Planning Approval Consistency Assessment Form

SM-17-00000111

Metro Body of Knowledge (MBoK)

Assessment name:	Sydney Metro West – Moderate Risk Boreholes and Monitoring Wells Outside Approved Construction Boundary
Prepared by:	GLC
Prepared for:	Sydney Metro
Assessment number:	GLC06
Status:	Final (October 2022)
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For information – do not alter:

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The Planning Approval Consistency Assessment Form should be completed in accordance with SM-17-00000103 Planning Approval Consistency Assessment Procedure.

1. Existing Approved Project

Planning approval reference details (Application/Document No. (including modifications)):

- SSI-10038 Sydney Metro West – Concept and major civil construction work for Sydney Metro West between Westmead and The Bays (Stage 1 of the planning approval process for Sydney Metro West)
- SSI-10038-Mod-1 The Sydney Metro West Westmead to The Bays and Sydney CBD - Modification 1 (Administrative Modification)
- SSI-10038-Mod-2 The Sydney Metro West Westmead to The Bays and Sydney CBD – Modification 2 (Clyde Stabling and Maintenance Facility)
- SSI-10038-Mod-3 The Sydney Metro West Westmead to The Bays and Sydney CBD - Modification 3 (Administrative Modification)

Date of determination:

- SSI 10038: 11 March 2021
- SSI-10038-Mod-1: 28 July 2021
- SSI-10038-Mod-2: 03 June 2022
- SSI-10038-Mod-3: 04 July 2022

Type of planning approval: Critical SSI (Division 5.2 “State significant infrastructure”, *Environmental Planning and Assessment Act 1979*)

Approved Project

The approved project includes the Concept and major civil construction works between Westmead and The Bays (Stage 1 of the planning approval process). This Consistency Assessment relates to Stage 1 works, as described below.

Approved Major Civil Construction Work for Sydney Metro West between Westmead and The Bays

Approved major civil construction works for Sydney Metro West between Westmead and The Bays (Stage 1 of the planning approval process) includes the following: (Refer to Section 9 of the Environmental Impact Statement (EIS) for more detail).

- Enabling works, such as demolition, utility supply to construction sites, utility adjustments and modifications to the existing transport network

- Tunnel excavation including tunnel support activities between Westmead and The Bays
- Station excavation for new metro stations at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays
- Shaft excavation for services facilities
- Civil work for the stabling and maintenance facility at Clyde.

Stage 1 Construction Sites and Tunnel Alignment

Sydney Metro West - Stage 1 involves major civil construction works for Sydney Metro West (Westmead to The Bays) at nine surface construction sites, including:

- Westmead Metro Station
- Parramatta Metro Station
- Clyde Maintenance and Stabling Facility
- Sydney Olympic Park Metro Station
- North Strathfield Metro Station
- Burwood North Metro Station
- Five Dock Metro Station
- The Bays Metro Station

The location and layout of these construction sites are described in Section 9 of this EIS, with the exception of:

- Westmead Metro Station which received approval for a revised construction site boundary in Consistency Assessment SMW04: Sydney Metro West – Revised Westmead Station Box (endorsed 16 February 2022);
- Clyde Maintenance and Stabling Facility which received approval for, amongst other things, a revised layout and expanded construction site boundary in Consistency Assessment SMW01: Sydney Metro West – Tunnel boring machine drive strategy and future Rosehill crossover (endorsed 13 September 2021) and SSI-10038-Mod-2; and
- Clyde Dive and Portal Structure, which received approval for amendments to the Clyde Dive Portal construction methodology in Consistency Assessment GLC02: Sydney Metro West – Clyde Dive and Portal Structure (endorsed July/August 2022).

The location of Stage 1, including the underground tunnel and surface construction sites for the stations and services facilities are shown on Figure 1 below.

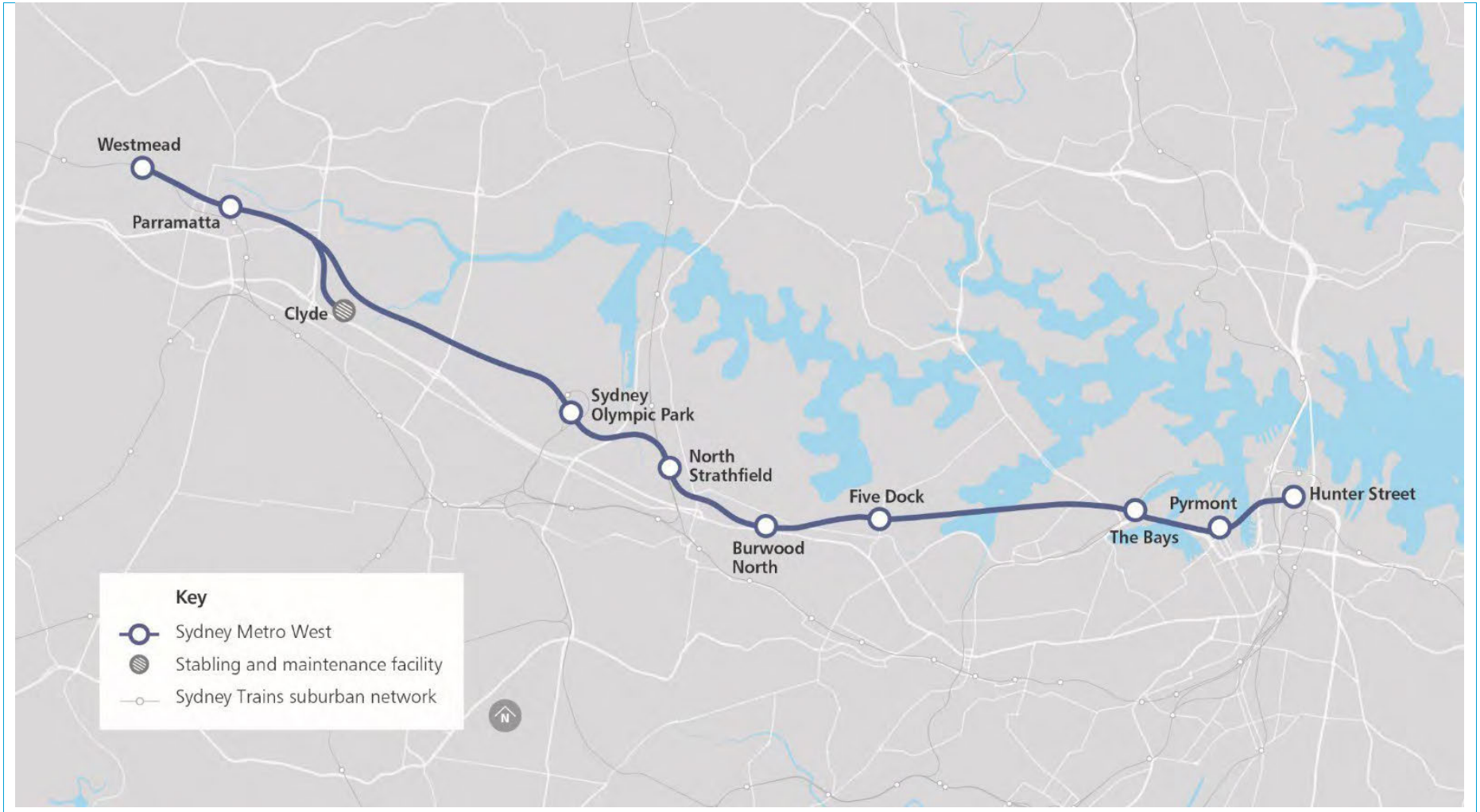


Figure 1: Location of Sydney Metro West - Stage 1

Stage 1 Delivery Phases

The Sydney Metro West - Stage 1 construction works were split into seven delivery phases, including:

- Phase A – Power Enabling Works
- Phase B1 – Central Tunnelling Early Works
- Phase B2 – Central Tunnelling Main Works
- Phase C – Parramatta and Clyde Enabling Works
- Phase E – Existing Rail Corridor Enabling Works
- Phase F – Western Tunnelling Works

This Consistency Assessment has been prepared to support a scope of works to carry out geotechnical services (e.g. borehole investigations or monitoring well installations) at 14 locations between Parramatta and Sydney Olympic Park, which is one aspect of the Detailed Site Investigations (DSI) required for Phase F – Western Tunnelling Works to obtain geotechnical and groundwater data for the design of the project. This phase includes nine kilometres of twin railway tunnels between Sydney Olympic Park and Westmead, as well as station box excavation works, associated support works, retrieval of Tunnel Boring Machines, and construction works for the Clyde Maintenance and Stabling Facility / Rosehill Services Facility.

All borehole/monitoring well sites (refer Figure 2 below) are located outside the surface construction site boundaries (but in the vicinity of the tunnelling alignment) as identified for the approved project. A targeted assessment of the scope of works was not conducted for the approved project, and as such, the existing environment, potential impacts and additional mitigation measures (if any) for the geotechnical services are subject to the assessment undertaken in this Consistency Assessment.

This Consistency Assessment has been prepared using the approved project information and site descriptions for construction activities between Sydney Olympic Park and Parramatta, as documented in the 'Relevant background information' section below.

Relevant background information (including EA, REF, Submissions Report, Director General's Report, MCoA):

This Consistency Assessment has been undertaken for the Sydney Metro West – Stage 1 Concept and major civil construction work for Sydney Metro. This includes consideration of the following planning approval documentation:

- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Environmental Impact Statement (15 April 2020)
- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Submissions Report (20 November 2020)
- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Amendment Report (20 November 2020)

- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Modification 1 - Administrative Modification (28 July 2021)
- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Modification 2 – Clyde Stabling and Maintenance Facility Modification Report (03 June 2022)
- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Modification 3 - Administrative Modification (04 July 2022)
- Consolidated Instrument of Approval (04 July 2022).

All documentation has been published on the Department of Planning and Environment Major Projects website located here (Major Project Number: SSI-10038): https://www.planningportal.nsw.gov.au/major-projects/project/25631

Other relevant documentation prepared as part of design development and construction planning include:

- Consistency Assessment SMW01: Sydney Metro West – Tunnel boring machine drive strategy and future Rosehill crossover (endorsed 13 September 2021).
- Consistency Assessment SMW04: Sydney Metro West – Revised Westmead Station Box (endorsed 16 February 2022).
- Consistency Assessment GLC02: Sydney Metro West – Clyde Dive and Portal Structure

All proposed works identified in this assessment would be undertaken in accordance with the mitigation measures identified in the EIS, Submissions Report, Amendment Report and the Ministers Conditions of Approval (MCoA).

2. Description of Proposed Development/Activity/Works

The purpose of this Consistency Assessment is to assess the location and methodology for the proposed moderate environmental risk borehole/monitoring well sites, as shown on Figure 2 below. Refer to Appendix A for more detailed location and Appendix B for the environmental characteristics for each site.

44 borehole/monitoring well locations were originally proposed as part of the DSI scope required to support the Western Tunnelling Package phase, however three (3) locations were either completed by Sydney Metro or were no longer required and subsequently removed from the package. An additional monitoring well site (MW26) was also included in the broader DSI scope of works. Of the remaining 40 locations, 16 locations were deemed as moderate environmental risk following the completion of a heritage and ecological constraints review undertaken across all borehole/monitoring well sites (refer to Appendix C).

Note: Following the first submission of this Consistency Assessment (draft version 1.1 - REV A on TeamBinder), two (2) monitoring well sites (MW32 and MW33) were relocated to be within the existing approved Sydney Metro Parramatta Station construction site boundary and will be implemented as part of general construction works for the existing approved project. No further assessment of these two monitoring well sites is provided in this Consistency Assessment. These two locations are however depicted in Figure 2 below (and relevant figures throughout this Consistency Assessment) so a record of their location is retained in the context of this Consistency Assessment.

The remaining 14 moderate risk borehole/monitoring well sites located outside of approved construction boundaries are subject to assessment under this Consistency Assessment.

The low and high environmental risk sites will be assessed in separate Consistency Assessments and are not addressed within this Consistency Assessment.

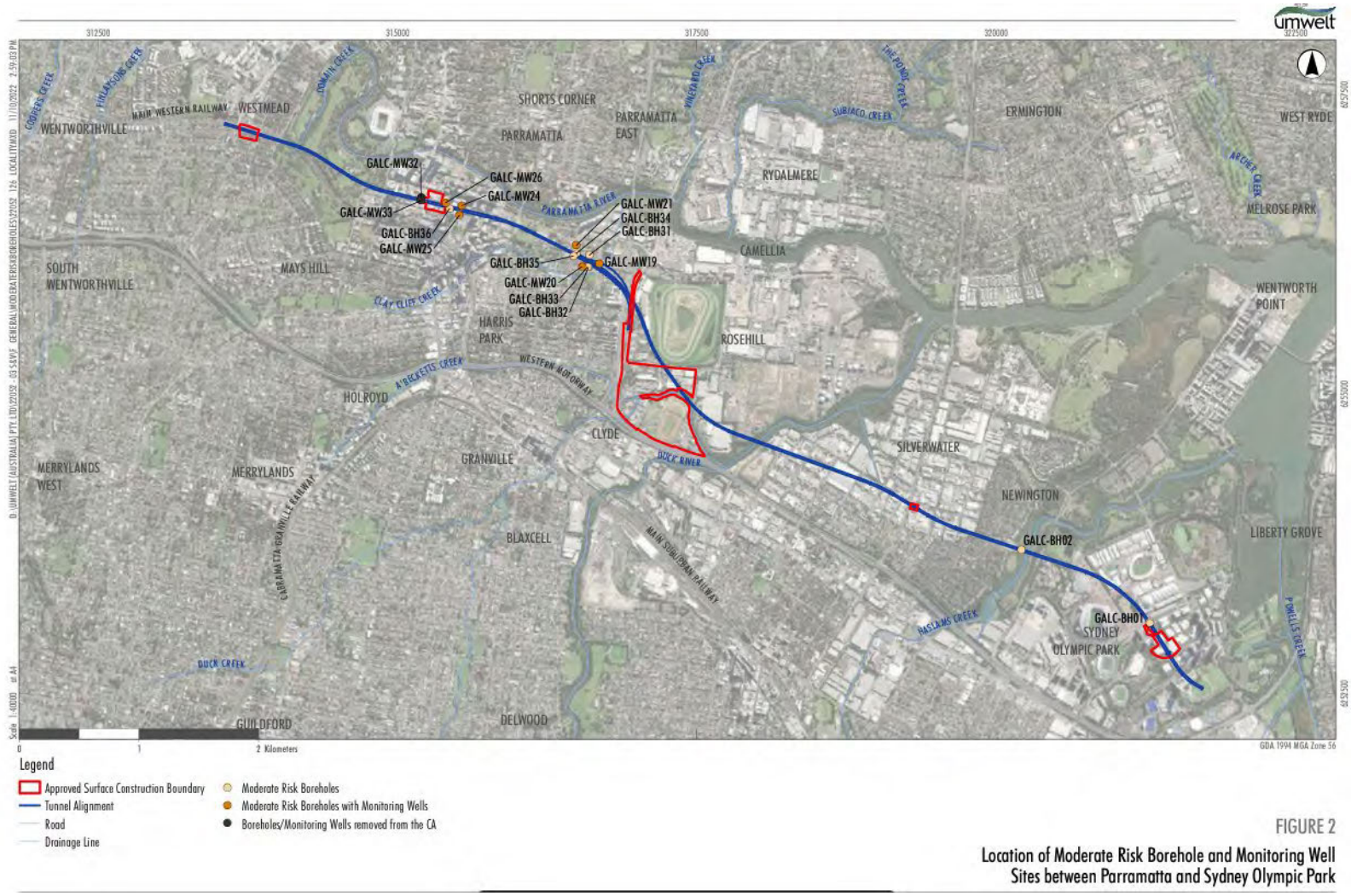


Figure 2: Location of moderate risk borehole/monitoring well sites between Parramatta and Sydney Olympic Park

Proposed Methodology

The geotechnical services involve borehole investigations and the installation of permanent monitoring wells above the underground tunnel alignment to understand groundwater conditions and soil profile to inform the project design. The proposed methodology for the geotechnical services is discussed below.

- Undertake pre-condition surveys
- Undertake site setup including traffic control, temporary site fencing, heritage buffers, shade cloths, erosion/sediment controls and noise blankets
- Undertake onsite service location, service clearance and proving activities (to determine service location, depth, and type) using an accredited service locator and non-destructive digging method
- Transport drill rig to each site via a float truck and drill boreholes using a truck or tractor mounted augur drill rig
- Drilling operation – drilling of boreholes and installation of groundwater monitoring wells where required
- Surplus soil from drilling operation to be managed as per the approved SWMP and WMP
- Any excess water will be removed from site using a vacuum truck
- Reinstate each borehole/monitoring well site, including:
    - Demobilisation of drill rig and other plant and equipment from the site including removal of any waste related to the drilling activities
    - Backfill drilled hole with grout to just under surface level
    - Reinstate surface area around drill location
    - Clean site and undertake post-construction dilapidation survey
    - Remove traffic controls and environmental controls
- Undertake fortnightly manual dripping and groundwater sampling (only required for monitoring well sites – refer to Section 4 – Site description for details on location and number of monitoring wells)
- Decommissioning of the monitoring well post completion including backfilling of the drilled hole and reinstatement of surface area consistent with the surrounding

Each drilling site will be in operation for a duration of approximately 2 weeks, inclusive of pre-works, drilling and reinstatement phases. For proposed monitoring well sites, the monitoring well will stay in place for the duration of the project (monitoring well flush to ground). The monitoring well will be decommission as required once redundant.

The location of the proposed boreholes/monitoring wells has been selected based on detailed design considerations and consultation within project teams, supported by field inspections where required. It is expected that these locations will be fit for purpose to undertake the required geotechnical investigation. However, in the event that the locations become inadequate to safely undertake the geotechnical investigations (i.e. existing services are identified during potholing that need to be avoided), a nearby location within the vicinity of the proposed site and within the same risk category (i.e. moderate risk) would be selected to carry out the geotechnical services. Each revised location would be assessed against a Health, Safety and Environment (HSE) Checklist to ensure that works could safely proceed, in accordance with the approved project.

Public safety measures and signage will be used at each site to reduce the potential for localised impacts during drilling operation. Safety cones will be placed around each site to demarcate potential trip hazards. Appropriate signage will be used at each site to notify the public of the proposed works. Community notification will also be undertaken as required. The plant and equipment required to carry out the different phases of the proposed geotechnical services include but are not limited to:

Site Setup

- Safety water barriers
- ATF fencing
- Road plates

NDD

- 1 x Road saw
- 1x vacuum truck
- 1 x 2t tipper
- 1x 5t excavator
- Hammer attachment
- 1 x watercart (occasionally if required)
- 1 x sweeper (occasionally if required)

Operations

- 1 x Drill rig
- Up to 4x light vehicles (Surveillance officer, Safety officers and field manager to conduct inspections of the work site where required)
- 1x light vehicle for the purpose of periodic groundwater well monitoring (for monitoring wells only)

Reinstatement

- Plate compactor
- General hand power tools

Nightshift (if required)

- Lighting towers

Figures 3 and 4 showing an example borehole/monitoring well site set-up, as well example monitoring well installation and sampling, are provided below:.

Figure 3: Example of a borehole/monitoring well set-up required for the proposed geotechnical services

Figure 4: Example of an installed monitoring well (left) and periodic monitoring well sampling (right)

3. Timeframe

The geotechnical services activities are estimated to take approximately two weeks per borehole/monitoring well site, inclusive of pre-works, drilling and reinstatement phases. It is expected that these works will be undertaken from October/November 2022, dependent on the approval timeline for this Consistency Assessment.

The geotechnical services are proposed to occur within the approved standard hours for the project and will comply with MCoA D37 and D38, however out-of-hours works (OOHW) may be required to carry out the proposed works at certain sites. All OOHW would be managed in accordance with the Project Noise and Vibration Management Plan, the Project EPL 21676 and the Out-of-hours Work (OOHW) Protocol (for BH/MW sites not covered by the existing EPL).

4. Site Description

There are 14 moderate risk borehole/monitoring well sites between Parramatta and Sydney Olympic Park, all of which fall within the City of Parramatta Local Government Area (LGA). These borehole/monitoring well sites have been separated into four portions being Parramatta, Rosehill, Newington, and Sydney Olympic Park (SOP), based on shared geographic locations and characteristics across borehole/monitoring well sites within each of these portions.

Refer to Table 1 for the description at each site, Appendix A for figures presenting each site, and Appendix B for further detail of the environmental characteristics within each portion.

Table 1: Site Description

BH/MW ID	Site Description
Portion 1 (Parramatta)	
MW24, MW25, MW26, BH36	Portion 1 is located in Parramatta, with MW24 and MW25 located on Barrack Lane, within approximately 140m of the eastern boundary of the Parramatta Metro surface construction site. MW26 is located on Macquarie Lane, approximately 15m north of the eastern portion of the Parramatta Metro Station surface construction site. BH36 is located on Smith Street, approximately 70m of the eastern boundary of the Parramatta Metro Station surface construction site. Portion 1 is surrounded by the Parramatta Central Business District (CBD), which consists of a mixture of residential, commercial and special purpose land use zones in all directions, extending to public recreational land uses (i.e. Parramatta Park) approximately 300m to the west. Portion 1 sites fall within the following land use zones under the Parramatta Local Environmental Plan 2011: • MW24, MW25, BH36 - 'B3 – Commercial Core' • MW26 - 'B4 – Mixed Use'
Portion 2 (Rosehill)	
MW19, MW20, MW21, BH31, BH32, BH33, BH34, BH35	Portion 2 is located in Rosehill in a primarily residential setting, approximately 350m west of the northern most boundary of the Clyde Maintenance and Stabling Facility surface construction site. All Portion 2 sites sit primarily between Hassall Street and Oak Street, bordered by Alfred Street to the west and Arthur Street to the east, with the exception of MW21, which is located further north along Alfred Street, approximately 60m north of the Hassall Street and Alfred Street intersection. All Portion 2 sites (excluding BH31 and BH34) fall within the 'R2 – Low Density Residential' land use zone under the Parramatta Local Environmental Plan 2011. BH31 and BH34 fall within the 'SP2 – Infrastructure (Classified Road)' special purposes land use zone under the Parramatta Local Environmental Plan 2011.
Portion 3 (Newington)	

BH02	Portion 3 is located in Newington, adjacent to the south eastern border of Newington Public School and located approximately 20m west of Haslams Creek. Portion 3 is generally characterised by a mixture of residential and recreational land uses, which are frequently utilised by the public. BH02 is located adjacent to Louise Savage Pathway, a walkway that provides pedestrian access north towards the broader Sydney Olympic parklands. BH02 falls within the 'RE1 – Public Recreation' land use zone under the State Environmental Planning Policy (Precincts – Central River City) 2021.
Portion 4 (Sydney Olympic Park)	
BH01	Portion 4 is located within the Sydney Olympic Park (SOP) precinct which is characterised by a mixture of land use zones (including commercial, public and private recreation, and light residential). BH01 is located on Dawn Fraser Avenue, adjacent to the Olympic Park railway station and approximately 30m east of the Sydney Olympic Park Metro Station construction site. BH01 falls within the 'B4 – Mixed Use' land use zone under the State Environmental Planning Policy (Precincts – Central River City) 2021.

5. Site Environmental Characteristics

The proposed borehole/monitoring well sites are generally located in proximity to the tunnel alignment between Parramatta to Sydney Olympic Park. As these sites are located outside the surface construction site boundaries, environmental characteristics for each site have not been previously described as part of the approved project.

A desktop assessment, review of the EIS and supporting assessments, as well as site inspections in July/August 2022 at publicly accessible locations was undertaken to understand the existing environment for each site and potential impacts associated with the proposed works. A desktop heritage and ecological constraints review of the borehole/monitoring well sites was also undertaken to support the broader DSI scope of works (refer to Appendix C).

The surrounding environmental characteristics is described for each site in Appendix B of this Consistency Assessment but summarised below for the broader scope of works.

Land Use

A review of the NSW Spatial Services Historical Imagery Viewer was undertaken in August 2022 to understand the historic and current land use for each site.

The land surrounding these sites were typically used for agricultural purposes and residential areas prior to the 1950s. Parramatta CBD and Sydney Olympic Park gradually developed into commercial precincts leading up to the early 2000s. Areas around Westmead and Silverwater developed into higher density residential areas. The land surrounding the borehole/monitoring well sites in Clyde and Rosehill were historically used as racecourses (for horses and vehicles) and developed into industrial areas between the 1950s and 1970s.

Currently, all borehole/monitoring well sites sit within industrial, commercial and residential land use areas, excluding BH02 which is located on land zoned as public recreation.

Aboriginal Heritage

The Aboriginal Heritage Information System (AHIMS) database, administered by Heritage NSW, contains records of all Aboriginal objects reported to Heritage NSW in accordance with Section 89A of the NPW Act. It also contains information about Aboriginal places, which have been declared to have Aboriginal cultural significance. Recorded Aboriginal objects and declared Aboriginal places are defined under the NPW Act as 'Aboriginal sites'. A search of the AHIMS register undertaken on the 6 July 2022 for a representative area encompassing and extending beyond (distances varied) all infrastructure under investigation (i.e., the 'AHIMS search area'; AHIMS Reference: 697967 and 697938) which identified 187 Aboriginal sites. No Aboriginal sites are located within the footprints of any proposed geotechnical testing locations; however, seven (7) proposed locations are within the mapped Pleistocene unit of the archaeologically-sensitive Parramatta Sand Body, including GALC-BH36, GALC-MW24, GALC-BH31, GALC-BH34, GALC-BH35, GALC-MW19 and GALC-MW21. However, in consideration of the available evidence, the current assessment determined that the risk of intercepting extant Aboriginal objects is unlikely due to the small (c. 150 mm) impact footprint of the proposed boreholes. Site cards and archaeological reports were obtained as required, as well as review of applicable previous Aboriginal archaeological assessments.

Key observations to be drawn from this review of both the environmental and Aboriginal archaeological context of the geotechnical investigation sites and environs are as follows:

- The topography of land within the geotechnical investigation sites suggests that landscape elements within it would have been favourable to occupation, being flat, open areas adjacent to Parramatta River and its associated tributaries.
- Contemporary condition notwithstanding, major watercourses in the vicinity of the geotechnical investigation sites; the Parramatta River, Haslams Creek and Clay Cliff Creek, would likely have supported diverse plant and faunal resources, as well as providing an important transport network towards Sydney Harbour and as such, represented favourable environs for Aboriginal occupation. The prevalence of recorded Aboriginal sites along the Parramatta River and environs attests to these watercourses as local focal points for Aboriginal occupation.
- Instances of deep (>250 cm) Yellow Podzolic Soils of the Birrong (bg) soil landscape (Chapman and Murphy 1989:88) and locally associated with the 'Parramatta Sand Body' are mapped within parts of the geotechnical investigation sites. Reference to previous archaeological (e.g., AHMS 2013; AHMS 2014; Dominic Steele Consulting Archaeology 2017; KNC Pty Ltd 2017) and geomorphological (e.g., Mitchell 2008) investigations undertaken within the Parramatta CBD environs indicates that Aboriginal archaeological evidence is often associated with this stratigraphy.

- While contemporary vegetation communities within the geotechnical investigation sites are generally not indicative of pre-European occupation, indicative mapping suggests that pre-European vegetation regimes would have supported a range of terrestrial faunal and floral resources favoured by Aboriginal peoples occupying the geotechnical investigation sites and environs.

Refer to Appendix D for the combined Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment.

Historical (non-Aboriginal) Heritage

A desktop review of relevant heritage registers (i.e. Australian Heritage Database, NSW State Heritage Inventory (SHI) and Schedule 5 of relevant Local Environmental Plans (LEP) was undertaken in August/September 2022. A visual inspection of the geotechnical investigation sites by Umwelt's Luke Wolfe (Principal Archaeologist) was then undertaken on Wednesday, 7 September 2022. Key observations to be drawn from this review of the historical (non-Aboriginal) heritage context of the geotechnical investigation sites and environs are as follows:

- Two (2) historical items 'State Abattoirs Conservation Area' and 'Elizabeth Farm Conservation Area' intersect with the locations of four (4) proposed geotechnical testing locations; GALC-BH01, GALC-MW20, GALC-BH32 and GALC-BH33. The State Abattoirs Conservation Area is located within the Abattoir Heritage Precinct, a collection of five buildings, set within landscaped gardens in Sydney Olympic Park. All fabric associated with the State Abattoirs Conservation Area are largely isolated to the area bounded by Herb Elliott Avenue, Showground Road, Dawn Fraser Avenue and the Railway Garden.
- Three (3) proposed geotechnical testing locations, GALC-MW26, GALC-MW25 and GALC-MW24 fall within 5 m of heritage items; the 'Roxy Theatre', 'Convict barracks wall' and 'Warders Cottage', respectively.
- The visual inspection component of the current inspection did not observe any surface evidence or historical fabric located within the proposed footprints of the associated geotechnical testing locations.
- The item currently listed as 'Item – General (I655)' comprises Parramatta Convict Drain located beneath Macquarie Lane and 74 Macquarie Street. The proposed geotechnical testing location 'GALC-BH36' is located approximately 30 m south of the estimated location of the Parramatta Convict Drain heritage item (GML Heritage 2021:207).
- The proposed footprints of all proposed geotechnical testing locations in the Parramatta CBD environs are located within footpaths and/or road corridors. Reference to historical mapping indicates that road alignments have remained largely unchanged since the early 19th century, suggesting that the archaeological potential of the road corridors is limited. While it is unlikely that former buildings, building footings etc would be present. Evidence of former road surfaces (hoggin surfaces, cobblestones etc), within these alignments may however, remain.

- Seven (7) geotechnical testing locations (GALC-BH36, GALC-MW24, GALC-BH31, GALC-BH34, GALC-BH35, GALC-MW19 and GALC-MW21) are within the mapping extents of the SHR listed Parramatta Sand Body, which will result in highly-localised (c.150 mm), minor adverse impact to the item but will not impact on the overall significance as a geomorphological landscape element.
- In summary, through a review of environmental and archaeological context for the Project area and environs, the current assessment identified that the some of the proposed geotechnical testing locations intersect the curtilages of existing historic heritage items. However, these items were determined to retain no or low archaeological potential and will have no other impacts to the items' historical and/or aesthetic heritage values.

Refer to Appendix D for the combined Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment.

Noise and Vibration

A Construction Noise and Vibration Impact Assessment (CNVIA) was prepared by SLR Consulting in October 2022 to assess potential noise and vibration impacts associated with the geotechnical service scope of works along the project alignment during approved hours and out-of-hours (OOH) assessment periods. The CNVIA was prepared to assess potential noise and vibration impacts of the moderate risk borehole/monitoring well site. . An assessment of predicted NML exceedances at NCA's in which boreholes fall within is provided in Appendix B. The assessment mainly assesses the potential noise impact of each site separately, however the construction team may carry out works on BH32, BH33 and MW20 at the same time to limit the impact on the surrounding community and therefore the CNVIA also includes a cumulative assessment on these potential concurrent works.

Refer to Appendix E for the CNVIA prepared across the 14 moderate risk borehole/monitoring well sites.

Surface Water and Groundwater

The borehole/monitoring well sites are located at varying distances from local watercourses. The four sites within Portion 1 are located within 300m to 400m of Parramatta River (which is north of the sites), with MW24 being the closest site to Parramatta River. The eight boreholes within Portion 2 are within 220m to 425m of Parramatta River (also north of the sites), with MW21 being the closest site to Parramatta River. The borehole in Portion 3 is located 20m to the west of Haslams Creek. The borehole in Portion 4 is located approximately 870m southeast of Haslams Creek.

Parramatta River and Haslams Creek are considered to be sensitive receiving environments due to their proximity to Coastal Wetlands and mapping by the NSW Department of Primary Industries (DPI) as Key Fish Habitat.

There are terrestrial groundwater dependent ecosystems associated with vegetation along Parramatta River and Haslams Creek.

Soils and Contamination

In addition to reviewing the EIS and supporting documents, a search of the NSW Environmental Protection Authority (EPA) public registers and the NSW DPE eSPADE portal were undertaken in August 2022.

The borehole/monitoring well sites are located on the Cumberland Plain, an extensive low-lying plain within the Cumberland Basin, within three soil landscapes; Blacktown, Disturbed Terrain and Birrong.

The sites within Portion 1 and Portion 3 are located within approximately 250m of an Area of Environmental Interest (AEI) with moderate contamination risk (as identified in the EIS) due to current and historical activities. Portion 3 is also within 250m of an AEI with high contamination risk, which has known waste and groundwater contamination due to uncontrolled landfilling.

No areas of acid sulfate soil risk were identified for the borehole/monitoring well sites. Refer to Appendix F for figures showing areas of acid sulfate soil risk in context to the borehole/monitoring well sites.

Biodiversity

Borehole/monitoring well locations with potential for ecological risk were identified as part of the heritage and ecological constraints review across all 41 boreholes (refer to Appendix C). Of the 41 boreholes/monitoring well sites, five were deemed as having ecological constraints, of which one site within Portion 3 (BH02) was deemed as having moderate ecological risk and is subject to assessment within the biodiversity briefing note prepared to support this Consistency Assessment (refer to Appendix G).

The biodiversity briefing note identified two threatened flora species (Narrow-leafed Wilsonia and *Zannichellia palustris*) and two threatened fauna species (Grey-headed Flying Fox and Green and Golden Bell Frog) as having a high likelihood of occurrence within the study area, however these species were not identified during the site visit or rapid flora surveys. Narrow-leafed Wilsonia, *Zannichellia palustris* and Green and Golden Bell Frog may be directly impacted by ground disturbing works, but this is considered to be unlikely with appropriate mitigation measures in place. There may be some impacts to suitable habitat for the Grey-headed Flying Fox due to trimming of native vegetation, and Green and Golden Bell Frog as a result of ground disturbing works, however this is expected to be minor and not impact the availability of resources.

The biodiversity briefing note also identified one Plant Community Type (PCT) within the BH02 site and 50m study area, which conforms to two threatened ecological communities (TECs) listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) *and Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Assessments of significance were carried out under the BC Act and EPBC Act, which found that the proposed works, including trimming of overhanging tree branches and ground disturbance works, were unlikely to have a significant impact on the TECs.

All other remaining portions (i.e. Portion 1, 2 and 4) are located over 50m from PCTs and are unlikely to have any impacts to biodiversity.

Traffic, Transport and Access

All borehole/monitoring well sites are located in publicly accessible locations with adequate parking to accommodate vehicle use required for the geotechnical services. Traffic control will be established at each borehole/monitoring well site to safety coordinate and mange local traffic whilst undertaking the necessary geotechnical services. Periodic visitation of monitoring wells following installation will also be required, which would involve the use of a standard fleet vehicle to access the monitoring well.

All work on or adjacent to roads would be carried out in accordance with a relevant Traffic Control Plan (TCP) and/or Road Occupancy Licence (ROL) to facilitate safe work near live traffic. Where an ROL cannot be obtained for the approved project hours and/or proposed works cannot be undertaken safely during these hours, some works will be required to be undertaken outside of approved project hours (i.e. Out of Hours Work, OOHW).

Land access agreements will be in place for each of these borehole/monitoring well site prior to commencement of works.

6. Justification for the proposed works

The proposed geotechnical services along the underground tunnel alignment between Parramatta and Sydney Olympic Park are required to collect geotechnical, groundwater and soil profile information deemed necessary to facilitate the design of the Project. The periodic visitation of the monitoring wells is also required to obtain real-time groundwater conditions, including groundwater levels and flow conditions, groundwater quality and enables the evaluation of hydraulic properties of water-bearing strata, as required.

Without the proposed geotechnical services scope of works occurring, these essential geotechnical inputs will not be available to inform the design of the project.

7. Environmental Benefit

Due to the minor scope associated with the proposed geotechnical services, no significant environmental benefits are expected.

8. Control Measures

The proposal would be undertaken in accordance with the mitigation measures and the conditions of approval for the approved Sydney Metro West – Stage 1 project. Any additional mitigation measures identified in this assessment will be implemented as required. The proposal would be managed in accordance with the approved Construction Environment Management Plan (CEMP) and CEMP Sub-plans.

9. Climate Change Impacts

No change in climate change risk (as identified in the EIS) will occur as a result of the proposed geotechnical surveys.

10. Impact Assessment – Construction

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Flora and fauna	BH02 within Portion 3 is within a patch of PCT 4023: Coastal Valleys Swamp Oak Riparian Forest, which conforms to two TECs listed under the BC Act and EPBC Act. Direct impacts to this PCT is expected to be minimal, with appropriate mitigations in place to reduce the total extent of impact to the ground stratum and canopy. There may be direct impacts to Narrow-leafed Wilsonia, *Zannichellia palustris* and Green and Golden Bell Frog during ground disturbing works, but this is considered unlikely with appropriate mitigation measures in place. There may be some impacts to suitable habitat for the Grey-headed Flying Fox due to trimming of native vegetation, and Green and Golden Bell Frog as a result of ground disturbing works, however this is expected to be minor and not impact the availability of resources. All other remaining portions (i.e. Portion 1, 2 and 4) are located over 50m from PCT's and are unlikely to have any impacts to biodiversity.	The Sydney Metro West – Western Tunnelling Package – Flora and Fauna Management Plan (SMWSTWTP-GLO-1NL-NL000-EO-PLN-000001) will be implemented where applicable. The following targeted mitigation and management measures will be implemented for works within Portion 3, as identified in Appendix G: • No-go zones to be implemented around PCT 4023 for areas outside the proposed works footprint • Establishment of 'impact limits' and exclusion zones for trimming of branches • Grass seeds selected for remediation of ground disturbed areas should include sterile cover crop species • Hygiene controls for all vehicles, machinery, equipment and people working at the site to minimise weed and pathogen dispersal • Any weed material removed will be disposed of in a suitable waste facility and not mulched on site	Y	Y	
Water (surface and groundwater)	The proposed works would have negligible impact on surface water, as there will be minimal ground disturbance near watercourses. There is potential for erosion and sediment impacts, however these will be	The Sydney Metro West – Western Tunnelling Package – Soil and Water Management Plan (SMWSTWTP-GLO-1NL-EN-PLN-000001) and Sydney Metro West – Western Tunnelling Package –	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	minimised with the implementation of appropriate control measures. The proposed geotechnical services will interact with groundwater during temporary borehole works and installation of permanent groundwater monitoring wells. The proposed geotechnical services are considered as minor and are unlikely to result in substantial groundwater impacts outside of those already assessed and understood under the approved project.	Groundwater Management Plan (SMWSTWTP-GLO-1NL-EN-PLN-000002) will be implemented where applicable. In addition, appropriate erosion and sediment controls will be implemented in accordance with the Blue Book and Attachment 3 (Erosion and Sediment Control Plan) of the Soil and Water Management Plan.			
Air quality	No additional impacts to the approved project, as the proposed geotechnical services will only generate minor, localised air quality emissions from the operation of plant and machinery required to undertake the geotechnical services.	No additional measures required. The Sydney Metro West – Western Tunnelling Package – Air Quality Management Plan (SMWSTWTP-GLO-1NL-NL000-AH-PLN-000001) will be implemented where applicable.	Y	Y	
Noise and vibration	A Construction Noise and Vibration Impact Assessment (CNVIA) was prepared by SLR Consulting in October 2022 to assess potential noise and vibration impacts associated with the geotechnical service scope of works along the project alignment during approved hours and out-of-hours (OOH) assessment periods. An assessment of predicted NML exceedances at NCA's in which the three Portions fall within is provided in Appendix B, and is summarised below: <u>Portion 1 (Parramatta)</u> • No exceedances are expected to occur at residential receivers within NCA03 during approved construction hours, and exceedances of 11- 20 dBA above the NML may occur at five (5) receivers may occur within NCA03 during night time OOHW.	The following targeted mitigation and management measures will be implemented where feasible and reasonable: • Implement mitigation measures identified within the CNVMP and DNVIS • Implement additional mitigation measures identified within the CNVMP and DNVIS • Ensure the minimum sized equipment necessary to complete the work are used • Implement portable noise barriers around noise intensive activities (i.e. drill rig)	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	Portion 2 (Rosehill) • Exceedances of up to >30 dBA above the NML may occur at up to 10 residential receivers within NCA04 during approved construction hours, and exceedance of >30 dBA above the NML may occur at 19 residential receivers within NCA04 during night time OOHW. • If BH32, BH33 and MW20 are undertaken concurrently, exceedances of up to 20-30dBA above the NML may occur at up to six (6) residential receivers during approved construction hours, and exceedances of >30dBA above the NML may occur at up to 9 residential receivers during night time OOHW Portion 3 (Newington) • Exceedances of up to 11-20 dBA above the NML may occur at up to five (5) residential receivers within NCA07 during approved construction hours, and exceedance of 20-30 dBA above the NML may occur at five (5) residential receives within NCA07 during night time OOHW. Portion 4 (SOP) • Exceedances of 1-10 dBA above the NML may occur at up to one (1) receiver during approved construction hours within NCA08, and exceedances of 1-10 dBA above the NML may occur at five (5) residential receivers within NCA08 during night time OOHW. A number of mitigation and management measures have been recommended. Where feasible and reasonable these should be applied to the project to	• Where multiple crews work simultaneously during the geotechnical investigations. Crews should avoid working within 500 m of each other to avoid cumulative impacts. • Provide respite periods for noise intensive activities • Shut down plant and machinery, including vehicles when not in operation • Notification to potentially affected receivers prior to OOHW • Undertake noise monitoring during works to confirm noise predictions. Monitoring locations should be targeted to most affected receivers or representative locations nearby. The Sydney Metro West – Western Tunnelling Package – Noise and Vibration Management Plan (SMWSTWTP-GLO-1NL-NL000-NV-PLN-000001) will be implemented where applicable.			

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	control and minimise the impacts during construction as far as practicable.				
Indigenous heritage	The results of the heritage and ecological constraints review (Appendix C) indicated that the 'moderate risk' boreholes and monitoring wells listed in this CA required further investigation of Aboriginal heritage. This has occurred as documented in the Appendix D combined Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment. The key findings of the Aboriginal component of this due diligence assessment were: • No registered Aboriginal sites are present within the geotechnical investigation sites and no new Aboriginal sites were identified during the visual inspection component of the current assessment. • A single Aboriginal site, 'Church St PAD-1' (AHIMS #45-6-4015) is located approximately 70m west of the eastern portion of the Parramatta Metro Station surface construction site boundary, though ultimately outside the footprints of both geotechnical testing locations. • Mapped instances of the Parramatta Sand Body occur within parts of the geotechnical investigation sites that are in the Parramatta CBD environs. Reference to previous archaeological and geomorphological investigations undertaken within the Parramatta CBD environs indicates that often significant Aboriginal archaeological evidence is associated with the Parramatta Sand Body, suggesting subsurface Aboriginal objects may be present in the Parramatta CBD portions of the geotechnical investigation sites.	The relevant control measures identified in the Sydney Metro West – Western Tunnelling Package – Heritage Management Plan (SMWSTWTP-GLO-1NL-HE-PLN-000001) will be implemented where applicable. Based on the findings of the Appendix D Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment two general recommendations were provided. These measures are already addressed within SMWSTWTP-GLO-1NL-HE-PLN-000001 and will be implemented. They are reproduced below for clarity: **Recommendation 1**. All relevant contractors and GLC personnel should be made aware of the nature and location of previously recorded Aboriginal and historic sites near the works. All relevant contractors and GLC personnel should also be made aware of their legal responsibilities under the NP&W Act 1974 and the Heritage Act 1977 and the need to avoid impacts adjacent sites/items. **Recommendation 2**. If, in the unlikely event that Aboriginal objects are located during the works, all works in the area must cease immediately and the Sydney Metro Unexpected Heritage Finds Procedure (SM-18-00105232) must be implemented.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	In summary no Aboriginal sites are located within the footprints of any proposed geotechnical testing locations; however, a number are located within the archaeologically sensitive Parramatta Sand Body. However, in consideration of the available evidence, the current assessment determined that the risk of intercepting extant Aboriginal objects is unlikely due to the small (c. 150 mm) impact footprint of the proposed boreholes. In view of the above, the proposed geotechnical testing activities will have negligible impact to Aboriginal sites. The Appendix D combined Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment concluded that works may proceed without any further archaeological or heritage assessment, approvals or associated constraint. Three recommendations were however provided.	In addition the Appendix D combined Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment recommended **(Recommendation 3)**: '*in the event that any proposed geotechnical testing location is moved for any reason, the revised location must be evaluated by a qualified heritage advisor to determine if the location represents a risk to Aboriginal heritage*'. This will occur if changes to geotechnical testing locations are identified.			
Non-indigenous heritage	The results of the heritage and ecological constraints review (Appendix C) indicated that the 'moderate risk' boreholes and monitoring wells listed in this CA required further investigation of Aboriginal heritage. This has occurred as documented in the Appendix D combined Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment. The key findings of the historical (non-Aboriginal) component of this due diligence assessment were: • Two (2) historical items 'State Abattoirs Conservation Area' and 'Elizabeth Farm Conservation Area' intersect with the locations of four (4) proposed geotechnical testing locations; GALC -BH01, GALC-MW20, GALC-BH32 and GALC-BH33. The visual inspection component of the current inspection did not observe any surface evidence or historical fabric located	The relevant control measures identified in the Sydney Metro West – Western Tunnelling Package – Heritage Management Plan (SMWSTWTP-GLO-1NL-HE-PLN-000001) will be implemented where applicable. Based on the findings of the Appendix D Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment three general recommendations were provided. These measures are already addressed within SMWSTWTP-GLO-1NL-HE-PLN-000001 and will be implemented. They are reproduced below for clarity: **Recommendation 1**. All relevant contractors and GLC personnel should be made aware of the nature and location of	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	within the proposed footprints of the associated geotechnical testing locations. • Pertinent to the works, the CMP (Devine, 2013) identifies that the Abattoir Heritage Precinct has low historical archaeological potential. • Three (3) proposed geotechnical testing locations, GALC-MW26, GALC-MW25 and GALC-MW24 fall within 5 m of heritage items; the 'Roxy Theatre', 'Convict barracks wall' and 'Warders Cottage', respectively. • The proposed works, being minor and highly localised in nature, will result in minor adverse impact to the broader geomorphological significance of the SHR-listed Parramatta Sand Body at five (5) sites, but will not reach the material threshold to be considered 'materially affected'. Through a review of environmental and archaeological context for the geotechnical investigation sites and environs, the current assessment identified that the some of the proposed geotechnical testing locations intersect the curtilages of existing heritage items. However, these items were determined to retain no or low archaeological potential and will have no other impacts to the items' historical and/or aesthetic heritage values. Three geotechnical investigation sites are located within 5m of a State or Local listed heritage item. GLC will investigate the vibration specification of all drilling equipment to determine the minimum safe working distance. The Appendix D combined Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment concluded that works may proceed without any further	previously recorded historic sites that lie within and near the geotechnical investigation sites, noting that a number of historic heritage items lie within 15 m. Proposed drilling equipment must be reviewed to determine the potential for generation of vibration. Proposed geotechnical testing locations which fall within 15 m must be moved away from historic heritage items if the minimum distance (5 m) is exceeded and/or proposed drilling equipment exceeds the specification identified in the Sydney Metro Construction Noise and Vibration Standard. All relevant contractors and GLC personnel should also be made aware of their legal responsibilitiesand the need to avoid impacts adjacent sites/items. **Recommendation 2**. If, in the unlikely event that historical relics are located during the works, all works in the area must cease immediately and the Sydney Metro Unexpected Heritage Finds Procedure (SM-18-00105232) must be implemented. **Recommendation 3.** GLC will contact the heritage advisor responsible for prior approvals in the Parramatta Metro construction site to determine if the proposed geotechnical locations GALC-MW32 and GALC-MW33 represent a risk to extant archaeological elements/fabric. In addition the Appendix D combined Aboriginal and Non-Aboriginal Heritage Due Diligence Assessment recommended:			

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	archaeological or heritage assessment, approvals or associated constraint. Three recommendations were however provided.	**(Recommendation 4)** '*in the event that any proposed geotechnical testing location is moved for any reason, the revised location must be evaluated by a qualified heritage advisor to determine if the location represents a risk to historical heritage*'. This will occur if changes to geotechnical testing locations are identified.			
Community and stakeholder	Consultation would continue with stakeholders in line with the approved project, and updates would be provided through the existing communication streams. As such, no additional impacts to the approved project are anticipated as a result of the geotechnical services scope of works.	No additional measures required. Land access approvals will be sought prior to commencement of works. Consultation by GLC is occurring with relevant councils and stakeholders for geotechnical investigations outside the approved construction site boundaries. Updates will be regularly provided through communication streams for the approved project.	Y	Y	
Traffic	Minor, temporary traffic-related impacts are anticipated during the proposed geotechnical services scope of works. Periodic visitation of monitoring wells following installation will also be required, which would involve the use of a standard fleet vehicle to access the monitoring wells as required. Traffic control will be established at each borehole/monitoring well site to safety coordinate and mange local traffic whilst undertaking the necessary geotechnical services. As such, traffic related impacts are expected to be minimal and temporary in nature.	All work on or adjacent to roads would be carried out in accordance with a relevant TCP and/or ROL to facilitate safe work near live traffic. Where an ROL cannot be obtained for the approved project hours and/or proposed works cannot be undertaken safely during these hours, some works will be required to be undertaken outside of approved project hours (i.e. Out of Hours Work, OOHW). The Sydney Metro West – Stage 1 Construction Traffic Management Framework will be implemented where applicable.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Waste	No additional impacts to the approved project. The geotechnical services scope of works will generate a small amount of waste which will be managed as per the approved WMP.	No additional measures required. The Sydney Metro West – Western Tunnelling Package – Waste Management Plan (SMWSTWTP-GLO-1NL-NL000-WM-PLN-000002) will be implemented where applicable.	Y	Y	
Social	Some of the proposed works will have temporary impacts with the local community including businesses due to their locations (e.g. footpath, near sensitive receivers). Those impacts will be managed as per the approved CNVMP and DNVIS. Mitigation measures listed in the CNVIA (Appendix E) will also be implemented as required. Consultation would continue with stakeholders in line with the approved project, and updates would be provided through the existing communication streams. If OOHW are required, specific notifications will be sent to impacted receivers as per the approved project. The level of noise impacts will define the appropriate notification processes (e.g. door knock, respite offers)..	No additional measures required. The Sydney Metro West – Western Tunnelling Package – Noise and Vibration Management Plan (SMWSTWTP-GLO-1NL-NL000-NV-PLN-000001) and the Overarching Community Communication Strategy will be implemented where applicable.	Y	Y	
Economic	The geotechnical services scope of works will interact with local businesses at some locations. The impacts (e.g. parking spaces availability, noise) will be of short duration and will be managed via consultation processes. The scope will not contribute to the economical value of the project.	No additional measures required. Consultation by GLC is occurring with relevant businesses and stakeholders for geotechnical investigations outside the approved construction site boundaries. Updates will be regularly provided through communication streams for the approved project.	Y	Y	
Visual	There will be minor changes to each borehole/monitoring well site when works are being	No additional measures required. The Sydney Metro West – Western Tunnelling	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	undertaken, however these will be temporary in nature and the sites will be reinstated to their previous condition once works are completed. As such, no additional impacts to the approved project are anticipated as the geotechnical services scope of works will not permanently alter the visual landscape of each site.	Package – Visual Amenity Management Plan (SMWSTWTP-GLO-1NL-NL000-EN-PLN-000003) will be implemented where applicable.			
Urban design	No additional impacts to the approved project, as the geotechnical services scope of works will not modify the existing urban design at each site.	No additional measures required.	Y	Y	
Geotechnical	The proposed geotechnical services will interact with geotechnical aspects of the environment at each borehole/monitoring well, as expected due to the nature of the proposed works. However no impacts to geotechnical aspects are anticipated as a result of the proposed geotechnical services outside of those already assessed and understood under the approved project.	No additional measures required.	Y	Y	
Land use	No additional impacts to the approved project, as the geotechnical services scope of works will only temporarily change the existing land use for each site during construction.	No additional measures required.	Y	Y	
Contamination	The sites within Portion 1 and Portion 3 are within approximately 250m of AEIs with moderate to high risk of contaminated soil, vapour and groundwater. As such, there is potential for the proposed works to interact with contaminated soil and groundwater. However, contamination impacts will be minimised with the appropriate mitigation measures in place. No sites are within areas at risk of encountering acid sulfate soils.	The Sydney Metro West – Western Tunnelling Package – Soil and Water Management Plan (SMWSTWTP-GLO-1NL-EN-PLN-000001) will be implemented where applicable. The following targeted control measures will be implemented: • Any contamination identified will require management in accordance with the Soil and Water Management	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
		Plan and relevant guidance made or approved by the EPA under Section 105 of the *Contaminated Land Management Act 1997.* • In-situ waste classification will occur for each site in accordance with the Waste Classification Guidelines (NSW EPA, 2014), which will allow material to be excavated and transported offsite to an appropriate facility. • All spills and leaks from vehicles and machinery will be immediately contained and managed. • If any unexpected contamination is identified, the procedure in Attachment 4 of Soil and Water Management Plan will be implemented. • If acid sulfate soils are encountered, they would be effectively managed in accordance with the Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998).			
Climate Change	The use of minor plant/equipment and light vehicles required to undertake the geotechnical services at each site are the only anticipated source of any greenhouse gas emissions proposed under this Consistency Assessment. As such, no additional impacts to the approved project are anticipated.	No additional measures required.	Y	Y	
Risk	No additional impacts to the approved project, as the risks associated with the geotechnical services scope	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	of works are consistent with the project risks for minor activities.				
Other	No additional impacts to the approved project.	No additional measures required.	Y	Y	
Management and mitigation measures	No additional impacts to the approved project.	No additional measures required.	Y	Y	

11. Impact Assessment – Operation

As noted in Section 3.0 above, the proposed geotechnical services works are predominantly limited to the construction phase, with the exception of the installation of permanent groundwater monitoring wells at six of the 14 moderate risk sites identified in this Consistency Assessment.

Furthermore, Stage 1 of the planning application for Sydney Metro West (subject of this Consistency Assessment) is for major civil construction work for Sydney Metro West between Westmead and The Bays.As discussed below, operational impacts of the proposal are negligible, and therefore there are no changes from the approved project are anticipated.

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed activity/works, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Flora and fauna	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Water	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Air quality	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Noise vibration	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Indigenous heritage	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Non-indigenous heritage	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Community and stakeholder	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed activity/works, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Traffic	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Waste	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Social	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Economic	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Visual	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Urban design	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Geotechnical	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed activity/works, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Land use	The geotechnical services involve the installation of permanent monitoring wells above the underground tunnel alignment to understand groundwater conditions to inform the project design. The installation of permanent monitoring wells is proposed at the following sites: • MW19, MW20, MW21, MW24, MW25 and MW26 These locations would also be accessed periodically to undertake groundwater monitoring as required. The installation of small monitoring wells is not considered as a substantial change to the existing use of the land at each monitoring well site and will have a minimal impact on the existing land use at these locations.	No additional measures required.	Y	Y	
Climate Change	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Risk	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Other	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	
Management and mitigation measures	As the scope of works are temporary and limited to the construction phase, these works will not change the operation of the approved project.	No additional measures required.	Y	Y	

12. Consistency with the Approved Project

Based on a review and understanding of the existing Approved Project and the proposed modifications, is there is a transformation of the Project?	No. The proposal would not transform the project. The project would continue to provide major civil works between Westmead and The Bays as part of the approved project.
Is the project as modified consistent with the objectives and functions of the Approved Project as a whole?	Yes. The proposal would be consistent with the objectives and functions of the approved project.
Is the project as modified consistent with the objectives and functions of elements of the Approved Project?	Yes. The proposal would be consistent with the objectives and functions of the approved works for the project. The activities proposed to be undertaken are generally consistent with the activities identified for the approved project.
Are there any new environmental impacts as a result of the proposed works/modifications?	No. There would be no new environmental risks as a result of the proposal. All risks identified for the approved project and the proposal would be adequately addressed through the application of the mitigation measures provided in the Environmental Impact Statement, Submissions Report, Amendment Report and the Instrument of Approval.
Is the project as modified consistent with the conditions of approval?	Yes. The proposal would be consistent with the conditions of approval.
Are the impacts of the proposed activity/works known and understood?	Yes. The impacts of the proposal are understood and will be accounted for by implementing the existing mitigation measures provided in the Environmental Impact Statement, Submissions Report, Amendment Report and the Instrument of Approval for the approved project. These would be implemented through the Sydney Metro Construction Environment Management Framework, Construction Traffic Management Framework and Construction Noise and Vibration Standard, as well as the CEMP and CEMP sub-plans.
Are the impacts of the proposed activity/works able to be managed so as not to have an adverse impact?	Yes. The impacts of the proposal can be managed to avoid an adverse impact.

13. Other Environmental Approvals

Identify all other approvals required for the project:	• A Work Permit is required for activities within Sydney Olympic Park. GLC will seek a permit from the Sydney Olympic Park Authority (SOPA) prior to works commencing at BH01 and BH02. • Road Occupancy Licences (ROL) will be obtained for all work on or adjacent to roads. • Approval for works that are required outside of approved construction hours (i.e. OOHW) will be sought in accordance with Condition D37 and/or D38 of the Instrument of Approval.

Author certification

To be completed by person preparing checklist.

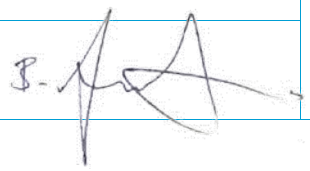
I certify that to the best of my knowledge this Consistency Checklist: • Examines and takes into account the fullest extent possible all matters affecting or likely to affect the environment as a result of activities associated with the Proposed Revision; and • Examines the consistency of the Proposed Revision with the Approved Project; is accurate in all material respects and does not omit any material information.			
Name:	Candice Somerville	Signature:	
Title:	Environmental Approvals Manager		
Company:	GLC	Date:	18 October 2022

This section is for Sydney Metro only.

Application supported and submitted by			
Name:	Yvette Buchli	Date:	20/10/2022
Title:	Associate Director – Planning and Approvals	Comments:	
Signature:			

Based on the above assessment, are the impacts and scope of the proposed activity/modification consistent with the existing Approved Project?

Yes	The proposed activity/works are consistent and no further assessment is required.
No	The proposed works/activity is not consistent with the Approved Project. A modification or a new activity approval/ consent is required. Advise Project Manager of appropriate alternative planning approvals pathway to be undertaken.

Endorsed by			
Name:	Ben Armstrong	Date:	21 October 2022
Title:	A/Director, Project ESP	Comments:	
Signature:			

Appendix A – Borehole/Monitoring Well Locations

Legend

- Approved Surface Construction Boundary
- Tunnel Alignment
- Moderate Risk Boreholes
- Moderate Risk Boreholes with Monitoring Wells
- 50m Search Buffer
- Boreholes/Monitoring Wells removed from the CA

Image Source: Nearmap (May 2022) Data source: DFSI (2021)

APPENDIX A.1

Borehole and Monitoring Well Locations

D:\UMWELT (AUSTRALIA) PTY LTD\2052 - 03 S&WF GENERAL\MODERATERISKBOREHOLES\2052 128 BOREHOLES ROSEHILL.MXD 11/10/2022 2:50:14 PM

Scale 1:2000 at A4

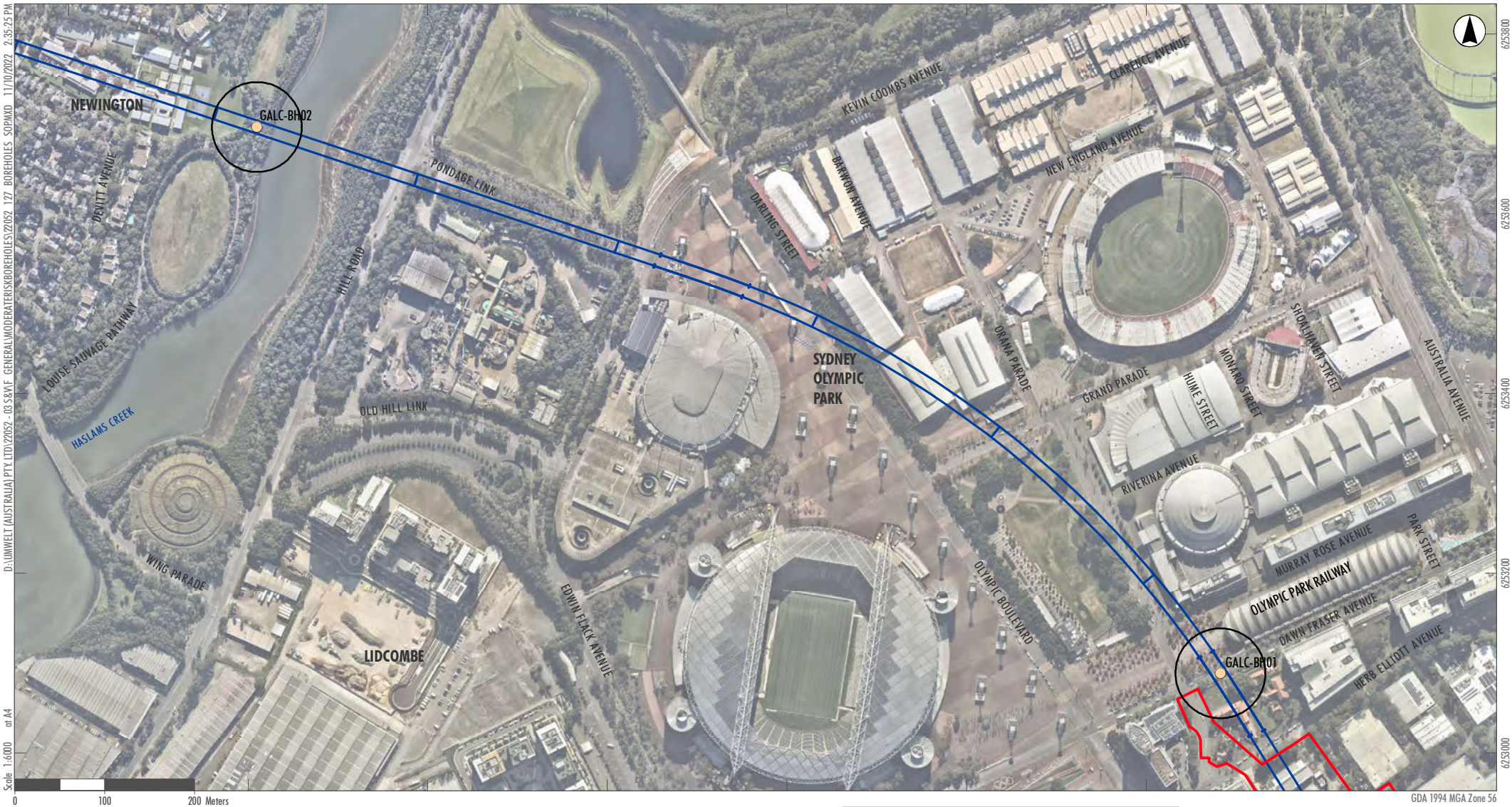
Legend

- Tunnel Alignment
- Moderate Risk Boreholes
- Moderate Risk Boreholes with Monitoring Wells
- 50m Search Buffer

APPENDIX A.2

Borehole and Monitoring Well Locations

Image Source: Nearmap (May 2022) Data source: DFSI (2021)



Legend

- Approved Surface Construction Boundary
- Tunnel Alignment
- Moderate Risk Boreholes
- 50m Search Buffer

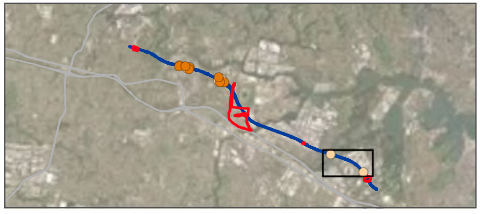


Image Source: Nearmap (May 2022) Data source: DFSI (2021)

APPENDIX A.3

Borehole and Monitoring Well Locations

Appendix B – Borehole/Monitoring Well Environmental Characteristics

Environmental Characteristic	Description
Portion 1 (Parramatta) – MW24, MW25, MW26, BH36	

Land use	• Portion 1 is located in Parramatta, with BH36 located on Smith Street, approximately 70m of the eastern boundary of the Parramatta Metro Station surface construction site, and MW26 located on Macquarie Lane, approximately 15m north of the eastern portion of the Parramatta Metro Station surface construction site.
	• MW24 and MW25 are located on Barrack Lane, within 140m of the eastern boundary of the Parramatta Metro Station surface construction site.
	• Portion 1 is surrounded by the Parramatta Central Business District (CBD), which consists of a mixture of residential, commercial and special purpose land use zones in all directions, extending to public recreational land uses (i.e. Parramatta Park) approximately 300m to the west.
	• Portion 1 sites fall within the following land use zones under the Parramatta Local Environmental Plan 2011:
	  • MW24, MW25, BH36 - 'B3 – Commercial Core'
	  • MW26 - 'B4 – Mixed Use'

Noise and vibration	• Existing noise levels around Portion 1 are dominated by road traffic noise and the general urban noise associated with the Parramatta CBD. • All Portion 1 sites sit within NCA03 (as identified in the EIS), which is largely commercial in nature and covers Parramatta CBD as well as residential receivers on the outskirts of the NCA. • NCA03 has a NML of 68dBA for daytime standard construction activities and 48dBA for night-time OOHW. • The results of the CNVIA (Appendix E) indicate that no exceedances are expected to occur within NCA03 during approved construction hours, and exceedance of11-20 dBA above the NML may occur at up to five (5) residential receivers within NCA03 during night time OOHW. •
Surface water and groundwater	• The four sites in Portion 1 are located within 400m of Parramatta River, which is north of the sites. MW24 is the closest site to Parramatta River in Portion 1, located approximately 300m from the river. • The EIS identified Parramatta River as a sensitive receiving environment as it is a Type 1 Key Fish Habitat. It is also identified as containing numerous SEPP Coastal Wetlands and has potential habitat for threatened aquatic species and protected aquatic vegetation. • There are no aquatic groundwater dependent ecosystems within 250m of Portion 1. • There are no terrestrial groundwater dependent ecosystems within 250m of Portion 1.

Environmental Characteristic	Description
Soils and contamination	• The EIS identified three areas within approximately 250m of the Portion 1 sites where the soils, vapour and groundwater have moderate contamination risk potential, all of which are associated with current and historical activities within the surface construction boundary for Parramatta Metro Station. These include: o AEI 6: Former and existing structures – Hazardous building materials within or from on-site buildings / structures, demolition wastes o AEI 7: Dry cleaners – Residuals from current dry cleaning activities. Inappropriate disposal of solvents, depth distribution associated with potential underground tanks o AEI 8: Historical commercial / industrial use within locality – Inappropriate chemical storage and use, industrial operations, waste disposal and management etc • There are no sites listed on the NSW EPA Contaminated Sites Register within 250 metres of Portion 1. • There are no sites notified to the NSW EPA as being potentially contaminated within 250 metres of Portion 1. • There are no environment protection licences listed in the NSW EPA Protection of the Environment Operations Act public register for areas within 250m of Portion 1. • There is no acid sulfate soil risk mapped for Portion 1. • MW24 is located within a mapped area of 'Disturbed Terrain'.
Biodiversity	• Borehole/monitoring well sites within Portion 1 are located within primarily commercial areas surrounding the Parramatta Metro Station surface construction site. There are no Plant Community Types (PCT) within 50m of Portion 1.
Aboriginal heritage	• [redacted]
Non-Aboriginal heritage	• State heritage items SHR 1762 Roxy Theatre, SHR 1760 Warders Cottage and SHR 346 Perth House and Stables, as well as Local heritage items I717 Convict barracks wall, I647 Residence, I655 House, I656 House, I657 Telstra House (former post office) (and potential archaeological site), I658 HMV (former Commonwealth Bank) (and potential archaeological site), I659 Former courthouse wall and sandstone cellblock (and potential archaeological site) and I720 Arthur Phillip High School (and potential archaeological site) are in the vicinity of the Portion 1 geotechnical investigation sites.
Portion 2 (Rosehill) – MW19, MW20, MW21, BH31, BH32, BH33, BH34, BH35	
Land use	• Portion 2 is located in Rosehill in a primarily residential setting, approximately 350m west of the northern most boundary of the Clyde Maintenance and Stabling Facility surface construction site. All Portion 2 sites sit primarily between Hassall Street and Oak Street, bordered by Alfred Street to the west and Arthur Street to the east, with the exception of MW21, which is located further north along Alfred Street, approximately 60m north of the Hassall Street and Alfred Street intersection.

Environmental Characteristic	Description
	• All Portion 2 sites (excluding BH31 and BH34) fall within the 'R2 – Low Density Residential' land use zone under the Parramatta Local Environmental Plan 2011. BH31 and BH34 fall within the 'SP2 – Infrastructure (Classified Road)' special purposes land use zone under the Parramatta Local Environmental Plan 2011.
Noise and vibration	• Existing noise levels in Portion 2 are generally attributed to road traffic noise on the surrounding road network. • The nearest receivers are residential dwellings located along Oak Street, Arthur Street, and Hassall Street. • All Portion 2 sites sit within NCA04 (as identified in the EIS) which is the area south of the Parramatta River and west of James Ruse Drive. The catchment is mainly residential with small areas of commercial receivers. • NCA04 has a NML of 61dBA for daytime standard construction activities and 46dBA for night-time OOHW. • The results of the CNVIA (Appendix E) indicate that exceedances of up to >30 dBA above the NML may occur at up to 10 residential receiver within NCA04 during approved construction hours, and exceedance of >30 dBA above the NML may occur at 19 residential receivers within NCA04 during night time OOHW. • If BH32, BH33 and MW20 are undertaken concurrently, exceedances of up to 20-30dBA above the NML may occur at up to six (6) residential receivers during approved construction hours, and exceedances of >30dBA above the NML may occur at up to 9 residential receivers during night time OOHW
Surface water and groundwater	• The eight sites in Portion 2 are within approximately 425m of Parramatta River, which is north of the sites. MW21 is the closest site to Parramatta River, located approximately 220m from the river. • Parramatta River is considered to be a sensitive receiving environment as it contains numerous SEPP Coastal Wetlands and is mapped by DPI as Key Fish Habitat. It also provides potential habitat for threatened aquatic species and protected aquatic vegetation. • There are no aquatic groundwater dependent ecosystems within 250m of Portion 2. • There are no terrestrial groundwater dependent ecosystem within 250m of Portion 2, however patches of vegetation along Parramatta River have been identified as a low to moderate potential groundwater dependent ecosystem from national assessment. Two of these patches of terrestrial groundwater dependent ecosystems are located within 300m of Portion 2, which comprise of Estuarine Mangrove Forest and Cumberland Shale Sandstone Transition F.
Soils and contamination	• The EIS did not identify any areas within 250m of Portion 2 with a contamination risk potential. • There are no sites listed on the NSW EPA Contaminated Sites Register within 250 metres of Portion 2. • There are no sites notified to the NSW EPA as being potentially contaminated within 250 metres of Portion 2. • There are no environment protection licences listed in the NSW EPA Protection of the Environment Operations Act public register for areas within 250m of Portion 2. • There is no acid sulfate soil risk mapped for Portion 2. All sites within Portion 2 are situated on land mapped as 'Disturbed Terrain'.

Environmental Characteristic	Description
Biodiversity	• The Portion 2 sites are located within an existing residential area, with the closest vegetative area located approximately 70m south of MW20 in land zoned as public recreation. There are no Plant Community Types (PCT) within 50m of Portion 2.
Aboriginal heritage	• There are no registered Aboriginal sites within 50 m of the Portion 2 geotechnical investigation sites.
Non-Aboriginal heritage	• Local heritage item I524 (Oak Street Cottage Group) is mapped in the vicinity of the Portion 2 geotechnical investigation sites, whilst conservation area (H_ID 'B') Elizabeth Farm Conservation Area is mapped, across or very close to, all but one (GALC-MW21) of the Portion 2 geotechnical investigation sites.
Portion 3 (Newington) – BH02	
Land use	• Portion 3 is located in Newington, adjacent to the south eastern border of Newington Public School and located approximately 20m west of Haslams Creek. Portion 3 is generally characterised by a mixture of residential and recreational land uses, which are frequently utilised by the public. BH02 is located adjacent to Louise Savage Pathway, a walkway that provides pedestrian access north towards the broader Sydney Olympic parklands. • BH02 falls within the 'RE1 – Public Recreation' land use zone under the State Environmental Planning Policy (Precincts – Central River City) 2021.
Noise and vibration	• Existing noise levels at Portion 3 are generally attributed to road traffic noise on the surrounding road network, public recreational land uses and the operation of industrial/commercial premises within SOP. • The nearest sensitive receiver is Newington Public School, located approximately 50m to the west of BH02. • BH02 sits within NCA07 (as identified in the EIS), which includes land east of James Ruse Drive, including mostly commercial premises and covers Rosehill Gardens racecourse (and associated stables), the Clyde commercial/industrial area, Silverwater and Newington. • NCA07 has a NML of 56dBA for daytime standard construction activities and 46dBA for night-time OOHW. • The results of the CNVIA (Appendix E) indicate that exceedances of up to 11-20 dBA above the NML may occur at up to five (5) residential receivers within NCA07 during approved construction hours, and exceedance of 20-30 dBA above the NML may occur at five (5) residential receivers within NCA07 during night time OOHW.
Surface water and groundwater	• The borehole in Portion 3 is located 20m to the west of Haslams Creek. • The EIS identified Haslams Creek as a sensitive receiving environment, as it is mapped by DPI as Key Fish Habitat. It is also located within 500m of a SEPP Coastal Wetland. • There are no aquatic groundwater dependent ecosystems within 250m of Portion 3. • There is one terrestrial groundwater dependent ecosystem within 250m of Portion 3, which is the Estuarine Mangrove Forest located in Haslams Creek. This has been identified as a high potential groundwater dependent ecosystem from national assessment.

Environmental Characteristic	Description
Soils and contamination	• The EIS identified one site within 250m of Portion 3 where the vapour and groundwater has a high contamination risk potential, which is associated with uncontrolled landfilling. This includes: o AEI 29: Uncontrolled landfilling (Corner Pondage Link and Hill Road, Sydney Olympic Park) – Known areas of waste and groundwater contamination o This landfill area is located 220m to the east of Portion 3. • The EIS identified one area within 250m of Portion 3 where the groundwater has a moderate contamination risk potential, which is associated with waste storage. This includes: o AEI 26: Waste storage – hazardous, restricted solid, liquid, clinical and related waste and asbestos waste Non-thermal treatment of hazardous and other waste o This waste storage facility is located 200m to the east of Portion 3. • There are no sites listed on the NSW EPA Contaminated Sites Register within 250 metres of Portion 3. • There are two notified to the NSW EPA as being potentially contaminated within 250 metres of Portion 3, one of which had contamination formerly regulated under the *Contaminated Land Management Act 1997* and one where the NSW EPA determined that regulation under the *Contaminated Land Management Act 1997* is not required. • There is one environment protection licence listed in the NSW EPA Protection of the Environment Operations Act public register for areas within 250m of Portion 3, which has approval to treat and store waste. • There is no acid sulfate soil risk mapped for Portion 3. Portion 3 is situated on land mapped as 'Disturbed Terrain'.
Biodiversity	• The Portion 3 site is located within a vegetated area that comprises PCT 4023: Coastal Valleys Swamp Oak Riparian Forest. PCT 4023 is associated with two TECs, including the Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act) and Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (EPBC Act). • 14 threatened flora species have a moderate to high likelihood of occurrence within 50m of Portion 3, including Narrow-leafed Wilsonia and *Zannichellia palustris* which have a high likelihood of occurrence. • 48 threatened fauna species have a moderate to high likelihood of occurrence within 50m of Portion 3, including the Grey-headed Flying Fox and Green and Golden Bell Frog which have a high likelihood of occurrence.
Aboriginal heritage	• There are no registered Aboriginal sites within 50 m of the Portion 3 geotechnical investigation sites.
Non-Aboriginal heritage	• There are no heritage items or conservation areas within Portion 3.
Portion 4 (SOP) - BH01	

Environmental Characteristic	Description
Land use	• Portion 4 is located within the Sydney Olympic Park (SOP) precinct which is characterised by a mixture of land use zones (including commercial, public and private recreation, and light residential). BH01 is located on Dawn Fraser Avenue, adjacent to the Olympic Park railway station and approximately 30m east of the Sydney Olympic Park Metro Station construction site. • BH01 falls within the 'B4 – Mixed Use' land use zone under the State Environmental Planning Policy (Precincts – Central River City) 2021.
Noise and vibration	• Existing noise levels at Portion 4 (surrounding the Sydney Olympic Park construction site) are generally dominated by distant road traffic noise from the M4 Motorway and Homebush Bay Drive and general noise from the sport and entertainment complex • BH01 is located within NCA08, which is characterised by a mixture of commercial and outdoor areas including Sydney Olympic Park Athletic Centre, Sydney Olympic Park Hockey Centre, Sydney Olympic Park Aquatic Centre and the Cathy Freeman Park. • The nearest receivers are commercial buildings on Dawn Fraser Avenue, Olympic Boulevard, Herb Elliott Avenue and Figtree Drive. • NCA08 has a NML of 58dBA for daytime standard construction activities and 51dBA for night-time OOHW. • The results of the CNVIA (Appendix E) indicate that exceedances of up to 1-10 dBA above the NML may occur at up to one (1)receiver during approved construction hours within NCA08, and exceedances of 1-10 dBA above the NML may occur at five (5) residential receives within NCA08 during night time OOHW.
Surface water and groundwater	• The borehole in Portion 4 is located approximately 870m southeast of Haslams Creek. • The EIS identified Haslams Creek as a sensitive receiving environment, as it is mapped by DPI as a Type 1 Key Fish Habitat. It is also located within 500m of a SEPP Coastal Wetland. • There are no aquatic groundwater dependent ecosystems within 250m of Portion 4. • There are no terrestrial groundwater dependent ecosystems within 250m of Portion 4.
Soils and contamination	• The EIS did not identify any areas within 250m of Portion 4 with a contamination risk potential. • There are no sites listed on the NSW EPA Contaminated Sites Register within 250 metres of Portion 4, however it is worth noting that there are five sites within 850m of Portion 4 that have current notices from the NSW EPA. • There are no sites notified to the NSW EPA as being potentially contaminated within 250 metres of Portion 4. • There is one environment protection licence listed in the NSW EPA Protection of the Environment Operations Act public register for areas within 250m of Portion 4, which has approval to undertake construction works. • There is no acid sulfate soil risk mapped for Portion 4.
Biodiversity	• BH01 is located on existing hardstand area within a predominantly commercial area in Sydney Olympic Park. There are no Plant Community Types (PCT) within 50m of BH01.
Aboriginal heritage	• There are no registered Aboriginal sites within 50 m of the Portion 4 geotechnical investigation sites.

Environmental Characteristic	Description
Non-Aboriginal heritage	• Conservation Area (H_ID 'A') State Abattoirs is mapped across the Portion 4 geotechnical investigation area.

Appendix C – Ecology and Heritage Constraints Review

Borehole ID	Investigation Type	Heritage Constraint/s	Ecology Constraint/s	Heritage Constraint Rating	Eco Constraint Rating	Overall Risk	Recommendation
GALC-BH01	Borehole	Located within the curtilage of State Abattoirs, listed on the State Environmental Planning Policy (Precincts—Central River City). Works require assessment confirming no impacts to listed heritage item.	No native vegetation mapped within the 50 buffer. Vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Historical** heritage due diligence documentation required **No further ecology assessment required.**
GALC-BH02	Borehole	Potential historical (non-Aboriginal) items and/or Aboriginal sites located within the GALC-BH02 footprint. Potential heritage constraints.	No native vegetation mapped within the 50 buffer. Some vegetation present is likely to be planted, but TEC associated with riparian areas, such as Swamp Oak Floodplain Forest may be present. Potential high biodiversity constraint	Moderate	**High**	Moderate	Aboriginal and historic heritage due diligence assessment required. **Eco field survey and briefing note required**.
GALC-BH31	Borehole	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity.	No native vegetation mapped within the 50 buffer. Vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal** heritage due diligence assessment required **No further ecology assessment required**
GALC-BH32	Borehole	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity. Located within the Elizabeth Farm Heritage Conservation Area (local).	No native vegetation mapped within the 50 buffer. Vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal and historical heritage due diligence assessment required** **No further ecology assessment required.**
GALC-BH33	Borehole	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity. Located within the Elizabeth Farm Heritage Conservation Area (local).	No native vegetation mapped within the 50 buffer. Vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal and historical heritage due diligence assessment required** **No further ecology assessment required.**
GALC-BH34	Borehole	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity.	No native vegetation mapped within the 50 buffer. Vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal** heritage due diligence assessment required **No further ecology assessment required**
GALC-BH35	Borehole	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity.	No native vegetation mapped within the 50 buffer. Vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal** heritage due diligence assessment required **No further ecology assessment required**
GALC-BH36	Borehole	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity. Located within close proximity to Parramatta Town Drain, an archaeological item listed on the Parramatta LEP 2011. Note the alignment of this heritage item as mapped is not confirmed.	No native vegetation mapped within the 50 buffer. Vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal and historic heritage due diligence assessment required** **No further ecology assessment required**
GALC-MW19	Monitoring well	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity. Located within the Elizabeth Farm Heritage Conservation Area (local).	No native vegetation mapped within the 50 buffer. Vegetation within the buffer has already been cleared been cleared Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal and historical heritage** due diligence assessment required **No further ecology assessment required.**
GALC-MW20	Monitoring well	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity. Located within the Elizabeth Farm Heritage Conservation Area (local).	No native vegetation mapped within the 50 buffer. Vegetation within the buffer has already been cleared been cleared Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal and historical heritage** due diligence assessment required **No further ecology assessment required.**
GALC-MW21	Monitoring well	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity.	No native vegetation mapped within the 50 buffer. Vegetation within the buffer has already been cleared been cleared Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal** due diligence assessment required **No further ecology assessment required**
GALC-MW24	Monitoring well	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity.	No native vegetation mapped within the 50 buffer. Little to no vegetation within buffer, any vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal** due diligence assessment required **No further ecology assessment required**
GALC-MW25	Monitoring well	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity.	No native vegetation mapped within the 50 buffer. Little to no vegetation within buffer, any vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal** due diligence assessment required **No further ecology assessment required**
GALC-MW26	Monitoring well	The proposed geotechnical testing location is located within 5 m from the heritage item 'Roxy Theatre', which may be less than the minimum distance required to prevent damage to historic heritage items with reference to the Sydney Metro Construction Noise and Vibration Standard. The proposed works, being minor and highly localised in nature, will result in minor adverse impact to the broader geomorphological significance of the SHR-listed Parramatta Sand Body, but will not reach the material threshold to be	No native vegetation mapped within the 50 buffer. Little to no vegetation within buffer, any vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Aboriginal** due diligence assessment required **No further ecology assessment required**
GALC-MW32	Monitoring well	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity.	No native vegetation mapped within the 50 buffer. Little to no vegetation within buffer, any vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Moved to within Parramatta site boundary. No further assessment required**
GALC-MW33	Monitoring well	Located within mapped areas of the Parramatta Sand Body which is a known area of Aboriginal archaeological sensitivity.	No native vegetation mapped within the 50 buffer. Little to no vegetation within buffer, any vegetation present is likely to be planted. Low biodiversity constraint	Moderate	Low	Moderate	**Moved to within Parramatta site boundary. No further assessment required**

Appendix D – Aboriginal and Historic Heritage Due Diligence Assessment

Appendix E – Construction Noise and Vibration Impact Assessment (CNVIA)

Memorandum

To:	Candice Somerville	**At:**	GLC
From:	M. Bruck / S. Luzuriaga	**At:**	SLR Consulting Australia Pty Ltd
Date:	14 October 2022	**Ref:**	610.30644-M07b-Moderate Risk Sites-v1.0-20221014.docx
Subject:	Sydney Metro West WTP NVIA Geotechnical Investigations (Moderate Risk)		

1 Introduction

SLR Consulting has been engaged by Gamuda & Laing O'Rourke Consortium (GLC) to provide noise and vibration advice in relation to the Sydney Metro West Western Tunnelling Package. This Construction Noise and Vibration Impact Assessment (NVIA) has been prepared to assess potential noise and vibration impacts associated with Geotechnical Investigations along the project alignment during approved hours and out-of-hours (OOH) assessment periods.

All work on or adjacent to roads would be carried out in accordance with a relevant Traffic Control Plan (TCP) and/or Road Occupancy Licence (ROL) to facilitate safe work near live traffic. Where an ROL cannot be obtained for the approved project hours and/or proposed works cannot be undertaken safely during these hours, some works will be required to be undertaken outside of approved project hours (ie Out of Hours Work, OOHW).

2 Overview of Proposed Work

Table 1 presents an overview of key information relevant to this NVIA. **Table 2** presents the Construction Scenarios and Equipment. The construction equipment and locations included in the assessment are based on information contained in the scope of works supplied on 9 August 2022 from project team, and subsequent updates. Further detail of existing conditions, management levels and assessment methodology are outlined in the Detailed Noise and Vibration Impact Statement (DNVIS).

Table 1 Details of proposed work

Item	Description		
CNIA Reference	M07b		
Works Type	Geotechnical Investigations (Moderate Risk)		
Location	Westmead to Sydney Olympic Park		
Assessment Periods (refer CNVMP)	**Approved Project Hours (AH)**	**OOHW1 (Evening)**	**OOHW2 (Night)**
	Monday -Friday (7am – 6pm) Saturday (8am – 6pm) Sunday / Public Holidays (Nil)	Monday -Friday (6pm – 10pm) Saturday (6pm – 10pm) Sun. / P. Holidays (8am -6pm)	Monday -Friday (10pm – 7am) Saturday (10pm – 8am) Sun. / P. Holidays (6pm -7am)
Ambient Acoustic Environment at Nearest Receiver	The acoustical environment along the project alignment changes depending on the area of interest but is generally dominated by road traffic noise and 'urban hum'.		
Noise Modelling	ISO 9613:2 algorithm in SoundPLAN v8.2		
Results Presentation	Free field – no façade reflections		

Table 2 Construction Scenarios and Equipment

			Total Lw (dBA)	Excavator 3-6T + hydraulic Hammer[3]	Plate Compactor	Lighting Tower	Saw – Concrete[3]	Tipper Truck	Truck - Vacuum (NDD)	Water Cart	Tracked Hydraulic Drilling Rig	Hand tools (electric)	Light Vehicle (accelerating)[2]	Tracked Excavator 10t
Sound Power Level (Lw)				115	104	80	118	103	109	107	114	102	96	100
Estimated utilisation per period (%)				30%	30%	100%	30%	25%	30%	10%	100%	50%	25%	50%
ID	**Construction Scenario**	**Assessment Period**												
W.001	Non-Destructive Digger (NDD)	AH (Day) / OOHW2 (Night)	**120**	1		1	1	1	1	1		1		1
W.002	Drilling Operations	AH (Day) / OOHW2 (Night)	**114**			1				1	1	1	4	
W.003	Reinstatement	AH (Day) / OOHW2 (Night)	**105**		1	1		1		1		1		1

Note 1: Individual Sound Power Levels (Lw) for key activities have been adopted from the DEFRA Noise Database, AS2436, TfNSW *Construction Noise and Vibration Strategy* and Sydney Metro *Construction Noise and Vibration Standard.*

Note 2: Taken from *Road Traffic Noise Prediction Model "ASJ RTN-Model 2013" Proposed by the Acoustical Society of Japan – Part 2: Study on Sound Emission of Road Vehicles*, OKADA et al, Internoise 2014, and accounts for vehicles accelerating.

Note 3: The ICNG requires 'annoying' activities (eg saw operations) to have a 5 dB 'penalty' applied to the source sound power level.

A total of 30 borehole (BH) /monitoring well (MW) locations have been assessed as part of this geotechnical investigation scope of work. Following the heritage and ecological constraints review, these locations were divided into three categories:

- Low environmental risk: *BH03, BH13, BH90, BH91, MW01, MW06, MW37, MW40*
- Moderate environmental risk: *BH01, BH02, BH31, BH32, BH33, BH34, BH35, BH36, MW19, MW20, MW21, MW24, MW25, MW26*
- High environmental risk: *BH05, BH92, BH97, MW22, MW23, MW34, MW35, MW36, MW54*

This assessment addresses the **moderate environmental risk locations only**.

The construction team may carry out works on BH32, BH33 and MW20 at the same time to limit the impact on the surrounding community. A cumulative assessment on these potential concurrent works has been conducted.

3 Assessment Criteria

3.1 Noise Management Levels

The noise management levels (NMLs) for residential (**Table 3**) and other sensitive receivers (**Table 4**) have been adopted from the Construction Noise and Vibration Management Plan (CNVMP). Project-specific NMLs for residential receivers were determined for each Noise Catchment Area (NCA). During out-of-hours work (OOHW) the residential NML is determined as 5 dB above the Rating Background Noise level (RBL) (ie RBL + 5dB).

NMLs for other sensitive receivers have been adopted from the Interim Construction Noise Guideline (ICNG), Sydney Metro - Construction Noise and Vibration Standard (CNVS), *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors*, and previous assessments undertaken for the Sydney Metro West Project (eg EIS and modification reports).

Table 3 Project Residential NMLs

NCA	Receiver Type	Representative Logger Location	Noise Management Level ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Level (52 dBA or RBL +15 dB whichever is higher) (L_{Amax} dBA)
			Approved Construction Hours (RBL+10dB)	Out of Hours (RBL+5dB)			
			Day	Day[1]	Evening	Night	Night
NCA01	Residential	B.02	58	53	51	46	56
NCA02	Residential	B.01	59	54	52	42	52
NCA03	Residential	B.03	68	63	58	48	58
NCA04	Residential	B.04	61	56	53	46	56
NCA05	Residential	B.05	60	55	54	50	60
NCA06	Residential	B.06	62	57	56	49	59
NCA07	Residential	B.07	56	51	49	46	56
NCA08	Residential	B.08	58	53	53	51	61
NCA09	Residential	B.09	58	53	51	46	56

Note 1: Daytime out of hours is 7 am to 8 am on Saturday, and 8 am to 6 pm on Sunday and public holidays

Table 4 NMLs for 'Other Sensitive' Receivers

Land Use	Assessment Period	Noise Management Level $L_{Aeq(15minute)}$ (dBA)	
		Internal	External
ICNG 'Other Sensitive' Receivers			
Classrooms at schools and other educational institutions	When in use	45	55[1]
Hospital wards and operating theatres	When in use	45	65[2]

Land Use	Assessment Period	Noise Management Level $L_{Aeq(15minute)}$ (dBA)	
		Internal	External
Places of worship	When in use	45	55[1]
Active recreation areas (characterised by sporting activities and activities which generate noise)	When in use	-	65
Passive recreation areas (characterised by contemplative activities that generate little noise)	When in use	-	60
Commercial	When in use	-	70
Industrial	When in use	-	75
Non-ICNG 'Other Sensitive' Receivers			
Hotel[3]	Day / Evening	50	70[2]
	Night-time	40	60[2]
Café / Bar / Restaurant[3]	When in use	50	70[2]
Child Care Centres – Sleeping areas[4]	When in use	40	50[1]
Public Building	When in use	50	60[1]
Recording Studio	When in use	25	45[2]
Theatre/Auditorium	When in use	30	50[2]
Rosehill Gardens Racecourse Stables[5]	When in use	-	60

Note 1: It is assumed that these receivers have windows partially open for ventilation which results in internal noise levels being around 10 dB lower than the external noise level.

Note 2: It is assumed that these receivers have fixed windows which conservatively results in internal noise levels being around 20 dB lower than the external noise level.

Note 3: Adopted from AS2107.

Note 4: Adopted from *Association of Australian Acoustical Consultants Guideline for Child Care Centre Acoustic Assessment*.

Note 5: Adopted from the ICNG – passive recreation.

3.2 Vibration Guidelines

The effects of vibration from construction work can be divided into three categories:

- Those in which the occupants of buildings are disturbed (**human comfort**). People can sometimes perceive vibration impacts when vibration generating construction work is located close to occupied buildings. Vibration from construction work tends to be intermittent in nature and the *Assessing Vibration: a technical guideline* (AVTG) (DEC, 2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV).
- Those where the integrity of the building may be compromised (**structural/cosmetic damage**). If vibration from construction work is sufficiently high, it can cause cosmetic damage to elements of affected buildings. Industry standard cosmetic damage vibration limits are specified in British Standard BS 7385 *Part 2-1993 Evaluation and measurement for vibration in buildings Part 2, BSI, 1993* and German Standard DIN 4150 *Part 3-2016 Structural vibration – Effects of vibration on structures, Deutsches Institute fur Normung, 1999*.

- Those where building contents may be affected (**building contents**). People perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents. Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes or medical imaging equipment, are in buildings near to construction work, refer Sydney Metro *Construction Noise and Vibration Standard*.

Based on the equipment and activities identified for the geotechnical investigation work, vibration impacts are not expected for human comfort, structural/cosmetic damage or building contents. Given the limited potential for any vibration impacts to occur, no further assessment of construction vibration is considered necessary.

4 Assessment Findings

Noise modelling was conducted in accordance with the method outlined in the DNVIS. A summary of the number of buildings where NML exceedances were predicted for the various work scenarios is shown in **Table 6** to **Table 7**. A summary of the number of buildings where NML exceedances were predicted for the cumulative assessment of the three concurrent geotechnical investigations for the various work scenarios are shown in **Table 8** to **Table 9**. Maps of the predicted (worst-case) noise impacts are presented in **Appendix A** (Approved Hours) **Appendix B** (OOHW). As the timing of all work locations has not yet been confirmed, noise impacts are presented for both approved hours and OOHW for all work locations. It is noted that most of the work locations will be undertaken during approved hours.

The assessment shows the predicted impacts based on the exceedance of the management levels, as per the categories in **Table 5**.

Table 5 Exceedance Bands and Impact Colouring

Exceedance of Management Level	Impact Colouring
No exceedance	
1 to 10 dB	
11 dB to 20 dB	
21 dB to 30 dB	
>30 dB	

The noise impact maps in **Appendix A** and **Appendix B** present the worst-case predicted noise impacts (ie when work is occurring closest to each receiver). It is noted that there may be up to three crews working simultaneously during the geotechnical investigations. The noise impact maps in **Appendix C** present the worst-case cumulative predicted noise impacts when works on all three geotechnical investigations (*BH32, BH33 and MW20*) are occurring at the same time.

Recommendations are provided in **Section 5** to reduce impacts where practicable.

The assessment is generally considered conservative as the calculations assume several items of construction equipment are in use at the same time within individual scenarios. In reality, there would frequently be periods when construction noise levels are much lower than the worst-case levels predicted as well as times when no equipment is in use and no noise impacts occur.

Table 6 Construction Noise Assessment – Moderate Risk Work Locations – Approved Hours

Work ID	Assessment Period	Exceedance Category Above NML	Number of Receivers with NML Exceedance									
			Residential Receivers									Other Sensitive Receivers
			NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	All NCAs
W.001	Approved Hours (AH)	1-10 dB	-	-	-	59	-	-	47	1	-	45
		11-20 dB	-	-	-	20	-	-	5	-	-	32
		20-30 dB	-	-	-	10	-	-	-	-	-	10
		>30 dB	-	-	-	-	-	-	-	-	-	-
		HNA[1]	-	-	-	**5**	-	-	-	-	-	-
W.002	Approved Hours (AH)	1-10 dB	-	-	-	23	18	-	-	-	-	41
		11-20 dB	-	-	-	15	-	-	-	-	-	13
		20-30 dB	-	-	-	4	-	-	-	-	-	4
		>30 dB	-	-	-	-	-	-	-	-	-	-
		HNA[1]	-	-	-	**2**	-	-	-	-	-	-
W.003	Approved Hours (AH)	1-10 dB	-	-	-	14	-	-	-	-	-	19
		11-20 dB	-	-	-	5	-	-	-	-	-	4
		20-30 dB	-	-	-	-	-	-	-	-	-	-
		>30 dB	-	-	-	-	-	-	-	-	-	-
		HNA[1]	-	-	-	-	-	-	-	-	-	-

Note 1: Highly noise affected, based on ICNG definition (i.e. predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Table 7 Construction Noise Assessment – Moderate Risk Work Locations - OOHW

Work ID	Assessment Period	Exceedance Category Above NML	Number of Receivers with NML Exceedance									
			Residential Receivers									Other Sensitive Receivers
			NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	All NCAs
W.001	OOHW2 (Night)	1-10 dB	-	-	49	61	35	-	248	5	2	46
		11-20 dB	-	-	5	99	-	-	46	-	-	34
		20-30 dB	-	-	-	29	-	-	5	-	-	10
		>30 dB	-	-	-	19	-	-	-	-	-	-
		SD[1]	**-**	**-**	**9**	**181**	**-**	**-**	**103**	**2**	-	-
W.002	OOHW2 (Night)	1-10 dB	-	-	8	109	2	-	85	2	-	45
		11-20 dB	-	-	1	49	-	-	18	-	-	13
		20-30 dB	-	-	-	16	-	-		-	-	4
		>30 dB	-	-	-	10	-	-		-	-	-
		SD[1]	**-**	**-**	**3**	**128**	-	-	**37**	-	-	-
W.003	OOHW2 (Night)	1-10 dB	-	-	1	59	-	-	20	-	-	20
		11-20 dB	-	-	-	20	-	-	-	-	-	4
		20-30 dB	-	-	-	10	-	-	-	-	-	-
		>30 dB	-	-	-	-	-	-	-	-	-	-
		SD[1]	**-**	**-**	-	**42**	-	-	**3**	-	-	-

Note 1: Sleep Disturbance Screening Level – (L_{Amax})

Table 8 Cumulative Construction Noise Assessment for BH32, BH33 and MW20 – Moderate Risk Work Locations – Approved Hours

Work ID	Assessment Period	Exceedance Category Above NML	Number of Receivers with NML Exceedance									
			Residential Receivers									Other Sensitive Receivers
			NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	All NCAs
W.001	Approved Hours (AH)	1-10 dB	-	-	-	61	-	-	-	-	-	7
		11-20 dB	-	-	-	8	-	-	-	-	-	1
		20-30 dB	-	-	-	6	-	-	-	-	-	-
		>30 dB	-	-	-	-	-	-	-	-	-	-
		HNA[1]	-	-	-	**5**	-	-	-	-	-	-
W.002	Approved Hours (AH)	1-10 dB	-	-	-	19	-	-	-	-	-	3
		11-20 dB	-	-	-	7	-	-	-	-	-	-
		20-30 dB	-	-	-	1	-	-	-	-	-	-
		>30 dB	-	-	-	-	-	-	-	-	-	-
		HNA[1]	-	-	-	**2**	-	-	-	-	-	-
W.003	Approved Hours (AH)	1-10 dB	-	-	-	7	-	-		-	-	-
		11-20 dB	-	-	-	2	-	-	-	-	-	-
		20-30 dB	-	-	-	-	-	-	-	-	-	-
		>30 dB	-	-	-	-	-	-	-	-	-	-
		HNA[1]	-	-	-	-	-	-	-	-	-	-

Note 1: Highly noise affected, based on ICNG definition (i.e. predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Table 9 Cumulative Construction Noise Assessment for BH32, BH33 and MW20 – Moderate Risk Work Locations – OOHW

Work ID	Assessment Period	Exceedance Category Above NML	Number of Receivers with NML Exceedance									
			Residential Receivers									Other Sensitive Receivers
			NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	All NCAs
W.001	OOHW2 (Night)	1-10 dB	-	-	40	80	36	-	-	-	-	10
		11-20 dB	-	-	-	96	-	-	-	-	-	1
		20-30 dB	-	-	-	22	-	-	-	-	-	-
		>30 dB	-	-	-	9	-	-	-	-	-	-
		SD[1]	-	-	-	**138**	-	-	-	-	-	-
W.002	OOHW2 (Night)	1-10 dB	-	-	2	93	11	-	-	-	-	3
		11-20 dB	-	-	-	52	-	-	-	-	-	-
		20-30 dB	-	-	-	9	-	-	-	-	-	-
		>30 dB	-	-	-	5	-	-	-	-	-	-
		SD[1]	-	-	-	**82**	-	-	-	-	-	-
W.003	OOHW2 (Night)	1-10 dB	-	-	-	61	-	-	-	-	-	-
		11-20 dB	-	-	-	8	-	-	-	-	-	-
		20-30 dB	-	-	-	6	-	-	-	-	-	-
		>30 dB	-	-	-	-	-	-	-	-	-	-
		SD[1]	-	-	-	**21**	-	-	-	-	-	-

5 Conclusion and Recommendations

Noise emissions from the project have been predicted at the surrounding receivers. Worst-case noise levels are expected to exceed the noise management level (NML) by up to '21 - 30 dB' at the closest 'other sensitive' receivers and by up to '> 30 dB' at the closest residential receiver during OOHW2 (Night). Impacts are predicted to be lower during the approved project hours, where receivers are less sensitive to construction noise.

A number of mitigation and management measures have been recommended below. Where feasible and reasonable these should be applied to the project to control and minimise the impacts during construction as far as practicable.

Consider the following recommendations (where feasible and reasonable) during commencement of each work scenario:

- Implement mitigation measures identified within the CNVMP and DNVIS
- Implement additional mitigation measures identified within the CNVMP and DNVIS
- Ensure the minimum sized equipment necessary to complete the work are used
- Implement portable noise barriers around noise intensive activities (ie drill rig, concrete saw and hydraulic hammer)
- Where multiple crews work simultaneously during the geotechnical investigations crews should avoid working within 500 m of each other to avoid cumulative impacts
- Provide respite periods for noise intensive activities
- Shut down plant and machinery, including vehicles when not in operation
- Undertake noise monitoring during works to confirm noise predictions. Monitoring locations should be targeted to most affected receivers (**Appendix A, B and C**), or representative locations nearby.

Checked/
Authorised by: DL

APPENDIX A – NOISE IMPACT MAPS (APPROVED HOURS)

Figure A1 W.001: Non-Destructive Digger (NDD) - AH

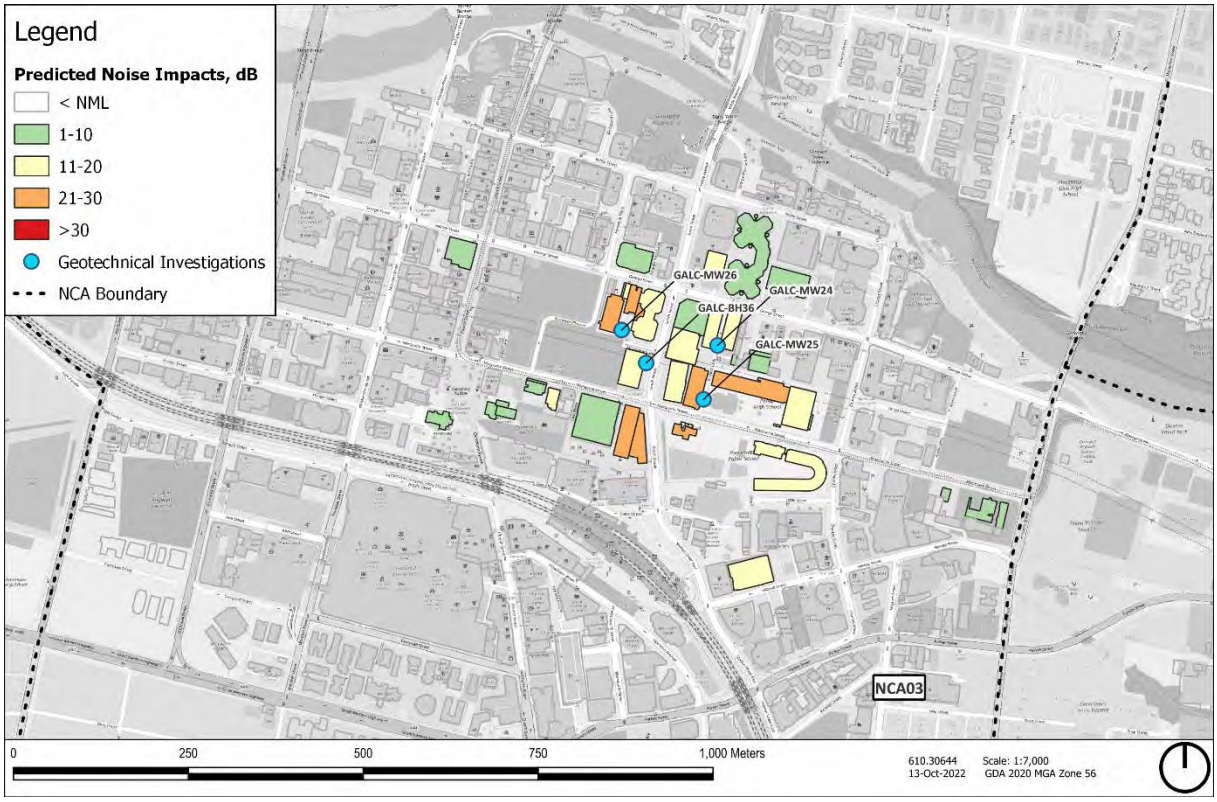


Figure A2 W.001: Non-Destructive Digger (NDD) - AH

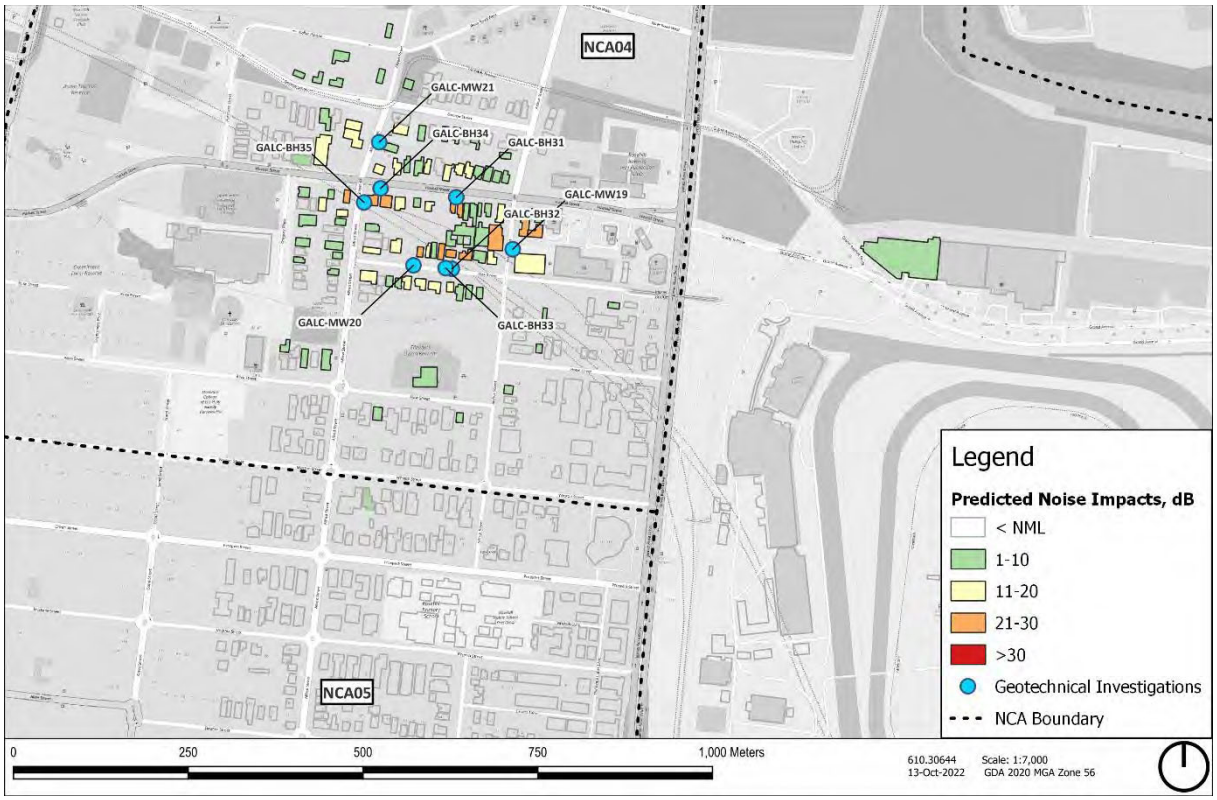


Figure A3 W.001: Non-Destructive Digger (NDD) - AH

Figure A4 W.001: Non-Destructive Digger (NDD) - AH

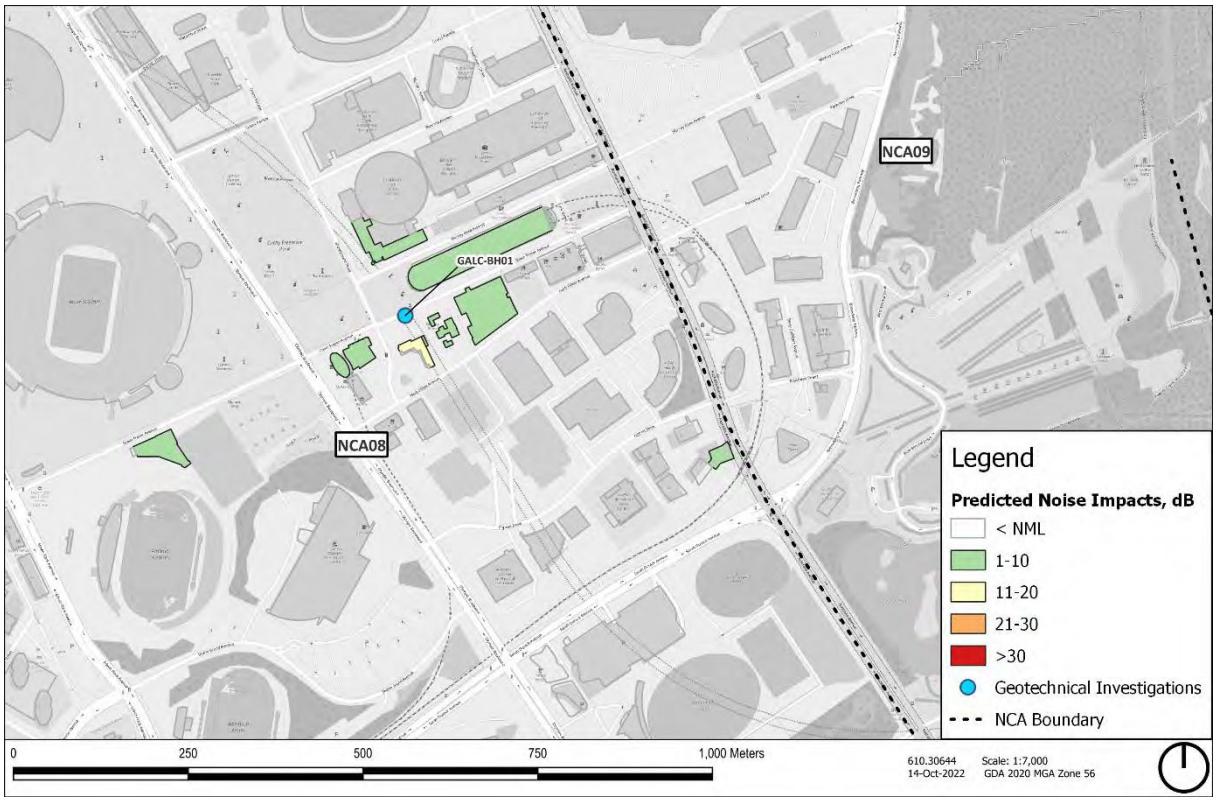


Figure A5 W.002: Drilling Operations - AH

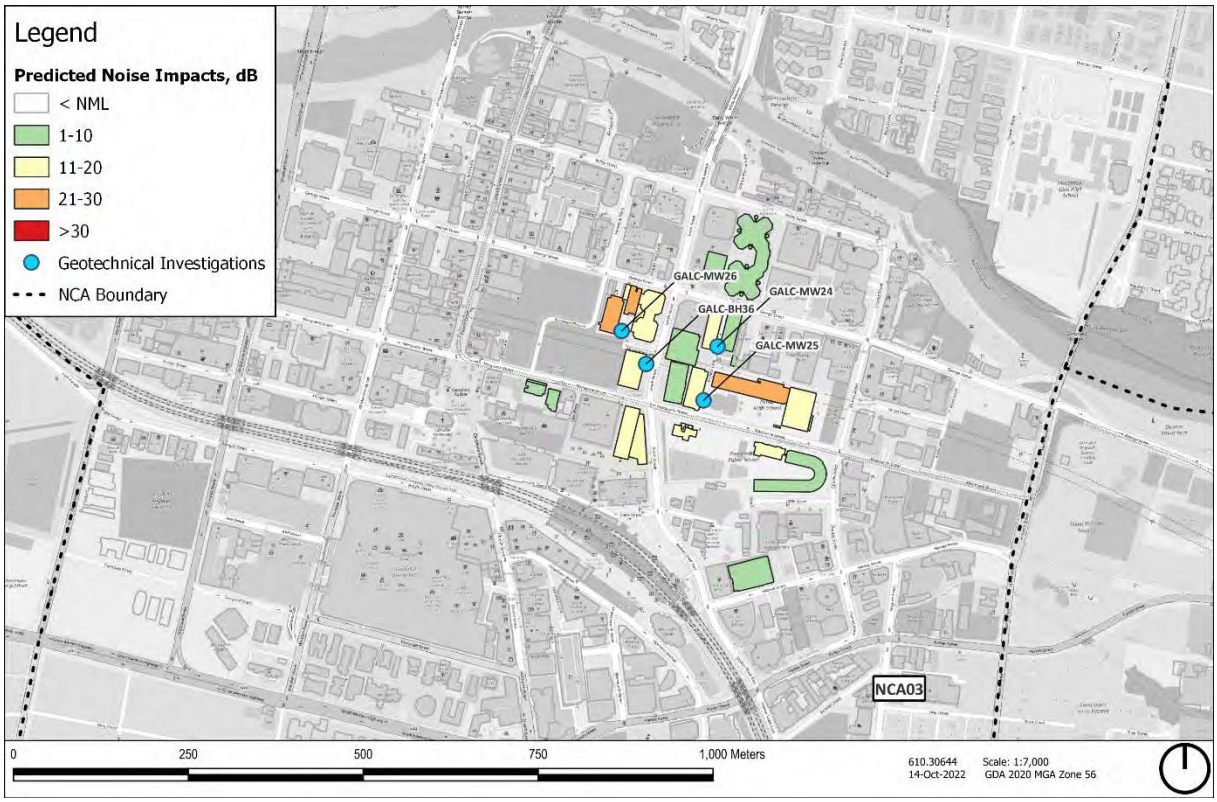


Figure A6 W.002: Drilling Operations - AH

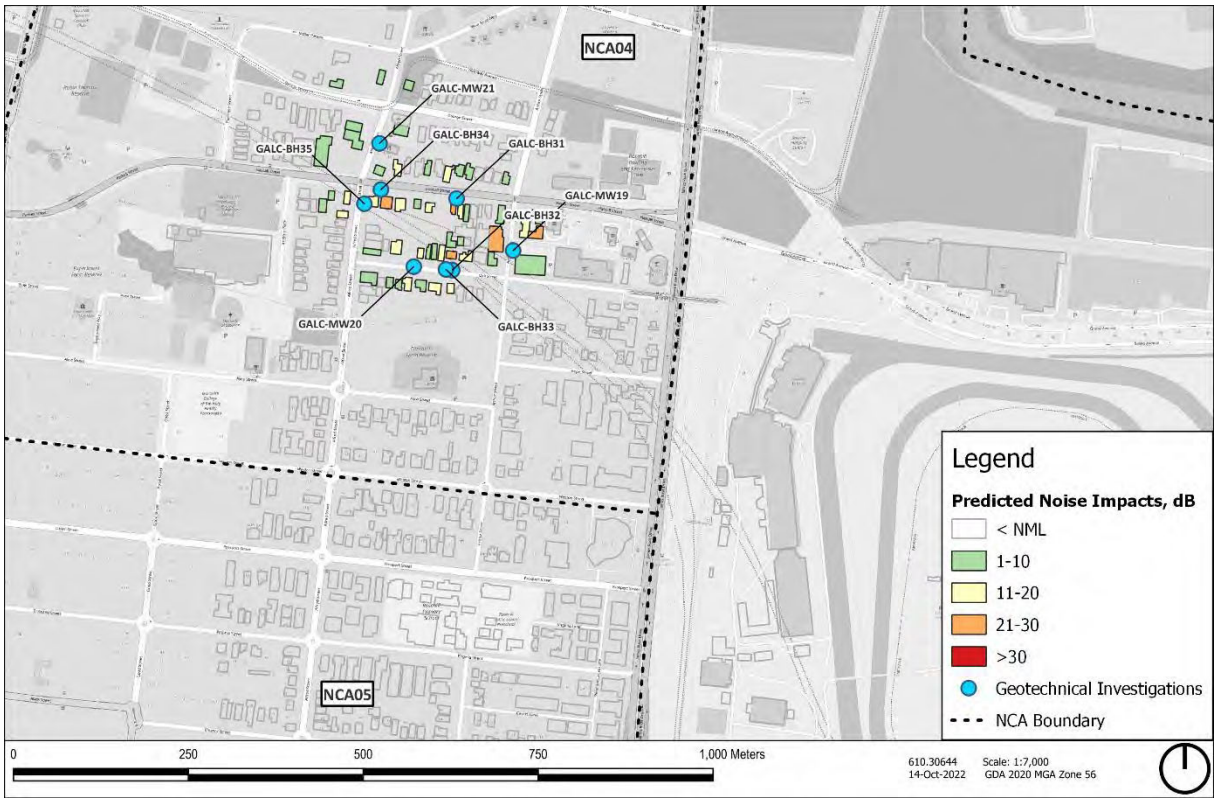


Figure A7 W.002: Drilling Operations - AH

Figure A8 W.002: Drilling Operations - AH

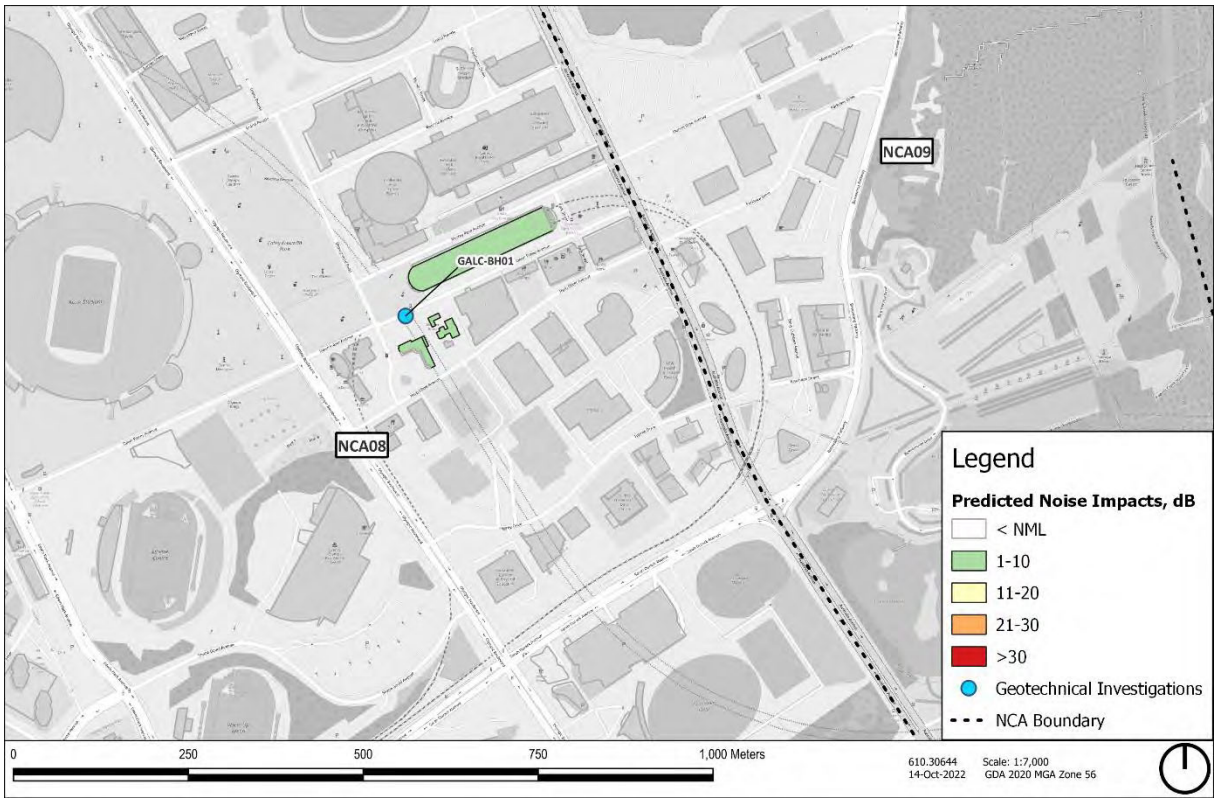


Figure A9 W.003: Reinstatement - AH

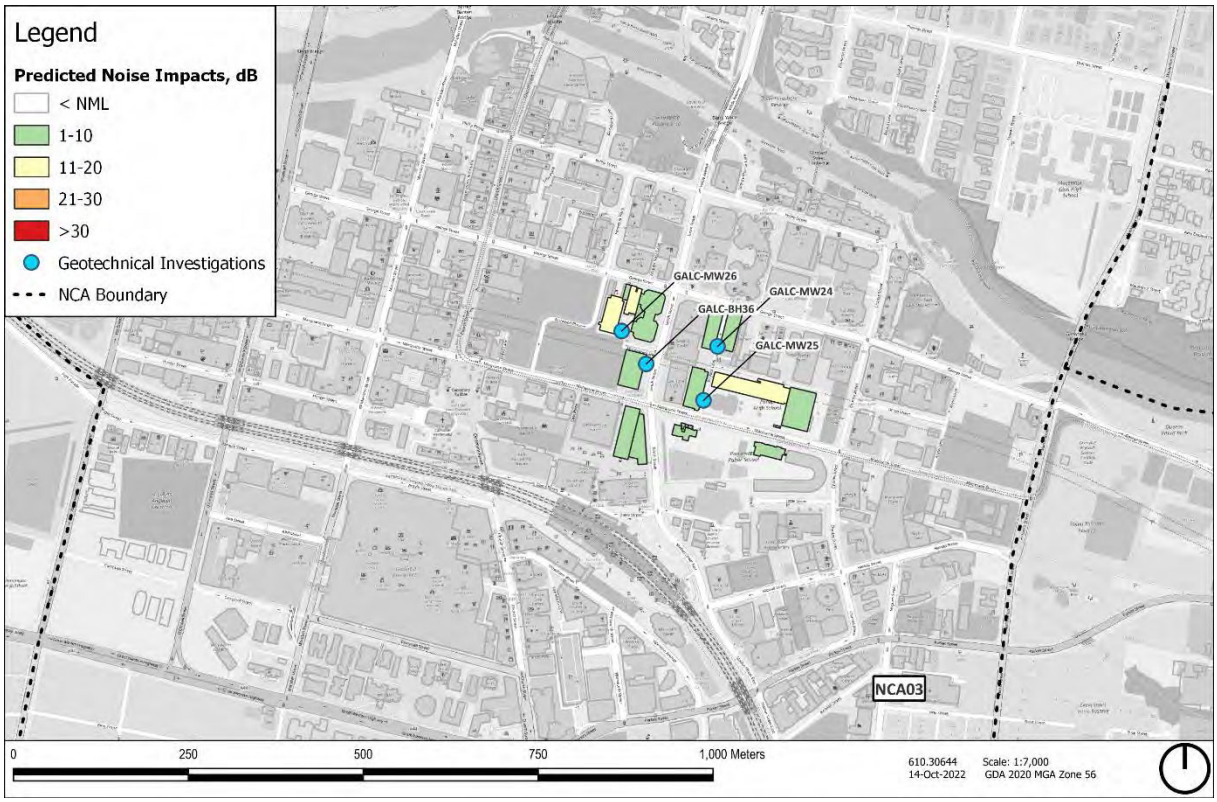


Figure A10 W.003: Reinstatement - AH

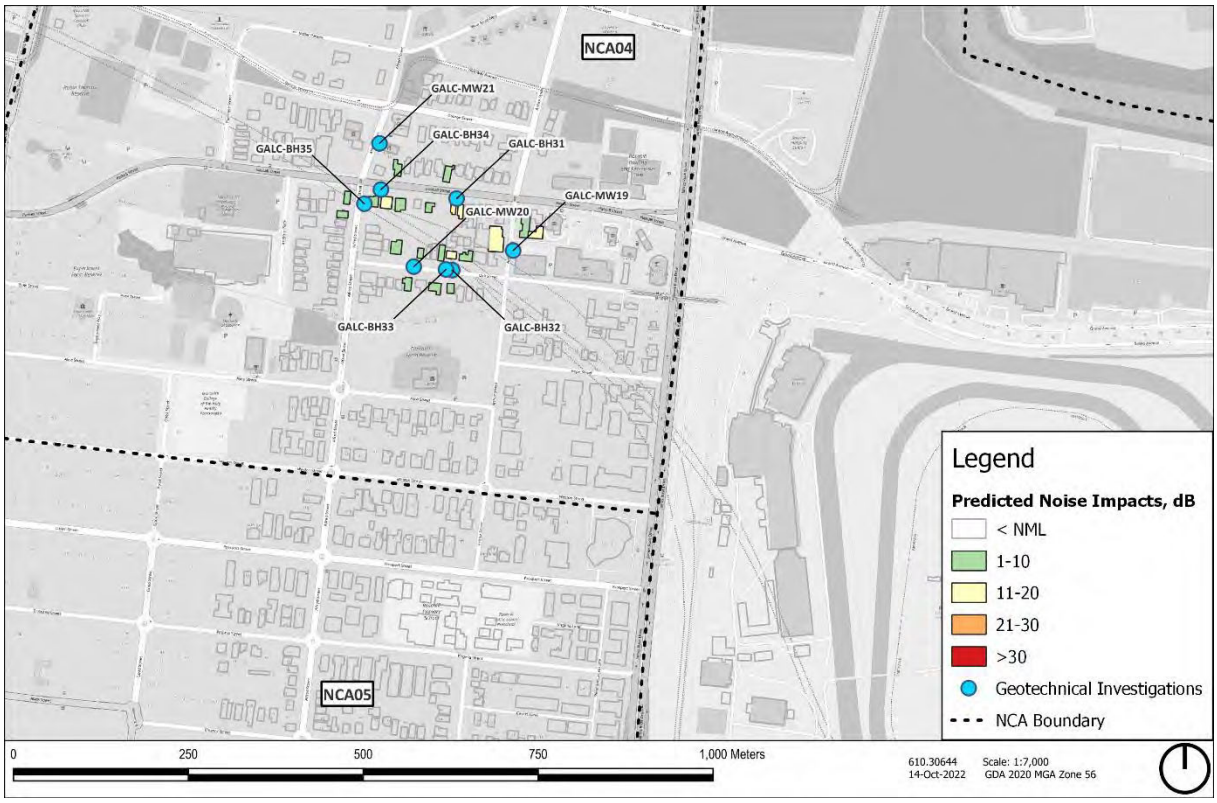
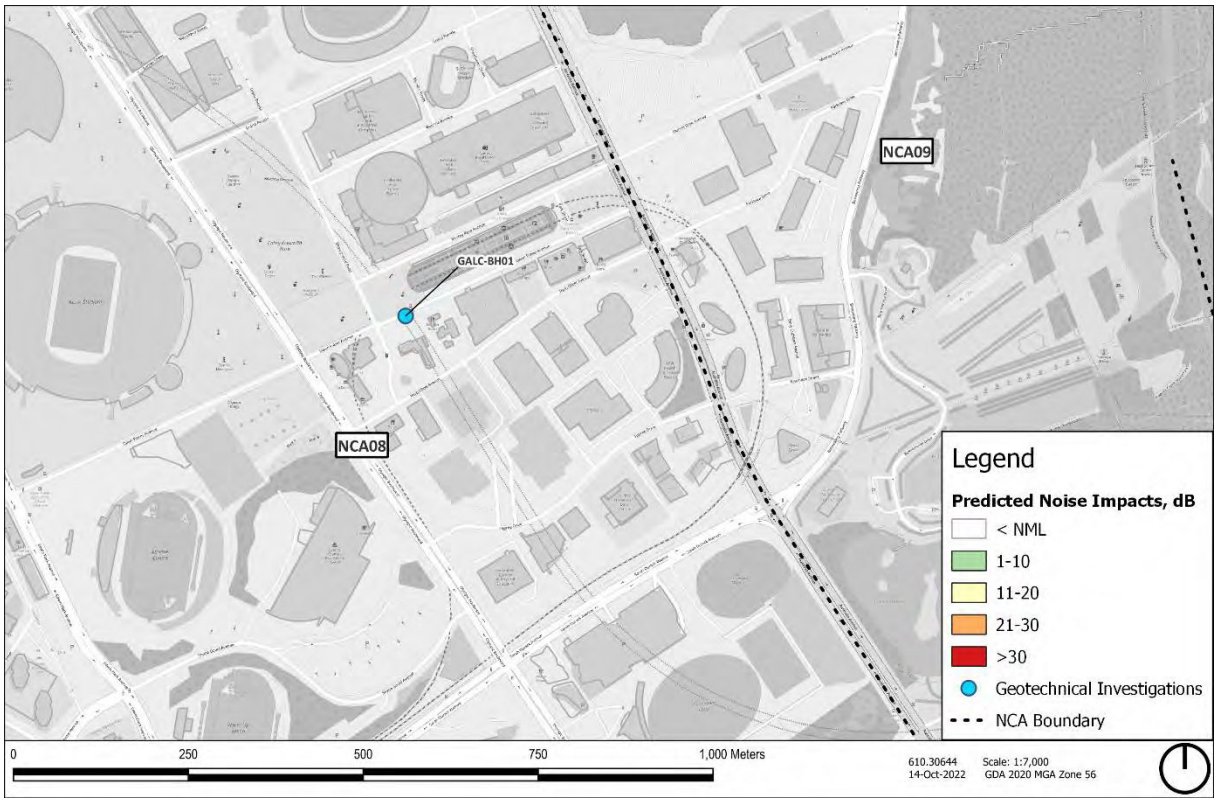


Figure A11 W.003: Reinstatement - AH

Figure A12 W.003: Reinstatement - AH



APPENDIX B – NOISE IMPACT MAPS (OOHW2)

Figure B1 W.001: Non-Destructive Digger (NDD) - OOHW2

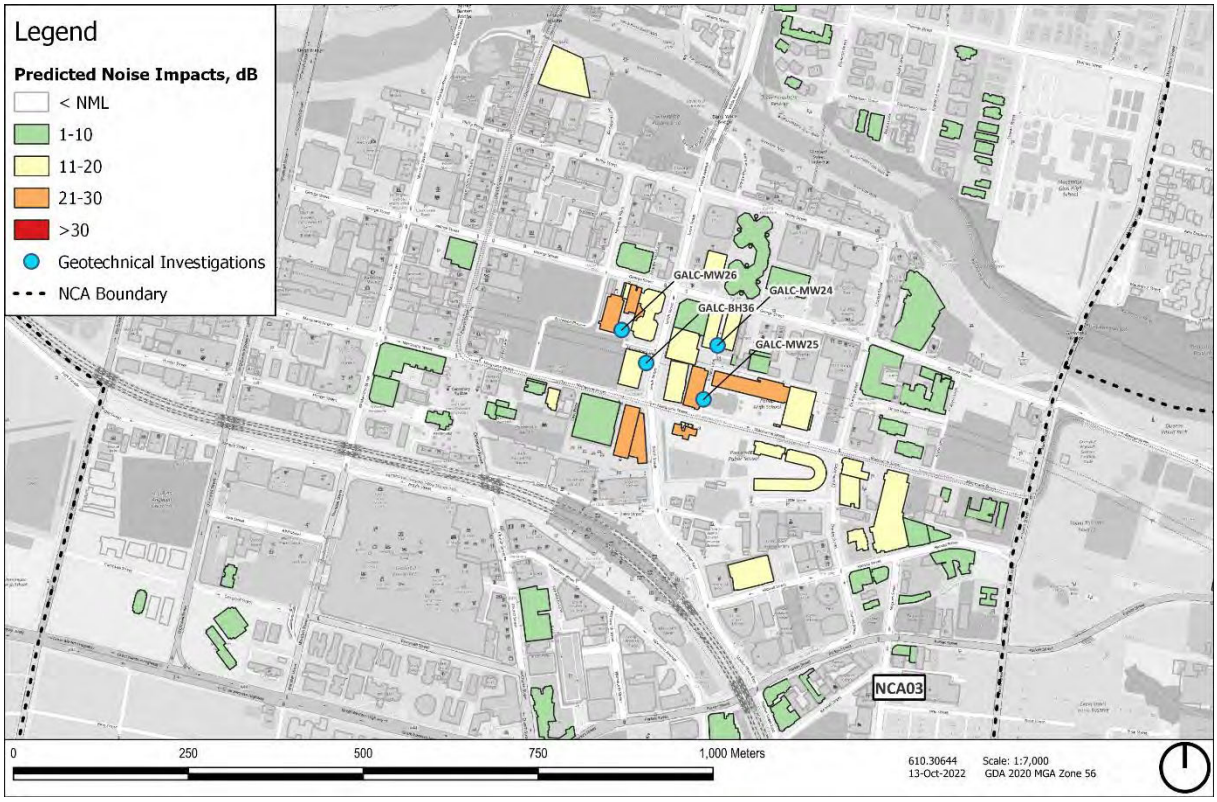


Figure B2 W.001: Non-Destructive Digger (NDD) - OOHW2

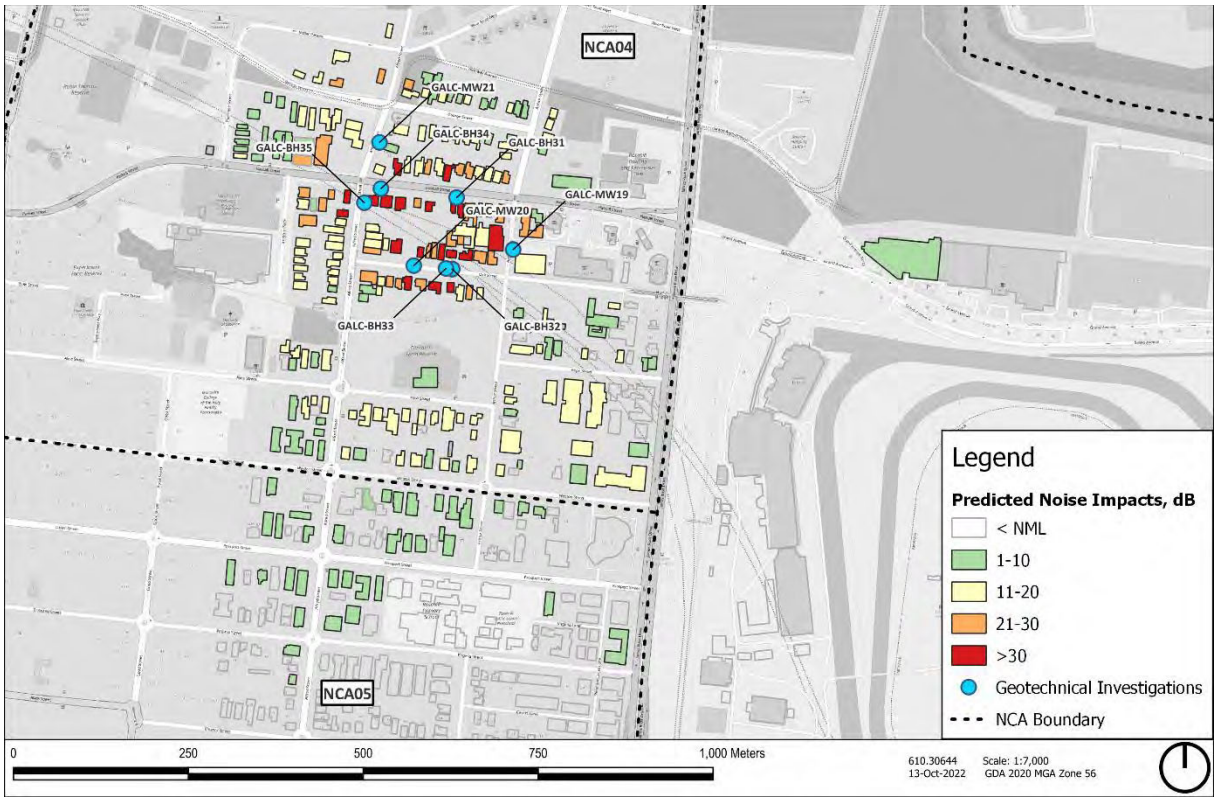


Figure B3 W.001: Non-Destructive Digger (NDD) - OOHW2

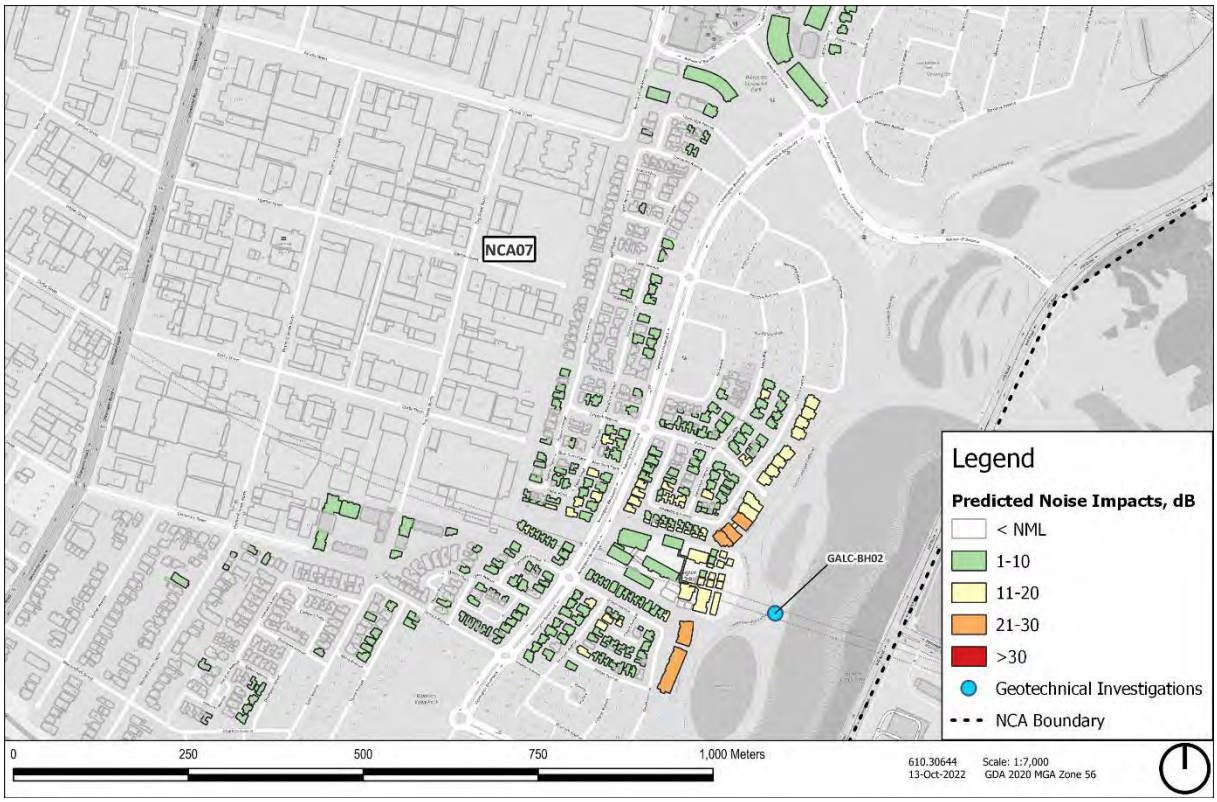


Figure B4 W.001: Non-Destructive Digger (NDD) - OOHW2

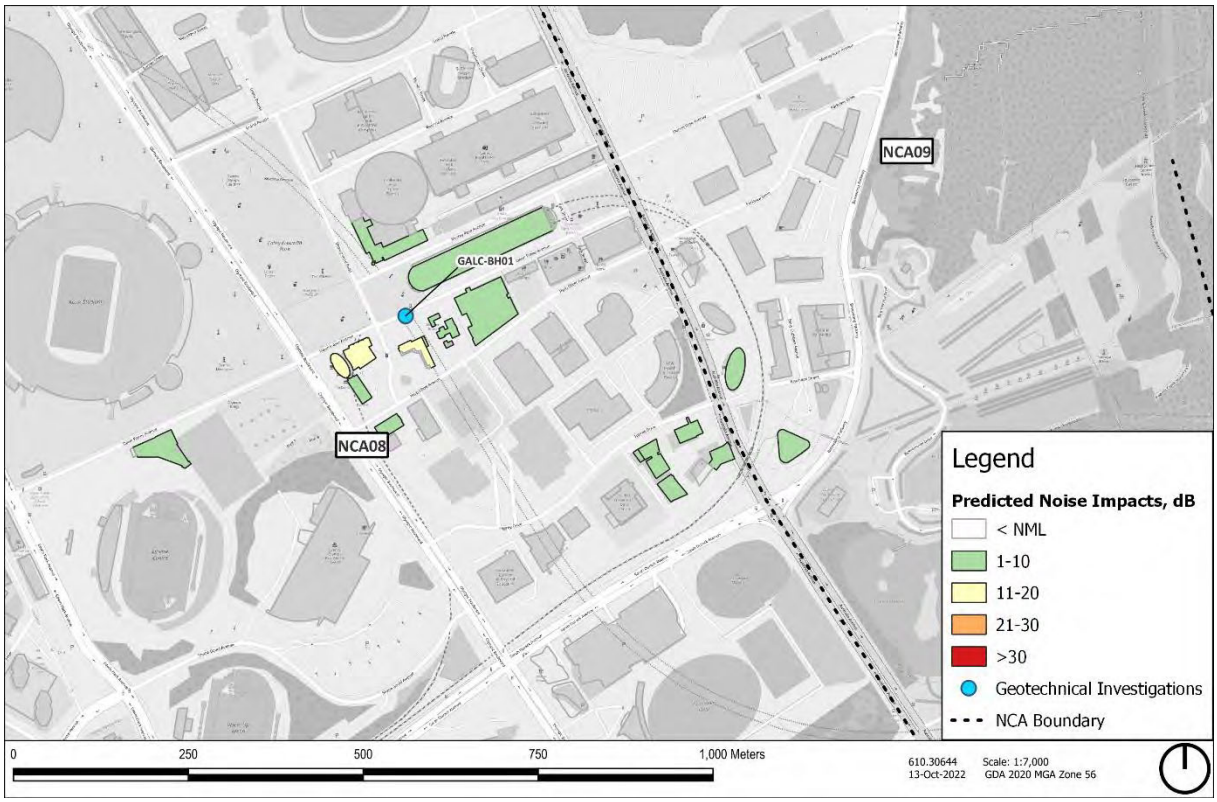


Figure B5 W.002: Drilling Operations - OOHW2

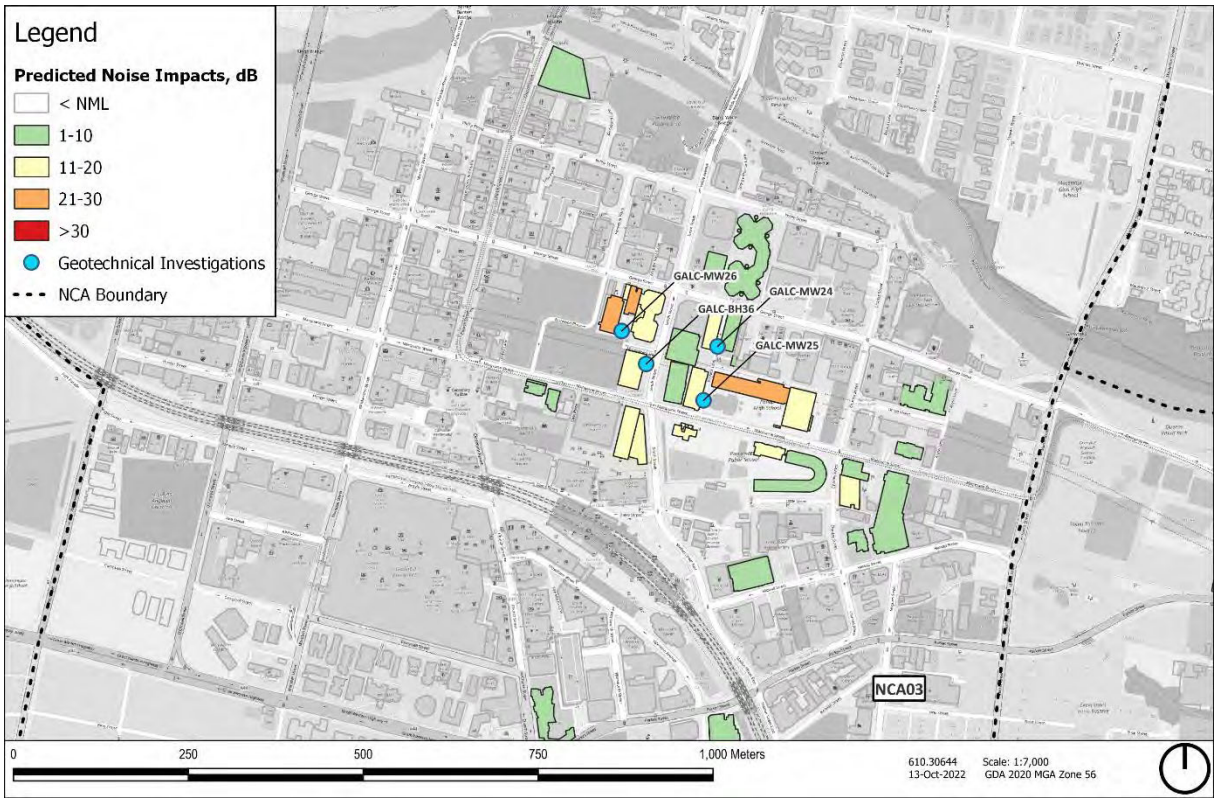


Figure B6 W.002: Drilling Operations - OOHW2

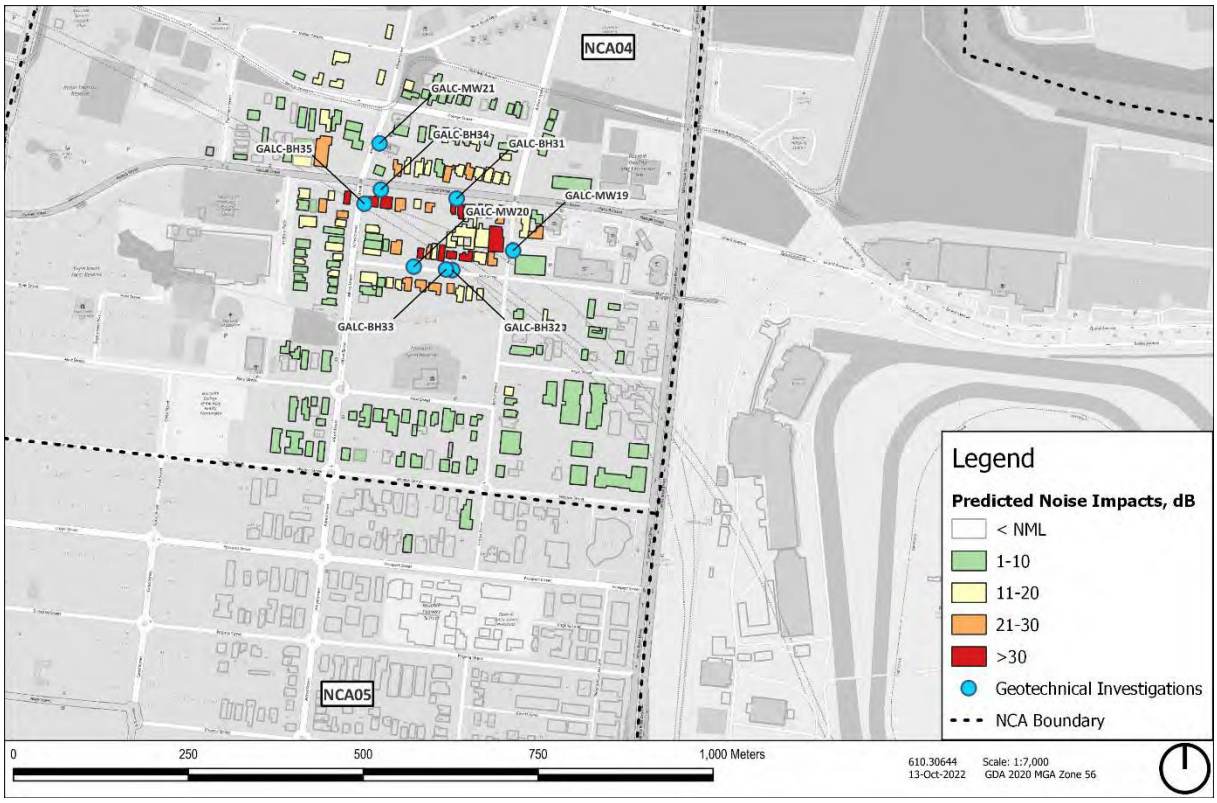


Figure B7 W.002: Drilling Operations - OOHW2

Figure B8 W.002: Drilling Operations - OOHW2

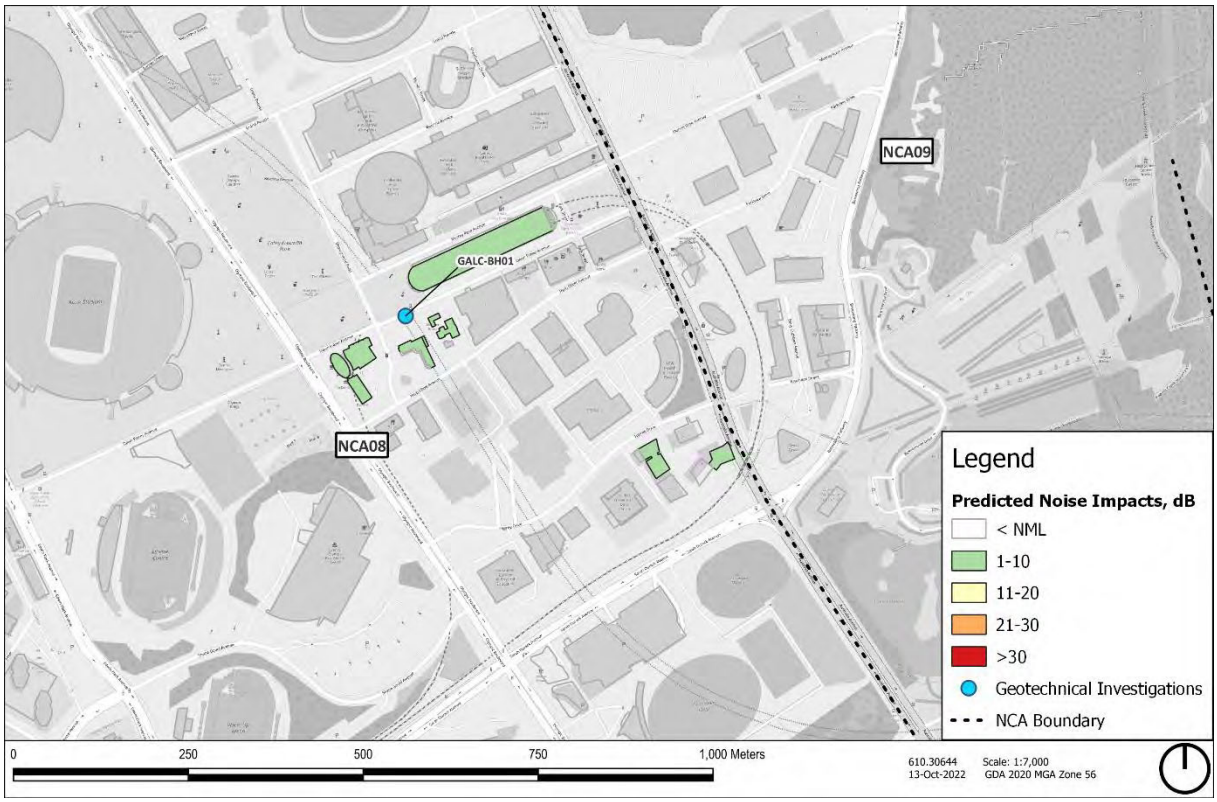


Figure B9 W.003: Reinstatement - OOHW2

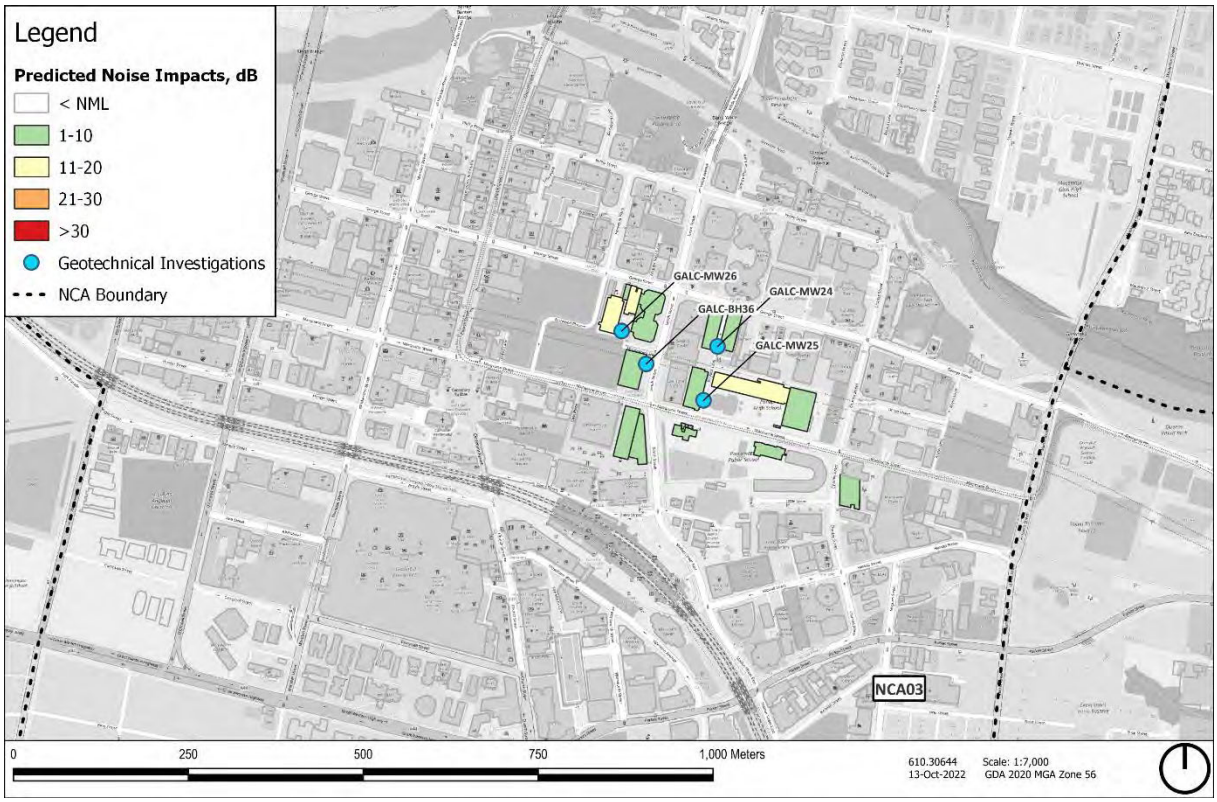


Figure B10 W.003: Reinstatement - OOHW2

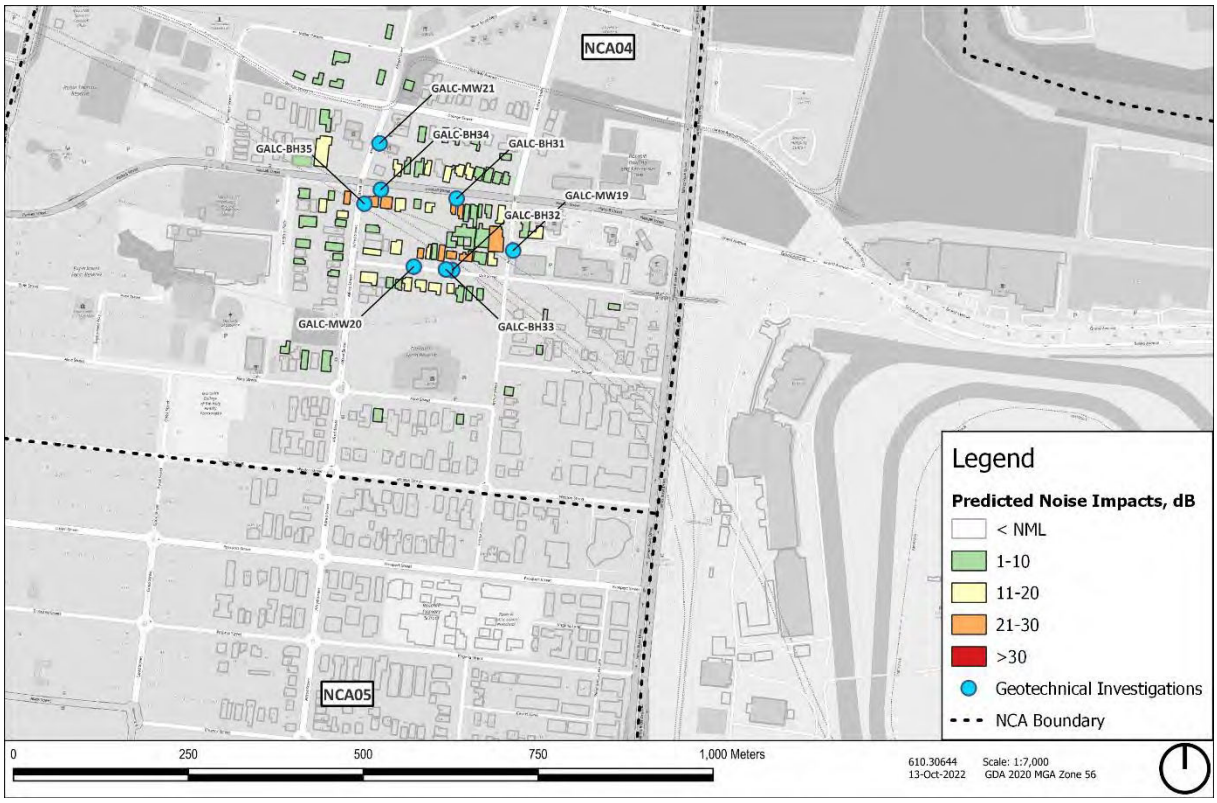
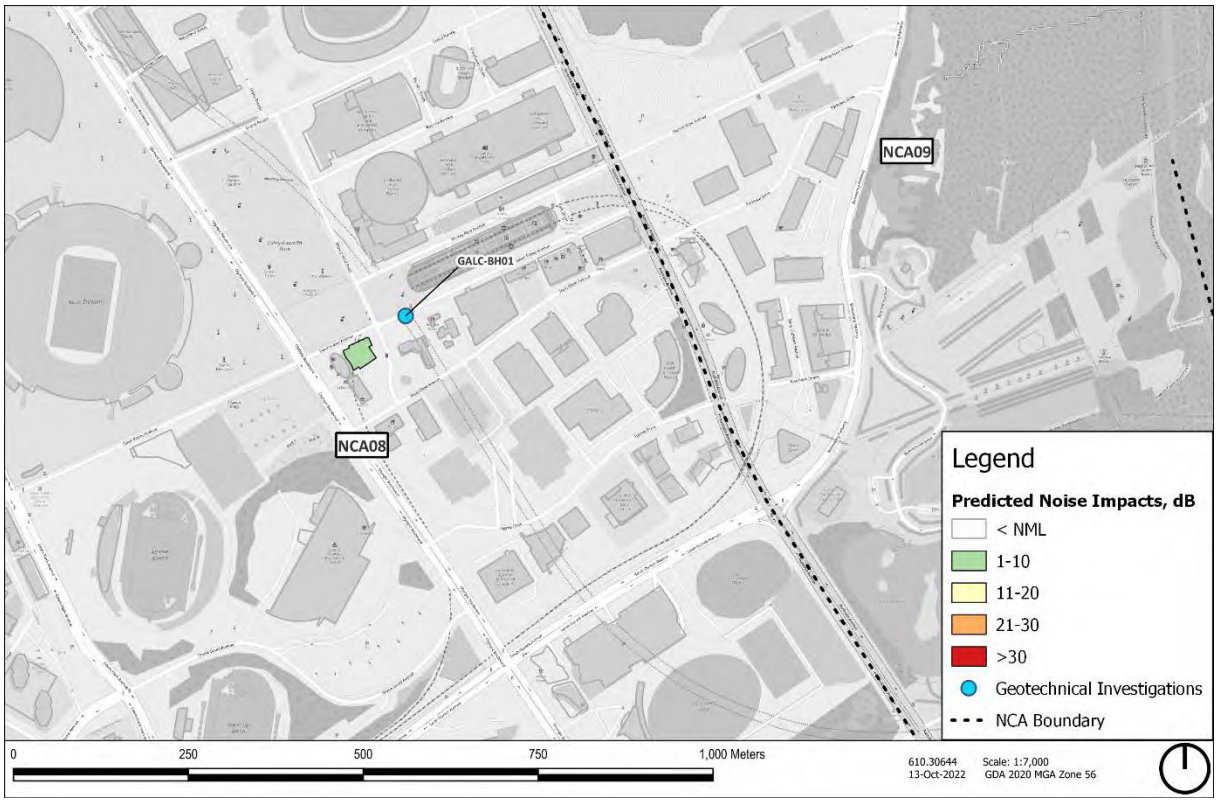


Figure B11 W.003: Reinstatement - OOHW2

Figure B12 W.003: Reinstatement - OOHW2



APPENDIX C – CUMULATIVE BH32, BH33 & MW20 NOISE IMPACT MAPS

Figure C1 W.001: Non-Destructive Digger (NDD) - AH

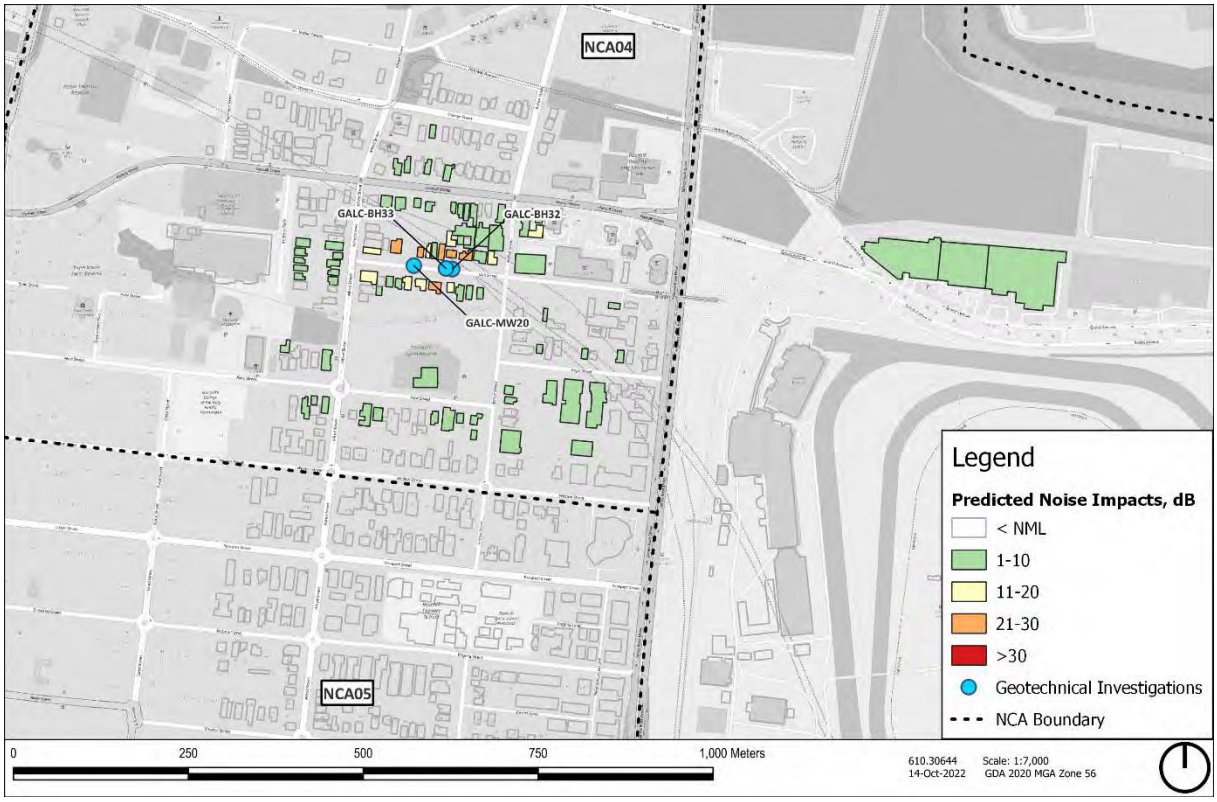


Figure C2 W.001: Non-Destructive Digger (NDD) - OOHW2

Figure C3 W.002: Drilling Operations - AH

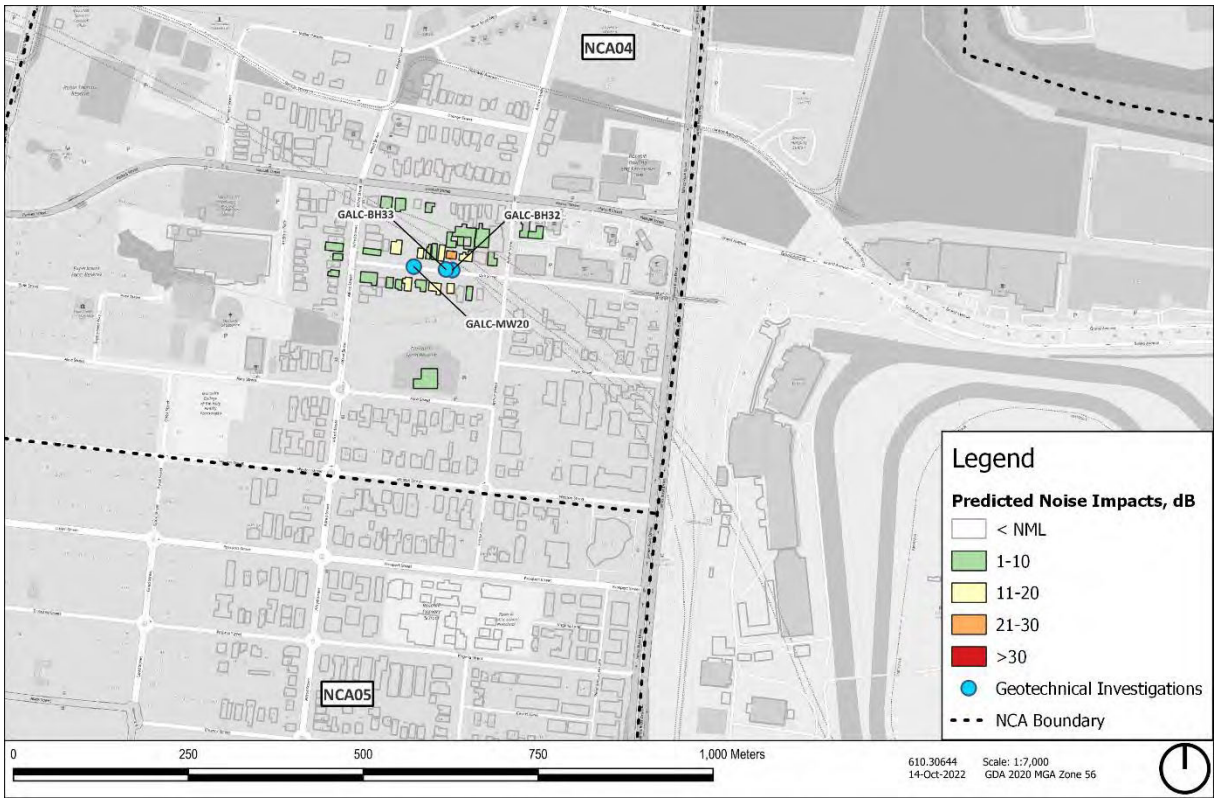


Figure C4 W.002: Drilling Operations - OOHW2

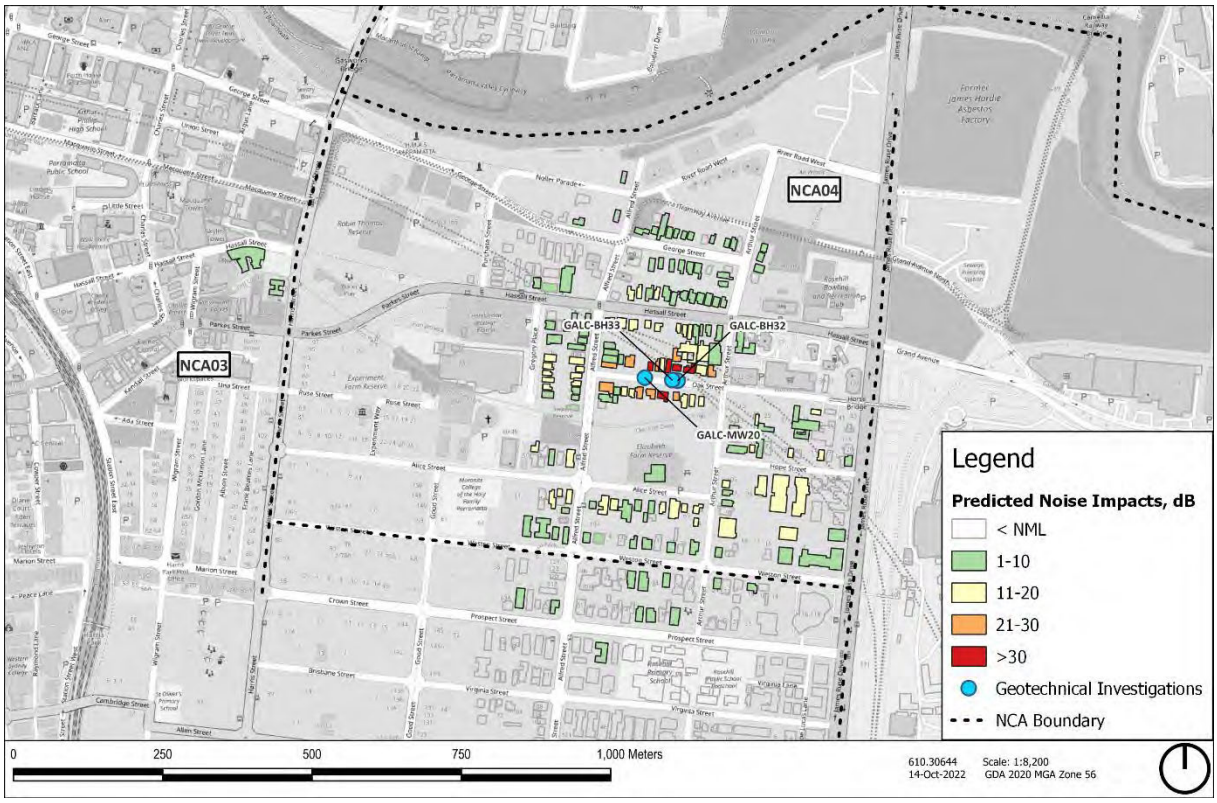


Figure C5 W.003: Reinstatement - AH

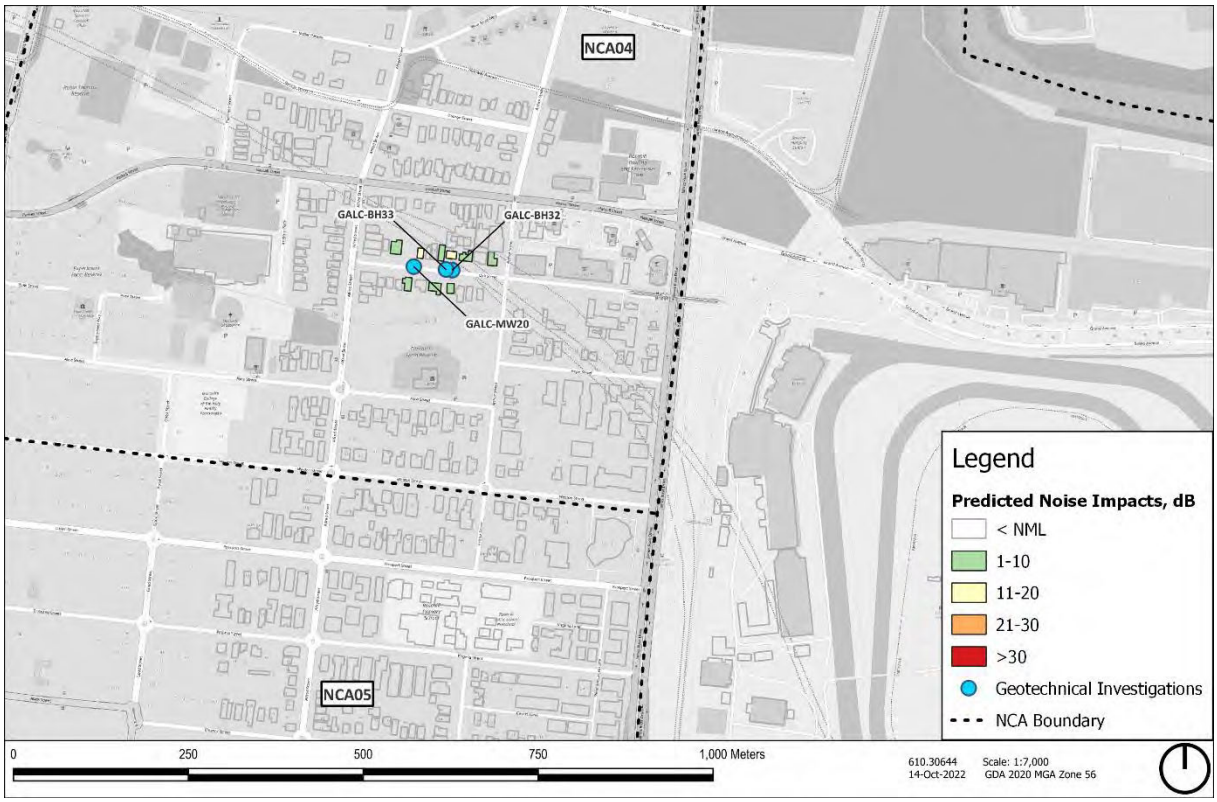
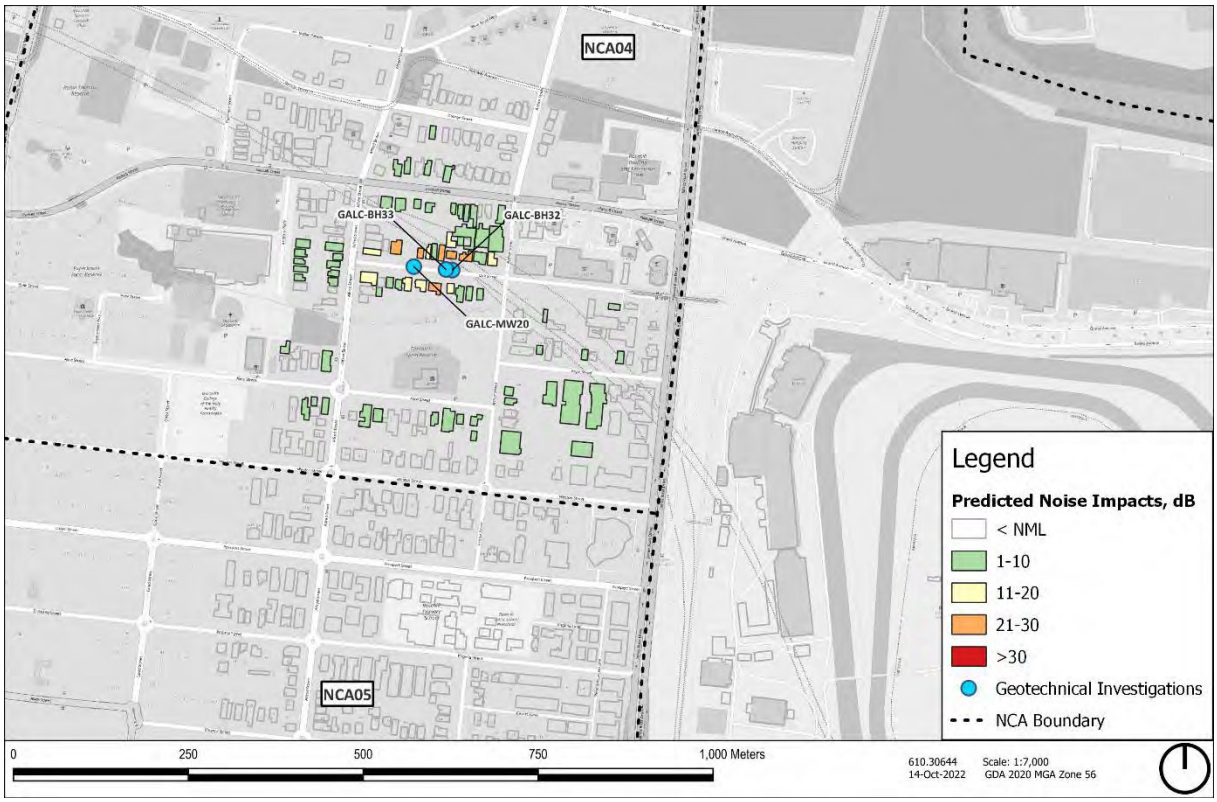
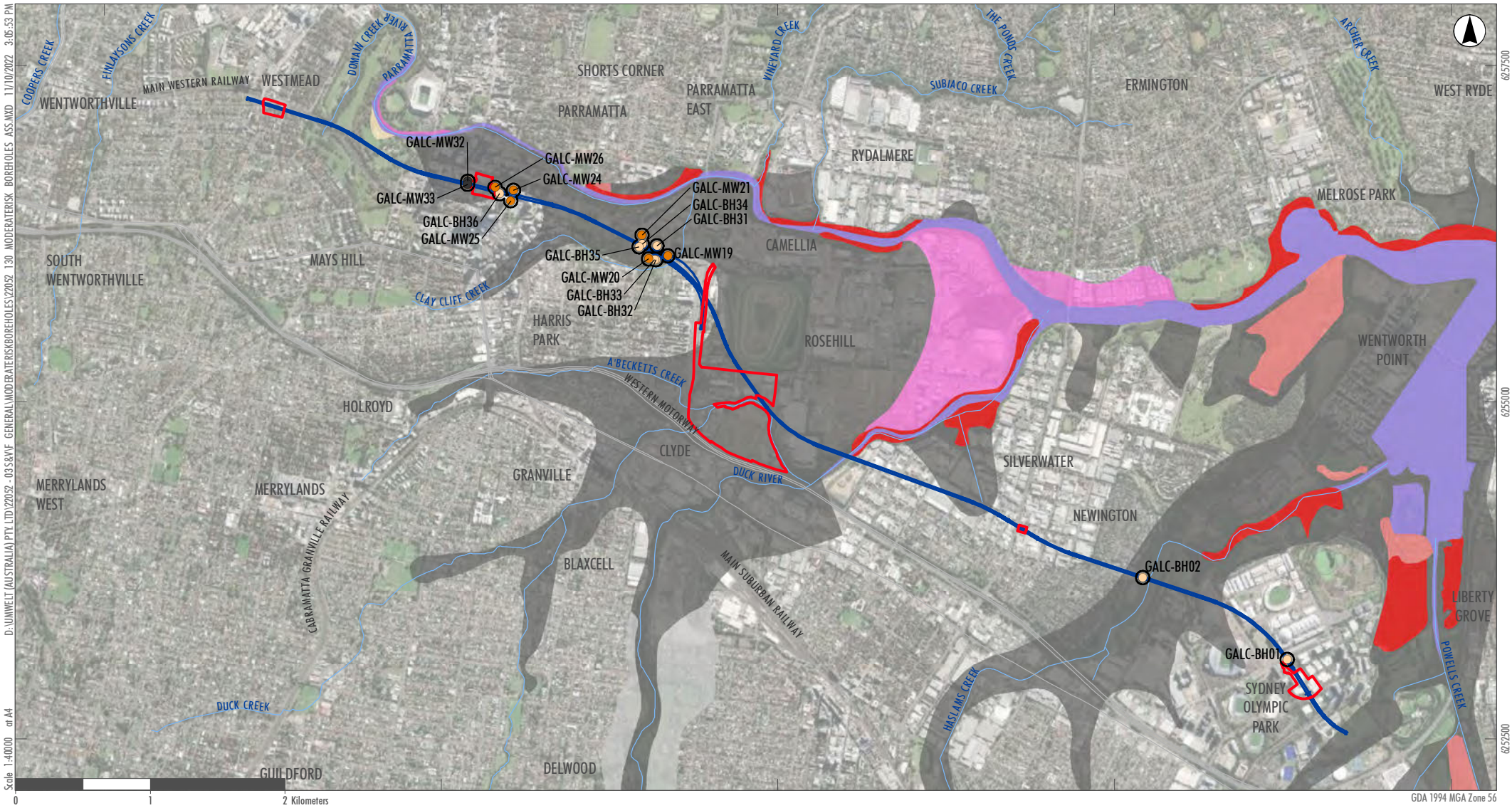


Figure C6 W.003: Reinstatement - OOHW2



Appendix F – Acid Sulfate Soil Risk Map



Legend

- Approved Surface Construction Boundary
- Tunnel Alignment
- Road
- Drainage Line
- Moderate Risk Boreholes
- Moderate Risk Boreholes with Monitoring Wells
- Boreholes/Monitoring Wells removed from the CA

Acid Sulfate Soil Risk

- High Risk 0-1m
- High Risk 1-2m
- High Risk 2-4m
- High Risk Sediments
- Low Risk above 4m
- No Risk
- Disturbed Terrain

APPENDIX F

Acid Sulfate Soil Risk

Image Source: ESRI (2021) Data source: DFSI (2021)

Appendix G – Biodiversity Memo

Inspired People.
Dedicated Team.
Quality Outcomes.

Briefing Note

To: Stephanie Mifsud
E \| steph.mifsud@gamuda.com.au
Cc: Nathan Baker, Thomas Buchan
E \| nbaker@umwelt.com.au, tbuchan@umwelt.com.au
From: Rachel Musgrave
Date: 16 September 2022

Purpose

This briefing note was prepared for Gamuda Australia Lang O'Rourke Consortium (GLC) to assess the impacts to biodiversity resulting from the proposed temporary borehole works and installation of monitoring wells required for the Sydney Metro West – Western Tunnelling Package project.

Outcomes/Key Messages

One Plant Community Type (PCT) would be impacted as a result of the proposed works. This PCT conforms to two threatened ecological communities (TECs) listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), namely

- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – listed as endangered under BC Act
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community – listed as endangered under the EPBC Act.

Direct impacts to this PCT are expected to be minimal and would involve minor trimming of canopy trees and limited disturbance to the groundcover stratum to allow for drilling and ancillary activities associated with the geotechnical investigations proposed under the Consistency Assessment.

The desktop assessment identified two threatened flora species and two threatened fauna species with a high likelihood of occurrence within the study area, however these species were not detected during opportunistic threatened flora surveys undertaken within the study area. The presence of Narrow-leafed Wilsonia, *Zannichellia palustris* and Green and Golden Bell Frog may be directly impacted by ground disturbing works, but this is considered to be unlikely with appropriate mitigation measures in place. There may be some impacts to suitable habitat for the Grey-headed Flying Fox due to trimming of native vegetation, and Green and Golden Bell Frog as a result of ground disturbing works, however this is expected to be minor and not impact the availability of resources. No further impacts to threatened flora and fauna habitat were identified.

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Assessments of significance carried out under the BC Act and EPBC Act found that the proposed works were unlikely to have a significant impact on biodiversity values within the study area.

In this document

1.0 Background

Umwelt has been engaged by GLC to prepare a Biodiversity Briefing Note to understand potential impacts to biodiversity resulting from the proposed geotechnical investigations associated with the Sydney Metro West - Western Tunnelling Package (the Project). This will form part of the Planning Approval Consistency Assessment for 'Moderate Risk Boreholes and Monitoring Wells Outside Approved Construction Boundary' (referred to as the 'CA' from this point forward). This report includes Umwelt's assessment of impacts and provides recommendations for the temporary borehole works proposed for the tunnelling alignment between Westmead and Sydney Olympic Park.

The proposed borehole works and monitoring wells are required to collect groundwater data and inform the design for the tunnelling works between Parramatta and Sydney Olympic Park.

1.1 The Proposed Works

41 boreholes and monitoring wells were proposed for the Project, which are located along (or adjacent to) the Project's tunnel alignment between Westmead and Sydney Olympic Park. A high-level desktop assessment and subsequent site inspection was undertaken in August 2022 to identify 'high constraint sites' for biodiversity impacts (refer to Appendix C of the CA). Five sites were identified, four of which are located within Parramatta Park. One site (GALC-BH02) is located 50 metres (m) north of Haslams Field in Newington, which is the focus of this assessment. The sites within Parramatta Park will be assessed as part of a separate Consistency Assessment ('High Risk Boreholes and Monitoring Wells Outside Approved Construction Boundary') and thus has been excluded from this memo.

GALC-BH02 (referred to as 'the site' from this point forward) is located within the City of Parramatta Local Government Area (LGA), approximately 14 kilometres (km) west of the Sydney Central Business District (CBD).

A study area was determined to capture all potential direct and indirect impacts caused by the site. The study area was produced by buffering the approximate location of the proposed borehole works by 50 m. The location of the site and study area are shown in **Figure 1.1**.

1.1.1 Methodology

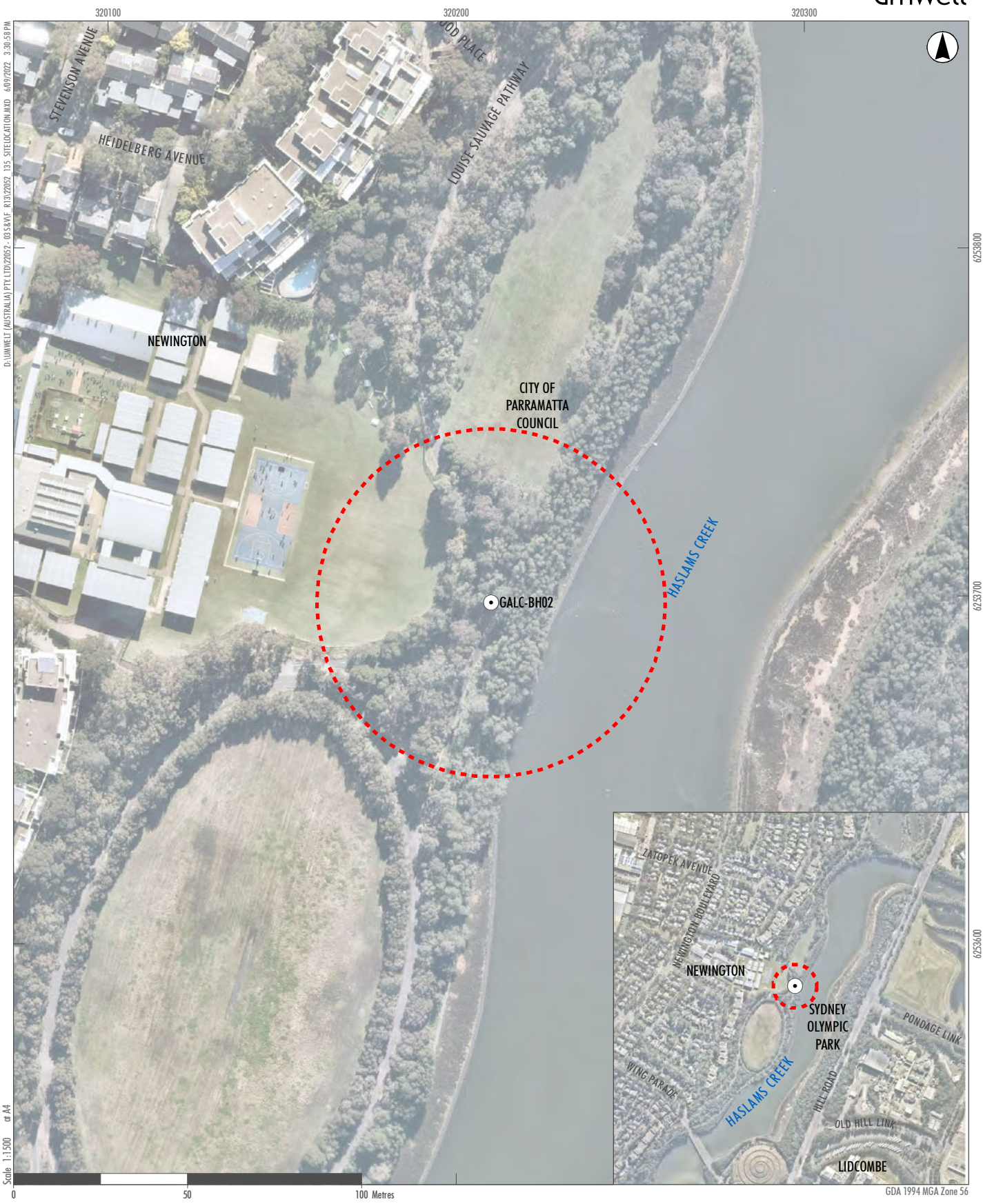
The temporary borehole works for the site (referred to as 'the proposed works' from this point forward) includes the following activities:

1. Undertake site setup, including traffic control, temporary fencing, noise blankets and signage.
2. Undertake onsite service location, service clearance and proving (service location, depth, and type) using an accredited service locator and non-destructive digging method.
3. Setup and drill boreholes using a float truck and drill rig. Works will be undertaken between 5 am to 5.30 pm every day over approximately 8-12 days. The drill rig will remain onsite for the duration of works where possible. A support vehicle will set up and demobilise from the site each day.
4. Reinstate each borehole/monitoring well site, including:
    - Demobilisation of drill rig and other plant and equipment from the site
    - Backfill drilled hole with grout to just under surface level
    - Reinstate surface area around drill location

- Clean site and undertake post-construction dilapidation survey
- Remove traffic controls and environmental controls
- The disturbed area around drill locations in grassed areas will be reinstated with topsoil and grass seeds.

5. Undertake fortnightly manual dripping and groundwater sampling (only required for monitoring well sites).

No removal of native canopy species is required, however there will be some trimming of overhanging branches from surrounding trees where necessary, and limited disturbance to the groundcover stratum during the course of the proposed work.



Legend

- Study Area (50m Buffer)
- GALC-BH02

FIGURE 1.1

Site Location

Image Source: Nearmap (August 2022) Data source: DFSI (2021)

2.0 Assessment Methodology

2.1 Desktop Assessment

A review of relevant public databases and literature was undertaken in August 2022 to identify threatened and migratory species, endangered populations, Threatened Ecological Communities (TECs) and their habitats that have previously been recorded within the locality (a 10 km radius around the study area). Threatened species, migratory species, endangered populations and TECs (listed under the NSW BC Act, NSW *Fisheries Management Act 1994* (FM Act) and the EPBC Act) that have the potential to occur within the locality were also considered based on the type of habitat present and the NSW bioregion within which the study area occurs.

Databases and literature reviewed as part of this assessment include:

- A search of the Department of Planning and Environment (DPE) BioNet Atlas based on a 10 km radius around the site
- A search of the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) based on a 10 km radius around the site
- A search of the BioNet Threatened Biodiversity Data Collection (TBDC)
- A search of the Biodiversity Values Map Threshold Tool (BVMTT)
- A search of the NSW eSPADE spatial viewer
- A search of the National Flying-fox monitoring viewer accessed by the DCCEEW Interactive Flying-fox Web Viewer
- A search of the NSW Spatial Services Historical Imagery Viewer Portal.

2.2 Vegetation Mapping

The following sets of regional vegetation mapping were reviewed to inform the assessment of the vegetation communities present within the study area:

- The NSW State Vegetation Type Map (SVTM), 2022 (DPE, 2022)
- Native Vegetation of the Sydney Metropolitan Area - Version 3.1, 2016. VIS_ID 4489 (OEH, 2016).

Additionally, a Biodiversity Development Assessment Report (BDAR) (Jacobs, 2020) was prepared to support the Sydney Metro West – Stage 1 Environmental Impact Statement (EIS) for the Project. The findings from the BDAR were also considered for the assessment of the vegetation communities.

2.3 Site Visit

A site visit was conducted on 25 August 2022. An Umwelt ecologist inspected the site to record observations of any threatened and/or migratory species, endangered populations, TECs and any other ecological features that had the potential to be impacted. All investigations were limited to the extent of the study area**.**

Rapid data assessments to record the flora species occurring in the areas of the site were conducted at points using random meanders as described by Cropper (1993). Two rapid data assessments were undertaken to capture the structural variation in vegetation communities, the variation in species diversity across the study area and to define changes in abiotic conditions (the occurrence of creek lines and past disturbances). The rapid data assessments recorded the dominant species present, the frequency of their occurrence (common, uncommon, or rare) and their status as either threatened, native or non-native (to the Sydney Basin Bioregion).

The presence of fauna habitat within the study area was also assessed. Specific attention was paid to the potential occurrence of hollow bearing trees, course woody debris, semi-permanent waterbodies and structures with the potential to support bat roosts.

2.4 Limitations

Field surveys were conducted over one day in August 2022. In addition to the surveys undertaken, the full spectrum of flora and fauna species and ecological processes likely to occur on the site were considered by identifying potential habitats for such species and assessing the potential for these species to occur on the site based on previous records, the type and condition of habitats present, the land use of the site and its landscape context.

As stated by the DEC (2004a):

> '*The absence of a species from survey data does not necessarily mean it does not inhabit the survey area. It may simply mean that the species was not detected at that time with the survey method adopted and the prevailing seasonal or climatic conditions.'*

Accordingly, the relative brevity of the survey and its timing mean that the full spectrum of flora and fauna species, as well as ecological processes, likely to occur on the subject site may not be fully quantified or described in this report.

3.0 Results

3.1 Vegetation Communities

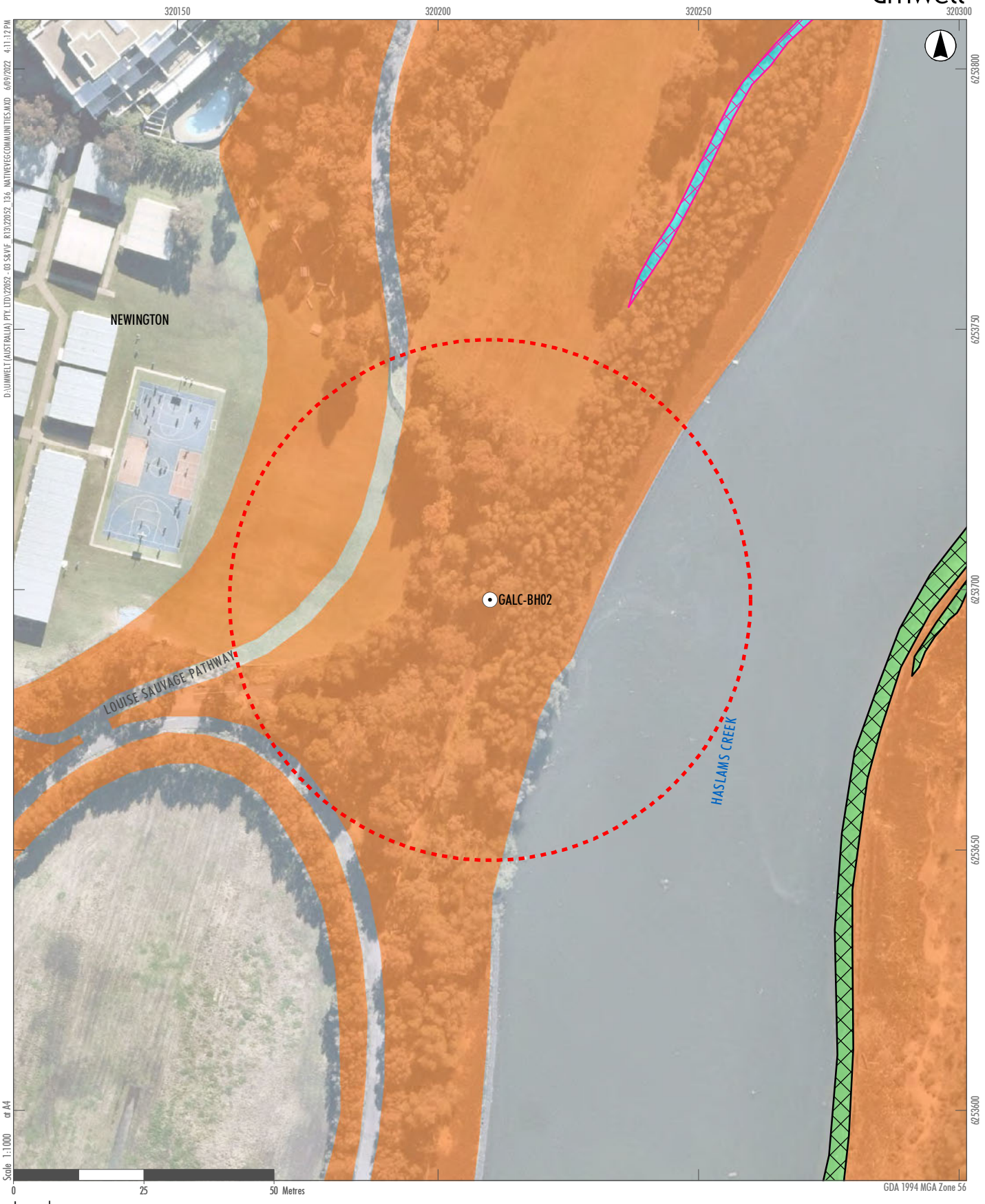
3.1.1 Review of Regional Mapping

The vegetation within the study area was not mapped as a PCT within any of the regional vegetation mapping methodologies considered for this assessment. However, the VIS 4489 vegetation mapping (OEH, 2016) and Sydney Metro West – Stage 1 EIS BDAR (Jacobs, 2020) identified several patches of PCTs along the riparian zones of Haslams Creek. This vegetation has been classified as PCT 1126: Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion.

PCT 1126 is mapped along the eastern riparian edge of Haslams Creek, including the areas directly across the water from the site. This PCT was also identified along the western edge of Haslams Creek 200 m north of the site. Refer to ***Figure 3.1*** for the location of this PCT.

PCT 1126 is associated with two TECs listed under the BC Act and one TEC listed under the EPBC Act, including:

- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered under the BC Act)
- The Shorebird Community occurring on the relict tidal delta sands at Taren Point (Endangered under the BC Act)
- Subtropical and Temperate Coastal Saltmarsh (Vulnerable under the EPBC Act).



Legend

Study Area (50m Buffer)

GALC-BH02

Native Vegetation of the Sydney Metropolitan Area (VIS 4489)

PCT: 1126, Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

Plantation (native and/or exotic)

Artificial Wetland

Jacobs Biodiversity Development Assessment Report

PCT: 1126, Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

Artificial Wetland

FIGURE 3.1

Mapped Native Vegetation Communities

Image Source: Nearmap (August 2022) Data source: DFSI (2021), © State Government of NSW and Department of Planning and Environment 2016

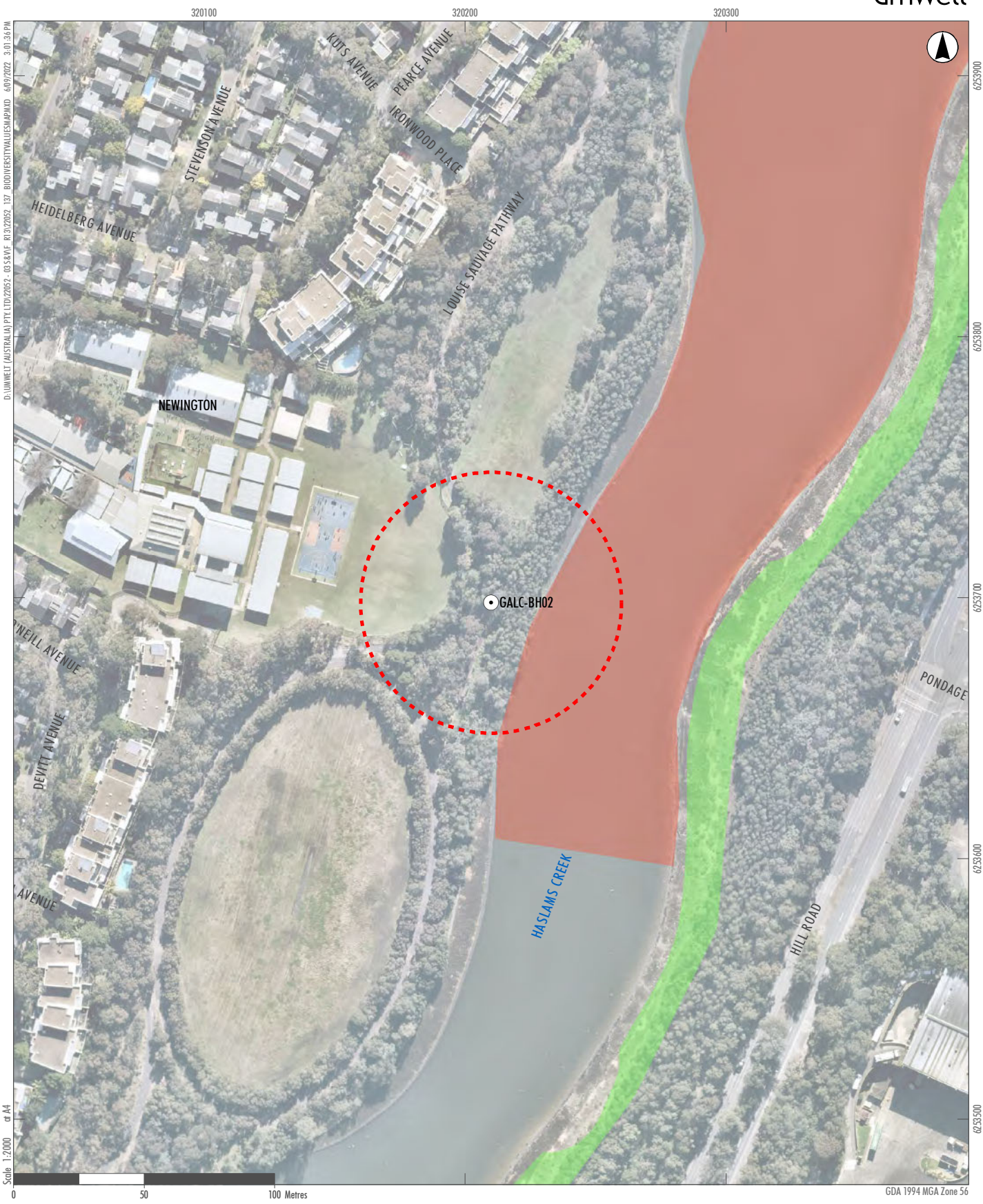
3.1.2 Soil Landscape

The *Soil Landscapes of the Sydney 1:100,000 Sheet* (Chapman et al., 2009) mapped the study area as 'Birrong' soil landscape. This soil landscape is characterised by level to gently undulating alluvial floodplains dominated by silt and clay sized alluvial materials derived from the Wianamatta Group. It is typically found within floodplains of watercourses draining Wianamatta Group shales on the Cumberland Lowlands. The vegetation commonly found in this soil landscape include extensively cleared tall open-forest and woodland, with small relict stands of ironbark *Eucalyptus paniculata*, turpentine *Syncarpia glomulifera*, and Sydney blue gum *Eucalyptus saligna* forest and woodland.

3.1.3 Biodiversity Values Map

Haslams Creek and associated riparian zones have been mapped as 'threatened species or communities with potential for serious and irreversible impacts' under the Biodiversity Values Map and Threshold Tool. This includes the portion of Haslams Creek within the study area for the site, as shown in **Figure 3.2.** This area is considered important habitat for specific migratory shorebirds listed under both the BC Act and EPBC Act. A number of these migratory shorebirds, including Curlew Sandpiper (*Calidris ferruginea*) are considered entities where impacts to areas of mapped important habitat have the potential to be serious and irreversible.

There are also areas along Haslams Creek mapped as 'Protected Riparian Land' and 'Coastal Management Act – Wetlands'.



Legend

- Study Area (50m Buffer)
- GALC-BH02

Biodiversity Values

- Protected Riparian Land
- Threatened species or communities with potential for serious and irreversible impacts

FIGURE 3.2

Biodiversity Values Map

3.1.4 Historical Aerial Imagery

A review of the NSW Spatial Services Historical Imagery Viewer was undertaken to understand the history of the site and surrounding native vegetation communities. The landscape around the site was generally cleared agricultural land since at least the 1930's. The riparian zones of Haslams Creek contained remnant vegetation, which was cleared around the site by 1951. In 1998, the site underwent landscaping works and realignment works of Haslams Creek. By 2002, native vegetation was planted around the site and along the western edges of Haslams Creek. Refer to **Figure 3.3** to **Figure 3.6** for the changes in landscape since the 1930s.

Figure 3.3 Aerial Imagery from 1930

Figure 3.4 Aerial Imagery from 1951

Figure 3.5 Aerial Imagery from 1998

Figure 3.6 Aerial Imagery from 2002

3.1.5 Site Visit

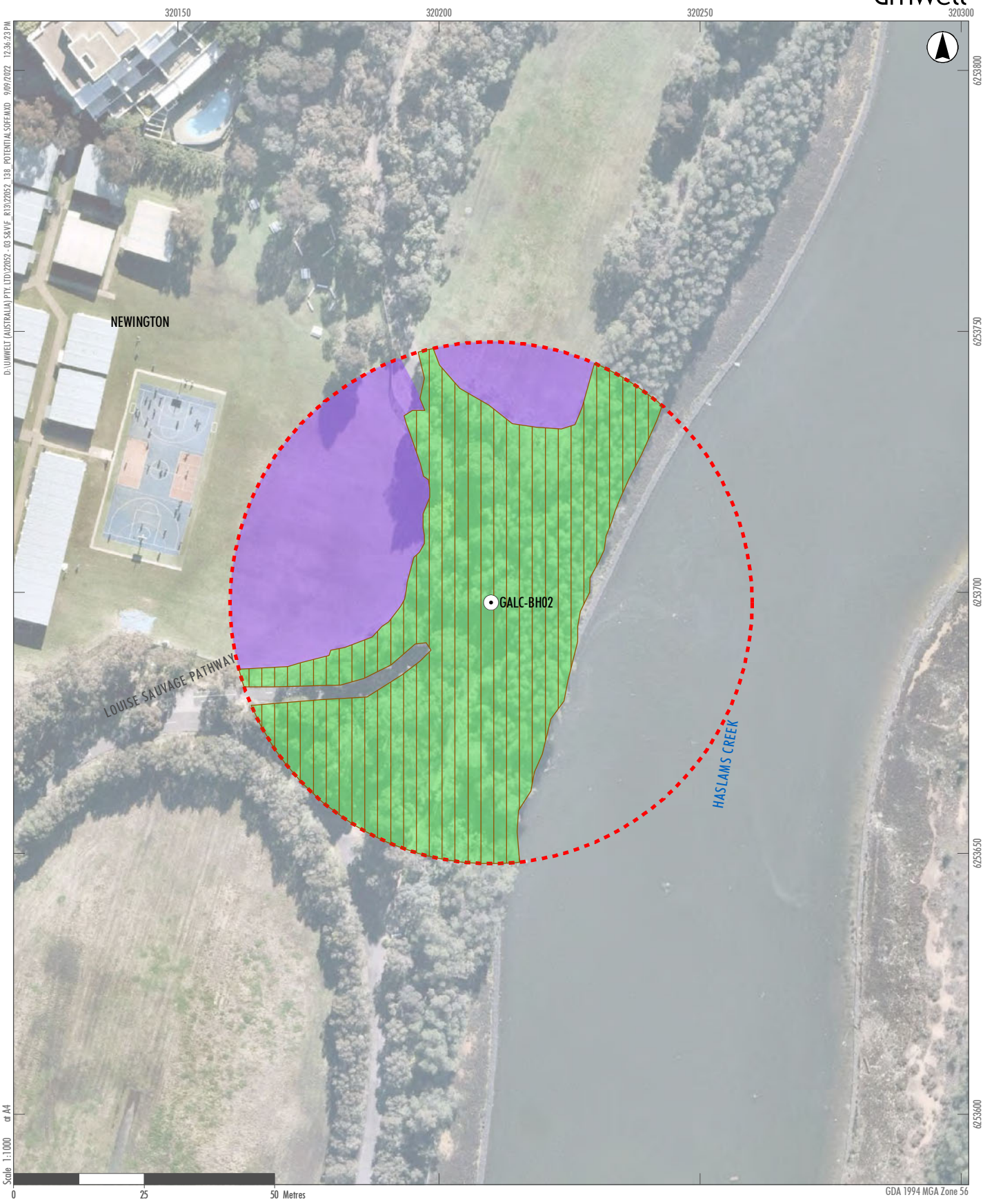
The site visit identified two PCTs occurring within the study area as described in **Table 3.1** and illustrated on ***Figure 3.7***. One of these vegetation communities, PCT 4023 is associated with Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions TEC, due to the presence of *Casuarina glauca* along the creekline of Haslams Creek. Swamp Oak Floodplain Forest is a TEC listed as 'endangered' under the BC Act. The PCT is also associated with Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community, listed as endangered under the EPBC Act.

Table 3.1 Plant Community Types within the study area

Plant Community Type	Status – BC Act	Status – EPBC Act	Extent in study area (ha) (approximate)
PCT 4023: Coastal Valleys Swamp Oak Riparian Forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	0.36
Exotic grassland	-	-	0.19

The vegetation within the study area is comprised of canopy species such as *Casuarina glauca*, *Eucalyptus moluccana*, *Angophora floribunda*, *Eucalyptus robusta*, and *Melaleuca styphelioides*. The ground cover is predominantly comprised of exotic species such as *Ehrharta erecta*, *Bidens pilosa*, and *Tradescantia fluminensis*, however native species such as *Lomandra longifolia*, *Commelina cyanea*, and *Dianella caerulea* are also present in low abundance. Midstorey species are absent within the study area.

As discussed in **Section 3.1.4**, the study area was cleared during the 1950s before being subsequently revegetated in the early 2002s. Although the majority of vegetation within the study area was likely planted as part of revegetation works, the species composition of the community is consistent with a natural PCT (that is PCT 4023). It also possesses recruitment of locally indigenous species found both within the study area and across the general locality. As such, the vegetation is functioning as a native ecosystem despite having been planted.



Legend

- Study Area (50m Buffer)
- GALC-BH02
- PCT 4023: Coastal Valleys Swamp Oak Riparian Forest
- Exotic Grassland
- BC Act: Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

FIGURE 3.7

Location of PCT 4023

Image Source: Nearmap (August 2022) Data source: DFSI (2021), © State Government of NSW and Department of Planning and Environment 2018

3.1.5.1 Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions

The occurrence of PCT 4023 within the study area has been assessed as conforming to Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (from here on in referred to as SOFF), listed as endangered under the BC Act. A justification for the identification of SOFF within the study area is as detailed in ***Table 3.2***.

Table 3.2 Key Diagnostics of SOFF (BC Act)

Key diagnostic characteristics and supplementary descriptors for SOFF (BC Act) as per final determination	PCT 4023
Occurs within Sydney Basin Bioregion	Study area occurs within Sydney Basin Bioregion
Assemblage of species as listed within Part 1 of the Final Determination	The assemblage of species occurring within the study area is consistent with those listed in Part 1 of the Final Determination, namely: • *Casuarina glauca* • *Melaleuca styphelioides* • *Dianella caerulea* • *Lomandra longifolia* • *Commelina cyanea*
Is associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains.	The study area occurs on an alluvial plain next to Haslams Creek, with the mapped soil landscape in the study area comprised of silt and clay sized alluvial materials derived from the Wianamatta Group shales
Occurs below 20 m in elevation	The study area occurs below 10 m in elevation.

3.1.5.2 Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

PCT 4023 has been assessed as conforming to Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community, listed as endangered under the EPBC Act. Both structurally and floristically, this TEC is similar to the BC Act listed SOFF. The list of key diagnostic features and key condition thresholds developed by the DCCEEW (2020) was used to determine the presence of this TEC in the study area. The application of DCCEEW's (2020) list against the native vegetation within the study area (and contiguous to) is described ***Table 3.3*** below.

Table 3.3 Key Diagnostics of Coastal Swamp Oak (Casuarina glauca) Forest (EPBC Act)

Key diagnostic characteristics and supplementary descriptors for Coastal Swamp Oak Forest (EPBC Act) as per final determination	PCT 4023
Occurs from south-east Queensland to southern NSW within the South Eastern Queensland, NSW North Coast, Sydney Basin, or South East Corner bioregions	The study area occurs within Sydney Basin Bioregion
Occurs in coastal catchments at elevations up to 50 m ASL, typically less than 20 m ASL, on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. There are also minor occurrences on coastal dune swales or flats, particularly deflated dunes and dune soaks.	The study area occurs in a coastal catchment below 10 m in elevation, and on the Haslams Creek floodplain.

Key diagnostic characteristics and supplementary descriptors for Coastal Swamp Oak Forest (EPBC Act) as per final determination	PCT 4023
Occurs on soils derived from unconsolidated sediments (including alluvium), typically hydrosols (grey-black clay-loam and/or sandy loam soils) and sometimes organosols (peaty soils). It may occur in transitional soils (or catenas) where shallow unconsolidated sediments border lithic substrates.	The study area occurs on an alluvial plain next to Haslams Creek, with the mapped soil landscape in the study area comprised of silt and clay sized alluvial materials derived from the Wianamatta Group shales
Has an open woodland, woodland, forest, or closed forest structure, with a tree canopy that has a total crown cover of at least 10 percent.	The vegetation within the study area is structurally an open forest, and has a canopy cover of >10 percent
Has a canopy of trees dominated by *Casuarina glauca*.	The vegetation within the study area is dominated by *Casuarina glauca*.
Assemblage of species as listed within Part 1 of the Final Determination	The assemblage of species occurring within the study area is consistent with those listed in Part 1 of the Final Determination, namely: • *Casuarina glauca* • *Melaleuca styphelioides* • *Dianella caerulea* • *Lomandra longifolia* • *Commelina cyanea*
The patch is at least 0.5 hectares	The vegetation within the study area is part of a contiguous patch of Coastal Swamp Oak (*Casuarina glauca*) Forest at least 5 hectares in size.
The patch contains some native understorey species. Non-native species comprise < 80% of total understorey vegetation cover	The vegetation within the study area contains locally indigenous species consistent with Coastal Swamp Oak (*Casuarina glauca*). Exotic species comprise between 70-80% total understorey cover.
AND	
Transformer species comprise less than 50% of total understorey vegetation cover	There are no transformer species occurring within the study area.

3.2 Threatened Species

3.2.1 Threatened Flora

The desktop assessment used a 10 km radius around the site to identify threatened flora species with the potential to occur in the study area. The assessment identified the study area as providing potential habitat for 54 threatened flora species and four endangered flora populations. Of these, 14 species were identified as having a moderate or higher likelihood of occurring within the study area based on known habitat preference and distribution as identified in ***Table 3.4***. The potential habitat for these species and population was assessed as part of the site visit.

Table 3.4 Threatened flora with a moderate or higher likelihood of occurring within the study area

Common Name	Scientific Name	BC Act	EPBC Act	Likelihood of occurrence
Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	*Wahlenbergia multicaulis*	EP	-	Moderate

Common Name	Scientific Name	BC Act	EPBC Act	Likelihood of occurrence
Narrow-leafed Wilsonia	*Wilsonia backhousei*	V	-	High
Matted Bush-pea	*Pultenaea pedunculata*	E	-	Moderate
Downy Wattle	*Acacia pubescens*	V	V	Moderate
Netted Bottle Brush	*Callistemon linearifolius*	V	-	Moderate
Scrub Turpentine	*Rhodamnia rubescens*	CE	CE	Moderate
Magenta Lilly Pilly	*Syzygium paniculatum*	E	V	Moderate
Pomaderris prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	*Pomaderris prunifolia*	EP	-	Moderate
Spiked Rice-flower	*Pimelea spicata*	E	E	Moderate
Zannichellia palustris	*Zannichellia palustris*	E	-	High
Leafless Tongue-orchid	*Cryptostylis hunteriana*	V	V	Moderate
Small-flower Grevillea	*Grevillea parviflora subsp. parviflora*	V	V	Moderate
Knotweed, Tall Knotweed	*Persicaria elatior*	V	V	Moderate
Eastern Underground Orchid	*Rhizanthella slateri*	V	E	Moderate

V = Vulnerable
E = Endangered
EP = Endangered Population
CE = Critically Endangered

3.2.2 Threatened Fauna

The desktop assessment used a 10 km radius around the site to identify threatened fauna species with the potential to occur in the study area. The assessment identified the study area as providing potential habitat for 106 threatened fauna species and three threatened fauna populations. Of these, 48 were identified as having a moderate or higher likelihood of occurring within the study area based on known habitat preference and distribution as identified in **Table 3.5.**

None of the listed species were incidentally recorded during the site investigation. The vegetation within the study area provides little by the way of breeding habitat for threatened fauna species with no hollow bearing trees, culverts, freshwater waterbodies, or decorticating bark present. The study area provides suitable foraging habitat for a range of threatened and protected fauna with flowering canopy trees, flyways, and Haslams Creek.

Table 3.5 Threatened fauna with a moderate or higher likelihood of occurring within the study area

Common Name	Scientific Name	BC Act	EPBC Act	Likelihood of occurrence
Amphibians				
Green and Golden Bell Frog	*Litoria aurea*	E	V	High
Aves				
Freckled Duck	*Stictonetta naevosa*	V	-	Moderate
Black-necked Stork	*Ephippiorhynchus asiaticus*	E	-	Moderate
Australasian Bittern	*Botaurus poiciloptilus*	E	E	Moderate

Common Name	Scientific Name	BC Act	EPBC Act	Likelihood of occurrence
Black Bittern	*Ixobrychus flavicollis*	V	-	Moderate
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	-	Moderate
Little Eagle	*Hieraaetus morphnoides*	V	-	Moderate
Eastern Osprey	*Pandion cristatus*	V	-	Moderate
Black Falcon	*Falco subniger*	V	-	Moderate
Bush Stone-curlew	*Burhinus grallarius*	E	-	Moderate
Australian Painted Snipe	*Rostratula australis*	E	E	Moderate
Curlew Sandpiper	*Calidris ferruginea*	E	CE	Moderate
Great Knot	*Calidris tenuirostris*	V	CE	Moderate
Broad-billed Sandpiper	*Limicola falcinellus*	V	-	Moderate
Black-tailed Godwit	*Limosa limosa*	V	-	Moderate
Little Tern	*Sternula albifrons*	E	-	Moderate
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	E	Moderate
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V	-	Moderate
Little Lorikeet	*Glossopsitta pusilla*	V	-	Moderate
Swift Parrot	*Lathamus discolor*	E	CE	Moderate
Turquoise Parrot	*Neophema pulchella*	V	-	Moderate
Barking Owl	*Ninox connivens*	V	-	Moderate
Powerful Owl	*Ninox strenua*	V	-	Moderate
Eastern Grass Owl	*Tyto longimembris*	V	-	Moderate
Regent Honeyeater	*Anthochaera phrygia*	CE	CE	Moderate
White-fronted Chat	*Epthianura albifrons*	V	-	Moderate
White-fronted Chat population in the Sydney Metropolitan Catchment Management Area	*Epthianura albifrons*	EP, V	-	Moderate
Varied Sittella	*Daphoenositta chrysoptera*	V	-	Moderate
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	Moderate
Scarlet Robin	*Petroica boodang*	V	-	Moderate
Flame Robin	*Petroica phoenicea*	V	-	Moderate
Spotted Harrier	*Circus assimilis*	V	-	Moderate
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-	Moderate
Terek Sandpiper	*Xenus cinereus*	V	-	Moderate
Red Knot, Knot	*Calidris canutus*	-	E	Moderate
Painted Honeyeater	*Grantiella picta*	V	V	Moderate
White-throated Needletail	*Hirundapus caudacutus*	-	V	Moderate
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	*Limosa lapponica baueri*	-	V	Moderate
Eastern Curlew, Far Eastern Curlew	*Numenius madagascariensis*	-	CE	Moderate

Common Name	Scientific Name	BC Act	EPBC Act	Likelihood of occurrence
Mammals				
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	High
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V	-	Moderate
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-	Moderate
Southern Myotis	*Myotis macropus*	V	-	Moderate
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	Moderate
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V	-	Moderate
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	Moderate
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	Moderate
Little Bent-winged Bat	*Miniopterus australis*	V	-	Moderate

V = Vulnerable
E = Endangered
EP = Endangered Population
CE = Critically Endangered
CD = Conservation Dependent

3.2.3 Grey-headed Flying Fox Camps

Three Grey-headed Flying Fox camps were identified within 10 km, including:

- Clyde (234) – located approximately 3.5 km west of the site
- Parramatta Park 1 (134) – located approximately 6.5 km northwest of the site
- Gladesville (481) – located approximately 6.8 km northeast of the site.

The site contains potential foraging habitat for the Grey-headed Flying Fox colonies roosting at these nearby camps, due to the presence of flowering eucalypt species.

3.2.4 Tree Hollows and Log Habitat

No tree hollows or log habitat were recorded within the study area during the site visit. No tree hollows or log habitat are expected to be disturbed as part of the proposed works.

3.2.5 Migratory Species

The desktop assessment used a 10 km radius around the site to identify migratory fauna species with the potential to occur in the study area. The study area may provide habitat for the migratory bird species detailed in **Table 3.6**. These species may forage and move through the vegetation within the study area – as well as the airspace above it – as they migrate up and down the coast.

Table 3.6 Migratory species with a moderate or higher likelihood of occurring within the study area

Common Name	Scientific Name	BC Act	EPBC Act	Likelihood of Occurrence
Sharp-tailed Sandpiper	*Calidris acuminata*	-	Mig	Moderate
Eastern Osprey	*Pandion cristatus*	-	Mig	Moderate
Ruddy Turnstone	*Arenaria interpres*	-	Mig	Moderate

Common Name	Scientific Name	BC Act	EPBC Act	Likelihood of Occurrence
Double-banded Plover	*Charadrius bicinctus*	-	Mig	Moderate
Marsh Sandpiper, Little Greenshank	*Tringa stagnatilis*	-	Mig	Moderate
Satin Flycatcher	*Myiagra cyanoleuca*	-	Mig	Moderate
Oriental Cuckoo, Horsfield's Cuckoo	*Cuculus optatus*	-	Mig	Moderate
White-throated Needletail	*Hirundapus caudacutus*	-	Mig	Moderate
Common Greenshank, Greenshank	*Tringa nebularia*	-	Mig	Moderate
Rufous Fantail	*Rhipidura rufifrons*	-	Mig	Moderate
Common Sandpiper	*Actitis hypoleucos*	-	Mig	Moderate
Spectacled Monarch	*Symposiachrus trivirgatus*	-	Mig	Moderate
Red-necked Stint	*Calidris ruficollis*	-	Mig	Moderate
Fork-tailed Swift	*Apus pacificus*	-	Mig	Moderate
Pectoral Sandpiper	*Calidris melanotos*	-	Mig	Moderate
Pacific Golden Plover	*Pluvialis fulva*	-	Mig	Moderate
Red Knot, Knot	*Calidris canutus*	-	Mig	Moderate
Curlew Sandpiper	*Calidris ferruginea*	-	Mig	Moderate
Ruff (Reeve)	*Philomachus pugnax*	-	Mig	Moderate
Little Curlew, Little Whimbrel	*Numenius minutus*	-	Mig	Moderate
Whimbrel	*Numenius phaeopus*	-	Mig	Moderate
Pin-tailed Snipe	*Gallinago stenura*	-	Mig	Moderate
Bar-tailed Godwit	*Limosa lapponica*	-	Mig	Moderate
Yellow Wagtail	*Motacilla flava*	-	Mig	Moderate
Eastern Curlew, Far Eastern Curlew	*Numenius madagascariensis*	-	Mig	Moderate
Black-tailed Godwit	*Limosa limosa*	-	Mig	Moderate
Black-faced Monarch	*Monarcha melanopsis*	-	Mig	Moderate
Swinhoe's Snipe	*Gallinago megala*	-	Mig	Moderate
Great Knot	*Calidris tenuirostris*	-	Mig	Moderate
Latham's Snipe, Japanese Snipe	*Gallinago hardwickii*	-	Mig	Moderate
Broad-billed Sandpiper	*Limicola falcinellus*	-	Mig	Moderate
Grey Plover	*Pluvialis squatarola*	-	Mig	Moderate
Marsh Sandpiper	*Tringa stagnatilis*	-	Mig	Moderate
Terek Sandpiper	*Xenus cinereus*	-	Mig	Moderate
Wood Sandpiper	*Tringa glareola*	-	Mig	Moderate

4.0 Potential Impacts

4.1 Direct Impacts

4.1.1 Vegetation Removal/Trimming

No tree removal is required as part of the proposed works. There will be trimming of overhanging branches from surrounding trees where necessary, which form part of PCT 4023 as discussed in **Section 3.1.5**. There may also be some disturbance to the ground strata, including soil stored seedbank, through direct drilling and ancillary works such as temporary laydowns. As such, there will be impact to PCT 4023 through vegetation trimming works.

4.1.2 Estimated Loss of Native Canopy

No trees will be removed. Trimming of native vegetation will be required but will not involve the complete clearing of the individual plant.

4.2 Ground Disturbances

The proposed works will require geotechnical borehole excavations of soil and rock to a 45 m inclined depth. The site is within PCT 4023, as discussed in **Section 3.1.5**, which is characterised by the composition of native vegetation, understorey and ground stratum. Where feasible, the boreholes and associated works would be micro-sited within disturbed land, which includes a paved pedestrian pathway along the western extent of the site and an unpaved dirt pathway along the eastern extent. However, it is likely that the ground stratum will be disturbed during the proposed works, including through drilling works and movement of vehicles on unpaved surfaces.

4.3 Threatened Species

The desktop assessment identified two threatened flora species (Narrow-leafed Wilsonia and *Zannichellia palustris*) and two threatened fauna species (Grey-headed Flying Fox and Green and Golden Bell Frog) as having a high likelihood of occurrence within the study area, however these were not recorded during the rapid flora surveys or general site inspection.

There is potential for directly impacting both threatened flora species and the Green and Golden Bell Frog when undertaking ground-disturbing works and moving vehicles and machinery to and from the site, but this is considered unlikely with appropriate mitigation measures in place.

4.4 Habitat Disturbances

The Grey-headed Flying Fox is a highly mobile species that utilises a range of vegetation communities for foraging and roosting, including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. They can travel up to 50 km from their roosting camp to forage. There may be some impacts to suitable habitat for the Grey-headed Flying Fox due to trimming of native vegetation, however this is expected to be minor and not impact the availability of resources.

The Green and Golden Bell Frog prefers water-bodies that are unshaded, contain aquatic plants and are free of predatory fish such as the Mosquito Fish (*Gambusia holbrooki*). The terrestrial habitat should consist of grassy areas and vegetation no higher than woodlands, with diurnal sheltering sites available. This species can also occur in disturbed areas. This species may inhabit Haslams Creek and the riparian land along the eastern side of Haslams Creek, but may find it difficult accessing the terrestrial areas along the western side of Haslams Creek (including the study area) due to the Gabion Walls used for bank

stabilisation works along this side. There may be some impacts to suitable habitat for the Green and Golden Bell Frog due to ground disturbing works, yet this is expected to be minimal as the drilling works are temporary and the species can inhabit disturbed landscapes.

4.5 Indirect Impacts

The proposed works have the potential to indirectly impact the biodiversity occurring within the study area. These indirect impacts and a description of how they may impact the biodiversity present in the study area are outlined in

Table 4.1.

Table 4.1 Indirect impacts to biodiversity

Indirect impact	Explanation	Affected biodiversity
Erosion	Ground disturbing works may lead to erosion in adjacent areas. This may come as a result from borehole drilling works.	All vegetation communities within the study area.
Spread of weeds and exotic species	The movement of machinery and people have the potential to spread weeds to and from the site.	All vegetation communities within the study area.
Spread of pathogens and disease	Soil borne pathogens with the potential to infect plants e.g., *Phytophthora cinnamomi*, may be mobilised by the proposed works.	All vegetation communities within the study area. Potentially vegetation occurring outside of the study area.
Noise and vibration	The proposed works would temporarily alter the noise environment within the study area.	The flying patterns and foraging/hunting behaviour of the and microbats may be altered if construction activities are to occur at night.
Changes to the light environment	The proposed works will be undertaken during the day. If any works are required to occur at night, there is potential to alter the light environment within the study area.	The flying patterns and foraging/hunting behaviour of the grey-headed flying-Fox, nocturnal birds, and microbats may be altered if construction activities are to occur at night

4.6 Habitat Connectivity

The proposed works are not expected to introduce any new barriers to habitat connectivity or wildlife movement across the available habitat in areas between Parramatta and Sydney Olympic Park.

5.0 Mitigation Measures

Mitigation measures and safeguards to avoid and minimise the impacts of the proposed works on the biodiversity values identified in the study area are detailed in **Table 5.1**.

Table 5.1 Mitigation measures

Impact	Mitigation	Timing
Trimming of vegetation	Minimised through detailed design and construction planning, specifically attempting to avoid setting up near native vegetation where possible.	Detailed design
	Establishment of exclusion zones.	Prior to and during the proposed works
Impacts to threatened species	A no-go zone should be placed around PCT 4023 within the study area to avoid unintended disturbance during proposed works. A toolbox talk should be undertaken with all site personnel that includes information on the presence of PCT 4023 and threatened species with high likelihood of occurrence. The Sydney Metro West – Western Tunnelling Package – Flora and Fauna Management Plan (SMWSTWTP-GLO-1NL-NL000-EO-PLN-000001) should be implemented as applicable to the scope of works, including the procedures to follow when there is an unexpected find.	Prior to and during proposed works
Impacts to understorey cover	Grass seeds selected for remediation of ground disturbed areas should include sterile cover crop species.	Prior to and during proposed works
Spread of pathogens and disease	Hygiene controls for all vehicles, equipment and people working in the study area.	During proposed works
	Machinery will be washed following best practice hygiene protocols prior to being brought to site to prevent the spread of weeds, seeds, pathogens and fungi.	Prior to proposed works
Spread of weeds and exotic species	Hygiene controls for all vehicles, equipment and people working in the study area.	During proposed works
	All weed material removed will be disposed of in a suitable waste facility and not mulched on site. This is to avoid the reintroduction and further spread of weeds in the area.	During proposed works
	Machinery will be washed following best practice hygiene protocols prior to being brought to site to prevent the spread of weeds, seeds, pathogens and fungi.	Prior to proposed works
Edge effects	Establishment of vegetation trimming limits and exclusion zones.	During proposed works
Erosion	Establishment of appropriate erosion and sediment controls.	During proposed works

6.0 Conclusion

This biodiversity briefing note assesses the potential impacts to biodiversity resulting from the geotechnical borehole works for the Sydney Metro West – Western Tunnelling Package project. The proposed works as detailed in **Section 1.1** include ground disturbing works and trimming of native vegetation. A site visit was conducted on the 25 August 2022 to assess the biodiversity values present onsite and to determine the occurrence of any threatened biodiversity that may be impacted by the proposed works.

PCT 4023: Coastal Valleys Swamp Oak Riparian Forest was identified within the study area and within the proposed works footprint, which is a listed TEC under the BC Act and EPBC Act. There will be impacts to PCT 4023 as a result of trimming of overhanging tree branches and ground disturbing works.

Two threatened flora species (Narrow-leafed Wilsonia and *Zannichellia palustris*) and two threatened fauna species (Grey-headed Flying Fox and Green and Golden Bell Frog) were identified as having a high likelihood of occurrence within the study area, however these were not recorded during the rapid flora surveys or site inspection. There is potential for direct impact to Narrow-leafed Wilsonia, *Zannichellia palustris* and Green and Golden Bell Frog during ground disturbing works, but this is considered to be unlikely with appropriate mitigation measures in place. There may be some impacts to suitable habitat for the Grey-headed Flying Fox due to trimming of native vegetation, and Green and Golden Bell Frog as a result of ground disturbing works, however this is expected to be minor and not impact the availability of resources.

Assessments of significance carried out under the BC Act and EPBC Act (included in **Attachment C**) found that the proposed works were unlikely to have a significant impact on the TEC within the study area. No other significant impacts to biodiversity or threatened species habitat have been identified as a result of the proposed works.

7.0 References

Chapman G.A., Murphy C.L., Tille P.J., Atkinson G. and Morse R.J. (2009). Soil Landscapes of the Sydney 1:100,000 Sheet

Cropper, S. C. (1993). Management of endangered plants Department of Agriculture, Water and the Environment , CSIRO, East Melbourne

Jacobs (2020). Westmead to The Bays and Sydney CBD - Environmental Impact Statement Concept and Stage 1 - Technical Paper 10 Biodiversity development assessment report

Attachment A - Likelihood of Occurrence Table

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey.
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e., for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10 km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e., for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e., for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area, or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded. Do not include this species in the final letter.
None	Suitable habitat is absent from the study area. Do not include this species in the final letter.

Habitat Assessment Table – Threatened Flora

**Marine and pelagic species, and shorebird species have been assessed as having a nil likelihood of occurrence and are not included in this table.*

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	*Marsdenia viridiflora subsp. viridiflora*	EP	-	Grows in vine thickets and open shale woodland.	Atlas	Low. Study area does not possess the species preferred edaphics and vegetation associations.
Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	*Wahlenbergia multicaulis*	EP	-	Found across the Hornsby LGA and Western Sydney in disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. Typically occurs in damp, disturbed sites (with natural or human disturbance of various forms), typically amongst other herbs rather than in the open.	Atlas	Moderate. Study area possesses preferred edaphics and vegetation associations. Species recorded within 2 km of study area.
Narrow-leafed Wilsonia	*Wilsonia backhousei*	V	-	In NSW, Narrow-leaf Wilsonia is found on the coast between Mimosa Rocks National Park and Wamberal north of Sydney. This is a species of the margins of salt marshes and lakes.	Atlas	High. Study area possesses preferred edaphics and vegetation associations. Species recorded within 200 metres of study area.
Hibbertia superans	*Hibbertia superans*	E	-	Occurs from Baulkham Hills to South Maroota in the northern outskirts of Sydney, in both open woodland and heathland, and appears to prefer open disturbed areas, such as tracksides.	Atlas	Low. Study area does not possess the species preferred edaphics and vegetation associations.
Tetratheca glandulosa	*Tetratheca glandulosa*	V	-	Restricted to the following Local Government Areas: Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong. Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with	Atlas	Low. The study area is outside the species known and restricted distribution.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
				associated soil landscapes such as Lucas Heights, Gymea, Lambert and Faulconbridge.		
Black-eyed Susan	*Tetratheca juncea*	V	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion. It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest.	Atlas	Low. The study area possesses some preferred edaphic and vegetation associations but is located outside the species known and restricted distribution.
Epacris purpurascens var. purpurascens	*Epacris purpurascens var. purpurascens*	V	-	Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence.	Atlas	Low. Study area does not possess the edaphics and vegetation associations preferred by this species. However, species recorded within 2 km of study area.
Pultenaea parviflora	*Pultenaea parviflora*	E	V	Endemic to the Cumberland Plain. Core distribution is from Windsor to Penrith and east to Dean Park. Outlier populations are recorded from Kemps Creek and Wilberforce. May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays.	Atlas	Low. Study area does not possess the species preferred edaphics and vegetation associations. No recently recorded sightings within 10 km.
Matted Bush-pea	*Pultenaea pedunculata*	E	-	In NSW, the Matted Bush-pea is represented by just three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn. NSW populations are generally among woodland vegetation but plants have also been found on road batters and coastal cliffs.	Atlas	Moderate. Study area possesses preferred edaphics and vegetation associations.
Bynoe's Wattle	*Acacia bynoeana*	E	V	Bynoe's wattle is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such	Atlas PMST	Low. Study area does not possess the species preferred vegetation associations. No recently recorded sightings within 10 km.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
				as trail margins, edges of roadside spoil mounds and in recently burnt patches.		
Downy Wattle	*Acacia pubescens*	V	V	Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area. Occurs on alluviums, shales and at the intergrade between shales and sandstones. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland.	Atlas PMST	Moderate. Study area possesses preferred edaphics and vegetation associations. Species recorded within 2 km of study area.
Narrow-leaf Finger Fern	*Grammitis stenophylla*	E	-	Moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest.	Atlas	Low. Study area does not possess the species preferred edaphics and vegetation associations. No recently recorded sightings within 10 km.
Seaforth Mintbush	*Prostanthera marifolia*	CE	CE	*Prostanthera marifolia* is currently only known from the northern Sydney suburb of Seaforth and has a very highly restricted distribution within the Sydney Basin Bioregion. Occurs in localised patches in or in close proximity to the endangered Duffys Forest ecological community.	Atlas	Low. The study area is located outside the species known and restricted distribution.
Netted Bottle Brush	*Callistemon linearifolius*	V	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Atlas	Moderate. Study area possesses preferred edaphics and vegetation associations. Species recorded within 5 km of study area.
Darwinia biflora	*Darwinia biflora*	V	V	Recorded in Ku-ring-gai, Hornsby, Baulkham Hills and Ryde local government areas. Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone.	Atlas PMST	Low. Study area does not possess the species preferred edaphics and vegetation associations.
Narrow-leaved Black Peppermint	*Eucalyptus nicholii*	V	V	This species is sparsely distributed but widespread on the New England Tablelands from Nundle to north of Tenterfield, being most common in central portions of	Atlas	Low. Study area does not possess the species preferred edaphics and vegetation

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
				its range. Typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock.		associations. The study area is outside the species natural distribution of the Northern Tablelands. No recently recorded sightings within 10 km.
Wallangarra White Gum	*Eucalyptus scoparia*	E	V	In NSW it is known from only three locations near Tenterfield, including Bald Rock National Park. Found in open eucalypt forest, woodland and heaths on well-drained granite/rhyolite hilltops, slopes and rocky outcrops, typically at high altitudes.	Atlas	Low. Study area does not possess the species preferred edaphics and vegetation associations. The study area is outside the species natural distribution of the Northern Tablelands. No recently recorded sightings within 10 km.
Leptospermum deanei	*Leptospermum deanei*	V	V	Occurs in Hornsby, Warringah, Ku-ring-gai and Ryde LGAs. Woodland on lower hill slopes or near creeks. Sandy alluvial soil or sand over sandstone.	Atlas PMST	Low. Study area does not possess the species preferred edaphics and vegetation associations. No recently recorded sightings within 10 km.
Deane's Paperbark	*Melaleuca deanei*	V	V	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone.	Atlas PMST	Low. Study area does not possess the species preferred vegetation associations.
Scrub Turpentine	*Rhodamnia rubescens*	CE	CE	Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	Atlas PMST	Moderate. Suitable habitat for the species may be present within the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Magenta Lilly Pilly	*Syzygium paniculatum*	E	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Atlas PMST	Moderate. Suitable habitat for the species may be present within the study area.
Creek Triplarina	*Triplarina imbricata*	E	E	The species was previously recorded in Parramatta, near Sydney, however, the species is no longer thought to occur in this area. Occurs along watercourses in low open forest with Water Gum (*Tristaniopsis laurina*) or in montane bogs, often with *Baekea amissa*.	Atlas	Low. Study area does not possess the species preferred habitat. No recently recorded sightings within 10 km.
Bauer's Midge Orchid	*Genoplesium baueri*	E	E	The species has been recorded from locations between Ulladulla and Port Stephens. Grows in dry sclerophyll forest and moss gardens over sandstone.	Atlas PMST	Low. Study area does not possess the species preferred edaphics and vegetation associations. No recently recorded sightings within 10 km.
Beadle's Grevillea	*Grevillea beadleana*	E	E	Known from four separate areas, all in north-east NSW: the Torrington area west of Tenterfield, Oxley Wild Rivers National Park, Guy Fawkes River National Park and at Chambigne Nature Reserve south-west of Grafton. Occurs in open eucalypt forest and woodland with a shrubby understorey on granite.	Atlas	Low. Study area does not possess the species preferred edaphics and vegetation associations. No recently recorded sightings within 10 km.
Hairy Geebung	*Persoonia hirsuta*	E	E	*Persoonia hirsuta* has a scattered distribution around Sydney. Found in clayey and sandy soils in dry sclerophyll open forest, woodland and heath, primarily on the Mittagong Formation and on the upper Hawkesbury Sandstone.	Atlas PMST	Low. Study area does not possess the species preferred vegetation associations. No recently recorded sightings within 10 km.
Nodding Geebung	*Persoonia nutans*	E	E	Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. Northern populations are confined to	Atlas PMST	Low. Study area does not possess the species preferred edaphics and vegetation

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
				aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River / Castlereagh Ironbark Forests.		associations. No recently recorded sightings within 10 km.
Pomaderris prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	*Pomaderris prunifolia*	EP	-	Known from only three sites within the listed local government areas, at Rydalmere, within Rookwood Cemetery and at The Crest of Bankstown. It is known to occur along a road reserve near a creek, among grass species on sandstone, as well as in a small gully of degraded Cooks River / Castlereagh Ironbark Forest on shale soils.	Atlas	Moderate. Suitable habitat for the species may be present within the study area. One recently recorded sighting within 2 km.
Pimelea curviflora var. curviflora	*Pimelea curviflora var. curviflora*	V	V	Confined to the coastal area of the Sydney and Illawarra regions. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	Atlas PMST	Low. Study area does not possess the species preferred habitat.
Spiked Rice-flower	*Pimelea spicata*	E	E	Once widespread on the Cumberland Plain, the Spiked Rice-flower occurs in two disjunct areas: the Cumberland Plain and the Illawarra. In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils.	Atlas PMST	Moderate. Suitable habitat may be present within the study area.
Julian's Hibbertia	*Hibbertia spanantha*	CE	CE	Endemic to NSW where it is restricted to four known locations. Grows in forest with canopy species including *Eucalyptus pilularis, E. resinifera, Corymbia gummifera and Angophora costata.*	Atlas PMST	Low. Study area does not possess the species preferred habitat.
Brown Pomaderris	*Pomaderris brunnea*	E	V	Brown Pomaderris is found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	Atlas PMST	Low. The study area is outside the restricted habitat locations for the species.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Zannichellia palustris	*Zannichellia palustris*	E	-	In NSW, known from the lower Hunter and in Sydney Olympic Park. Grows in fresh or slightly saline stationary or slowly flowing water.	Atlas	High. The study area possesses the species preferred habitat. Several sightings of this species within 2 km of the study area.
Dillwynia tenuifolia Sieber ex D.C. in the Baulkham Hills local government area	*Dillwynia tenuifolia*	EP, V	-	The core distribution is the Cumberland Plain from Windsor and Penrith east to Dean Park near Colebee. In western Sydney, may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays.	Atlas	Low. Study area does not possess the species preferred edaphics and vegetation associations.
Kanangra Wattle	*Acacia clunies-rossiae*	V	-	Kanangra Wattle grows in the Kowmung and Coxs River areas entirely within Kanangra-Boyd and Blue Mountains National Parks. Grows in dry sclerophyll forest on skeletal soils on rocky slopes, or on alluvium along creeks.	Atlas	Low. Study area does not possess preferred vegetation associations.
Macadamia Nut	*Macadamia integrifolia*	-	V	Not known to occur naturally in the wild in NSW.	Atlas	Low. Not anticipated to occur in the wild.
Sunshine Wattle (Sydney region)	*Acacia terminalis subsp. terminalis MS*	E	E	Very limited distribution, mainly in near-coastal areas from the northern shores of Sydney Harbour south to Botany Bay. Coastal scrub and dry sclerophyll woodland on sandy soils.	PMST	Low. Study area does not possess preferred edaphics and vegetation associations.
Allocasuarina glareicola	*Allocasuarina glareicola*	E	E	Primarily restricted to the Richmond (NW Cumberland Plain) district. Grows in Castlereagh woodland on lateritic soil.	PMST	Low. Study area does not possess preferred edaphics and vegetation associations.
Asterolasia elegans	*Asterolasia elegans*	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Found on Hawkesbury sandstone in sheltered forests on mid- to lower slopes and valleys.	PMST	Low. Study area does not possess preferred edaphics and vegetation associations.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Thick-lipped Spider-orchid, Daddy Long-legs	*Caladenia tessellata*	E	V	The Thick Lip Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. 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. Study area does not possess preferred vegetation associations.
Leafless Tongue-orchid	*Cryptostylis hunteriana*	V	V	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland.	PMST	Moderate. Suitable habitat for the species may be present within the study area.
Deyeuxia appressa	*Deyeuxia appressa*	E	E	A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Given that *D. appressa* has not been seen in over 60 years, almost nothing is known of the species' habitat and ecology.	PMST	Low. This species has not been recently sighted in the Sydney area.
Epacris sparsa	*Epacris sparsa*	V	V	Restricted to the lower Grose River, within the Hawkesbury and Blue Mountains LGAs. Grows in Riparian Sandstone Scrub, where it is found on the base of cliffs or rock faces, on rock ledges or among rocks in the riparian flood zone.	PMST	Low. Study area does not possess preferred edaphics and vegetation associations.
Camfield's Stringybark	*Eucalyptus camfieldii*	V	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Found in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges.	PMST	Low. Study area does not possess preferred edaphics and vegetation associations.
Small-flower Grevillea	*Grevillea parviflora subsp. parviflora*	V	V	Sporadically distributed throughout the Sydney Basin with sizeable populations around Picton, Appin and Bargo. Grows in sandy or light clay soils usually over	PMST	Moderate. Suitable habitat for the species may be present within the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
				thin shales, often with lateritic ironstone gravels and nodules.		
Haloragodendron lucasii	*Haloragodendron lucasii*	E	E	The known locations of this species are confined to a very narrow distribution on the north shore of Sydney. Associated with dry sclerophyll forest.	PMST	Low. Study area does not possess preferred vegetation associations.
Hibbertia puberula subsp. glabrescens	*Hibbertia puberula subsp. glabrescens*	CE	CE	Recent work on this species and its relatives have shown it to be widespread, but never common. Occurs on sandy soil often associated with sandstone, or on clay. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied.	PMST	Low. Study area does not possess preferred edaphics and vegetation associations.
Lasiopetalum joyceae	*Lasiopetalum joyceae*	V	V	Has a restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. Grows in heath on sandstone.	PMST	Low. Study area does not possess preferred edaphics and vegetation associations.
Biconvex Paperbark	*Melaleuca biconvexa*	V	V	Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	PMST	Low. Suitable habitat for the species may be present within the study area, however the species is known from two populations in the Central Coast and Nowra.
Knotweed, Tall Knotweed	*Persicaria elatior*	V	V	Tall Knotweed has been recorded in south-eastern NSW, Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. This species normally grows in damp places, especially beside streams and lakes.	PMST	Moderate. Suitable habitat for the species may be present within the study area.
Villous Mintbush	*Prostanthera densa*	V	V	The Sydney and Royal National Park populations were thought possibly extinct, but the species is now known to occur at Bass and Flinders Point in Cronulla. *Prostanthera densa* generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea.	PMST	Low. Study area does not possess preferred edaphics and vegetation associations.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood	*Pterostylis gibbosa*	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.	PMST	Low. The study area is outside the species known and restricted distribution.
Sydney Plains Greenhood	*Pterostylis saxicola*	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines.	PMST	Low. Study area does not possess preferred edaphics.
Eastern Underground Orchid	*Rhizanthella slateri*	V	E	Occurs from south-east Queensland to south-east NSW. Habitat requirements are poorly understood, and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	PMST	Moderate. Suitable habitat for the species may be present within the study area, due to the limited understanding of the species' preferred habitat.
Native Guava	*Rhodomyrtus psidioides*	CE	CE	Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines.	PMST	Low. Study area is too exposed compared to known preferred habitat requirements.
Austral Toadflax, Toadflax	*Thesium australe*	V	V	Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast.	PMST	Low. Study area does not possess preferred edaphics and vegetation associations.

Habitat Assessment Table – Threatened Fauna

**Marine and pelagic species, and shorebird species have been assessed as having a nil likelihood of occurrence and are not included in this table.*

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Amphibians						
Green and Golden Bell Frog	*Litoria aurea*	E	V	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha spp.*) or spikerushes (*Eleocharis spp*.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.	Atlas	High. This species has been sighted along Haslams Creek, including at a site within 30 m of the study area.
Red Crowned-toadlet	*Pseudophryne australis*	V	-	The Red-crowned Toadlet has a restricted distribution. It is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings.	Atlas	Low. The study area does not contain the preferred sandstone soil composition for this species.
Giant Burrowing Frog	*Heleioporus australiacus*	V	V	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	PMST	Low. The study area is located within a predominately clay loam soil landscape.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Stuttering Frog, Southern Barred Frog (in Victoria)	*Mixophyes balbus*	E	V	Stuttering Frogs occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	PMST	Low. The study area does not contain the moist micro-habitat required for this species.
Aves						
Freckled Duck	*Stictonetta naevosa*	V	-	The Freckled Duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	Atlas	Moderate. The species may occasionally utilise the study area. There has been one recent sighting of this species within 500 m of the study area.
Superb Fruit-Dove	*Ptilinopus superbus*	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.	Atlas	Low. The study area does not contain suitable habitat or food resources for this species. There are no recent sightings for this species within 10km of the study area.
Black-necked Stork	*Ephippiorhynchus asiaticus*	E	-	Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	Atlas	Moderate. The species may occasionally utilise the study area. There are no recent sightings for this species within 10 km of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Australasian Bittern	*Botaurus poiciloptilus*	E	E	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha spp.*) and spikerushes (Eleocharis spp.)	Atlas PMST	Moderate. The species may occasionally utilise the study area. This species has been sighted along Haslams Creek, including at a site within 800 m of the study area.
Black Bittern	*Ixobrychus flavicollis*	V	-	The Black Bittern has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	Atlas	Moderate. The study area may provide suitable habitat for this species. This species has been recently sighted within 800 m of the study area.
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	-	In New South Wales the White-bellied Sea-eagle is widespread along the east coast, and along all major inland rivers and waterways. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been sighted along Haslams Creek and surrounding mangroves, including at a site within 400 m of the study area.
Little Eagle	*Hieraaetus morphnoides*	V	-	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been sighted within 750 m of the study area.
Eastern Osprey	*Pandion cristatus*	V	M	Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been sighted within 1.5 km of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Black Falcon	*Falco subniger*	V	-	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been sighted within 1.5 km of the study area.
Bush Stone-curlew	*Burhinus grallarius*	E	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber.	Atlas	Moderate. The species may occasionally utilise the study area.
Pied Oystercatcher	*Haematopus longirostris*	E	-	In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State. Favours intertidal flats of inlets and bays, open beaches and sandbanks.	Atlas	Low. The study area does not provide suitable habitat for the species.
Greater Sand-plover	*Charadrius leschenaultii*	V	V	In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks.	Atlas PMST	Low. The study area does not provide suitable habitat for the species.
Australian Painted Snipe	*Rostratula australis*	E	E	In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Atlas PMST	Moderate. The study area may provide suitable habitat for this species. This species has been recently sighted within 1.5 km of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Sanderling	*Calidris alba*	V	-	Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands.	Atlas	Low. The study area does not provide suitable habitat for the species.
Curlew Sandpiper	*Calidris ferruginea*	E	CE	The Curlew Sandpiper occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	Atlas PMST	Moderate. The study area may provide suitable habitat for this species. This species has been recently sighted within 1.5 km of the study area.
Great Knot	*Calidris tenuirostris*	V	CE	In NSW, the species has been recorded at scattered sites along the coast down to about Narooma. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons.	Atlas PMST	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been recently sighted within 2 km of the study area.
Broad-billed Sandpiper	*Limicola falcinellus*	V	-	In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. Favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been recently sighted within 2 km of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Black-tailed Godwit	*Limosa limosa*	V	-	In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the coast, and inland. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been recently sighted within 2 km of the study area.
Little Tern	*Sternula albifrons*	E	-	The Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. Almost exclusively coastal, preferring sheltered environments; however, may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records).	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been recently sighted within 2 km of the study area.
Gang-gang Cockatoo	*Callocephalon fimbriatum*	EP, V	E	In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas.	Atlas PMST	Moderate. The species may occasionally utilise the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	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. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis)* and Forest Sheoak (*A. torulosa*) are important foods.	Atlas	Moderate. The species may occasionally utilise the study area.
Little Lorikeet	*Glossopsitta pusilla*	V	-	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	Atlas	Moderate. The species may occasionally utilise the study area. This species has been recently sighted within 1.5 km of the study area.
Swift Parrot	*Lathamus discolor*	E	CE	In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations.	Atlas PMST	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been recently sighted within 2 km of the study area.
Turquoise Parrot	*Neophema pulchella*	V	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Barking Owl	*Ninox connivens*	V	-	The Barking Owl is found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby.
Powerful Owl	*Ninox strenua*	V	-	In NSW, the species is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. 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.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby.
Eastern Grass Owl	*Tyto longimembris*	V	-	Eastern Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. In NSW they are more likely to be resident in the north-east. Found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been recently sighted within 2 km of the study area.
Masked Owl	*Tyto novaehollandiae*	V	-	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides.	Atlas	Low. The study area does not provide suitable habitat for the species.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Regent Honeyeater	*Anthochaera phrygia*	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species.	Atlas PMST	Moderate. The species may occasionally utilise the study area when foraging nearby. This species has been recently sighted within 2 km of the study area.
White-fronted Chat	*Epthianura albifrons*	EP, V	-	In NSW, the species occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas.	Atlas PMST	Moderate. The study area may provide suitable habitat for this species. This species has been recently sighted within 2 km of the study area.
Varied Sittella	*Daphoenositta chrysoptera*	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. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Atlas	Moderate. The species may occasionally utilise the study area.
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest.	Atlas	Moderate. The species may occasionally utilise the study area. This species has been recently sighted within 250 m of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Scarlet Robin	*Petroica boodang*	V	-	In NSW, this species occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	Atlas	Moderate. The species may occasionally utilise the study area. This species has been recently sighted within 2 km of the study area.
Flame Robin	*Petroica phoenicea*	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. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes.	Atlas	Moderate. The species may occasionally utilise the study area. This species has been recently sighted within 2 km of the study area.
Spotted Harrier	*Circus assimilis*	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges. 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.	Atlas	Moderate. The species may occasionally utilise the study area. This species has been recently sighted within 1.5 km of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-	The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*)	Atlas	Moderate. The species may occasionally utilise the study area.
Rose-crowned Fruit-Dove	*Ptilinopus regina*	V	-	Found along coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Occurs mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	Atlas	Low. The study area does not provide suitable habitat for this species.
Terek Sandpiper	*Xenus cinereus*	V	-	The two main sites for the species in NSW are the Richmond River estuary and the Hunter River estuary. Favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools.	Atlas	Moderate. The species may occasionally utilise the study area. This species has been recently sighted within 2.5 km of the study area.
Sooty Owl	*Tyto tenebricosa*	V	-	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	Atlas	Low. The study area does not provide suitable habitat for this species.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Speckled Warbler	*Chthonicola sagittata*	V	-	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. Lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	Atlas	Low. The study area does not provide suitable habitat for this species.
Red Knot, Knot	*Calidris canutus*	-	E	In NSW, this species is recorded in small numbers along some of the major river estuaries and sheltered embayments of the coastline, in particular the Hunter River estuary. The Red Knot mainly occurs in small numbers on intertidal mudflats, estuaries, bays, inlets, lagoons, harbours and sandflats and sandy beaches of sheltered coasts. It is occasionally found on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms and is a rare visitor to terrestrial saline wetlands and freshwater swamps.	PMST	Moderate. The study area may contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.
Lesser Sand Plover, Mongolian Plover	*Charadrius mongolus*	V	E	In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. This species is found in almost entirely coastal habitats in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms.	PMST	Low. This species may utilize the coastal habitats along Parramatta River. There are no recent sightings for this species within 10 km of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Eastern Bristlebird	*Dasyornis brachypterus*	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey.	PMST	Low. The study area does not contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.
Red Goshawk	*Erythrotriorchis radiatus*	CE	V	The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.	PMST	Low. The study area does not contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.
Grey Falcon	*Falco hypoleucos*	E	-	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.	PMST	Low. This species typically inhabits areas in regional NSW. There are no recent sightings for this species within 10km of the study area.
Painted Honeyeater	*Grantiella picta*	V	V	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. Inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) and Box-Gum Woodlands and Box-Ironbark Forests.	PMST	Moderate. The species may utilise the study area on occasion. There are no recent sightings for this species within 10 km of the study area.
White-throated Needletail	*Hirundapus caudacutus*	-	V	Migratory and usually seen in eastern Australia from October to April. The White-throated Needletail is almost exclusively aerial, occurring over most types of habitat, yet are probably recorded most often above wooded areas, including open forest and rainforest.	PMST	Moderate. The species may utilise the airspace above the study area. There are no recent sightings for this species within 10 km of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	*Limosa lapponica baueri*	-	V	The species is most frequently recorded along major coastal river estuaries and sheltered embayments, particularly the Tweed, Richmond, Clarence, Macleay, Hastings, Hunter and Shoalhaven River estuaries, Port Stephens and Botany Bay. It is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms.	PMST	Moderate. The study area may contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.
Orange-bellied Parrot	*Neophema chrysogaster*	CE	CE	There are occasional reports from NSW, with the most recent records from Shellharbour and Maroubra in May 2003. It is expected that NSW habitats may be being more frequently utilised than observations suggest. The Orange-bellied Parrot spends winter mostly within 3 km of the coast in sheltered coastal habitats including bays, lagoons, estuaries, coastal dunes and saltmarshes.	PMST	Low. The study area may contain suitable habitat for this species; however they are not often found in the Sydney Basin area.
Eastern Curlew, Far Eastern Curlew	*Numenius madagascariensis*	-	CE	In NSW the species occurs across the entire coast but is mainly found in estuaries such as the Hunter River, Port Stephens, Clarence River, Richmond River and ICOLLs of the south coast. The species is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts.	PMST	Moderate. The study area may contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.
Pilotbird	*Pycnoptilus floccosus*	-	V	Pilotbirds are endemic to south-east Australia. Pilotbirds are strictly terrestrial, living on the ground in dense forests with heavy undergrowth – typically in wet sclerophyll forests in temperate zones in moist gullies with dense undergrowth or dry sclerophyll forests and woodlands occupying dry slopes and ridges.	PMST	Low. The study area does not contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Australian Fairy Tern	*Sternula nereis nereis*	-	V	The Fairy Tern nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The species has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline.	PMST	Low. The study area may contain suitable habitat for this species; however they are not often found in the Sydney Basin area.
Gastropoda						
Cumberland Plain Land Snail	*Meridolum corneovirens*	E	-	Lives in small areas on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains. Primarily inhabits Cumberland Plain Woodland (a critically endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed communities.	Atlas	Low. The study area does not contain suitable habitat for this species.
Dural Land Snail	*Pommerhelix duralensis*	E	E	The species is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris.	Atlas	Low. The study area does not contain suitable habitat for this species.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Mammals						
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	The Spotted-tailed Quoll is found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Atlas PMST	Low. The study area does not contain suitable habitat for this species.
Long-nosed Bandicoot population in inner western Sydney	*Perameles nasuta*	EP	-	The exact area occupied by the population is not clearly defined, and includes the LGA of Marrickville and Canada Bay, with the likelihood that it also includes Canterbury, Ashfield and Leichhardt LGAs. Shelters mostly under older houses and buildings. Forages in parkland and back-yards.	Atlas	Low. The study area does not contain suitable habitat for this species.
Eastern Pygmy-possum	*Cercartetus nanus*	V	-	In NSW, the species extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	Atlas	Low. The study area does not contain suitable habitat for this species.
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	Atlas PMST	High. This species would likely utilize the study area on occasion but would not likely use the study area as a roosting site. There have been several recent sightings of this species within 2 km.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V	-	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. No hollows were identified within the study area. There has been a recent sighting of this species within 2km.
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. Prefers moist habitats, with trees taller than 20 m.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. No hollows were identified within the study area.
Southern Myotis	*Myotis macropus*	V	-	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally, roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. No hollows, buildings or bridges were identified within the study area. There have been several recent sightings within 1.5 km of the study area.
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	In NSW, the species is widespread on the New England Tablelands, however, does not occur at altitudes above 500 m. 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.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. No hollows were identified within the study area. There has been a recent sighting of this species within 2 km.
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V	-	The Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. No hollows were identified within the study area. There have been several recent sightings within 1.5 km of the study area, particularly along Haslams Creek.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Koala	*Phascolarctos cinereus*	E	E	In New South Wales, koala populations are found on the central and north coasts, southern highlands, southern and northern tablelands, Blue Mountains, southern coastal forests, with some smaller populations on the plains west of the Great Dividing Range. Inhabit eucalypt woodlands and forests.	Atlas PMST	Low. The study area does not provide suitable habitat for this species.
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	The Yellow-bellied Sheathtail-bat is a 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.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. No hollows were identified within the study area. There has been a recent sighting of this species within 2 km of the study area.
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Found in well-timbered areas containing gullies.	Atlas PMST	Moderate. The species may occasionally utilise the study area when foraging nearby. No hollows were identified within the study area.
Little Bent-winged Bat	*Miniopterus australis*	V	-	Found along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Preferred habitat includes moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas.	Atlas	Moderate. The species may occasionally utilise the study area when foraging nearby. No hollows were identified within the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*	V	-	In NSW the Eastern Chestnut Mouse mainly occurs north from the Hawkesbury River area as scattered records along to coast and eastern fall of the Great Dividing Range extending north into Queensland. The Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands.	Atlas	Low. The study area does not provide suitable habitat for this species.
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern)	*Isoodon obesulus obesulus*	E	E	This species is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. Southern Brown Bandicoots are largely crepuscular (active mainly after dusk and/or before dawn). They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils.	PMST	Low. The study area does not contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.
Greater Glider (southern and central)	*Petauroides volans*	-	E	The greater glider (southern and central) occurs in eastern Australia, where it has a broad distribution from around Proserpine in Queensland, south through NSW and the ACT, to Wombat State Forest in central Victoria. The species is predominantly solitary and largely restricted to eucalypt forests and woodlands of eastern Australia.	PMST	Low. The study area does not contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.

Common Name	Scientific Name	BC Act	EPBC Act	Habitat Preference	Source	Likelihood of occurrence
Yellow-bellied Glider (south-eastern)	*Petaurus australis australis*	V	V	The Yellow-bellied Glider is 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.	PMST	Low. The study area does not contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.
New Holland Mouse, Pookila	*Pseudomys novaehollandiae*	-	V	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes.	PMST	Low. The study area does not contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.
Reptiles						
Striped Legless Lizard, Striped Snake-lizard	*Delma impar*	V	V	The Striped Legless Lizard occurs in the Southern Tablelands, the South West Slopes, the Upper Hunter and possibly on the Riverina. Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass Themeda australis, spear-grasses Austrostipa spp. and poa tussocks Poa spp., and occasionally wallaby grasses Austrodanthonia spp.	PMST	Low. The study area does not contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.
Broad-headed Snake	*Hoplocephalus bungaroides*	E	V	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring.	PMST	Low. The study area does not contain suitable habitat for this species. There are no recent sightings for this species within 10 km of the study area.

Attachment B – Species Identified During Rapid Flora Surveys

Species name	Common Name	Status (native, non-native)
Canopy Species		
Casuarina glauca	Swamp Oak	Native
Angophora floribunda	Rough-barked Apple	Native
Eucalyptus moluccana	Grey Box	Native
Eucalyptus robusta	Swamp Mahogany	Native
Melaleuca styphelioides	Prickly-leaved Tea Tree	Native
Ground Cover Species		
Ehrharta erecta	Panic Veldtgrass	Non-native
Lomandra longifolia	Spiny-Headed Mat-Rush	Native
Bidens pilosa	Cobblers Pegs	Non-native
Solanum nigrum	Black-berry Nightshade	Non-native
Commelina cyanea	-	Non-native
Paspalum dilatatum	Paspalum	Non-native
Dianella caerulea	Blue Flax-lily	Native
Araujia sericifera	Moth Vine	Non-native
Tradescantia fluminensis	-	Non-native
Cyclospermum leptophyllum	Slender Celery	Non-native
Trifolium sp.	-	Non-native

Attachment C – Assessment of Significance

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (endangered – BC Act)

Swamp Oak Floodplain Forest (SOFF) is a coastal floodplain community with a tall and dense tree layer dominated by *Casuarina glauca*. A subcanopy comprised of smaller trees such as *Melaleuca decora*, *M. styphelioides*, *Acmena smithii* and *Glochidion* spp. may also occur. Scattered shrubs are present, including species such as *Bursaria spinosa, Rubus parvifolius, Breynia oblongifolia* and *Acacia floribunda*. A diverse groundcover is often present with species composition dependent upon salinity. Species commonly present include *Parsonsia straminea*, *Geitonoplesium cymosum*, *Stephania japonica var. discolor*, *Centella asiatica*, *Commelina cyanea, Persicaria decipiens*, *Viola banksia*, *Carex appressa, Gahnia clarkei, Lomandra longifolia,* and *Oplismenus imbecillis*. Where soils are more saline, the ground layer may include *Baumea juncea, Juncus kraussii, Phragmites australis*, and *Selliera radicans.*

The BioNet Atlas and the BioNet Vegetation Classification list PCT 4023: Coastal Valleys Swamp Oak Riparian Forest as associated with RFEF. Within the study area PCT 4023 has been mapped immediately around the proposed location of BH02. As such, this PCT may be directly impacted by the proposed works through tree trimming and through limited disturbance to the groundcover stratum.

The local occurrence of an ecological community is defined in the Threatened Species Test of Significance Guidelines (OEH, 2018) as:

The ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.

The area of SOFF occurring throughout the study area is contiguous with a larger patch of the TEC that runs in a north-south direction along Haslams Creek that is estimated to be over five hectares in size. While seed dispersal and exchange of genetic material between characteristic species likely occurs across the larger extent of TEC along Haslams Creek, for the purposes of this assessment, the local occurrence has been assessed as the five-hectare patch of TEC contiguous with the study area.

Response
(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Not applicable to a TEC.
b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: ***(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*** ***(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction***
(i) The proposed works may directly impact the SOFF within the study area through trimming of *Casuarina glauca*, as well as through limited disturbance to the groundcover stratum via drilling works and ancillary activities such as placement of laydowns. This represents a very small proportion of the five-hectare local occurrence along Haslams Creek. The direct impacts associated with the geotechnical activities, while having an adverse impact on the TEC, would be unlikely to place the local occurrence at risk of extinction. (ii) The proposed works may direct impact the SOFF within the study area to allow geotechnical works to proceed within the area. The trimming works will impact upon the canopy stratum, namely to *Casuarina glauca* surrounding

Response
the proposed borehole location. There is also expected to be limited disturbance to the groundcover stratum through the drilling itself, as well as through ancillary activities such as placement of laydowns. The direct impacts to the SOFF as a result of the proposed geotechnical activities exacerbate the edge effects in the remaining local occurrence of SOFF, however, with high levels of weed abundance and cover across the study area, these edge effects are unlikely to increase the presence of weed and non-native species within the study area thus changing the composition of the remaining local occurrence. While directly impacting the local occurrence, the proposed works will be concentrated within a small area of SOFF. The SOFF north and south of the study area along Haslams Creek would likely remain un-impacted. The proposed works are therefore unlikely to place the local occurrence at risk of extinction.
(c) in relation to the habitat of a threatened species or ecological community: ***(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*** ***(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and*** ***(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality***
(i) The proposed works may result in trimming of canopy tress and limited direct disturbance to groundcover stratum within SOFF. Habitat for the TEC is also expected to be indirectly impacted, however this is more difficult to quantify, and would by speculative. (ii) The proposed works may result in limited direct impacts to SOFF habitat. The associated trimming is unlikely to increase the fragmented occurrence of the local occurrence. (iii) The proposed works may result in directly impacts to SOFF, however, the impact would be only a small proportion of the of the local occurrence, which is estimated to be at least five hectares in size. While impacts to this habitat would have a short-term negative effect on the SOFF ecological community, its removal would not jeopardise the long-term survival of the local occurrence
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
The declared areas of outstanding biodiversity value (AOBV) are as follows: • Gould's Petrel – critical habitat declaration • Little penguin population in Sydney's North Harbour – critical habitat declaration • Mitchell's Rainforest Snail in Stotts Island Nature Reserve – critical habitat declaration • Wollemi Pine – critical habitat declaration. The proposed works would not impact any of the declared AOBVs.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
Threatening process means a process that threatens or may have the capability to threaten the survival or evolutionary development of species, populations or ecological communities. Key threatening processes are listed under the BC Act. The proposed works constitute, and/or are part of, and/or would be likely to result in the operation of, and/or increase the impact of, a number of key threatening process that particularly relate to SOFF: • Clearing of native vegetation • Invasion and establishment of exotic vines and scramblers • Invasion establishment and spread of Lantana (*Lantana camara L. sens. Lat*) • Infection of native plants by *Phytophthora cinnamomi* • Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae
Conclusion
The proposed works may result in direct impacts to SOFF through trimming of canopy trees and limited disturbance to groundcover stratum to allow for drilling and ancillary works. These impacts would occur within a very small proportion of the approximately five-hectare local occurrence along Haslams Creek. Clearing for the stabilisation works may also increase edge effects and may introduce and promote the occurrence of weed and exotic flora species, however, this increase is expected to be minimal given the already disturbed

Response
nature of the understorey. The proposed works may also introduce plant disease that could adversely affect the local occurrence of SOFF if hygiene controls are not followed. While harmful to the local extent of the TEC, these direct and indirect impacts would not cause an extinction to the local occurrence. The proposed works are unlikely to have a significant impact such that the local occurrence of SOFF was placed at risk of extinction.

Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community (endangered – EPBC Act)

Response
(a) reduce the extent of an ecological community
Coastal Swamp Oak Forest occurs on alluvial landforms related to coastal river floodplains and associated sites where transient water accumulates, including floodplains, river-banks, riparian zones, lake foreshores, creek lines (including the floors of tributary gullies), floodplain pockets, depressions, alluvial flats, fans, terraces, and localised colluvial fans within the South East Corner and Sydney Basin Bioregions. The proposed works would require trimming of canopy species and limited disturbance to groundcover stratum of Coastal Swamp Oak Forest within the study area and is unlikely to substantially reduce the extent of the TEC within the local occurrence.
(b) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
The proposed works would result in limited direct impacts to Coastal Swamp Oak Forest habitat. The associated trimming is unlikely to increase the fragmented occurrence of the local occurrence.
(c) adversely affect habitat critical to the survival of an ecological community
The proposed works would result in limited direct impacts to Coastal Swamp Oak Forest within the study area. This includes trimming of canopy species and limited disturbance within the groundcover strata as a result of drilling and ancillary activities. No critical habitat has been registered for Coastal Swamp Oak Forest, and no areas of habitat have been identified within a recovery plan as being critical to the survival of the TEC.
(d) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
The proposed works will impact all soil and soil-stored seed directly within the borehole location. In addition, ancillary activities such as placement of laydowns may also adversely impact any native species within the soil stored seedbank. The proposed works are unlikely to result in any changes to hydrology within the TEC.
(e) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
The proposed works may direct impact the Coastal Swamp Oak Forest within the study area to allow geotechnical works to proceed within the area. The trimming works will impact upon the canopy stratum, namely to *Casuarina glauca* surrounding the proposed borehole location. There is also expected to be limited disturbance to the groundcover stratum through the drilling itself, as well as through ancillary activities such as placement of laydowns. The direct impacts to the Coastal Swamp Oak Forest as a result of the proposed geotechnical activities exacerbate the edge effects in the remaining local occurrence of Coastal Swamp Oak Forest, however, with high levels of weed abundance and cover across the study area, these edge effects are unlikely to increase the presence of weed and non-native species within the study area thus changing the composition of the remaining local occurrence.
(f) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: ***(i) assisting invasive species, that are harmful to the listed ecological community, to become established, or*** ***(ii) causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community***
(i) The direct impacts to the Coastal Swamp Oak Forest as a result of the proposed geotechnical activities exacerbate the edge effects in the remaining local occurrence of Coastal Swamp Oak Forest, however, with high

Response
levels of weed abundance and cover across the study area, these edge effects are unlikely to increase the presence of weed and non-native species within the study area thus changing the composition of the remaining local occurrence. (ii) It is unlikely that the proposed works would mobilise chemicals, herbicides or fertilisers that may be harmful to the native plants that make up Coast Swamp Oak Floodplain Forest
(g) interfere with the recovery of an ecological community.
The proposed works would require tree trimming of canopy species and limited disturbance to the groundcover stratum in the Coastal Swamp Oak Forest. These impacts are temporary and of a small scale, therefore would be unlikely to interfere with the recovery of the TEC.
Conclusion
The proposed works may result in direct impacts to Coastal Swamp Oak Forest through trimming of canopy trees and limited disturbance to groundcover stratum to allow for drilling and ancillary works. These impacts would occur within a very small proportion of the approximately five-hectare local occurrence along Haslams Creek. Clearing for the stabilisation works may also increase edge effects and may introduce and promote the occurrence of weed and exotic flora species, however, this increase is expected to be minimal given the already disturbed nature of the understorey. The proposed works may also introduce plant disease that could adversely affect the local occurrence of SOFF if hygiene controls are not followed. While harmful to the local extent of the TEC, these direct and indirect impacts would not cause an extinction to the local occurrence. The proposed works are unlikely to have a significant impact such that the local occurrence of Coastal Swamp Oak Forest was placed at risk of extinction.