likely	Potential	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. Generally the species forages in shallow water and on bare soft mud at the edges of wetlands. Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia (DEE, 2018hh). Desktop review confirmed records of the species nearby the study area. However, suitable potential habitat is not present within the study area.
Apus pacificus	Fork-tailed Swift	Mi, M	-	Likely	Unlikely	The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground. They mostly occur over inland plains but sometimes above foothills or in coastal areas. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. They sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines. They are widespread but scattered in coastal areas from 20° S, south to Brisbane and in much of the south south-eastern region (DEE, 2018ii). Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.
Cuculus optatus	Oriental Cuckoo	Mi	-	Potential	Potential	This species has an extremely large range, breeding from Russia to Japan and Siberia. During winter, birds occur throughout Indonesia, the Philippines, Papua New Guinea and in northern and eastern Australia. The species is found in forest canopy, open wooded areas and orchards, often in hill country, also in coniferous forest and in birch (*Betula*) above the tree-line. It is sometimes found in pure broad-leaved forests, steppe birch copses, riverside willows, and thickets (BirdLife, 2016a). Desktop review confirmed records of the species within the study area. However, suitable potential habitat does not occur in the study area.

Table A.7 Likelihood of occurrence assessment – threatened fauna (migratory)

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Monarcha melanopsis	Black-faced Monarch	Mi, M		Known	Likely	The Black-faced Monarch mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest. In Queensland, it is widespread from the islands of the Torres Strait and on Cape York Peninsula, south along the coasts (occasionally including offshore islands) and the eastern slopes of the Great Divide, to the New South Wales border (DEE, 2018jj). Desktop review confirmed known records of the species surrounding within the study area. No rainforest habitat though but lots of records around area
Symposiachrus trivirgatus	Spectacled Monarch	Mi, M		Known	Potential	Usually considered a denizen of the dense rainforests and moist eucalypt forests of eastern and north-eastern Australia, the Spectacled Monarch sometimes also inhabits mangroves and other densely vegetated habitats. The species occurs at all strata of the forest, but stays mostly in the middle to lower levels, where it gleans, sallies and flutter-chases insect prey among the inner foliage of the trees and shrubs (Birdlife, 2018). Desktop review confirmed records of the species south of the study area in Toowoomba. However, suitable potential habitat does not occur in the study area.
Calidris acuminata	Sharp-tailed Sandpiper	Mi, M		Known	Potential	The Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. In Queensland, they are recorded in most regions, being widespread along much of the coast and are very sparsely scattered inland, particularly in central and south-western regions (DEE, 2018kk). Desktop review confirmed records of the species south of the study area. However, suitable wet habitat does not occur in the study area.

Table A.7 Likelihood of occurrence assessment – threatened fauna (migratory)

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Calidris melanotos	Pectoral Sandpiper	Mi, M	-	Likely	Potential	These species are found at coastal habitats such as lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. In Queensland, most records for the Pectoral Sandpiper occur around Cairns (DEE, 2018ll). The Red-necked Stint is distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts (DEE, 2018mm). Inland for the Common Greenshank, there have been a few records south of a line from near Dalby to Mt Guide, and sparsely scattered records elsewhere (DEE, 2018pp). The Marsh Sandpiper is found on coastal and inland wetlands throughout Australia. The species is widespread in coastal Queensland, but few records exist north of Cooktown (DEE, 2018qq). Desktop review confirmed records of these species surrounding study area. However, suitable coastal habitat does not occur in the study area.
Calidris ruficollis	Red-necked Stint	Mi, M		Known		
Tringa nebularia	Common Greenshank	Mi, M		Likely		
Tringa stagnatilis	Marsh Sandpiper	Mi, M		Likely		
Gallinago hardwickii	Latham's Snipe	Mi, M		Potential	Likely	Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). The range extends inland over the eastern tablelands in south-eastern Queensland (and occasionally from Rockhampton in the north), and to west of the Great Dividing Range in New South Wales (DEE, 2018nn). Desktop review confirmed known records of these species surrounding the study area. Suitable habitat is available in close proximity to the study area.
Pandion haliaetus	Osprey	Mi, M		Known	Potential	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. The breeding range of the Eastern Osprey extends around the northern coast of Australia (including many offshore islands) from Albany in Western Australia to Lake Macquarie in NSW (DEE, 2018oo). Desktop review confirmed records of these species surrounding study area. However, suitable wet tropical habitat does not occur in the study area.

Table A.7 Likelihood of occurrence assessment – threatened fauna (migratory)

Scientific name	Common Name	EPBC Act status[1]	NC Act status[2]	Potential to occur in the survey area (desktop assessment)	Likelihood of occurrence following detailed vegetation mapping	Rationale
Hirundapus caudacutus	White-throated Needletail	Mi, M		Known	Likely	The White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. The species has been recorded roosting in trees in forests and woodlands, both among dense foliage in the canopy or in hollows. In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains (DEE, 2018rr). Desktop review confirmed records of these species in close proximity to the study area. Suitable habitat is present within the study area.
Motacilla flava	Yellow Wagtail	Mi, M		Potential	Unlikely	This species occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra (BirdLife International, 2017). Desktop review did not confirm records of the species in the study area and the study area is outside the known distribution of the species.
Myiagra cyanoleuca	Satin Flycatcher	Mi, M		Known	Potential	Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. In Queensland, it is widespread but scattered in the east, being recorded on passage on a few islands in the western Torres Strait (DEE, 2018ss). Desktop review confirmed few records of these species surrounding study area.
Rhipidura rufifrons	Rufous Fantail	Mi, M		Known	Likely	The Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts, usually with a dense shrubby understorey often including ferns. The Rufous Fantail occurs in coastal and near coastal districts of northern and eastern (DEE, 2018tt). Desktop review confirmed records of these species within the study area. Suitable habitat is present within the study area.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, M – marine, Mi - migratory

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

Appendix C

Significant Impact Assessments

Species Profile **Koala (*Phascolarctos cinereus*)** (*combined populations of Qld, NSW and the ACT*)
Status: Vulnerable (EPBC Act), Vulnerable (NC Act)

Distribution:
The Koala is endemic to Australia. The biological species range extends from north-eastern Queensland (QLD) to the south-east corner of South Australia (SA) (ANZECC 1998). The distribution of the Koala and its habitat are influenced by altitude (generally limited to <800 m above sea level), temperature, and at the western and northern ends of the range, leaf moisture (Munks et al. 1996). In the semi-arid regions in the western and northern parts of the species' range, Koala distribution and abundance is strongly influenced by the availability of water in soils from which food trees draw water. Given that average, annual rainfall is considerably higher towards the coast, the density of the Koala population is generally greater there than inland.

Fragmented sub-populations of the Koala occur throughout QLD (Queensland EPA 2006). Densities of these sub-populations range from moderately high in south-east Queensland (SEQ) and some parts of central QLD (1–3 Koalas/ha) to low in other parts of central QLD (≥0.01 Koalas/ha) (Melzer et al. 2000). Parts of SEQ support high densities of Koala populations including Redlands and Pine Rivers which are recognised as under threat from factors including habitat loss, dog attacks, vehicles and disease.

A review of desktop information and results of ecology surveys that have been completed in the study area for G2K have confirmed the presence of Koalas in all sections, including the Toowoomba Range, foothills of the range, the lowland areas in H2C and Teviot Range in C2K. It is therefore expected Koalas will utilise eucalypt woodlands and trees across the alignment.

Habitat

Koalas naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by eucalyptus species (Martin & Handasyde 1999). Along the Great Dividing Range and the coastal belt throughout the species' range, Koalas inhabit moist forests and woodlands mostly dominated by eucalyptus species. Koalas are habitat specialists and feed almost exclusively on eucalypts leaves which have low nutrional value and high in indigestible or toxic materials. Therefore they are selective about which tree species and leaves they consume and nutritional value. In general, soils with higher fertility and moisture holding capacity produce better quality, more palatable browse, which support Koalas (Rhodes et al 2015).

QLD Government has previously released Koala habitat mapping for SEQ. The mapping is applicable under the *Planning Act 2016*. This mapping is currently under review. Parts of the study area in proximity to Ebenezer, Rosewood and Willowbank are mapped as 'bushland habitat' or 'suitable for rehabilitation'.

Based on an assessment of regional ecosystems (REs), including remnant vegetation and high value regrowth (HVR), that occur in the study area, the following REs were identified as providing potential habitat for Koalas. Some REs support preferred food trees and provide more primary foraging habitat for Koalas (these REs are noted with *). Koalas will also utilise individual eucalypt trees in paddocks for foraging and Koalas will move through partially cleared landscapes between larger habitat patches.

Regional Ecosystem	Description
12.3.7*	*Eucalyptus tereticornis, Casuarina cunninghamiana subsp. cunninghamiana +/- Melaleuca spp. fringing woodland*
12.9-10.2*	*Corymbia citriodora* subsp. *variegata +/- Eucalyptus crebra* open forest on sedimentary rocks

12.9-10.17a	*Lophostemon confertus* or *L. suaveolens* dominated open forest usually with emergent Eucalyptus and/or Corymbia species. Occurs in gullies and southern slopes on Cainozoic and Mesozoic sediments
12.9-10.7*	*Eucalyptus crebra* +/- *E. tereticornis*, *Corymbia tessellaris*, *Angophora spp., E. melanophloia* woodland o sedimentary rocks
12.3.3d*	*Eucalyptus moluccana woodland. Other frequently occurring species include Eucalyptus tereticornis, E. crebra, E. siderophloia, Corymbia citriodora subsp. variegata, Angophora leiocarpa and C. intermedia. Occurs on margins of Quaternary alluvial plains often adjacent sedimentary geologies. May also occur on stranded Pleistocene river terraces. Floodplain (other than floodplain wetlands).*
12.3.3*	*Eucalyptus tereticornis* woodland on Quaternary alluvium
12.9-10.3	*Eucalyptus moluccana* open forest on sedimentary rocks
12.8.14	*Eucalyptus eugenioides, E. biturbinata, E. melliodora +/- E. tereticornis, Corymbia intermedia woodland on Cainozoic igneous rocks*
12.8.17*	*Eucalyptus melanophloia* +/- *E. crebra, E. tereticornis, Corymbia tessellaris* woodland on Cainozoic igneo rocks
11.8.5	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks
11.3.25*	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines

Threats:

The main threats to the Koala are:

- ongoing habitat loss and habitat fragmentation;
- vehicle strike;
- predation by the domestic or feral dogs (*Canis lupus familiaris*);
- disease (in particular chlamydial infection); and
- drought and incidences of extreme heat are also known to cause very significant mortality, and post-drought recovery may be substantially impaired by the range of other threatening factors (TSSC 2012o).

Is an important population likely to be present?

There are Koala records throughout the study area (as mapped in Appendix E).

Applying the Koala habitat assessment tool from Section 6 of the EPBC Act Koala referral guidelines (DoE, 2014) an evaluation of Koala habitat that occurs in the study area, and has potential to be impacted has been completed. The entire alignment, on average, falls under the coastal rainfall

category of over or equal to 800mm of annual precipitation, as shown in Table 1 of the guidelines. Results of the habitat assessment are summarised below.

Koala Habitat Assessment Tool

Attribute	*Score*	*Habitat appraisal*
Koala occurrence	+2	Koalas have been recorded in the study area and Koala populations are known to occur in the region. Portions of the study area are likely to provide preferred foraging resources for Koalas and important movement corridors. It is also recognised large portions of the study area are cleared or support isolated patches of eucalypt woodland which are of lower quality and value to Koalas. Overall the proposed areas for geotechnical investigations are considered to have a high likelihood of Koala occurrence and support Koala populations.
Vegetation structure and composition	+1	RE mapping shows the alignment crosses 13 vegetation communities of which 11 have known Koala food tree species. • RE 12.3.7 *Eucalyptus tereticornis*, *Casuarina cunninghamiana* subsp. *cunninghamiana* +/- *Melaleuca* spp. fringing woodland • RE 12.9-10.2 *Corymbia citriodora* subsp. *variegata* +/- *Eucalyptus crebra* open forest on sedimentary rocks • RE 12.9-10.17 *Lophostemon confertus* or *L. suaveolens* dominated open forest usually with emergent Eucalyptus and/or Corymbia species. Occurs in gullies and southern slopes on Cainozoic and Mesozoic sediments. • RE 12.9-10.7 *Eucalyptus crebra* +/- *E. tereticornis*, *Corymbia tessellaris*, *Angophora* spp., *E. melanophloia* woodland on sedimentary rocks • RE 12.3.3d *Eucalyptus moluccana* woodland. Other frequently occurring species include *Eucalyptus tereticornis*, *E. crebra*, *E. siderophloia*, *Corymbia citriodora* subsp. *variegata*, *Angophora leiocarpa* and *C. intermedia*. Occurs on margins of Quaternary alluvial plains often adjacent sedimentary geologies. May also occur on stranded Pleistocene river terraces. Floodplain (other than floodplain wetlands). • RE 12.3.3 *Eucalyptus tereticornis* woodland on Quaternary alluvium • RE 12.9-10.3 *Eucalyptus moluccana* open forest on sedimentary rocks • RE 12.8.4 *Eucalyptus eugenioides*, *E. biturbinata*, *E. melliodora* +/- *E. tereticornis*, *Corymbia intermedia* woodland on Cainozoic igneous rocks • RE 12.8.17 *Eucalyptus melanophloia* +/- *E. crebra*, *E. tereticornis*, *Corymbia tessellaris* woodland on Cainozoic igneous rocks • RE 11.3.25 *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines • RE11.8.5 *Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks.

		Koala habitat within areas proposed for geotechnical investigations range from areas in good condition and structure which are large, well connected remnant patches supporting preferred food trees, to areas of poor condition due to being weed infested or small isolated pockets of eucalypt woodland, and individual eucalypt trees. Overall the study area is considered to support Koala habitats in moderate to good condition.
Habitat connectivity	+1	The project alignment is situated in, mostly pastoral, agricultural land. However there are sections which go through large tracts of remnant woodlands including the Toowoomba Range and Teviot Range. There are also patches of remnant woodland along creeklines that have the potential to provide important movement corridors for Koalas through the cleared landscape. There is considerable infestation of Lantana (*Lantana camara*) on the Toowoomba Range which hinders Koala movement through some areas. Across G2K habitat connectivity for Koalas is considered moderate.
Key existing threats	+1	Threats to Koalas near to and along the alignment will be from habitat fragmentation associated with agricultural activities and urban expansion, vehicle collision along roads and highways and dog attack. Threats are considered high across the G2K alignment, particularly in areas where habitat is fragmented and Koalas are having to move across roads and cleared areas to access foraging resources.
Recovery value	+2	The G2K alignment is known to support Koala populations and Koala habitat that varies in its quality and connectivity. Threats to Koalas in the area are recognised as high. There is potential for recovery of these habitats and reduction in threats through a range of measures which are currently being investigated by the QLD Government. They may include protection of important habitats, revegetation of Koala habitat and improved connectivity between habitats, reduction in threats from vehicle strike through road design, exclusion fencing, and dog attacks by improving education for dog owners. The study area supports vegetation that contains preferred foraging trees on land zone 3 that are known to have higher soil moisture content. Riparian vegetation is also known to provide important connectivity for Koalas particularly in cleared landscapes. Therefore there is potential for restoration of these important Koala corridors and habitats within the study area.
Total	**7**	

Criteria	**Discussion**
Lead to a long term decrease in size of a	Koalas have been recorded across the entire G2K alignment. The study area is known to support Koala populations and areas that contain Koala habitat. A large portion of the alignment is through cleared and disturbed areas. Therefore it is mostly where there are large areas of eucalypt woodlands or

population	patches of woodland, particularly along creeklines, where impacts to Koala habitat may occur. Removal of Koala habitat including individual Koala habitat trees will be avoided as much as practicable. Based on mapping potential Koala habitat (including remnant and HVR) it is estimated that the geotechnical investigations may result in the loss of: • 13.54 ha in the base alignment • 14.97 ha in the 3216 alignment. For a large portion of access tracks and investigation sites no clearing of native vegetation is required. Greatest impacts have the potential to occur from the construction of 5 m wide access tracks and boreholes where they occur in remnant woodlands where clearing can't be avoided. Other direct impacts to Koalas may be during vegetation clearing. Fauna spotters will check areas for Koalas prior to any clearing and during clearing to ensure they are not harmed during clearing process. Clearing will be done in a sequential manner to ensure Koalas can safely move out of the area to adjacent habitat. If Koalas are found to be present that tree, and adjacent trees, will not be cleared until the Koala has moved from the area on its own accord. No impact to Koalas is expected from vehicles or machinery due to the very slow speed at which they will be travelling and presence of fauna spotters to check an area prior to works occurring. Indirect impacts may occur to Koalas as a result of noise associated with drilling activities. The noise will be during the day for a short period of time, therefore is not expected to have a significant impact on Koalas. Impacts to Koala habitat and individual food trees will be avoided as much as practicable. Where impacts are unavoidable, a cumulative impact of up to 15.37 ha of potential habitat could be impacted. As a result of mitigation measures to be put in place, no direct loss of Koalas from clearing or vehicles is likely to occur. As a result, the proposed geotechnical works are not likely to result in the long-term decrease in size of a Koala population.
Reduce the area of occupancy of an important population	The geotechnical investigations project will result in minor areas of impact to Koala habitat as in majority of cases clearing of native vegetation can be avoided. This may be through moving the location of the investigation site or access track. Where vegetation cannot be avoided only minor areas need to be cleared; up to 100 m^2 maximum for borehole pads and 5 m wide tracks. Koalas are widespread in the SEQ region and there will be still be large areas of Koala habitat adjacent to the proposed works for Koalas to utilise, and post completion of investigations rehabilitation will occur. Therefore the geotechnical investigations are not expected to reduce the area of occupancy for Koalas.
Fragment an existing important population into two or more populations	Geotechnical investigations will only require very minor disturbances to Koala habitat across the G2K alignment. In most instances these works will occur in existing cleared areas or disturbed areas therefore no fragmentation of habitats will occur. The nature of the works does not include putting up any barriers to Koala movement, and cleared areas where required are of such a small size Koala movement will not be impacted. The geotechnical investigations are also of short duration. As a result no fragmentation of Koala populations or habitat will occur.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Koala consists of forests and woodlands dominated by eucalypt species (DEE, 2018vv). Based on the habitat assessment completed (7/10) the habitat along the alignment is not considered critical to the survival of the species. Many areas are in poor condition due to Lantana and other weed invasion, or occur as small isolated patches. It is recognised Koala habitat does occur along the G2K alignment and potentially up to 14.97 ha may be lost due to clearing for access tracks and boreholes. Clearing Koala habitat and individual preferred foraging trees will be avoided as much as possible. Where clearing is required these areas will be rehabilitated once geotechnical investigations cease.

Other direct impacts to Koalas may be during vegetation clearing. Fauna spotters will check areas for Koalas prior to any clearing and ensure they are not harmed during clearing process. Clearing will be done in a sequential manner to ensure Koalas can safely move out of the area to adjacent habitat. If Koalas are found to be present that tree, and adjacent trees, will not be cleared until the Koala has moved from the area on its own accord. No impact to Koalas is expected from vehicles or machinery due to the very slow speed at which they will be travelling and presence of fauna spotters to check an area prior to works occurring.

Impacts to Koala habitat and food trees will be minimised. Where impacts are unavoidable, up to 14.97 ha of potential habitat could be impacted. In areas not required for construction of the Inland Rail project the disturbance areas will be rehabilitated. It is not expected that the geotechnical investigations will adversely affect habitat critical to survival of the species.

Disrupt the breeding cycle of an important population

Female Koalas can potentially produce one offspring each year, with births occurring between October and May (DEE, 2018y).

Geotechnical investigations will avoid eucalypt trees where possible throughout the alignment. Spotter catchers will be present during clearing to identify Koalas and ensure they are not harmed during clearing process or as works progress (eg movement of machinery). If a Koala is confirmed the tree in which it is located and adjacent trees will not be cleared to ensure the animal is not harmed and permitted to move from the area of its own accord. Works will also only occur during the day which avoids periods when Koalas are most active. The drilling is for a short duration (one to two days) and due to small areas required for each investigation site, no disruption to Koalas breeding cycle is expected.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

A large portion of the alignment is through cleared and disturbed lands. Therefore it is mostly where there are large areas of eucalypt woodlands or patches of woodland where impacts to Koala habitat may occur.

Removal of Koala habitat including individual Koala habitat trees will be avoided as much as practicable. Based on mapping potential Koala habitat it is estimated that the geotechnical investigations may result in the loss of:

- 13.54 ha in the base alignment
- 14.97 ha in the 3216 alignment

Where vegetation clearing cannot be avoided rehabilitation will occur. Due to the small areas required for each borehole (up to 100 m^2) and access tracks being no wider than 5 m Koalas will still be able to move across or around these areas to adjacent habitat.

The project may result in indirect impacts to Koala habitat through introduction or spread of weeds. Hygiene protocols will be put in place to ensure vehicles, machinery etc have had weed washdowns and weeds are not introduced or spread between properties. Noting that many areas already contain significant weed infestations including the Toowoomba range where large areas of lantana exist.

Due to very minor areas of vegetation clearing that may be required, rehabilitation proposed and mitigation measures to manage weeds, the proposed investigations are not expected to reduce the quality or extent of habitat to the extent the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in

The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities, will also be put in place to ensure weeds are not brought in with vehicles or machinery.

Based on implementing the proposed mitigation measures it is not expected the geotechnical

the vulnerable species' habitat	investigations will result in an increase of invasive species.
Introduce disease that may cause the species to decline	The most well-known disease present in the Koala population is associated with particular strains of *Chlamydia*. Koala Retrovirus was recently identified and is thought to be responsible for a range of conditions, including leukaemia and an immunodeficiency syndrome (DEE, 2018y). The geotechnical investigations will not introduce or spread these diseases.
Interfere substantially with the recovery of the species	DEE (2018y) identifies a number of recovery and conservation objectives through Commonwealth Conservation Advice. These are listed below: • Develop and implement a development planning protocol to be used in areas of Koala subpopulations or subpopulation fragments to prevent loss of Koala subpopulations, habitat critical to the survival of the species and vital habitat connectivity. • Development plans should explicitly address ways to mitigate risk of vehicle strike when development occurs adjacent to, or within, Koala habitat. • Develop and implement a management plan to control the adverse impacts of predation on Koalas by dogs in urban, peri-urban and rural environments. • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them, if necessary. • Identify populations of high conservation priority. • Develop and implement options of vegetation recovery and re-connection in regions containing fragmented Koala populations, including inland regions in which Koala populations were diminished by drought and coastal regions where development pressures have isolated Koala populations. • Investigate formal conservation arrangements, management agreements and covenants on private land, and, for both Crown and private land, investigate and/or secure inclusion of habitat critical to the survival of the Koala in reserve tenure, if possible. • Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions. • Manage any other known, potential or emerging threats such a Bell Miner (*Manorina melanophrys*) Associated Dieback or Eucalyptus rust. The geotechnical investigations will not interfere substantially with any of these objectives.
Conclusion	The geotechnical investigations will not have a significant impact on the Koala as: • minor areas of Koala habitat may be impacted by the proposed investigations. However it is expected that clearing of Koala food trees and habitat can be avoided across a large portion of the G2K alignment; • due to the very small area of each investigation site no impact to Koala movement will occur, and the works will not increase threats such as dogs or vehicle strike; and • fauna spotters will be present prior to, and during clearing, to ensure no direct impacts occur to the species.

Species Profile	**Black-breasted Button-quail (*Turnix melanogaster*)** **Status: Vulnerable (EPBC Act), Vulnerable (NC Act)**
	Distribution: The Black-breasted Button-quail is distributed in SEQ from near Byfield in the north to the Border Ranges rainforests in the south, generally east of the Great Dividing Range; although there are records up to 300 km inland at locations at Palmgrove National Park and Barakula State Forest in QLD. The largest subpopulation is believed to occur in a 3 km × 100 km strip along the eastern edge of Fraser Island National Park in habitat that is difficult to survey. Density in QLD has been reduced in many areas, particularly in the Dawson and Fitzroy River catchments (TSSC, 2015b).
	Habitat: The Black-breasted Button-quail in SEQ are most frequently reported in vine thicket rainforests that have a largely closed canopy and deep litter layer in areas that receive 800–1200 mm annual average rainfall. They also occur in softwood scrubs in the Brigalow Belt; vine scrub regrowth; mature Hoop Pine (*Araucaria cunninghamii*) plantations, especially where there is Lantana (*Lantana camara*); dry sclerophyll forest adjacent to rainforest; and Acacia and Austromyrtus scrubs on sandy coastal soils (TSSC, 2015b).
	Threats: Currently the main threats to the species are habitat degradation as a result of domestic livestock and feral pigs (*Sus scrofa*), habitat loss or degradation from fires of increasing intensity or frequency and predation by feral animals such as feral cats (*Felis catus*) and foxes (*Vulpes vulpes*). At least 90% of Black-breasted Button-quail habitat was cleared for agriculture or plantations of Hoop Pine, with the area of bottle-tree scrubs being reduced from several hundred thousand to only a few thousand hectares by the 1960s. However, almost all lands currently occupied are under state control and most are now conserved, nevertheless grazing by domestic livestock may still be occurring across parts of the species range.
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species was identified as having potential to occur in Toowoomba Range and Flinders Peak Conservation Park through desktop assessment and field surveys. The geotechnical investigations will be conducted in the northern area of Toowoomba Range and southern area of the Flinders Peak Conservation Park through a valley. Minor clearing of potential Black-breasted Button-quail habitat has the potential to occur for establishment of access tracks and pads for borehole drilling. The geotechnical investigations have potential to result in clearing the following areas of potential habitat for the Black-breasted Button-quail: • 0.53 ha in the base alignment • 0.67 ha in the 3216 alignment Where vegetation clearing cannot be avoided, impacts from the geotechnical investigations will be focused on more disturbed areas rather than areas of higher quality habitat for the species. Where clearing is required these areas will be rehabilitated once geotechnical investigations cease, except for some access tracks that may be required for construction of the railway. The minor areas of habitat that may be removed (no greater than a total of 0.67 ha) is not expected to impact on the Black-breasted Button-quail population as there are large, intact areas of habitat in adjacent areas, and post geotechnical works rehabilitation will occur. To avoid and minimise impacts on Black-breasted Button-quail fauna spotter catchers will be present prior to clearing to check for the presence of the species. Procedures will then be put

in place to avoid impacts including moving access roads or drill pads.

Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is not likely to harm any individuals or lead to a long term decrease in the size of an important population.

Reduce the area of occupancy of an important population

The geotechnical investigations project will result in clearing of potential habitat for the Black-breasted Button-quail (areas are stated above). The Black-breasted Button-quail are distributed throughout SEQ. A large portion of the population is concentrated around the Bunya Mountains and Brisbane's western suburbs, around Mount Crosby and Moggill Regional park. The geotechnical investigations will result in the loss of very minor areas of potential habitat for this species. However, given the range of this species, extent of habitat remaining in the locality and rehabilitation of the minor habitat areas to be lost, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.

Fragment an existing important population into two or more populations

Geotechnical investigations will be prioritised in cleared and disturbed areas where possible. Geotechnical sites will be sited in these disturbed areas to limit impacts to native vegetation and fauna habitat. Large areas of suitable habitat will remain in the locality in Toowoomba Range and Flinders Peak Conservation Park. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation.

The geotechnical investigations will not result in any major fragmentation of habitat. The clearing areas required for access tracks will be no greater than 5 m in width, and pads no more than 100 m^2. Black-breasted Button-quail will be able to move across these areas to adjacent habitats.

Adversely affect habitat critical to the survival of a species

Habitat critical to the survival of the Black-breasted Button-quail is identified as vine thicket rainforests that have a largely closed canopy and deep litter layer in areas that receive 800–1200 mm annual average rainfall (TSSC, 2015b). The vegetation in Toowoomba Range has small patches that meet these criteria, in particular areas of lantana that provide suitable refuge habitat. Such habitat is limited within the survey area.

Impacts to key habitat in areas containing vine thickets in Toowoomba Range and Flinders Peak Conservation Park will be avoided by moving the location of access tracks and pads away from these habitats where possible. Minor impacts to vine thickets in Toowoomba Range and Flinders Peak Conservation Park may occur due to the intact vegetation in this area, and steep terrain.

To avoid and minimise impacts on Black-breasted Button-quail fauna spotter catchers will be present prior to clearing to check for the presence of the species and their nests, including in lantana. Procedures will then be put in place to avoid impacts including moving access roads or pads. It is estimated that up to only 0.67 ha of potential habitat would need to be cleared. This impact is not predicted to adversely affect habitat critical to the survival of the species.

Disrupt the breeding cycle of an important population

Breeding season occurs from September to April/May for the Black-breasted Button-quail, and it produces three to five eggs. Nests consist of a scrape in the ground, lined with leaves, grass or moss. Nests are well-concealed and are often in areas where the common understorey plants include species such as Bracken (*Pteridium esculentum*), Rasp Fern (*Doodia aspera*) and Lantana (*Lantana camara*) (TSSC, 2015b).

Geotechnical investigations may occur in breeding season. Spotter catchers will be present prior to, and during clearing, to identify the species or its nest in proposed disturbance areas

	including lantana thickets. If nests are observed all measures will be taken to avoid them. A Species Management Program (SMP) will be prepared and implemented as a mitigation measure. It is prepared as a requirement for tampering with a protected animal breeding place in QLD under the *Nature Conservation (Wildlife Management) Regulation 2006*. It is not expected the works will disrupt their breeding cycle as the clearing and drilling will occur over a short period of time and measures taken to avoid harm to their nests.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project has potential to result in minor impacts to potential habitat for Black-breasted Button-quail. Indirect impacts may occur due to noise. Noise will only occur diurnally and will be short-term (only over a few days). The location of geotechnical sites and access tracks will be placed to avoid native vegetation or preference areas of lower quality/disturbed habitat. Large areas of potential habitat for the Black-breasted Button-quail will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to result in the spread of weed species such as lantana. Lantana is widespread throughout the region. Lantana is considered as important habitat for the species and is often used for foraging, nesting and nocturnal roosting. The spread of lantana in this case would not negatively impact the species. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.
Introduce disease that may cause the species to decline	Disease is not recognised as a threat to the Black-breasted Button-quail. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Mathieson & Smith (2009) identify a number of recovery and conservation objectives through the Australian Government. These are listed below: • Consolidate current knowledge and define assessment and monitoring strategies for black-breasted button-quail, including an assessment of current status throughout its range and a clear definition of the habitats occupied by the species. • Protect key ecosystems/habitat that support populations of Black-breasted Button-quail from human-induced threatening processes, thus maintaining current populations and habitat. • Maintain or improve the extent, condition (quality) and connectivity of black-breasted button-quail habitat. • Reduce the impacts of introduced predators and competitors. • Increase understanding of the ecology of Black-breasted Button-quail. • Administer and review the operation of the recovery process. The geotechnical investigations will not interfere substantially with any of these objectives.
Conclusion	The geotechnical investigations will not have a significant impact on the Black-breasted Button-quail as: • vegetation clearing will be minimised as far as practicable to a 5 m wide access track

and no greater than 100 m^2 drill pads. No more than a total of approx. 0. 67 ha of habitat will be lost;

- loss of minor habitat areas will be temporary as rehabilitation will occur once geotechnical investigations are complete;
- fauna spotter catchers will be present prior to, and during clearing, to check for presence of the species and their nests. The SMP addresses avoidance and mitigation measures that will be implemented to ensure clearing or activities do not impact on the species or their nests.

Species Profile	**Australian Painted Snipe (*Rostratula australis*)** **Status: Endangered (EPBC Act), Vulnerable (NC Act)** **Latham's Snipe (*Gallinago hardwickii*)** **Status: Marine, Migratory (EPBC Act)** **Distribution:** The Australian Painted Snipe has been recorded at wetlands in all states of Australia. It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of QLD, New South Wales (NSW) and Victoria (VIC). The total population size of the Australian Painted Snipe is effectively unknown, but tentative estimates range from a few hundred individuals to 5000 breeding adults (DEE, 2018t). Latham's Snipe is a non-breeding visitor to south-eastern Australia. The range extends inland over the eastern tablelands in SEQ (and occasionally from Rockhampton in the north), and to west of the Great Dividing Range in NSW (DEE, 2018nn). **Habitat:** The Australian Painted Snipe and Latham's Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps, muddy bogs and claypans. Low, dense vegetation cover is a common habitat feature for these species (DEE, 2018t) (DEE, 2018nn). **Threats:** The primary factor in the decline of the Australian Painted Snipe and Latham's Snipe is a loss and alteration of wetland habitat. The two major sources of this have been the drainage of wetlands and the diversion of water to agriculture and reservoirs, the latter process reducing flooding and precluding the formation of temporary shallow wetlands. The replacement of endemic wetland vegetation by invasive, noxious weeds could render habitats less suitable or unsuitable for the Australian Painted Snipe and Latham's Snipe (DEE, 2018t) (DEE, 2018nn).
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The Australian Painted Snipe and Latham's Snipe were identified as having potential to occur through desktop assessments in wetlands near Helidon Spa and Laidley Heights. The geotechnical investigations will be conducted north of Helidon Spa and east of Laidley Heights. Minor clearing of potential Australian Painted Snipe and Latham's Snipe habitat has the potential to occur for establishment of access tracks and pads for borehole drilling. The geotechnical investigations have potential to result in clearing the following areas of potential habitat for the Australian Painted Snipe and Latham's Snipe: • 1.83 ha in the base alignment • 1.83 ha in the 3216 alignment Where vegetation clearing cannot be avoided, impacts from the geotechnical investigations will be focused on more disturbed areas rather than areas of higher quality habitat for the species. Where clearing is required these areas will be rehabilitated once geotechnical investigations cease, except for some access tracks that may be required for construction of the railway. The areas of habitat that may be removed (no greater than a total of 1.83 ha) is not expected to impact on the Australian Painted Snipe and Latham's Snipe populations as there are wetlands in adjacent areas, and post geotechnical works rehabilitation will occur. To avoid and minimise impacts on the Australian Painted Snipe and Latham's Snipe, fauna

	spotter catchers will be present prior to clearing to check for the presence of the species. Procedures will then be put in place to avoid impacts including moving access road or pads where possible. Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is not likely to harm any individuals or lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations have potential to result in clearing of up to 1.93 ha of potential habitat for the Australian Painted Snipe and Latham's Snipe. The Australian Painted Snipe has been recorded at wetlands in all states of Australia. Latham's Snipe is a non-breeding visitor to south-eastern Australia. The geotechnical investigations may result in the removal of small wetland areas for the Australian Painted Snipe and Latham's Snipe. However, as wetland habitat is available in the surrounding areas it is expected the activities will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be placed in areas to avoid preferred wetland areas. Where vegetation clearing can't be avoided the area of disturbance will be very minimal, and rehabilitation will occur post completion of works. The Australian Painted Snipe and Latham's Snipe movement between wetlands areas will not be impacted by the nature of work that is proposed. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Australian Painted Snipe and Latham's Snipe consists of shallow terrestrial freshwater wetlands (DEE, 2018t). Wetlands are defined as ecosystems that are wet for a period of time (WetlandInfo, 2013). Wetlands in Helidon Spa and Laidley Heights would meet these criteria and wetland habitat is available in surrounding areas. The geotechnical investigations will not result in any direct impacts to habitat critical to the survival of the Australian Painted Snipe and Latham's Snipe.
Disrupt the breeding cycle of an important population	The Australian Painted Snipe may breed in response to wetland conditions rather than during a particular season. It has been recorded breeding in all months in Australia. Eggs have been recorded from mid August to March (DEE, 2018t). Latham's Snipe breeds in Japan and far eastern Russia (DEE, 2018tt). An SMP will be prepared and implemented as a mitigation measure. It is prepared as a requirement for tampering with a protected animal breeding place in QLD under the *Nature Conservation (Wildlife Management) Regulation 2006*. The geotechnical investigations will not disrupt the breeding cycle of the Australian Painted Snipe population in Helidon Spa or Laidley Heights areas. No works are proposed near wetlands.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will not result in any direct impacts to potential habitat for the Australian Painted Snipe and Latham's Snipe. While wetlands are located in surrounding areas, there are no wetlands near the proposed geotechnical sites and any disturbance will be located away from riparian vegetation and watercourses. Indirect impacts from sediment runoff will be managed through appropriate erosion and sediment control measures. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the Australian Painted Snipe and Latham's Snipe are likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species, such as *Salvinia* spp. and Water lettuce (*Pistia stratiotes*). The geotechnical investigations do not have the potential to result in the spread of invasive species.
Introduce disease that may cause the species to decline	Disease is not recognised as a threat to the snipes. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	DEE (2018t) identifies a number of recovery and conservation objectives initiated by the Threatened Bird Network and Australasian Wader Studies Group. These are listed below: • Development of a database of records. • The introduction of national targeted surveys conducted twice per year at important historic and contemporary sites and other sites of interest. • An assessment of habitat preferences. The geotechnical investigations will not interfere substantially with any of these objectives. There is no adopted or made Recovery Plan for Latham's Snipe.
Conclusion	The geotechnical investigations will not have a significant impact on the Australian Painted Snipe or Latham's Snipe as: • no direct impacts will occur to preferred wetland habitat for the species; • erosion and sediment control measures will be put in place to ensure sediment runoff does not impact water quality of nearby waterways; • geotechnical sites will ensure appropriate buffers are in place to watercourses and riparian vegetation; • potential impacts arising from increased weeds will be managed through implementation of weed identification during preclearance surveys and strict hygiene protocols.

Species Profile	**Swift Parrot (*Lathamus discolour*)** **Status: Critically Endangered (EPBC Act), Endagered (NC Act)**
	Distribution: The Swift Parrot breeds in Tasmania (TAS) during the summer and the entire population migrates north to mainland Australia for the winter for the non-breeding season. Whilst on the mainland the Swift Parrot disperses widely to forage on flowers and *psyllid* lerps in eucalypt species, with the majority being found in VIC and NSW. Small numbers of Swift Parrots are observed in the Australian Capital Territory (ACT) and in SEQ on a regular basis (TSSC, 2016b).
	Habitat: Swift Parrots breed in tree-hollows in old-growth or other forest with suitable hollows, in relatively close proximity to the main food source, flowering Tasmanian Blue Gum (*Eucalyptus globulus*). They disperse across eastern TAS after breeding and migrate to overwinter on the mainland in flowering woodlands and forests. They feed preferentially in the largest trees available. Key feed trees in SEQ and NSW include Forest Red Gum (*E. tereticornis*), Swamp Mahogany (*E. robusta*), Yellow Box (*E. melliodora*) and Grey Box (*E. macrocarpa*). Their distribution fluctuates with food availability as they feed on *psyllid* lerps, seeds and fruit. Non-breeding birds preferentially feed in inland box-ironbark and grassy woodlands, and Swamp Mahogany (*Eucalyptus robusta*) and Spotted Gum (*Corymbia maculata*) woodland when in flower; otherwise often in coastal forests from eastern VIC to the central coast of NSW. Commonly used lerp infested trees include Grey Box and Grey Box (TSSC, 2016b).
	Threats: Predation on nests by Sugar Gliders (*Petaurus breviceps*) is considered to pose a significant threat to the species, as Sugar Gliders take not only the young or eggs in the nest but also often kill the sitting female. Land clearing for plantation development and native forest silviculture has dramatically reduced landscape cover of nesting and foraging habitat for Swift Parrots. Habitat loss and alteration also occurs via residential, agricultural and industrial development, and dieback and suppression of regeneration in agricultural and urban areas. Psittacine Beak and Feather Disease is a widespread, lethal parrot disease which is known to occur in Swift Parrots and has been recorded in Swift Parrot nestlings in the wild population (TSSC, 2016b).
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species was recorded in the C2K section south of Rosewood during field surveys. Minor clearing of potential Swift Parrot habitat has the potential to occur for establishment of access tracks and pads for borehole drilling. The geotechnical investigations have potential to result in clearing the following areas of potential habitat for Swift Parrot: • 6.37 ha in the base alignment • 7.83 ha in the 3216 alignment It is considered likely that potential foraging habitat for the species can be avoided, given the nature of individual eucalypt trees or open woodland they prefer to utilise. Geotechnical investigation sites and access tracks can be moved to avoid clearing of these individual eucalypt trees or remnant woodlands. Indirect impacts to the species may occur from increased noise levels from drilling, but this will be only a short-term impact and there are other adjacent areas of foraging habitat the species can move into. Given the extent of habitat remaining in the locality, and minor area of habitat that may be

	lost, as well as short-term nature of activities, it is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations have potential to result in clearing of up to 7.83 ha of potential habitat in the base alignment for the Swift Parrot. The mainland population of Swift Parrot is largely distributed throughout VIC and NSW, with smaller populations distributed in SEQ. Their distribution fluctuates with food availability as they feed on *psyllid* lerps, seeds and fruit. The geotechnical investigations may result in the removal of key feed trees for the species. However, foraging resources are dependent on nectar availability, which can be temporally and spatially variable. Due to this, the species is highly mobile and is capable of locating nectar surrounding eucalypt woodlands. Based on the very small areas of potential impact, and the species' ability to locate nectar sources around eastern Australia, is expected the activities will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be placed in areas to avoid preferred foraging trees and woodland patches. Where vegetation clearing can't be avoided the area of disturbance will be very minimal, and rehabilitation will occur post completion of works. The species movement between foraging areas will not be impacted by the nature of work that is proposed. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Swift Parrot on the mainland consists of flowering eucalypt woodlands and forests with large trees (TSSC, 2016b). Non-breeding birds preferentially feed in inland box-ironbark and grassy woodlands. The species identified during field surveys were observed in Grey Box woodland. These woodlands occur in the C2K section and large areas of foraging resources will be undisturbed. Impacts to key habitat in areas containing Grey Box woodland will be largely avoided. Up to 7.83 ha may be impacted if clearing can't be avoided due to access tracks and boreholes. Based on the very small areas of potential impact, ability for the species to utilise a range of foraging resources in the area, and ability for geotechnical investigation sites to be moved away from preferred feed trees, it is not expected the activities will adversely affect habitat critical to the species.
Disrupt the breeding cycle of an important population	Breeding occurs in Tasmania during the summer. The geotechnical investigations will not disrupt the breeding cycle of the population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for Swift Parrot, with 7.83 ha of potential habitat in the base alignment to be directly impacted. Indirect impacts may occur due to noise. Noise will only occur diurnally and will be short-term (only over a few days). Large areas of potential foraging habitat for the Swift Parrot will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical

investigations will result in an increase of invasive species.

Introduce disease that may cause the species to decline

Psittacine Beak and Feather Disease is a highly infectious viral disease that affects the Swift Parrots and other parrot species.

The disease occurs naturally in the wild and there is no effective treatment of the disease (DoE 2015). The geotechnical investigations will not introduce or spread the disease as it occurs naturally in the wild.

Interfere substantially with the recovery of the species

Saunders & Tzaros (2011) identify a number of recovery and conservation objectives through the Australian Government. These are listed below:

- Identify and prioritise habitats and sites used by the species across its range, on all land tenures.
- Implement management strategies to protect and improve habitats and sites on all land tenures.
- Monitor and manage the incidence of collisions, competition and Beak and Feather Disease
- Monitor population trends and distribution throughout the range.

The geotechnical investigations will not interfere substantially with any of these objectives.

Conclusion

The geotechnical investigations will not have a significant impact on the Swift Parrot as:

- direct impacts to preferred foraging resources are likely to be avoided as geotechnical investigation sites can be moved to avoid individual trees or open woodland used by the species;
- any potential foraging habitat that is disturbed will be minor and rehabilitated; and
- the species breeds outside the study area and the geotechnical investigations will not impact the life cycle of the species.

Species Profile	**Spot-tail Quoll (southern subspecies) (*Dasyurus maculatus maculatus*)** **Status: Critically Endangered (EPBC Act), Endagered (NC Act)**
	Distribution: The Spot-tail Quoll (southern subspecies) occurs in coastal areas and adjacent ranges throughout south-eastern Australia from southern QLD to VIC and TAS. In SEQ, the species occurs coastally from Bundaberg to the border and inland to Monto and Stanthorpe. Occurrences from five broad geographic areas are known: four from coastal ranges and the Great Dividing Range from the NSW border to Gladstone. The fifth is centred on the eastern Darling Downs-Inglewood Sandstone provinces of the Brigalow Belt South Bioregion (DEE, 2018vv). **Habitat:** The Spot-tailed Quoll has a preference for mature wet forest habitat but has also been recorded in a wide range of habitats including eucalypt woodlands, subtropical rainforests in mountain areas and dry woodland. The Spot-tailed Quoll is predominantly nocturnal and rests during the day in dens (Jones et al. 2001). Habitat requirements include suitable den sites such as hollow logs, tree hollows, rock outcrops or caves (NPWS 1999at). Individuals also require an abundance of food, such as birds and small mammals, and areas of relatively intact vegetation through which to forage (NPWS 1999at). Spot-tail Quolls are solitary and have overlapping home ranges. Home ranges of individuals can be up to 580 ha for the southern subspecies. This subspecies is moderately arboreal and approximately 11% of travelling is done in trees (DEE, 2018vv). **Threats:** The loss, fragmentation, disturbance and degradation of habitat through clearing of native vegetation, timber harvesting and other forest management practices are the greatest threats to the Spot-tail Quoll. Predation from Red Foxes, Dingos (*Canis lupus dingo*) and domestic dogs (*Canis lupus familiaris*), are also current threats to the species. Timber harvesting, forest management activities and land clearing may increase Red Fox accessibility into forests. The large home ranges of the Spot-tail Quoll, particularly males, makes them susceptible to road mortality in forested areas fragmented by roads, and a tendency to scavenge road-killed carcasses may increase this threat (DEE, 2018vv).
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The Spot-tail Quoll was identified as having potential to occur in Little Liverpool Range through desktop assessments and potential habitat was identified in Toowoomba Range during field surveys. The geotechnical investigations will be conducted in the northern area of Toowoomba Range and the midsection of Little Liverpool Range. Minor clearing of potential Spot-tail Quoll foraging habitat will occur, with the geotechnical investigations occurring over less than 5 linear kilometres of Toowoomba Range and less than 3 linear kilometres of Little Liverpool

Range. The geotechnical investigations will result in clearing the following areas of potential habitat for the Spot-tail quoll:

- 4.62 ha in the base alignment
- 5.48 ha in the 3216 alignment

Where potential habitat for the species cannot be avoided impacts from the geotechnical investigations will be focused on more disturbed areas rather than high quality habitat. Rocky outcrops will not be impacted. Greatest impacts have potential to occur from the construction of access tracks and boreholes, which will be rehabilitated once geotechnical investigations cease.

Indirect impacts to the species may occur from noise associated with drilling. Noise will only be diurnal and short-term, with works in a particular area no more than one to two days.

Due to the very low area of potential habitat that may be impacted, avoidance of any rocky outcrops, and large home range of the Spot-tail Quoll, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.

Reduce the area of occupancy of an important population

The geotechnical investigations project will result in clearing of potential habitat for the Spot-tail Quoll (areas are stated above). The population of Spot-tail Quoll is largely distributed throughout VIC and NSW, with smaller populations distributed in SEQ. The geotechnical investigations will result in the loss of potential habitat for this species. However, given the home range of this species and amount of clearing required, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.

Fragment an existing important population into two or more populations

Geotechnical investigations will be undertaken in a disturbed environment where possible, subject to past clearing. Geotechnical sites have been sited in these disturbed areas to limit impacts to native vegetation and fauna habitat. Large areas of suitable habitat will remain in the locality in Toowoomba Range and Little Liverpool Range. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation.

The geotechnical investigations will not result in any major fragmentation of habitat.

Adversely affect habitat critical to the survival of a species

Habitat critical to the survival of the Spot-tail Quoll consists of large areas of relatively intact woodlands with suitable den sites such as hollow logs, tree hollows, rock outcrops or caves (DEE, 2018vv). The vegetation in Toowoomba Range and Little Liverpool Range would meet these criteria; however, such habitat is limited within the survey area.

Impacts to key habitat in areas containing rocky outcrops in Toowoomba Range and Little Liverpool Range will be avoided where possible by moving location of investigation sites to existing disturbed areas, and using existing access tracks. Rocky outcrops will be avoided. Where habitat areas cannot be avoided, spotter catchers will be available on site to assess the potential presence of quolls and den sites and put in place avoidance and mitigation measures. The geotechnical investigations will result in minor impacts to habitat critical to the survival of the Spot-tail Quoll. Given the extent of such habitat in the locality, these impacts would be considered negligible.

Disrupt the breeding cycle of an important population

Mating and births for the Spot-tailed Quoll occur between June and August. Litters of between four and six are born in late July to mid-August in the dens.

Geotechnical investigations will avoid potential den sites in Toowoomba Range and Little Liverpool Range area. Spotter catchers will be present during clearing to identify breeding

	sites. An SMP will be prepared and implemented as a mitigation measure. It is prepared as a requirement for tampering with a protected animal breeding place in QLD under the *Nature Conservation (Wildlife Management) Regulation 2006*. The geotechnical investigations will not disrupt the breeding cycle of the population in Toowoomba Range and Little Liverpool Range.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for the Spot-tail Quoll due to clearing. Indirect impacts may occur due to noise and weed invasion or spread of pathogens. Controls have been implemented to minimise these impacts. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for the Spot-tail Quoll will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.
Introduce disease that may cause the species to decline	Disease is not recognised as a threat to the Spot-tail Quoll. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	DELWP (2016) identifies a number of recovery and conservation objectives. These are listed below: • Determine the distribution and status of Spot-tailed Quoll populations throughout the range, and identify key threats and implement threat abatement management practices. • Investigate key aspects of the biology and ecology of the Spot-tailed Quoll to acquire targeted information to aid recovery. • Reduce the rate of habitat loss and fragmentation on private land. • Evaluate and manage the risk posed by silvicultural practices. • Determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spot-tailed Quoll populations. • Determine and manage the impact of fire regimes on Spot-tailed Quoll populations. • Reduce deliberate killings of Spot-tailed Quolls. • Reduce the frequency of Spot-tailed Quoll road mortality. • Determine the likely impact of climate change on Spot-tailed Quoll populations. • Increase community awareness of the Spot-tailed Quoll and involvement in the Recovery Program. The geotechnical investigations will not interfere substantially with any of these objectives.
Conclusion	The geotechnical investigations will not have a significant impact on the Spot-tail Quoll as: • only minor areas of potential foraging habitat may be impacted on the Toowoomba range and midsection of Little Liverpool Range where clearing for access roads and

borehole pads can't be avoided. The maximum extent of impact is estimated at 5.48 ha;

- no impacts to denning sites will occur;
- fauna spotter catchers will be present during clearing to check for presence of den sites and ensure they are avoided; and
- potential impacts arising from increased weeds will be managed through implementation of weed identification during preclearance surveys and strict hygiene protocols.

Species Profile	**Greater Glider (*Petauroides volans*)** **Status: Critically Endangered (EPBC Act), Endagered (NC Act)**
	Distribution: The Greater Glider is restricted to eastern Australia, occurring from the Windsor Tableland in north QLD through to central VIC (Wombat State Forest), with an elevation range from sea level to 1200 m above sea level (TSSC, 2016a).
	Habitat: The Greater Glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. During the day it shelters in tree hollows, with a particular selection for large hollows in large, old trees.
	Threats: Main threat to Greater Glider is habitat loss through clearing and clearfell logging. The Greater Glider is also sensitive to wildfire, and is slow to recover following major disturbance. Greater Gliders may be sensitive to fragmentation have relatively low persistence in small forest fragments, and disperse poorly across vegetation that is not native forest. The *Phytophthora* root fungus impacts on the health of eucalypt trees which are key feeding habitat for the species.
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species was identified in Lockyer National Park through desktop assessments and potential habitat was identified in Toowoomba Range and Flinders Peak Conservation Park. The geotechnical investigations will be conducted in the northern area of Toowoomba Range and southern area of Flinders Peak Conservation Park through a valley. Minor clearing of potential Greater Glider habitat will occur, with the geotechnical investigations occurring over less than 5 linear kilometres over Toowoomba Range and 15 linear kilometres in Flinders Peak Conservation Park. The geotechnical investigations will result in clearing the following areas of potential habitat for the Greater Glider: • 4.0 ha in the base alignment • 4.7 ha in the 3216 alignment Impacts from the geotechnical investigations will avoid hollow bearing trees and focused on disturbed areas rather than higher quality habitat areas. Greatest impacts will occur from the construction of access tracks and boreholes, which will be rehabilitated once geotechnical investigations cease. Indirect impacts may occur. Noise associated with operational activities, and vibrations caused from drilling may cause disruption to wildlife within the area. These may result in short-term avoidance by the Greater Glider; however, no long-term impacts are predicted. Activities will be limited to daylight hours therefore noise should not affect Greater glider foraging at night. Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations project will result in clearing of potential habitat for the Greater Glider (areas are stated above). The population of Greater Glider is largely distributed throughout VIC and NSW. In SEQ, the species is populated around Brisbane. The geotechnical investigations will result in the loss of potential habitat for this species. However, given the

	range of this species and amount of clearing required, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be undertaken in existing cleared and disturbed environments where possible. Geotechnical sites have been sited in these disturbed areas to limit impacts to native vegetation and fauna habitat, including avoidance of hollow bearing trees. Large areas of suitable habitat will remain in the locality in Toowoomba Range and Flinders Peak Conservation Park. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Greater Glider consists of large areas of intact eucalypt forest with large and abundant hollows (DEE, 2018vv). The vegetation in Toowoomba Range and Flinders Peak Conservation Park would meet these criteria; however, such habitat is limited within the survey area. Impacts to key habitat in areas containing large hollow-bearing eucalypt trees in the Toowoomba Range and Flinders Peak Conservation Park have been largely avoided. Minor impacts to hollow-bearing trees in the Toowoomba Range and Flinders Peak Conservation Park will occur due to construction of access roads and boreholes. Where these areas cannot be avoided, fauna spotter catchers will be available on site to ensure hollow bearing trees are identified, avoided where possible, and if clearing does occur measures are taken to minimise impacts o the species. The geotechnical investigations will result in minor impacts to habitat critical to the survival of the Greater Glider. Given the extent of such habitat in the locality, these impacts would not be considered significant.
Disrupt the breeding cycle of an important population	Females give birth to a single young from March to June. The relatively low reproductive rate may render small isolated populations in small remnants prone to extinction (TSSC, 2016a). Large hollows are required for breeding. Geotechnical investigations will avoid large hollow-bearing trees throughout the alignment. Spotter catchers will be present during clearing to identify breeding sites. An SMP will be prepared and implemented as a mitigation measure. It is prepared as a requirement for tampering with a protected animal breeding place in QLD under the *Nature Conservation (Wildlife Management) Regulation 2006*. The geotechnical investigations will not disrupt the breeding cycle of the population in Toowoomba Range and Flinders Peak Conservation Park.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project may result in direct impacts to potential habitat for Greater Glider due to clearing required for access tracks and boreholes. Indirect impacts may occur due to noise and weed invasion or spread of pathogens. Controls have been implemented to minimise these impacts. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for the Greater Glider will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species'	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not

habitat	brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.
Introduce disease that may cause the species to decline	The *Phytophthora* root rot fungus (*Phytophthora cinnamomi*) is a soil-borne species that invades the roots and crowns of woody trees, including eucalypt species (DAF, 2018d). This indirectly impacts the Greater Glider. Hygiene protocols, such as wash-down facilities, will also be put in place to ensure contaminated soils are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of the *Phyophthora* root rot disease.
Interfere substantially with the recovery of the species	TSSC (2016a) identifies a number of recovery and conservation objectives. These are listed below: • Reduce the frequency and intensity of prescribed burns. • Identify appropriate levels of patch retention, habitat tree retention, and logging rotation in hardwood production. • Protect and retain hollow-bearing trees, suitable habitat and habitat connectivity. The geotechnical investigations will not interfere substantially with any of these objectives.
Conclusion	The geotechnical investigations will not have a significant impact on the Greater Glider as: • minor areas of foraging habitat are estimated to be impacted within large patches of remnant vegetation; • hollow-bearing trees will be avoided to the greatest extent possible to ensure the geotechnical investigations will not impact the life cycle of the species; • a fauna spotter catcher will be present prior to, and during clearing, to ensure hollow bearing trees are identified, assessed for likely presence of gliders, and measures taken to avoid hollow bearing trees and minimise impacts to the species; • rehabilitation of cleared foraging habitat will be undertaken post works; • impacts arising from increased weeds and diseases will be managed through implementation of weed identification during preclearance surveys and strict hygiene protocols.

Species Profile	**Grey-heading Flying fox (*Pteropus poliocephalus)*** **Status: Vulnerable (EPBC Act)**
	Distribution: The Grey-headed Flying-fox is Australia's only endemic flying-fox and occurs in the coastal belt from Rockhampton in central QLD to Melbourne in VIC. However, only a small proportion of this range is used at any one time, as the species selectively forages where food is available. As a result, patterns of occurrence and relative abundance within its distribution vary widely between seasons and between years. Brisbane, Newcastle, Sydney and Melbourne are occupied continuously (DEE, 2018aa).
	Habitat: The Grey-headed Flying-fox requires foraging resources and roosting sites. It is a canopy-feeding nectarivore and frugivore that utilises vegetation communities including rainforests, open forests, and closed and open woodland. The primary food source is blossom from eucalyptus species and fleshy fruit. None of the vegetation communities used by the Grey-headed Flying-fox produce continuous foraging resources throughout the year. As a result, the species has adopted complex migration traits in response to ephemeral and patchy food resources (DEE, 2018aa).
	Threats: Clearing of native vegetation for agriculture and forestry operations has accelerated and has been particularly widespread over the range of the Grey-headed Flying-fox in eastern Australia. The loss of native habitat is assumed to have resulted in the destruction or disturbance of roosting and foraging habitats of the species.
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species was identified in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park through desktop assessments. The geotechnical investigations will be conducted in the northern area of Toowoomba Range, midsection of Little Liverpool Range and southern area of Flinders Peak Conservation Park through a valley. Minor clearing of potential Grey-headed Flying-fox habitat will occur, with the geotechnical investigations occurring over less than 5 linear kilometres over Toowoomba Range, less than 2 linear kilometres over Little Liverpool Range and 15 linear kilometres in Flinders Peak Conservation Park. The geotechnical investigations will result in clearing the following areas of potential habitat for the Grey-headed Flying-fox: • 13.54 ha in the base alignment • 14.97 ha in the 3216 alignment Impacts from the geotechnical investigations will be focused on disturbed areas rather than high quality habitat areas. Greatest impacts will occur from the construction of access tracks and boreholes, which will be rehabilitated once geotechnical investigations cease. Residual, indirect impacts are expected to occur. Noise associated with operational activities, and vibrations caused from drilling may cause disruption to wildlife within the area. These may result in short-term avoidance by the Grey-headed Flying-fox; however, no long-term impacts are predicted. Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.

Reduce the area of occupancy of an important population	The geotechnical investigations project will result in clearing of potential habitat for the Grey-headed Flying-fox (areas are stated above). The population of Grey-headed Flying-fox is largely distributed along the east coast of Australia, from Rockhampton, QLD to Adelaide, SA. In SEQ, the species is populated around Brisbane. The geotechnical investigations will result in the loss of potential habitat for this species. However, given the range of this species and amount of clearing required, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be undertaken in existing cleared and disturbed environments where possible. Geotechnical sites have been sited in these disturbed areas to limit impacts to native vegetation and fauna habitat. Large areas of suitable habitat will remain in the locality in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Grey-headed Flying-fox consists of exposed branches of various sizes in rainforests, open forests and woodlands for roosting (DEE, 2018vv). The vegetation in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park would meet these criteria; however, such habitat is limited within the survey area. Impacts to key habitat in areas containing trees with many branches in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park have been largely avoided. Minor impacts to branched trees in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park will result due to construction of access roads and boreholes. Where these areas cannot be avoided, fauna spotter catchers will be available on site to ensure species are captured and relocated safely. The geotechnical investigations will result in minor impacts to habitat critical to the survival of the Grey-headed Flying-fox. Given the extent of such habitat in the locality, these impacts would be considered negligible.
Disrupt the breeding cycle of an important population	Males and females segregate in October when females usually give birth to a single young each year. During birthing, the female hangs by the feet from a branch with young being born headfirst. Geotechnical investigations will avoid trees with many branches throughout the alignment. Fauna spotter catchers will be present during clearing to identify breeding sites. An SMP will be prepared and implemented as a mitigation measure. It is prepared as a requirement for tampering with a protected animal breeding place in QLD under the *Nature Conservation (Wildlife Management) Regulation 2006*. The geotechnical investigations will not disrupt the breeding cycle of the population in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for Grey-headed Flying-fox due to clearing. Indirect impacts may occur due to noise and weed invasion or spread of pathogens. Controls have been implemented to minimise these impacts. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for the Grey-headed Flying-fox will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery.

Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.

Introduce disease that may cause the species to decline

Disease is not recognised as a threat to the Grey-headed Flying-fox. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.

Interfere substantially with the recovery of the species

Duncan et al. (1999) identifies a number of recovery and conservation objectives through Environment Australia. These are listed below:

- Stabilise the population at its current level.
- Define patterns of landscape use, and identify and protect essential habitat.
- Develop non-destructive methods for crop protection.
- Develop non-destructive methods for management of camps in problem areas.
- Ensure consistent management of the species across all range states (Queensland, New South Wales and Victoria).

The geotechnical investigations will not interfere substantially with any of these objectives.

Conclusion

The geotechnical investigations will not have a significant impact on the Grey-headed Flying-fox as:

- minor areas of foraging habitat are estimated to be impacted within large patches of remnant vegetation;
- no roost sites will be disturbed and if any are identified appropriate buffers will be put in place to ensure the roosting species are not disturbed by noise;
- rehabilitation of cleared foraging habitat will be undertaken post works;
- impacts arising from increased weeds and diseases will be managed through implementation of weed identification during preclearance surveys and strict hygiene protocols; and
- works will not occur at night therefore the species foraging will not be disturbed.

Species Profile	**Australian Lungfish (*Neoceratodus forsteri*)** **Status: Vulnerable (EPBC Act)**
	Distribution: The Australian Lungfish is endemic to Australia and restricted to south-eastern QLD. The species' natural distribution is the Mary, Burnett and Brisbane River systems and (possibly) the Pine River system. The species has been translocated to many other locations and translocated populations persist in the Coomera, Condamine, Albert and Logan Rivers (DEE, 2018ww).
	Habitat: The Australian Lungfish occurs in a number of water body types, ranging from relatively undisturbed streams to highly altered environments, such as Lake Samsonvale and Lake Wivenhoe. The species requires still or slow-flowing, shallow, vegetated pools with clear or turbid water in which to spawn and feed. The species is restricted to areas of permanent water and cannot live in saline waters or migrate through sea water. Emergent or submerged vegetation are essential for successful deposition of eggs and for providing refuges for juveniles (DEE, 2018ww).
	Threats: Flooding as a result of dams and weirs removes the breeding habitat of Australian Lungfish (shallow water containing dense macrophytes), and dam walls block the movement of adult lungfish to the remaining breeding sites. The cumulative effect of multiple weirs and dams progressively removes Australian Lungfish breeding habitat and disrupts movements. As a result of breeding habitat reductions, the population is likely to undergo a substantial decline within the next three generations. Australian Lungfish are also caught by recreational anglers targeting other fish (DEE, 2018ww).
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species was identified through desktop assessments in Lockyer Creek, north of Gatton. The geotechnical investigations will be conducted through Gatton. Habitat suitable for Australian Lungfish will not be cleared for geotechnical investigations as there will be no removal of riparian or stream habitat. Residual, indirect impacts are expected to occur. Sediment runoff from construction of geotechnical investigations may occur. This may result in short-term impact to the Australian Lungfish; however, no long-term impacts are predicted. Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.

Reduce the area of occupancy of an important population	The geotechnical investigations will not result in clearing of habitat for the Australian Lungfish. The impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	The geotechnical investigations will not result in any major fragmentation of habitat for the Australian Lungfish.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Australian Lungfish consists of still or slow-flowing, shallow, vegetated pools with clear or turbid water in which to spawn and feed (DEE, 2018ww). Lockyer Creek would meet these criteria; however, such habitat is limited within the survey area. The geotechnical investigations will not result in direct impacts to habitat critical to the survival of the Australian Lungfish.
Disrupt the breeding cycle of an important population	The Australian Lungfish spawns at night between August and December, with peak activity in late October. The pairs spawn amongst aquatic macrophytes. Australian Lungfish delay or skip breeding if their spawning habitat is disturbed (DEE, 2018ww). The geotechnical investigations will not disrupt the breeding cycle of the population in Lockyer Creek.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will not result in direct impacts to potential habitat for the Australian lungfish due to clearing. Indirect impacts may occur due to sediment runoff from construction of the geotechnical investigations. An approved erosion sediment control plan will be implemented as part of the Environmental Management Plan to minimise the impact of sedimentation. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for the Australian Lungfish will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Exotic or translocated native fishes, such as the exotic Tilapia (family Cichlidae), are believed to prey on Australian Lungfish eggs and young and compete with adults for breeding habitat (DEE, 2018ww). The geotechnical investigations do not have the potential to result in the spread of exotic fish species.
Introduce disease that may cause the species to decline	Disease is not recognised as a threat to the Australian Lungfish. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the	No adopted or made Recovery Plans are available for this species.

species

Conclusion

The geotechnical investigations will not have a significant impact on the Australian Lungfish as:

- direct impacts of habitat clearing will not occur; and
- potential impacts arising from sediment runoff into Lockyer Creek will be managed through implementation of strict erosion and sediment control protocols.

Species Profile	**Collared Delma (*Delma torquata*)** **Status: Vulnerable (EPBC Act), Vulnerable (NC Act)** **Distribution:** The Collared Delma is known from the western suburbs of Brisbane, and the following sites: Bunya Mountains, Blackdown Tableland National Park (NP), Bullyard Conservation Park, D'Aguilar Range NP, Expedition NP, Naumgna and Lockyer Forest Reserves, Western Creek near Millmerran and the Toowoomba Range (Davidson, 1993; Ryan, 2006). The Collared Delma occurs within the SEQ, Condamine, Burnett Mary and Fitzroy (QLD) Natural Resource Management regions (DEE, 2008k). Large concentrations of records are from the western suburbs of Brisbane, including Kenmore, Pinjarra Hills, Anstead, Mt Crosby, Lake Manchester and Karana Downs (DEE, 2018ee). **Habitat:** The Collared Delma normally inhabits eucalypt dominated woodland and open forest where it is associated with suitable micro-habitats (exposed rocky outcrops). The ground cover is predominantly native grasses, such as Kangaroo Grass (*Themeda triandra*), Barbed-wire Grass (*Cymbopogon refractus*), Wiregrass (*Aristida sp.*) and Lomandra (*Lomandra sp.*) **Threats:** The main identified threat to the Collared Delma is the loss and modification of habitat from urban and agricultural development. The removal of surface rocks during the development process or landscaping activities poses a significant threat, as these rocks are critical habitat for this species. The Collared Delma's sensitivity to disturbance is likely to be significant given that it appears to be a sedentary species that stays within a very small area, possibly using the same rock for shelter. Other threats to the species include fire and invasive weeds, particularly Dwarf Lantana (*Lantana montividensis*) (DEE, 2008k).
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species was identified in a number of locations along Toowoomba Range through field surveys from previous projects. The geotechnical investigations will be conducted in the northern area of Toowoomba Range. Minor clearing of potential Collared Delma habitat will occur, with the geotechnical investigations occurring over less than 5 linear kilometres over the Toowoomba Range. The geotechnical investigations will result in clearing the following areas of potential habitat for the Collared Delma: • 7.22 ha in the base alignment • 8.82 ha in the 3216 alignment Impacts from the geotechnical investigations will focus on cleared and disturbed areas rather than higher quality habitat areas associated with rocky outcrops. Greatest impacts will occur from the construction of access tracks and boreholes, which will be rehabilitated once geotechnical investigations cease. Indirect impacts may occur. Noise associated with operational activities, and vibrations caused from drilling may cause disruption to wildlife within the area. These may result in short-term avoidance by the Collared Delma; however, no long-term impacts are predicted. Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.

Reduce the area of occupancy of an important population	The geotechnical investigations project will result in clearing of potential habitat for the Collared Delma (areas stated above). The Collared Delma is endemic to QLD and occurs from Warwick to Gladstone. A large portion of the population is concentrated around Brisbane's western suburbs, around Mount Crosby and Moggill Regional park. The geotechnical investigations will result in the loss of potential habitat for this species. However, given the range of this species and amount of clearing required, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be undertaken in existing cleared and disturbed environments where possible. Geotechnical sites have been sited in these disturbed areas to limit impacts to native vegetation and fauna habitat. Large areas of suitable habitat will remain in the locality in Toowoomba Range. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Collared Delma is identified as eucalypt dominated woodland and open forest where it is associated with suitable micro-habitats (exposed rocky outcrops for shelter) (DEE, 2008k). The vegetation in Toowoomba Range would meet these criteria; however, such habitat is limited within the survey area. Impacts to primary habitat in areas containing rocky outcrops in Toowoomba Range will be avoided. Minor impacts to potential woodland habitat in area of Toowoomba Range may occur due to access tracks and clearing for boreholes given steep terrain. Where potential habitat cannot be avoided, fauna spotter catchers will be available on site to ensure species are captured and relocated safely. This would be in line with best practice as approved for the second range crossing by Nexus. It is predicted up to 8.82 ha may be impacted however this is a conservative estimate given it allows for 5 m access tracks to all investigation sites. Given the extent of suitable habitat in adjacent areas, and that rehabilitation will occur for some of these disturbance areas, these impacts would not be considered significant.
Disrupt the breeding cycle of an important population	The Collared Delma produces two small white, elongated eggs in December. These then hatch in February–March. Geotechnical investigations in the area of Collared Delma habitat will be avoided as much as practical throughout December. Fauna spotter catchers will be present prior to disturbance to check for eggs and Collared Delma. An SMP will be prepared and implemented as a mitigation measure. It is prepared as a requirement for tampering with a protected animal breeding place in QLD under the *Nature Conservation (Wildlife Management) Regulation 2006*. If eggs or the species are located and cannot be avoided translocation to suitable adjacent habitat is proposed. The geotechnical investigations will not disrupt the breeding cycle of the population in Toowoomba Range.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for the Collared Delma. Indirect impacts may occur due to noise and weed invasion or spread of pathogens. Controls have been implemented to minimise these impacts. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for the Collared Delma will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery.

Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.

Introduce disease that may cause the species to decline

Disease is not recognised as a threat to the Collared Delma. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.

Interfere substantially with the recovery of the species

Richardson (2006) identifies a number of recovery objectives through WWF Australia. These are listed below:

- Encourage involvement, provide incentives and adopt a collaborative approach with government agencies, NRM regional bodies, the Indigenous community, key industry stakeholders and local governments to deliver region-specific information and implement sustained, effective recovery actions.
- Identify research priorities: develop and support the implementation of research projects undertaken by tertiary and research institutions.
- Inspect and identify suitable habitat for conservation of the Collared Delma.
- Identify key threats and develop management guidelines to protect key habitat.
- Maximise the establishment of appropriate reserves to protect Collared Delma habitat and landscape connectivity over the long term, e.g. on stock route networks, road reserves and private lands.
- Ensure Collared Delma conservation is incorporated into appropriate land management decisions made by all levels of government and industry.
- Develop and provide land-management guidelines and incentives for landowners to reduce the impact of current land use practices on the species outside reserves, e.g. restricting the use and spread of agricultural weeds, such as Buffel Grass.
- Negotiate management agreements and voluntary conservation agreements with landholders, on whose land the Collared Delma occurs, in line with the recommended management guidelines.
- Facilitate on-grounds projects to manage and protect habitats on a range of land tenures in line with recommended management guidelines, e.g. in integrated weed and feral predator management programs.
- Develop community awareness within the species' known range through media campaigns and education material and provide incentives for wider community involvement, e.g. local governments and schools participating in reptile educational programs and adopting a local reptile species as their shire and/or school icon.
- Implement recommended fire management guidelines in property and reserve designs.
- Work with landholders and key stakeholders to undertake monitoring programs on selected sites.
- Monitor and evaluate recovery actions applying an adaptive management approach.

The geotechnical investigations will not interfere substantially with any of these objectives.

Conclusion

The geotechnical investigations will not have a significant impact on the Collared Delma as:

- direct impacts to primary habitat including rocky outcrops will be avoided, and if loss of habitat cannot be avoided areas of lower quality habitat will be prioritised. It is estimated impacts of no more than 8.82 ha of habitat would be lost;

- rehabilitation of cleared habitat will occur;
- key egg laying season will be avoided in the Toowoomba Range where possible;
- fauna spotter catchers will be used to ensure eggs and the species are not harmed, and if required relocated to suitable adjacent habitats;
- potential impacts arising from increased weeds will be managed through implementation of weed identification during preclearance surveys and strict hygiene protocols.

Species Profile	***Grevillea quadricauda***
	Status: Vulnerable (EPBC Act), Vulnerable (NC Act)
	Distribution: *Grevillea quadricauda* occurs in three isolated patches. Two populations are located in NSW in Mount Belmore State Forest and Tucabia. One population occurs near Toowoomba in Lockyer National Park and Toowoomba Range (OEH, 2018a).
	Habitat: The species grows in gravely loam, in the understorey of dry eucalypt forest, usually along or near creeks.
	Threats: *G. quadricauda* is at risk of local extinction due to small, isolated populations and its limited distribution. Clearing for development and agriculture has resulted in the loss of habitat for the species. Frequent fires also pose a threat to *G. quadricauda*.
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species was identified in Lockyer National Park and the southern section of Toowoomba Range through desktop assessments. The geotechnical investigations will be conducted in the southern area of Lockyer National Park and northern area of the Toowoomba Range. Minor clearing of potential *G. quadricauda* habitat may occur, with the geotechnical investigations occurring over less than 10 linear kilometres through Lockyer National Park and Toowoomba Range. Pre-clearance surveys will be conducted to identify the presence of the species and avoid potential habitat as much as practicable. The geotechnical investigations will result in clearing the following areas of potential habitat for *G. quadricauda*: • 0.69 ha in the base alignment • 1.26 ha in the 3216 alignment Impacts from the geotechnical investigations will be focused on disturbed areas rather than high quality habitat areas. Greatest impacts will occur from the construction of access tracks and boreholes, which will be rehabilitated once geotechnical investigations cease. Residual, indirect impacts are expected to occur. The spread of invasive weed species and accidental vehicle strikes may occur. No long-term impacts are predicted. Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations project will result in clearing of potential habitat for *G. quadricauda* (areas stated above). *G. quadricauda* occurs in two populations in NSW and one population exists in QLD. A large portion of the population is concentrated in northern Lockyer National Park. The geotechnical investigations will result in the loss of potential habitat for this species. However, clearing *G. quadricauda* individuals will be avoided as much as practicable. A suitably qualified person will conduct preclearance surveys to identify individuals. If individual *G. quadricauda* are identified, a buffer with exclusion fencing will be placed around the individual to avoid removal of the species.

	Given that the location of the species in Toowoomba is outside the study area and individual specimens will be avoided, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be undertaken in existing cleared and disturbed environments where possible. Geotechnical sites have been sited in these disturbed areas to limit impacts to native vegetation. Large areas of suitable habitat will remain in the locality in Lockyer National Park and Toowoomba Range. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the *G. quadricauda* is identified as gravely loam environment, in the understorey of dry eucalypt forest, usually along or near creeks (OEH, 2018a). The vegetation in Lockyer National Park and Toowoomba Range would meet these criteria; however, such habitat is limited within the survey area. Impacts to key habitat in areas along creek lines in Lockyer National Park and Toowoomba Range have been largely avoided due to restriction of works to existing cleared and disturbed areas. Minor impacts to eucalypt forest in Lockyer National Park and Toowoomba Range will result due to construction of access roads and boreholes. A suitably qualified person will conduct preclearance surveys in potential habitat to identify if the species exists along the alignment. The geotechnical investigations will result in minor impacts to habitat critical to the survival of *G. quadricauda*. Given the extent of such habitat in the locality, these impacts would be considered negligible.
Disrupt the breeding cycle of an important population	The species flowers between August and September. A suitably qualified person will conduct preclearance surveys in potential habitat to identify if the species exists along the alignment. The geotechnical investigations will not disrupt the flowering cycle of the population in Lockyer National Park and Toowoomba Range.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for *G. quadricauda*. Indirect impacts may occur due to weed invasion or spread of pathogens. Controls have been implemented to minimise these impacts. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for *G. quadricauda* will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.

Introduce disease that may cause the species to decline

Disease is not recognised as a threat to *G. quadricauda*. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.

Interfere substantially with the recovery of the species

DEE (2008l) identifies a number of regional recovery objectives. These are listed below:

- Identify populations of high conservation priority.
- Manage threats to areas of vegetation that contain populations of the species.
- Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on *G. quadricauda*.
- Ensure road widening and maintenance activities (or other infrastructure or development activities as appropriate) in areas where *G. quadricauda* occurs do not adversely affect known populations.
- Manage any changes to hydrology that may result in changes to water table levels, increased run-off, sedimentation or pollution.
- Investigate formal conservation arrangements, such as the use of covenants, conservation agreements or inclusion in reserve tenure.
- Develop and implement a management plan for the control of weeds, such as Lantana, in the local region.
- Develop and implement a suitable fire management strategy for the species.
- Provide maps of known occurrences to local and state Rural Fire Services and seek inclusion of mitigative measures in bush fire risk management plans, risk register and/or operation maps.
- Raise awareness of *G. quadricauda* within the local community.
- Liaise with landowners to ensure appropriate management of populations of *G. quadricauda*.
- Develop environmental impact assessment guidelines.
- Include direction for the protection of known populations and potential habitat of the species in the Code of Practice for Private Native Forestry
- Consider locations of the species during park management planning.
- Undertake appropriate seed collection and storage.
- Investigate options for linking, enhancing or establishing additional populations.
- Implement national translocation protocols if establishing additional populations is considered necessary and feasible
- Undertake seed germination and propagation trials to enhance the likelihood of successful establishment.
- Report new occurrences of the species to the relevant authorities.
- Map known populations and validate and amend old database records.

The geotechnical investigations will not interfere substantially with any of these objectives.

Conclusion

The geotechnical investigations will not have a significant impact on *G. quadricauda* as:

- direct impacts to suitable habitat will be avoided, and if loss of habitat cannot be avoided areas of lower quality habitat will be prioritised. Removal of individual *G. quadricauda* will be avoided. It is estimated impacts of no more than 1.26 ha of habitat would be lost;
- rehabilitation of cleared habitat will occur;
- A suitably qualified person will conduct a preclearance survey to identify the species in potential habitat areas; and
- potential impacts arising from increased weeds will be managed through implementation of weed identification during preclearance surveys and strict hygiene protocols.

Species Profile	***Paspalidium grandispiculatum***
	Status: Vulnerable (EPBC Act), Vulnerable (NC Act)
	Distribution: *Paspalidium grandispiculatum* occurs in SEQ in a band from Canungra to Kingaroy, over a range of approximately 100 km (DEE, 2008h).
	Habitat: The species occurs in mixed eucalypt forest, mixed open forest, and native pasture occurring as a result of land clearing for agriculture (DEE, 2008h).
	Threats: The main identified threats to *P. grandispiculatum* include destruction of habitat by clearing; habitat disturbance by timber harvesting; inappropriate grazing regimes; and inappropriate fire regimes. Most known populations are on private land and those within state forests are threatened by illegal grazing, which is difficult to exclude because of insufficient fencing. The above ground parts are killed by fire but the species is capable of regenerating from the rhizome (DEE, 2008h).
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species was identified in Lockyer National Park through desktop assessments. The geotechnical investigations will be conducted in the southern area of Lockyer National Park. Minor clearing of potential *P. grandispiculatum* habitat will occur, with the geotechnical investigations occurring over less than 10 linear kilometres through Lockyer National Park. Pre-clearance surveys will be conducted to identify and avoid potential habitat as much as practicable. The geotechnical investigations will result in clearing the following areas of potential habitat for *P. grandispiculatum*: • 7.4 ha in the base alignment • 8.9 ha in the 3216 alignment Impacts from the geotechnical investigations will be focused on disturbed areas rather than high quality habitat areas. Greatest impacts will occur from the construction of access tracks and boreholes, which will be rehabilitated once geotechnical investigations cease. Residual, indirect impacts are expected to occur. The spread of invasive weed species and accidental vehicle strikes may occur. No long-term impacts are predicted. Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations project will result in clearing of potential habitat for *P. grandispiculatum* (areas stated above). *P. grandispiculatum* occurs in northern NSW and SEQ. A large portion of the population is concentrated in central Lockyer National Park. The geotechnical investigations will result in the loss of potential habitat for this species. However, clearing *P. grandispiculatum* individuals will be avoided as much as practicable. A suitably qualified person will conduct preclearance surveys to identify individuals. If individual *P. grandispiculatum* are identified, a buffer with exclusion fencing will be placed around the individual to avoid removal of the species.

	Given that the location of the species in Toowoomba is outside the study area and individual specimens will be avoided, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be undertaken in existing cleared and disturbed environments where possible. Geotechnical sites have been sited in these disturbed areas to limit impacts to native vegetation. Large areas of suitable habitat will remain in the locality in Lockyer National Park. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the *P. grandispiculatum* is identified as mixed eucalypt forest, mixed open forest, and native pasture (DEE, 2008h). The vegetation in Lockyer National Park would meet these criteria. Impacts to key habitat in Lockyer National Park have been largely avoided due to restriction of works to existing cleared and disturbed areas. Minor impacts to eucalypt forest in Lockyer National Park will result due to construction of access roads and boreholes. A suitably qualified person will conduct preclearance surveys in potential habitat to identify if the species exists along the alignment. The geotechnical investigations will result in minor impacts to habitat critical to the survival of *P. grandispiculatum*. Given the extent of such habitat in the locality, these impacts would be considered negligible.
Disrupt the breeding cycle of an important population	*P. grandispiculatum* is a perennial grass which is assumed to be wind-pollinated. It is known to produce flowers and fruits from January to May in QLD populations (DEE, 2018h). A suitably qualified person will conduct preclearance surveys in potential habitat to identify if the species exists along the alignment. The geotechnical investigations will not disrupt the flowering cycle of the population in Lockyer National Park.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for *P. grandispiculatum*. Indirect impacts may occur due to weed invasion or spread of pathogens. Controls have been implemented to minimise these impacts. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for *P. grandispiculatum* will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.

Introduce disease that may cause the species to decline

Disease is not recognised as a threat to *P. grandispiculatum*. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.

Interfere substantially with the recovery of the species

DEE (2008h) identifies a number of regional recovery objectives. These are listed below:

- Monitor known populations to identify key threats.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- Identify populations of high conservation priority.
- Ensure road widening and maintenance activities or other infrastructure or development activities involving substrate or vegetation disturbance in areas where *P. grandispiculatum* occurs do not adversely impact on known populations.
- Minimise adverse impacts from land use at known sites.
- Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible.
- Develop and implement a stock management plan for roadside verges and travelling stock routes.
- Manage known sites to ensure appropriate grazing regimes occur.
- Prevent grazing pressure at known sites through exclusion fencing or other barriers.
- Develop and implement a suitable fire management strategy for *P. grandispiculatum*.
- Provide maps of known occurrences to local and state Rural Fire Services and land managers and seek inclusion of mitigative measures in bush fire risk management plans, risk register and/or operation maps.
- Raise awareness of *P. grandispiculatum* within the local community.
- Undertake appropriate seed collection and storage.
- Investigate options for linking, enhancing or establishing additional populations.
- Implement national translocation protocols if establishing additional populations is considered necessary and feasible.

The geotechnical investigations will not interfere substantially with any of these objectives.

Conclusion

The geotechnical investigations will not have a significant impact on *P.grandispiculatum* as:

- direct impacts to suitable habitat will be avoided, and if loss of habitat cannot be avoided areas of lower quality habitat will be prioritised. Removal of individual *P. grandispiculatum* will be avoided. It is estimated impacts of no more than 8.9 ha of habitat would be lost;
- rehabilitation of cleared habitat will occur;
- a suitably qualified person will conduct a preclearance survey to identify the species in potential habitat areas; and
- potential impacts arising from increased weeds will be managed through implementation of weed identification during preclearance surveys and strict hygiene protocols.

Species Profile

Hawkweed (*Picris evae*)

Status: Vulnerable (EPBC Act), Vulnerable (NC Act)

Distribution:
Hawkweed occurs north of the Inverell area in NSW and has been collected at Elsmore, Oxley Park, and Dangars Falls in Oxley Wild Rivers National Park in the NSW northern tablelands.

This species also occurs at 30 sites in the Darling Downs and Moreton pastoral districts in SEQ (DEE, 2018i).

Habitat:
Hawkweed occurs in eucalypt open woodland with a grassy understorey composed of *Dichanthium spp*. Upper stratum species include Yellow Box (*Eucalyptus melliodora*), Narrow-leaved Ironbark (*E. crebra*), Poplar Box (*E. populnea*), White Box (*E. albens*), Broad-leaved Apple (*Angophora subvelutina*), Rose She-oak (*Allocasuarina torulosa*) and *Casuarina cunninghamiana*. Collections have been made along roadsides and in cultivated areas, such as paddocks, on black, dark grey or red-brown soils, reddish clay-loam or medium clay soils (DEE, 2018i).

Threats:
The main identified threats to Hawkweed are weed invasion, inappropriate fire regimes, habitat fragmentation and clearing of vegetation for cropping and grazing (DEE, 2018i).

Criteria	Discussion
Lead to a long term decrease in size of a population	The species was identified west of Toowoomba Range through desktop assessments and potential habitat was identified in Toowoomba Range during field surveys. The geotechnical investigations will be conducted in the northern area of Toowoomba Range. Minor clearing of potential Hawkweed habitat will occur, with the geotechnical investigations occurring over less than 5 linear kilometres through Toowoomba Range. Pre-clearance surveys will be conducted to identify the presence of the species and ensure impacts to the species is avoided. The geotechnical investigations will result in clearing the following areas of potential habitat for Hawkweed: • 7.4 ha in the base alignment • 8.9 ha in the 3216 alignment Greatest impacts will occur from the construction of access tracks and boreholes, which will be rehabilitated once geotechnical investigations cease. Residual, indirect impacts are expected to occur. The spread of invasive weed species and accidental vehicle strikes may occur. No long-term impacts are predicted. Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations project will result in clearing of potential habitat for Hawkweed (areas stated above). Hawkweed occurs in NSW and SEQ. A large portion of the population is concentrated south of Toowoomba. The geotechnical investigations will result in the loss of potential habitat for this species. However, clearing Hawkweed individuals will be avoided as much as practicable. A suitably qualified person will conduct preclearance surveys to identify individuals. If individual Hawkweed are identified, a buffer with exclusion fencing will be placed around the individual to avoid removal of the species. Given that the location of the species in Toowoomba is outside the study area and individual specimens will be avoided, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing	Geotechnical investigations will be undertaken in existing cleared and disturbed environments

important population into two or more populations	where possible. Geotechnical sites have been sited in these disturbed areas to limit impacts to native vegetation. Large areas of suitable habitat will remain in the locality in Lockyer National Park. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Hawkweed is identified as eucalypt open woodland with a grassy understorey composed of *Dicanthium* spp. (DEE, 2018i). The vegetation in Toowoomba Range would meet these criteria. Impacts to key habitat of eucalypt forests in Toowoomba Range have been largely avoided due to restriction of works to existing cleared and disturbed areas. Minor impacts to eucalypt forest in Toowoomba Range will result due to construction of access roads and boreholes. A suitably qualified person will conduct preclearance surveys in potential habitat to identify if the species exists along the alignment. The geotechnical investigations will result in minor impacts to habitat critical to the survival of Hawkweed. Given the extent of such habitat in the locality, these impacts would be considered negligible.
Disrupt the breeding cycle of an important population	Hawkweed flowers and fruits between October and January, with a few plants collected in flower or fruit in May (DEE, 2018i). A suitably qualified person will conduct preclearance surveys in potential habitat to identify if the species exists along the alignment. The geotechnical investigations will not disrupt the flowering cycle of the population in Lockyer National Park.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for Hawkweed. Indirect impacts may occur due to weed invasion or spread of pathogens. Controls have been implemented to minimise these impacts. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for Hawkweed will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.
Introduce disease that may cause the species to decline	Disease is not recognised as a threat to Hawkweed. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the	DEE (2018i) identifies a number of regional recovery objectives. These are listed below:

species

- Identify significant vulnerable populations of high conservation priority; focus recovery actions and adaptive management at these sites.
- Ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where Hawkweed occurs do not adversely impact on known populations.
- Investigate further formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible.
- Develop and implement a suitable fire management strategy for Hawkweed.
- Provide maps of known occurrences to local and state Rural Fire Services and seek inclusion of mitigative measures in bush fire risk management plan(s), risk register and/or operation maps.
- Raise awareness of Hawkweed within the local community.
- Negotiate with landholders to prepare and implement site management plans that address threats.
- Undertake appropriate seed collection and storage.
- Investigate options for linking, enhancing or establishing additional populations.
- Implement national translocation protocols if establishing additional populations is considered necessary and feasible.

The geotechnical investigations will not interfere substantially with any of these objectives.

Conclusion

The geotechnical investigations will not have a significant impact on Hawkweed as:

- direct impacts to suitable habitat will be avoided, and if loss of habitat cannot be avoided areas of lower quality habitat will be prioritised. Removal of individual Hawkweed will be avoided. It is estimated impacts of no more than 8.9 ha of habitat would be lost;
- rehabilitation of cleared habitat will occur;
- a suitably qualified person will conduct a preclearance survey to identify the species in potential habitat areas; and
- potential impacts arising from increased weeds will be managed through implementation of weed identification during preclearance surveys and strict hygiene protocols.

Species Profile

Austral Toadflax (*Thesium austral*e)

Status: Vulnerable (EPBC Act), Vulnerable (NC Act)

Distribution:
Austral Toadflax occurs in NSW, the ACT, QLD and VIC. Its current distribution is sporadic but widespread, occurring between the Bunya Mountains in SEQ to north-east VIC and as far inland as the southern, central and northern tablelands in NSW and the Toowoomba region. There is an outlier in Carnarvon National Park on the Consuelo Tableland of the southern Brigalow Belt (DEE, 2018k).

Habitat:
Austral Toadflax occurs in shrubland, grassland or woodland, often on damp sites. Vegetation types include open grassy heath dominated by Swamp Myrtle (*Leptospermum myrtifolium*), Small-fruit Hakea (*Hakea microcarpa*), Alpine Bottlebrush (*Callistemon sieberi*), Woolly Grevillea (*Grevillea lanigera*), Coral Heath (*Epacris microphylla*) and *Poa* spp.; Kangaroo Grass grassland surrounded by *Eucalyptus* woodland; and grassland dominated by Barbed-wire Grass (*Cymbopogon refractus*). The species appears to cope well with but does not require frequent disturbance (DEE, 2018k).

Threats:

Austral Toadflax has several identified threats. These include lack of fire/disturbance, development for infrastructure and agriculture and weed invasion. Grazing by livestock also poses a threat to the species (DEE, 2018k).

Criteria	Discussion
Lead to a long term decrease in size of a population	The species was identified in the southern area of Toowoomba Range through desktop assessments and potential habitat was identified in Toowoomba Range during field surveys. The geotechnical investigations will be conducted in the northern area of Toowoomba Range. Minor clearing of potential Austral Toadflax habitat will occur, with the geotechnical investigations occurring over less than 5 linear kilometres through Toowoomba Range. Pre-clearance surveys will be conducted to identify the presence of the species and ensure impacts are avoided. Impacts to potential habitat will also be avoided as much as practicable. The geotechnical investigations will result in clearing the following areas of potential habitat for Austral Toadflax: • 5.2 ha in the base alignment • 6.6 ha in the 3216 alignment Greatest impacts will occur from the construction of access tracks and boreholes, which will be rehabilitated once geotechnical investigations cease. Residual, indirect impacts may occur such as the spread of invasive weed species. No long-term impacts are predicted. Given the extent of habitat remaining in the locality, and limitation of works to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations project will result in clearing of potential habitat for Austral Toadflax (areas stated above). Austral Toadflax occurs throughout the east coast from SEQ to VIC. A large portion of the population is concentrated south west of Toowoomba. The geotechnical investigations will result in the loss of potential habitat for this species. However, clearing Austral Toadflax individuals will be avoided as much as practicable. A suitably qualified person will conduct preclearance surveys to identify individuals. If individual Austral Toadflax are identified, a buffer with exclusion fencing will be placed around the individual to avoid removal of the species. Given that individual specimens will be avoided, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be undertaken in existing cleared and disturbed environments where possible. Geotechnical sites have been sited in these disturbed areas to limit impacts to native vegetation. Large areas of suitable habitat will remain in the locality in Toowoomba Range. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of	Habitat critical to the survival of the Austral Toadflax is identified as shrubland, grassland or woodland, often on damp sites (DEE, 2018k). The vegetation in Toowoomba Range would

a species	meet these criteria. Impacts to key habitat in damp woodland in Toowoomba Range have been largely avoided due to restriction of works to existing cleared and disturbed areas. Minor impacts to damp woodland in Toowoomba Range will result due to construction of access roads and boreholes. A suitably qualified person will conduct preclearance surveys in potential habitat to identify if the species exists along the alignment. The geotechnical investigations will result in minor impacts to habitat critical to the survival of Austral Toadflax. Given the extent of such habitat in the locality, these impacts would be considered negligible.
Disrupt the breeding cycle of an important population	Austral Toadflax flowers and fruits throughout the year on the coast and during summer at higher altitudes (DEE, 2018k). A suitably qualified person will conduct preclearance surveys in potential habitat to identify if the species exists along the alignment. The geotechnical investigations will not disrupt the flowering cycle of the population in Toowoomba Range.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for Austral Toadflax. Indirect impacts may occur due to weed invasion or spread of pathogens. Controls have been implemented to minimise these impacts. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for Hawkweed will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.
Introduce disease that may cause the species to decline	Disease is not recognised as a threat to Austral Toadflax. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	DEE (2018k) identifies a number of regional recovery objectives. These are listed below: • Identify populations of high conservation priority. • Ensure there is no disturbance in areas where the Austral Toadflax occurs, excluding necessary actions to manage the conservation of the species. • Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate and/or secure inclusion in reserve tenure if possible. • Develop and implement a stock management plan for roadside verges and travelling stock routes. • Develop and implement a suitable fire management strategy for the habitat of the austral toadflax that inhibits canopy thickening.

- Where appropriate provide maps of known occurrences to local and state Rural Fire Services and seek inclusion of mitigative measures in bush fire risk management plan/s, risk register and/or operation maps
- Raise awareness of the Austral Toadflax within the local community.
- Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.
- Enable recovery of additional sites and/or populations.
- Undertake appropriate seed collection and storage.
- Investigate options for linking, enhancing or establishing additional populations.
- Maintain existing ex situ populations.

The geotechnical investigations will not interfere substantially with any of these objectives.

Conclusion

The geotechnical investigations will not have a significant impact on Austral Toadflax as:

- direct impacts to suitable habitat will be avoided, and if loss of habitat cannot be avoided areas of lower quality habitat will be prioritised. Removal of individual Hawkweed will be avoided. It is estimated impacts of no more than 6.6 ha of habitat would be lost;
- rehabilitation of cleared habitat will occur;
- A suitably qualified person will conduct a preclearance survey to identify the species in potential habitat areas; and
- potential impacts arising from increased weeds will be managed through implementation of weed identification during preclearance surveys and strict hygiene protocols.

Species Profile	**Black-faced Monarch (*Monarcha melanopsis*)** **Status: Marine, Migratory (EPBC Act)** **Distribution:** The Black-faced Monarch is widespread in eastern Australia. In QLD, it is widespread from the islands of the Torres Strait and on Cape York Peninsula, south along the coasts (occasionally including offshore islands) and the eastern slopes of the Great Divide, to the NSW border. It is also recorded in Papua New Guinea from March to August (DEE, 2018jj). **Habitat:** The Black-faced Monarch mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest. The species also occurs in selectively logged and 20—30 years old regrowth rainforest (DEE, 2018jj). **Threats:** Individuals occasionally collide with windows and lighthouses (DEE, 2018jj).
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species was identified in Toowoomba Range and Flinders Peak Conservation Park through desktop assessments. The geotechnical investigations will be conducted in the northern area of the Toowoomba Range and throughout Flinders Peak Conservation Park. Minor clearing of potential Black-faced Monarch habitat has the potential to occur for establishment of access tracks and pads for borehole drilling. The geotechnical investigations will result in clearing the following areas of potential habitat for the Black-faced Monarch: • 12.07 ha in the base alignment • 13.67 ha in the 3216 alignment Where vegetation clearing cannot be avoided, impacts from the geotechnical investigations will be focused on disturbed areas rather than areas of higher quality habitat for the species. Where clearing is required these areas will be rehabilitated once geotechnical investigations cease, except for access tracks that may be required for construction of the railway. Residual, indirect impacts are expected to occur. Noise associated with operational activities, and vibrations caused from drilling may cause disruption to wildlife within the area. These may result in short-term avoidance by the Black-faced Monarch; however, no long-term impacts are predicted. Given that the species is migratory, and that works will be limited to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations project will result in clearing of potential habitat for the Black-faced Monarch (areas stated above). The Black-faced Monarch is distributed throughout eastern Australia during spring, summer and autumn. Records have identified the species along Toowoomba Range and Flinders Peak Conservation Park. Large concentrations exist throughout SEQ's coast. The geotechnical investigations will result in the loss of potential habitat for this species. However, given the range of this species, extent of habitat remaining in the locality and rehabilitation of the minor habitat areas to be lost, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of

	occupancy for the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be prioritised in cleared and disturbed areas where possible. Geotechnical sites will be sited in these disturbed areas to limit impacts to native vegetation and fauna habitat. Large areas of suitable habitat will remain in the locality in Toowoomba Range and Flinders Peak Conservation Park. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Black-faced Monarch is identified as rainforest habitat thickets (DEE, 2018jj). The vegetation in the Toowoomba Range has small patches that meet these criteria; however, such habitat is limited within the survey area. Impacts to key habitat in areas containing vine thickets in Toowoomba Range have been largely avoided due to restriction of works to existing cleared and disturbed areas. Minor impacts to vine thickets in Toowoomba Range may occur due to the intact vegetation in this area, and steep terrain. Minor impacts may occur to habitat in Flinders Peak Conservation Park due to the intact vegetation in this area, and steep terrain. The geotechnical investigations will result in very minor impacts to habitat of the Black-faced Monarch.
Disrupt the breeding cycle of an important population	The Black-faced Monarch breeds in rainforest habitat and breeds from October to March, with eggs recorded mostly from November to mid-January (DEE, 2018jj). An SMP will be prepared and implemented as a mitigation measure. It is prepared as a requirement for tampering with a protected animal breeding place in QLD under the *Nature Conservation (Wildlife Management) Regulation 2006*. Rainforest habitat is not present in the study area. The geotechnical investigations will not disrupt the breeding cycle for the Black-faced Monarch.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for the Black-faced Monarch. Indirect impacts may occur due to noise. Noise will only occur diurnally and will be short-term. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for the Black-faced Monarch will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.
Introduce disease that may cause the species to	Disease is not recognised as a threat to the Black-faced Monarch. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.

decline	
Interfere substantially with the recovery of the species	No adopted or made Recovery Plans are available for this species.
Conclusion	The geotechnical investigations will not have a significant impact on the Black-faced Monarch as: • vegetation clearing will be minimised as far as practicable to a 3 m wide access track and no greater than 100 m^2 drill pads. No more than a total of approximately 13.67 ha of habitat will be lost; • direct impacts will be prioritised in existing cleared areas or areas of lower quality habitat, and rehabilitation of habitat will occur; and • fauna spotter catchers will be present during clearing to identify and relocate nests safely to ensure that the geotechnical investigations will not impact of the life cycle of the species.

Species Profile	**White-throated Needletail (*Hirundapus caudacutus*)** **Status: Marine, Migratory (EPBC Act)** **Distribution:** The White-throated Needletail is widespread in eastern and south-eastern Australia. In eastern Australia, it is recorded in all coastal regions of QLD and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains (DEE, 2018rr). **Habitat:** In Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable, but there are certain preferences exhibited by the species. Although they occur over most types of habitat, they are probably recorded most often above wooded areas (DEE, 2018rr). **Threats:** Individuals occasionally collide with overhead wires, windows and lighthouses (DEE, 2018rr).
Criteria	**Discussion**
Lead to a long term decrease in size of a population	The species has been recorded identified from Gowrie to Kagaru through desktop assessments. As the species is exclusively aerial, direct impacts to habitat are not expected to occur. Residual, indirect impacts are expected to occur. Noise associated with operational activities, and vibrations caused from drilling may cause disruption to wildlife within the area. These may result in short-term avoidance by the White-throated Needletail; however, no long-term impacts are predicted. Given that the species is migratory and aerial, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations project will not result in clearing of potential habitat for the White-throated Needletail as the species is exclusively aerial. The impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for the important population.
Fragment an existing important population into two or more populations	The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	The White-throated Needletail is exclusively aerial and forage aerially. The geotechnical investigations will not impact White-throated Needletail habitat.
Disrupt the breeding cycle of an important	The White-throated Needletail does not breed in Australia.

population	The geotechnical investigations will not disrupt the breeding cycle for the White-throated Needletail.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will not result in direct impacts to potential habitat for the White-throated Needletail. Indirect impacts may occur due to noise. Noise will only occur diurnally and will be short-term. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The White-throated Needletail is not affected by invasive species. In general, weeds will be identified during preclearance surveys. Hygiene protocols, such as wash-down facilities, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.
Introduce disease that may cause the species to decline	Disease is not recognised as a threat to the White-throated Needletail. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	No adopted or made Recovery Plans are available for this species.
Conclusion	The geotechnical investigations will not have a significant impact on the White-throated Needletail as the species is almost exclusively aerial.

Species Profile

Rufous Fantail (*Rhipidura rufifrons*)
Status: Marine, Migratory (EPBC Act)

Distribution:
The Rufous Fantail occurs in coastal and near coastal districts of northern and eastern Australia. The species winter farther north from Cape York Peninsula in QLD to Torres Strait and southern Papua New Guinea (DEE, 2018tt).

Habitat:
In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (*Eucalyptus microcorys*), Mountain Grey Gum (*E. cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (*E. regnans*), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (*E. resinifera*); usually with a dense shrubby

understorey often including ferns. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including Spotted Gum (*Eucalyptus maculata*), Yellow Box (*E. melliodora*), ironbarks or stringybarks, often with a shrubby or heath understorey (DEE, 2018ss).

Threats:
The main threat to populations of Rufous Fantail is probably fragmentation and loss of core moist forest breeding habitat through land clearing and urbanisation (DEE, 2018ss).

Criteria	Discussion
Lead to a long term decrease in size of a population	The species was identified in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park through desktop assessments. The geotechnical investigations will be conducted in the northern area of the Toowoomba Range and Little Liverpool Range. Minor clearing of potential Rufous Fantail habitat has the potential to occur for establishment of access tracks and pads for borehole drilling. The geotechnical investigations will result in clearing the following areas of potential habitat for the Rufous Fantail : • 13.54 ha in the base alignment • 14.97 ha in the 3216 alignment Where vegetation clearing cannot be avoided, impacts from the geotechnical investigations will be focused on disturbed areas rather than areas of higher quality habitat for the species. Where clearing is required these areas will be rehabilitated once geotechnical investigations cease, except for access tracks that may be required for construction of the railway. Residual, indirect impacts are expected to occur. Noise associated with operational activities, and vibrations caused from drilling may cause disruption to wildlife within the area. These may result in short-term avoidance by the Rufous Fantail; however, no long-term impacts are predicted. Given that the species is migratory, and that works will be limited to lower quality habitat, coupled with the implementation of strong controls, the geotechnical project is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The geotechnical investigations project will result in clearing of potential habitat for the Rufous Fantail (areas stated above). The Rufous Fantail is distributed throughout eastern Australia. Records have identified the species along Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park. Large concentrations exist throughout SEQ's coast. The geotechnical investigations will result in the loss of potential habitat for this species. However, given the range of this species, extent of habitat remaining in the locality and rehabilitation of the minor habitat areas to be lost, the impact arising from the geotechnical investigations will not result in a detectable decrease in the area of occupancy for

	the important population.
Fragment an existing important population into two or more populations	Geotechnical investigations will be prioritised in cleared and disturbed areas where possible. Geotechnical sites will be sited in these disturbed areas to limit impacts to native vegetation and fauna habitat. Large areas of suitable habitat will remain in the locality in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park. Land cleared in remnant areas for access tracks and boreholes will be rehabilitated as soon as practicable and reinstated to match the previous vegetation. The geotechnical investigations will not result in any major fragmentation of habitat.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Rufous Fantail is identified as wet sclerophyll forest with eucalypt canopy (DEE, 2018ss). The vegetation in the Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park have habitat that meet these criteria; however, such habitat is limited within the survey area. Impacts to key habitat in areas containing wet forest in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park have been largely avoided due to restriction of works to existing cleared and disturbed areas. Minor impacts to wet forest in Toowoomba Range, Little Liverpool Range and Flinders Peak Conservation Park may occur due to the intact vegetation in this area, and steep terrain. The geotechnical investigations will result in very minor impacts to habitat of the Rufous Fantail.
Disrupt the breeding cycle of an important population	The Rufous Fantail breeds from September to February, laying two- to four eggs in a nest above 0.3 m above the ground (DEE, 2018ss). Geotechnical investigations may occur in breeding season. Spotter catchers will be present during clearing to identify the species or its nest in proposed disturbance areas. An SMP will be prepared and implemented as a mitigation measure. It is prepared as a requirement for tampering with a protected animal breeding place in QLD under the *Nature Conservation (Wildlife Management) Regulation 2006*. It is not expected the works will disrupt their breeding cycle as the clearing and drilling will occur over a short period of time and measures taken to avoid harm to their nests.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will result in direct impacts to potential habitat for the Rufous Fantail. Indirect impacts may occur due to noise. Noise will only occur diurnally and will be short-term. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat. Large areas of high quality potential habitat for the Rufous Fantail will remain unimpacted. Given this, the geotechnical investigations will not result in a decrease in the availability or quality of habitat to such an extent that the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The geotechnical investigations have the potential to spread weed species. Weeds are currently present throughout the study area. Weed surveys to identify any weeds of national significance will be conducted during preclearance surveys. Hygiene protocols, such as wash-down facilities at an external approved site, will also be put in place to ensure weeds are not brought in with vehicles or machinery. Based on implementing the proposed mitigation measures it is not expected the geotechnical investigations will result in an increase of invasive species.
Introduce disease that may cause the species to decline	Disease is not recognised as a threat to the Rufous Fantail. Given this, the geotechnical investigations will not introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	No adopted or made Recovery Plans are available for this species.
Conclusion	The geotechnical investigations will not have a significant impact on the Rufous Fantail as: • vegetation clearing will be minimised as far as practicable to a 3 m wide access track and no greater than 100 m^2 drill pads. No more than a total of approximately 14.97 ha of habitat will be lost; • direct impacts will be prioritised in existing cleared areas or areas of lower quality habitat, and rehabilitation of habitat will occur; and • fauna spotter catchers will be present during clearing to identify and relocate nests safely to ensure that the geotechnical investigations will not impact of the life cycle of the species.

TEC Profile

Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland

Status: Critically Endangered

Distribution:
The Swamp Tea-tree Forest is distributed in south-eastern Queensland exclusively, particularly in the local government areas of Beaudesert, Boonah, Logan, Ipswich, Laidley and Esk. It is estimated that there are 644 ha of Swamp Tea-tree Forest, comprising of 234 ha of Regional Ecosystem 12.9-10.11, 68 ha of Regional Ecosystem 11.3.18, and 342 ha of additional patches identified by local council vegetation mapping (Department of the Environment and Heritage, 2005).

Two small patches of the Swamp Tea-tree Forest TEC has been confirmed in the study area. They were confirmed in suburb of Ebenezer (as illustrated in Appendix E).

Characteristics:

	The Swamp Tea-tree Forest of South-east Queensland is characterised by the presence of Swamp Tea-trees (*Melaleuca irbyana*), usually in thickets about 8-12m high. The thickets grow underneath an open canopy of eucalypt trees typically including Narrow-leaved Ironbark (*Eucalyptus crebra*), Silver-leaved Ironbark (*E. melanophlopia*), Grey Box (*E. moluccana*) or Forest Red Gum (*E. tereticornis*). The understorey flora beneath thickets of Swamp Tea-trees includes a range of native forbs, twiners, grasses and sedges. The Swamp Tea-tree Forest grows on poorly draining clay soils known as Tea Tree Clays on the gilgais of the Moreton basin. The ecological community provides suitable habitat for a range of native vertebrate fauna. Thickets of *M. irbyana* provide shelter and nesting sites for forest-dwelling bird species; the abundance of fallen logs provides favourable habitat for ground-dwelling reptiles and frog populations are evident during wet seasons when temporary pools form (Department of the Environment and Heritage, 2005). **Threats:** Currently the main threats to the Swamp Tea-tree Forest are environmental degradation partially due to the activities of stock and feral animals, clearing as a result of urban expansion and development and weed invasion. As a consequence of these threats, less than 30% of the original forest remains (Department of the Environment and Heritage, 2005) (Redland City Council, 2018).
Criteria	**Discussion**
Reduce the extent of an ecological community	The Swamp Tea-tree Forest of South East Queensland was identified in the C2K section in two small patches and is known to occur near Woodlands, Calvert and Harrisville. The TEC will not be cleared or disturbed by geotechnical activities as they have been moved away from the confirmed extent of the TEC and appropriate buffers will be put in place for any disturbances or activities that may be required in adjacent areas. Consequently, there will be no reduction in the extent of the TEC as a result of geotechnical investigations. Additionally, control measures will be put in place to limit indirect impacts. Given the avoidance of the area, coupled with the implementation of strong environmental management controls, the geotechnical works are unlikely to reduce the extent of the ecological community.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	The geotechnical investigation sites will be placed away from the TEC patches and will not fragment the communities. The investigation sites will only require minor disturbance areas for the required test pits which will then be rehabilitated once completed. These temporary activities will not create any fragmentation or prevent regeneration in between the two TEC patches.
Adversely affect habitat critical to the survival of an ecological community	The geotechnical investigation sites will be placed away from the TEC patches and will not have any direct impact on the community. Indirect impacts will also be managed including hygiene protocols to ensure weeds are not introduced or increased in the area. Appropriate control measures will also be put in place to manage sediment runoff and ensure that vehicles/machinery as well as stockpiles of spoil etc are not placed near the TEC areas. Appropriate exclusion fencing will be put in place to ensure the TEC areas are not directly or indirectly impacted by the proposed works.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or	The abiotic factors necessary for the Swamp Tea-tree Forest's survival will not be impacted by the geotechnical investigations. Control measures including erosion and sediment control and surface water drainage will be managed to ensure the climatic conditions currently experienced

soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	by the TEC are maintained. Groundwater will not be impacted by the proposed investigations. Site conditions will be regularly monitored by a suitably qualified ecologist during works to ensure there are no adverse conditions occurring and to ensure the mitigation measures are being implemented.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	The geotechnical investigations will not cause a substantial change in the species composition of the TEC. The TEC will be avoided by any required works. Hygiene protocols will be implemented to ensure weeds are not introduced or increased in the area. No burning will be required and measures will be taken to ensure no wildlfires are started.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community,	The geotechnical investigations are unlikely to cause a reduction in the quality or integrity of the Swamp Tea-tree Forest. Geotechnical investigations will occur away from the TEC and appropriate buffers put in place to minimise any indirect impacts. Also through appropriate mitigation measures there will be no increase in weeds, pollutants or invasive species introduced or increased as a result of the works. Activities will be managed in accordance with the EMP and associated management plans.
Interfere with the recovery of an ecological community	The Australian Government's Species Profile and Threats Database identified a number of recovery and conservation objectives for the Swamp Tea-tree Forest. Majority of these objectives have been met including preventing further clearing or fragmentation of the community, minimising adverse impacts. Other recommended actions include: • preventing the felling of eucalypts growing within or adjacent to Swamp Tea-tree remnants (Cooper et al. 1995; Boulton et al. 1998) • retaining fallen timber within remnants, especially on private land (Cooper et al. 1995) • establishing bushland linkages between remnants (Boulton et al. 1998). The proposed geotechnical investigations will not interfere with the recovery of the TEC. Measures will be taken to improve the condition of the area through weed management and rehabilitation post completion of the work.
Conclusion	The geotechnical investigations will not have a significant impact on the Swamp tea-tree TEC as: • geotechnical investigation sites and access tracks have been relocated to be outside of the confirmed TEC locations; • mitigation measures including clearly demarcating and fencing off the TEC areas will be undertaken to ensure no vehicles or machinery access these areas, no stockpiling of

soil material occurs near these areas and no accidental clearing occurs within the TEC patches;

- erosion and sediment control measures will be put in place to ensure no sediment runoff occurs into the TEC areas;
- hygiene protocols will be implemented in adjacent areas to ensure weed abundance is not increased, or no new weeds are introduced to the area;
- during works occurring and post works occurring, measures will be taken to ensure surface water flow is not altered from the current conditions to the TEC areas.

Appendix D

Environmental Management Plan

Appendix E

MNES Habitat Mapping