



Shoalhaven Pumped Hydro Energy Storage Expansion - Geotechnical Investigations

Origin Energy

State Significant Infrastructure Scoping Report

IA193700 | 01

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Shoalhaven Pumped Hydro Energy Storage Expansion - Geotechnical Investigations

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00	11/12/2018	First draft for client review	T. Muddle & J. Vernon	M. Luger	
01	11/12/2018	Final for issue to DPE	T. Muddle & J. Vernon	M. Luger	M Luger

Executive Summary

Origin Energy Eraring Pty Ltd (a subsidiary of Origin Energy Limited) (collectively, Origin) is the current operator of the Shoalhaven Pumped Hydro Energy Storage Scheme (the existing scheme). The existing scheme is located in the NSW Southern Highlands, approximately 150km south east of Sydney. The existing scheme was commissioned in 1977 and currently has a generating capacity of 240MW. Origin now proposes to almost double the electricity generation capacity of the existing scheme with the Shoalhaven Hydro Expansion Project, which will provide approximately an additional 235MW of pumped storage generation capacity. Origin has completed a Pre Feasibility Study and is now undertaking a Feasibility Study for the Shoalhaven Hydro Expansion Project.

To confirm the feasibility of the Shoalhaven Hydro Expansion Project, geotechnical investigations are required to provide confidence that the below ground structures can be constructed and operated safely and cost effectively. The purpose of this report is to support an application for Secretary's Environmental Assessment Requirements under section 5.16 of the Environmental Planning and Assessment Act 1979 for these geotechnical investigations.

Scope of geotechnical investigations

The geotechnical investigations the subject of this application are limited to the drilling of up to eight boreholes ranging in depth from 25 to 650 metres below ground level and ancillary works to establish temporary access and works areas, geotechnical testing, decommissioning and rehabilitation. The target locations of the geotechnical investigations are illustrated in Figure E1 and are located at the proposed locations of key components of the Shoalhaven Hydro Expansion Project or are aimed at facilitating improved understanding of identified higher risk ground conditions. In the event that the project is deemed unfeasible, all geotechnical drilling locations would be decommissioned and rehabilitated to match the existing land use and habitat values of each location. Should the Shoalhaven Hydro Expansion Project proceed, some bores would be converted to monitoring bores.

The geotechnical investigations are proposed in land owned by WaterNSW associated with the existing Kangaroo Valley and Bendeela Power Stations and water transfer operations.

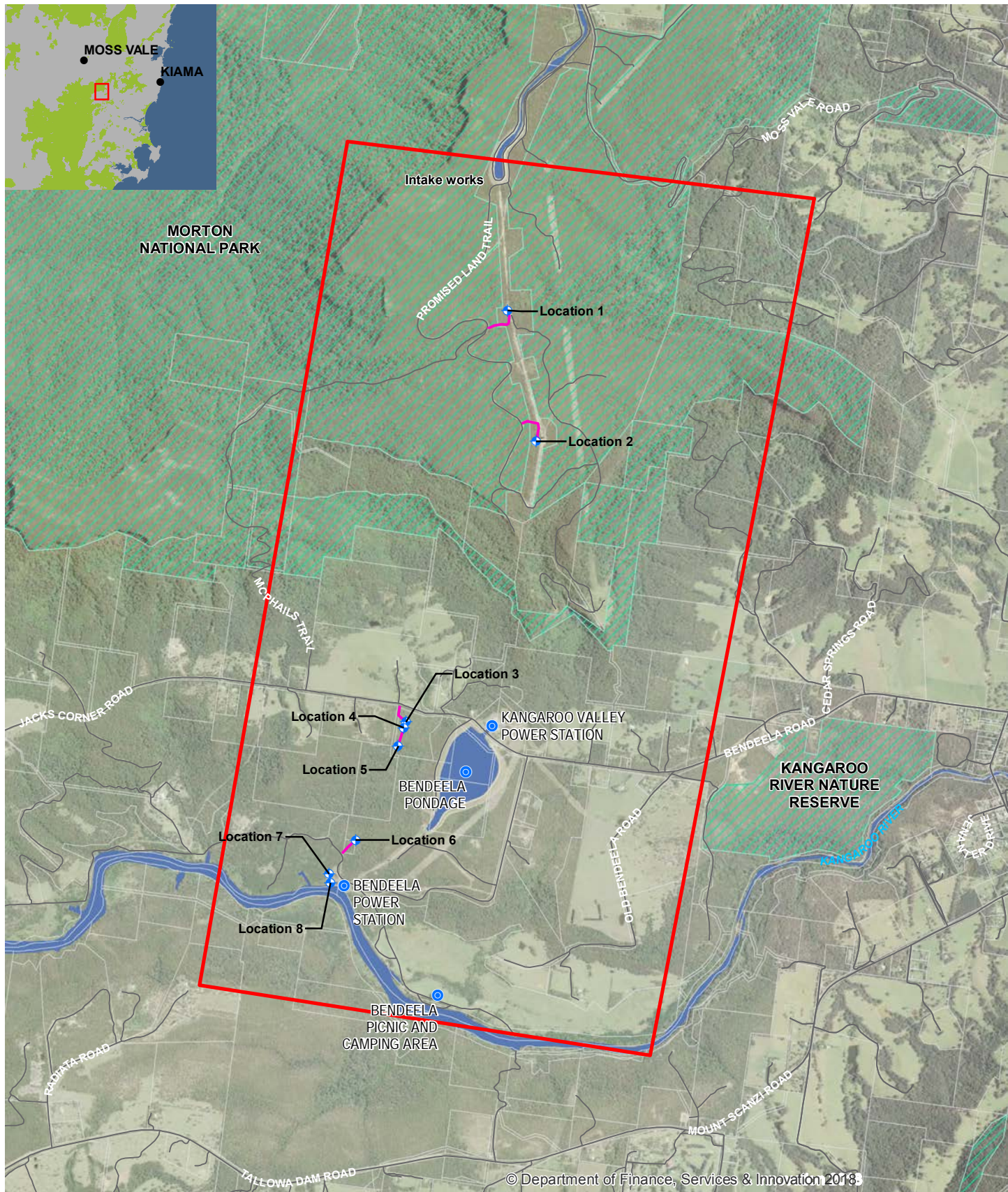
Geotechnical investigation locations were selected by the geotechnical engineering team according to the reference design for the Shoalhaven Hydro Expansion Project. These proposed locations were then reviewed by an Archaeologist, Ecologist and Environmental scientist and planner for potential environmental, cultural and social impacts. The reviews identified a number of investigation locations in moderately sensitive areas. Moderate sensitivity locations have been removed or relocated to minimise environmental, cultural and social impacts. Following these reviews, a total of eight investigation locations were confirmed as part of the proposal. The environmental context of each is illustrated in Table E 1 and shown in Figures E 2 to E6.

Approval Process

The Shoalhaven Hydro Expansion Project, including geotechnical investigations, was declared to be State significant infrastructure and critical State significant infrastructure (CSSI) by an amendment made to the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

Project Need

The geotechnical investigations are required to facilitate an understanding of below ground geotechnical conditions and are essential for confirming that the Shoalhaven Hydro Expansion Project can be constructed and operated in a safe and economically viable manner. The geotechnical investigations are necessary to allow the broader benefits of the Shoalhaven Hydro Expansion Project to be realised. These wider benefits are outlined below.



Legend

- Points of interest ◆ Indicative Geotech Locations
- Study area — Access tracks
- NPWS Reserve

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1:40,000 @ A4



Figure E1 | Geotechnical Investigation Locations

Data sources
DFSI - Spatial Services
Jacobs 2018

Table E 1: Geotechnical investigation location photolog

Photo	Location and description
	<p>Location 1</p> <p>Proposed anchor block location with works to be limited to the existing area of disturbance and concrete and access via existing access track requiring no vegetation clearing.</p>
	<p>Location 2</p> <p>Proposed vertical shaft location with works to be limited to areas largely devoid of vegetation and within an area previously disturbed by construction of the original scheme.</p>
	<p>Locations 3 and 4</p> <p>Ground above indicative power station cavern location require establishment of an approximately 200 metre long and 3 metre wide temporary access track positioned to avoid disturbance of habitat features.</p> <p>Establishment of two works areas, one for each location, would require clearing to ground level of a further two areas of approximately 20 metre by 20 metre dimension avoiding habitat features.</p>



Photo	Location and description
	<p>Location 5</p> <p>Location 5 is targeting the indicative tailrace and access tunnels and is aimed at providing improved understanding ancient landslide formation.</p> <p>Drilling location and works areas would be in an area previously cleared and naturally revegetated.</p> <p>Location 5 would require establishment of an approximate 150 metre long and 3 metre wide temporary access track extending from location 4 and positioned to avoid disturbance of habitat features.</p> <p>The establishment of a works areas of approximate 20 metre by 20 metre dimension avoiding habitat features would also be required.</p>
	<p>Location 6</p> <p>Indicative access tunnel portal location with geotechnical investigations positioned to limit clearing to the extent possible and access provided by a 175 metre long, and 3 metre wide temporary access track and 20 metre by 20 metre works area positioned to avoid disturbance of habitat features.</p> <p>No ground disturbance is proposed other than the bore hole.</p>

Photo	Location and description
	<p>Location 7</p> <p>Indicative tailrace tunnel initial drive location with works to be limited to cleared and previously disturbed area with Bendeela power station site as shown. No new clearing is required for establishment of access or works area.</p>
	<p>Location 8</p> <p>Targeting geotechnical properties of the indicative intake structure, with bore location relocated further east with the existing access to the Bendeela power station forebay, out of an adjacent area identified as moderate archaeological potential.</p>

Issues identification and screening

The identification of likely environmental consequences of the Geotechnical investigations has involved:

- Desktop review of relevant databases, historical aerial photography, reports associated with the existing scheme and available background data;
- Review of Department of Planning and Environment Codes of Practice for exploration works;
- Environmental specialist site walkover; and
- Outcomes of stakeholder consultation to date.

From this process, issues requiring further consideration are identified as:

- Biodiversity;
- Aboriginal heritage;
- Land and water management; and
- Noise.

Environmental constraints of each location are illustrated in Figure E2 to E6.

Biodiversity

Part 7 of the Biodiversity Conservation Act 2016 (BC Act) requires that an application for State significant infrastructure approval under Division 5.2 of the EP&A Act be accompanied by a "biodiversity development assessment report unless" the Secretary of the Department of Planning and the Chief Executive of the Office of Environment and Heritage" determine that the proposed development is not likely to have any significant impact on biodiversity values".

Based on the minor and temporary nature of the geotechnical investigations, the avoidance of habitat features in locating works areas and access tracks and the low to moderate condition of plant community types present it is considered unlikely that significant impacts to biodiversity values would occur. Following completion of geotechnical investigations, all locations would be allowed to, or actively managed to, rehabilitate to their current standard. An exemption to the need for a biodiversity development assessment report is requested.

Aboriginal heritage

This preliminary Aboriginal cultural heritage assessment has been undertaken with reference to the Due Diligence of Practice Code of Practice for the Protection of Aboriginal Objects in NSW published by the Office of Environment & Heritage (OEH).

Extensive AHIMS searches was undertaken on 13 and 17 September 2018. The AHIMS search identified 15 sites in the surrounding area with the nearest AHIMS site, an artefact scatter, located over 2 km to the west of the geotechnical investigation locations.

The preliminary site inspection confirmed that most of the geotechnical investigations occurs within significantly disturbed landforms, with extensive ground disturbance from the original pipeline and project construction. There were no Aboriginal objects or sites identified during the inspection. One area of moderate archaeological sensitivity was recorded near the intake site adjacent near Lake Yarrunga. The findings of this assessment have resulted in geotechnical investigation locations being located in areas of low sensitivity.

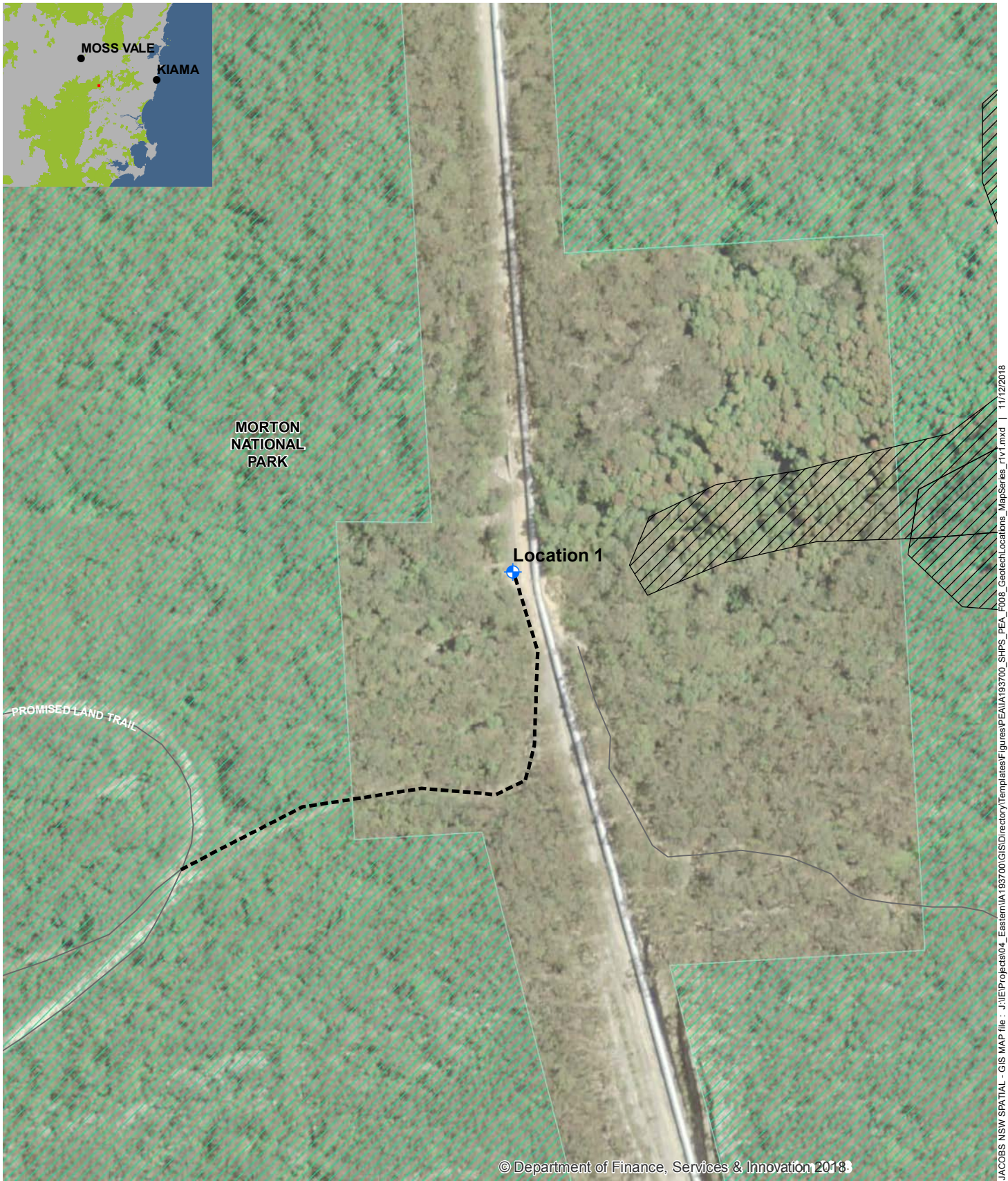
Formal consultation under the *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH, 2010) is not proposed based on the avoidance of potential for harm to known Aboriginal objects and places and sensitive landforms.

Water management

The Geotechnical investigations are located within the Sydney Drinking Water Catchment and some locations are within the Shoalhaven Special Area. Standard mitigation measures are available to managed known risks associated with geotechnical investigations. An assessment of the potential for impacts to land and water resources would be included as part of the EIS including consideration of neutral or beneficial water quality outcomes.

Noise

Locations 3, 4 and 5 are located in proximity to four private residences. The ambient noise environment of the study area is defined by natural elements and limited human activity, therefore the surrounding area has the potential to be exposed to noise impacts. All other geotechnical investigations would occur at substantial distance from private receptors. The main impacts associated with noise would include short term noise impacts during working hours from geotechnical investigations. These impacts would be managed in accordance with the Interim Construction Noise Guidelines and a noise impact assessment would be undertaken as part of the EIS.

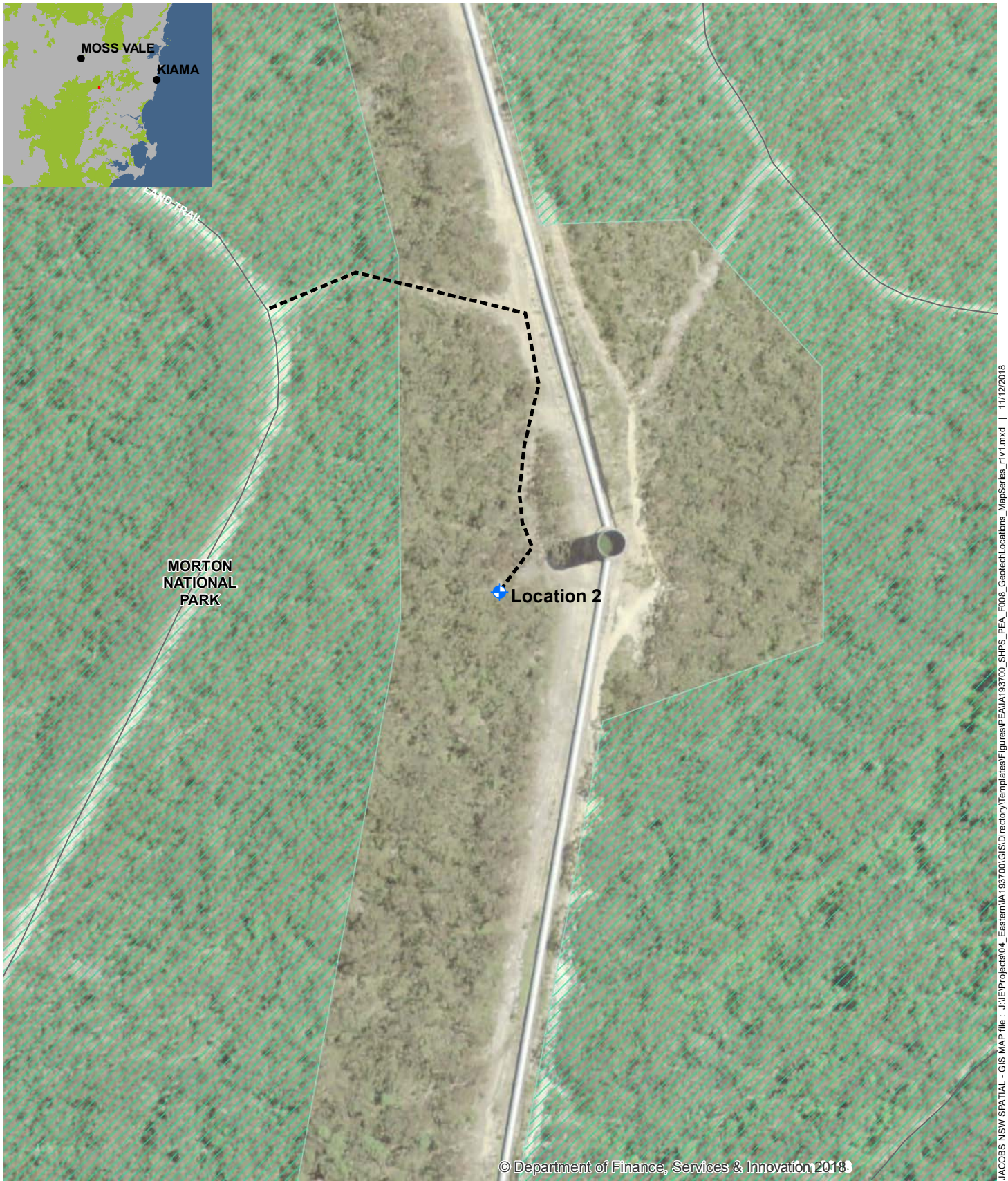


- Legend**
- Study area
 - NPWS Reserve
 - EECs
 - Existing access tracks (No clearing required)
 - Indicative Geotech Locations

Figure E2 | Location 1 constraints

Data sources
 DFSI - Spatial Services
 Jacobs 2018

JACOBS NSW SPATIAL - GIS MAP file : J:\IE\Projects\04_Eastern\VA193700\GIS\Directory\Templates\Figures\PEA\VA193700_SHPS_PEA_F008_GeotechLocations_MapSeries_r1v1.mxd | 11/12/2018



Legend

- Study area
- NPWS Reserve
- + Indicative Geotech Locations
- Existing access tracks (No clearing required)

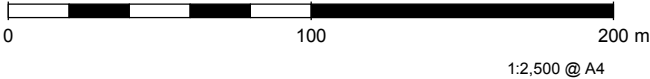


Figure E3 | Location 2 constraints

Data sources
 DFSI - Spatial Services
 Jacobs 2018



Legend

- Study area
- + Indicative Geotech Locations
- Temporary access track
- EECs

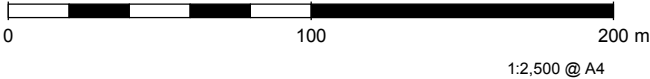


Figure E4 | Location 3,4,5 constraints

Data sources
 DFSI - Spatial Services
 Jacobs 2018



Legend

- Study area
- Indicative Geotech Locations
- Temporary access track
- EECs

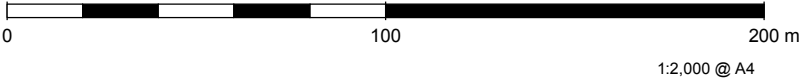
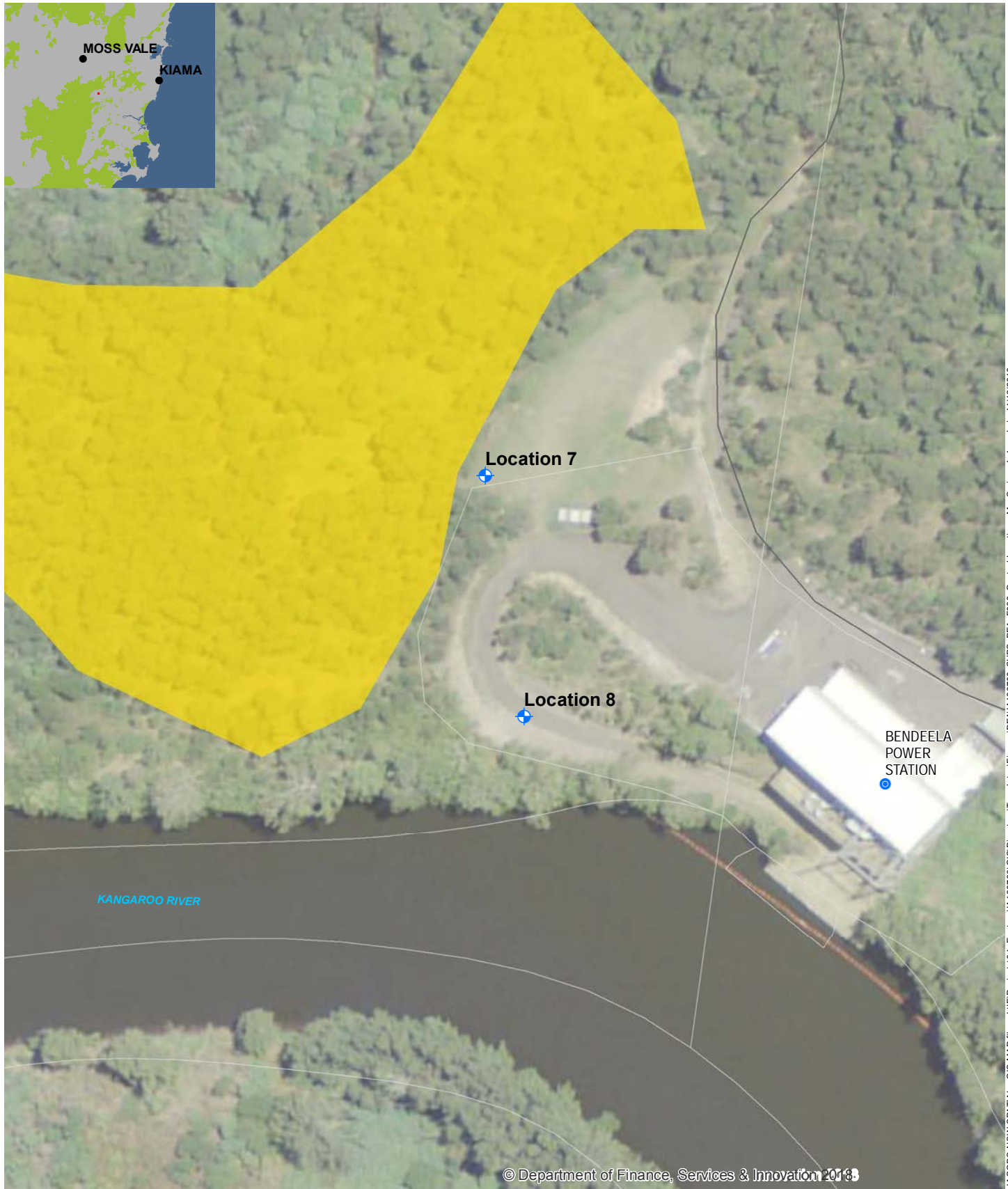


Figure E5 | Location 6 constraints

Data sources
 DFSI - Spatial Services
 Jacobs 2018



Legend

- Points of interest
- ◆ Indicative Geotech Locations
- Study area
- Potential archaeological sensitivity

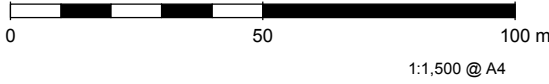


Figure E6 | Location 7,8 constraints

Data sources
DFSI - Spatial Services
Jacobs 2018

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1. Introduction

1.1 Background

Origin Energy Eraring Pty Ltd (a subsidiary of Origin Energy Limited) (collectively, Origin) is the current operator of the Shoalhaven Pumped Hydro Energy Storage (PHES) Scheme (the existing scheme). The existing scheme is located in the NSW Southern Highlands, approximately 150km south east of Sydney (refer to Figure 1.1). The existing scheme was commissioned in 1977 and currently has a generating capacity of 240MW.

The existing scheme was designed and constructed as a dual-purpose system, having both pumped storage generation capacity and inter-region water supply ability to move water from the Shoalhaven catchment to the Sydney drinking water catchment.

The existing scheme was designed in the late 1960's and Stage 1 Phase 1 was constructed in the 1970's including two generating / pumping units at Kangaroo Valley Power Station and two generating units at the Bendeela Power Station. Origin purchased the generation and pumping assets within the existing scheme from the State of NSW in 2013. Origin has since been progressively undertaking major overhauls to improve reliability of the existing scheme out to at least 2070 under agreements with Water NSW. Water NSW retains ownership of the water storage and transfer infrastructure including the Fitzroy Falls canal, existing above ground and below ground pipelines, Bendeela Pondage and Lake Yarrunga.

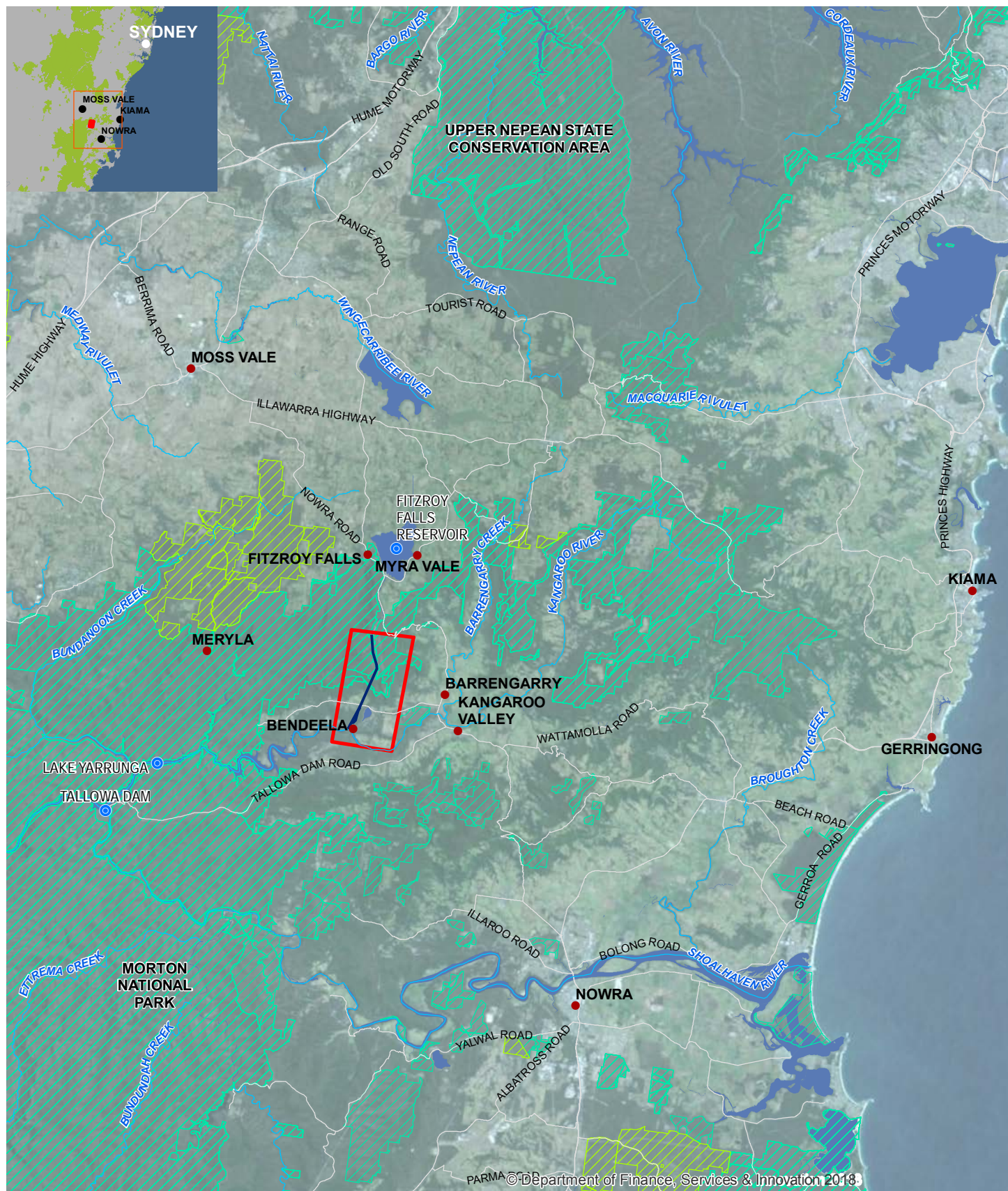
The existing scheme was designed to allow for expansion and much of the required infrastructure needed for duplicating the scheme is already in place. As a result there is unconstructed expansion capacity at the site which was contemplated in the original waterway, switchyard located near the Kangaroo Valley Power Station and transmission lines, while the earthworks for duplicating the above ground pipeline on the plateau was also completed.

Origin now proposes to almost double the electricity generation capacity of the existing scheme with the Shoalhaven Hydro Expansion Project (SHEP), which will provide approximately an additional 235MW of pumped storage generation capacity. Origin has completed a Pre Feasibility Study and is now undertaking a Feasibility Study for the Shoalhaven Hydro Expansion Project which has and will include:

- Investment in feasibility study approved by the Origin Investment Committee;
- The Australian Renewable Energy Agency (ARENA) has committed \$2 million to supporting the feasibility study under its Advancing Renewables Fund;
- Jacobs Group (Australia) Pty Limited (Jacobs) has been engaged as Owners Engineer and will undertake the feasibility study, including environmental assessment, with Origin; and
- The NSW Government has declared the expansion Shoalhaven Hydro Expansion Project to be Critical State Significant Infrastructure (CSSI) to be assessed under a full merits based assessment under Division 5.2 of the Environmental Planning and Assessment Act (EP&A Act).

To confirm the feasibility of the Shoalhaven Hydro Expansion Project, geotechnical investigations are required to provide confidence that the belowground structures can be constructed and operated safely and cost effectively. The purpose of this report is to support an application for Secretary's Environmental Assessment Requirements (SEARs) under section 5.16 of the EP&A Act for these geotechnical investigations.

Once issued, the SEARs will set out the matters to be addressed by Origin in the Environmental Impact Statement (EIS) to be prepared and submitted for the geotechnical investigations under section 5.17 of the EP&A Act. This report documents the outcomes of the preliminary environmental risk analysis for the geotechnical investigations.



Legend

- Points of interest
- Study area
- NPWS Reserve
- State Forest
- Indicative Shoalhaven Hydro Expansion Project Footprint

0 5 10 km
1:300,000 @ A4



Figure 1.1 | Shoalhaven Hydro Expansion Project Location

Data sources
DFS - Spatial Services
Jacobs 2018

1.2 Project overview

The geotechnical investigations the subject of this application are limited to the drilling of up to eight boreholes ranging in depth from 25 to 650 metres below ground level and ancillary works to establish temporary access and works areas, geotechnical testing, decommissioning and rehabilitation. The target locations of the geotechnical investigations are illustrated in Figure 1.2 and are located at the proposed locations of key components of the Shoalhaven Hydro Expansion Project or are aimed at facilitating improved understanding of identified higher risk ground conditions. In the event that the project is deemed unfeasible, all geotechnical drilling locations would be decommissioned and rehabilitated to match the existing land use and habitat values of each location. Some bores would be converted to monitoring bores.

1.2.1 Relationship to Shoalhaven Hydro Expansion Project

The geotechnical investigations are aimed at confirming the feasibility of the Shoalhaven Hydro Expansion Project. The Shoalhaven Hydro Expansion Project would involve the construction and operation of a new pumped hydro power station on and under the land between the Fitzroy Falls Reservoir and Lake Yarrunga. The Shoalhaven Hydro Expansion Project would draw on Origin's existing water allocations to pump water up from Lake Yarrunga consuming energy when it is in less demand. Energy would then be generated through the return of water from Fitzroy Falls Reservoir to Lake Yarrunga when demand for energy increases.

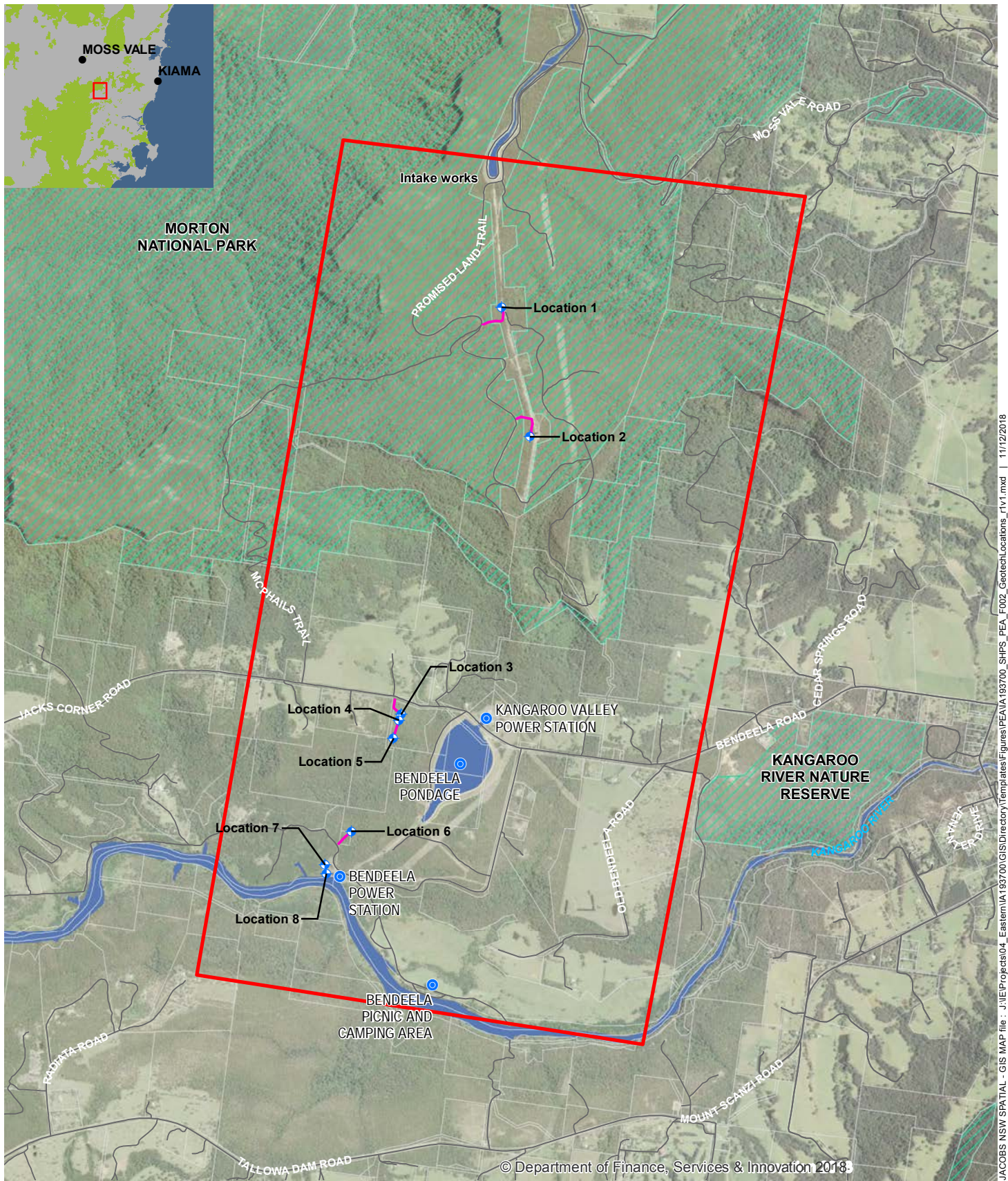
The indicative Shoalhaven Hydro Expansion Project layout is provided in Figure 1.3 and consists of the construction and operation of:

- A surface pipeline from the existing Fitzroy Falls canal control structure to a surge tank;
- Vertical shaft and headrace tunnel to an underground cavern;
- An underground power station cavern housing a reversible generator and pump capable of supplying approximately 235 megawatts of hydroelectric power, including associated access and ventilation tunnels, transformer and high voltage cable route to the existing Kangaroo Valley power station substation;
- A tailrace tunnel and intake /outlet structure in the vicinity of the existing Bendeela power station on Lake Yarrunga;
- A vehicular access tunnel to the underground power station from the vicinity of the existing Bendeela power station; and
- Ancillary works which may including the carrying out of works to upgrade or construct access roads, spoil disposal, utilities infrastructure, construction compounds and construction power supply.

The Shoalhaven Hydro Expansion Project is to be carried out in the *Wingecarribee* and *Shoalhaven Local Government Areas*. Access to the upper portion of the Shoalhaven Hydro Expansion Project on the plateau, for pipeline, surge tank and vertical shaft construction would be via existing access tracks constructed as part of the original scheme through the Morton National Park from Moss Vale Road. Access to the lower portion of the Shoalhaven Hydro Expansion Project within Kangaroo Valley would be via Bendeela Road from Moss Vale Road in the vicinity of the townships of Kangaroo Valley and Barrengarry.

Importantly, the Shoalhaven Hydro Expansion Project essentially duplicates the existing scheme and as such no new water storages or connections between waterbodies is proposed. In addition, no transmission augmentations are required to receive or distribute the electricity from the Shoalhaven Hydro Expansion Project.

The Shoalhaven Hydro Expansion Project would be assessed through a separate application. This separation of the assessments is necessary to allow the geotechnical investigations to proceed in parallel to full Shoalhaven Hydro Expansion Project environmental assessment and approvals process.



Legend

- Points of interest ◆ Indicative Geotech Locations
- Study area — Access tracks
- NPWS Reserve

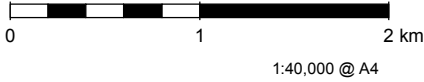


Figure 1.2 | Geotechnical Investigation Locations

Data sources
 DFSI - Spatial Services
 Jacobs 2018

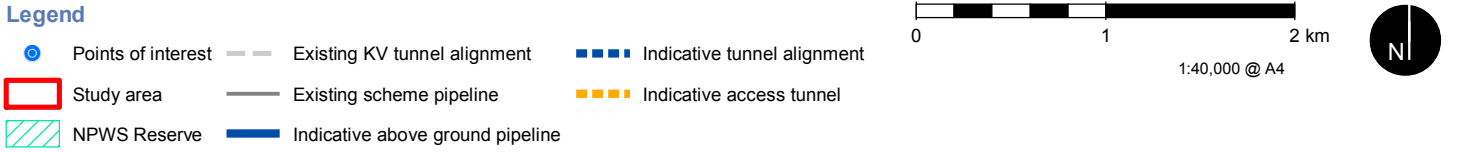
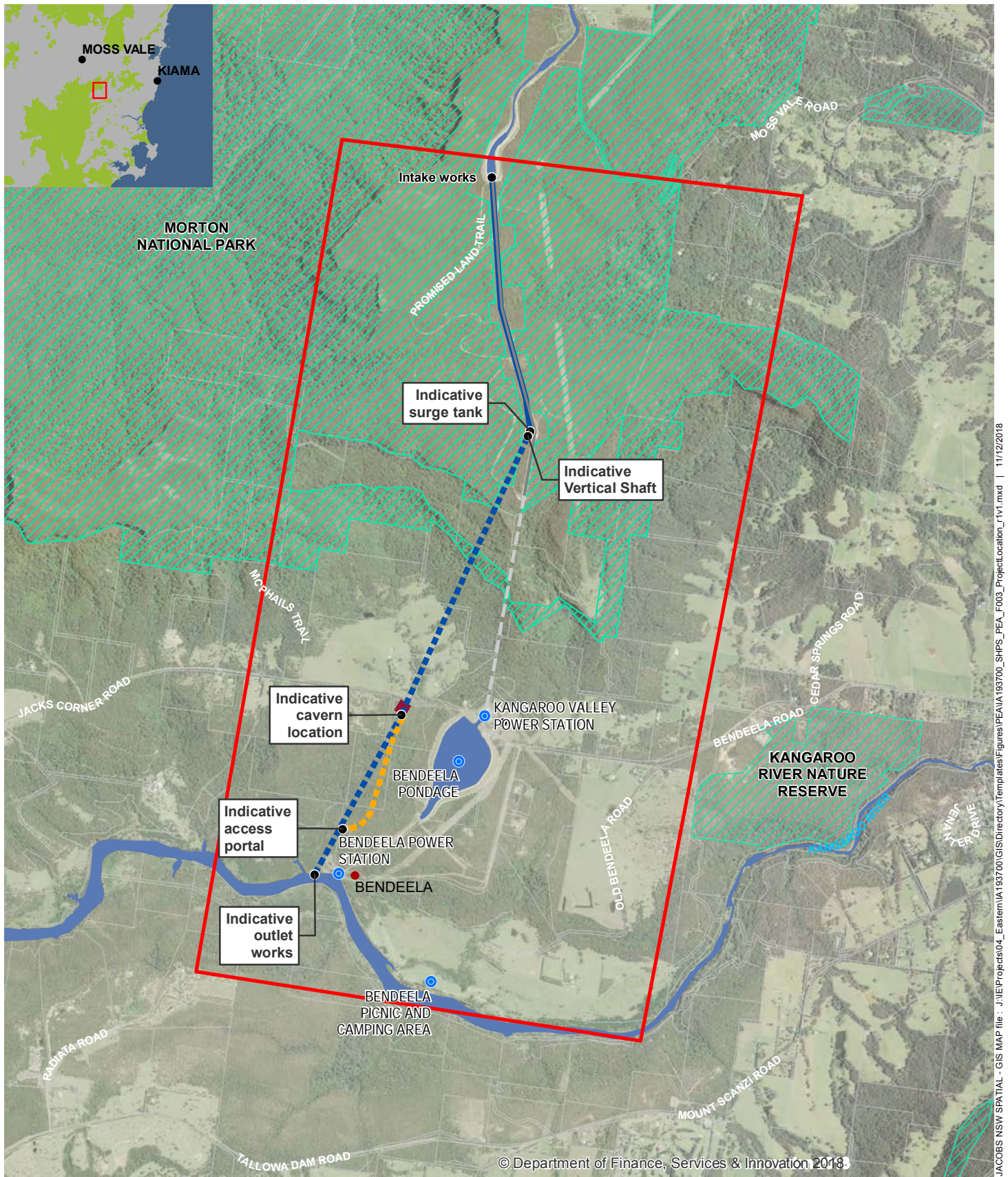


Figure 1.3 | Shoalhaven Hydro Expansion project location and layout

Data sources
DFSI - Spatial Services
Jacobs 2018

1.3 Proponent

Origin is the entity that owns the existing Shoalhaven Scheme generating and pumping assets and is the proponent of the Shoalhaven Hydro Expansion Project. Origin is Australia's largest energy retailer by customer accounts, with 4.3 million customers across electricity, natural gas and LPG. Origin has an electricity generation capacity of more than 6,000MW, has over 6,000 employees, and has a market capitalisation of around \$16 billion (AUD).

Origin is deeply committed to leadership on climate change through the development and deployment of renewable energy. Origin has extensive experience in investing in renewable energy technologies and projects and offers a range of low carbon products to its diverse customer base. Origin is Australia's largest green energy retailer, providing Green Power to over 200,000 customers, installing solar energy on more than 80,000 homes and providing market leading solutions to the 360,000 of its customers with solar installed on their rooftops. Complementing the Solar PV business, Origin has two market leading battery storage products with world leading battery suppliers.

Origin has provided power purchase agreements to more than 1,200 MW of renewable energy projects throughout Australia over the last 3 years and has demonstrated a long-term commitment to the Renewable Energy Target through full compliance with the scheme for the 17 years since its inception. Origin was the world's first energy company to sign up to all seven initiatives under the global 'We Mean Business Coalition', joining a worldwide group of NGOs, signatory companies and institutional investors committed to leadership on climate change.

Origin is committed to "getting energy right for customers, the community and the planet". To ensure this commitment is delivered upon Origin has publicly stated three key areas of focus for the near term:

- Decarbonisation: efforts to tackle climate change continue to support strong growth in renewables and gas as a partner of renewables;
- Decentralisation: technological advancement enabling consumer empowerment and transition towards a decentralised energy future; and
- Digitisation: changing all aspects of operations and requiring an overhaul of business processes and interactions with customers

To ensure that these objectives can be achieved, Origin acknowledges the importance of collaboration with the transmission and distribution network owners to ensure that the infrastructure that supports Origin's activities can adapt to the changes that these objectives present.

The Shoalhaven Hydro Expansion Project is consistent with Origin's decarbonisation aims.

1.4 Planning and Assessment Process

The Shoalhaven Hydro Expansion Project, including geotechnical investigations, was declared to be State significant infrastructure and critical State significant infrastructure (CSSI) by an amendment made to the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

Accordingly, Origin has lodged its application for approval for the geotechnical investigations as CSSI under section 5.15 of the EP&A Act. A separate application for approval of the Shoalhaven Hydro Expansion Project is intended to be lodged in the near future, when the design is suitably advanced.

2. Geotechnical investigation context

2.1 Location

The geotechnical investigations for the Shoalhaven Hydro Expansion Project would be undertaken in the NSW Southern Highlands, approximately 150km south east of Sydney. The geotechnical investigations would be located within the Shoalhaven Local Government Area (Refer to Figure 1.1).

The geotechnical investigations are proposed in land owned by WaterNSW associated with the existing Kangaroo Valley and Bendeela Power Stations and water transfer operations (Refer to Figure 2.1). WaterNSW land includes land either side of the existing surface pipeline and surge tank at the top of the plateau and land between Jacks Corner Road and Lake Yarrunga.

Access to geotechnical investigation areas on the plateau would be required via existing access tracks through the Morton National Park.

2.2 Site and surrounds

The major features of the area surrounding the geotechnical investigations include:

- The existing scheme;
- Morton National Park; and
- Rural landholdings.

2.2.1 The existing scheme

The existing Shoalhaven Scheme is jointly owned by WaterNSW and Origin Energy in a long-term arrangement running until 2070. The existing Shoalhaven Scheme comprises the Fitzroy Falls reservoir, Fitzroy Falls canal, Kangaroo Pipeline, Kangaroo Valley Power Station, Bendeela Pondage, Bendeela Pipeline, Bendeela Power Station, Tallowa Dam (Lake Yarrunga). Origin owns and operates only the generating and pumping assets while WaterNSW owns the water related assets.

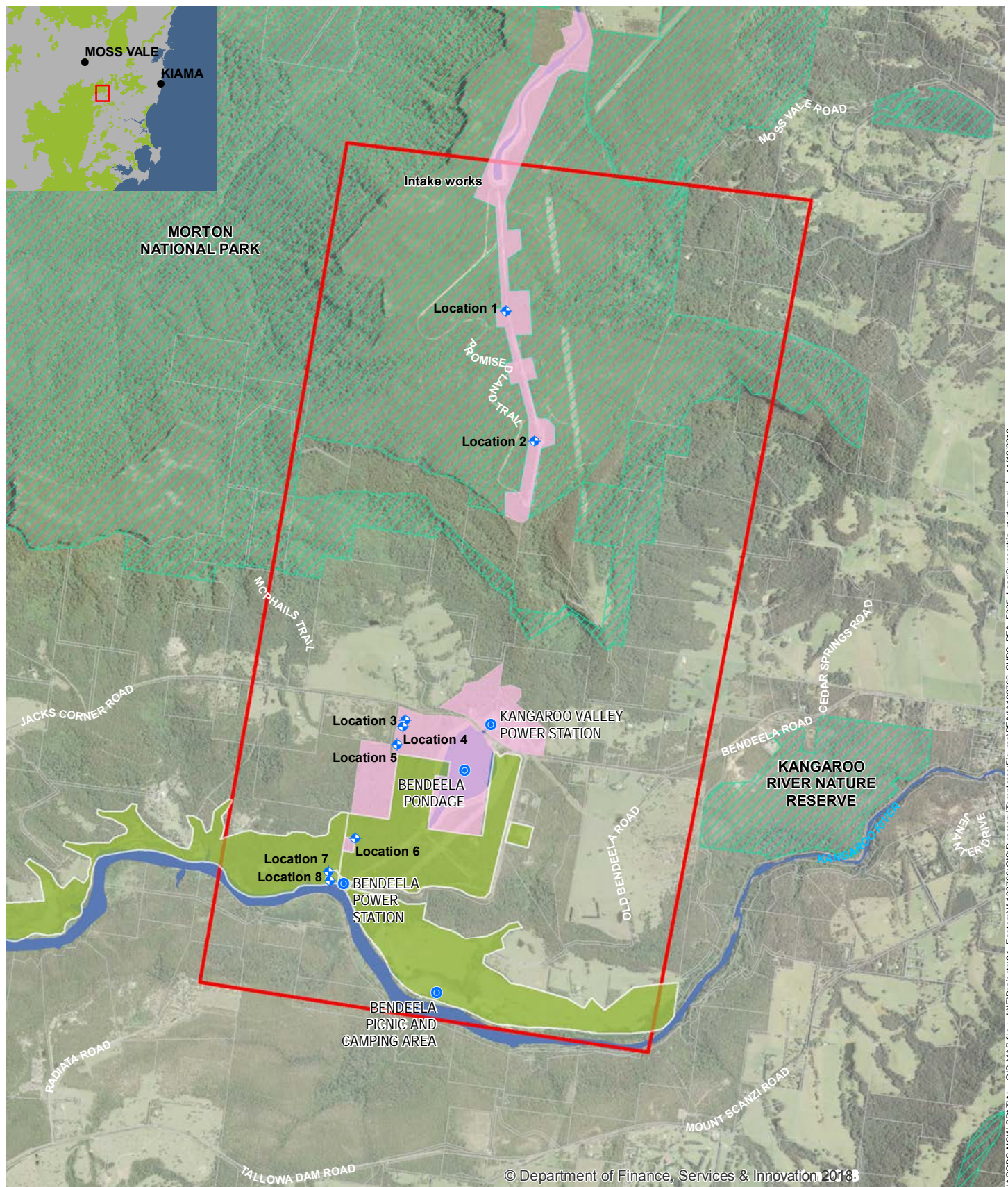
The original design and construction of the existing scheme allowed for future expansion through the provision of sufficient capacity in the station services such as high voltage transmission lines and the Fitzroy Falls canal and canal interface structures (inlet gates and pipe head). Construction of the existing scheme also extended to much of the bulk earthworks required for the surface pipeline on the plateau being completed.

The Geotechnical investigations would require access through land associated with the existing scheme but would not lead to any cumulative or ongoing impacts affecting the scheme or the environment.

2.2.2 Morton National Park

The Morton and Budawang National Parks together comprise an area of over 190,000 hectares on the eastern escarpment of the Southern Tablelands. The park stretches from Bundanoon in the north to southeast of Braidwood and covers a diverse, rugged and scenically magnificent landscape. The Morton National Park is managed in accordance with the *Morton and Budawang National Parks Plan of Management* (NSW NPWS, 2001). This document recognises the important landscape, geology, biodiversity, heritage and wilderness values of the Morton National Park. The document also recognises existing uses associated with water and electricity infrastructure.

The geotechnical investigations would require access via short sections of existing access tracks established as part of the construction of the existing Shoalhaven Scheme. No impacts to the National Park will result from the geotechnical investigations.



Legend

- Points of interest
- Indicative Geotech Locations
- Study area
- Water NSW lands
- NPWS Reserve
- Shoalhaven Special Area

Figure 2.1 | Land ownership

Data sources
 DFSI - Spatial Services
 DPE NSW 2018
 Jacobs 2018

2.2.3 Surrounding landholdings

There are several communities and townships within the zone of influence of the Shoalhaven Hydro Expansion Project. These include Barrengarry and Kangaroo Valley Fitzroy Falls, Wildes Meadow, Avoca and Burrawang. The scale of the geotechnical investigations would not impact any of these population centres.

Landholdings surrounding the geotechnical investigation areas are rural in nature consisting of isolated dwellings. The Scots Collage Glengarry Campus is located approximately 500 metres to the west of the geotechnical investigations.

3. Project Description

3.1 Overview

The currently proposed drilling program includes eight cored boreholes as shown in Figure 1.2. Most holes are to be drilled vertically with target depth ranging from 25 m to 650 m as provided in Table 3.1, totalling 2015m of drilling. Location 4 is planned to be drilled at a nominal inclination of 60° towards NNE to target a possible fault in the cavern area.

Table 3.1: Preliminary borehole collar locations and depths

Borehole ID	Location	Inclination (°)	Approximate Elevation RL (m)	Hole Length (m)
Location 1	Pipeline anchor block	90	548	25
Location 2	Vertical shaft	90	636	480 - 650
Location 3	Cavern Area	90	179	250
Location 4	Cavern Area	60	178	235
Location 5	Tailrace and crest of cliff	90	185	210
Location 6	Access tunnel portal + tailrace tunnel	90	69	70
Location 7	Tailrace Tunnel initial portal drive	90	73	55
Location 8	Tailrace channel cut	90	73	45

The environmental constraints of each location are illustrated in Figures 3.1 to 3.5. Final borehole locations, depths, and orientations will be confirmed before the commencement of the drilling program.

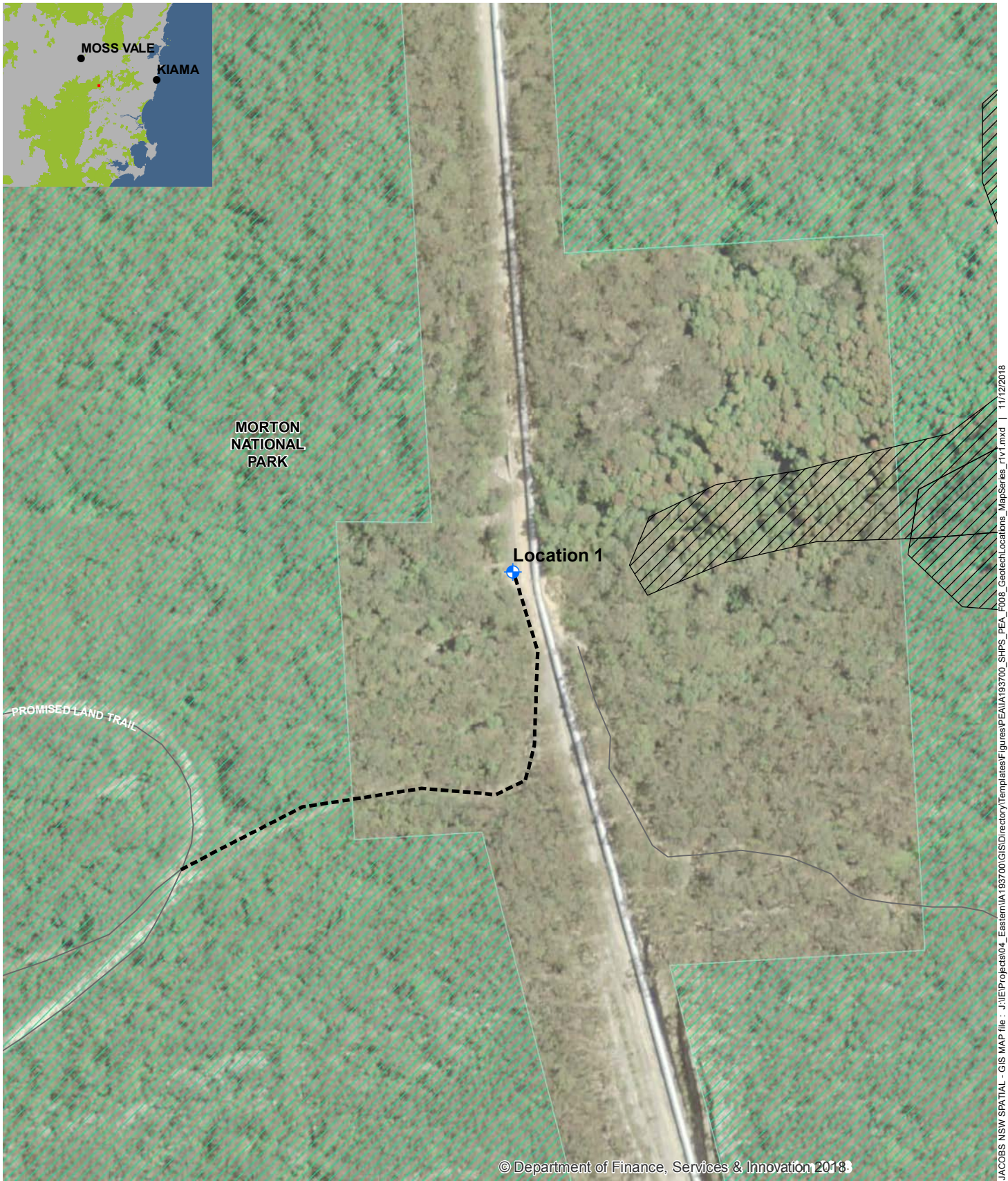
3.2 Drilling Works

3.2.1 Methods and core sizes

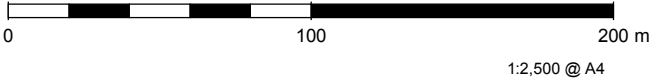
General methods and requirements for drilling are expected to involve the following:

- Preparation of a bunded area and above ground mud pits/ tanks suitably lined in the work area to prevent off site drilling fluid discharges and other requirements;
- Boreholes may be advanced by augering in the upper soil profile, followed by wash boring to rock head. For drilling in soils, Standard Penetration Tests (SPT) may be performed in soils and undisturbed tube samples may be collected in cohesive or fine-grained soils; and
- Rock core drilling would commence from the top of bedrock and advanced to the target depth.

The drilling sizes are likely to range from 75 to 150 millimetres in diameter.



- Legend**
- Study area
 - NPWS Reserve
 - EECs
 - Indicative Geotech Locations
 - Existing access tracks (No clearing required)



Data sources
 DFSI - Spatial Services
 Jacobs 2018

Figure 3.1 | Location 1 constraints



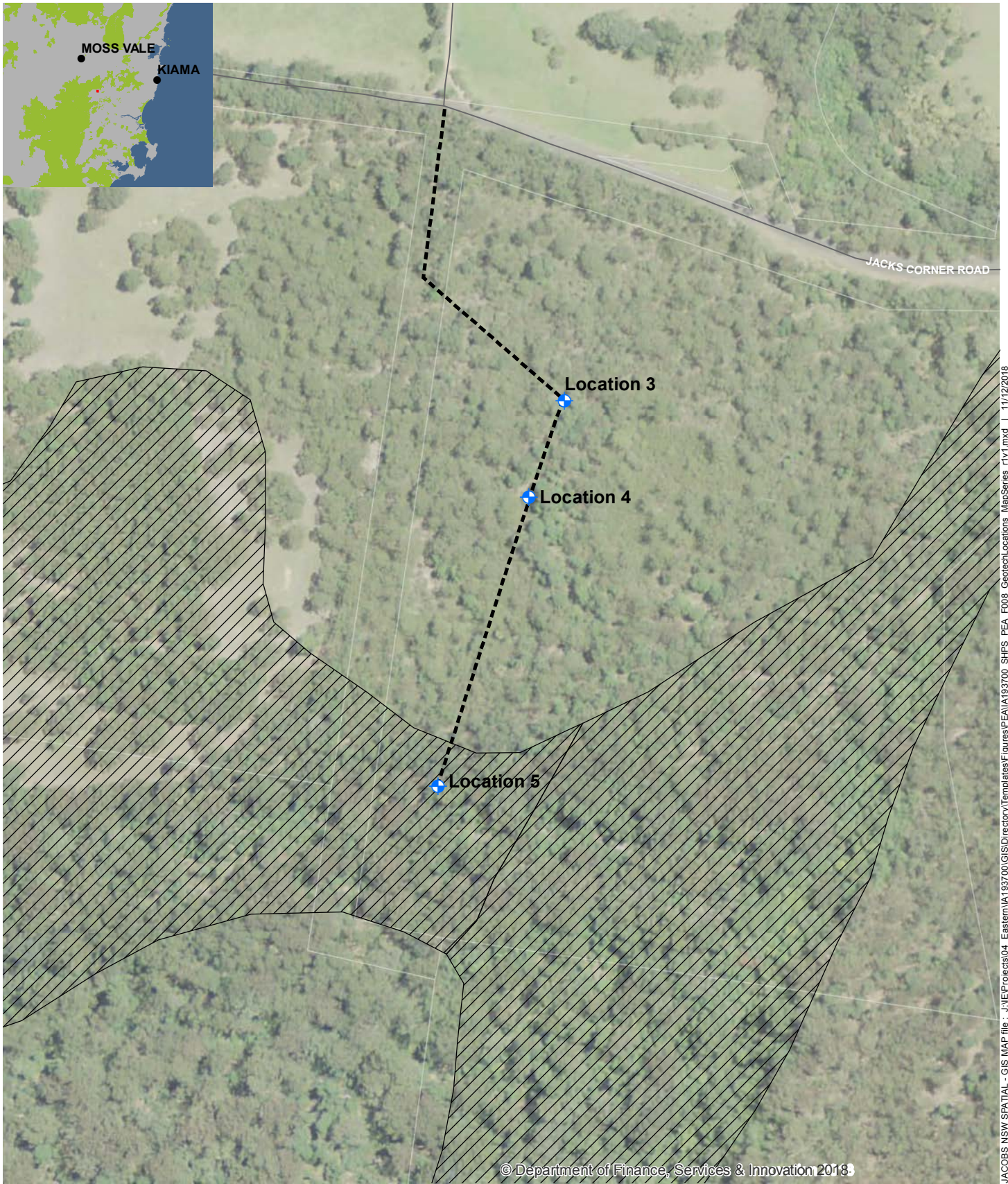
- Legend**
- Study area
 - NPWS Reserve
 - + Indicative Geotech Locations
 - Existing access tracks (No clearing required)



Figure 3.2 | Location 2 constraints

Data sources
 DFSI - Spatial Services
 Jacobs 2018

JACOBS NSW SPATIAL - GIS MAP file : J:\IE\Projects\04_Eastern\VA193700\GIS\Directory\Templates\Figures\PEA\VA193700_SHPS_PEA_F008_GeotechLocations_MapSeries_r1v1.mxd | 11/12/2018



Legend

- Study area
- + Indicative Geotech Locations
- Temporary access track
- EECs

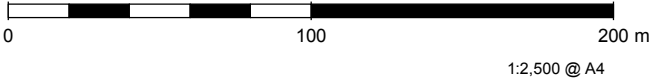


Figure 3.3 | Location 3,4,5 constraints

Data sources
 DFSI - Spatial Services
 Jacobs 2018



Legend

- Study area
- + Indicative Geotech Locations
- Temporary access track
- EECs

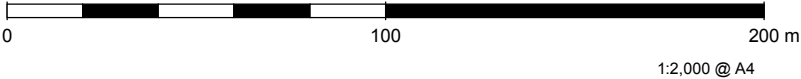
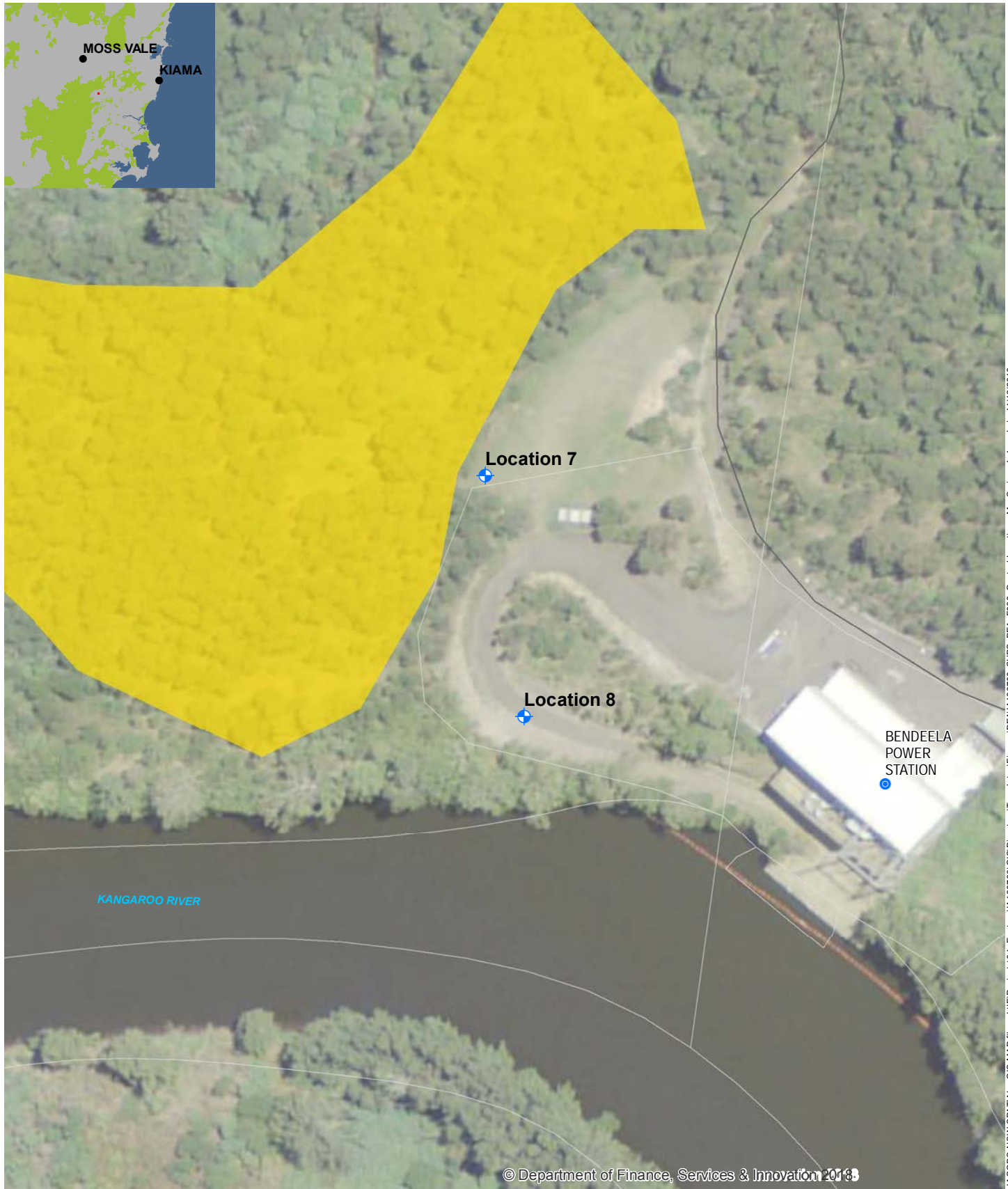


Figure 3.4 | Location 6 constraints

Data sources
 DFSI - Spatial Services
 Jacobs 2018



Legend

- Points of interest
- ◆ Indicative Geotech Locations
- Study area
- Potential archaeological sensitivity

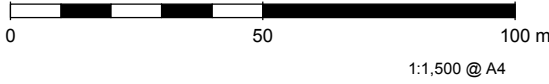


Figure E6 | Location 7,8 constraints

Data sources
DFSI - Spatial Services
Jacobs 2018

3.3 Ancillary works

The following ancillary works would be undertaken at each geotechnical investigation location:

- Packer Testing - Down-hole water injection (Lugeon) rock mass permeability testing will be carried within various boreholes using a gas-inflated packer wireline apparatus with a single packer configuration as the hole is advanced to the required depth for each test interval.
- In situ stress testing – A narrow 0.5m deep pilot hole drill will be drilled into the base of the borehole at various depths and a stress testing tool wedged into pilot hole. The pilot hole will then be over-cored and the stress testing tool will record deformations in the pilot hole resulting from relief of in situ stress during the over coring process.
- Borehole Geophysics and Televiwer Surveys - All borehole walls will be imaged using acoustic televiwer (ATV) below the water table and optical televiwer (OTV) in dry sections of borehole. Geophysical surveys including full wave sonic, natural gamma, density and temperature profiles for the full depth for each hole will also be undertaken.
- Groundwater Monitoring Installations - Groundwater monitoring installations will include a combination of screened standpipe piezometers and grouted-in vibrating wire piezometers (VWP). The standpipe piezometers will allow for periodic groundwater quality sampling and level monitoring.
- Bore Completion Works - All holes that are not to be instrumented for long term monitoring will be fully grouted at the completion of drilling work. The remaining holes will be grouted to the surface. The piezometer will be finished with stick up of between 0.6m and 0.8m above ground level and finished with installation of a steel lockable monument.

3.4 Access

Access to bore holes 1 and 2 would be via the existing Promised Lands Trail off Moss Vale Road between Fitzroy Falls and Barrengarry. The Promised Lands Trail runs through WaterNSW land and the Morton National Park and was constructed to facilitate construction and operation of the existing scheme. No new, or modified access tracks are required for these locations

Access to the remaining bore holes would be via Jacks Corner Road and Lower Bendeela Road off Moss Vale Road between Shoalhaven and Barrengarry. No upgrades to public roads would be required. Access to boreholes 3 to 6 would require limited clearing of shrubs to ground level to establish a corridor to facilitate the daily access of drill rig, support vehicles and worker vehicles. No excavation of the ground surface would be undertaken and large, mature vegetation is expected to be avoidable due to historic clearing.

3.5 Duration and Timing

The deepest borehole drilling associated with the geotechnical investigations are anticipated to take up to three months. Shallow bores would be completed over a period of a few weeks.

Drilling is proposed to be limited to 12 hours per day, seven days per week and during day daylight hours.

3.6 Workforce

Workforce numbers will be modest and estimated as part of the EIS in consultation with drilling contractors. Workers would be sourced locally to the extent possible and be accommodated in existing facilities in the surrounding towns.

3.7 Environmental Management

Works would be undertaken generally in accordance with Department of Planning and Environment (2017a) *Exploration Code of Practice: Environmental Management* and Department of Planning and Environment (2017b) *Exploration Code of Practice: Rehabilitation*.

4. Strategic justification

4.1 Consideration of Project Need

The geotechnical investigations are essential to facilitate a financial investment decision on the Shoalhaven Hydro Expansion Project. The geotechnical investigations are required to facilitate an understanding of below ground geotechnical conditions and are essential for confirming that the Shoalhaven Hydro Expansion Project can be constructed and operated in a safe and economically viable manner. The geotechnical investigations are necessary to allow the broader benefits of the Shoalhaven Hydro Expansion Project to be realised. These wider benefits are outlined below.

4.2 Justification for Shoalhaven Expansion Project

Since the maturation of intermittent renewable energy sources, Origin has sought to secure additional dispatchable energy generation capacity such that the decarbonisation of the Australian electricity system can be supported by the facilitation of renewables with increased storage capacity. This objective is aligned with the need identified by the Independent Review into the Future Security of the National Electricity Market (the Finkel Review), that the National Electricity Market (NEM) requires stable, dispatchable generation to balance network requirements as renewable generation fluctuates depending on the predominate solar or wind resources available at the time.

Origin has undertaken a review of how this intermittency may be managed and concluded that the provision of additional, rapidly dispatchable energy storage via the project would provide a positive outcome. To that end Origin commissioned two pre-feasibility studies to be undertaken to explore the opportunities which may be present in expanding the existing scheme, which has ultimately determined the preferred option that will be pursued.

The selection of the Shoalhaven Hydro Expansion Project to meet this need is consistent with the NSW Energy Security Taskforce Final Report issued in December 2017, which recognised the significant benefits of pumped hydro energy storage as means of addressing New South Wales' critical energy, economic, social and environmental needs:

Pumped hydro energy storage (PHES) increasingly has potential in Australia to act as an effective electrical energy storage technology as an alternative to, or in conjunction with, batteries. PHES can contribute to both reliability and security of the grid, as it can provide the system security services associated with synchronous generation. Energy is stored when prices are low, such as from solar or wind energy, or overnight coal generation. During this time, water is pumped to the higher of two reservoirs and stored, then released when energy is needed.

The National Electricity Market (NEM) is currently experiencing unprecedented change. The NSW Energy Security Taskforce Final Report identified the increasing penetration of intermittent renewable sources of electricity requires systems to respond more rapidly and flexibly, and that pumped hydro is likely to be needed to provide this capability.

The potential for unserved energy and not meeting current reliability standard is projected to increase in New South Wales and Victoria after Liddell Power Station closes (announced as 2022). In worst case scenarios this could lead to controlled load shedding or loss of supply in NSW. There are currently no committed dispatchable generation projects for New South Wales which could provide firming capacity for the significant amounts of non-firm renewables planned and committed. There is also a need for dispatchable energy generation projects to be able to respond to carbon reduction policies such as the NSW Renewable Energy Action Plan.

The Department of Planning and Environment's *South East and Tablelands Regional Plan 2036* includes a priority growth sector of renewable energy to diversify the economy. Specifically, the *South East and Tablelands Regional Plan 2036* includes Direction 6 to position the region as a hub of renewable energy excellence by promoting new opportunities for renewable energy industries and encouraging the co-location of renewable energy projects to maximise infrastructure, including corridors with access to the electricity network.

The Shoalhaven Hydro Expansion Project represents a response to all of these needs, and subject to approval, may be delivered by the end of 2022, the same year as the planned Liddell Power Station closure.

4.3 Shoalhaven Hydro Expansion Project Opportunity

The Shoalhaven Hydro Expansion Project opportunity has arisen from:

- The existing major water storage infrastructure at appropriate elevation differences;
- Existing scheme infrastructure appropriately sized and constructed in anticipation of future expansion;
- Existing water allocations that can accommodate the expansion without need for changes in current upper and lower storage minimum and maximum operating levels;
- Available capacity within the existing transmission network; and
- Favourable market dynamics.

Subject to completion of feasibility study, it is considered highly likely that based on these opportunities, the project can be constructed and operated in an economically feasible manner with long term environmental and social impacts largely consistent with those associated with the existing scheme.

4.4 Consideration of Options

4.4.1 Do nothing

The 'do nothing' option would involve not carrying out any geotechnical investigations for the project. The 'do nothing' option would be unsuitable as it would not provide the necessary information on soil and rock conditions to inform the design development and environmental assessment. Failure to adequately consider the ground conditions along the alignment could result in poor safety and economic outcomes for the project.

4.4.2 Carry out geotechnical investigations

The preferred option would be to carry out geotechnical investigations to provide necessary information on soil, rock and groundwater conditions for the project. Investigation locations have been selected for the purpose of gathering certain geological data required to inform critical components of the Shoalhaven Hydro Expansion Project, namely the Pipeline Anchor Block, Vertical Shaft, Power Station Cavern, Access Portal and Intake from Lake Yarrunga. A further location (location 5) has been included to provide additional context around ground conditions adjacent to what has been interpreted as an ancient landslide feature. During the identification of investigation locations, all efforts were made to avoid or minimise environmental and social impacts.

Additional geotechnical locations would provide increased certainty but would require additional land-owner approvals and additional Aboriginal and ecological investigations. Approval of additional investigation locations may be sought subject to these additional surveys.

4.5 Location selection process

Investigation locations were selected by the geotechnical engineering team according to the reference design for the Shoalhaven Hydro Expansion Project. Existing data and investigations carried out for the existing scheme, as well as a number of other investigations, were reviewed and collated to inform the need and target location for the geotechnical investigations.

These identified target locations were then reviewed by an Archaeologist, Ecologist and Environmental scientist and planner for potential environmental, cultural and social impacts. The reviews identified a number of investigation locations in moderately sensitive areas. Where possible these locations have been removed or relocated to minimise environmental, cultural and social impacts. Following these reviews, a total of eight investigation locations were confirmed as part of the proposal as described in Chapter 3.

5. Statutory framework

5.1 NSW Planning Framework

The *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes the planning and approvals process in NSW. The EP&A Act provides for the making of Environmental Planning Instruments (EPIs) including Local Environmental Plans (LEPs) and State Environmental Planning Policies (SEPPs), which set out requirements for particular localities and/or particular types of development. The applicable EPIs and the Regulations made under the EP&A Act determine the relevant planning approval pathway and the associated environmental assessment requirements for proposed development activities.

5.1.1 Critical State significant infrastructure

Clause 16 of the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) provides that:

Development specified in Schedule 5:

- (a) *may be carried out without development consent under Part 4 of the Act, and*
- (b) *is declared to be State significant infrastructure for the purposes of the Act if it is not otherwise so declared, and*
- (c) *is declared to be critical State significant infrastructure for the purposes of the Act.*

Schedule 5 of the SRD SEPP lists:

- (1) *Development for the purposes of the Shoalhaven Hydro Expansion Project, being the construction operation, and decommissioning of an underground pumped hydro power station on and under land between Fitzroy Falls Reservoir and Lake Yarrunga.*
- (2) *The development includes the following:*
 - a. *The carrying out of exploratory geotechnical works for the design of the underground pumped hydro power station,*
 - b. *A single underground hydroelectric power and pump station capable of supplying approximately 235 megawatts of hydroelectric power connecting to the existing Kangaroo Valley substation,*
 - c. *An underground cavern, water pipelines and tunnels, access tunnels, surface pipelines, surge tank, intake and outlet structures at Fitzroy Falls Reservoir and Lake Yarrunga,*
 - d. *Development that is ancillary to any other development in this clause, including the carrying out of works to upgrade or construct access roads, utilities infrastructure, construction accommodation, construction compounds and construction power supply,*
 - e. *The decommissioning of the underground pumped hydro power station and rehabilitation of the site.*
- (3) *The development is to be carried out on land in Kangaroo Valley, Barrengarry and Fitzroy Falls.*
- (4) *In this clause, development does not include the carrying out of surveys, sampling, environmental investigations, archaeological excavations or other tests or investigations, for the assessment of the Shoalhaven Hydro Expansion Project.*

Accordingly, the project is Critical SSI which requires approval under Division 5.2 of the EP&A Act and the NSW Minister for Planning is the determining authority.

5.1.2 Application of other parts of EP&A Act

Under Division 5.2, Section 5.22 (Application of other provisions of Act):

- “(1) Part 4 and Division 5.1 do not, except as provided by this Division, apply to or in respect of State significant infrastructure (including the declaration of the infrastructure as State significant infrastructure and any approval or other requirement under this Division for the infrastructure)”.*
- (2) Part 3 and environmental planning instruments do not apply to or in respect of State significant infrastructure, except that:*
- (a) they apply to the declaration of infrastructure as State significant infrastructure or as critical State significant infrastructure (and to the declaration of development that does not require consent), and*
 - (b) they apply in so far as they relate to section 3.16, and for that purpose a reference in that section to enabling development to be carried out in accordance with an environmental planning instrument or in accordance with a consent granted under this Act is to be construed as a reference to enabling State significant infrastructure to be carried out in accordance with an approval granted under this Division.*

Accordingly, SEPPs and the LEPs do not affect the permissibility or assessment process for the project.

5.2 Application of other legislation to State significant infrastructure

Section 5.23 of the EP&A Act the following authorisations are not required for approved State significant infrastructure (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):

- a permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*;
- an approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977*;
- an Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974*;
- a bush fire safety authority under section 100B of the *Rural Fires Act 1997*;
- a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000*; and
- Division 8 of Part 6 of the *Heritage Act 1977* does not apply to prevent or interfere with the carrying out of approved State significant infrastructure.

Under Division 5.2, section 5.24 an authorisation of the following kind cannot be refused if it is necessary for carrying out approved State significant infrastructure and is to be substantially consistent with the approval under this Division:

- an aquaculture permit under section 144 of the *Fisheries Management Act 1994*;
- an approval under section 15 of the *Mine Subsidence Compensation Act 1961*;
- a mining lease under the *Mining Act 1992*;
- a production lease under the *Petroleum (Onshore) Act 1991*;
- an environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* (for any of the purposes referred to in section 43 of that Act);
- a consent under section 138 of the *Roads Act 1993*; and
- a licence under the *Pipelines Act 1967*.

The need for additional authorisations and approvals would be confirmed in the EIS.

5.3 Biodiversity Conservation Act 2016

Part 7 of the Biodiversity Conservation Act 2016 (BC Act) requires that an application for State significant infrastructure approval under Division 5.2 of the EP&A Act be accompanied by a "biodiversity development assessment report unless " the Secretary of the Department of Planning and the Chief Executive of the Office of Environment and Heritage" determine that the proposed development is not likely to have any significant impact on biodiversity values".

The BC Act defines "biodiversity values" as follows:

- (a) vegetation integrity--being the degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state,*
- (b) habitat suitability--being the degree to which the habitat needs of threatened species are present at a particular site,*
- (c) biodiversity values, or biodiversity-related values, prescribed by the regulations.*

The regulations made under the BC Act relevantly prescribe the following as additional biodiversity values:

- (a) threatened species abundance--being the occurrence and abundance of threatened species or threatened ecological communities, or their habitat, at a particular site,*
- (b) vegetation abundance--being the occurrence and abundance of vegetation at a particular site,*
- (c) habitat connectivity--being the degree to which a particular site connects different areas of habitat of threatened species to facilitate the movement of those species across their range,*
- (d) threatened species movement--being the degree to which a particular site contributes to the movement of threatened species to maintain their lifecycle,*
- (e) flight path integrity—being the degree to which the flight paths of protected animals over a particular site are free from interference,*
- (f) water sustainability--being the degree to which water quality, water bodies and hydrological processes sustain threatened species and threatened ecological communities at a particular site.*

Consideration of the impact of the geotechnical investigations on biodiversity values is provided in Section 7.3 and concludes that on the basis that the biodiversity impacts would be temporary, avoid clearing to the extent possible and be fully rehabilitated, no significant impacts to Biodiversity Values are likely. An exemption to the need for a biodiversity development assessment report is requested.

5.4 National Parks and Wildlife Act 1974

Under Section 86 of the National Parks and Wildlife Act 1974 (NPW Act) it is an offence to harm or desecrate an Aboriginal object or Aboriginal place. Under the NPW Act harm an object or place includes any act or omission that:

- (a) destroys, defaces or damages the object or place, or*
- (b) in relation to an object—moves the object from the land on which it had been situated, or*
- (c) is specified by the regulations, or*
- (d) causes or permits the object or place to be harmed in a manner referred to in paragraph (a), (b) or (c), but does not include any act or omission that:*
- (e) desecrates the object or place, or*
- (f) is trivial or negligible, or*

(g) is excluded from this definition by the regulations.

Clause 3A of the National Parks and Wildlife Regulations excludes the following from the definition of harm:

An act carried out in accordance with the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW as published by the Department in the Gazette on 24 September 2010 is excluded from the definition of harm an object or place in section 5 (1) of the Act.

The Geotechnical investigations will be carried out in accordance with this Code of Practice. Further, under Section 5.23 of the EP&A Act an Aboriginal heritage impact permit under section 90 of the NPW Act is not required for approved State Significant Infrastructure. Formal consultation under the *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH, 2010) is not proposed based on the avoidance of potential for harm to known Aboriginal objects and places and sensitive landforms.

5.5 Commonwealth referral requirements

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the primary Commonwealth legislation relating to the environment. Under Part 3 of the EPBC Act, approval from the Australian Minister for the Environment and Energy is required for a controlled action being an action that:

- Has, will have, or is likely to have a significant impact on a matter of national environmental significance;
- Is undertaken on Commonwealth land and has, will have, or is likely to have a significant impact on the environment;
- Is undertaken outside Commonwealth land and has, will have or is likely to have a significant impact on the environment of Commonwealth land; or
- Is undertaken by the Commonwealth and has, will have or is likely to have a significant impact on the environment.

A significant impact under the EPBC Act is 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. Matters of national environmental significance (MNES) include:

- World heritage properties;
- National heritage places;
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed);
- 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.

It is generally the responsibility of the proponent (or the land owner if owned by the Commonwealth) of a proposed action to determine whether the Project, or action, has the potential to impact upon a MNES and constitute the need for a referral to the Commonwealth for determination. An action that is referred for consideration by the Australian Minister for the Environment and Energy cannot be undertaken until the outcome of the referral process is completed - either through the decision of the Minister that the action is not a controlled action or that the assessment and approval process has been completed.

Given the limited disturbance and short-term nature of the project, significant impacts to MNES are considered unlikely and a Referral is not proposed. The need for a referral would be confirmed as part of the EIS.

6. Stakeholder Engagement

Origin seeks to establish and maintain open and effective communication and relationships with the community of Shoalhaven and all impacted stakeholders. Origin's community engagement approach is based on meeting community expectations and being open and transparent about their operations in line with their values.

6.1 Stakeholder identification and approach

Origin has identified a wide range of agency and private stakeholders that are expected to have an interest in or be impacted by the Shoalhaven Hydro Expansion Project. Following the announcement of the Shoalhaven Hydro Expansion Project as Critical State Significant Infrastructure, Origin has commenced the process of consulting with these identified stakeholders.

As the geotechnical investigations are of a minor nature, only a small sub-set of the identified stakeholders will be affected. These stakeholders include:

- Water NSW as the owner of all land directly impacted by the Geotechnical investigations;
- National Parks and Wildlife as the owner of the access tracks to locations 1 and 2; and
- Immediately surrounding rural properties with potential to experience minor increased noise and traffic impacts.

Origin will proactively inform stakeholders ahead of any work associated with the Geotechnical investigations and Shoalhaven Hydro Expansion Project. Communication will provide stakeholders with information on the feasibility study, project stages, potential impacts and steps taken to mitigate impacts.

6.2 Consultation to date

Origin publicly announced its plan for the project on 29 October 2018 and established a project specific website available at:

<https://www.originenergy.com.au/about/who-we-are/what-we-do/generation/shoalhaven-proposed-expansion.html>

The website provides options for stakeholders to seek further information and connect with the project. To date no issues of relevance to the Geotechnical investigations have been raised.

Following the announcement of the project and declaration of the project as CSSI, Origin has commenced proactive consultation with directly affected stakeholders. A record of consultation to date is provided in Table 6.1.

Table 6.1: Consultation summary

Stakeholder	Consultation
Water NSW	Origin has an existing relationship with Water NSW through the shared ownership of the existing scheme. Origin has been consulting with Water NSW on a continuous basis since plans for the Expansion Project first emerged. Consultation has included establishment of access agreements and the process of gaining Water NSW support for the Shoalhaven Hydro Expansion Project. Consultation will continue firstly to secure Water NSW landowner agreement for the geotechnical investigations, environmental management requirements, and ultimately will address the security of tenure for the Shoalhaven Hydro Expansion Project. To date, Water NSW requirements have focussed on safe and environmentally protective measures for access to their landholding.

Stakeholder	Consultation
National Parks and Wildlife Services	Origin has agreed formal access arrangements for the use of existing access track through the Morton National Park. Origin will continue to consult with National Parks and Wildlife Services. As the geotechnical investigations do not involve works other than access through the National Park, not concerns are anticipated.
Surrounding landowners	Origin has recently commenced the process of contacting adjacent landowners. This consultation will be continued in relation to the Geotechnical Locations and broader Shoalhaven Hydro Expansion Project.

6.3 Ongoing consultation

Following the lodgement of the application and request for SEARs, Origin consultation is expected to include ongoing consultation with neighbours and directly affected landowners. The ongoing consultation will be considered during the detailed assessment of the Geotechnical investigations and outcomes of consultation will be included in the EIS. The EIS would then be publicly displayed and the opportunity for stakeholder submissions will be available which would be considered in a response to submissions report, including description of how submissions have been addressed.

6.4 Aboriginal stakeholder consultation

As the Geotechnical Investigation locations have been confined to areas of low risk or previously disturbed landforms, consultation with Aboriginal stakeholders is proposed to be limited. Consultation with the Local Aboriginal Land Council to validate low risk locations is proposed.

For the Shoalhaven Hydro Expansion Project, Aboriginal Community consultation will be undertaken in accordance with the *Aboriginal cultural heritage consultation requirements for Proponents (DECCW 2010)*. This consultation has commenced and will include advertisement of invitation for Aboriginal people and Aboriginal groups, who hold cultural knowledge relevant to determining the significance of Aboriginal objects and places in the project area to register an interest in a process of community consultation. Written correspondence with relevant agencies requesting names and contact details of Aboriginal people who may hold cultural knowledge relevant to determining the significance of relevant Aboriginal objects and/or places has also commenced.

7. Consideration of Environmental Impacts

7.1 Issue Identification and screening

The likely environmental consequences of the Geotechnical investigations has involved:

- Desktop review of relevant databases, historical aerial photography, reports associated with the existing scheme and available background data;
- Review of Department of Planning and Environment Codes of Practice for exploration works Environmental specialist site walkover; and
- Outcomes of stakeholder consultation to date.

All aspects of the environment potentially impacted by the proposal are considered in Table 7-1. Table 7-1 outlines the environmental aspects relevant to the proposal and identifies the environmental issues that require further assessment and management.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

Table 7-1 Identification of key issues

Environmental aspect	Summary of existing environment	Potential risks	Further assessment required?
Biodiversity	<p>Threatened Species which have the potential to occur within the study area are collected from searches across the following databases.</p> <p>NSW OEH Threatened Species Records: The NSW Office of Environment and Heritage records provides information on species which have been sighted within a 10km radius of the area. The search returned 28 threatened species records - 23 fauna and five flora.</p> <p>EPBC PMST Potential Threatened Species: The EPBC Protected Matters Search Tool lists federally listed threatened and endangered species which may occur in the area, or species whose preferred habitat may occur in the area. The search returned 48 potential threatened species, including 8 birds, 5 frogs and reptiles, 9 mammals, 3 fish/crustaceans, and 23 plants;</p> <p>BAM Calculator Predicted Species: The Biodiversity Assessment Method (BAM) Calculator is used to predict potentially occurring threatened species based on the mapped Plant Community Types (PCTs) identified above. These can later be used for calculating ecosystem and species credits if the area is being assessed using the BAM.</p> <p>Two Endangered Ecological Communities (EECs) have been mapped in proximity to the Geotechnical Investigation Locations.</p>	<p>The main risks to biodiversity would be:</p> <ul style="list-style-type: none"> • Vegetation disturbance, comprising disturbance of groundcover, driving over shrubs and bushes and trimming or lopping of tree branches to obtain access to investigation locations • The potential for the proposal to spread weeds including noxious weed species • Disturbance of fauna habitat including logs, wood debris and groundcover • Indirect impacts to terrestrial and aquatic habitats as a result of impacts to water quality. 	Yes, refer to section 7.3 for further details.
Aboriginal heritage	No previously identified Aboriginal sites are located within the disturbance area of the Geotechnical	The main risks to Aboriginal heritage would be disturbance of or harm to	Yes, refer to Section 7.2

Environmental aspect	Summary of existing environment	Potential risks	Further assessment required?
	investigations. A due diligence assessment has commenced and led to the locating of Geotechnical investigations in low risk or previously disturbed land.	previously unidentified Aboriginal heritage artefacts from ground disturbing activities.	for further details.
Land and water	<p>The Geotechnical investigations are located within the Sydney Drinking Water Catchment and some locations are within the Shoalhaven Special Area.</p> <p>The geology of the study area is varied across distance and depth. The surface geology of the lower valley in the southern extent of the study area is comprised of the Broughton formation, while the elevated plateau is chiefly comprised of the Hawkesbury Sandstone formation. The Broughton formation is largely characterised as sandstone, siltstone and mudstone, and was deposited in the Permian Period (252 to 299 million years old) (Geoscience Australia, 2018). The Hawkesbury Sandstone formation is characterised as quartz-lithic to quartz-rich sandstone with conglomerate, mudstone and siltstone, and was deposited in the Triassic Period (201 to 252 million years old) (Geoscience Australia, 2018). Table 7.1 provides further details about the underlying geological units within the study area.</p> <p>A number of geological units within the study area have potential for generating acid rock. These include the Snapper Point Formation, Wandrawandian Siltstone and Berry Siltstone.</p> <p>Soil profiles taken from the elevated plateau near the Kangaroo Pipeline indicated moist, yellowish brown soils with a loamy sand to sandy loam texture (OEH, 2018). Soil profiles measured on the slope near Bendeela Road indicated moist, black soils with a sandy loam texture (OEH, 2018).</p>	<p>The main risks to Land and water would include:</p> <ul style="list-style-type: none"> Increased soil erosion due to ground disturbing activities such as geotechnical investigations, vehicle access and vegetation removal Mixing groundwater units during drilling Contaminating groundwater and surface water with contaminated materials or accidental spills Mobilisation of sediments into receiving environments Release of contaminated or sediment-laden drilling or wash down water Release of contaminants into the environment. 	Yes, an assessment of the potential for impacts to land and water resources would be included as part of the EIS including consideration of neutral or beneficial water quality outcomes.
Noise and vibration	<p>Locations 3, 4 and 5 are located near several private residences with the nearest being approximately 200 metres to the North of Location 3. The ambient noise environment of the study area is defined by natural elements and limited human activity, therefore the surrounding area has the potential to be exposed to noise impacts.</p> <p>With the exception of locations 3, 4 and 5, the geotechnical investigations would occur at substantial distance from private receptors.</p>	The main impacts associated with noise and vibration would include short term noise impacts during working hours from geotechnical investigations.	Yes, a noise impact assessment would be undertaken as part of the EIS.
Fire	Shoalhaven typically experiences mild temperatures with bush fire season generally occurring between September and March each year. Prevailing weather conditions associated with the bush fire season in the Shoalhaven area are north-westerly winds accompanied by high daytime temperatures and low relative humidity. There are also frequently dry lightning storms occurring during bush fire season (Shoalhaven BFMC, 1997).	With the implementation of standard mitigation measures for hot works and refuelling, the geotechnical investigations are not considered to significantly increase bushfire risks. Water NSW closes access to lands during periods of elevated bush fire risk. The	No

Environmental aspect	Summary of existing environment	Potential risks	Further assessment required?
	<p>The Shoalhaven Bush Fire Risk Management Plan (BFRMP) (1997) indicated an average of 600 bush fires per year, of which approximately 20 fires were considered to be 'major', requiring response by two or more fire authorities. The main sources of ignition in the Shoalhaven BFMC area included arson, accidental ignitions and lightning.</p> <p>The Geotechnical Investigation locations are surrounded by dry, densely vegetated bush land of the Morton National Park and vegetated lands closer to Lake Yurranga. As such the project area is considered to be a fire-prone location.</p>	Geotechnical investigations would comply with these closures.	
Traffic and transport	<p>Moss Vale Road is the main road that will be used to access both the upper and lower portions of the study area. Moss Vale Road links Nowra to the Southern Highlands via Kangaroo Valley. The road features narrow and steep mountain passes through Barrengarry and Cambewarra and is an important route within the southern region, providing access for freight, tourism and local traffic (RMS, 2018). The most recent traffic survey for Moss Vale Road was in 2007 by Roads & Maritime Services (RMS, 2007). Traffic counts for Moss Vale Road near Kangaroo Valley (150m north of Jenanter Drive) recorded an average daily traffic count of 1,552 for north-bound traffic and 1,591 for south-bound traffic. Of these, 94 per cent were light vehicles and six per cent were heavy vehicles.</p>	Plant and equipment would arrive in the vicinity of the geotechnical investigation locations and remain in the area for the duration of works. Subject to Water NSW and security requirements, vehicles may mobilise daily to each location with support vehicles entering and exiting works areas as required. A noticeable increase in traffic would not be expected as a result of the proposal in the local area.	No
Landscape character and visual amenity	<p>The surrounding area includes locations that are considered to have high scenic value, particularly within the Morton National Park.</p> <p>The area is characterised by a diverse range of landscape character types including woodland, pasture, arable land, floodplain, ridgelines and foothills. The visual setting of the proposal area is influenced by the existing scheme.</p>	The proposal would not impact on the landscape character of the proposal area. Visual impacts would be minor, short term in nature and limited to the immediate vicinity of geotechnical investigation activities.	No
Land use and property	<p>The geotechnical investigations are located within the Shoalhaven Local Government Area (LGA). The surrounding region is comprised of multiple land zones, these include:</p> <ul style="list-style-type: none"> • SP2 Infrastructure (Water Supply System); • RU2 Rural Landscape; • E1 National Parks and Nature Reserves; and • E2 Environmental Conservation. <p>The Geotechnical investigations are limited to land zoned SP2 Infrastructure.</p> <p>The closest communities and townships in the vicinity of the lower study area are Barrengarry and Kangaroo Valley. These townships are located approximately 5.8 kilometres and 6 kilometres away from the closest point of the project footprint, respectively.</p>	The proposal would not result in any permanent changes to land use, or impact on private property.	No

Environmental aspect	Summary of existing environment	Potential risks	Further assessment required?
	The closest townships to the upper portion of the study area is Fitzroy Falls, approximately 4.8 kilometres, from the access point.		
Socio-economic	The proposal area comprises a mix of land uses including residential, agriculture and conservation. The study also contains a number of features likely to be important to local and regional communities, including Lake Yarrunga and associated Water NSW camp ground and recreation area.	Potential socio-economic impacts associated with the proposal relate to noise, traffic and interruption with agricultural or recreational activities. These impacts would be temporary and localised, and can be adequately managed with standard safeguards and management measures.	No
Non-Aboriginal heritage	Searches of the historical databases identified 26 heritage items within the locality. None are in proximity to the Geotechnical Investigation locations.	Nil	No
Air quality	Existing sources of air pollution within the local setting are limited, consisting primarily of dust and vehicle/machinery exhaust emissions associated with transport along Moss Vale Road. The region surrounding the site is sparsely populated, with most of the land comprised of rural residential properties, agricultural land and the Morton National Park.	All impacts would be short term and highly localised. The area of disturbance associated with each investigation location would be relatively small. As a result, it is considered unlikely that the proposal would result in noticeable impacts provided that standard safeguards and management measures are implemented.	No
Contamination and Waste	<p>A search of the list of NSW contaminated sites notified to the EPA for Shoalhaven City Council LGA identified that there are no sites near Kangaroo Valley or close to the study area.</p> <p>A search of the public contaminated land record of notices database was undertaken and revealed that two sites within the Shoalhaven City LGA are currently or have been formerly regulated under the <i>Contaminated Land Management Act 1997</i> (CLM Act).</p> <p>Based on understanding of local geology there is low risk of encountering geological units with naturally occurring asbestos within the study area.</p> <p>The Geotechnical Investigation locations are in close proximity to the existing scheme and in areas previously cleared and used for agricultural purposes. The existing scheme involved the placement of spoil. Historic farming practices may have included disposal of waste to land.</p>	The proposal would generate a range of waste streams including drilling fluids, excess drill cuttings, green waste and general waste. Quantities of waste generated by the proposal would not be expected to be large. As a result it is considered unlikely that the proposal would result in waste impacts provided that standard safeguards and management measures are implemented.	No

7.2 Aboriginal Cultural Heritage

This preliminary Aboriginal cultural heritage assessment has been provided with reference to the Due Diligence of Practice Code of Practice for the Protection of Aboriginal Objects in NSW published by the Office of Environment & Heritage (OEH).

The preparation of current heritage and spatial data relating to the geotechnical investigation locations has included:

- A search and review of the relevant Aboriginal heritage register - the Aboriginal Heritage Information Management System (AHIMS);
- A review of available ethnographic and historical literature, including local and regional Aboriginal land use information, relevant to the project area;
- A review of the current and historical land use practices, including a review of a series of historical aerial photographs;
- Data from the Australian Heritage Database; and
- GIS and spatial data generation

A targeted preliminary site inspection of each proposed borehole location was undertaken on 3 – 4 December 2018.

7.2.1 Existing environment

Much of the area of the proposed Shoalhaven Hydro Expansion Project has been previously disturbed during construction of the existing scheme. This includes four of the eight geotechnical investigation locations.

An extensive AHIMS search was undertaken on 13 September 2018 using a 'shapefile' search of the Project area. No registered Aboriginal heritage sites were identified within the project study area. It is recognised that the AHIMS database identifies only officially recorded Aboriginal sites and therefore does not necessarily represent a complete recording of Aboriginal sites within the area.

To contextualize the broader archaeological character of the area another search was undertaken on 17 September 2018 using the 'map feature' with a search buffer of 200m. The AHIMS search identified 15 sites surrounding area as illustrated in Figure 7.1 and described in Table 7.2.

The nearest AHIMS site is an artefact scatter over 2 km to the west of the geotechnical investigation locations.

Table 7.3 provides summaries of archaeological reports that contextualize the broader Aboriginal heritage themes of the project locality.

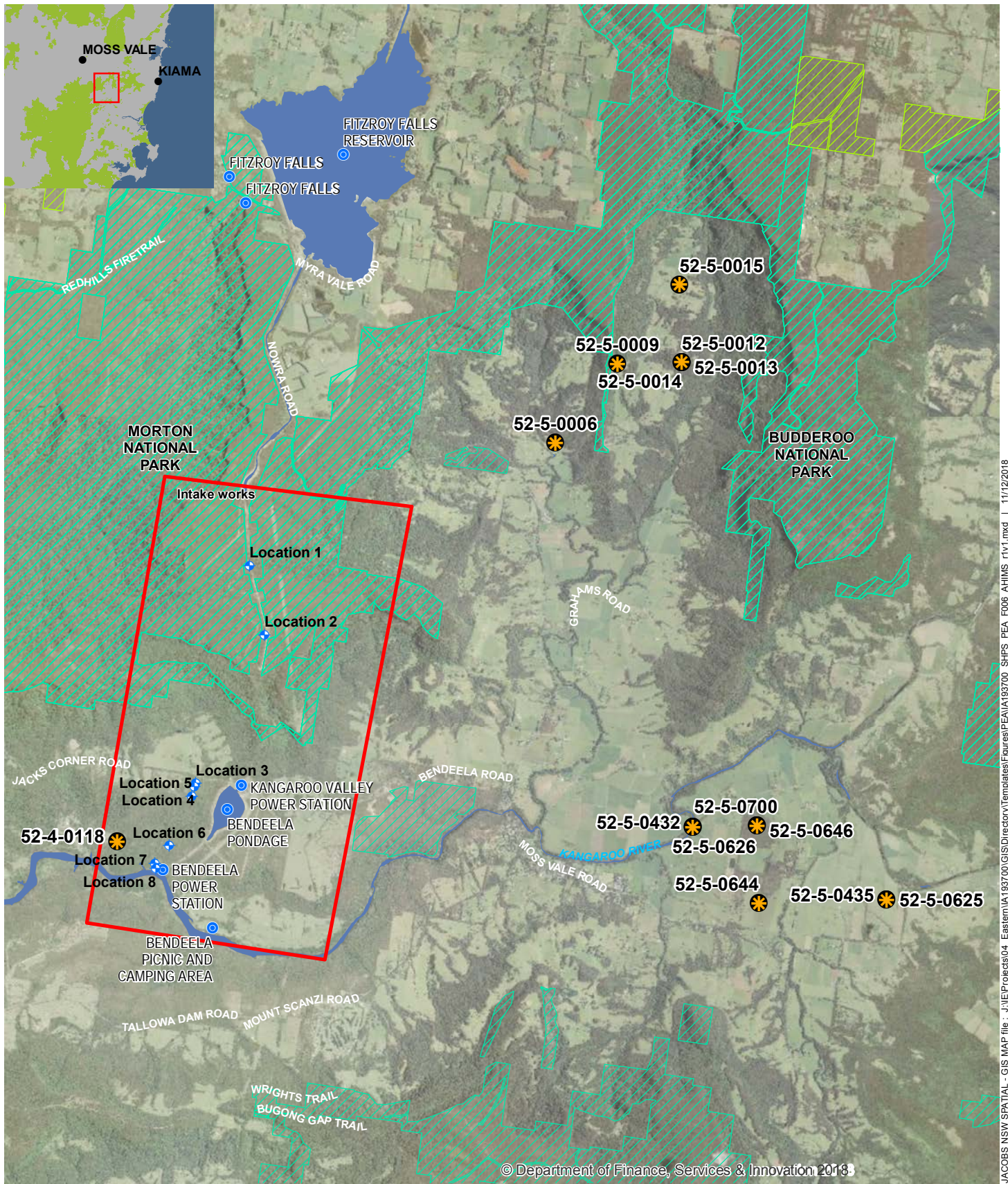


Figure 7.1 | Registered Aboriginal sites (AHIMS) within 200m the project area

Data sources
 DFSI - Spatial Services
 AHIMS OEH NSW 2018
 Jacobs 2018

Table 7.2 : AHIMS sites within 200 m of the Project Study Area

AHIMS ID	Site name	Eastings	Northings	Site features	Site type
52-5-0006	Barrengarry;	273259	6159554	Grinding Groove	Axe Grinding Groove
52-5-0009	Bunkers Hill;	274786	6160957	Grinding Groove	Axe Grinding Groove
52-5-0013	Bunkers Hill;	275057	6161145	Grinding Groove	Axe Grinding Groove
52-5-0014	Bunkers Hill;	275057	6161145	Grinding Groove	Axe Grinding Groove
52-5-0015	Bunkers Hill;	275136	6161787	Grinding Groove	Axe Grinding Groove
52-4-0118	Lake Yarrunga 4	266927	6153640	Artefact (1)	Artefact Scatter
52-5-0435	KVAS 1	277897	6153130	Artefact (11)	Artefact Scatter
52-5-0432	Kangaroo Valley 1	275966	6154118	Artefact (2) / Potential Archaeological Deposit (PAD)	Artefact Scatter
52-5-0012	Barrengarry;	275057	6161145	Grinding Groove	Axe Grinding Groove
52-5-0625	Kangaroo Valley Artefact Scatter Duplicate copy of 52-5-0435	277897	6153130	Artefact (11)	Artefact Scatter
52-5-0626	Kangaroo Valley Isolated Find 1 (Duplicate copy of 52-5-0432)	275964	6153930	Artefact (1)	Artefact Scatter
52-5-0644	Kangaroo Valley PAD 1	276350	6153400	Artefact (12) / PAD	Artefact Scatter
52-5-0645	Kangaroo Valley 2	276119	6153913	Artefact (14) / PAD	Artefact Scatter
52-5-0646	Kangaroo Valley 3	276309	6153716	Artefact (1) / PAD	Artefact Scatter
52-5-0700	KVSS Artefact Repatriation	276275	6154244	Artefact (41)	Artefact Scatter

Table 7.3 : Previous Aboriginal archaeological studies within or surrounding the project area

Author	Summary
Artefact Heritage (2018)	<p>Artefact Heritage to undertake and Aboriginal Cultural Assessment Report as part of the proposal to construct a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra in accordance with Roads and Maritime Stage 3 Procedure for Aboriginal Cultural Heritage Consultation and Investigation. The survey conducted as part of this assessment identified five Aboriginal sites and five areas of Potential Aboriginal Deposits. These included:</p> <p>Nowra Bridge 1 (AHIMS ID 52-5-0852)</p> <p>Nowra Bridge 2 (AHIMS ID 52-5-0853)</p> <p>Nowra Bridge 3 (AHIMS ID 52-5-0855)</p> <p>Nowra Bridge 4 (AHIMS ID 52-5-0857)</p> <p>Nowra Bridge 5 (AHIMS ID 52-5-0856)</p> <p>Nowra Bridge PAD 1 (AHIMS ID 52-5-0859)</p> <p>Nowra Bridge PAD 2 (AHIMS ID 52-5-0860)</p> <p>Nowra Bridge PAD 3 Cliff & Rock shelter Complex (AHIMS ID 52-5-0861)</p> <p>Nowra Bridge PAD 4 (AHIMS ID 52-5-0858)</p> <p>Nowra Bridge PAD 5 (AHIMS ID 52-5-0854).</p> <p>Test excavation identified five new Aboriginal archaeological sites:</p> <p>Nowra Bridge 6 (AHIMS ID 52-5-0872)</p> <p>Nowra Bridge 7 (AHIMS ID 52-5-0875)</p> <p>Nowra Bridge 8 (AHIMS ID 52-5-0876)</p> <p>Nowra Bridge 9 (AHIMS ID 52-5-0874)</p> <p>Nowra Bridge 10 (AHIMS ID 52-5-0873)</p> <p>And led to the deregistration of 52-5-0855, 52-5-0859 and 52-5-0860.</p>

Author	Summary
	These included artefact scatters, scarred trees, sub-surface deposit and grinding grooves. Artefact scatters were generally associated with alluvial floodplains and included hammerstones and microliths made from a variety of different raw materials including glass.
Kuskie (2008)	Manildra Group engaged South East Archaeology to undertake an Aboriginal Heritage Impact Assessment of the proposed ethanol plant upgrade at Shoalhaven Starches. The survey undertaken a part of this assessment included an area of 4160m ² of the river levee on the western side of the factory and 2240m ² on the levee on the eastern side of the factory. Posited to be related to the extent of recent land use impacts of the area no Aboriginal heritage evidence was identified in the study area for this project. Those artefacts previously identified within the area we deemed to be unlikely to reflect archaeological potential because of the disturbance already related to the study area.
Clarke and Kuskie (2006)	This report composed the fourth stage of the Lower Shoalhaven River Valley Aboriginal Heritage and Cultural Mapping Project for DECC. The spatial model, developed by Clarke and Kuskie (2006) was used to predict Aboriginal site occurrence using key environmental variables. Extrapolated from the research of Boot (2002), Clark and Kuskie's model identified two main resource zones within the Shoalhaven region; primary resource zones and secondary resource zones. Primary zones were defined as areas close to major river (e.g. Shoalhaven and Crookhaven) and predicted to have higher probability of archaeological evidence of continued occupation related to gathering, camping and congregational use of these areas. Secondary resource zones were defined as land close to higher order creek and associated flats, terraces and slopes and evidence of sporadic occupation for nuclear family camps and hunting parties. Their predictions based on this model suggested: artefact scatters were the most likely site type within the Project area. Grinding grooves and rock shelters may also occur. Rock shelters are likely to occur in steep drainage depressions or spur crest units or sloping terrain. Grinding grooves are likely to occur on homogenous stone outcrops such as sandstone close to water sources.

7.2.2 Predictive modelling

Based on the search of the AHIMS and Australian Heritage database and review of previous archaeological reports pertaining to the broader project locality, the following site types, characteristics and potential location of Aboriginal places within the project area are identified:

- Artefact scatters, grinding grooves, PADS, scarred trees and rock shelters are likely to be associated with primary resources zones along major rivers and also evident along higher order creek flats, slopes and terraces;
- Grinding grooves and rock shelters are a likely site type. Rock shelters are likely to occur in steep drainage depressions or spur crest units or sloping terrain. Grinding grooves are likely to occur on homogenous stone outcrops such as sandstone close to water sources;
- Artefacts scatters and isolated artefacts are a likely site type. These are likely to be located along alluvial floodplains and are likely to include surface and subsurface deposits;
- PADs are a likely site type. Surface scatters may indicate potential for sub-surface deposit; and
- Scarred trees are a less likely site type. These are less abundant and are likely to occur on mature vegetation and in the vicinity of or in association with other cultural and archaeological material.

Although no registered AHIMS sites were identified within the project footprint, the continuous flooding and largely undeveloped landscape does indicate potential for previously unidentified archaeological remains. Moreover, the cultural heritage values of the Shoalhaven river and its immediate environment encompass a cultural significant landscape underpinned by sporadic tangible remains and intangible social and cultural associations to the landscape (Moody *et al.* 2006).

Fifteen Aboriginal heritage sites were identified within the surrounding area. None of the registered Aboriginal sites intersect with the geotechnical investigations or wider Shoalhaven Hydro Expansion Project indicative footprint. However, the alluvial context of the area through flooding does indicate potential for Aboriginal heritage artefacts to be identified within the area.

Aboriginal objects are often associated with particular landscape features. As per the Due Diligence Code of Practice, consideration of likelihood of Aboriginal objects with regard to association of landscape features “if your proposed activity is within 200m of waters and is not on disturbed land” and disturbance cannot be avoided you must undertake a desktop assessment and visual inspection. A number of watercourses are directly adjacent to geotechnical investigation locations. Consultation with local Aboriginal community groups identified Shoalhaven River as a ‘defining element of country’. The River is described to demonstrate social, linguistic, place stories, daily practices and beliefs affiliations. The river was also a primary subsistence source to Aboriginal people of the area (Moody et al. 2006).

An extensive history of disturbance associated with vegetation clearing for agricultural purposes and the construction of the original scheme is documented in the area surrounding geotechnical investigations. Nevertheless, there is potential for the works to disturb unidentified Aboriginal sites through ground disturbance and vegetation clearance in previously undisturbed, or limited disturbance, areas associated with geotechnical investigations.

7.2.3 Site inspection

The aim of the site inspection was to visit all areas where access was possible and where impacts are proposed associated with the geotechnical investigations to identify whether or not Aboriginal objects are, or are likely to be, present, and whether or not the proposal is likely to harm Aboriginal objects. The sites inspection had the following objectives:

- Inspect areas of higher visibility and soil exposures;
- Inspect elevated areas near waterways, water bodies and creek lines;
- Inspect all rock shelters within the Project area; and
- Inspect all mature trees in the Project area for cultural modification or scarring.

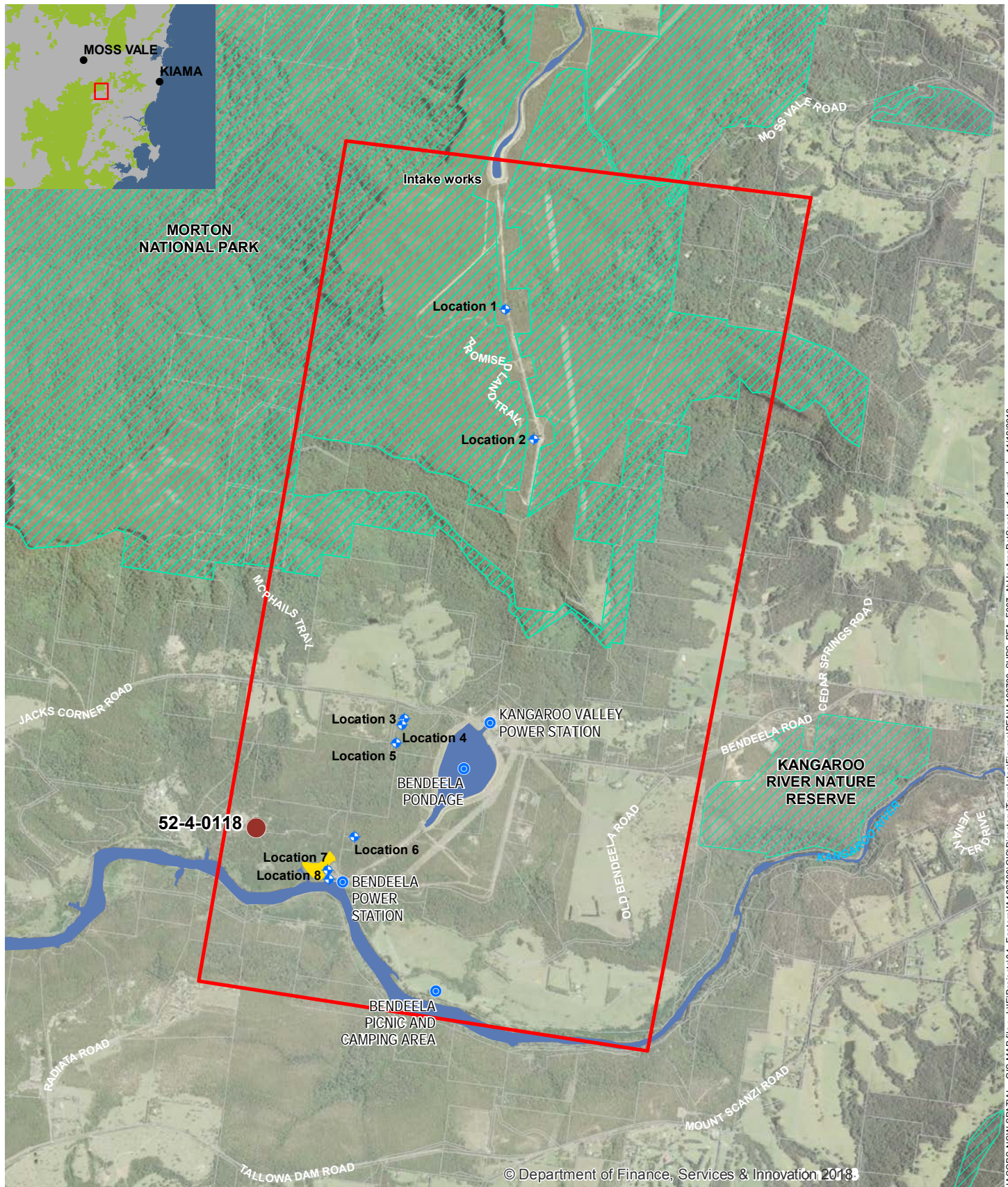
The preliminary site inspection was undertaken in accordance with the due diligence code of practice from 3 - 4 December 2018. Andrew Costello (Senior Archaeologist, Jacobs) undertook the inspection with Thomas Muddle, Jorja Vernon, Mike Luger and Ajay Arcot (Environmental Services, Jacobs), and Tony Schinkel (Origin). Details of conditions were recorded using a field notebook and differential GPS. Photos were taken with a digital camera. Information recorded during the inspection included:

- Landforms;
- Observable disturbance;
- Ground surface visibility (GSV);
- Areas of exposure; and
- Areas of potential archaeological sensitivity.

The Project area is characterised by steep hills, valleys, ridgelines and flat alluvial terraces. Some areas of alluvial deposits are found adjacent to waterways, particularly near Tallowa Dam (Lake Yarrunga). The vegetation comprises fairly dense stands of native trees. Much of the Project area has been heavily disturbed. As expected in such conditions, there are unlikely to be many visible Aboriginal objects, and what traces of past Aboriginal behaviour remain are largely obscured by the heavy vegetation and resultant low GSV. In forested areas, visibility was low and the terrain included some ephemeral and highly eroded drainage lines.

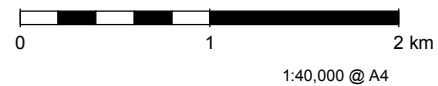
The preliminary site inspection confirmed that most of the geotechnical investigations occurs within significantly disturbed landforms, with extensive ground disturbance from the original pipeline and project construction. There were no Aboriginal objects or sites identified during the inspection. One area of moderate archaeological sensitivity was recorded near the intake site adjacent near Lake Yarrunga.

Aboriginal heritage sensitivity and constraints have been mapped and registered on the Project GIS system and are shown on Figure 7.2. For the purpose of this preliminary assessment, areas are ranked as having high, moderate or low risk as identified below in Table 7 4. The rankings are based on the likelihood of sub-surface Aboriginal objects being present in areas of proposed impact by the geotechnical investigations.



Legend

- Points of interest
- + Indicative Geotech Locations
- Study area
- Artefact scatter
- NPWS Reserve
- Potential archaeological sensitivity



Data sources

DFSI - Spatial Services
AHIMS OEH NSW 2018
Jacobs 2018

Figure 7.2 | Areas of potential archaeological sensitivity

Table 7 4: Summary of sensitivity for each bore hole location

Geotechnical investigation location	Location description	Landform	Sensitivity
Location 1	Concreted pipeline alinement adjacent to existing pipeline anchor block.	Bottom of steep valley – disturbed	Low
Location 2	Vertical shaft adjacent to existing surge tank	Top of ridgeline - disturbed	Low
Location 3	Powerhouse cavern	Mid slope spur - disturbed	Low
Location 4	Powerhouse cavern	Mid slope spur - disturbed	Low
Location 5	Access tunnel alignment	Mid slope spur - disturbed	Low
Location 6	Shaft access portal	Mid alluvial terrace	Low
Location 7	Tailrace tunnel drive portal	Low alluvial terrace	Moderate – bore location subsequently moved east into area of significant prior disturbance and current use associated with existing scheme.
L08	Yarrunga Intake	Low alluvial terrace	Moderate – bore location subsequently moved east into area of prior disturbance in cut for access to existing scheme intake.

The results of the preliminary site inspection determined that there are no areas of high sensitivity or risk.

The results of the preliminary site inspection determined that there is moderate risk designated to two proposed borehole locations

Following the site inspection, boreholes 7 and 8 were moved to the east into areas of prior disturbance. The remaining boreholes within the Project area are considered to have low sensitivity due to extensive ground disturbance as a result of construction of the original scheme.

Recommendations and risk mitigation

The following recommendations apply to the geotechnical investigations. Excavation or ground disturbing activities at areas of moderate archaeological sensitivity should not proceed until an archaeologist and Local Aboriginal Land Council representative have determined the activity will not impact Aboriginal objects. Table 7 5 lists the two recommended safeguards for risk mitigation. An unexpected finds protocol is described below.

Table 7 5: Risk mitigation safeguards

ID	Impact	Environmental safeguards	Responsibility	Timing
Rec1	Training/induction	Aboriginal heritage training/induction for geotechnical contractors.	Jacobs archaeologist and Local Aboriginal Land Council	Prior to work
Rec2	Unexpected finds	If any unexpected Aboriginal objects are found during the proposal, the Unexpected Finds Protocol outlined below will be implemented.	Jacobs and Geotech contractors	During work

Unexpected finds protocol

Aboriginal artefacts can occur in most locations, especially within sensitive landscapes, even if there has been no previously recorded site. An Aboriginal object is anything which is the result of past Aboriginal activity. This includes setone artefacts, rock engravings and culturally scarred trees. Human bone (skeletal) remains may also be uncovered while onsite.

Cultural heritage significance is assessed by the Aboriginal community and is typically based on traditional and contemporary lore, spiritual values, and oral history, and may also take into account scientific and educational value.

Protocol to be followed in the event that previously unrecorded or unanticipated Aboriginal object(s) are encountered:

- 1) All ground surface disturbance in the area of the finds should cease immediately and Jacobs site manager notified immediately.
- 2) If the find is suspected to be human skeletal material, Jacobs/ Origin to contact the NSW police as soon as possible.
- 3) If there is doubt regarding an Aboriginal origin for the finds, then gain a qualified opinion from a Jacobs archaeologist. This can circumvent proceeding further along the protocol for items which turn out not to be of cultural origins. If the identification is positive, then proceed to the next step.
- 4) Immediately notify the following authorities or personnel of the discovery:
 - a. OEH (Environment Line: 131 555); and
 - b. Relevant Aboriginal Community Representatives.
- 5) Facilitate, in co-operation with the appropriate authorities and relevant Aboriginal community representatives:
 - a. The recording and assessment of the finds;
 - b. Fulfilling any legal constraints arising from the find(s). This will include complying with OEH directions; and
 - c. The development and implementation of appropriate management strategies. Strategies will depend on consultation with stakeholders and the assessment of the significance of the find(s). Where the find(s) are determined to be Aboriginal Objects, any re-commencement of construction related ground surface disturbance may only resume in the area of the find(s) following the issuing of an Aboriginal Heritage Impact Permit (AHIP) from OEH.

7.3 Biodiversity

7.3.1 Existing environment

The majority of the proposed project footprint has been previously disturbed during the construction of existing scheme. However, a review of satellite imagery indicates considerable regeneration along the easement adjacent to existing scheme infrastructure and the surrounding locality is known to retain considerable biodiversity values including a number of threatened or endangered species and communities listed under State and Commonwealth legislation.

A background review of available online information was undertaken to identify the existing environment of the proposal within a search area of 10 kilometres. The review focussed on database searches, relevant ecological reports pertaining to the study area, property boundaries, and relevant GIS layers. The review was used to prepare a list of threatened species, populations and communities as well as important habitat for migratory species with a likelihood of occurrence in the study area and locality. The searches were also undertaken to identify if any Areas of Outstanding Biodiversity Value were present.

The following database searches were performed:

- BioNet - the website for the Atlas of NSW Wildlife and OEH Threatened Species Profile Database;
- The federal Department of Environment and Energy Protected Matters Search Tool;
- The Biodiversity Assessment Method (BAM) calculator predicted species function;
- NSW Department of Primary Industries freshwater threatened species distribution maps (DPI, 2016);
- OEH BioNet Vegetation Classification System database;
- The federal Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE);
- Department of Environment and Energy directory of important wetlands;
- Atlas of Living Australia;
- Register of Declared areas of Outstanding Biodiversity Value; and
- Key fish habitat maps (DPI 2007)

The searches did not reveal any Areas of Outstanding Biodiversity, or Wetlands of National Importance in the study area.

Existing vegetation mapping from the NSW OEH was used as a benchmark to provide information on potential threatened species or communities which may be located in the vicinity of the geotechnical investigations. This also provides approximate expectations for what plant species might be present.

Table 7.6 outlines the PCTs mapped within the study area, with Figure 7.3 illustrating approximate locations of each.

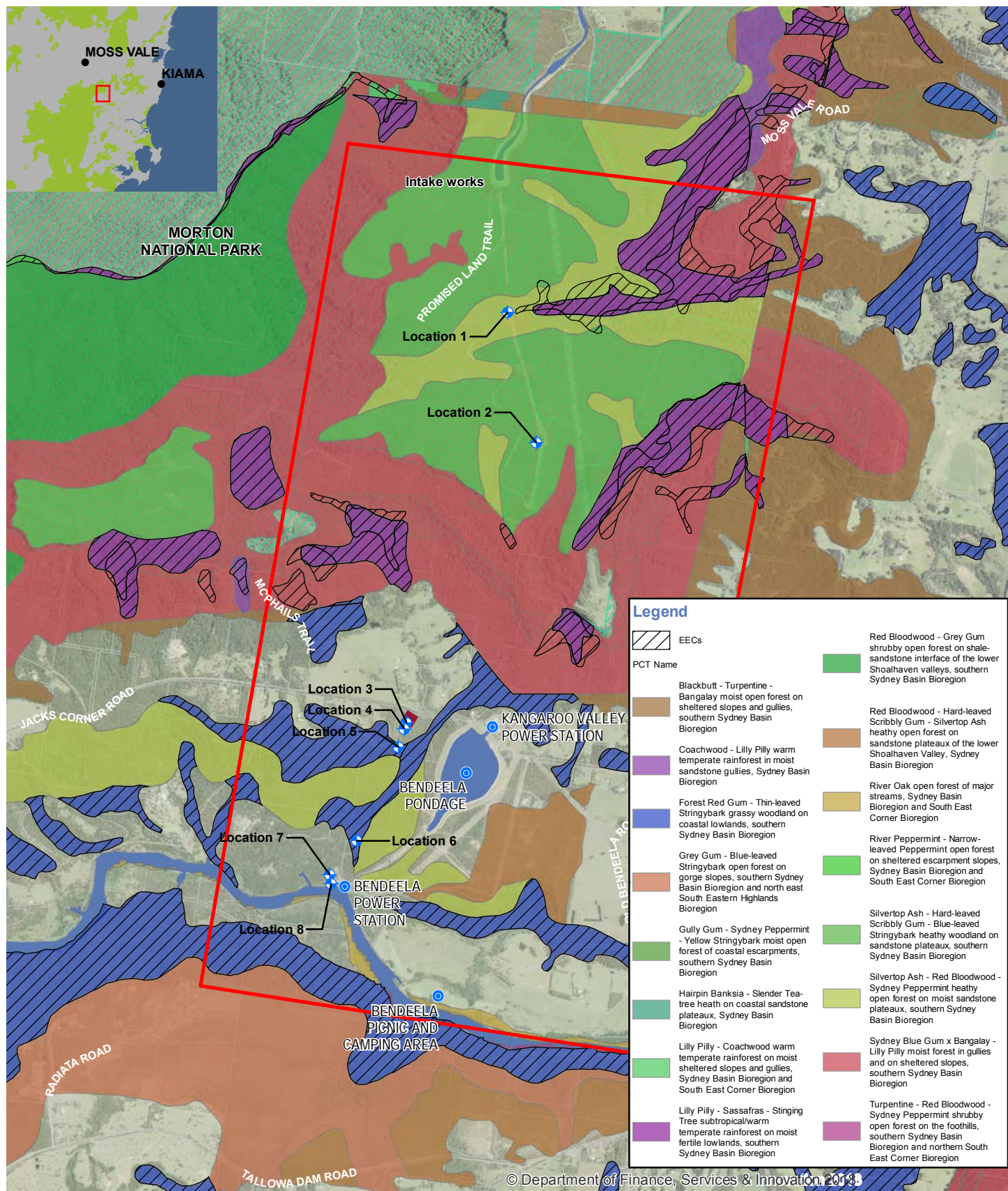
Table 7.6: Plant Community Types mapped as present within the area

PCT#	Community Name
1152	Silvertop Ash - Hard-leaved Scribbly Gum - Blue-leaved Stringybark heathy woodland on sandstone plateaux, southern Sydney Basin
1156	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin
906	Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin
1245	Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin
838	Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin
1105	River Oak open forest of major streams, Sydney Basin and South East Corner
1082	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

Table 7.7 identifies the two Endangered Ecological Communities (EECs) mapped within the study area, with locations of each illustrated in **Error! Reference source not found.**

Table 7.7: Endangered Ecological Communities within the study area

BC Act	EPBC	Community Name
E	CE	Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion
E	-	Illawarra Subtropical Rainforest in the Sydney Basin Bioregion



- Legend**
- Points of interest
 - Study area
 - NPWS Reserve
 - Indicative Geotech Locations

0 1 2 km
1:40,000 @ A4



Data sources
DFSI - Spatial Services
OEH NSW 2018
Jacobs 2018

Figure 7.3 | PCT and EEC Mapping

Threatened Species which have the potential to occur within the study area are collected from searches across the following databases.

- **NSW OEH Threatened Species Records:** The NSW Office of Environment and Heritage records provides information on species which have been sighted within a 10km radius of the area. The search returned 28 threatened species records - 23 fauna and five flora.
- **EPBC PMST Potential Threatened Species:** The EPBC Protected Matters Search Tool lists federally listed threatened and endangered species which may occur in the area, or species whose preferred habitat may occur in the area. The search returned 48 potential threatened species, including 8 birds, 5 frogs and reptiles, 9 mammals, 3 fish/crustaceans, and 23 plants; and
- **BAM Calculator Predicted Species:** The Biodiversity Assessment Method (BAM) Calculator is used to predict potentially occurring threatened species based on the mapped PCTs identified above. These can later be used for calculating ecosystem and species credits if the area is being assessed using the BAM. The BAM calculator predicted 38 ecosystem credit species (species which are assumed to be present based on the presence of their habitat), and 48 species credit species (which are species requiring survey).

Once the searches were complete, the compiled list of threatened flora, fauna, and ecological communities was assessed for their likelihood of occurrence (refer to Appendix A).

Likelihood of occurrence for each species identified in the desktop search was assigned based on knowledge of the species' preferred habitats and known distributions, contrasted against the assumed habitat in the study area. Verified sightings of threatened species were also used to determine a species' presence in the area.

The likelihood of Occurrence Table (Appendix A) summarises all potential threatened species which may occur at the site based on the above searches. The table indicates which search the species was listed in, as well as the species known range/habitat, and the deemed likelihood of occurrence at the site.

7.3.2 Issues for consideration

Part 7 of the Biodiversity Conservation Act 2016 (BC Act) requires that an application for State significant infrastructure approval under Division 5.2 of the EP&A Act be accompanied by a "biodiversity development assessment report unless" the Secretary of the Department of Planning and the Chief Executive of the Office of Environment and Heritage" determine that the proposed development is not likely to have any significant impact on biodiversity values". Preliminary consideration of the likelihood of significant impacts to biodiversity values is provided in Table 7 8.

The consideration of impacts to biodiversity values would be confirmed as part of the EIS.

Table 7 8: Consideration of potential impacts to biodiversity values

Biodiversity Value	Meaning	Relevant (P or NA)	Explain and Document potential impacts	
			Information required	Applicant to Complete
Vegetation abundance	Occurrence and abundance of vegetation at a particular site.	P	<p>Where vegetation is present on the development site, provide a map on digital aerial photography or the best available imagery of the development site showing:</p> <ul style="list-style-type: none"> native vegetation (including grasslands and other non-woody vegetation types) and non-native vegetation, and the area of land that is directly impacted by the proposed development, including related infrastructure such as roads, pipelines, access tracks, temporary material stockpiles, asset protection zones and powerlines, if applicable. <p>Describe how the proposed development avoids impacts on native vegetation and identify the likelihood and extent of any remaining impacts including removal of isolated or cultivated native plants.</p>	<p>The proposed geotechnical investigation Locations and associated access routes have been located wherever possible to avoid areas of intact native vegetation. Some areas of native vegetation are however found in or in close proximity to the proposed sites and access routes. Native vegetation includes the following plant community types and associated threatened ecological communities:</p> <ul style="list-style-type: none"> Silvertop Ash - Hard-leaved Scribbly Gum - Blue-leaved Stringybark heathy woodland on sandstone plateaux, southern Sydney Basin (PCT 1152). Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin (PCT1156) Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin (PCT838); consistent with <i>Illawarra lowlands grassy woodland in the Sydney Basin Bioregion</i> - endangered ecological community listed under BC Act. <p>The area of ground/vegetation disturbance at each location will be approximately 400 m² (20 m x 20 m). Temporary access tracks through areas of vegetation will be approximately 3 m width and variable length will be required for the bore holes. Removal of woody vegetation comprising shrubs, saplings, low-hanging branches and woody debris would need to be undertaken in some of these areas to facilitate access but no earthworks would be required.</p> <p>Location 1 is within an area completely devoid of vegetation within a previously concreted section of the pipeline easement. Access to location 1 is via existing cleared access tracks. No impact on native vegetation is required associated with either access or establishment of geotechnical investigations at Location 1.</p> <p>Location 2 is at the edge of a maturing regrowth patch of PCT 1152 and an adjacent cleared and maintained area associated with existing surface pipeline and surge tank. The vegetation is in moderate condition. The access to Location 2 would be via an existing vehicle path adjacent to the pipeline. No clearing of vegetation is expected to be required for the access or establishment of Location 2. Minor pruning of overhanging trees and shrubs may be required. This amount of clearing is unlikely to significantly affect the extent of the plant community in the locality.</p>

Biodiversity Value	Meaning	Relevant (P or NA)	Explain and Document potential impacts	
			Information required	Applicant to Complete
				<p>Location 3 is situated approximately 110 metres south of Jacks Corner Road within a regrowth area of PCT 838 in moderate condition. Access to Location 3 would be from the roadway and require establishment of an access track approximately 150 metres in length and 3 metres in width. Approximately 400 m² of vegetation may be cleared at Location 3 to establish a temporary geotechnical investigation works area. This amount of clearing is unlikely to significantly affect the extent of the plant community in the locality.</p> <p>Location 4 and its access route are located in a regrowth area of PCT 838, likely to be in moderate condition. Access to Location 4 would be via a 50 metre extension of the access track from Location 3. Approximately 400 m² of vegetation may be cleared at Location 4 to establish a temporary geotechnical investigation works area. This amount of clearing is unlikely to significantly affect the extent of the plant community in the locality.</p> <p>Location 5 and its access route and are in an area mapped as PCT 838 and <i>Illawarra lowlands grassy woodland in the Sydney Basin Bioregion</i> - endangered ecological community. This area has not been visited by an ecologist but based on its location it is assumed to be in good condition. Access to location 5 would be via a 150 metre extension to the access track to Location 4. Approximately 400 m² of vegetation may be cleared at Location 5 to establish a temporary geotechnical investigation works area. This amount of clearing is unlikely to significantly affect the extent of the plant community in the locality.</p> <p>Location 6 and its access route are located in an area of PCT 838, in moderate condition. Approximately 400 m² of vegetation may be cleared at Location 6 to establish a temporary geotechnical investigation works area. Removal of shrubs and minor pruning of overhanging trees may be required over a length of around 175 metres and 3 metres in width to provide access. This amount of clearing is unlikely to significantly affect the extent of the plant community in the locality.</p> <p>Locations 7 and 8 are situated within an area of prior disturbance associated with the existing scheme. No clearing of vegetation is required for the establishment of works areas or access to these locations.</p> <p>The geotechnical investigation works areas and access paths are unlikely to have a significant impact on vegetation abundance either individually or cumulatively.</p>

Biodiversity Value	Meaning	Relevant (P or NA)	Explain and Document potential impacts	
			Information required	Applicant to Complete
Vegetation integrity	Degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state	P	Describe any impacts on the vegetation integrity of identified plant communities.	<p>No impacts to vegetation integrity are required at Locations 1, 2, 7 or 8 as these locations are within cleared and disturbed locations and do not require clearing for either the establishment of works areas or access.</p> <p>The establishment of access for locations 3, 4, 5 and 6 would require the clearing to ground level of approximately 500 metres of access tracks, approximately 3 metres wide within areas mapped as PCT 838. The establishment of four works areas of approximately 400 m² (20 m x 20 m).</p> <p>The regrowth woodland vegetation at Locations 3 and 4, is already modified with reduced understorey diversity (<i>Acacia</i> dominated) and reduced canopy cover, exhibiting weed invasion and reduced native ground-layer diversity. The additional disturbance at these locations would reduce the vegetation integrity through the removal of some native shrubs and groundcover. These works would cause some disturbance, but the vegetation affected is unlikely to be significantly or permanently altered and is likely to return to a similar condition in the absence of ongoing disturbance.</p> <p>The vegetation at Locations 5 and 6 is in moderate to good condition and the works in these areas could impact vegetation integrity in the absence of restoration measures. The precise locations of access routes would be designed to avoid the removal or substantial damage of any mature trees, rock outcrops or very large woody debris. Following completion of Geotechnical Investigations the works areas and access tracks would be rehabilitated generally in accordance with the Department of Planning and Environment (2017b) Rehabilitation Code of Practice unless approved for subsequent clearing associated with the Shoalhaven Hydro Expansion Project.</p> <p>The bore hole sites and temporary access track will be surveyed by an ecologist to avoid or minimise any threatened trees and shrubs.</p> <p>Measures will also be put in place at all locations to prevent the introduction or spread of weeds and plant pathogens that could have an adverse effect on native vegetation integrity.</p> <p>With these measures in place, the works are unlikely to have a significant impact on vegetation integrity.</p>

Biodiversity Value	Meaning	Relevant (P or NA)	Explain and Document potential impacts	
			Information required	Applicant to Complete
Threatened species habitat	Degree to which the habitat needs of threatened species are present at a particular site	P	<p>Identify any threatened species or ecological communities or their habitat on the development site. In addition to native vegetation, habitat may include non-native vegetation, human made structures, rocks, karst, caves, crevices, cliffs and other geological features of significance.</p> <p>Describe how the proposed development avoids impacts on habitat suitability and identify the likelihood and extent of any remaining impacts including the removal or modification (e.g. noise, light etc.) of threatened species habitat or ecological communities.</p>	<p>Threatened ecological communities and species that may be affected by the geotechnical investigations include:</p> <ul style="list-style-type: none"> • Illawarra lowlands grassy woodland in the Sydney Basin Bioregion - endangered ecological community listed under BC Act and under a slightly different name under the EPBC Act; comprises PCT838. Approximately 1,600 m² of clearing and removal of shrubs, saplings and overhanging branches over temporary access tracks of approximately 500 metres by 3 m. • Parrots; Glossy Black-Cockatoo, Gang-gang Cockatoo, Swift Parrot, Little Lorikeet, Turquoise Parrot; minor modification to foraging habitat only as any large trees possibly suitable for nesting would be avoided. • Raptors and owls; Square-tailed Kite, Barking Owl, Powerful Owl, Masked Owl, Sooty Owl; minor modification to foraging habitat only as any large trees possibly suitable for nesting would be avoided. • Small birds; Flame Robin, Scarlet Robin, Dusky Woodswallow, Varied Sittella, Diamond Firetail, Olive Whistler; minor modification to foraging habitat only as pre-clearance checks of habitat for active nests would be undertaken to avoid impacts on nest sites. • Spotted-tail Quoll; minor modification to foraging habitat only as rock outcrops and large fallen logs possibly suitable as dens sites would be avoided. • Cave-roosting bats; Large-eared Pied Bat, Little Bentwing-bat, Eastern Bentwing-bat, Southern Myotis; minor modification to foraging habitat only as rock outcrops possibly suitable as roost sites would be avoided. • Tree-roosting bats; Eastern Freetail-bat, Golden-tipped Bat, Greater Broad-nosed Bat, Yellow-bellied Sheath-tail Bat, Eastern False Pipistrelle; minor modification to foraging habitat only as any large trees or dead stags possibly suitable for roosting would be avoided. • Possums; Squirrel Glider, Yellow-bellied Glider, Greater Glider, Eastern Pygmy-possum; minor modification to foraging habitat only as any large trees or dead stags possibly suitable for dens would be avoided. • Koala; minor modification to foraging habitat only as any large trees would be avoided.

Biodiversity Value	Meaning	Relevant (P or NA)	Explain and Document potential impacts	
			Information required	Applicant to Complete
				<ul style="list-style-type: none"> Long-nosed Potoroo; minor modification to foraging habitat only as areas of dense undergrowth would be avoided. Grey-headed Flying-fox; minor modification to foraging habitat only as known and possible suitable camp sites would be avoided. Broad-headed Snake; No impact to habitat as seasonal servays have been completed and ruled out the presence of suitable habitat in the vicinity of the geotechnical locations. Rock outcrops and hollow trees possibly suitable as shelter sites would nevertheless be avoided. Giant Burrowing Frog; minor modification to foraging habitat only water bodies and nearby areas would be avoided. Rosenberg's Goanna; minor modification to foraging habitat only as rock outcrops and termite nests possibly suitable as shelter and/or breeding sites would be avoided. Inconspicuous groundlayer and ephemeral plants - <i>Cryptostylis hunteriana</i>, <i>Irenepharsus tryphurus</i> and <i>Acacia bynoeana</i>. Only a small area of potential habitat and a small proportion of any local population is likely to be affected; only likely to be affected if they occur in actual geotechnical investigation locations as ground disturbance in access areas would not be substantial. Conspicuous plant species - <i>Daphnandra johnsonii</i>, <i>Solanum celatum</i>, and <i>Pomaderris cotoneaster</i>; bore hole sites in suitable habitat would be inspected for the presence of these readily detectible species and they would be avoided if found. <p>The works would be undertaken while minimising impacts on habitat in general and specifically avoiding habitat features likely to be important to threatened species.</p> <p>With these measures in place, the impact on the habitat of threatened species, populations and ecological communities is unlikely to be significant.</p>
Threatened species abundance	Occurrence and abundance of threatened species or	P	Describe how the proposed development avoids impacts on threatened species abundance and identify the likelihood and extent of	<p>Impacts on the abundance of threatened ecological communities are discussed under the previous heading.</p> <p>Threatened animals likely to utilise the affected habitat are listed under the previous heading. As the works would be undertaken so as to avoid likely sheltering and breeding sites for animals it is</p>

Biodiversity Value	Meaning	Relevant (P or NA)	Explain and Document potential impacts	
			Information required	Applicant to Complete
	threatened ecological communities, or their habitat, at a particular site		any remaining impacts including whether the proposed development is likely to result in vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.	<p>unlikely that it would cause mortality and thereby reduce the abundance of any species. The temporary and small reduction in habitat associated with the works is also unlikely to reduce the carrying capacity of the habitats.</p> <p>It is possible that some individuals of inconspicuous groundlayer and ephemeral plants including <i>Cryptostylis hunteriana</i>, <i>Irenepharsus trypherus</i> and <i>Acacia bynoeana</i> could be lost if they occur in small numbers and are overlooked during surveys or are only represented by underground seeds or storage organs at the time. Given the small area of temporary disturbance, however, only a small area of potential habitat and a small proportion of any local population may be affected. Similarly, conspicuous plant species such as <i>Daphnandra johnsonii</i>, <i>Solanum celatum</i>, and <i>Pomaderrus cotoneaster</i> would only be at risk of impact if a seedbank or small, inconspicuous seedlings were to be present in the affected areas.</p> <p>It is unlikely that an ecologically significant proportion of any threatened species, population or ecological communities would be lost as a result of the works. The works are unlikely to significantly impact the abundance of any threatened species, population or ecological community.</p>
Habitat connectivity	Degree to which a particular site connects different areas of habitat of threatened species to facilitate the movement of those species across their range	P	<p>Identify whether the development site contributes to habitat connectivity.</p> <p>Describe how the proposed development avoids impacts on habitat connectivity and identify the likelihood and extent of any remaining impacts.</p>	Habitats encompassing the sites contribute substantially to wildlife habitat connectivity at local and regional scales. Given the very small extent and temporary nature of the geotechnical investigations and the relatively minor vegetation removal required for access, the works are unlikely to have any appreciable impact on habitat connectivity.

Biodiversity Value	Meaning	Relevant (P or NA)	Explain and Document potential impacts	
			Information required	Applicant to Complete
Threatened species movement	Degree to which a particular site contributes to the movement of threatened species to maintain their lifecycle	P	Describe how the proposed development avoids impacts on threatened species movement and identify the likelihood and extent of any remaining impacts.	Habitats encompassing the sites are likely to be regionally important for the movement of threatened species, particularly during juvenile dispersal and mate-searching behaviours. Given the very small extent and temporary nature of the geotechnical investigations and the relatively minor vegetation removal required for access, the works are unlikely to have any appreciable impact on movement ability of threatened species across the landscape.
Flight path integrity	Degree to which the flight paths of protected animals over a particular site are free from interference	P	<p>Identify whether flight paths of protected animals occur over the development site.</p> <p>Describe how the proposed development avoids impacts on flight path integrity and identify the likelihood and extent of any remaining impacts.</p> <p>For proposed wind farms, describe any impacts of wind turbine strikes on protected animals.</p>	<p>Flight path integrity is the degree to which the flight paths of protected animals over a particular site are free from interference. There will be no increase in structure height that would affect species movement or interfere with the current flight paths of any protected species.</p> <p>The movement of migratory, nomadic or local species is likely to continue unaltered as no obstacles will be placed in the flight path of any species. Importantly, no important habitats along the flight path of any species will be affected and the project does not impose an increased collision risk to flying species.</p> <p>The geotechnical investigation is highly unlikely to affect the current flight paths of any species as no new obstacles will be constructed and geotechnical drilling rigs do not present a substantial or high-risk (i.e. they are not of low visibility or fast-moving).</p> <p>The sites are located in the East Asia-Australasia Flyway which includes the migratory routes of Arctic breeding birds in the far north of Siberia and Alaska down through East and South-east Asia to Australia and New Zealand. Migratory birds arrive in Australia in November and December in the non-breeding season. The landscape within which the sites are situated is part of the broader non-breeding area for migratory birds that spend the summer season in Australia. However, the sites do not provide any habitat for migratory wetland birds or migratory raptors which are particularly susceptible to collision due to their size and flight behaviour. Impacts to the East Asia-Australasia Flyway are therefore negligible.</p>

Biodiversity Value	Meaning	Relevant (P or NA)	Explain and Document potential impacts	
			Information required	Applicant to Complete
				<p>Another example is a smaller scale migrant such as the Swift Parrot. This species breeds in Tasmania and migrates across Bass Strait to mainland Australia in Autumn. During winter the birds disperse across Victoria and New South Wales with small numbers also recorded in the Australian Capital Territory, South Australia and Queensland. Once Swift Parrots arrive on the mainland, they move across the landscape in search of food. The specific pathways used on the mainland are currently unknown and are likely to differ widely based on food availability and competition. Foraging habitat is present on the sites but is considered to be marginal due to it having a low density of winter-flowering species and no significant foraging resources are located nearby. As such, it is unlikely a significant proportion of the species population will visit the study area. If birds were to fly over the sites, the current flight path would not be interfered with as there will be no appreciable increase in structure height.</p> <p>The flight paths of altitudinal migrants, for example the Scarlet Robin, which move down from the Great Dividing Range to the coastal forests in autumn and winter but are similarly unlikely to be affected.</p> <p>Local species such as the White-bellied Sea-Eagle, and irregular visitors such as Eastern Osprey, may use the estuary as a foraging ground and a movement pathway (they will however also fly over adjacent land habitat). These species are high flyers and are unlikely to fly near to the project while they are moving around the Shoalhaven River.</p> <p>The flight paths of the Grey-headed Flying-fox are unlikely to be affected by the project. This species occupies habitats on the coastal lowlands, tablelands and slopes of southeast Australia from Bundaberg to Geelong in one large interconnected population. The presence of the Grey-headed Flying-fox in an area is dependent on food availability and this species will move between camps to find food. In the locality, the greatest numbers of Grey-headed Flying-foxes are found in summer and most bats disperse to the coast of northern New South Wales and Queensland areas in winter. The Grey-headed Flying-fox is able to move freely over and between buildings and the project will not have an effect on the current flight paths of this species.</p>

Biodiversity Value	Meaning	Relevant (P or NA)	Explain and Document potential impacts	
			Information required	Applicant to Complete
				The Southern Myotis forages over estuarine and freshwater habitats. The sites do not contain likely foraging areas for the Southern Myotis and there is unlikely to be a high level of flight activity around the sites.
Water sustainability	Degree to which water quality, water bodies and hydrological processes sustain threatened species and threatened ecological communities at a particular site.	P	Describe how the proposed development avoids impacts on water sustainability and identify the likelihood and extent of any remaining impacts (including from subsidence or upsidence resulting from underground mining or other development).	The geotechnical investigations have been located at a suitable distance from water bodies and would be bundled and otherwise managed to ensure that no significant runoff of sediment or other pollutants will occur during the works.

8. Summary and Conclusions

Geotechnical investigations are required to confirm that the Shoalhaven Hydro Expansion Project can be constructed and operated in a safe and cost-effective manner. The Shoalhaven Hydro Expansion Project, including the required Geotechnical investigations, has been declared Critical SSI and as such will be assessed under Division 5.2 of the EP&A Act.

This document provides a description of the project, existing information on environmental context and potential for environmental impacts and has been prepared in support of an application for the SEARs for the Geotechnical investigations. An EIS will be prepared addressing these SEARs and focus on key issues of biodiversity, Aboriginal heritage, water quality and noise impacts. The EIS is intended to be placed on public exhibition in accordance with Division 5.2 of the EP&A Act.

The preliminary site inspection confirmed that most of the geotechnical investigations occurs within significantly disturbed landforms, with extensive ground disturbance from the original pipeline and project construction. There were no Aboriginal objects or sites identified during the inspection. One area of moderate archaeological sensitivity was recorded near the intake site adjacent near Lake Yarrunga. The findings of this assessment have resulted in geotechnical investigation locations being located in areas of low sensitivity. Formal consultation under the *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH, 2010) is not proposed based on the avoidance of potential for harm to known Aboriginal objects and places and sensitive landforms.

Based on the minor and temporary nature of the geotechnical investigations, the avoidance of habitat features in locating works areas and access tracks and the low to moderate condition of plant community types present it is considered unlikely that significant impacts to biodiversity values would occur. Following completion of geotechnical investigations, all locations would be allowed to, or actively managed to, rehabilitate to their current standard. An exemption to the need for a biodiversity development assessment report is requested.

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Appendix A. Likelihood of occurrence

Likelihood of occurrence indicates how likely it is that a threatened species will be present within the project study area. Species are assigned a likelihood of occurrence from unlikely to high based on the following criteria:

Likelihood of Occurrence	Criteria
Unlikely	<ul style="list-style-type: none"> Species highly restricted to certain geographical areas not within the proposal footprint Species has specific habitat requirements that are not present in the study area
Low	<p>Species that fit into one or more of the following criteria:</p> <ul style="list-style-type: none"> Have not been recorded previously in the study area/surrounds, and for which the study area is beyond the current distribution range Use specific habitats or resources not present in the study area. Are non-cryptic perennial flora species that were targeted by surveys and were not recorded.
Moderate	<p>Species that fit into one or more of the following criteria:</p> <ul style="list-style-type: none"> Have infrequently been recorded previously in the study area/surrounds Use specific habitats or resources present in the study area but in poor or modified condition Are unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration Are cryptic flowering species that were not seasonally targeted by surveys and have not been recorded.
High	<p>Species that fit into one or more of the following criteria:</p> <ul style="list-style-type: none"> Have frequently been recorded previously in the study area/surrounds Use habitat types or resources that are present in the study area in abundance and/or in good condition Are known or likely to maintain resident populations surrounding the study area Are known or likely to visit the site during regular seasonal movements or migration

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
<p>*BAM P: Means species was listed in the BAM Predicted Species Report based on PCTs</p> <p>*BAM C: Means the species was listed in the BAM Candidate Species Report based on PCTs</p> <p>*# records: number of records from OEH BioNet Species Sightings Search</p>						
Birds						
<i>Burhinus grallarius</i> Bush Stone-curlew	E	-	Open forests and woodlands with a sparse grassy ground layer and fallen timber.	BAM C	Low	Year round
<i>Calyptrorhynchus lathamii</i> Glossy Black-Cockatoo	V	-	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Inland populations feed on a wide range of Sheoaks, including Drooping Sheoak, <i>Allocasuarina diminuta</i> , and <i>A. gymnanthera</i> . Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (<i>Casuarina cristata</i>).	BioNet Atlas 8 Records BAM P	High Foraging evidence in Sep site visit	Mar-Aug
<i>Lathamus discolor</i> Swift Parrot	E	CE	Where eucalypts are flowering profusely or where there is abundant lerp infestations. Favour Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum	PMST BAM P C	Moderate	May-Aug

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			(<i>Corymbia maculata</i>), Red Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>).			
<i>Botaurus poiciloptilus</i> Australasian Bittern	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats.	PMST BAM P	Low	
<i>Calidris ferruginea</i> Curlew Sandpiper	E	CE	The breeding range of the Curlew Sandpiper is mainly restricted to the Arctic of northern Siberia, including Yamal Peninsula east to Kolyuchiskaya Gulf, Chokotka Peninsula, and also New Siberian Island. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in salt works and sewage farms.	PMST	Low	
<i>Numenius madagascariensis</i> Eastern Curlew	-	CE	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats, often with beds of seagrass.	PMST	Low	
<i>Grantiella picta</i> Painted Honeyeater	V	V	Nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	PMST	Low	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .			
<i>Rostratula australis</i> Australian Painted Snipe	E	E	Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	PMST	Unlikely	
<i>Lophoictinia isura</i> Square-tailed Kite	V	-	In NSW it is often associated with ridge and gully forests dominated by <i>Eucalyptus longifolia</i> , <i>Corymbia maculata</i> , <i>E. elata</i> , or <i>E. smithii</i> . Individuals appear to occupy large hunting ranges of more than 100 km ² . They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	BioNet Atlas 1 Record BAM P C	High	Sep-Jan
<i>Hieraaetus morphnoides</i> Little Eagle	V	-	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	BAM P C	High	Aug-Oct
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	V	M	Found in coastal habitats and terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Nests require living or dead mature trees within suitable vegetation within 1km of rivers, lakes, large dams or creeks, wetlands and coastlines	BAM P C	Moderate	Jul-Dec

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
<i>Ninox connivens</i> Barking Owl	V	-	Inhabits woodland and open forest, including fragmented remnants and partially cleared farmland. Hunting can extend into closed forests and more open areas. Require hollows of large old trees, living eucalypts preferred.	BAM P C	Moderate	May-Dec
<i>Ninox strenua</i> Powerful Owl	V	-	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. Roosts by day in dense vegetation comprising species such as Turpentine <i>Syncarpia glomulifera</i> , Black She-oak <i>Allocasuarina littoralis</i> , Blackwood <i>Acacia melanoxylon</i> , Rough-barked Apple <i>Angophora floribunda</i> , Cherry Ballart <i>Exocarpus cupressiformis</i> and a number of eucalypt species.	BAM P C	Moderate	May-Aug
<i>Pandion cristatus</i> Eastern Osprey	V	M	Global distribution with four subspecies previously recognised throughout its range. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Nests are made high in trees, usually within one kilometre of the sea.	BAM P C	Low	Apr-Nov
<i>Tyto novaehollandiae</i> Masked Owl	V	-	Dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	BAM P C	Moderate	May-Aug
<i>Tyto tenebricosa</i> Sooty Owl	V	-	Occupies the coast, coastal escarpment and eastern tablelands. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as most eucalypt forests. Nests in very large tree hollows.	BAM P C	Moderate	Apr-Aug

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
<i>Circus assimilis</i> Spotted Harrier	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	BAM P	Low	
<i>Anthochaera phrygia</i> Regent Honeyeater	CE	CE	Dry open forest in temperate woodlands, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Nest in horizontal branches or forks in tall mature eucalypts and Sheoaks.	PMST BAM P	Low	Sep-Dec
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	V	-	In summer, tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, lower altitudes in drier, more open eucalypt woodlands. Require tree hollows for breeding.	BioNet Atlas 12 records BAM P C	High	Oct-Jan
<i>Petroica rodinogaster</i> Pink Robin	V	-	On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	BAM C	Low – The study area would be close to the northern fringes of the species' range.	Year round
<i>Petroica phoenicea</i> Flame Robin	V	-	The Flame Robin is endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in	BAM P	Moderate	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgeland at high altitudes.			
<i>Petroica boodang</i> Scarlet Robin	V	-	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps.	BioNet Atlas 4 records BAM P	Moderate	
<i>Artamus cyanopterus</i> Dusky Woodswallow	V	-	Dusky woodswallows are widespread in eastern, southern and south western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range.	BioNet Atlas 4 records	High	Year round
<i>Dasyornis brachypterus</i> Eastern Bristlebird	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern Queensland/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula and Southern - Nadgee NR and Croajingalong NP in	PMST BioNet Atlas 2 records	Low	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			the vicinity of the NSW/Victorian border. The estimated population size is less than 2000 individuals occupying a total area of about 120 sq km. There are now only four populations in the southern Queensland/northern NSW area with a total of 35 birds, compared to 15 years ago when 14 populations and 154 birds were recorded. This population once extended as far south as at least Dorrigo and has recently been identified as a separate ultrataxon (monoides) but further research is being undertaken to determine the validity of this. The remaining populations are the nominate ultrataxon (brachypterus) and once extended at least to what is now the Sydney urban area. The central population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. The southern population in Nadgee Nature Reserve and Howe's Flat is around 200 birds. Further surveys are required in parts of Ben Boyd National Park and Sydney Catchment Authority lands to determine whether further populations of the Eastern Bristlebird occur in these areas.			
<i>Daphoenositta chrysoptera</i> Varied Sittella	V	-	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia	BioNet Atlas 2 records BAM P	Moderate	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			woodland. Feeds on arthropods gleaned from crevices in rough or decorticated bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.			
<i>Stagonopleura guttata</i> Diamond Firetail	V	-	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (<i>Eucalyptus pauciflora</i>) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	BioNet Atlas 1 record BAM P	Moderate	
<i>Pachycephala olivacea</i> Olive Whistler	V	-	The Olive Whistler inhabits the wet forests on the ranges of the east coast. It has a disjunct distribution in NSW chiefly occupying the beech forests around Barrington Tops and the MacPherson Ranges in the north and wet forests from Illawarra south to Victoria. In the south it is found inland to the Snowy Mountains and the Brindabella Range. Mostly inhabit wet forests above about 500m. During the winter months they may move to lower altitudes.	BioNet Atlas 1 record BAM P	Moderate	
<i>Glossopsitta pusilla</i> Little Lorikeet	V	-	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples (<i>angophora</i> sp.), paperbarks (<i>melaleuca</i> sp.) and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species.	BAM P	Moderate	
<i>Neophema pulchella</i> Turquoise Parrot	V	-	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on	BAM P	Moderate	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.			
<i>Ptilinopus regina</i> Rose-crowned Fruit Dove	V	-	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria. Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	BAM P	Low	
<i>Ptilinopus superbus</i> Superb Fruit-Dove	V	-	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	BAM P	Low	
<i>Ixobrychus flavicollis</i> Black Bittern	V	-	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats.	BAM P	Low	
Mammals						
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	Forages over a broad range of open forest and woodland habitats. Cave roosting bat which favours sandstone escarpment habitats for roosting, in shallow overhangs, crevices, and caves.	PMST BAM C	Moderate – Could occur along Fitzroy Falls escarpment	Sep-Mar
<i>Cercartetus nanus</i> Eastern Pygmy-possum	V	-	Found in a broad range of habitats from rainforest through to wet and dry sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred.	BAM C	Moderate – study area includes wet sclerophyll forests.	October-March

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
<i>Dasyurus maculatus</i> Spotted-tail Quoll	V	E	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	PMST BioNet Atlas 6 records BAM P	Moderate	
<i>Miniopterus australis</i> Little Bentwing-bat	V	-	Eastern coast and ranges from Cape York to Wollongong. Roost in caves, tunnels, tree hollows, stormwater drains, culverts, bridges, and sometime buildings.	BAM P C	Moderate	Dec-Feb
<i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat	V	-	East and north-west coasts of Australia. Primarily roost in caves, but also use abandoned mines, stormwater tunnels, buildings and other man-made structures.	BioNet Atlas 7 records BAM P C	Moderate	Nov-Feb
<i>Mormopterus norfolkensis</i> Eastern Freetail-bat	V	-	Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in human-made structures.	BioNet Atlas 6 records BAM P	Moderate	
<i>Myotis macropus</i> Southern Myotis	V		Roosts close to water in caves, mine shafts, hollow-bearing trees, buildings, bridges, and in dense foliage. Forages over streams and ponds.	BioNet Atlas 2 records BAM C	Moderate	Nov-Mar
<i>Kerivoula papuensis</i> Golden-tipped Bat	V	-	The Golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to south of Eden in southern NSW. It also occurs in New Guinea. Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Roost mainly in rainforest gullies on small first- and second-order streams in usually	BAM P	Moderate	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole on the underside. Bats may also roost under thick moss on tree trunks, in tree hollows, dense foliage and epiphytes.			
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat	V	-	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	BAM P	Moderate	
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheathtail Bat	V	-	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	BAM P	Moderate	
<i>Phascolarctos cinereus</i> Koala	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	PSMT BioNet Atlas 1 record BAM P C	High	Year round
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	Generally found within 200km of the eastern coast. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	PMST BioNet Atlas 4 records BAM P C		October-December
<i>Potorous tridactylus</i> Long-nosed Potoroo	V	V	The long-nosed potoroo is found on the south-eastern coast of Australia, from Queensland to eastern	PSMT	Moderate	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			Victoria and Tasmania, including some of the Bass Strait islands. Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruited) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil.	BioNet Atlas 8 records BAM P		
<i>Pseudomys novaehollandiae</i> New Holland Mouse		V	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.	PMST	Low	
<i>Isoodon obesulus obesulus</i> Southern Brown Bandicoot (eastern)	E	E	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burned from time to time. A mosaic of post fire vegetation is important for this species.	PMST	Low	Year round
<i>Petaurus norfolcensis</i> Squirrel Glider	V	-	Dispersed widely but sparsely through eastern Australia. Prefers mixed species stands with a shrub or Acacia midstorey.	BioNet Atlas 1 record BAM C	Moderate	Year round
<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby	E	V	Range follows roughly the line of the Great Dividing Range. Occupies rocky escarpments, outcrops, and cliffs with a preference for complex structures. Browse on vegetation in and adjacent to rocky areas.	PMST BioNet Atlas 14 records BAM C	High	Year Round
<i>Sminthopsis leucopus</i> White-footed Dunnart			The White-footed Dunnart occurs in Tasmania and along the Victorian and southern NSW coast. The Shoalhaven area is the species' northern-most limit. It has not been recorded west of the coastal	BAM C	Low	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			escarpment with the western-most record being from Coolangubra State Forest, approximately 10 km south-east of Bombala. In NSW, the species seems to favour vegetation communities with an open understorey structure (contrasting with populations in Victoria which apparently prefer dense shrub and ground layers). It is patchily distributed across these habitats and, where present, typically occurs at low densities. Breeding populations have been recorded in logged forest shortly after disturbance, but these usually do not persist as regeneration proceeds and a dense ground cover of vegetation establishes.			
<i>Petaurus australis</i> Yellow-bellied Glider	V	-	Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.	BioNet Atlas 12 records BAM P	Moderate	
<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle	V	-	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania.	BioNet Atlas 1 record BAM P	Moderate	
<i>Petauroides volans</i> Greater Glider	-	V	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of	PMST	Moderate	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			Victoria. This population of Greater Gliders on the south coast of NSW is bounded by the Moruya River to the north, Coila Lake to the south and the Princes Highway and cleared land exceeding 700 m in width to the west. Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use up to 18 hollows in their home range. Occupy a relatively small home range with an average size of 1 to 3 ha.	BioNet Atlas 2 records		
Reptiles & Amphibians						
<i>Hoplocephalus bungaroides</i> Broad-headed Snake	V	V	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Shelters in hollows of large trees within 200m of escarpments in summer	BioNet Atlas 2 records BAM P C	Moderate	Aug-Sep
<i>Litoria aurea</i> Green and Golden Bell Frog	E	V	50 recorded locations in NSW, mostly coastal or near coastal. Large populations are located around metropolitan Sydney, Shoalhaven, and mid north coast.	PMST BAM C	Low	November-March
<i>Mixophyes balbus</i> Stuttering Frog	V	V	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	PMST BAM C	Low – recent surveys have only found three locations south of Sydney	Sep-Mar
<i>Heleioporus australiacus</i> Giant Burrowing Frog	V	V	Northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	PMST BAM C	Moderate	Sep-May

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
<i>Litoria littlejohni</i> Littlejohn's Tree Frog	V	V	Distribution includes the plateaus and eastern slopes of the Great Dividing Range. Breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation.	PMST BAM C	Low	July-Nov
<i>Pseudophryne australis</i> Red-crowned Toadlet	V	-	It has restricted distribution from Pokolbin to Nowra and west to Mt Victoria. Occurs in open forests and wet drainage lines below sandstone ridges that often have shale lenses or cappings in the Hawkesbury and Narrabeen Sandstones.	BAM C	Low	Year round
<i>Varanus rosenbergi</i> Rosenberg's Goanna	V	-	Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia. Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.	BioNet Atlas 1 record BAM P	Moderate	
Plants						
<i>Haloragis exalata</i> subsp. <i>exalata</i> Square Raspwort / Wingless Raspwort	V	V	Four scattered localities in eastern NSW. Requires protected and shaded damp situations in riparian habitats.	PMST BAM C	Unlikely – closest known location in Wollongong	Year round

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
<i>Cryptostylis hunteriana</i> Leafless Tongue Orchid	V	V	Larger populations typically occur in woodland dominated by Scribbly Gum (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (<i>C. subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>).	PSMT BioNet Atlas 1 record BAM C	Moderate	November-February
<i>Cynanchum elegans</i> White-flowered Wax Plant	E	E	Occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest, Coastal Tea-tree (<i>Leptospermum laevigatum</i>) – Coastal Banksia (<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>) coastal scrub; Forest Red Gum (<i>Eucalyptus tereticornis</i>) aligned open forest and woodland; Spotted Gum (<i>Corymbia maculata</i>) aligned open forest and woodland; and Bracelet Honey myrtle (<i>Melaleuca armillaris</i>) scrub to open scrub.	PMST BAM C	Moderate – potential in open forest and woodland with Forest Gum and any rainforest edges	Year round
<i>Daphnandra johnsonii</i> Illawarra Socketwood	E	E	Restricted to the Illawarra region where it has been recorded from the local government areas of Shoalhaven, Kiama, Shellharbour and Wollongong. Occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes. Associated vegetation includes rainforest and moist eucalypt forest.	BAM C	Moderate – Could occur along the Fitzroy Falls escarpment	Year round
<i>Irenepharsus trypherus</i> Illawarra Irene	E	E	Prefers to grow on steep rocky slopes near cliff lines and ridge tops that extend south and east of the Illawarra escarpment. Has also been recorded in deep sandstone gorges along the Shoalhaven River.	PMST BioNet Atlas 15 records BAM C	High	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
<i>Chorizema parviflorum</i> - endangered population Chorizema parviflorum Benth. in the Wollongong and Shellharbour Local Government Areas	EP	-	Endangered population recorded between Austinmer and Albion Park in local government areas of Wollongong and Shellharbour. Occupy woodland dominated by Forest Red Gum (<i>Eucalyptus tereticornis</i>) and/or Woollybutt (<i>E. longifolia</i>).	BAM C	Unlikely – this is a local Wollongong population only	
<i>Lespedeza juncea</i> subsp. <i>sericea</i> - endangered population Lespedeza juncea subsp. sericea in the Wollongong Local Government Area	EP	-	Just south of Dapto in the Wollongong local government area. This population is distinct from the other (non-endangered) populations of the species in NSW. Known from its singular roadside population of approximately 200 plants, located in a small strip of open forest dominated by <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>E. longifolia</i> (Woollybutt), and <i>Melaleuca decora</i> (White Feather Honey Myrtle), on Budgong Sandstone.	BAM C	Unlikely – This is a local Wollongong population only	
<i>Pimelea curviflora</i> var. <i>curviflora</i> Pimelea curviflora var. curviflora	V	V	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	BAM C	Low	Year round
<i>Pimelea spicata</i> Spiked Rice-flower	E	E	Broad distribution in western Sydney, occurring on the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas). Another smaller population is recorded in districts (Landsdowne to Shellharbour to northern Kiama) Illawarra. It grows on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coastal Banksia open	PMST BAM C	Low	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			woodland with a more well developed shrub and grass understorey.			
<i>Pterostylis gibbosa</i> Illawarra Greenhood	E	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Forest Red Gum (<i>Eucalyptus tereticornis</i>) and Black Cypress Pine (<i>Callitris endlicheri</i>).	PMST BAM C	Low	Jun-Sep
<i>Solanum celatum</i> Solanum celatum	E	-	This shrub is restricted to an area from Wollongong to south of Nowra and west to Bungonia. Its habitat includes rainforest clearings or wet sclerophyll forest and is generally found in disturbed margins and clearings.	BioNet Atlas 10 records BAM C	High	Sep-Nov
<i>Syzygium paniculatum</i> Magenta Lilly Pilly	E	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	PMST BAM C	Low	
<i>Zieria granulata</i>	E	E	Illawarra Zieria is a bushy shrubs restricted to the Illawarra region primarily in coastal lowlands. It	BAM C	Low	Year round

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
Illawarra Zieria			typically occupies dry ridges and rocky outcrops on shallow volcanic soils and less frequently found on moist slopes of the Illawarra escarpment. It grows in association with vegetation comprising Melaleuca armillaris scrub and Eucalyptus tereticornis woodland and rainforest margins.			
<i>Hibbertia stricta</i> subsp. <i>furcatula</i> Hibbertia stricta subsp. <i>furcatula</i>	E	-	Known to occur in two populations, one in the southern outskirts of Sydney, and one near Nowra on the mid-South Coast of NSW. Habitat of the Southern Sydney population is broadly dry eucalypt forest and woodland. This population appears to occur mainly on upper slopes and above the Woronora River gorge escarpment, at or near the interface between the Lucas Heights soil landscape and Hawkesbury sandstone. The species usually grows in 'gravelly loam or clay soil in heath under open woodland'. Habitat of the South Coast population is poorly recorded, but appears to be dry sclerophyll forest or woodland associations in sandy soils over sandstone.	BAM C	Low	Oct-Mar
<i>Acacia bynoeana</i> Bynoe's Wattle	E	V	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood (<i>Corymbia gummiifera</i>), Scribbly Gum (<i>Eucalyptus haemastoma</i>), Drooping Red Gum (E.	PSMT	Moderate	Sep-Mar

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			parramattensis), Old Man Banksia (<i>Banksia serrata</i>) and Small-leaved Apple (<i>Angophora bakeri</i>).			
<i>Boronia deanei</i>	V	V	There are scattered populations of Deane's Boronia between the far south-east of NSW and the Blue Mountains (including the upper Kangaroo River near Carrington Falls, the Endrick River near Nerriga and Nalbaugh Plateau), mainly in conservation reserves. Wildfires have depleted some populations.	PMST	Low	
<i>Asterolasia elegans</i>	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone. Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine (<i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i>), Smooth-barked Apple (<i>Angophora costata</i>), Sydney Peppermint (<i>Eucalyptus piperita</i>), Forest Oak (<i>Allocasuarina torulosa</i>) and Christmas Bush (<i>Ceratopetalum gummiferum</i>).	PMST	Unlikely – Study area not in species known range	
<i>Caladenia tessellate</i> Thick-lipped Spider-orchid	E	V	Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	PMST	Low	
<i>Eucalyptus macarthurii</i> Camden Woollybutt	V	E	Has a moderately restricted distribution. It is currently recorded from the Moss Vale District to Kanangra Boyd National Park. In the Southern Highlands it	PMST	Unlikely	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			occurs mainly on private land, often as isolated individuals in, or on the edges, of paddocks. Isolated stands occur in the north west part of the range on the Boyd Plateau. The only known record in the conservation estate is within Kanangra Boyd National Park			
<i>Genoplesium baueri</i> Yellow Gnat-orchid	E	E	Recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the several conservation reserves including Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Found in sparse sclerophyll forest and moss gardens over sandstone	PSMT BAM C	Low	Feb-Mar
<i>Melaleuca biconvexa</i> Biconvex Paperbark	V	V	Found only in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	PMST	Unlikely – outside of range	
<i>Melaleuca deanei</i> Deane's Melaleuca	V	V	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai, Berowra, Holsworthy and Wedderburn areas, and there are also more isolated occurrences at Springwood, Wollemi National Park, Yalwal and the	PMST	Low – Just on fringes of known range	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			Central Coast areas. The species grows in heath on sandstone			
<i>Pelargonium</i> sp. <i>Striatellum</i> Omeo Stork's-bill	E	E	Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. A population at a fourth known site on the Monaro has not been seen in recent years. The only other known population is at Lake Omeo, Victoria. It occurs at altitudes between 680 to 1030 m. It is known to occur in the local government areas of Goulburn-Mulwaree, Cooma-Monaro, and Snowy River, but may occur in other areas with suitable habitat; these may include Bombala, Eurobodalla, Palerang, Tumbarumba, Tumut, Upper Lachlan, and Yass Valley local government areas. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities. It sometimes colonises exposed lake beds during dry periods.	PMST	Unlikely	
<i>Persoonia glaucescens</i> Mittagong Geebung	E	V	The Mittagong Geebung's historical distribution places the northern and eastern limit at Couridjah (Thirlmere Lakes), the southern limit at Fitzroy Falls and the western limit at High Range. However, recent surveys have indicated that the species no longer extends to Fitzroy Falls or Kangaloon and that the present southern limit is near Berrima. The Mittagong Geebung grows in woodland to dry sclerophyll forest on clayey and gravely laterite. The preferred topography is ridge-tops, plateaux and upper slopes.	PMST	Unlikely – outside of known range	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
<i>Prasophyllum fuscum</i> Slaty Leek-orchid	CE	V	Grows in moist heath, often along seepage lines. The known population grows in moist sandy soil over sandstone amongst sedges and grasses in an area that appears to be regularly slashed by the local council.	PMST	Unlikely – outside of known range	
<i>Pterostylis pulchella</i> Waterfall greenhood	V	V	The Waterfall Greenhood is found only at Fitzroy Falls, Belmore Falls, upper Bundanoon Creek (Meryla) and Minnamurra Falls. Found on cliff faces close to waterfalls and creek banks and mossy rocks alongside running water.	PMST	Moderate	Feb-May (flowering)
<i>Thelymitra kangaloonica</i> Kangaloon Sun Orchid	CE	CE	Only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. It is found in swamps in sedgeland over grey silty grey loam soils	PMST	Low – No known swampy areas within study area	
<i>Thesium australe</i> Austral Toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (<i>Themeda australis</i>).	PMST	Low	
<i>Triplarina nowraensis</i> Nowra Heath-myrtle	E	E	There are five known populations of Nowra Heath Myrtle. Three of these form a cluster to the immediate west of Nowra. A fourth, much smaller population is found 18km south-west of Nowra in the Boolijong Creek Valley. The fifth population is located north of the Shoalhaven River on the plateau above Bundanon.	PMST BAM C	Low	Year round

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
<i>Xerochrysum palustre</i> Swamp Everlasting	V	V	Found in Kosciuszko National Park and the eastern escarpment south of Badja. Also found in eastern Victoria. Grows in swamps and bogs which are often dominated by heaths. Also grows at the edges of bog margins on peaty soils with a cover of shrubs or grasses.	PMST	Unlikely	
<i>Pomaderrus cotoneaster</i> Cotoneaster Pomaderris	E	E	Cotoneaster Pomaderris has a very disjunct distribution, being known from the Nungatta area, northern Kosciuszko National Park (near Tumut), the Tantawangalo area in South-East Forests National Park and adjoining freehold land, Badgery's Lookout near Tallong, Bungonia State Conservation Area, the Yerranderie area, Kanangra-Boyd National Park, the Canyonleigh area and Ettrema Gorge in Morton National Park. The species has also been recorded along the Genoa River in Victoria	BioNet Atlas 2 records	Moderate	Oct-Nov
<i>Eucalyptus langleyi</i> Albatross Mallee	V	-	The main occurrence of the Albatross Mallee is to the south-west of Nowra as far as Yarramunmun Creek. A very small population is found to the north of the Shoalhaven River in the Bomaderry Creek Regional Park.	BAM C	Low/Moderate?	Year round
<i>Callistemon linearifolius</i> Netted bottle brush	V	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai	BioNet Atlas 1 record	Low	

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence	Targeted Survey Timing
			Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park.			
<i>Gossia acmenoides</i> Gossia acmenoides population in the Sydney Basin Bioregion south of the Georges River	EP	-	Gossia acmenoides grows in dry rainforest, as well as in subtropical rainforest, on the ranges and coastal plain of eastern Australia from the Illawarra (in the south) to Queensland. The population of Gossia acmenoides in the Sydney Basin Bioregion south of the Georges River is found in the local government areas of Wollongong, Shellharbour and Kiama. There are currently about 30 sites where G. acmenoides is found, often as single individual plants or as a small group of up to four individuals. There are estimated to be less than 100 mature G. acmenoides plants in the population.	BAM C	Low	Not specified