Integrated Management System

Blues Point wharf relocation

Planning Approval Consistency Assessment Form

SM ES-FT-414	
Sydney Metro Integrated Management System (IMS)	
Prepared by:	Anne Andersen, JHCPBG
Prepared for:	Sydney Metro Chatswood to Sydenham
Assessment number:	TSE3
Status / Version:	Final for Submission to TfNSW
Planning approval:	SSI-7400 and Mod 1, 2 and 4
Date required:	15 September 2018
Date approved:	20 September 2018
iCentral number:	SM-18-00164289

Applicable to:	Sydney Metro
Document Owner:	Principal Manager, Sustainability, Environment & Planning
System Owner:	Executive Director, Safety, Sustainability & Environment
Status:	Final
Version:	2.0
Date of issue:	14 July 2017
Review date:	14 July 2018

Table of Contents

The Planning Approval Consistency Assessment Form should be completed in accordance with the Sydney Metro Planning Approval Consistency Assessment Procedure (SM ES-PW-314) and Sydney Metro Environmental Planning and Approval Manual (SM ES-ST-216)

1.0 Existing Approved Project

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

Sydney Metro Chatswood to Sydenham SSI-7400 as modified 18 October 2017, 13 December 2017 and 21 December 2017.

Date of determination:

Infrastructure Approval date 09 January 2017

Modification 1 Approval date 18 October 2017

Modification 4 Approval date 13 December 2017

Modification 2 Approval date 21 December 2017

Modification 3 Approval date 22 March 2018

Type of planning approval:

Critical State Significant Infrastructure

Description of existing approved project you are assessing for consistency:

The Chatswood to Sydenham component of Sydney Metro City & Southwest comprises a new metro rail line, approximately 16 kilometres long, between Chatswood and Sydenham. New metro stations would be provided at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo, as well as new underground metro platforms provided at Central Station. Given the modifications that have been approved, CSSI Approval No. 15_7400 is now approved to operate to Sydenham Station and also includes the upgrade of Sydenham Station.

Tunnel boring machines would be used to excavate the twin tunnels. It was anticipated that tunnelling would occur from three tunnel boring machine launch and support sites as follows:

- A site in Chatswood (south of Chatswood Station and north of Mowbray Road), referred to as the Chatswood dive site (northern)
- A site in Marrickville (north of Sydenham Station and south of Bedwin Road), referred to as the Marrickville dive site (southern)
- A site at the proposed Barangaroo Station for the crossing of Sydney Harbour (Barangaroo Station construction site)

EIS description of Blues Point Temporary Site

The Environmental Impact Statement (EIS) assessed the excavation of a shaft for a temporary site at Blues Point for the retrieval of the cutter head and shields of the tunnel boring machines driven from the Chatswood dive site and the Barangaroo Station construction site.

The EIS noted that two tunnel boring machines (one for each tunnel) would be driven from the Chatswood dive site about six kilometres to the Blues Point temporary site. There, the cutter heads and shields from these tunnel boring machines would be dismantled and retrieved, with the remaining components of each tunnel boring machine (including support services) pulled back and retrieved from the Chatswood dive site.

The EIS also noted that due to the different ground conditions expected under Sydney Harbour, a separate tunnel boring machine would be driven from Barangaroo Station about one kilometre to the Blues Point temporary site where the cutter heads and shields would be retrieved and transported back to Barangaroo Station. The remaining components (including support services) would be pulled back to the Barangaroo Station box. The tunnel boring machine would be re-assembled to carry out the excavation of the other tunnel under Sydney Harbour. The cutter heads and shields would then again be retrieved through the Blues Point temporary site and the remaining components (including support services) pulled back and retrieved from Barangaroo Station.

The Blues Point temporary site would cover about 2,100 square metres within Blues Point Reserve, at the end of Blues Point Road. The site contains public open space and a public road. Public access to the foreshore would be maintained during works at this site.

Works at this site would involve the excavation of a shaft to the tunnels below resulting in about 8,000 cubic metres of spoil being removed through the site. The cutter heads and shield of the tunnel boring machines from the Chatswood dive site and from Barangaroo would be retrieved through this shaft. During retrieval of these components, this site would expand to encompass the current car parking on Blues Point Road adjacent to the reserve at the end of Blues Point Road. Access to and egress from the site would be left-in from Blues Point Road and left-out to Henry Lawson Avenue. The removal of the tunnel boring machine components via Blues Point Road would occur on four occasions and require oversized truck movements. This would involve the temporary short-term closure of the road (most likely overnight) and the temporary removal of street furniture, such as signage, pedestrian islands and bollards. It may also be feasible to remove the tunnel boring machines via barge using the wharf at the end of Blues Point Road. This opportunity would be further investigated during detailed design. Figure 7-12 from the EIS, which included an indicative site layout, as provided in Appendix A. Note: the EIS does indicate that to use the existing wharf for TBM removal, an upgrade to the wharf facilities may be required.

Changes to the Blues Point Temporary Worksite made in the SPIR

The Chatswood to Sydenham Submissions and Preferred Infrastructure Report (SPIR) included a description of the potential barging of the tunnel boring machine components, if this is determined to be a feasible solution. Figure 2-2 included in the SPIR (see Appendix A) shows the potential barging arrangements at Blues Point. The SPIR states that indicatively, a barge would be moored at or close to the existing wharf at the end of Blues Point Road. The water is around four metres deep at this location, which provides sufficient depth without the need for any dredging. A crane would be established at the end of Blues Point Road (within the expanded site area) to lift the tunnel boring machine components onto the barge. Alternatively, a crane mounted on a barge could be used. A maximum of four barge trips would occur within the harbour as a result of this activity (if adopted). The SPIR stated that no further assessment of this activity is necessary.

Project Planning Approval

The Project Planning Approval which was issued by the Minister for Planning on 9 January 2017 (SSI 15_7400) required the Construction Environmental Management Plan prepared under Conditions C1, C2, C7 and C8 to include an environmental risk assessment. The indicative environmental control map for Blues Point included in Appendix C, Figure 12 of the Construction Environmental Management Plan (SMCSWTSE-JCG-TPW-EM-PLN-002010-05) approved by the Department of Environment and Planning on 22 December 2017 shows the wharf relocated to the north east directly in front of the temporary Blues Point worksite and an acoustic shed over the temporary shaft (see Appendix B).

The Project Planning Approval also requires that the option of barging spoil be further investigated in accordance with Condition E84.

Modification No 5

A modification application was lodged with DPE in August 2018 and was placed on public exhibition from 5-19 September 2018. The modification application is seeking approval for the following works:

- Installation of a temporary acoustic shed
- Retrieval of all components of the tunnel boring machines from the Chatswood dive site and from Barangaroo, increasing required barge movements.

Determination of the modification application is expected before the end of 2018.

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

- Chatswood to Sydenham Environmental Impact Statement and accompanying technical papers (May 2016)
- Chatswood to Sydenham Submissions and Preferred Infrastructure Report (SPIR) (October 2016)
- Chatswood to Sydenham Modification - Blues Point temporary acoustic shed (August 2018) [Modification not yet determined].

All proposed works identified in this assessment would be undertaken in accordance with the mitigation measures identified in the EIS and SPIR and the Infrastructure Approval as modified.

2.0 Description of proposed development/activity/works

Describe ancillary activities, duration of work, working hours, machinery, staffing levels, impacts on utilities/authorities, wastes generated or hazardous substances/dangerous goods used.

While the SPIR assessed the use of barging from the Blues Point site, detailed investigations have identified that the existing wharf at Blues Point cannot be used for this purpose and a new temporary wharf is required to support these activities. Construction planning has also identified the ability to use the barging to remove spoil from the Blues Point temporary site.

JHCPBG have assessed the following works as part of this consistency assessment:

- That the location of the temporary wharf be moved to directly adjacent to the worksite. This scope of work consists of:

- A ramp (approximately 6 m wide and 38 m long, plain steel), supported by four piles set in the seafloor, allowing access to the barge and safe docking;
- Approximately two mooring piles set in the seafloor securing the barge during loading activities; and
- The existing boat mooring points to the north of the relocated wharf will also need to be removed to allow space for the barge to manoeuvre for the duration of the temporary barging operation and this work would be undertaken by Roads and Maritime Services in accordance with their standard management protocols.

- Removal of clean spoil via barge instead of trucks. This spoil would be barged to the Clyde barging facility. This would require approximately 35 additional barge arrivals. This change is in accordance with Planning Condition E84 relating to use of non-road transport.
- Barging operations would be 24 hours per day, 7 days per week with most likely one barge movement per day. Barges will be docked at Blues Point for up to 2 days at a time and approximately 55 barge arrivals would be required to transport spoil and Tunnel Boring Machine components (compared to the 4 barge movements assessed in the SPIR). Barges to be utilised would be 55 metres long (2000 tonne) and manoeuvred with two 25 tonne tugs, which are commonly used in Sydney Harbour. The modification application for the proposed temporary acoustic shed (subject to separate assessment) has been prepared to manage the noise impacts of barging outside standard working hours.

The above changes are referenced as the 'proposal' in the assessment below. An indicative site layout showing the SIPR site footprint and the footprint of the proposal is provided in Appendix C along with a concept design for the relocated wharf.

3.0 Timeframe

When will the proposed change take place? For how long?

There is no change to the construction program under the proposal. Site establishment at the Blues Point worksite commenced in July 2018. The temporary worksite will be in place for approximately 2 years and will be decommissioned and removed by mid 2020.

4.0 Site description

Provide a description of the site on which the proposed works are to be carried out, including, Lot and Deposited Plan details, where available. Map to be included here or as an appendix. Detail of land owner.

The Blues Point temporary worksite is located within Blues Point Reserve at the end of Blues Point Road. The site is owned by North Sydney Council and TfNSW has secured a lease (or similar) over the site. This lease has been obtained as per the TSE Site Access of 1 June 2018. The marine environment adjacent to the site is under ownership of NSW Roads and Maritime Services (RMS).

As noted in Section 13 below, wharf construction requires land owner consent from the Roads and Maritime Services and needs to address the requirements of *Ports and Maritime Administration Act 1995*, the *Marine Safety Act 1998*, and the *Marine Pollution Act 2012*. JHCPBG is working collaboratively with TfNSW, RMS and the NSW Port Authority to obtain all necessary approvals for barging including landowner consent from RMS.

5.0 Site Environmental Characteristics

Describe the environment (i.e., vegetation, nearby waterways, land use, surrounding land use), identify likely presence of protected flora/fauna and sensitive area.

The Blues Point temporary worksite is grassed and is situated adjacent to Sydney Harbour. A large fig tree is located at the eastern end of Blues Point Reserve. The multi-storey residential building, Blues Point Tower, is set just to the west of the site, with other residential premises around 50 to 150 metres away along Warung Street. One residential receiver is also present adjacent to the site to the east.

A public playground on Blues Point Road is nearby and a heritage listed bus stop is located on Henry Lawson Avenue. Within the footprint are a number of identified heritage items including the Blues Point Waterfront Group comprising eight individual items (0423–0450), which appear to be located along or adjacent to the eastern shoreline, but are described in the inventory as:

- Blues Point vehicular ferry dock (I0451)
- World War II Observation Post and stone stairs (I0424)
- Blues Point Foreshore Shelf (I0425)
- Stone retaining wall (I0426)
- Bollard (I0427)
- Bollard with chain (I0428)
- Excavation (archaeological site) (I0429)
- Steps with bollards (I0450)

The site is also within the Buffer Zone of the Sydney Opera House, which is on the World Heritage List.

The temporary wharf facility will be located in Blues Bay adjacent to the site. Blues Bay is a small bay between McMahons Point and Blues Point. The area is situated in a busy part of Sydney Harbour. A number of ferry routes operating from McMahons Point Wharf go directly past the bay and there are a number of boat moorings within the bay. The site is located within Sydney Harbour. Sydney Harbour and tributaries encompass a large range of benthic habitats, such as mangroves, seagrass beds (Posidonia australis, Zostera capricorni, Halophila sp.), algae (Creese et al., 2009), un-vegetated areas (beaches and mudflats) and also hard bottoms (natural and artificial). A detailed summary of the existing marine environment is provided in the Marine Ecological Assessment contained in Appendix D.

6.0 Justification for the proposed works

Address the need for the proposed works, whether there are alternatives to the proposed works (and why these are not appropriate), and the consequences with not proceeding with the proposed work.

Justification for each of the proposal elements is as follows:

- While the SPIR contemplated use of the existing wharf, JHCPBG has completed a detailed survey of this structure and confirmed that it would not be suitable for use in its current state. It would need extensive works to increase both width and strength to enable the roll on roll off TBM transfer operations. Barge mooring to the existing wharf would also be difficult and require installation of facilities outside of the worksite boundaries such as bollards. Due to tides, dredging would also be required to use this facility. Relocation of the temporary wharf to directly adjacent to the worksite is therefore proposed to avoid impacts on Blues Point Road in the vicinity of the worksite (including loss of parking and road closures) and also removes the need for dredging.
- Removal of clean spoil via barge instead of trucks to reduce road traffic impacts on Blues Point Road.

Alternatives considered

1. No change to the wharf location shown in the SPIR – this would have structural integrity issues requiring works to increase the width and strength of the wharf and would result in the temporary loss of car parking and temporary closure of Blues Point Road in the vicinity of the worksite
2. Transportation of spoil and TBM components by road – this would require the temporary loss of car parking and temporary closure of Blues Point Road in the vicinity of the worksite, the closure of Blues Point Road for night-time transportation of oversize TBM components and approximately 1,150 truck departures to transport spoil excavated from the temporary shaft.

7.0 Environmental Benefit

Identify whether there are environmental benefits associated with the proposed works. If so, provide details:

Blues Point Road is a relatively narrow and winding road with many street trees and a vibrant restaurant precinct. Spoil barging from Blues Point would remove approximately 1,150 truck arrivals (singles) over a period of 3 months and would have significant amenity and safety benefits compared to road transport. Road transport of TBM components would involve the temporary night time closures of the road and the temporary removal of street furniture, such as signage, pedestrian islands and bollards.

8.0 Control Measures

Will a project and site specific EMP be prepared? Are appropriate control measures already identified in an existing EMP?

A site-specific EMP would not be prepared for this scope, as the proposed works would be managed in accordance with the approved TSE Works Construction Environmental Management Plan (SMCSWTSE-JCG-TPW-EM-PLN-002010-05).

See Section 10 for more site-specific mitigation measures.

9.0 Climate Change Impacts

Is the site likely to be adversely affected by the impacts of climate change? If yes, what adaptation/mitigation measures will be incorporated into the design?

This scope is temporary and would not be directly impacted by climate change.

10.0 Impact Assessment – Construction

Attach supporting evidence in the Appendices if required. Make reference to the relevant Appendix if used.

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	The SPIR did not include any flora and fauna assessment associated with its indicative wharf location at Blues Point. There would be no impact to terrestrial flora and fauna as a result of this proposal as the minor areas of additional land required are grassed and no additional vegetation clearing is required. The fig tree referenced in Project Planning Approval Condition E7 would continue to be conserved under the proposal. Section 6.2 of the approved Construction Flora and Fauna Management Plan (SMCSWTSE-JCG-TPW-EM-PLN-002016-06) states that the extent of works is limited to driven piles and specific management measures will be included in site-specific Site Environmental Plans and Erosion and Sediment Control Plans (ESCPs). Disturbance to the seabed will be minimised. A detailed marine ecological assessment is included in Appendix D. A field survey was undertaken on 1 May 2018 by BIO-ANALYSIS marine ecologist Gwenael Cadiou supported by a team of commercial divers. A continuous seagrass bed of 791 m2 composed principally of Zostera capricorni and Halophila sp. was found in the survey area, including under the footprint of the proposed installations and activities. No threatened seagrass Posidonia australis has previously been mapped in the survey area and none was observed during	1. Relevant Department of Primary Industries Controlled Activity Guidelines would be considered in designing, constructing and decommissioning the works. 2. No anchors or mooring lines should be placed on or over the seagrass beds; 3. Ropes and mooring anchor lines should be placed so that they do not drag across the bottom; 4. Anchoring of work vessels at Caulerpa taxifolia infested sites is to be avoided where practicable, and If not, propellers and anchors will need to be inspected and if required thoroughly cleaned prior to entering the work site and any Caulerpa pieces disposed properly (bagged and binned). Procedures would be developed and implemented, in accordance with the National System for the Prevention and Management of Marine Pest Incursions and the NSW Control Plan for the Noxious Marine Algae Caulerpa Taxifolia	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
	the survey. No wetlands were identified in the survey area. No mangrove or saltmarsh were present in the survey area. One individual Pipefish (Syngnathiformes) was found in the survey area. Syngnathiformes are known to be present in the vicinity, with up to 16 species recorded in Sydney Harbour and its tributaries (source: Australian Museum – Fishes of Sydney Harbour - 11 April 2018 update). The study area encompasses suitable habitats for Syngnathiformes and the potential impacts on Syngnathiformes and mitigation measures have therefore been a focus of AMBS's assessment. AMBS (and subcontractor Bio-Analysis) conclude that subject to the additional mitigation measures set out in the column to the right: • The construction and installation of a ramp and barge facilities is considered to have a minor short-term impact on marine assemblages including seagrasses, macroalgae, fish and benthic invertebrates, which should all recover once the project is completed. • Two species of seagrass were found in the survey area, Eelgrass *Zostera capricorni* and Paddleweed *Halophila* sp. with potential direct (piling) and indirect (shading) impacts likely to occur. A permit to harm marine vegetation may be required by DPI Fisheries and deign of ramp may need to be in line with DPI Fisheries guidelines for shading seagrass habitats. • One individual tiger pipefish, *Filicampus tigris*, was recorded and relocation of Syngnathids may be required prior to commissioning works and prior to the de-commissioning phase. A permit to relocate syngnathids will be required by DPI Fisheries.	(I&I NSW, 2009), during the works to avoid transportation of marine pests from other locations. 5. All in-water activities associated with piling should be scheduled to coincide with favourable hydrodynamic conditions where practicable to ensure that sediment re-suspension and dispersion is minimised, e.g. calm conditions and minimal tidal fluctuation; 6. Disturbance should be confined to as small an area as practicable; 7. Floating booms, silt curtains or screens should be used during piling to minimise the mobilisation of sediments and the spread of suspended sediments. Details of mitigation are to be document in a site-specific Erosion and Sediment Control Plan. 8. Pre-construction and pre-decommissioning ecological survey dives are to be undertaken within one month prior to the commencement of piling and pile decommissioning respectively to confirm the presence or otherwise of Syngnathids (pipefish and seahorses). If the survey dive			

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
	Impacts on other fish assemblages would be negligible. • The construction of the new facilities can be implemented to satisfy the requirements of SREP (Sydney Harbour Catchment) 2005 and Fisheries Management Act 1994.	confirms the presence of Syngnathids (pipefish and seahorses) where direct impacts associated with piling are to occur the need for relocation shall be considered and determined by AMBS in consultation with BIO-ANALYSIS. If relocation is considered necessary, this would be undertaken using divers with DPI Fisheries Scientific Collection Permit. 9. If practicable, move the two seaward piles of the ramp further away from the existing seagrass bed. A buffer of 3 m from the dense seagrass could decrease the chance of impact due to changes in local hydrodynamics and smothering. 10. Implement site specific Erosion and Sediment Control Plan for on-shore activities, including installation controls in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Managing Urban Stormwater: Soils and Construction Volume 2 (Department of Environment and Climate Change, 2008a);			

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
		11. The worksite would be kept tidy and all litter promptly removed to minimise the potential for waste to be blown into the water 12. No fuels, oils and other potentially harmful substances should be stored on the foreshore fuels, oils and other potentially harmful substances would be stored when not in use in a bund sized to be at least 110% of the largest container to be stored; 13. A site-specific Spill Management Procedure would be developed and implemented. It would identify spill management equipment to be kept onsite and procedures to be implemented in the event of a spill; 14. Water quality monitoring around the worksite would be undertaken during piling and pile decommissioning at a frequency of at least two samples per fortnight.			
Water	There is the potential for water pollution as a result of materials handling, spills and leaks. Water pollution may also occur during transportation of materials to and from the wharf during construction.	No additional mitigation is 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
	Increased water turbidity may occur during construction due to the removal and installation of piles and the operation of construction vessels, especially in shallow waters. The impact on water quality would be minimised through the implementation of the approved TSE Works Construction Soil Water and Groundwater Management Plan (SMCSWTSE-JCG-TPW-EM-PLN-002014) and associated Environmental Procedures, which include the preparation of site-specific Site Environmental Plans and Erosion and Sediment Control Plans (ESCPs) and require that emergency spill kits (including hydrophobic spill equipment) would be kept on site at all times during site establishment and barging operations. Any dangerous goods should be located in accordance with the Site Environment Plans and in any case located sufficient distance from the water to prevent impact. The relocation of the existing boat mooring points to the north of the relocated wharf would be undertaken by Roads and Maritime Services in accordance with their standard management protocols.				
Air quality	The main potential air quality impacts during construction would be associated with the generation of dust. The revised location of the wharf would not cause any additional air quality impacts and barge loads would be covered during transportation.	No additional mitigation is required.	Y	Y	
Noise and vibration	While wharf construction would occur during standard daytime hours. A detailed Construction Noise and Vibration Impact Statement (CNVIS) has been prepared for the worksite establishment and operations to detail additional noise and vibration mitigation measures- **this includes construction**	No additional mitigation is 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 the wharf and operation of barges (refer Appendix E). The potential noise and vibration impacts associated with the proposed work are to be managed in accordance with the existing Conditions of Approval and conditions of Environment Protection Licence (EPL) No. 20971. An EPL variation would be sought to include out of hours works required at Blues Point.				
Aboriginal heritage	In its assessment of barging from Blues Point, the SPIR states that there would be no additional impact on Aboriginal heritage items to that described and assessed in the EIS. In accordance with Project Planning Approval Conditions E23 to E25 and REMM AH3 archaeological test excavation (and salvage where required) would be carried out where intact natural soil profiles with the potential to contain significant archaeological deposits are encountered at Blues Point. This would be managed in accordance with the approved TSE Works Construction Heritage Management Plan (SMCSWTSE-JCG-TPW-EM-PLN-002015). An Archaeological Method Statement (AMS) has been prepared by Casey and Lowe (June 2018, JHCPBG Document No SMCSWTSE-JCG-BPS-MST-004787). This AMS details the heritage significance of the marine environment at Blues Point and notes that the impact from the marine facility (piles and ramp for barging) will have low impact.	No additional mitigation is required.	Y	Y	
Non-Aboriginal heritage	In its assessment of barging from Blues Point, the SPIR states that there would be no additional impact on non-Aboriginal heritage items to that described and assessed in the EIS. In particular, the work would be undertaken in a manner that would not have an impact on the waterfront wall, which forms part of the Blues Point Waterfront Group, a local	No additional mitigation is 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
	heritage item under North Sydney Local Environmental Plan 2013. The TSE Works Construction Heritage Management Plan (SMCSWTSE-JCG-TPW-EM-PLN-002015-09), approved by the Department of Environment and Planning on the 22 December 2017, addresses the protection of the waterfront wall in Section 5.4.4. A detailed heritage assessment prepared by Casey and Lowe is included in Appendix F. This assessment concludes that impacts of the proposal would be mitigated by: • The preparation of a specific Archaeological Method Statement for Blues Point in accordance with the Project Planning Approval Condition E17 • Protection of the seawall in consultation with and as approved by Casey and Lowe				
Community and stakeholder	Communication on the temporary retrieval site has been ongoing including provision of information via: • Emails • Fact sheet • Individual stakeholder briefings • Door knocks • Notifications and newsletter. An introductory community information session was held in July 2017 to introduce the tunnelling contractor works required at the site were discussed. A community drop-in	No additional mitigation is 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
	session was held in June 2018 at the Henry Lawson Reserve with approximately 80 community members in attendance. Briefings to Owner's Corporations, Strata Managers and real estate agents of adjacent premises has been ongoing with emails about the temporary retrieval site, possible impacts and an invitation to meet the team at the community drop-in session. A briefing session on the proposed works at the Blues Point temporary retrieval site was held in May 2018 with agencies such as North Sydney Council, NSW EPA, Port Authority of NSW, RMS, Sydney Coordination Office, Harbour City Ferries, operator of Sydney Ferries on behalf of Transport for NSW, in attendance. The discussion was focussed on utility works, heritage investigations, protection of the marine environment, noise and dust mitigation, visual amenity, construction program and construction traffic (road and marine). In addition, the TSE Contractor is participating in the North Shore New Year's Eve (NYE) Stakeholder meeting (led by Police and attended by councils, Department of Premier and Cabinet, other emergency services, Road and Maritime Services, Sydney Trains and others involved in the planning and crowd management of the NYE event). An on-site meeting was held with a sub-committee focussed on the Blues Point precinct to explain the timing and location of the works at the temporary retrieval site and security measures. Further on-site meetings are planned.				
Traffic	The EIS notes that the use of the Blues Point temporary site would require the following road network, pedestrian and cyclist and public transport modifications:	No additional mitigation is 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
	• Blues Point Road – removal of 4 on street parking spaces at the end of Blues Point Road during shaft excavation • Blues Point Road – occupation of the end of Blues Point Road during tunnel boring machine removal • Blues Point Road – removal of on street parking spaces at the end of Blues Point Road during tunnel boring machine removal • Blues Point Road – potential short-term closure during tunnel boring machine transport. • Relocation of the bus stop on Henry Lawson Avenue • Blues Point Road – closure of the footpath adjacent to Blues Point Reserve during tunnel boring machine removal • Blues Point Road – temporary removal of street furniture and infrastructure along Blues Point Road for tunnel boring machine transport. The SPIR also indicates that the maximum of four barge trips that would occur within the harbour as a result of removal of the TBM cutter heads and shields would not result in any additional impacts on marine traffic in the harbour. In addition, the Project Planning Approval also requires that the option of barging spoil be further investigated in accordance with Condition E84. A separate report has been prepared to address this condition. Barging of spoil and TBM components would avoid significant impacts to Blues Point Road including loss of parking, foot path and road closures, and removal of street furniture.				

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
	The proposal would require approximately 55 barge arrivals for both spoil and TBM transport compared to the four trips indicated in the SPIR. The use of 55 metre long barges (2000 tonne) with accompanying harbour 25 tonne tugs is common in Sydney Harbour and this number of additional barges would not have a significant impact on other maritime operations within the harbour. Many community submissions to the EIS proposal to use Blues Point as a TBM retrieval site expressed concerns about pedestrian safety and noise from truck movements. Blues Point Road is a relatively narrow and winding road with many street trees and a vibrant restaurant precinct. Spoil barging from Blues Point would remove approximately 1,150 truck arrivals (singles) over a period of 3 months and would have significant amenity and safety benefits compared to road transport. As a number of community submissions recommended that barging be considered for Blues Point, implementing this proposal would address concerns of the community. Construction of the wharf facility would require some heavy vehicle movements for delivery of the ramp components and piles via Blues Point Road. Majority of the construction work would however be completed from the water using marine vessel movements and removing further need for heavy vehicle movements on Blues Point Road. The proposed works would be managed in accordance with the existing Project Planning Approval. Where permits/licences are required, these would be obtained prior to commencement of works, in accordance with the TSE Works Construction Traffic Management Plan (SMCSWTSE-JCG-TPW-EM-PLN-002013).				

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	The proposal has no additional impact on waste management however it is noted that the wharf ramp and piles will be removed on completion of the works. These components will be recycled and /or reused where practical. All waste generated would be classified and disposed of in accordance with the TSE Works Construction Waste and Recycling Management Plan (SMCSWTSE-JCG-TPW-EM-PLN-002022).	No additional mitigation is required.	Y	Y	
Social	The SPIR stated that the barging activities would not result in any change to the social and community infrastructure impacts as described and assessed in the EIS. Barging of spoil and TBM components would avoid significant impacts to Blues Point Road, including loss of parking, foot path and road closures, and removal of street furniture. There are a number of Community Groups active in the Blues Point Area. As noted above, community consultation has been ongoing and would continue in accordance with the Project Planning Approval and REMMs. Coordination of works with special events, including key harbour viewing events, is addressed the TSE Works' Community Communications Strategy (SMCSWTSE-JCG-TPW-SH-PLN-0426).	No additional mitigation is required.	Y	Y	
Economic	Barging of spoil and TBM components would avoid significant impacts to Blues Point Road, including loss of parking, foot path and road closures, and removal of street furniture, which would benefit local businesses relative to the EIS proposal. As per the EIS/SPIR mitigation measures, specific consultation would be carried out with businesses potentially	No additional mitigation is 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
	impacted during construction. Consultation would aim to identify and develop reasonable measures to manage the specific construction impacts for individual businesses. Impacts on businesses are to be managed in accordance with the TSE Works Business Management Plan (SMCSWTSE-JCG-TPW-SH-PLN-002042)				
Visual	The relocation of the temporary wharf from the location detailed in the SPIR represents a minor, if not negligible, change to the visual impact. Impacts to the Buffer Zone of the Sydney Opera House and locally listed heritage property at 1A Henry Lawson Avenue (North Sydney Council I0453) would be short term and would cease once the worksite is decommissioned and rehabilitated.	No additional mitigation is required.	Y	Y	
Urban design	The changed location of the barging facility would be consistent with the urban design outcomes of the SPIR.	No additional mitigation is required.	Y	Y	
Geotechnical	The design of the wharf has been undertaken considering geotechnical conditions of the area.	No additional mitigation is required.	Y	Y	
Land use	The change to the location of the wharf reduces the overall impact to land use as it does not encroach Blues Point Road and the existing wharf area.	No additional mitigation is required.	Y	Y	
Climate Change	No change from the EIS and SPIR impact.	No additional mitigation is required.	Y	Y	
Risk	The construction and operation of the wharf facility has risks associated with working in a marine environment however the alternate to establishing a wharf facility would be to use Blues Point Road for truck movements. This would cause additional impact to the local community. The risks associated with marine works such as spillage, water quality impacts, safety of working over water etc are all managed in	No additional mitigation is 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
	accordance with the relevant mitigation measures in place as detailed here and in supporting Project Plans.				
Other	N/A	No additional control measures are required.	Y	Y	
Management and mitigation measures	N/A	No additional mitigation is required.	Y	Y	

11.0 Impact Assessment – Operation

Attach supporting evidence in the Appendix if required. Make reference to the relevant Appendix if used.

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	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Water	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Air quality	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Noise vibration	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Indigenous heritage	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Non-indigenous heritage	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Community and stakeholder	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Traffic	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Waste	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Social	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Economic	There are no operational impacts as a result of the proposal.	No additional control 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
Visual	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Urban design	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Geotechnical	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Land use	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Climate Change	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Risk	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Other	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	
Management and mitigation measures	There are no operational impacts as a result of the proposal.	No additional control measures required	Y	Y	

12.0 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 proposed works would not transform the project. The project would continue to provide a new metro rail line between Chatswood and Sydenham. The proposal relocates the wharf only. The SPIR assessed an indicative concept for the wharf design which has been relocated as the existing wharf is not suitable for this purpose and to avoid impacts on Blues Point Road. The activities proposed to be undertaken at Blues Point are consistent with the activities identified in the EIS/SPIR to deliver the project at this location.
Is the project as modified consistent with the objectives and functions of the Approved Project as a whole?	Yes. The proposed works 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 changes identified in this assessment are temporary works required to support construction of that part of the Approved Project located at Blues Point. The activities proposed to be undertaken at Blues Point are generally consistent with the activities identified in the EIS/SPIR to deliver this element of the Approved Project within the program required.
Are there any new environmental impacts as a result of the proposed works/modifications?	The relocation of the wharf does not create any new environmental impacts. In this regard, no new environmental risks are outstanding. All risks would be adequately addressed through the application of the REMMs, Conditions of Approval.
Is the project as modified consistent with the conditions of approval?	Yes. The proposed works would be consistent with the Project Planning Approval. Condition E84 requires the investigation of non-road transport for the Project. This has been considered under a separate report submitted to DPE by TfNSW.
Are the impacts of the proposed activity/works known and understood?	Yes. The impacts of the proposed works are understood.
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 proposed works are temporary only and can be managed to avoid an adverse impact.

13.0 Other Environmental Approvals

Identify all other approvals required for the project:	The TSE Works EPL (No. 20971) is to be applied to this scope. A variation application specific to the out of hours works required would be submitted to the EPA for approval. The construction of the relocated wharf are exempt from requiring controlled activity approval as the works are being undertaken on behalf of a public authority. Wharf construction requires land owner consent from the Roads and Maritime Services and need to address the requirements of *Ports and Maritime Administration Act 1995*, the *Marine Safety Act 1998*, and the *Marine Pollution Act 2012*. Any marine ecological permits required for management of impacts to marine flora and fauna will be obtained prior to relevant works. As noted above, for any relocation works, JHCPBG will be using divers with a DPI Fisheries Scientific Collection Permit.

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:	Anne Andersen	Signature:	
Title:	Environment, Approvals, Sustainability & Interface Manager		
Company:	JHCPBG	Date:	18/09/2018

Environmental Representative Review

(Additional step for City & Southwest projects only – if this is a CA against a Northwest Project or REF delete this table)

As an approved ER for the Sydney Metro City & Southwest project, I have reviewed the information provided in this assessment. I am satisfied that mitigation measures are adequate to minimise the impact of the proposed work.			
Name:	Jo Robertson	Signature:	
Title:	Environmental Representative	Date:	19/09/18

This section is for Sydney Metro only.

Application supported and submitted by			
Name:	Yvette Buchli	Date:	19/9/18
Title:	Planning Approvals Manager	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.

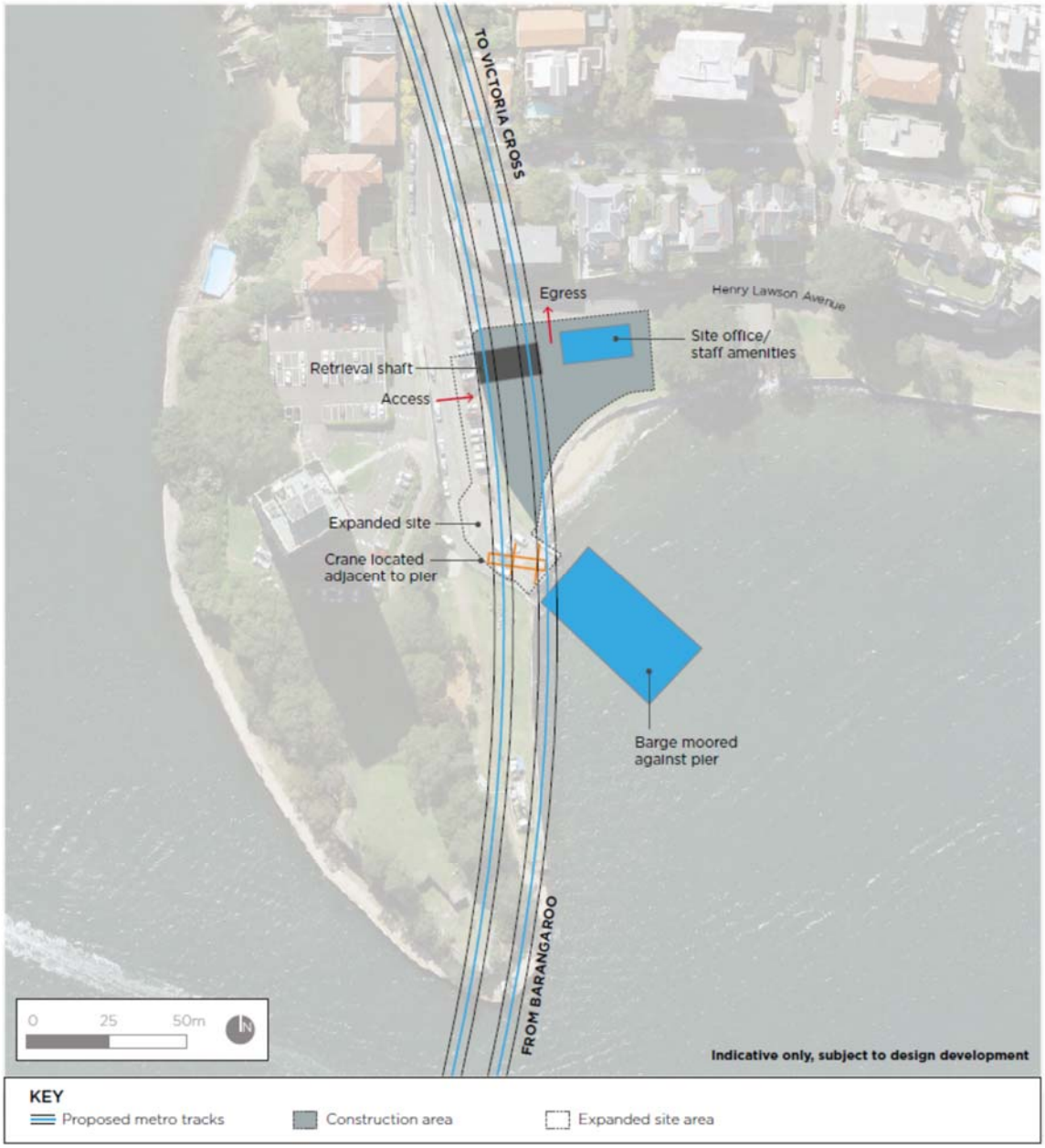
No ☐ The proposed works/activity is not consistent with the Approved Project. A modification or a new activity approval/ consent is required. Advise Project Manager of appropriate alternative planning approvals pathway to be undertaken.

Endorsed by			
Name:	CAROLYN KILEY ACTING	Date:	20/9/18
Title:	Principal Manager Northwest/City & Southwest, Sustainability, Environment & Planning	Comments:	
Signature:			

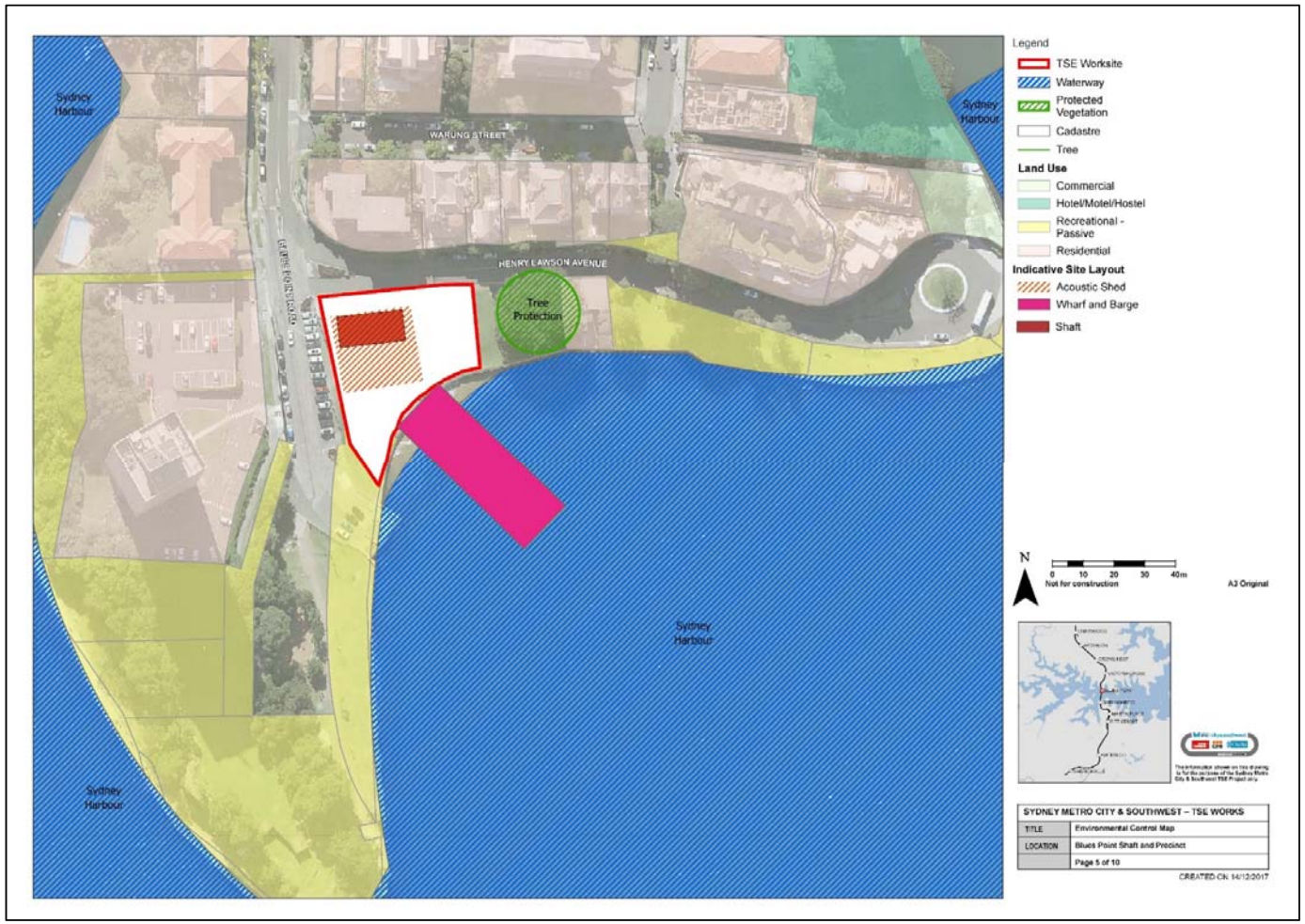
Appendix A - Map showing indicative construction layout from EIS and PIR and DP&E Approved CEMP

EIS Figure 7-12

SPIR Figure 2-2


TO VICTORIA CROSS
Egress
Henry Lawson Avenue
Site office/
staff amenities
Retrieval shaft
Access
Expanded site
Crane located
adjacent to pier
Barge moored
against pier
FROM BARANGAROO
0
25
50m
N
Indicative only, subject to design development
KEY
Proposed metro tracks
Construction area
Expanded site area

DP&E Approved Construction Environmental Management Plan Appendix C Figure 12



Appendix B - Noise Mitigation Measures

C.5 Blues Point worksite

Details in this Appendix are based on and indicative site layout and proposed mitigation measures based on modelling completed to date. As set out in Section 8.3.2 of the CNVMP, detailed outcomes from the design, construction planning and assessment process will be presented in the CNVIS for each worksite. These indicative mitigation measures are therefore current to the revision date of this Plan only. The actual site-specific mitigation measures to be implemented will be detailed in the CNVISs.

RENZO TONIN ASSOCIATES

1/12/2017

Figure C5.1: Site layout showing indicative mitigation

BLUES POINT SHAFT & TBM RETRIEVAL SITE

RENZO TONIN ASSOCIATES

1/12/2017

Table C5.1: Construction timetable/ activities/ equipment

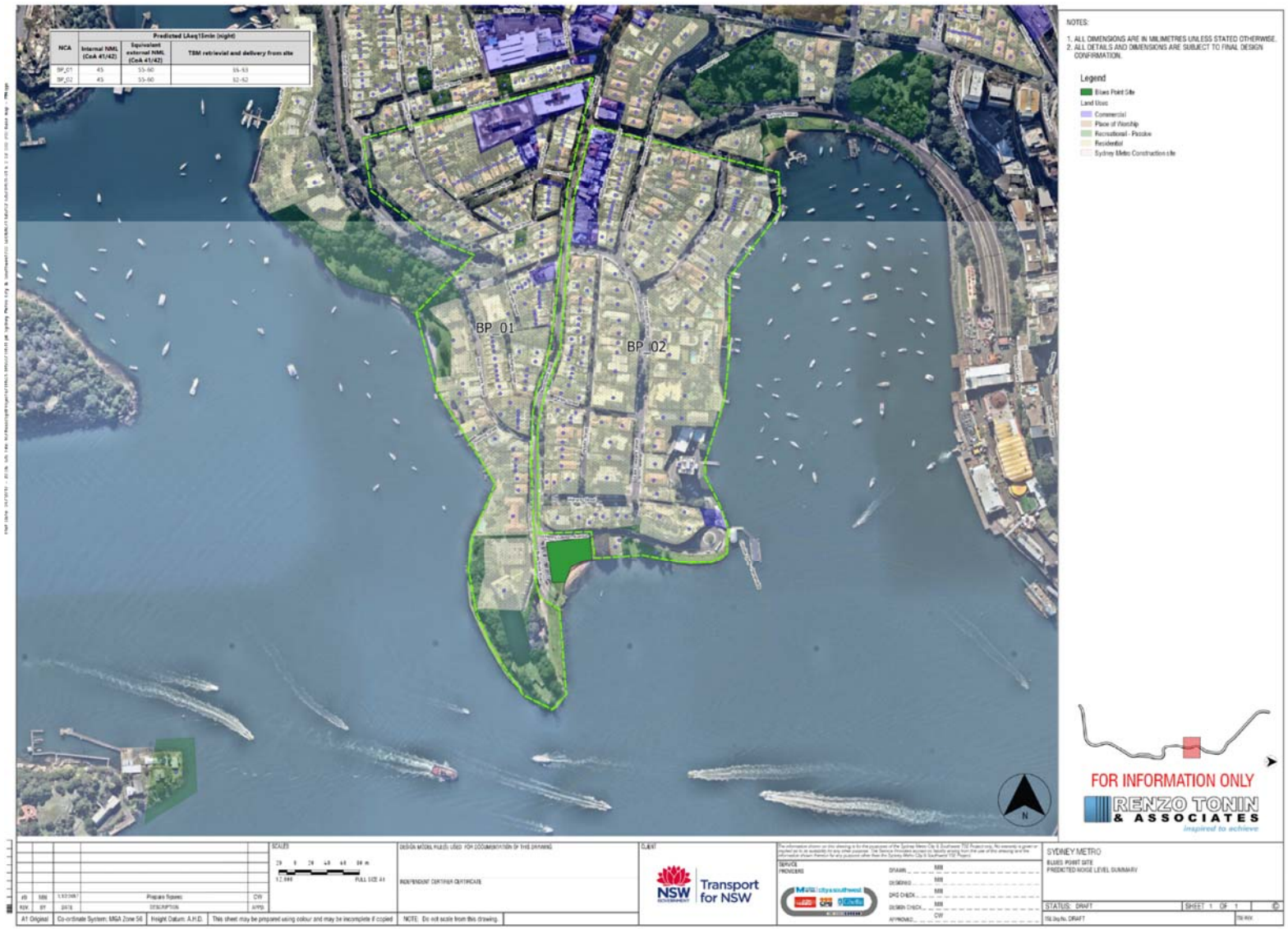
BLUES POINT SHAFT & TBM RETRIEVAL SITE

Activity/ Work Area	Aspect	Plant/ Equipment	Net Power kW	Operating Weight kg	Day 7am - 6pm	Evening 6pm - 10pm	Night 10pm - 7am	Timing of Activity (Aprox No. weeks)	Notes	Sound Power Level (Lw re: 1pW) in Noise L_{Aeq}	L_{eq}
Construction Compound & Car Park	General worksite and Car parking	Light vehicle	80		20 per hour	10 per hour	10 per hour	Duration	Busy on shift changes only	89	
		Wheel wash unit			1	-	-	Duration			
		Water treatment plant pumps	10		2	2	2	Duration		97	
Concurrent with all other activities	Workshop; Deliveries; Maintenance; Storage	Road truck (deliveries to site)			4 p.h.	-	-	Duration		108	
		Compressor	110	2660	2	2	2	Duration		70	
		Workshop Hand Tools			2	2	1	Duration		107	
		Franna Crane	Max 4 gantry	20 tonne	1	-	-	Duration	Outside shed	99	106
		Water cart		15kL	4 p.h.	4 p.h.	-	Duration		104	
Shaft Excavation & Construction	Excavation of soil and rock; Hammering/rock breaking; Drilling; Loading; Haulage.	Piling Rig (Bauer BG36)	1 gantry crane and 2 welding machines or 1 gantry crane and 1 forklift	BG36	1			2 months		114 + 5 pen	
		Workshop Hand tools			3					97	
		Generator			1					94	
		Water pump (diaphram pump)			2	2	2	Duration	Once the shaft starts generating water the pumps will need to run 24/7	97	100
		Bulldozer D10		D10	1			3 months		113	
		Excavator w bucket		35 tonne	1			3months		103	
		Excavator w rockhammer		45 tonne	2			2 months		123 + 5 pen	
		Drilling machine (ECM 660IV)	194	13 tonne	1			2months		120 + 5 pen	
		Soil nail		As above							
		Site Forklift		20T Franna	1					97	
		Compressor/s	317	5800	2				ECM drill rig has built in compressor	102	
		Single bodied truck			4 p. h.			3 months	14 trucks per hour (spoil onto barge)	108	
		Compactor (Roller)		16-18 tonne	1				Located on surface for minor earthworks	108	
		Water cart		As above						104	
		Roadsweeper truck			1			Duration	keeping hardstand and local roads clean	104	
		Shotcrete rig		Meyco or diesel	2	1		2months	OOHW P1 contingency if required	104	108
	Concreting with concrete trucks, concrete vibrators	Concrete pump (boom pump on semi)			1	1		3 months	OOHW P1 contingency if required	99	109
		Concrete truck		Agis	4 p.h.	2 p.h.		3 months	OOHW P1 contingency if required	108	112
		Compressor	317	5800	2	2		3 months	OOHW P1 contingency if required	76	79
		Generator			2			3 months		94	
		Pneumatic hammer			1			3 months		110	
		Drilling machine (ECM 660IV)	194	13 tonne	1			4 months		120	
		Welding equipment			1			3 months	Mig welders required to setup site	97	
TBM retrieval & delivery from Site	4 x TBM retrievals All OOHW inside shed	Gantry crane in acoustic shed		200 t	1	1	8 lifts/hr	Duration	200t rating	90	
		Hammering Steel			2 locations	-	-	12 weeks per TBM	Instantaneous noise level 115-120 dB(A). Assume hammering occurs for 1-2 min over 15 min period, so $L_{eq15\ min}$ 110 dB(A)	110	120
		Air/ hydraulic hand tools			2	2	2	12 weeks per TBM	Bottom of shaft	107	112
		Hydraulic Power Pack	45	60.3 hp	1	1	1	12 weeks per TBM	Bottom of shaft (with/ without acoustic attenuation)	63/76	76
		Welding Machines 400 amp			1	1	1	12 weeks per TBM	Bottom of shaft	100	110
		Welding Machines 400 amp			1	1	1	12 weeks per TBM	On surface within shed	100	110
		Site Forklift/ Franna		Franna 20T	1	1	1	12 weeks per TBM	1 in shaft/ 1 on surface	99	105
		Pneumatic impact gun 1"			4	4	4	12 weeks per TBM	In shaft		
		Hand Tools (grinders)			4	4	4	12 weeks per TBM	In shaft	96	
		Hand Tools (drills)			4	4	4	12 weeks per TBM	In shaft	96	
		Other Hand Tools			2	2	2	12 weeks per TBM	In shaft (Excluding grinders, drills rattle guns, welders)	96	
		Oxy cutting			4	4	4	12 weeks per TBM	Bottom of shaft		
		Air Arc gouging			2	2	0	12 weeks per TBM	Located in shaft		
		Diesel EWP			3	3	3	12 weeks per TBM	2 x Located in shaft, 1 x Located on surface	99	105
		Electric scissor lift			2	2	2	12 weeks per TBM	Located in shaft	99	
		Scaffold assemble & dismantle			1	1	0	12 weeks per TBM	Located in shaft		
		130t, 220t, 300t or 500t mobile crane		500 t	1	1	1	12 weeks per TBM	For trailing	101	113
		Generator small petrol 8KVA	10		1	1	1	12 weeks per TBM	On surface within shed	102 (97)	-
		High pressure water cleaning			2	2	2	12 weeks per TBM	1 in shaft/ 1 on surface	97	102
	TBM transportation	Road truck (deliveries to site)			4 per hour	-	-	2 days	DAY - 20 containers in total delivered over 2 days. Likely to be 2-3 weeks apart	108	112 117 (air brakes)
		Cargo barge			1	-	-		DAY- TBM leaving site via cargo barge	-	-

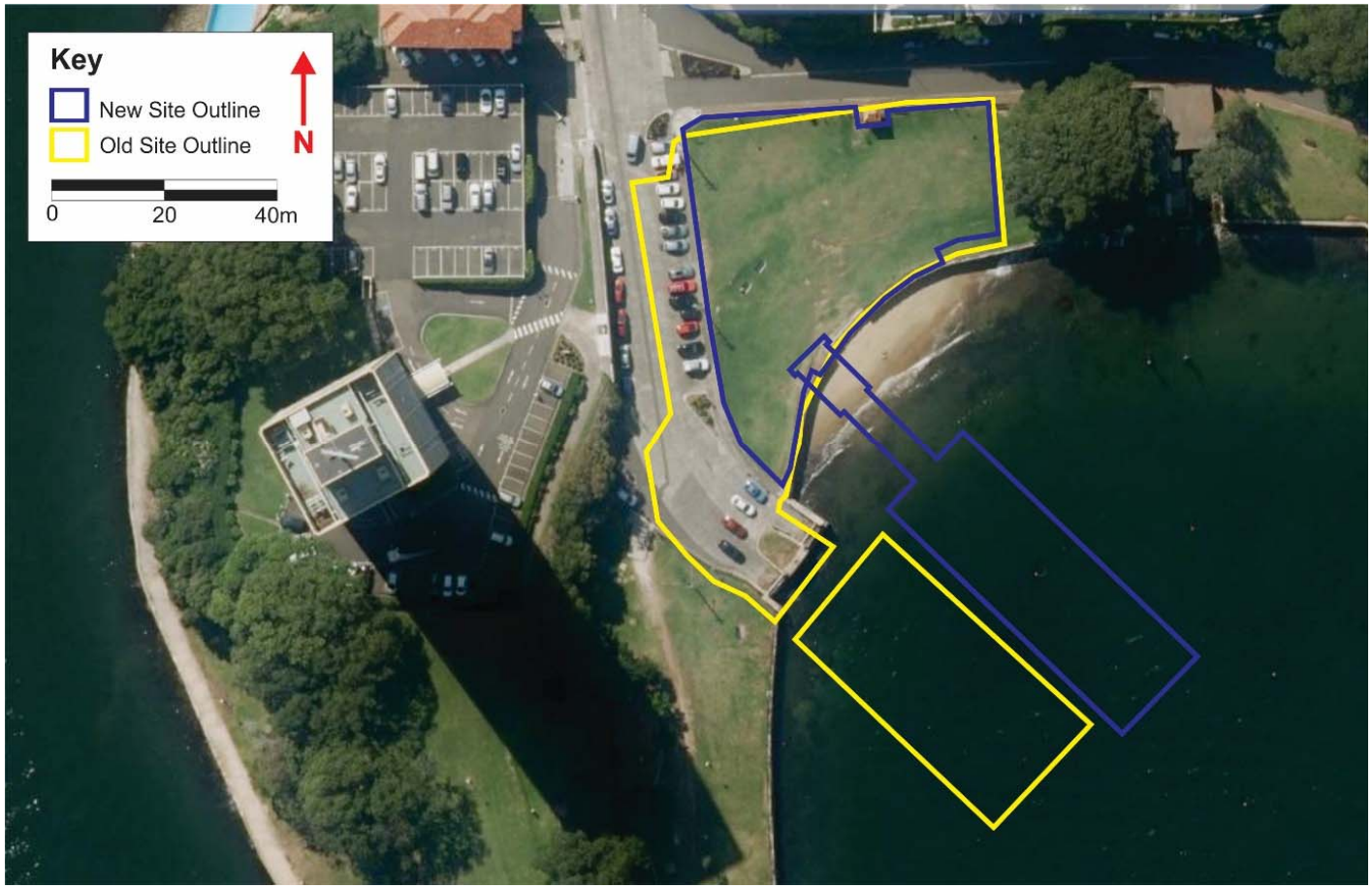
RENZO TONIN ASSOCIATES 5/12/2017

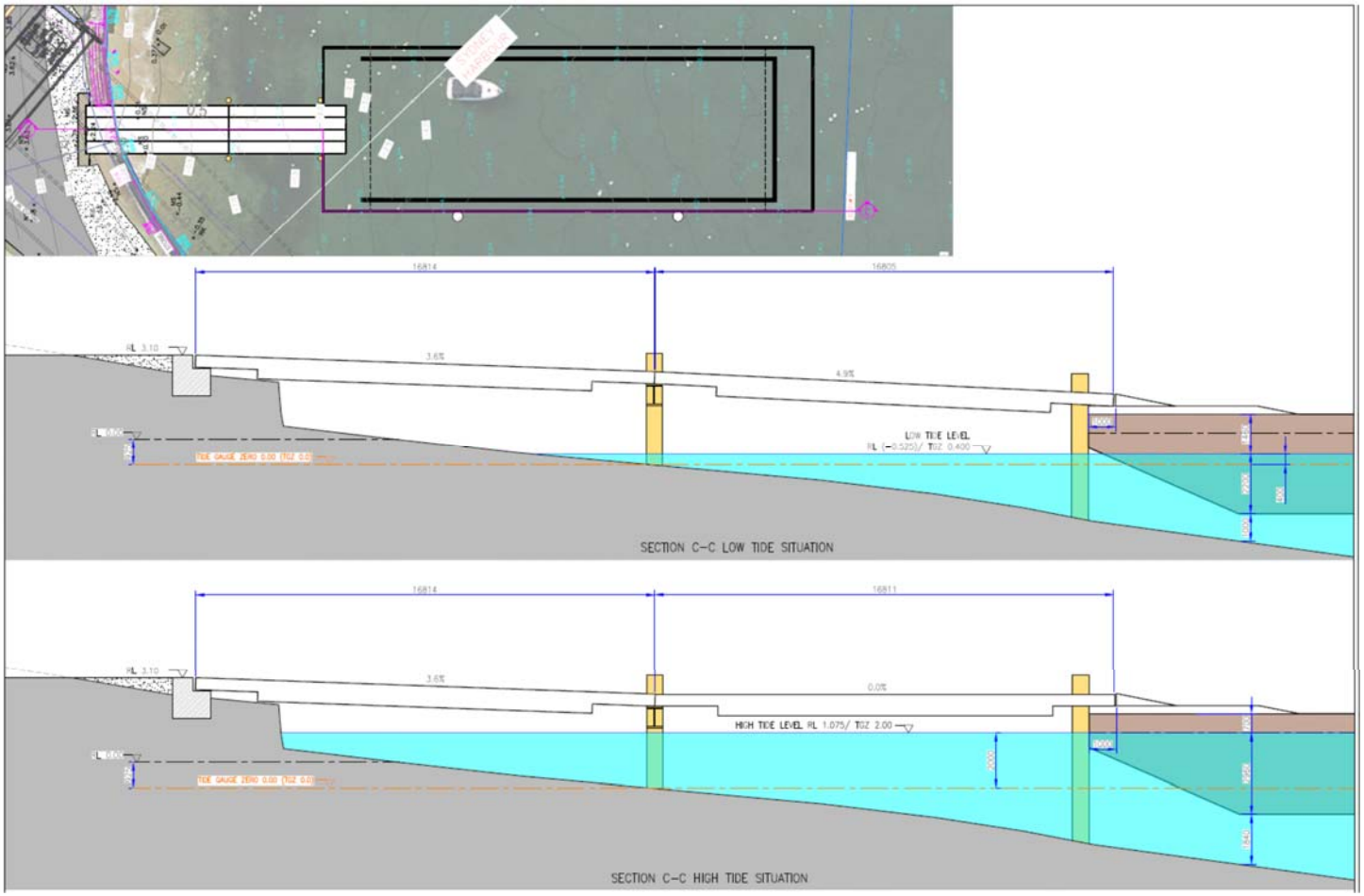
Table C5.2: Construction noise management schedule **BLUES POINT SHAFT & TBM RETRIEVAL SITE**

Area to be Managed	Specific Mitigation/ Management Measure		Typical Details
Airborne Noise			
1 Noise Barriers	NW01	Although noise walls will not provide significant mitigation to nearby residential receivers, it will be provide some benefit to areas of the park not used for construction	
2 Shaft excavation			
2.1 Work during Standard Construction Hours	DAY:	Rockhammering should only be undetaken in continuous blocks not exceeding 3 hours each with a minimum of 1 hour respite period between each block.	highly noise affected residential receivers during excavation
2.2 Work outside Standard Construction Hours	EVE/ NGT:	No rockhammering due to airborne and ground-borne noise. Shotcrete in evening inside the shed	
3 TBM disassemby and retrieval			
3.1 Work during Standard Construction Hours	DAY:	Standard hours activities	
3.2 Work outside Standard Construction Hours	EVE/ NGT:	Max 4 gantry crane lifts per hour during OOHW. All other activities within shed (e.g. lifting).	
3.3 Acoustic enclosures/ sheds	EVE/ NGT:	Acoustic shed to allow TBM disassembly and retrieval. Following plant in operation: 1 gantry crane and 2 welding machines or 1 gantry crane and 1 forklift	
3.4 Truck restrictions during the OOHW period	EVE:	≤ 2 Concrete trucks	Contingency only
	NGT:	No trucks	
3.5 Ventilation Fan (if required)		Ventilation fans with silencer + additional attenuation (duct lining/ inlet attenuator).	
Ground-borne Noise			
1 Shaft excavation (rockhammer) (where airborne noise not significant) Assuming hard rock is 5 m below surface level	Residential receivers:		
	DAY:	- Receivers within 50m (ground floor, level 1 and 2); within 40m (level 3 and above)	Apartments on Henry Lawson Ave and Blues Point Road. Notifications to residents.
		- Respite period within 20m	None
	EVE:	- Not within 65m (ground floor, level 1 and 2); not within 50m (level 3 and above)	No OOHW excavation
	Commericial receivers:		
	IN USE:	- Not within 40m	None
		- Respite period within 25m	None
Vibration			
1 Shaft excavation (rockhammer)	Residential receivers:		
		- Unreinforced or light framed structure (residential or light commercial): 10m	None
		- human disturbance (AVTG) 40 m	Apartments on Henry Lawson Ave and Blues Point Road. Notifications to residents.
	Heritage receivers:		
		- Unreinforced or light framed structure (residential or light commercial): 10m	None
	Commericial receivers:		
		- Reinforced or framed structures: 5m	None
		- human disturbance (AVTG) 30 m	None
2 Minimum working distances		Measurement of vibration on site from rockhammers to establish site specific minimum working distances	
3 Notification		Notification should be sent to all GBN affected receivers	


NCA
Predicted LAeq15min (night)
Internal NML (CoA 41/42)
Equivalent external NML (CoA 41/42)
TBM retrieval and delivery from site
BP_01
43
55-60
55-63
BP_02
43
55-60
52-62
NOTES:
1. ALL DIMENSIONS ARE IN MILIMETRES UNLESS STATED OTHERWISE.
2. ALL DETAILS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN CONFIRMATION.
Legend
Blues Point Site
Land Uses:
Commercial
Place of Worship
Recreational - Passive
Residential
Sydney Metro Construction site
BP_01
BP_02
N
FOR INFORMATION ONLY
RENZO TONIN & ASSOCIATES
inspired to achieve
Transport for NSW
SYDNEY METRO
BLUES POINT SITE
PREDICTED NOISE LEVEL SUMMARY
STATUS: DRAFT

Appendix C - Plans of showing the relocated wharf and additional land compared to the footprint in the SPIR





Indicative relocated wharf and ramp (including cross sections)

Appendix D - Marine Ecological Assessment

BIO-ANALYSIS Pty Ltd
Marine, Estuarine & Freshwater Ecology

Blues Point Marine Ecological Assessment

Prepared by BIO-ANALYSIS Pty Ltd and AMBS Ecology & Heritage Pty Ltd for JHCPBG JV

09/07/2018

BIO-ANALYSIS Pty Ltd
Marine, Estuarine & Freshwater Ecology
2/1 Botham Close Charmhaven, NSW 2263
(Email) info@bioanalysis.com.au
(Mobile) 0414 477066

Document Information

Citation:	BIO-ANALYSIS and AMBS 2018, *Blues Point Marine Ecological Assessment*. Consultancy report to John Holland CPB Ghella Joint Venture, prepared by BIO-ANALYSIS Pty Ltd and AMBS Ecology & Heritage Pty Ltd.
Versions:	Version 1: Draft Report issued 14 May 2018 Version 2: Final Draft Report issued 25 May 2018 Version 3: Final Report issued 28 May 2018 Version 4: Final Report updated 1 June 2018 Version 5: Final Report v2 issued 9 July 2018
Recipient:	Ann Andersen
Author(s):	Dan Roberts (BIO-ANALYSIS), Glenn Muir (AMBS)
Approved by:	Dan Roberts (BIO-ANALYSIS), Glenn Muir (AMBS)

Contents

Tables

Figures

1 Introduction

1.1 Background

The Sydney Metro Sydney & Southwest Tunnel and Station Excavation (TSE) Works are currently being undertaken by the John Holland CPB Contractors Ghella (JHCPBG) for Transport for New South Wales (TfNSW). The Chatswood to Sydenham component comprises a new metro rail line, approximately 16 kilometres long, between Chatswood and Sydenham. JHCPBG engaged AMBS Ecology & Heritage Pty Ltd (AMBS) to provide ecological and heritage services for the TSE Works.

The Environmental Impact Statement (EIS) and Submissions and Preferred Infrastructure Report (SPIR) assessed the use of Blues Point as a temporary worksite to be used to retrieve four Tunnel Boring Machines (TBMs). This involves the excavation of a temporary access shaft. To minimise road traffic impacts, the SPIR also assessed the use of barges to transport the TBMs which included the temporary installation and use of a wharf located at the end of Blues Point Road. The SPIR states "indicatively, a barge would be moored at or close to the existing wharf at the end of Blues Point Road. The water is around four metres deep at this location, which provides sufficient depth without the need for any dredging." It comments on marine traffic, noise impacts, visual impacts, Aboriginal and non-Aboriginal heritage and social and community infrastructure impacts, but is silent on potential marine ecology impacts. The SPIR concludes that no further assessment of this activity is considered necessary. It states that "overall, it is expected that using a barge to transport tunnel boring machine components would result in negligible changes in impacts when compared with those assessed in the Environmental Impact Statement."

AMBS understands that JHCPBG are proposing:

- Relocation of the temporary wharf from the end of Blues Point Road to directly in front of the Blues Point Worksite and relocation of existing mooring points
- Minor changes to the land area of the Blues Point temporary worksite
- The temporary installation of an acoustic shed over the access shaft to provide noise mitigation.

Given that the Blues Point Worksite is located in the Henry Lawson Reserve which is grassed, and that the large fig tree located to the north of the worksite would continue to be retained under the proposal, this assessment focuses on the potential ecological impacts of relocating the wharf to directly adjacent to the worksite (the proposal). This would involve the construction of a temporary wharf to the north of the existing dilapidated wharf at the end of Blues Point Road. Existing boat mooring points to the north of the relocated wharf would also need to be removed for the duration of the temporary barging operation and this work would be undertaken by Roads and Maritime Services in accordance with their standard management protocols.

1.2 Objectives and Scope

BIO-ANALYSIS Pty Ltd (BIO-ANALYSIS) was engaged by AMBS to undertake a marine ecological assessment of the proposal at Blues Point. The aims were to provide an assessment of the marine habitat and to assess potential impacts of the proposed installations and activities on the marine environment, with a particular focus on threatened and protected species, populations and ecological communities.

The scope of works for the assessment included:

- A desktop study, reviewing the existing information on the site and the presence or potential presence of aquatic species and habitats.
- Conducting a field-based marine habitat survey of the study area based on indicative mark-ups provided by JHCPBG.
- Identification of the presence of wetland and marine vegetation and estimating its relative abundance as well as ascertaining whether or not the introduced algae *Caulerpa taxifolia* was present at the site.
- Mapping the marine aquatic vegetation and other aquatic ecological features.
- Assessing the occurrence of threatened and protected species, populations and ecological communities, as listed under the NSW *Fisheries Management Act 1994* (FM Act), NSW *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Addressing the provisions in the *Sydney Regional Environment Plan (Sydney Harbour Catchment) 2005* relating to aquatic habitat.
- Considering NSW Department of Primary Industries requirements for reviewing foreshore developments (DPI Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (Fairfull 2013)).
- Providing recommendations in order to mitigate impacts of the construction of the barging facility and of barging activities.

1.3 Site Description

The Blues Point site is located on the foreshore of Sydney Harbour, in the suburb of McMahons Point within the lower North Shore area of Sydney. The area is part of Henry Lawson Reserve, which is a grassed foreshore area between McMahons Point Wharf to the east and Blues Point Reserve to the south (also a grassed public reserve). The area to the north and west is mainly residential development and the area to the east (past McMahons Point Wharf) and south is Sydney Harbour.

The Blues Point Temporary Worksite comprises approximately 0.21 hectares of mown grass with a constructed sandstone sea-wall fronting the harbour. The dominant species across the site is Couch (*Cynodon dactylon*) (Arcadis 2016), a common and widespread grass often cultivated for lawns or pasture. A set of steps in the central part of the sea-wall leads to a small area of sand that is exposed at low tide. The site contains a single fig tree on the eastern side and a heritage-listed bus stop on the northern side, both of which will be retained. The site is bordered by Blues Point Road to the west, Henry Lawson Avenue to the north, a boat shed to the east and Blues Bay to the south.

The proposal considered in this report comprises the construction, operation and decommissioning of a temporary wharf in Blues Bay adjacent to the site. Blues Bay is a small bay between McMahons Point and Blues Point. The area is situated in a busy part of Sydney Harbour. A number of ferry routes operating from McMahons Point Wharf go directly past the bay and there are a number of boat moorings within the bay, which as noted above would need to be temporarily relocated. A detailed description of the marine environment is presented in Section 3 of this report.

1.4 The Proposal

The layout of the proposed temporary ramp and barge mooring at Blues Point are shown in Figures 1.1 and 1.2. The scope of works consists of:

- A ramp (approximately 6 m wide and 38 m long, plain steel), allowing access to the barge and safe docking;
- Approximately eight piles would be required, six to secure the ramp and two mooring piles set in the seafloor securing the barge during loading activities; and
- The relocation of the existing moorings to allow space for the barge to manoeuvre.

The installations (access ramp and piles) would remain in place during the shaft excavation and Tunnel Boring Machine retrieval works, which is anticipated to be between mid 2018 and early 2020. Barging operations during this period would be 24 hours per day, 7 days per week with most likely one barge movement per day. Barges will be docked at Blues Point for up to 2 days at a time and approximately 55 barge arrivals would be required to transport spoil and Tunnel Boring Machine (TBM) components (compared to the 4 barge movements assessed in the SPIR). The size of the temporary ramp structure is limited and barge arrivals are timed to coincide with spoil removal for shaft excavation (approximately 35 barges over approximately a three-month period) and TBM component retrieval (approximately20 barges over approximately six months from the third quarter of 2019 to first quarter of 2020). Barges to be utilised would be 55 metres long (2000 tonne) and manoeuvred with two 25 tonne tugs, which are commonly used in Sydney Harbour.

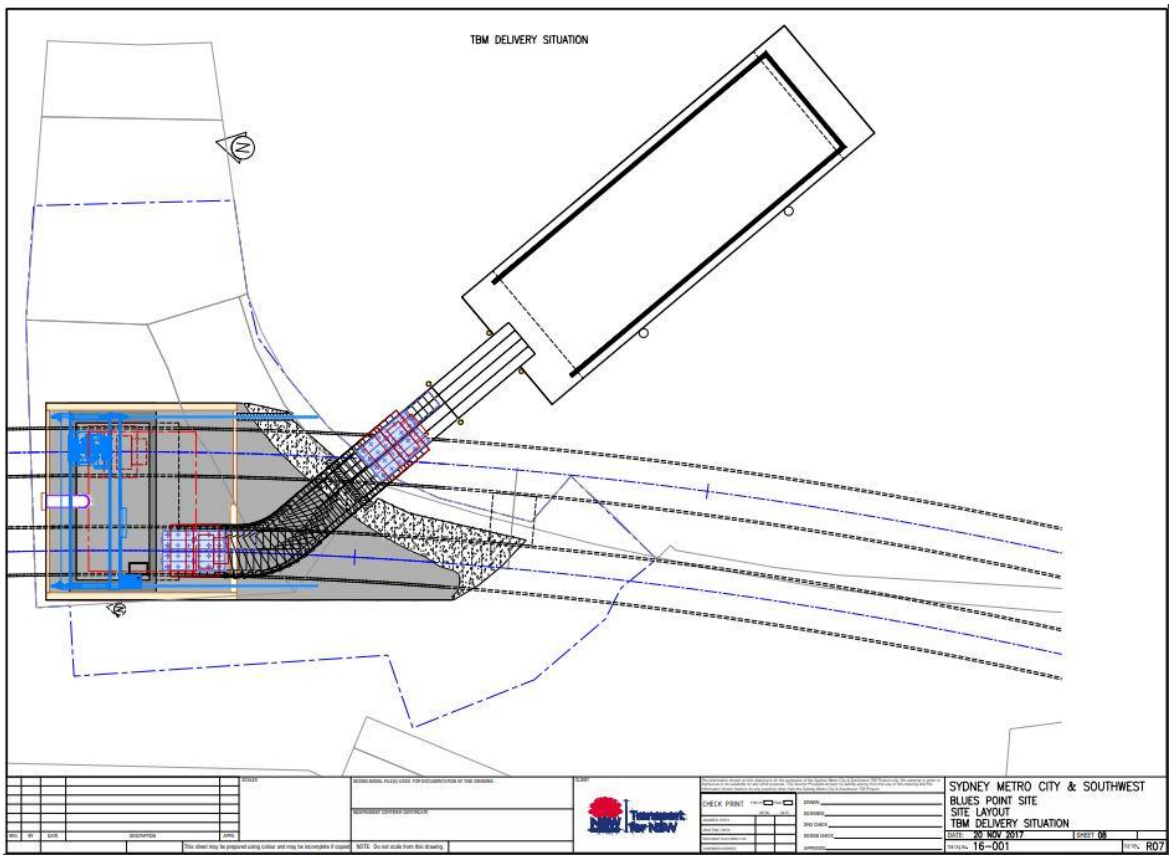


Figure 1.1. Indicative site layout barge arrangement (source: JHCPBG) (to be updated with current design including six piles for ramp and two mooring piles)

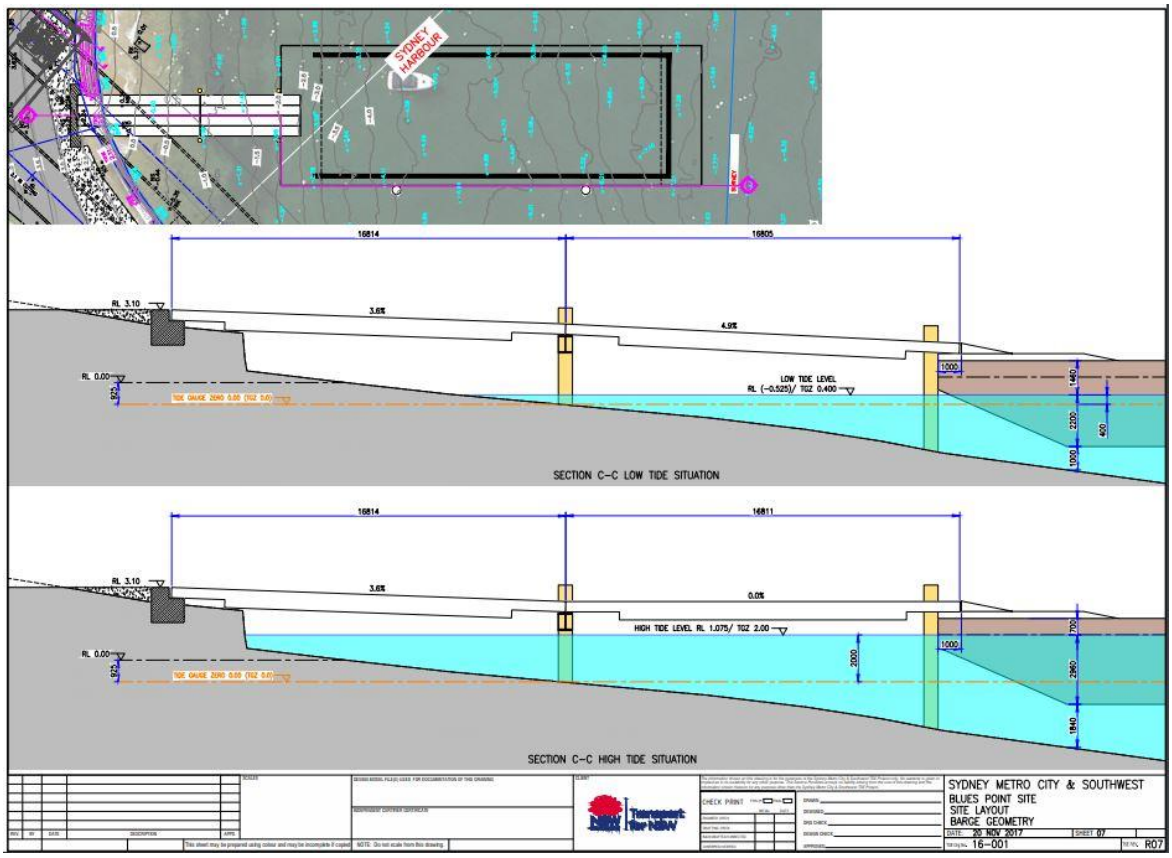


Figure 1.2. Indicative site layout barge arrangement (source: JHCPBG) (to be updated with current design including six piles for ramp and two mooring piles)

1.5 Project Team

The field survey for this study was undertaken by Gwenael Cadiou (BIO-ANALYSIS). This report was prepared by Dan Roberts (BIO-ANALYSIS) with some of the text provided by Glenn Muir (AMBS). Information regarding the proposed development was provided by JHCPBG. This study was directed by Dan Roberts (BIO-ANALYSIS) and Glenn Muir (AMBS), who also reviewed this Report.

2 Methodology

2.1 Study Area

Proposal means the temporary works and intermittent barging operations set out in Section 1.4 of this Report.

Subject site means the area directly affected by the proposal. In the case of this assessment the subject site corresponds to the footprint of the ramp and piles, barge mooring piles, barge and swing moorings to be relocated.

Survey area corresponds to the study area plus additional buffer to encompass important habitat features during the field surveys as shown in Figure 2.1.

Study area means the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take

all potential impacts into account. In the case of this assessment the study corresponds to the survey area plus an additional buffer (up to 10 km) to take into accounts the potential presence of threatened species, populations and ecological communities based on database searches (Table 1).

2.2 Desktop Review

The desktop review consisted of searches of relevant databases and consultation of maps and other documentation in relation to the study area. Only estuarine and marine species and communities were considered in the assessment of presence of habitat and likelihood of occurrence of threatened species, populations and ecological communities. The databases and resources consulted for the desktop review are listed in Table 1. The results of the database searches are summarised in Appendix A. An evaluation of presence of habitat and likelihood of occurrence of threatened species, populations and ecological communities as well as the potential for impacts are provided in Appendix A.

Table 1. Database and existing documentation consulted for the desktop review

Source	Objective	Search area
BioNet Atlas – OEH website	Threatened and protected aquatic flora and fauna and populations	10 km radius of site
EPBC Act Protected Matters Search	Threatened aquatic flora and fauna, endangered populations and ecological communities and migratory species	5 km radius of site
NSW Department of Primary Industries (DPI) fisheries website	Listed aquatic threatened species, populations and ecological communities; protected species – Species FactSheets and PrimeFacts	Sydney Metropolitan area
NSW DPI Fisheries Spatial Data Portal	Critical habitats, estuarine habitats, key fish habitats	5 km radius
OEH website	Critical habitats (Little penguin) OEH Threatened Species Profiles	5 km radius
NSW DPI website	Aquatic pests and diseases	1 km radius
NSW Department of Planning and Environment website	Sydney Harbour Catchment Regional Environmental Plan 2005 (REP) Sydney Harbour Foreshores and Waterways Area Development Control Plan 2005 (DCP)	1 km radius
SIX Maps, NSW Government – Spatial services	Aerial photographs	1 km radius
The Atlas of Living Australia	Threatened species occurrences	1 km radius

2.3 Field Surveys

A field survey was undertaken on 1 May 2018 by BIO-ANALYSIS marine ecologist Gwenael Cadiou supported by a team of commercial divers. Diving operations were undertaken under the AS2299.1 diving standards. The site was surveyed on 1 May 2018 between 10:30 am and 3:00 pm on an outgoing tide (low tide was at 2:59 pm with a height of 0.51 m at McMahons Point). Weather conditions were good with no swell (just wash from the nearby ferries), no wind and clear sky (<10% cloud cover). The visibility of the water was average, between three and five metres. The

area comprising the proposal and an additional buffer as shown in Figure 2.1 were inspected using the following combination of survey methods:

- Two 80 m graduated transect lines were placed along the seafloor and the diver swam along the transect collecting information on the habitat and species present up to 3 meters on either side of the line;
- The shallow seagrass beds were contoured using a GPS set on track mode whilst swimming the edges;
- The seagrass beds present in the survey area were inspected and percentage cover estimates and information on epiphyte loading were collected;
- The eight moorings (mooring line, chain and block) and an additional 5m buffer were inspected by diving;
- Targeted surveys for Syngnathiformes and other potential threatened or protected species were done along the transects, on the mooring lines and in the vicinity, in seagrass beds and in random swims between transects.
- Information collected in the field was merged into a Geographic Information System (GIS) project.

2.4 Limitations

The species detected during the survey are only an indication of the species that potentially occur within the study area. Marine species can be highly mobile and the field surveys provide only a snapshot of the species assemblages at a time of the year and under certain climatic conditions, therefore this list is not exhaustive.

The habitat mapping of the study area was made by extrapolating information from the transects and dives through the study area. Whilst the shallow habitats (intertidal area and shallow seagrass beds) were surveyed thoroughly, it is estimated that 50% of the deeper habitats were inspected by diving.

Based on the desktop review and the field survey findings, the information gathered is considered sufficient to produce habitat maps and make an assessment of potential impacts of the proposal.

This present assessment focuses on the potential impacts of the proposal on threatened species, populations and ecological communities found in estuarine and marine environments; it does not include primarily terrestrial or primarily avian species (such as albatross and similar birds that would occur within the study area only rarely, if at all, and are not likely to be affected by the proposal).

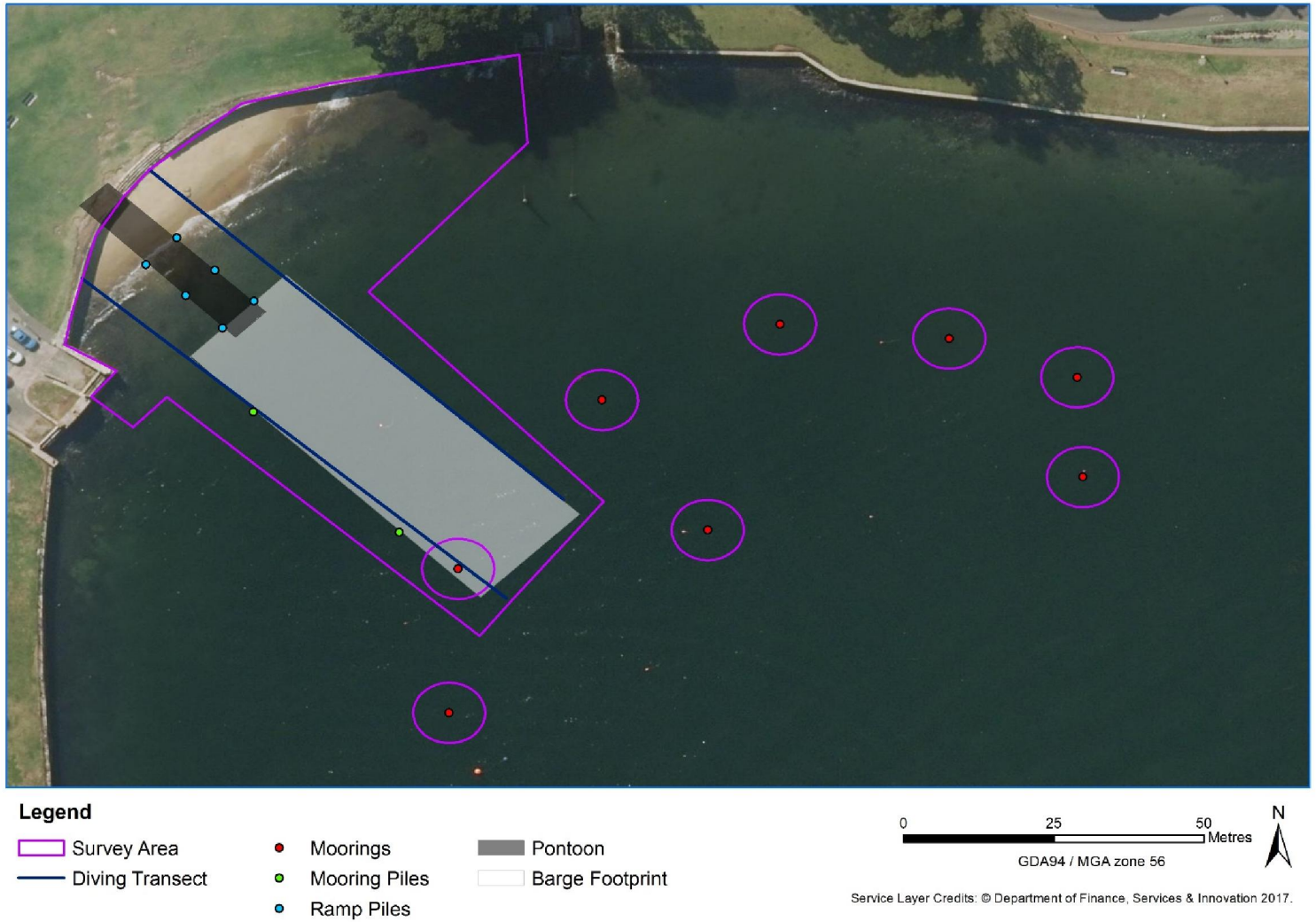


Figure 2.1. Subject site, survey area and field survey effort.

3 Results

3.1 Existing environment/available information on aquatic habitats

Marine vegetation comprising saltmarsh, mangroves, seagrasses, and macroalgae are essential to coastal and estuarine systems. Marine vegetation provides food, habitat and nursery areas for many species including fish, crustaceans and birds, and also plays a role against erosion of the shoreline by stabilising bottom sediments (Butler and Jernakoff, 1999).

There have been large-scale declines of marine vegetation within NSW estuaries, especially seagrass meadows (Smith and Pollard, 1998), and in some cases these declines have been permanent (West *et al.,* 1990). Increased turbidity, siltation and the growth of epiphytic and benthic algae all have the potential to reduce the distribution and abundance of seagrass meadows.

Artificial structures such as wharves, jetties and mooring points have the potential to adversely affect marine vegetation either directly through construction activities or indirectly by causing shading to the bottom.

The study area is located at Blues Point, on the Parramatta River, which is the main tributary of Sydney Harbour. Sydney Harbour and tributaries encompass a large range of benthic habitats, such as mangroves, seagrass beds (*Posidonia australis, Zostera capricorni, Halophila* sp.), algae (Creese *et al*., 2009), un-vegetated areas (beaches and mudflats) and also hard bottoms (natural and artificial).

Parramatta River is considered as a class 1 waterway (major key fish habitat) following the NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (Fairfull 2013).

The seagrass *Zostera capricorni* has been mapped at the study site by NSW DPI (Creese *et al*., 2009) (Figure 3.1). The *Z. capricorni* bed was estimated at 62 m^2 (NSW DPI Fisheries NSW Spatial Data Portal, Creese *et al*., 2009). The mapped *Zostera capricorni* bed falls within the footprint of the proposed installations and activities (Figure 3.1).

The seagrass *Posidonia australis*, listed as an endangered population in Sydney Harbour, was not found in the study area and this species is only present East of the Harbour Bridge (Creese *et al*., 2009; NSW DPI FactSheet *Posidonia australis*) (Figure 3.2).

The introduction of the exotic algae *Caulerpa taxifolia* in recent times has added new problems for managers of estuaries. The genus Caulerpa is highly invasive (Davis *et al.*, 1997) and direct disturbance associated with dredging and construction has the potential to exacerbate its spread. *Caulerpa taxifolia* can now be found in a number of NSW estuaries, and DPI (Fisheries) require that prior to any disturbance (e.g. construction of jetties) an assessment for the presence or absence of this noxious marine algae be done.

The noxious macroalgae *Caulerpa taxifolia* is known to occur within Sydney Harbour and tributaries. The closest location where this pest species was previously recorded was at Neutral Bay approximately 2 km East of the study area (Figure 3.2).

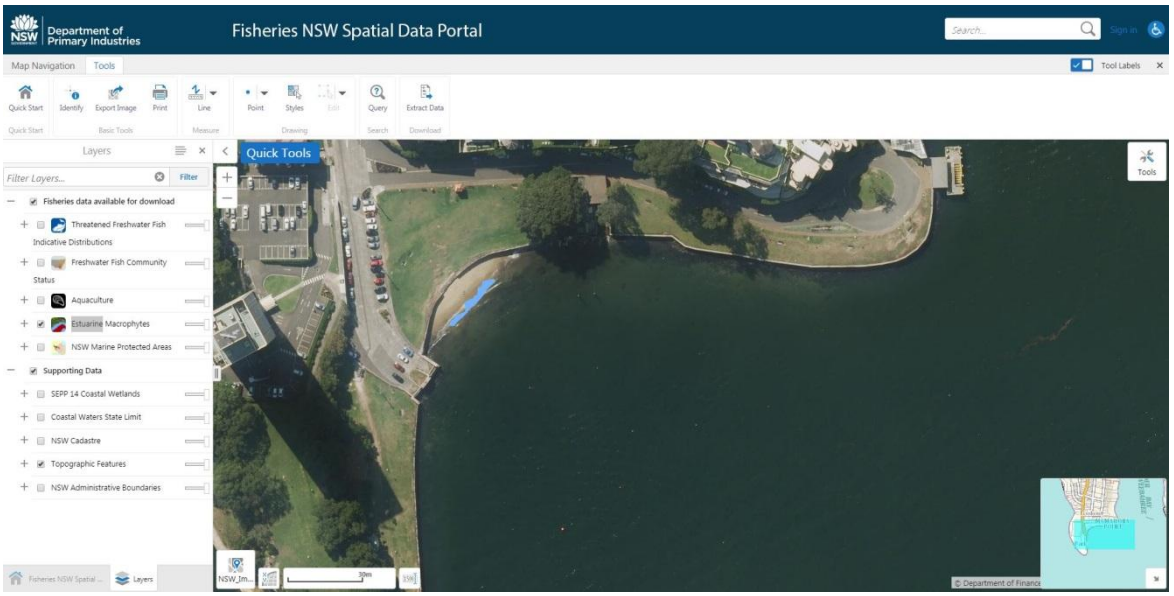


Figure 3.1. *Zostera capricorni* bed mapped by NSW DPI. (Source: NSW DPI - Fisheries NSW Spatial Data Portal)

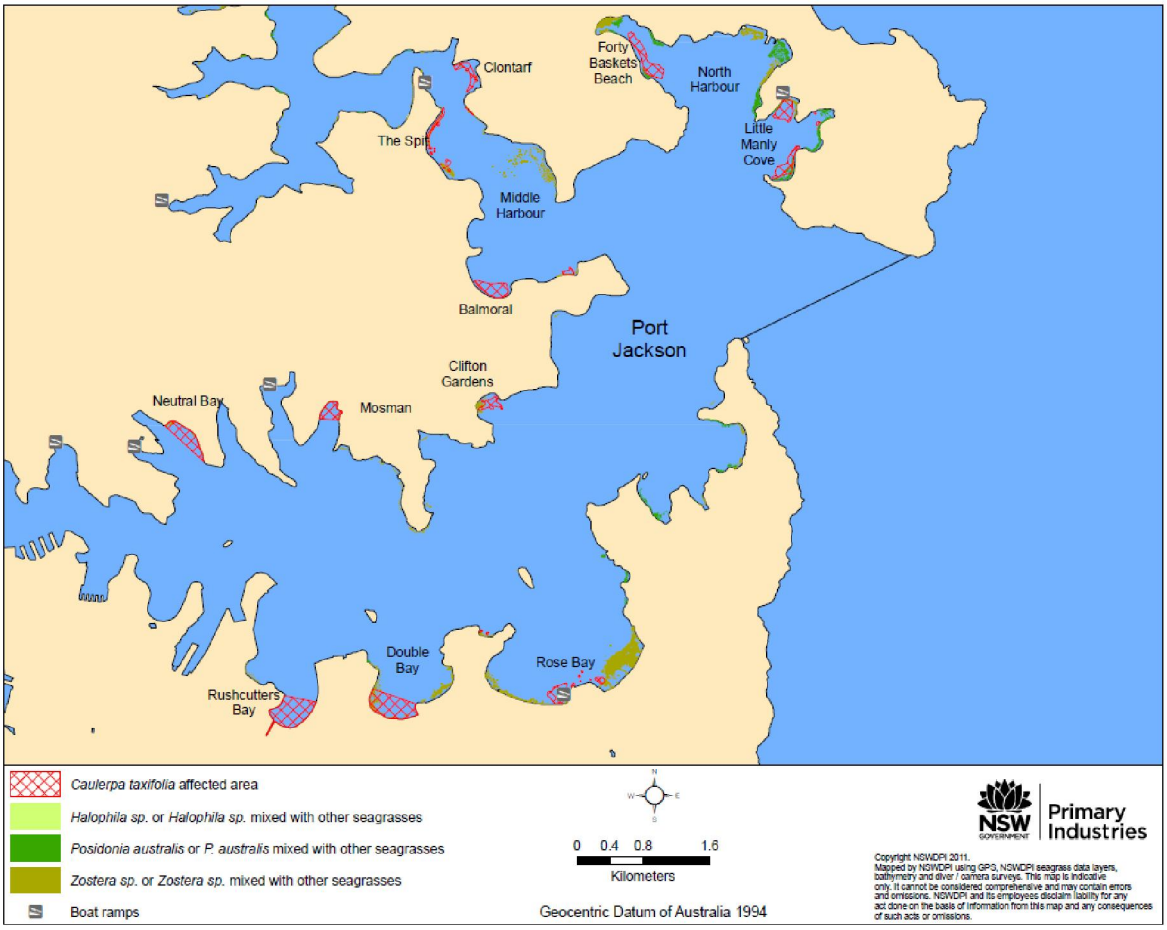


Figure 3.2. Distribution and extent of seagrasses and *Caulerpa taxifolia* in Sydney Harbour (Source: NSW DPI)

The proposal is identified as being within a designated Wetlands Protection Area (Wetlands Protection Area Map 11 under the SREP, Figure 3.3), and therefore a further assessment of potential impact on the wetlands under s63 of the SREP has been undertaken.

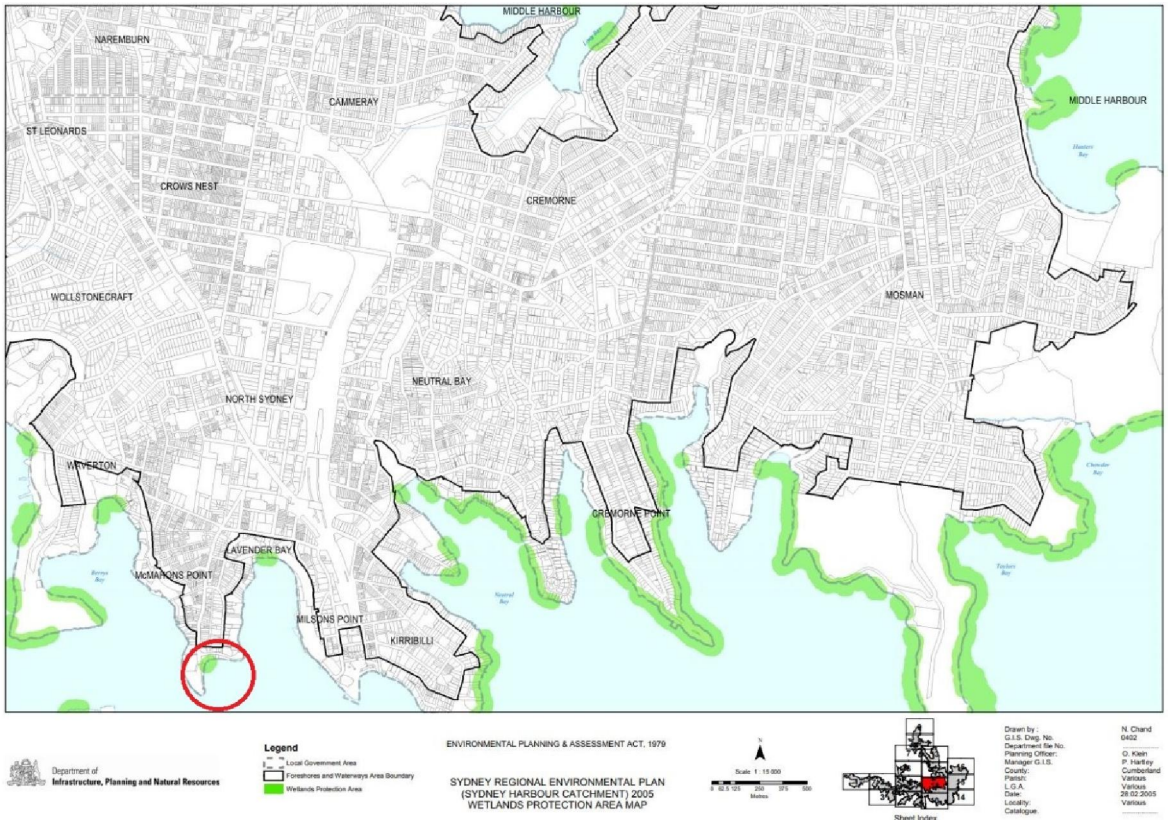


Figure 3.3. Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 – Wetlands protection area map 11

Under Part 2 of the Sydney Harbour Foreshores and Waterways Area Development Control Plan (DCP), the Ecological Communities and Landscape Characters map identifies the terrestrial ecological community in the vicinity of the subject site as Grassland and Sandy Beaches were identified as an aquatic ecological community under the DCP for the surveyed area. The DCP identifies the Conservation Value of Ecological Communities. Grassland (terrestrial) has a low conservation status; Sandy Beaches has a medium conservation status, which requires further assessment of potential impact.

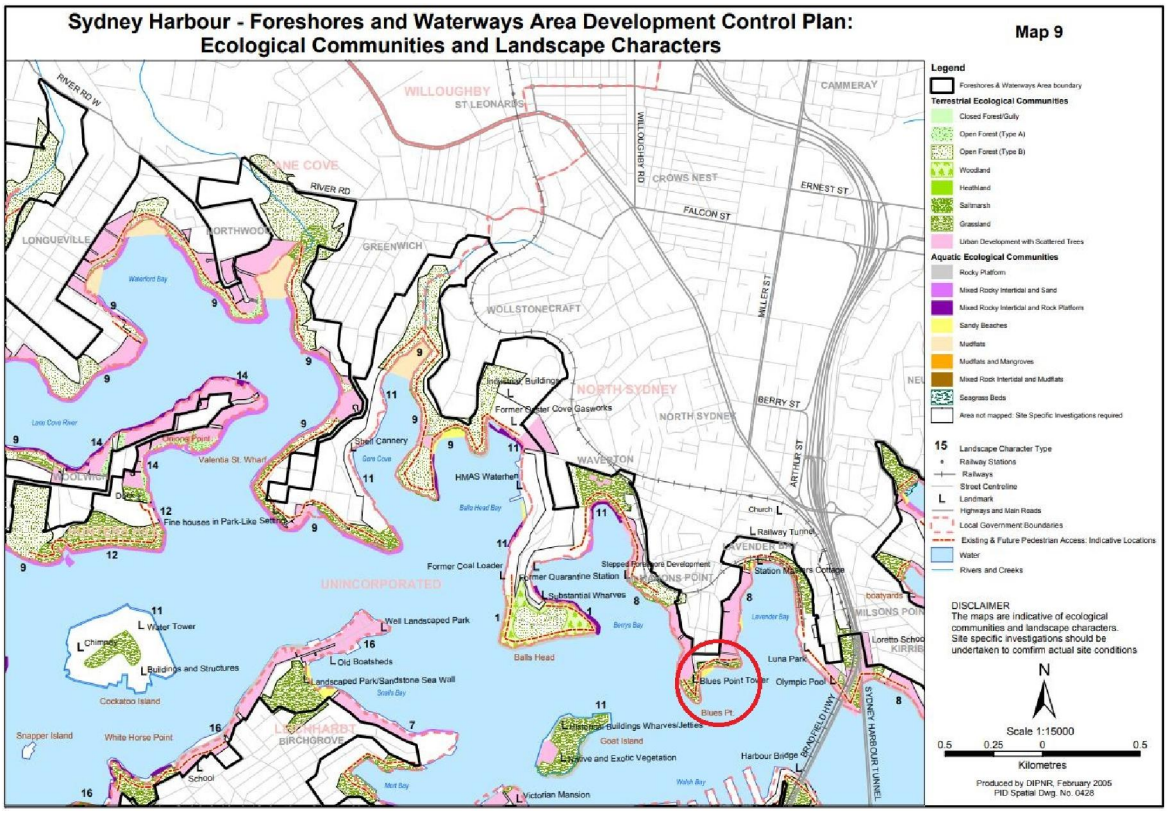


Figure 3.4. Sydney Harbour Foreshore and Waterways Area Development and Control Plan: Ecological Communities and Landscape Characters Map 9

No critical habitat for the Little Penguin endangered population (Little Manly; Figure 3.5) or Grey Nurse Shark (Figure 3.6) occurs within a 5 km radius of the subject site.

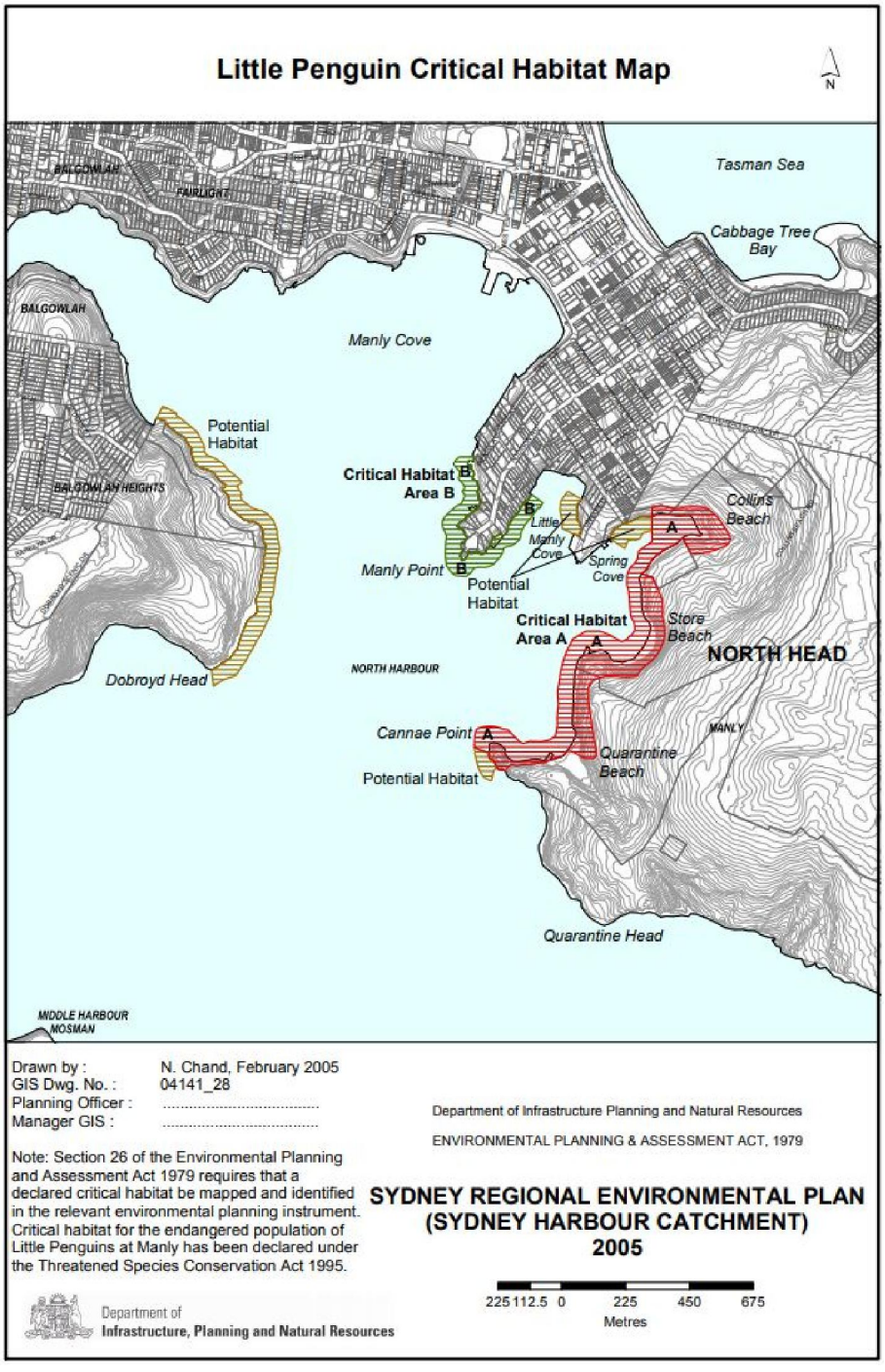


Figure 3.5. Little Penguin critical habitat map. Source: DIPNR.

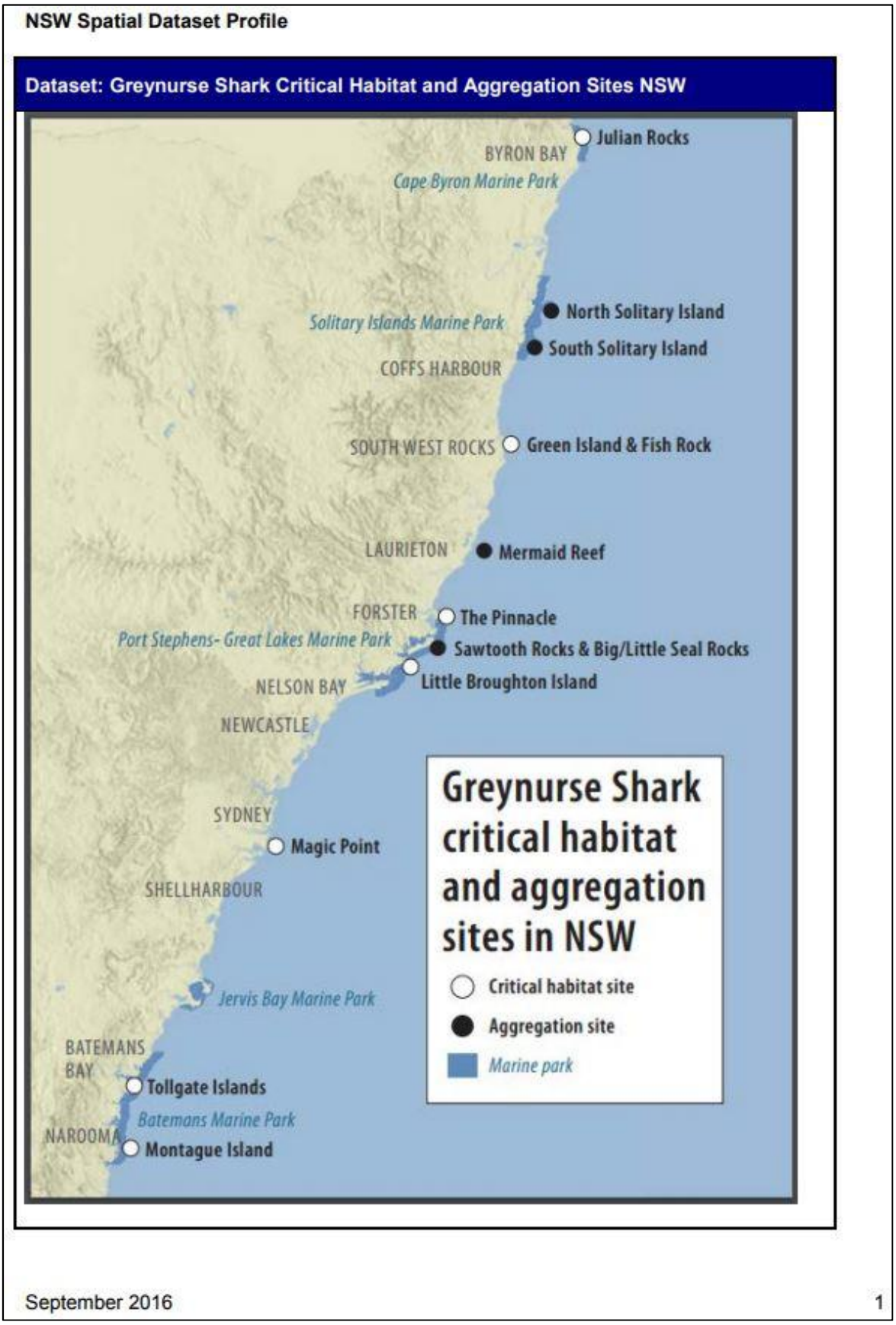


Figure 3.6. Grey Nurse Shark critical habitat and aggregation sites in NSW (2016). Source: NSW DPI.

3.2 Aquatic survey of the study area

The results of field surveys are detailed by tidal areas and describe aquatic fauna and vegetation found during the site inspection.

Information collected in the field was merged into a Geographic Information System (GIS). Habitat maps were produced based on the field data and georeferenced aerial photographs (NSW Government – Spatial services 2017).

3.2.1 Intertidal area

An artificial sandstone seawall extended along the entire length of the foreshore within the survey area (Figure 3.7). The intertidal zone consisted of the seawall, boulders found at the base of the pier south of the survey area and on the sandy beach covering most of this zone (Figure 3.7).

3.2.2 Subtidal area

Seaward from the shore the bottom sloped gradually, with maximum depth 8 m found at the end of the transects and 12 m at the deepest mooring.

The subtidal area was characterised by six successive different habitats in a seaward direction and increasing depth as shown in the habitat map (Figure 3.9):

- Bare fine sand in continuity with the beach;
- Shallow seagrass beds extending from just below the low tide mark up to 24 m from the shore (1.8 m depth in the subject site) (Figures 3.10 – 3.13);
- Boulders in the southern part of the survey area, up to 5 m from the pier (Figure 3.14);
- Fine sand with sparse seagrass (low percentage cover ~1 %) and scattered macroalgae (<5-10% cover) (Figures 3.15 and 3.16);
- Rubble with scattered boulders and debris colonised by marine vegetation, up to the 5 m depth mark (Figure 3.17);
- Fine sand and silts with sparse scattered boulders and debris colonised by marine vegetation found in the deepest sections of the survey area, including around the moorings (5 to 12 m depth) (Figure 3.18).

Various jetsam debris, such as tyres, beams, piping, bottles, as well as old mooring blocks were found scattered on the bottom. These hard structures provided substratum for marine vegetation (Kelp and *Sargassum* sp.) and fauna (sponges, ascidians and encrusting macrobenthos).

3.2.3 Vegetation

<u>Seagrasses</u>

Two species of seagrass were found in the survey area; Eelgrass *Zostera capricorni* and Paddleweed *Halophila* sp.. The location and extent of seagrasses are shown in Figure 3.9. A dense seagrass bed was found parallel to the shore in the shallow area (up to 1.5 m depth). This bed was composed mainly of *Zostera capricorni* (60 to 70% cover, average leaf length 20 cm) and sparse *Halophila* sp. (10 to 20% cover, average leaf length 8 cm) (Figures 3.10 and 3.11). The epiphyte loading was very low (<10%). The dense seagrass covered an area estimated at 485 m^2 within the survey area. The dense seagrass area was surrounded by a mixed bed of *Halophila* sp. (30 to 60% cover shore side and 5 to 20% seaside) and *Zostera capricorni* (5 to 20 % cover) (Figures 3.12 and 3.13). The total area of these seagrass beds (i.e. dense Zostera/mixed bed) was estimated at around 791 m^2. From the site inspection, the seagrass bed present in the survey area is likely to play a major role in retaining and stabilising the intertidal sand (beach). Seaward of the main bed, sparse *Zostera capricorni* (1% cover) was found in the form of isolated strands up to 4 m depth and sparse

Halophila sp. (<5% cover) was present either in clumps of 1 to 2m^2 or in isolated strands (Figures 3.15 and 3.16).

Macroalgae

The macroalgae Red Coralline Algae (*Corallina* sp. turfing form, up to 40% cover) was found at the base of the seawall (pier side) and on the shallow boulders (Figure 3.14). Several species of brown macroalgae were present in the survey area, growing on the shallow boulders and scattered hard substratum (boulders, mooring blocks and various debris). The main species were *Ecklonia radiata* (Kelp; 5 to 30% cover), *Sargassum* sp. (5 to 10%), *Padina* sp. (<5% cover, also found in the seagrass beds) and *Dictyota* sp. (1% cover) (Figures 3.14, 3.17, 3.18 and 3.21).

The green algae *Caulerpa filiformis* was present at shallow depths (up to 3 m depth) scattered between the rocky boulders and within or at the edges of the seagrass beds (<5% cover). *Caulerpa filiformis* was present in isolated stolons or small clumps of less than 0.5m^2. *Caulerpa filiformis* is considered native in NSW.

The noxious algae *Caulerpa taxifolia* was not found in the survey area.

3.2.4 Wetlands

Although the subject site is within a designated Wetlands Protection Area (Wetlands Protection Area Map 11 under the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005, Figure 3.3), no wetlands were identified during the field survey.

3.2.5 Fauna

The hard substratum intertidal area and start of the subtidal area (seawall and boulders) was colonised by Sydney rock oysters (*Saccostrea glomerata*), barnacles, including the Honeycomb barnacle *Chamaesipho tasmanica*, and various gastropods such as the limpet *Cellana tramocerica* and sea snails *Austrococchlea porcata, Nerita atramentosa* and *Bembicium nanum* (Figures 3.7 and 3.8). Cunjevoi (*Pyura stolonifera)* was found on the seawall and boulders in the lower part of the intertidal zone (Figure 3.8). No fauna were found in the middle area of the arch formed by the seawall, probably due to the high energy in the area (wash generated by boat traffic and associated sand movements) (Figure 3.7).

Sessile fauna including various sponges, ascidians and bryozoans were found on the hard substratum (moorings and various debris) (Figures 3.19 and 3.20).

In terms of ichthyofauna, yellowfin bream (*Acanthopagrus australis*), luderick (*Girella tricuspidata*) dusky flathead (*Platycephalus fuscus*), fan-bellied leather jacket (*Monacanthus chinensis*) were observed in the survey area. The first three species are of commercial and recreational fishing interest.

One individual pipefish (Tiger Pipefish *Filicampus tigris*) was recorded along transect 2, approximately 44 m from the seawall (Figures 3.9 and 3.21). No further Syngnathiformes were found on the moorings or in the immediate vicinity during the field survey. All seahorses, pipefish, pipehorses and seadragons are listed as protected under the Fisheries Management Act.

3.2.6 Key fish habitats

Three key fish habitats were identified in the survey area (following the DPI Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (Fairfull 2013):

- Type 1 “Highly sensitive key fish habitat”: seagrass beds (high and low density);
- Type 2 “Moderately sensitive key fish habitat”: areas where seagrasses are sparse and the macroalgae *Ecklonia radiata* and *Sargassum* sp. are present;
- Type 3 “Minimally sensitive key fish habitat”: unvegetated sand.

Figure 3.22 summarises the location and extent of the three key fish habitats found in the survey area.

Figure 3.7. Seawall extending along the foreshore

Figure 3.8. Sydney rock oysters, barnacles and various gastropods found on the seawall

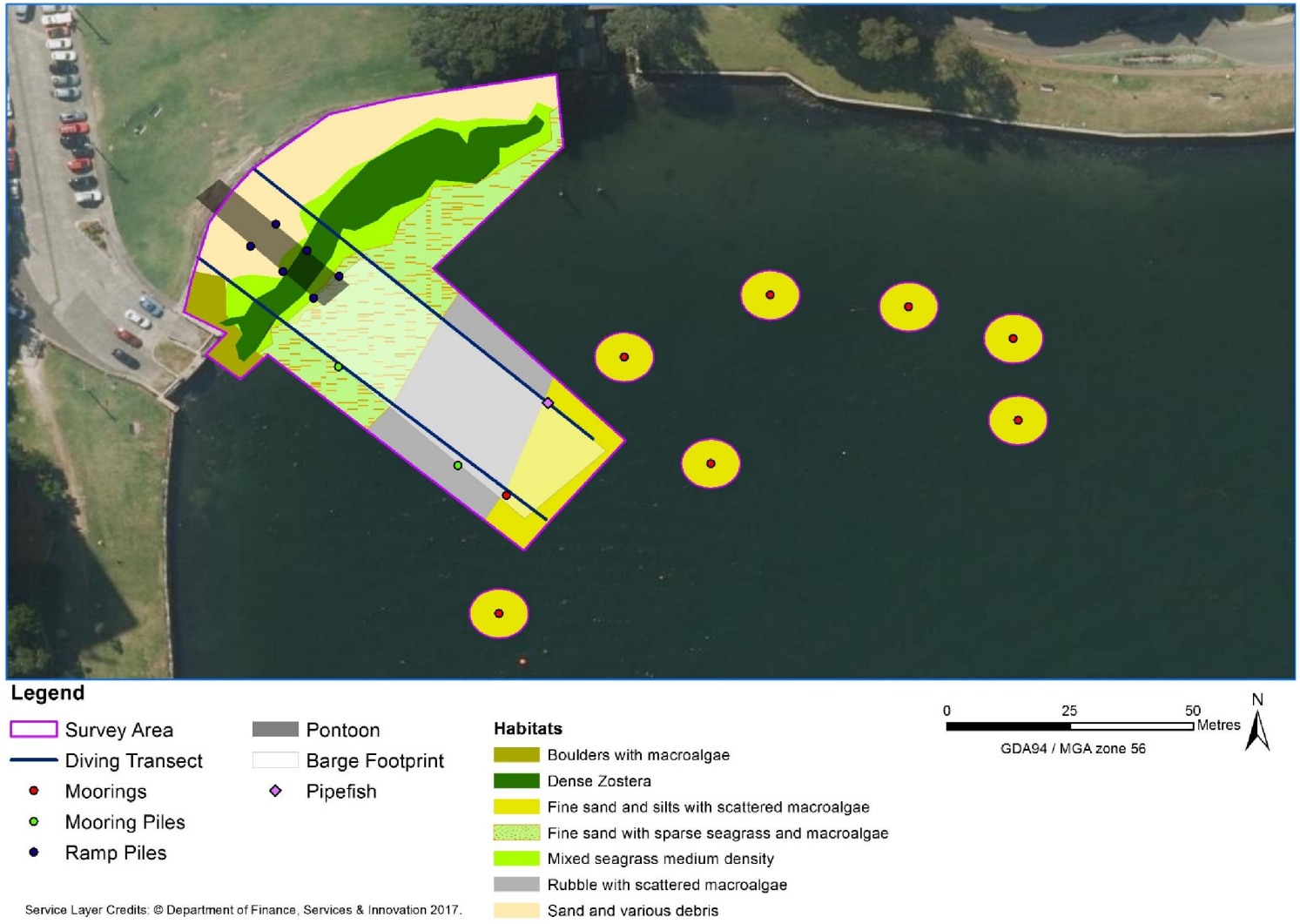


Figure 3.9. Map of the main habitats present in the survey area

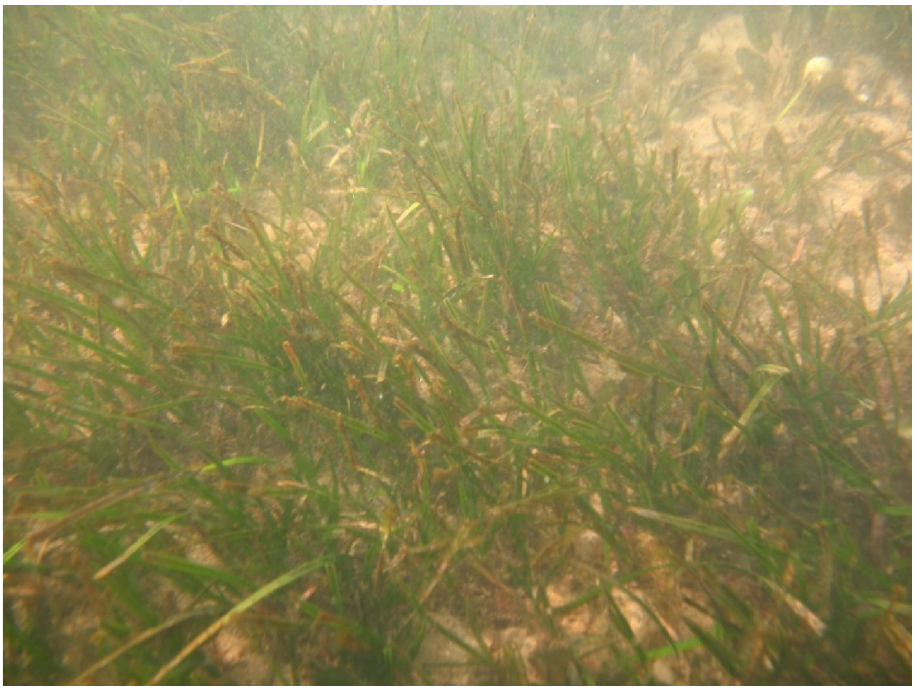


Figure 3.10. Shallow seagrass bed (dense *Zostera capricorni*)

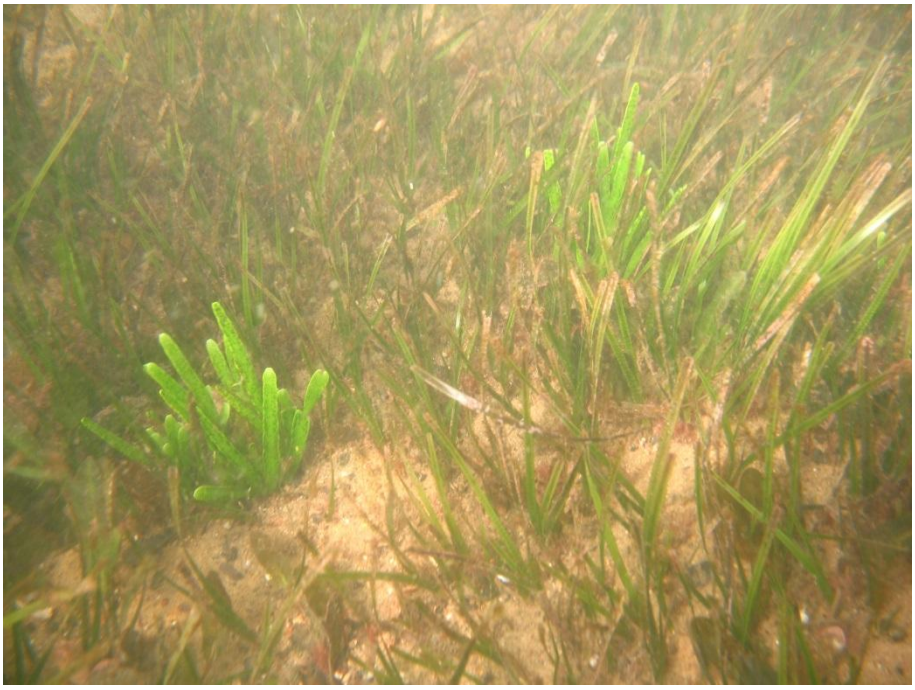


Figure 3.11. Dense shallow *Zostera capricorni* bed. The native macroalgae *Caulerpa filiformis* was also present in the survey area

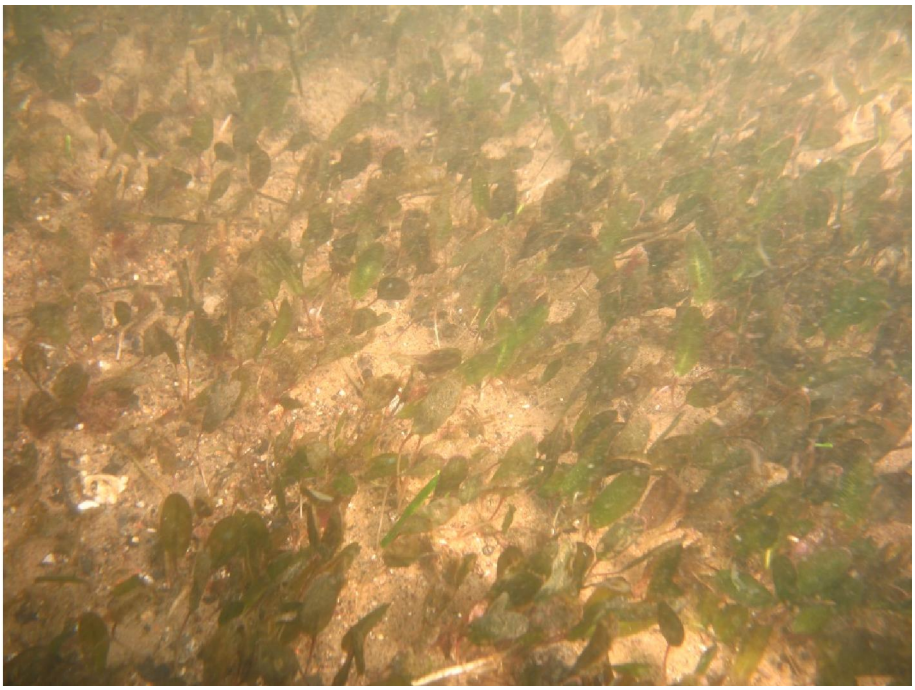


Figure 3.12. Mixed bed of *Halophila* sp. and *Zostera capricorni* (shallow side, close to the shore)

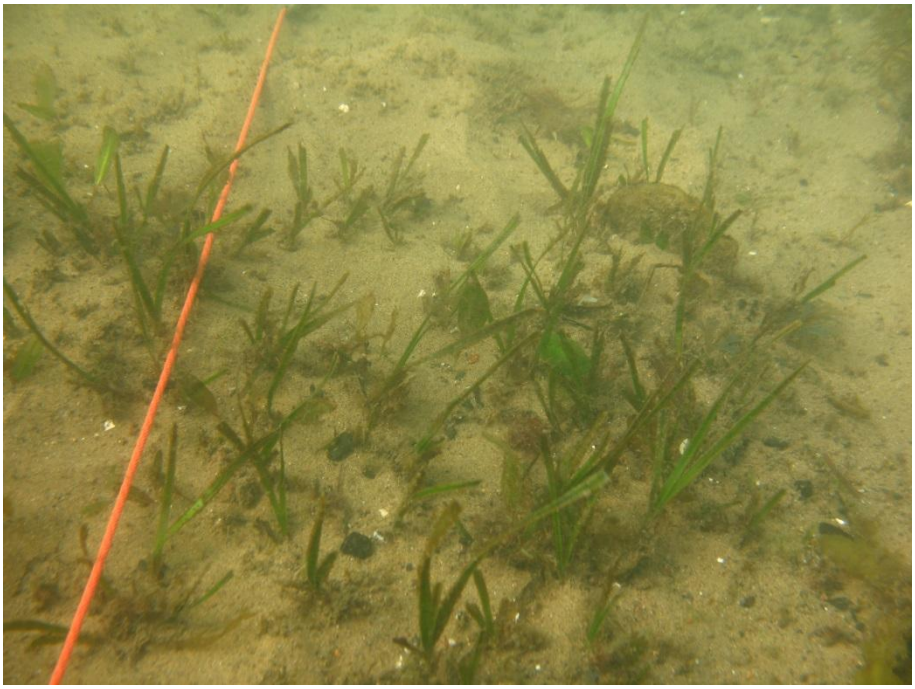


Figure 3.13. Low density mixed bed of *Halophila* sp. and *Zostera capricorni* (low percentage cover, deep side away from the shore). Note the presence of a razor clam *Pinna* sp..

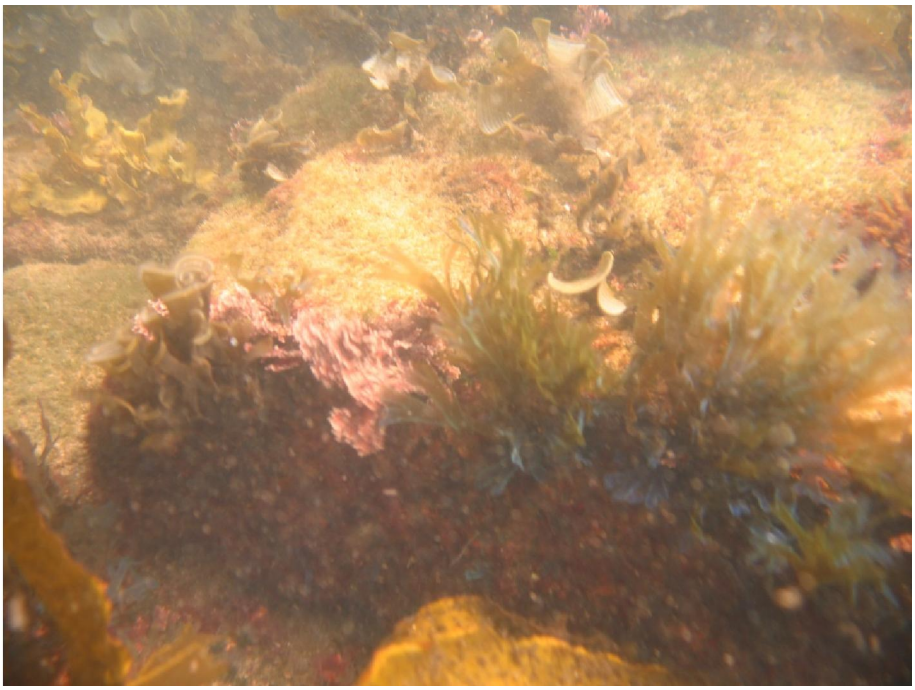


Figure 3.14. Shallow subtidal rocky boulders colonised by the macroalgae *Corallina* sp., *Padina* sp., *Dictyota* sp. and *Ecklonia radiata*

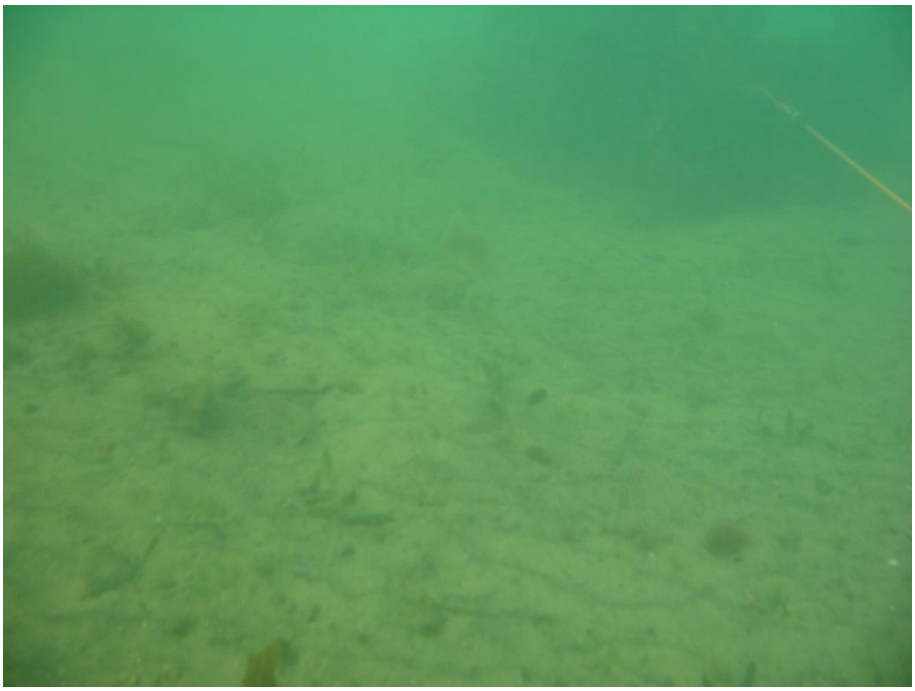


Figure 3.15. Fine sand with sparse seagrass and scattered macroalgae

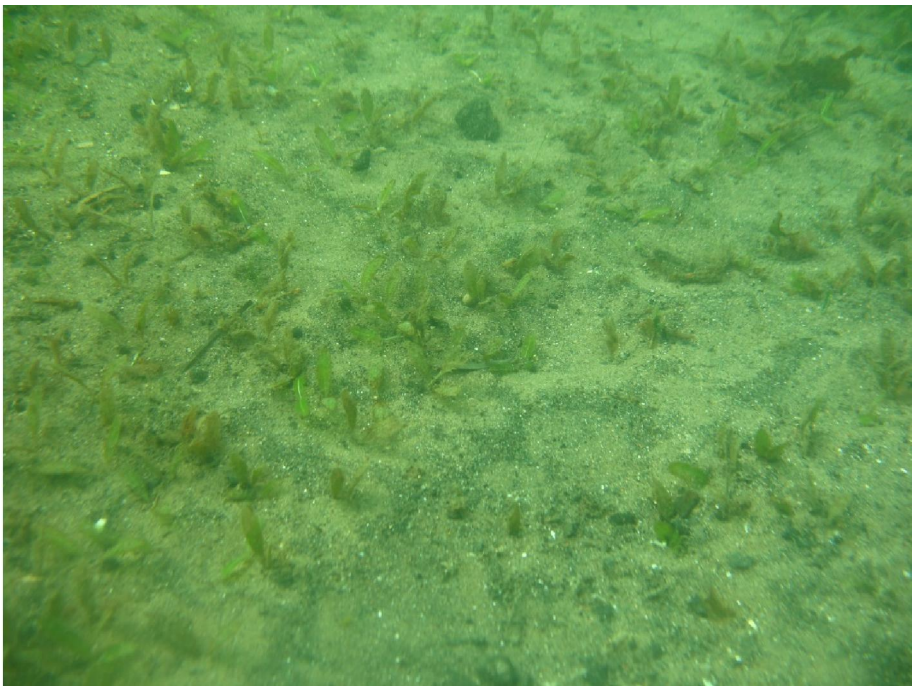


Figure 3.16. Clump of *Halophila* sp. found on fine sand

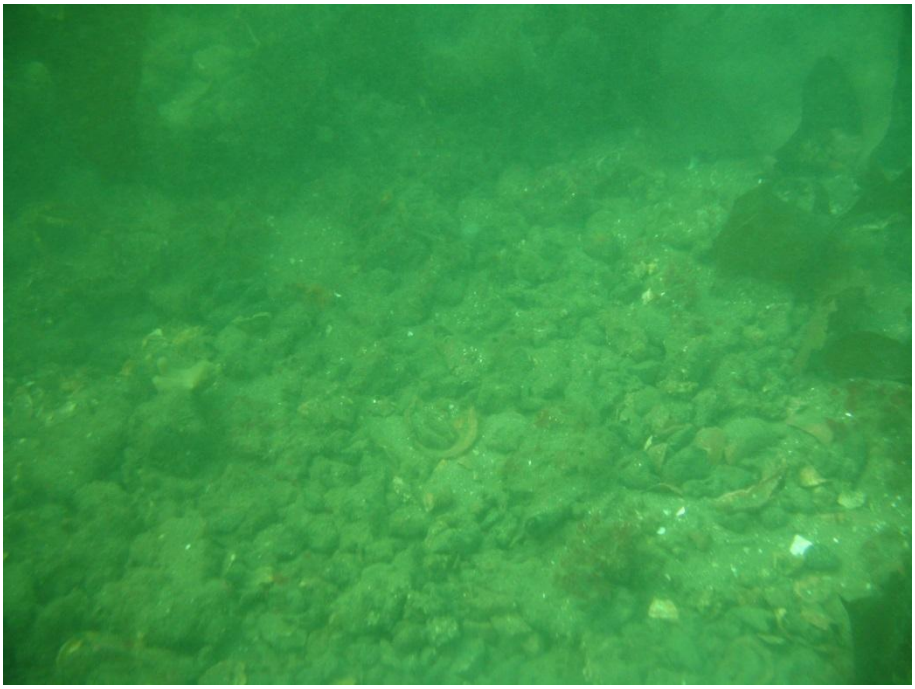


Figure 3.17. Rubble with sparse macroalgae

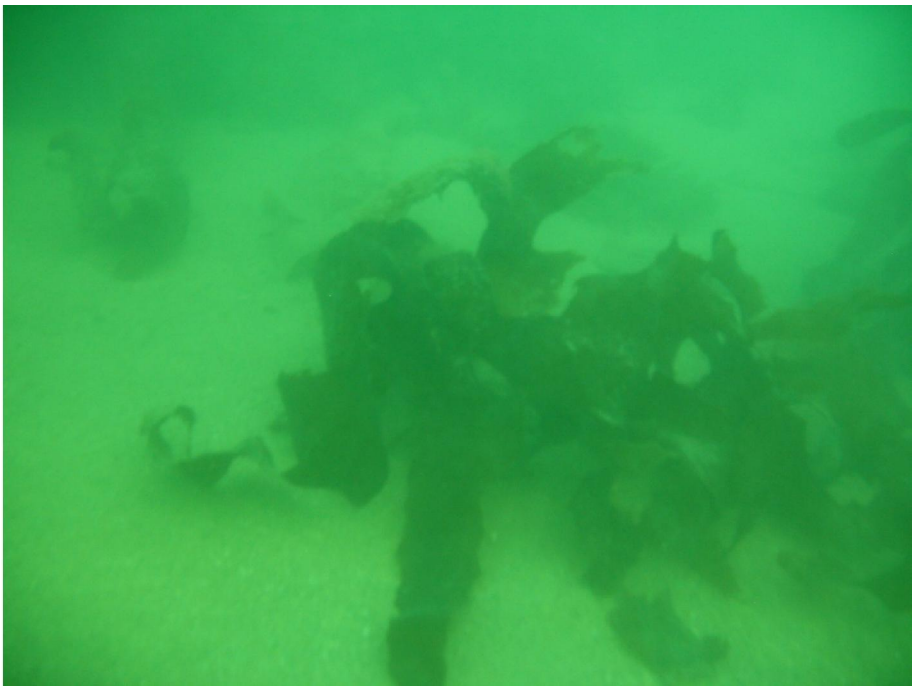


Figure 3.18. Fine sand and silts with sparse macroalgae (*Ecklonia radiata*)

Figure 3.19. Barnacles and encrusting fauna on mooring block

Figure 3.20. Ascidians, barnacles and mussels found on one of the mooring lines

Figure 3.21. Pipefish (Tiger pipefish *Filicampus tigris*) found along transect 2 amongst the brown macroalgae *Sargassum* sp. and *Dictyota* sp.

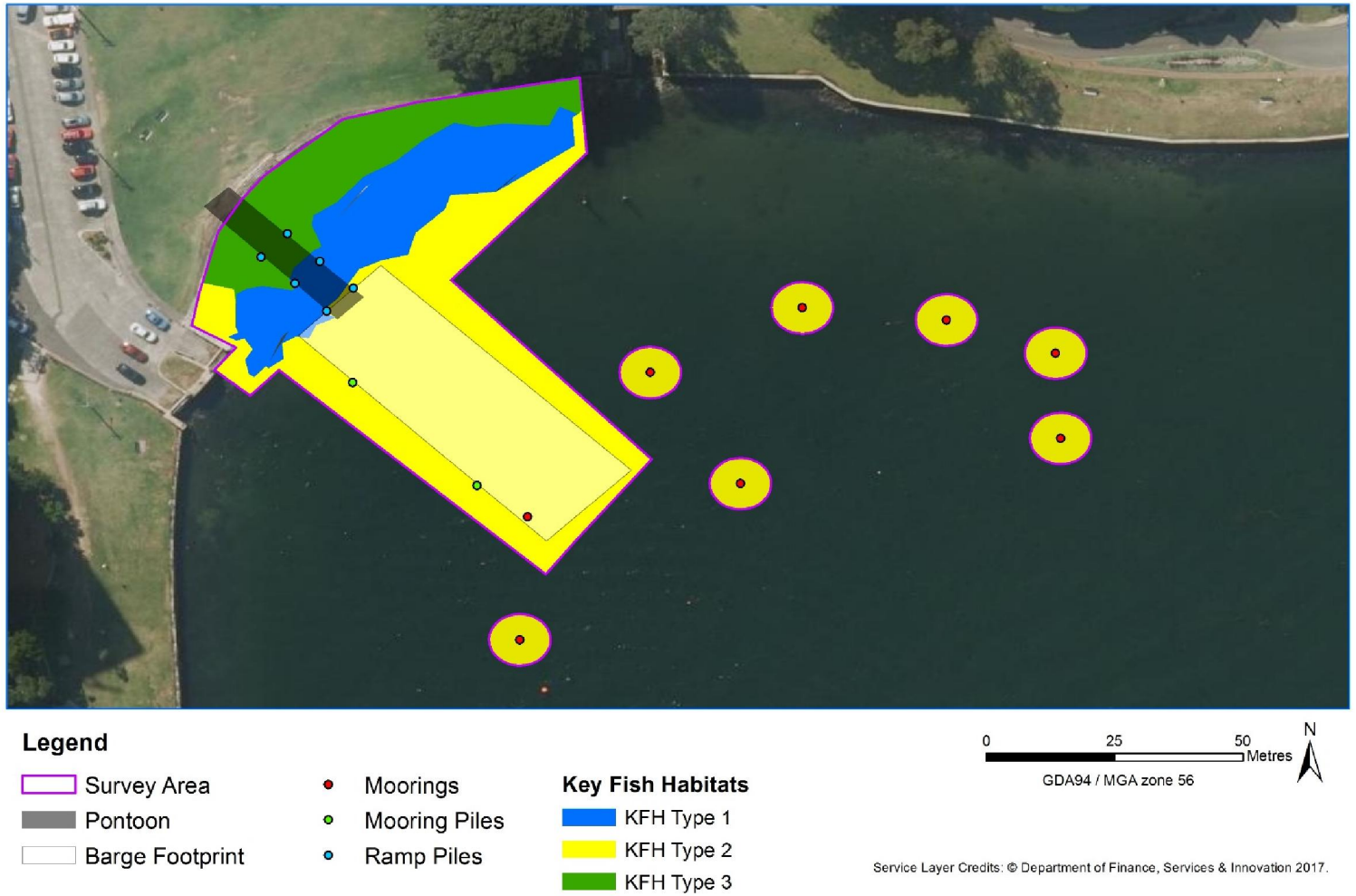


Figure 3.22. Location and extension of the three key fish habitats found in the survey area

3.3 Presence or likelihood of occurrence of threatened, migratory or protected species, populations and ecological communities

Appendix A provides a list of threatened species, populations and ecological communities under the EPBC Act, BC Act and FM Act that occur or are likely to occur in the study area and the likelihood of impact.

3.3.1 Vegetation (wetland and marine)

A continuous seagrass bed of 791 m^2 composed principally of *Zostera capricorni* and *Halophila* sp. was found in the survey area, including under the footprint of the proposed installations and activities. This seagrass bed was previously mapped as Zostera by NSW DPI (Creese et *al. 2009*) and re-mapped in more detail for this assessment. The potential impacts (direct and indirect) on marine vegetation are considered in Section 4.

No threatened seagrass *Posidonia australis* has previously been mapped in the survey area and none was observed during the survey.

No wetlands were identified in the survey area. No mangrove or saltmarsh were present in the survey area.

3.3.2 Ichthyofauna

Threatened species of fish that are unlikely to be present within the subject site and/or be affected by the proposal include: the Macquarie Perch, which is a freshwater species; the Australian Grayling, which has never been recorded in the catchment; and the Black Rockcod (*Epinephelus daemelii*), which is unlikely to utilise the study area due to lack of suitable habitats (caves and crevices).

Threatened sharks and rays might opportunistically venture in this part of the estuary (e.g. occasional visit and foraging); however, the study area offers relatively poor habitats for these species. In addition, the heavy boat traffic and underwater noise in this section of the river might deter large fauna to use this area.

One individual Pipefish (Syngnathiformes) was found in the survey area. Syngnathiformes are known to be present in the vicinity, with up to 16 species recorded in Sydney Harbour and its tributaries (source: Australian Museum – Fishes of Sydney Harbour - 11 April 2018 update). The study area encompasses suitable habitats for Syngnathiformes and the potential impacts on Syngnathiformes are considered in Section 4.

3.3.3 Other fauna

Threatened marine mammals (seals, whales, dolphins) are known to occur in Sydney Harbour and nearby coastal areas. These species are recorded mostly east of the Harbour Bridge but may occasionally pass through and visit the study area. Sydney Harbour and tributaries do not offer suitable habitat for dugongs.

These species would occur only very occasionally within the survey area and the heavy boat traffic and underwater noise occurring in this section of the river may deter marine mammals from use of this area.

Threatened marine turtles are occasionally present in the harbour and may occasionally venture into the study area or explore the greater area, but the proposal site offers very little suitable habitats to support marine turtles.

3.3.4 Key threatening processes

No Key threatening processes listed under the Fisheries Management Act were identified associated with the proposal and related activities.

4 Impact Assessment and Mitigation

The proposal consists of installation, operation and decommissioning of a temporary barging facility at Blues Point as described in Section 1.4.

4.1 Construction and Decommission Impacts and Mitigation

4.1.1 Ramp and wharf installation and decommissioning

Potential impacts include:

- During construction of the proposed barging facility and in particular piling is likely to disturb the seafloor sediment;
- Direct mooring and/or piling on seagrass beds and other marine vegetation. Based on the design drawings and the habitat mapping, some piles supporting the ramps are to be located at the edge and inside the main seagrass beds. The barge mooring piles are to be situated in soft sediments (sand/ silt) with sparse seagrasses and scattered macroalgae;
- Temporary increase in the turbidity of the water, which can reduce light availability for seagrass and macroalgae and affect sessile invertebrates. The seafloor is soft sediment however the risk of prolonged increased levels of turbidity during piling activities is low;
- Sedimentation in areas of seagrass beds causing smothering of this habitat;
- Mobilisation of contaminated sediments including Acid Sulfate Soils (ASS). The survey area is listed as high probability of occurrence of acid sulfate soils. The movement of sediments is likely to be confined to surrounding waters, which are likely to have the same levels of contaminants as the disturbed area;
- Noise (fish, marine mammals). Fish (and mammals if present) may avoid the area during the piling works as a result of habitat disturbances and underwater noise. This impact would be temporary and minor as the more mobile fish species have the ability to avoid the area and use adjacent habitats to the construction site;
- The use of construction boats, barges and underwater equipment may increase the risk of the establishment of non-indigenous species including invasive species such as the pest *Caulerpa taxifolia*, especially if these boats have worked or are moored in infested areas.

Mitigation

The following mitigation measures are proposed:

1. Relevant Department of Primary Industries Controlled Activity Guidelines would be considered in designing, constructing and decommissioning the works.
2. No anchors or mooring lines should be placed on or over the seagrass beds;
3. Ropes and mooring anchor lines should be placed so that they do not drag across the bottom;

4. Anchoring of work vessels at Caulerpa taxifolia infested sites is to be avoided where practicable, and If not, propellers and anchors will need to be inspected and if required thoroughly cleaned prior to entering the work site and any Caulerpa pieces disposed properly (bagged and binned). Procedures would be developed and implemented, in accordance with the National System for the Prevention and Management of Marine Pest Incursions and the NSW Control Plan for the Noxious Marine Algae Caulerpa Taxifolia (I&I NSW, 2009), during the works to avoid transportation of marine pests from other locations.
5. All in-water activities associated with piling should be scheduled to coincide with favourable hydrodynamic conditions where practicable to ensure that sediment re-suspension and dispersion is minimised, e.g. calm conditions and minimal tidal fluctuation;
6. Disturbance should be confined to as small an area as practicable;
7. Floating booms, silt curtains or screens should be used during piling to minimise the mobilisation of sediments and the spread of suspended sediments. Details of mitigation are to be document in a site-specific Erosion and Sediment Control Plan.

4.1.2 Syngnathids

As noted in Section 3.3.2, one individual Pipefish (Syngnathiformes) was found in the survey area. Syngnathiformes are known to be present in the vicinity, with up to 16 species recorded in Sydney Harbour and its tributaries. Potential impacts during construction include:

- Syngnathids at the site of piling operations may be harmed. Less mobile species have an increased risk of being impacted by decommissioning the installations. These include seahorses which could potentially be associated with the piles supporting the ramp and barge mooring piles. The removal of piles and associated biota has the potential to injure or kill Syngnathids;
- Loss of habitat (seagrass and macroalgae).

Mitigation

8. Pre-construction and pre-decommissioning ecological survey dives are to be undertaken within one month prior to the commencement of piling and pile decommissioning respectively to confirm the presence or otherwise of Syngnathids (pipefish and seahorses). If the survey dive confirms the presence of Syngnathids (pipefish and seahorses) where direct impacts associated with piling are to occur the need for relocation shall be considered and determined by AMBS in consultation with BIO-ANALYSIS. If relocation is considered necessary, this would be undertaken using divers with DPI Fisheries Scientific Collection Permit.

4.2 Operational Impacts and Mitigation

As noted in Section 1.4, barge operations would occur between approximately the third quarter 2018 and early 2020. Barging operations during this period would be 24 hours per day, 7 days per week with most likely only one barge movement per day. Barges will be docked at Blues Point for up to 2 days at a time and approximately 55 barge arrivals would be required to transport spoil and Tunnel Boring Machine (TBM) components (compared to the 4 barge movements assessed in the SPIR). The size of the temporary ramp structure is limited and barge arrivals are timed to coincide with spoil removal for shaft excavation (approximately 35 barges over approximately a

three-month period) and TBM component retrieval (approximately 20 barges over approximately six months from the third quarter of 2019 to first quarter of 2020). Barges to be utilised would be 55 metres long (2000 tonne) and manoeuvred with two tugs, which are commonly used in Sydney Harbour.

The proposal would directly and indirectly impact seagrasses and macroalgae, however, as the Project is approved State Significant Infrastructure, in accordance with Clause 5.23 (1) (b) of the Environmental Planning and Assessment Act a permit under Section 205 of the Fisheries Management Act is not required.

4.2.1 Direct impact by shading

Potential impacts include:

- Loss of seagrass in the immediate vicinity of piles
- Direct impacts from the ramp and the barge as a result of shading marine vegetation.

Table 2. Direct shading impacts to key fish habitat associated with the ramp and barge

		Footprint (m^2)	
Habitat	**Key Fish Habitat Type**	**Ramp**	**Barge**
Dense Seagrass	1	30	0
Medium-low density seagrass	1	22	7
Fine sand with sparse seagrass and macroalgae	2	17	403
Rocky rubble with scattered macroalgae	2	0	489
Bare sand	1	83	0

The areas of habitat overlapping with the proposed barging installations in Table 2 provide an indicative area of impact due to shading (i.e. top view). Shading may affect a larger area as the incidence of the sun is non-vertical (partial shading). It is important to note that the extent of pile installation is limited and the ramp and wharf structure is limited in size and that the shading from barges would be intermittent and not experienced for the entire duration of the operations. Once the works are completed, the Zostera should return once the intermittent shading impacts of the barge are complete, assuming that no erosion or major changes in local hydrodynamism occurred during this time.

4.2.2 Local change to hydrodynamics

Potential impacts include:

- Erosion/accumulation of sediments around the new piles, close to seagrass. Seagrasses could be affected by this local change as due to scouring of sediments;
- Although this area is already under great hydrodynamic pressure with ferry and boat traffic causing wash and noise.

Mitigation

9. If practicable, move the two seaward piles of the ramp further away from the existing seagrass bed. A buffer of 3 m from the dense seagrass could decrease the chance of impact due to changes in local hydrodynamics and smothering.

4.2.3 Run off, siltation accidental spills of equipment or excavated material

Potential impacts include:

- Works which cause runoff from the shore;
- Accidental spills. The use of construction boats, barges as well as shore-based plant and machinery are all potential sources of pollution as a result of accidental spills;
- Fine silt/clay etc from onshore facilities could increase turbidity;
- Accidental dumping of excavated material on seagrass.

Mitigation

10. Implement site specific Erosion and Sediment Control Plan for on-shore activities, including installation controls in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Managing Urban Stormwater: Soils and Construction Volume 2 (Department of Environment and Climate Change, 2008a);
11. The worksite would be kept tidy and all litter promptly removed to minimise the potential for waste to be blown into the water;
12. No fuels, oils and other potentially harmful substances should be stored on the foreshore fuels, oils and other potentially harmful substances would be stored when not in use in a bund sized to be at least 110% of the largest container to be stored;
13. A site-specific Spill Management Procedure would be developed and implemented. It would identify spill management equipment to be kept onsite and procedures to be implemented in the event of a spill;
14. Water quality monitoring around the worksite would be undertaken during piling and pile decommissioning at a frequency of at least two samples per fortnight.

4.3 Assessments of Significance/Consistency with relevant legislation and planning instruments

The proposal has been assessed under relevant biodiversity and threatened species legislation (where relevant to the marine environment) and planning instruments.

Based on the background study and the site inspection, no threatened species assessments of significance are required.

4.3.1 Commonwealth

EPBC Act

The EPBC Act provides for the assessment of impacts on matters of national environmental significance (MNES). MNES that are relevant to this study include nationally threatened species and ecological communities and migratory species. There are no wetlands of international importance in or near the study area; impacts on world heritage properties and national heritage places are not within the scope of this assessment; there are no likely impacts on the Great Barrier Reef Marine Park; the proposed action is not a nuclear action; and the proposed action is not a coal seam gas development or a large coal mining development.

A proponent must not take an action that has, will have or is likely to have a significant impact on a matters of environmental significance without approval from the Australian Government Minister for the Environment and Energy (the Minister). The Australian Government has released guidelines for the purpose of determining whether or not a proposed action will have a significant impact; these include the *Matters of National Environmental Significance - Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999* and, in some cases, additional guidelines for specific species or communities. If a significant impact on an MNES is considered likely, the proponent must refer the project to the Department.

Potential impacts of the proposal on flora and fauna are assessed in this assessment. Subject to the implementation of the mitigation measures set out in this report, the proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act.

4.3.2 New South Wales

Threatened Species Conservation Act and the Biodiversity Conservation Act

The primary mechanism for biodiversity protection and planning in NSW is now the Biodiversity Conservation (BC) Act, although a number of transitional arrangements are currently in place in relation to the now repealed *Threatened Species Conservation Act 1995* (TSC Act). Clause 30 of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* states that "The new Act applies to the modification of a planning approval even if the planning approval was granted before the commencement of the new Act (unless the application for the modification of the planning approval is a pending or interim planning application)." However a consistency assessment process is being undertaken to confirm that changes including the Blues Point wharf relocation are consistent with the Project Planning Approval and therefore that modification is not required. The Biodiversity Conservation Act 2016, which came into force in 2017 following the granting of the Project Planning Approval under the then Section 115ZB of the EP&A Act on 9 January 2017 therefore does not apply to the Blues Point consistency assessment process which must address the TSC Act. Notwithstanding, the BC Act has been considered alongside the TSC Act during the preparation of this assessment (for the purposes of informing the scope of the assessment).

The TSC Act aims to conserve biological diversity and promote ecologically sustainable development, prevent extinction and promote recovery of threatened species, populations and ecological communities, protect critical habitat, encourage the conservation of threatened species, populations and ecological communities and ensure the impact of any action affecting threatened species populations or ecological communities is properly assessed. The proposal would not significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the TSC Act and the preparation of a Species Impact Statement is not required.

Under the BC Act it is an offence to harm protected species or damage the habitat of a threatened species or threatened ecological community. It is a defence to a prosecution if the act was

necessary for the carrying out of State Significant Infrastructure approved under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

It is understood by AMBS that the proposed development will be assessed as part of a consistency assessment prepared in relation to the existing planning approval, which is an approval for State Significant Infrastructure (SSI-4700) granted on 9 January 2017 under Part 5.1 of the EP&A Act. Under the BC Act, applications for approval under Part 5.1 are to be accompanied by a biodiversity development assessment report unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values.

The BC Act also provides for the application of the Biodiversity Offsets Scheme in relation to proposed development above prescribed thresholds or clearing of native vegetation not authorised without approval, and for the determination of "serious and irreversible impacts" on biodiversity values. The Biodiversity Offsets Scheme applies to State Significant Infrastructure projects. The Offset Scheme thresholds include:

- Area criteria. The minimum threshold for clearing is 0.25 ha or more; it is understood by AMBS that the proposed development involves clearing of less than 0.25 ha.
- Biodiversity Values Map. The threshold is clearing of land identified as high conservation value. The site is not located on land identified as high conservation value on the Biodiversity Values Map.

For proposals that do not trigger the thresholds, a "test of significance" is required for threatened species or ecological communities, or their habitats. Development or an activity is "likely to significantly affect threatened species" if:

- (a) it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in section 7.3 of the Act (the "5-part test"), or
- (b) the development exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity values, or
- (c) it is carried out in a declared area of outstanding biodiversity value.

In relation to the above:

- (a) where relevant, impacts on threatened species or ecological communities, or their habitats, are assessed in this study according to the test in section 7.3 of the Act (the "5-part test");
- (b) the proposed development does not exceed the thresholds;
- (c) the site is not a declared area of outstanding biodiversity value.

The BC Act also provides for the assessment of "prescribed impacts" as set out in Section 6.1 of the Regulations. Prescribed impacts include "the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development)".

This assessment has concluded that the proposal would not have a significant impact on threatened species and does not exceed the other thresholds that would trigger the Biodiversity Offsets Scheme.

Fisheries Management Act (FM Act)

The FM Act aims 'to conserve, develop and share the fishery resources of the State for the benefit of present and future generations' and, in particular, to:

- Conserve fish stocks and key fish habitats;
- Conserve threatened species, populations and ecological communities of fish and marine vegetation;
- Promote ecologically sustainable development, including the conservation of biological diversity, and, consistently with those objectives;
- Promote viable commercial fishing and aquaculture industries;
- Promote quality recreational fishing opportunities;
- Appropriately share fisheries resources between the users of those resources; and
- Provide social and economic benefits for the wider community of New South Wales.

To meet these objectives, Part 7 of the FM Act outlines legislative provisions to protect fish habitat and Part 7A outlines provisions to conserve threatened species of fish and marine vegetation and their habitat. Under Part 7 of the Act, a person must not harm marine vegetation (e.g. mangroves, seagrasses, macroalgae or any other marine vegetation as declared in the Act). As the Project is approved State Significant Infrastructure, in accordance with Clause 5.23 (1) (b) of the Environmental Planning and Assessment Act a permit under Section 205 of the Fisheries Management Act is not required. Mitigation measures to minimise impacts are set out in this report.

Under the FM Act, fish means "marine, estuarine or freshwater fish or other aquatic animal life at any stage of their life history (whether alive or dead)" and includes oysters and other aquatic molluscs, crustaceans, echinoderms and beachworms and other aquatic polychaetes. The definition also includes any part of a fish, but does not include whales, other mammals, reptiles, birds, amphibians or other things excluded from the definition by the regulations.

Under Section 37, it is prohibited to possess, collect or harvest any species of Syngnathiformes in NSW without a collection permit issued by NSW DPI (i.e. seahorses, seadragons, pipefish, pipehorses, ghostpipefish and seamoths). As an individual Pipefish (Syngnathiformes) had been found in the survey area, pre-clearance surveys for Syngnathiformes and relocation if considered necessary are recommended prior to piling and pile decommissioning works. Relocation would need to be undertaken prior to the works. Under the Section 37 of the FM Act, relocation of Sygnathiformes requires a permit from NSW DPI. Any relocation would be undertaken using divers with DPI Fisheries Scientific Collection Permit.

Temporary direct shading would affect 59 m^2 of seagrass bed dominated by *Zostera capricorni* (Key fish Habitat type 1). Key Fish Habitat Type 2 would be mostly affected by the shading effect of the barge (Table 2). Mitigation and offset measures are discussed in Section 4.2.

One species of Syngnathid (pipefish) was found during the site survey and others from this family are likely to occur in the area. Mitigation measures are recommended in Sections 4.1-4.3.

Coastal Management Act 2016

The Coastal Management Act 2016 reflects the natural, social, cultural and economic values of NSW coastal areas and promotes the principles of ecologically sustainable development in managing these values. The Coastal Management Act 2016 divides the coastal zone into four coastal management areas, defined by the unique features of different local areas. Application of

the Coastal Management Act is of limited relevance in this instance as the installations will be temporary. See Section 4.3.4.

Water Management Act 2000

The subject site is located within 40 metres of the Parramatta River, which constitutes "waterfront land" under the Water Management Act 2000 (WM Act). Section 91E(1) of the WM Act states that it is an offence to carry out a controlled activity in, on or under waterfront land:

- Without holding a controlled activity approval for that activity
- In a manner that does not comply with the terms and conditions of a controlled activity approval
- When a controlled activity approval is suspended.

TfNSW is the proponent and determining authority for the Proposal. Subject to Clause 38 of the Water Management (General) Regulation 2011 a public authority is exempt in relation to all controlled activities that it carries out in, on or under waterfront land (i.e. section 91E (1) of the Water Management Act).

NSW DPI Fisheries' Policy and Guidelines for Fish Habitat Conservation and Management (Fairfull 2013) provides policies and guidelines to maintain and enhance fish habitat for native fish species, including threatened species. This document provides recommendations to preserve fish habitats and to mitigate potential impacts of developments, in order to ensure the sustainable management and 'no net loss' of key fish habitats in NSW. Relevant Department of Primary Industries Controlled Activity Guidelines would be considered in designing and constructing the works.

4.3.3 Sydney Regional Environment Plan

The declaration of the Project as critical State significant infrastructure has been made through the provisions of State Environmental Planning Policy (State and Regional Development) 2011. Section 5.22 of the Environmental Planning and Assessment Act, 1979 provides that environmental planning instruments (such as LEPs, REPs and SEPPs) do not apply to State significant infrastructure projects. Notwithstanding, the *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* has been considered during the preparation of this assessment (for the purposes of informing the scope of the assessment).

The *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*, (SREP), (DPI 2005) covers all the waterways of Sydney Harbour, the foreshores and the entire catchment. The SREP establishes a set of planning principles for the preparation of planning instruments for the hydrological catchment of Sydney Harbour and zones the waterways into nine different zones to suit the differing environmental characteristics and land uses of the harbour and its tributaries.

The proposal has been assessed against the objectives of the SREP, as set out in Table 3.

Table 3. Objectives of the Sydney Harbour SREP

Objective	Comment
(a) To ensure that the catchment, foreshores, waterways and islands of Sydney Harbour are recognised, protected, enhanced and maintained as an outstanding natural asset and as a public asset of national and heritage	The proposal involves construction of a wharf facility, which would be utilised temporarily to receive spoil and plant and equipment from the TSE Works.

Objective	Comment
significance for existing and future generations.	
(b) to ensure a healthy sustainable environment on land and water.	The proposal would not result in any ongoing adverse impacts on the environment of the land or water. Appropriate safeguards would be applied to the work to minimise impacts in both construction and operation.
(c) to achieve a high quality and ecologically sustainable urban environment.	The proposal would facilitate the sustainable reuse of spoil from the TSE Works in approved residential and industrial developments in Sydney.
(d) to ensure a prosperous working harbour and an effective transport corridor.	The proposal would enhance the role of the harbour as a working harbour. Site establishment works and operations would be managed to avoid impacts on ferries and scheduled cruise boats.
(e) to encourage a culturally rich and vibrant place for people.	Not relevant to the proposal.
(f) to ensure accessibility to and along Sydney Harbour and its foreshores.	Not relevant to the proposal.

Clause 20 of the SREP sets out matters that must be taken into consideration by public authorities before they carry out activities to which Part 5 of the EP&A Act applies. An assessment of the proposal against the matters for consideration listed in Division 2 of Part 3 of the SREP is provided in Table 4.

Table 4. Division 2 Matters

Division 2 Matters	Comment
Clause 21 Biodiversity, ecology and environment protection	This aquatic ecology assessment indicates that there would be no significant long-term harm to marine species as a result of the proposal. Impacts would be temporary and minimised by appropriate environment protection management measures. See below for comment against each element of Clause 21.
Clause 22 Public access to, and use of, foreshores and waterways	There would be some temporary disruptions to public water transport, during the construction period, however these would not be long term changes. The changes would be communicated to Sydney Ferries and commercial craft operators by JHCPBG ahead of the work commencing.
Clause 23 Maintenance of a working harbour	The proposal would enhance the role of the harbour as both a working harbour and an effective transport corridor by facilitating spoil transportation by barge and reducing impacts on the road network at North Sydney.
Clause 24 Interrelationship of waterway and foreshore uses	The interrelationship of waterway and foreshore uses would be unchanged in the long term as a result of the proposal.
Clause 25 Foreshores and waterways scenic quality	The proposal would have a minor, short-term impact on the scenic quality of the area – see consistency assessment for detailed assessment.

Division 2 Matters	Comment
Clause 26 Maintenance, protection and enhancement of views	The proposal would have a minor, short-term impact on the maintenance, protection and enhancement of views – see consistency assessment for detailed assessment.
Clause 27 Boat storage facilities	The proposal does not involve boat storage facilities.

In terms of addressing the detailed matters to be taken into consideration in relation to biodiversity, ecology and environment protection and to address Clause 21 of the Sydney Regional Environment Plan the following can be stated:

(a) development should have a neutral or beneficial effect on the quality of water entering the waterways

A detailed sitespecific Erosion and Sediment Control Plan for on-shore activities, including installation controls in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Managing Urban Stormwater: Soils and Construction Volume 2 (Department of Environment and Climate Change, 2008a would be put in place. The construction could result in direct impact on seagrass and macroalgae (siltation, smothering). In addition, an increase in turbidity is expected locally during the construction phase. The deployment of silt curtains during the construction work would minimise the effects of turbidity on the seabed and limit the impact on the dense seagrass beds located in the vicinity of the proposed development.

(b) development should protect and enhance terrestrial and aquatic species, populations and ecological communities and, in particular, should avoid physical damage and shading of aquatic vegetation (such as seagrass, saltmarsh and algal and mangrove communities)

A continuous seagrass bed approximately 791 m^2 dominated by *Zostera capricorni* and low to medium percentage cover of seagrass and macroalgae was present in the footprint of the proposal and in the near vicinity. Direct impact from shading (ramp and barge) should affect approximately 59 m^2 of seagrass. Shading impact would lead to the direct loss of seagrass and in the adjacent area (partial shading). The structures would be temporary and recolonisation by seagrass of the affected areas could be expected at medium-long term if the integrity and vitality of the overall seagrass bed is maintained and if no seabed erosion and change of the local hydrodynamism occurred.

Areas with scattered kelp which would be affected by barge and ramp shading was estimated at 917 m^2. Macroalgae assemblages were dominated by Kelp and Sargassum and recolonisation of affected areas by these species is expected in the mid-term.

No mangroves or saltmarshes were present in the survey area.

(c) development should promote ecological connectivity between neighbouring areas of aquatic vegetation (such as seagrass, saltmarsh and algal and mangrove communities)

Shading from the proposed structures would only impact a portion the seagrass bed present in the survey area and should not affect ecological connectivity. The new piles would provide new habitat for marine assemblages, similar to that colonising the neighbouring structures, providing connectivity between communities.

(d) development should avoid indirect impacts on aquatic vegetation (such as changes to flow, current and wave action and changes to water quality) as a result of increased access

The piles would have minimal alteration to flow, currents and wave action. Local changes in hydrodynamism are expected around the piles (turbulences and back-eddies), especially in close to the shore (high energy area – wash zone) where the piles supported the ramp are proposed to be installed. Only local and minor impact or changes are expected, if the seagrass bed is not affected. Setting the piles further away from the seagrass bed has been proposed as a mitigation measure to minimise erosion and sediment accumulation on the seagrass bed.

(e) development should protect and reinstate natural intertidal foreshore areas, natural landforms and native vegetation

The proposal would have a limited impact on the intertidal foreshore as it should not affect the communities colonising the seawall and the piles will be in intertidal bare sand.

(f) development should retain, rehabilitate and restore riparian land

The proposal would not result in disturbance to riparian land. Only grassed areas and artificial structures (seawall and pier) have been identified at the proposal site.

(g) development on land adjoining wetlands should maintain and enhance the ecological integrity of the wetlands and, where possible, should provide a vegetative buffer to protect the wetlands

No wetlands were identified in the survey area.

(h) the cumulative environmental impact of development

No cumulative impact of development on the aquatic ecology from the proposed installation and activities are expected if recommended mitigation measures and monitoring are put in place and followed. Environmental impact is expected to be local, minor and temporary.

(i) whether sediments in the waterway adjacent to the development are contaminated, and what means will minimise their disturbance.

Silt curtains and floating booms would be placed around any work area where sediments may be disturbed. In this fashion, any potential acid sulfate soils and contaminants present in the sediment would be contained and would resettle within the work area and will not impact the waterways.

The proposal is located in a designated Wetlands Protection Area (Wetlands Protection Area Maps under the SREP); however, no wetlands were found within the survey area. Therefore an assessment of potential impact on the wetlands under s63 of the SREP was not found relevant and the considerations addressing the provision of the Sydney Regional Environment Plan (Section 4.4.2) were considered sufficient.

Under Part 2 of the DCP the Ecological Communities and Landscape Characters identifies the aquatic ecological community as Sandy Beaches. Under Table 1 Conservation Value of Ecological Communities, Sandy Beaches has a medium conservation status. With regard to the relevant Performance Criteria at Table 5 of the DCP for the protection of aquatic ecological community (medium conservation status), the following observations and mitigating measures are provided:

Shading:

Shading by the temporary installations (ramp and barge) would locally impact the seagrass bed dominated by *Zostera capricorni* and scattered macroalgae dominated by Kelp and Sargassum. Shading and associated impacts are discussed in Section 4.1.

Reclamation:
Not applicable. The proposal would not involve any reclamation of land or water.

Urban runoff:
Urban runoff resulting from excavation of soil on the foreshore or any earthworks would be contained to avoid contamination, siltation and increase of turbidity on the seagrasses and macroalgae communities. The turbidity and siltation that would result from installation of the new structures including the piling and work on the foreshore should be monitored and be minimised through the use of silt curtains and other relevant controls as described in section 4.2.3.

Dredging:
Not applicable. No dredging is required.

4.3.4 State Environmental Planning Policy (Coastal Management) 2018

Clause 13 of the Coastal Management SEPP relating to development on land within the coastal environment area states that "This clause does not apply to land within the Foreshores and Waterways Area within the meaning of Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005". Clause 14 of the Coastal Management SEPP relating to development on land within the coastal use area states that "This clause does not apply to land within the Foreshores and Waterways Area within the meaning of Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005".

4.4 Permit Requirements

As the Project is approved State Significant Infrastructure, in accordance with Clause 5.23 (1) (b) of the Environmental Planning and Assessment Act a permit under Section 205 of the Fisheries Management Act is not required.

As an individual Pipefish (Syngnathiformes) had been found in the survey area, pre-clearance surveys for Syngnathiformes and relocation if considered necessary are recommended prior to piling and pile decommissioning works. Relocation would need to be undertaken prior to the works. Under the Section 37 of the FM Act, relocation of Sygnathiformes requires a permit from NSW DPI. Any relocation would be undertaken using divers with DPI Fisheries Scientific Collection Permit.

5 Conclusions

- The construction and installation of a ramp and barge facilities is considered to have a minor short-term impact on marine assemblages including seagrasses, macroalgae, fish and benthic invertebrates, which should all recover once the project is completed.
- Two species of seagrass were found in the survey area, Eelgrass *Zostera capricorni* and Paddleweed *Halophila* sp. with potential direct (piling) and indirect (shading) impacts likely to occur. The proposal would directly and indirectly impact seagrasses and macroalgae; however, BIO-ANALYSIS has been advised that, as the Project is approved State Significant Infrastructure, in accordance with Clause 5.23 (1) (b) of the Environmental Planning and Assessment Act a permit under Section 205 of the Fisheries Management Act is not required.
- One individual tiger pipefish, *Filicampus tigris*, was recorded and relocation of Syngnathids may be required prior to commissioning works and prior to the de-commissioning phase. If relocation is required based on the findings of pre-construction and pre-decommissioning ecological survey, a permit to relocate syngnathids will be required by DPI Fisheries. Impacts on other fish assemblages would be negligible.
- The construction of the new facilities can be implemented to satisfy the requirements of SREP (Sydney Harbour Catchment) 2005 and Fisheries Management Act 1994 (FM Act)

Bibliography

Butler, A., Jernakoff, P. (1999). Seagrass in Australia - strategic review and development of an R & D plan. Fisheries Research and Development Corporation and CSIRO.

Creese, R.G., Glasby, T.M., West, G., Gallen, C. (2009). Mapping the habitats of NSW estuaries. Industry & Investment NSW Fisheries Final Report Series 113, 95pp.

Davis, A. R., Roberts, D. E., Cummins, S. P. (1997). Rapid invasion of a sponge-dominated deep-reef by Caulerpa scalpelliformis (Chlorophyta) in Botany Bay, New South Wales. Aust. J. Ecol., 22 (2): 146-150.

Fairfull, S. (2013). DPI Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/468927/Policy-and-guidelines-for-fish-habitat.pdf)

Sydney Regional Environmental Plan (Sydney Harbour Catchment) (2005). http://www.planning.nsw.gov.au/Policy-and-Legislation/Environment-and-Heritage/Sharing-Sydney-Harbour (28 June 2016 version)

Smith, A. K., Pollard, D. A. (1998). Policy and guidelines – aquatic habitat management and fish conservation 1998. NSW Fisheries, Sydney.

West, R. J., Jacobs, N. E., Roberts, D. E. (1990). Experimental transplanting of seagrasses in Botany Bay, Australia. Mar. Poll. Bull., 21(4): 197-203.

APPENDIX A.

Summary of threatened/protected/migratory aquatic fauna species with the potential to occur within the study area (primarily terrestrial or primarily avian species not included).

Species	FM/BC Act Status	EPBC Status	Presence of Habitat	Likelihood of Occurrence	Likelihood of Impact
Fish (Teleosts)					
Epinephelus daemelii Black Rockcod	V	V	No suitable habitat in the study site	Unlikely	Low
Macquaria australasica Macquarie Perch	E1	E	None, mostly occurs in freshwater. Juveniles may occur in estuaries.	Unlikely, no records in catchment	Unlikely
Prototroctes maraena Australian Grayling	E	V	None, mostly occurs in freshwater. Juveniles may occur in estuaries.	Unlikely, no records in catchment	Unlikely
Syngnathiforms (seahorses, sea dragons, pipefish)	Collection and possession prohibited	Listed as marine species	Present, macroalgae, piles and jetty present at site	Present within the survey area	Medium
Fish (rays)					
Manta alfredi Reef Manta Ray		M	Poor foraging habitat	Vagrant, unlikely within this part of the estuary	Low
Manta birostris Giant Manta Ray		M	Poor foraging habitat	Vagrant, unlikely within this part of the estuary	Low
Pristis zijsron Green Sawfish	E4	V	Presumed extinct in NSW	Unlikely	Unlikely
Fish (sharks)					
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population)	E4A	CE	Absent, occurs in gutters or in rocky caves around inshore rocky reefs and islands.	Vagrant, no known critical habitat or aggregation site within 10 km radium	Low

Species	FM/BC Act Status	EPBC Status	Presence of Habitat	Likelihood of Occurrence	Likelihood of Impact
Carcharodon carcharias Great White Shark	V	V, M	Poor potential foraging habitat	Vagrant, unlikely within this part of the estuary	Low
Lamna nasus Porbeagle, Mackerel Shark		M	Poor potential foraging habitat	Vagrant, unlikely within this part of the estuary	Low
Rhincodon typus Whale Shark		V, M	Poor potential foraging habitat	Vagrant, unlikely within this part of the estuary	Low
Mammals (seal)					
Arctocephalus forsteri New Zealand fur-seal	V		Absent, prefers rocky parts of islands with jumbled terrain and boulders.	Vagrant. Two New Zealand Fur Seals were recorded near the Opera House in 2016.	Low
Arctocephalus pusillus doriferus Australian Fur-seal	V		Absent, prefers rocky parts of islands with jumbled terrain and boulders.	Vagrant	Low
Mammals (whales, dolphins, dugong)					
Balaenoptera bonaerensis Antarctic Minke Whale		M	Poor potential foraging habitat	Vagrant	Low
Balaenoptera edeni Bryde's Whale		M	Poor potential foraging habitat	Vagrant	Low
Balaenoptera musculus Blue Whale	E1	E	Poor potential foraging habitat	Vagrant	Low
Caperea marginata Pygmy Right Whale		M	Poor potential foraging habitat	Vagrant	Low
Dugong dugon Dugong	E1	M	Poor potential foraging habitat	Vagrant	Low
Eubalaena australis Southern Right Whale	E1	E	Poor potential foraging habitat	Vagrant	Low
Lagenorhynchus obscurus Dusky Dolphin		M	Poor potential foraging habitat	Vagrant	Low
Megaptera novaeangliae Humpback Whale	V	V, M	Poor potential foraging habitat	Vagrant – Recorded West of the Harbour bridge	Low
Sousa chinensis Indo-Pacific Humpback Dolphin		M	Present	Vagrant	Low

Species	FM/BC Act Status	EPBC Status	Presence of Habitat	Likelihood of Occurrence	Likelihood of Impact
Reptiles					
Caretta caretta Loggerhead Turtle	E1	E, M	May be present	Vagrant	Low
Chelonia mydas Green turtle	V	V, M	Present,	Vagrant, species occasionally sighted in Sydney Harbour	Low
Dermochelys coriacea Leathery Turtle, Leatherback Turtle, Luth		E, M	Present	Vagrant - Present (1 record in the study area)	Low
Eretmochelys imbricata Hawksbill Turtle		V, M	May be present	Vagrant	Low
Natator depressus Flatback Turtle		V, M	May be present	Vagrant	Low
Birds (restricted list)					
Eudyptula minor Little Penguin in the Manly Point Area (being the area on and near the shoreline from Cannae Point generally northward to the point near the intersection of Stuart Street and Oyama Cove Avenue, and extending 100 metres offshore from that shoreline)	E2		No breeding habitat present. Potential foraging habitat.	Vagrant (foraging)	Low
Vegetation					
Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion (populations)	E2	E	No presence known East of the Harbour Bridge	Unlikely, no Posidonia found in the survey area	Unlikely
Saltmarsh	E1		Potential	Unlikely, no saltmarsh found in the survey area	Unlikely
Wilsonia backhousei Narrow-leafed Wilsonia	V		Potential	Not found in the survey area	Unlikely

BC Act (carried over from TSC Act): E1 = Endangered, E2 = Endangered Population, E4 = Extinct, E4A = Critically Endangered, V = Vulnerable
FM Act: E1 = Endangered, E2 = Endangered Population, E4 = Extinct, E4A = Critically Endangered, V = Vulnerable
EPBC Act: M = Listed migratory species under Bonn Convention, CD = Conservation Dependent, CE = Critically Endangered, E = Endangered, V = Vulnerable, X = Extinct

Appendix E – Noise and Vibration Assessment Report

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

SYDNEY METRO CITY & SOUTHWEST-TSE WORKS

Construction Noise and Vibration Impact Statement: Blues Point Construction Site

9 August 2018

John Holland CPB Ghella Joint Venture

TH511-02 01.05.04 (r1) F01 BP CNVIS

30 1982 2012 ACOUSTIC EXCELLENCE
Sydney Melbourne Brisbane Gold Coast Kuwait
Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861
Level 1/418A Elizabeth St SURRY HILLS NSW 2010 | PO Box 877 STRAWBERRY HILLS NSW 2012
P (02) 8218 0500 F (02) 8218 0501 sydney@renzotonin.com.au www.renzotonin.com.au

Document details

Detail	Reference
Doc reference:	TH511-02 01.05.04 (r1) F01 BP CNVIS
Prepared for:	John Holland CPB Ghella Joint Venture
Address:	Level 3, 140 Sussex Street Sydney NSW 2000
Attention:	Stuart Anstee

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
20.07.2018	First Issue	-	0	SP/BC	MT	CW/MT
09.08.2018	Updating Table C1	-	1	BC	MT	MT

Contents

List of tables

1 Introduction

This Construction Noise and Vibration Impact Statement (CNVIS) has been prepared on behalf of John Holland CPB Ghella (JHCPBG) in accordance with the Construction Noise and Vibration Management Plan (CNVMP) [SMCSWTSE-JCG-TPW-EM-PLN-002012] [1], for the Design and Construction of the Tunnel and Station Excavation (TSE) Works of the Sydney Metro City & Southwest Project (the Project).

1.1 Relevant requirements and purpose of this CNVIS

Condition E33 from the Project Planning Approval requires that:

> *Construction Noise and Vibration Impact Statements must be prepared for each construction site before construction noise and vibration impacts commence and include specific mitigation measures identified through consultation with affected receivers.*

This CNVIS details the noise and vibration mitigation measures in relation to the construction and operation of the Sydney Metro Chatswood to Sydenham tunnelling site at Blues Point Site (BP). This is inclusive of the supporting services for the tunnelling site.

This CNVIS covers construction works during standard construction hours as well as outside of standard construction hours. The construction hours of work are defined by the Project Conditions of Approval as outlined in the CNVMP.

This CNVIS forms part of the CNVMP for the Project.

1.2 Structure of this CNVIS

This CNVIS is structured as follows:

- **Section 2** - Description of construction works and hours
- **Section 3** - Nearest sensitive receivers
- **Section 4** - Construction noise and vibration objectives
- **Section 5** - Construction noise assessment
- **Section 6** - Construction vibration impacts
- **Section 7** – Ground-borne noise assessment
- **Section 8 –** Traffic noise assessment
- **Section 9 –** Cumulative impacts

1.3 Quality assurance

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Description of construction works and hours

2.1 Summary of works addressed in this CNVIS

This CNVIS provides an assessment of noise and vibration impacts from activities associated with the construction and operation of the Blues Point worksite. The works covered by this CNVIS include:

Construction and operation activities within the worksite:

- Construction compound establishment including site establishment, accommodation installation, contamination and heritage investigations, hoarding installation, deliveries and substation installation;
- Excavation of park and import of material for piling pad to allow acoustic shed and shaft construction;
- Piling and capping beam installation;
- Acoustic shed construction;
- Wharf and ramp construction;
- Shaft excavation;
- TBM disassembly;
- TBM retrieval.

Construction traffic on the existing road network:

- Light vehicle movements generated by construction personnel travelling to and from work;
- Heavy vehicle movements generated by delivery vehicles bringing raw materials, plant, and equipment to the site.

Site establishment is expected to commence in August 2018. The shaft excavation works inside the acoustic shed will begin in April 2019 and are expected to be completed by July 2019. TBM retrieval and disassembly is expected to be initiated by August 2019 and expected to be completed by February 2020.

Stages within the construction period are described in Table C1 of APPENDIX C.

Ground-borne noise and vibration impacts from proposed TBM tunnelling will be addressed in a separate CNVIS.

2.2 Construction hours

The construction hours for the Project are defined by Project Planning Approval (PPA) Conditions E36, E37, E38, E41, E42 and E44. The standard hours and out-of-hours work (OOHW) periods are depicted in Table 2.1 below. The OOHW periods are further defined as OOHW Period 1 and 2 based on the Transport for NSW Construction Noise Strategy (TfNSW CNS), as noted in the CNVMP.

Table 2.1: Construction hours

Day	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
Monday																								
Tuesday																								
Wednesday			OOHW Period 2								Standard Hours									OOHW Period 1				
Thursday																								
Friday																								
Saturday																								
Sunday or Public Holiday											OOHW Period 1								OOHW Period 2					

2.2.1 24-hour construction (Condition PPA E39)

At Blues Point, an acoustic shed will be constructed to allow activities to be carried out 24 hours per day, 7 days a week. The acoustic enclosure will be installed as part of site establishment works and prior to activities which are required to be conducted 24 hours per day, 7 days a week within this enclosure as per PPA Condition E49.

2.3 Justification for OOHW

The Environmental Impact Statement (EIS) for the Sydney Metro City and Southwest Project [2] states that tunnelling and support operations will be undertaken 24-hours per day, seven days per week. The justification for OOHW tunnelling and support operations includes:

- The need to install ground support systems immediately following excavation;
- Reducing the overall duration of construction;
- Minimising impacts on already congested road networks around the worksites
- Reducing peak demand on the electricity network.

Each of these aspects is addressed in detail within the CNVMP.

Project Planning Approval (PPA) Condition E48 and Environment Protection Licence (EPL) Condition L4.4 allow the following activities to be carried out 24 hours per day, 7 days per week:

- Tunnelling and tunnel support activities,

- Excavation of shafts and caverns within an enclosure, and
- Haulage and delivery of spoil and materials.

Based on the above PPA and EPL Conditions and justification, the following work activities are proposed to be carried out at the Blues Point temporary worksite outside standard construction hours listed in Section 2.2 (additional details are provided in Appendix C Table C1):

- Tunnelling Boring Machine (TBM) disassembly: this tunnel support operation will be undertaken 24 hours per day seven days per week within the acoustic shed. This will occur for each of the four TBMs,
- Tunnelling Boring Machine (TBM) retrieval for each of the four TBMs: All components of the TBMs will be transported from Blues Point to other Sydney Metro sites via barge and will be transferred with the SPMT (self-propelled modular trailer) from the shed to the barge. Barge movements will replace a greater number of truck movements but are sensitive to tidal changes. TBM barging will be required to be undertaken OOH's due to the dependence on tides that limit access to the loading and unloading wharfs. There is a small window during which barge docking can occur and this will change throughout the duration of the works and may occur OOHs. TBM barging may take approximately 4 days per TBM (16 days in total) and will be required to be undertaken continuously, including outside of standard working hours. Transportation of TBM components outside standard construction hours is crucial to ensure key NSW government program milestones are met and most importantly, to ensure delivery of community and rail commuter user benefits.

All OOHW, including TBM disassembly and retrieval, will be managed in accordance with the Out of Hours Works Protocol which has been prepared for the project in accordance with PPA Condition E47.

2.4 Construction methodology (PPA Condition E35)

Discussion regarding alternatives to rock hammering and blasting for excavation to satisfy PPA Condition E35 has been addressed in the report SMCSTSE-JCG-TPW-EN-RPT-097229-02.

3 Nearest sensitive receivers

3.1 Residential receivers

To assess and manage construction noise and vibration impact, the residential areas surrounding the Project worksite have been divided into Noise Catchment Areas (NCAs) based on each area's similar acoustic environment prior to the commencement of construction work. The NCAs are based on those established in the EIS for the Project [2], with some modifications to allow for site specific characteristics.

All relevant residential sensitive receivers near the worksite are identified on aerial photographs located in APPENDIX B. At receivers more than about 500 m from the construction area, potential construction noise and vibration levels are expected to be within the adopted noise and vibration management levels described in Section 4 of this CNVIS. Receivers beyond 500 m are typically not included in this CNVIS assessment.

3.2 Other sensitive receivers (PPA Condition E34)

PPA Condition E34 states:

> *Noise generating works in the vicinity of potentially-affected, religious, educational, community institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) must not be timetabled within sensitive periods, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution or as otherwise approved by the Secretary.*

JHCPBG has undertaken consultation with identified sensitive receivers to determine sensitive periods and has taken this into consideration in finalising respite strategies for high noise impacts. TfNSW is working with sensitive receivers to further assess and determine other reasonable arrangements to be implemented.

3.3 Commercial and industrial premises

All commercial and industrial premises near the worksite have been considered in this assessment.

3.4 Heritage receivers

Heritage receivers have been identified in the Land Use Survey in Annexure B of the CNVMP. There are five heritage-listed buildings close to the work areas:

Table 3.1: Assessment heritage receivers

Site	Item	Address	Significance
Blues Point	Former tram turning circle and McMahons Point ferry wharf	Henry Lawson Avenue	Local
	Seawall	2a Henry Lawson Avenue	Local

Site	Item	Address	Significance
	Blues Point Waterfront Group	2 Henry Lawson Avenue McMahons Point	Local
	North Sydney bus shelters	BS061 Henry Lawson Avenue	Item 0407 North Sydney LEP 2013
	McMahons Point South	McMahons Point	CA14 North Sydney LEP 2013
	Blues Point Waterfront Group	Blues Point Road and Henry Lawson Drive	Items 0423–0450 North Sydney LEP 2013
	Slipway and site of former Holmes' residence	1 Henry Lawson Avenue	Item 0453 North Sydney LEP 2013

4 Construction noise and vibration objectives

4.1 Noise goals

4.1.1 Noise management levels (NMLs)

Construction NMLs have been determined using the NSW Interim Construction Noise Guideline (ICNG) [3] and the PPA Conditions, in accordance with the Sydney Metro City & Southwest Construction Noise and Vibration Strategy (SMCSNVS) [7].

For the Blues Point worksite, internal NMLs are applicable at residential receiver locations during the 8 pm to 7 am period per PPA Conditions E41 and E42. During daytime and evening periods (between 7 am and 8 pm), external NMLs are derived from the ICNG.

Table B1 in APPENDIX B and APPENDIX E of CNVMP identify the adopted construction NMLs for the nearest noise sensitive receivers to the worksite, including for airborne and ground-borne noise.

Works during 7am to 8pm day/evening period

During the 7 am to 8 pm day/evening period, airborne NMLs for residential receivers are based on long-term noise logging conducted by SLR on behalf of Transport for NSW (TfNSW) to quantify ambient noise levels for the Environmental Impact Statement (EIS).

Additional pre-construction noise monitoring was carried out to establish more accurate noise goals as outlined in Section 6.2 of the CNVMP. This additional long-term, unattended noise monitoring was carried out in July 2017 by RT&A following a review of the EIS noise monitoring.

The NMLs for 'other' sensitive receivers are from the ICNG, as reported in Section 5.2.3 of the CNVMP. These apply when the sensitive receiver is in use.

Receivers are considered 'noise affected' where construction noise levels are greater than the NMLs. During standard construction hours, a highly affected noise objective of $L_{Aeq(15min)}$ 75 dB(A) also applies to airborne noise at all residential receivers.

The noise affected level represents the point above which there may be some community reaction to noise. Where predicted and/or measured construction noise levels are above the NMLs, all feasible and reasonable work practices will be applied to meet the NMLs.

Works during 8pm to 7am evening/night period

If residential receivers are noise affected during the 8 pm to 7 am evening/night period [internal $L_{Aeq(15minute)}$ noise levels greater than 45 dB(A)], additional mitigation measures are required to be considered in accordance with the documented procedure in Addendum A of the SMCSNVS.

Additional requirements for all periods

In addition to the objectives identified above, where construction activities are tonal or impulsive in nature and are described in the ICNG as being particularly annoying, a +5 dB(A) correction should be added to the activity noise, as suggested by the ICNG.

Activities defined in the ICNG as particularly annoying include, but are not limited to the use of 'beeper' style reversing or movement alarms; power saws; vibratory rolling; jack hammering, rock hammering or rock breaking; and impact piling.

If construction works include ground-borne noise or a perceptible level of vibration at the affected receiver, a 5 dB(A) penalty should be added to the predicted construction noise level, in accordance with PPA Conditions E41 and E42.

Any construction related activities that could exceed the NMLs will be identified and managed in accordance with the CNVMP.

4.1.2 Residential receivers in residential and non-residential zones (PPA Conditions E41 and E42)

PPA Condition E41 requires that residential receivers within non-residential zones are not above the following internal noise levels (including a 5 dB(A) penalty if considered an annoying activity).

- $L_{Aeq(15minute)}$ 60 dB(A) between 8pm and 9pm
- $L_{Aeq(15minute)}$ 45 dB(A) between 9pm and 7am.

Condition E42 requires that residential receivers within residential zones are not above internal noise levels of $L_{Aeq(15minute)}$ 45 dB(A) (inclusive of a 5 dB(A) penalty if considered an annoying activity) between 8pm and 7am.

Where the above internal noise levels cannot be achieved, additional mitigation must be offered in accordance with the *Sydney Metro City and South West Noise and Vibration Strategy (SMCSNVS) [7]*.

Addendum A of the SMCSNVS notes that zoning will be used to identify if residential receivers are located within residential or non-residential zones.

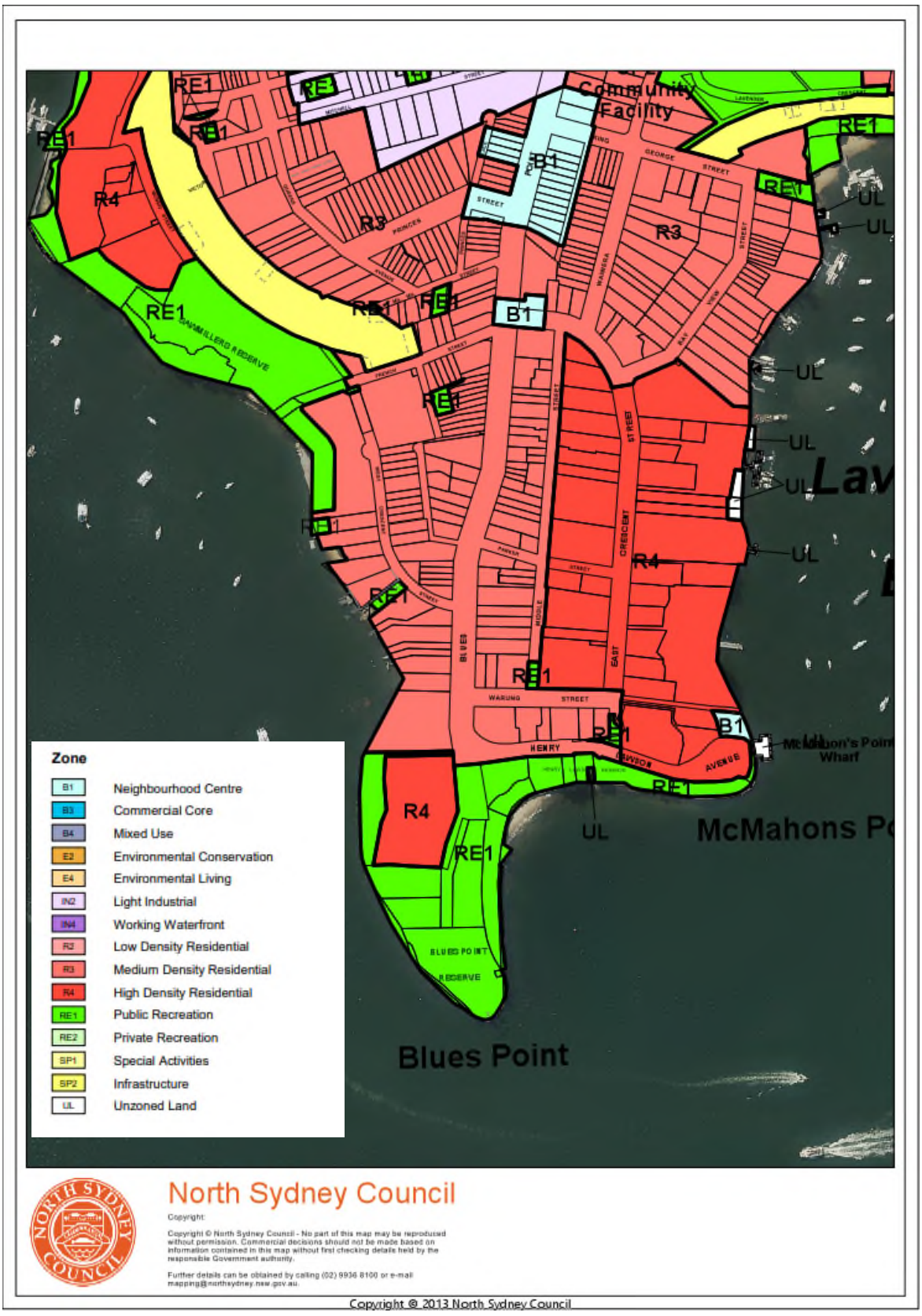
Figure 4.1 is an extract from North Sydney Local Environmental Plan 2013 land zoning maps (last accessed 06/03/2018). As shown in Figure 4.1, the nearest residential receivers are in a residential zone (i.e. R3 and R4).

For this assessment, all residential receivers are conservatively assumed to be in residential zones, with a corresponding internal noise threshold level of $L_{Aeq(15minute)}$ 45 dB(A) between 8pm and 7am. Based on a minimum (conservative) external to internal noise difference of 10 dB(A) (assuming windows open), an equivalent external noise threshold of $L_{Aeq(15minute)}$ 55 dB(A) applies between 8pm and 7am. Where

measured level is above the equivalent external noise threshold, additional mitigation will be offered in accordance with the SMCSNVS.

The assessment in Section 5 has assessed all receivers using the approach outlined in the SMCSNVS *[7]* and CNVMP [1] which achieves the requirements of conditions E41 and E42, and is consistent with the ICNG [3] and the EIS [2]. Details of additional mitigation measures are in Appendix E.

Figure 4.1: Extract from North Sydney Local Environmental Plan 2013 Land Zoning Map (last accessed 06.03.2018)



4.1.3 Respite for high noise impact works

Except for construction activities which require a Road Occupancy License (ROL), respite from other activities resulting in high noise impact (i.e. more than 75 dB(A) at nearest residential receiver) will be provided by limiting activities as follows to satisfy EPL Condition L4.5:

- Between the hours of 8:00am to 6:00pm Monday to Friday
- Between the hours of 8:00am to 1:00pm Saturday, and
- In continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block, except as expressly permitted by the EPL issued for the TSC Works.

For the purposes of this requirement 'continuous' includes any period during which there is less than one-hour respite between ceasing and recommencing any of the work that is subject to this requirement.

4.1.4 Sleep disturbance

Consistent with Section 5.2.3 of the CNVMP, an internal screening level of 45 dB(A) (L_{Amax} or $L_{A1(1minute)}$) has been adopted for potential sleep disturbance. The sleep disturbance screening level is applicable to airborne and ground-borne noise during the 10pm to 7am night-time period at residential receivers and hotels.

Where there are noise events found to be above the initial screening level, further analysis is made to identify:

- the likely number of events above 45 dB(A) L_{Amax} (internal) that might occur during the night assessment period
- whether events are above an 'awakening reaction' level of 55 dB(A) L_{Amax} (internal)

The ICNG recommends that where construction works are planned to extend over more than two consecutive nights, maximum noise levels and the extent and frequency that maximum noise levels are above the RBL should be analysed.

During construction, attended noise monitoring will be undertaken at representative residences most impacted by the works during night-time periods. The noise monitoring will follow the procedures outlined in Appendix D of the CNVMP, which includes measurement of L_{Amax} or $L_{A1\ (1minute)}$ noise metrics. If maximum noise levels are found to be above the internal NML of 55 dB(A), the responsible noise source(s) will be identified and further analysis undertaken to quantify the extent and frequency of the exceedances. Additional feasible and reasonable mitigation measures may need to be considered to reduce potential impacts.

4.1.5 National Standard for exposure to noise

In accordance with PPA Condition E43, TSE worksites will be managed to ensure that noise generated by construction will not be above the National Standard for exposure to noise in the occupational environment of an eight-hour equivalent continuous A-weighted sound pressure level of LAeq,8h, of 85 dB(A) for any employee working at a location near a TSE worksite.

4.1.6 Construction related road traffic noise objectives

On the roads immediately adjacent to construction sites, the community may associate heavy vehicle movements with the Sydney Metro TSE works. Construction traffic movements on public roads will aim to limit any increase in existing road traffic noise levels to no more than 2 dB(A). All feasible and reasonable noise mitigation and management measures will be implemented.

4.2 Vibration goals

As reported in Section 5.6 and 5.7 of the CNVMP, construction vibration goals have been determined in accordance with PPA Condition E28 and the Sydney Metro Construction Noise and Vibration Strategy as follows:

- **Human annoyance** - the acceptable vibration values set out in '*Assessing Vibration: A Technical Guideline*' (Department of Environment and Conservation, 2006) [4]; and
- **Structural damage** - the vibration limits set out in the British Standard 7385 Part 2 (1993) [5].

4.2.1 Disturbance to building occupants (human annoyance)

For disturbance to human occupants of buildings, we refer to '*Assessing Vibration; a technical guideline*' [4]. This document provides criteria which are based on the British Standard BS 6472-1992, *'Evaluation of human exposure to vibration in buildings (1-80Hz)' [6]*.

Intermittent vibration is assessed using vibration dose values (VDVs). For the assessment of potential vibration at the nearest vibration sensitive receivers preferred and maximum VDV goals for the day period (7:00am to 10:00pm) are presented in Table 4.1.

Table 4.1: Construction vibration disturbance goals

Location	Assessment period[1]	Vibration Dose Value (VDV), m/s$^{1.75}$	
		Preferred values	Maximum values
Critical areas[2]	Day or Night	0.10	0.20
Residences	Day	0.20	0.40
	Night	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or Night	0.40	0.80
Workshops	Day or Night	0.80	1.60

Location	Assessment period[1]	Vibration Dose Value (VDV), m/s$^{1.75}$	
		Preferred values	Maximum values

Notes: 1. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am

2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source: BS 6472-1992

4.2.2 Structural damage to buildings

A conservative vibration damage screening level per receiver type is given below:

- Reinforced or framed structures (Line 1): 25.0 mm/s
- Unreinforced or light framed structures (Line 2): 7.5 mm/s

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level.

It is noted that vibration levels required to cause minor cosmetic damage are typically 10 x higher than levels that will cause disturbance to building occupants. Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.

4.2.3 Heritage

As noted in the CNVMP, the approach to manage potential vibration impact shall be to:

1. Identify heritage items where the 2.5 mm/s peak component particle velocity objective may be exceeded during specific construction activities
2. Structural engineering report to be undertaken on identified heritage items, to confirm structural integrity of the building and confirm if item is 'structurally sound'
3. If item confirmed as 'structurally sound', the screening criteria in Section 4.2.2 shall be adopted, or
4. If item confirmed as 'structurally unsound', the more conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity would be adopted.

4.2.4 Sensitive Scientific and Medical Equipment

No sensitive scientific or medical equipment are known near the assessed works. If they are identified, relevant vibration criteria should be established for each item in line with Section 5.8.2 of the CNVMP [1], and any corresponding management or mitigation measures determined.

4.2.5 Utilities and Other Vibration Sensitive Structures

No utilities or other vibration sensitive structures are known to be located with proximity of the assessed works. Should such items be identified, then relevant vibration criteria will be established for each item per Section 5.8.3 of the CNVMP [1], and any corresponding management or mitigation measures determined.

4.2.6 Construction related road traffic noise objectives

On the roads immediately adjacent to construction sites, the community may associate heavy vehicle movements with the Sydney Metro TSE works. Construction traffic movements on public roads shall aim to limit any increase in existing road traffic noise levels to no more than 2 dB(A). All feasible and reasonable noise mitigation and management measures shall be implemented.

5 Construction noise assessment

5.1 Detailed design outcomes

During the development of the site design, Renzo Tonin & Associates played a key role in assisting JHCPBG to determine the physical noise mitigation measures required to reduce noise impact from the operation of the site. To ensure the timely and efficient provision of inputs to the design process, these mitigation and management measures were documented in the Noise Design Report.

The key noise mitigation measures that have been included in the noise modelling results presented in this CNVIS are:

- Acoustic shed for shaft excavation, TBM disassembly and retrieval works;
- Acoustic treatment of shed louvres to further reduce noise;
- Noise boundary walls;
- Partial/total enclosures for plant/equipment;
- Acoustic attenuators for dust scrubber, required to support shaft excavation.

The design input assumptions for the worksite are outlined in Table C1 in APPENDIX C.

5.2 Noise prediction methodology

Modelling and assessment of airborne noise impacts from activities associated with the construction works were determined by modelling the noise sources, receiver locations, topographical features, and possible noise mitigation measures using a Cadna-A computer noise model developed for this project. The model calculates the contribution of each noise source at identified sensitive receiver locations and allows for the prediction of the total noise from a site for the various stages of the construction works.

The noise prediction models consider:

- Location of noise sources and sensitive receiver locations.
- Height of sources and receivers referenced to one metre digital ground contours for the site area and surrounding area.
- Sound Power Levels (L_w) of plant and equipment likely to be used during the various construction activities (see Table C1 in APPENDIX C). Table C1 also identifies the plant and equipment that will operate during each assessment period.
- Separation distances between sources and receivers.
- Ground type between sources and receivers.

- Attenuation from barriers (natural and purpose built).

Key details regarding the construction site layout, the likely plant and equipment (including truck movements), and hours of operation were informed by the Design and Construction Teams. This information is presented in APPENDIX C and formed the basis for all modelling assumptions used in this assessment.

5.3 Predicted noise levels

5.3.1 Construction

Noise emissions were determined by modelling the noise sources, receiver locations, and operating activities, based on the information presented in APPENDIX C. Predicted L_{Aeq} noise levels from the sites are presented in APPENDIX D for all receivers in each NCA. The predictions in APPENDIX D are representative of external noise levels during the construction works and are assessed against equivalent external NMLs.

The noise predictions presented in this CNVIS represent a realistic worst-case scenario when construction occurs at work locations close to residences and other sensitive receivers. At each receiver, noise levels will vary during the construction period based on the position of equipment within the worksite, the distance to the receiver, the construction activities being undertaken and the noise levels of particular plant items and equipment. Actual noise levels will often be less than the predicted levels presented in this CNVIS.

The assessment includes the following activities:

- **CCE**: Construction compound establishment;
- **EP_H**: Excavation of park and material import for piling pad – High impact activities (including rockhammering);
- **EP_L**: Excavation of park and material import for piling pad – Low impact activities (excluding rockhammering);
- **PC**: Piling and capping beam construction;
- **ASC**: Acoustic shed construction;
- **WR**: Wharf and ramp construction;
- **SE**: Shaft excavation;
- **TBM_D**: TBM disassembly;
- **TBM_R**: TBM retrieval.

Works during 7am to 8pm day/evening period

Table 5.1 summarises the predicted impacts for each construction stage in each NCA. The colours in the table indicate whether receivers in the NCA are within the relevant NMLs and, where predicted levels are expected to be above the relevant NMLs and the perceived impact. Where predicted and/or measured construction noise levels are above the NMLs, all feasible and reasonable work practices will be applied to meet the NMLs.

The impacts presented are as follows for **Standard Hours:**

- Below NML
- < 10dB(A) above NML - construction noise clearly audible
- > 10dB(A) above NML - construction noise clearly moderately intrusive
- > 75dB(A) - highly noise affected

The impacts presented are as follows for **OOH Day, E1 (from 6pm to 8pm):**

- Below NML
- < 5dB(A) above NML - construction noise noticeable
- 5 to 15dB(A) above NML - construction noise clearly audible
- > 15 to 25dB(A) above NML - construction noise moderately intrusive
- >25dB(A) above NML - construction noise highly intrusive

Table 5.1: Summary of construction noise impacts at nearby residential receivers

NCA	CCE	EP_H	EP_L	PC	ASC	WR	SE	TBM_D			TBM_R		
	DS	DS	DS	DS	DS	DS	DS	DS	DO	E1	DS	DO	E1
BN_01	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
BP_01	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
BP_02	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
OSR	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆

Notes: DS: standard construction hours (7am to 6pm Monday to Friday and 8am to 1pm Saturday)
DO: day out-of-hour (1pm to 6pm Saturday and 8am to 6pm Sundays and public holidays)
E1: evening period from 6pm to 8pm. After this time (i.e. E2), work activities are assessed below in accordance with Section 4.1.2.
N: night period is assessed below in accordance with Section 4.1.2.
OSR: this includes all commercial, industrial and other sensitive receivers.

The results in Table 5.1 indicate that noise levels during construction activities leading up to the shaft excavation works (SE) within the acoustic shed are predicted to be above 75 dB(A) at the nearest noise sensitive receivers in NCAs BP_01 and BP_02. However, it is noted that the predicted noise levels will

potentially be lower than indicated in the table depending on the position of equipment within the worksite. In addition, dozers with ripper attachments (during EP_L stage) will be used whenever practicable to reduce noise levels further. Nonetheless, respite periods will be offered in accordance with Section 4.1.3 to minimise potential impacts.

The TBM disassembly and retrieval operations are expected occur between August 2019 and February 2020. Table 5.1 shows that for TBM disassembly (TBM_B) noise levels are expected to be below the relevant NMLs except for the nearest noise sensitive receivers in NCA BP_01 during daytime OOH, where noise levels may be noticeable (< 5dB(A)). For TBM retrieval (TBM_R) exceedances up to 25 dB(A) are predicted within NCA BP_01 during early evening (up to 8pm) and within NCA BP_02 during daytime OOH and early evening (up to 8pm). It is noted that the exceedances are caused by the SPMT operating external to the acoustic shed. The SPMT is used to transfer TBM components from the shed to the barge and will only be operational for approximately 16 nights in total between August 2019 and February 2020.

Nonetheless, proposed measures to minimise noise levels are outlined in Section 5.4. For more detailed predictions, see Appendix D. For more detailed additional noise measures, refer to Appendix E.

Works during 8pm to 7am evening/night period

Table 5.2 summarises the predicted noise impacts for each construction stage in each NCA compared with the internal NMLs in PPA Conditions E41 and E42. Where predicted levels are above the NMLs at residential receivers, additional mitigation measures are required to be considered in accordance with the documented procedure in Addendum A of the SMCSNVS. The impacts presented are as follow:

- ◆ Noise levels predicted to be below internal NMLs in PPA Conditions E41 and E42;
- ☐ Noise levels predicted to be above internal NMLs in PPA Conditions E41 and E42.

Table 5.2: Noise level summary for PPA Conditions E41/E42 (residential only)

NCA	TBM_D		TBM_R	
	E2	N	E2	N
BN_01	◆	◆	◆	◆
BP_01	◆	◆	☐	☐
BP_02	◆	◆	☐	☐

Notes: E2: evening period from 8pm to 10pm.
N: night-time period from 10pm to 7am.

The results in Table 5.2 indicate that during TBM disassembly (TBM_D) noise levels are predicted to be below the internal NMLs during the 8 pm to 7 am evening/night period at all locations.

For TBM retrieval (TBM_R) noise levels are predicted to be above the internal NMLs during the 8 pm to 7 am evening/night period at one receiver within NCA BP_01 and 11 receivers within NCA BP-02. It is noted that the exceedances are caused by the SPMT operating external to the acoustic shed. The SPMT is used to transfer TBM components from the shed to the barge and will only be operational for

approximately 4 days per TBM (16 days in total) between August 2019 and February 2020. As described before, TBM barging may be required to be undertaken outside standard construction hours due to the dependence on tides that limit access to the loading and unloading wharfs. There is a small window during which barge docking can occur and this will change throughout the duration of the works and may occur outside standard construction hours.

Measures for managing potential noise impacts are provided in Section 5.4. For more detailed predictions, see Appendix D. For more detailed additional noise measures, refer to Appendix E.

5.3.2 Sleep disturbance

There will be no on-site heavy vehicle movements during the night-time (10pm to 7am). The only activities/scenarios with the potential to cause sleep disturbance is TBM disassembly (TBM_D) and TBM retrieval (TBM_R).

For TBM_D all activities will be undertaken within the acoustic shed and shed door will be closed during the night-time. It has been determined that maximum noise levels are predicted to be between 56 dB(A) and 61 dB(A) at the nearest noise sensitive receivers, which is above the screening levels but below the sleep disturbance awakening criterion of 65 dB(A). Furthermore, the activity with the most potential to cause sleep disturbance, hammering steel, will be restricted during the night-time.

For TBM_R there is a greater potential for sleep disturbance from activities occurring within the shed as the shed door will be open. There may be instances where the sleep disturbance awakening criterion of 65 dB(A) will be exceeded, particularly at 14 Blues Point Rd, McMahons Point. In addition, exceedances of the 65 dB(A) criterion are expected from SPMT operation and clangs and bangs associated with TBM transportation from the shed to the barge. However, it is noted that TBM transfer operations will only occur for approximately 16 nights in total between August 2019 and February 2020 and additional mitigation measures will be offered in accordance with Section 5.4.3.

Other management measures are outlined in Section 5.4 to aid in providing additional noise reduction benefits where predicted levels are above the noise objectives.

5.4 Noise mitigation and management

5.4.1 Consultation with affected receivers (PPA Condition E33)

PPA Condition E33 requires consultation with affected receivers to assist in determining site-specific mitigation measures.

TSE has commenced and will continue to consult with potentially affected stakeholders including business and residential receivers regarding specific mitigation measures applicable to the works at the Blues Point site. A summary is provided below:

- JHCPBG is undertaking on going consultation and discussions with residential receivers and key stakeholders relevant to the Blues Point worksite. A briefing to key stakeholders including North Sydney Council, RMS (both road and maritime representatives), and SCO was held on 28 May 2018. This included details around the utilities works as well as ongoing site establishment and operations at the worksite. A community information session was also held on the side on Saturday 16 June 2018.
- JHCPBG carried out a doorknock to residents on Blues Point Road, Warung Street and East Crescent Street, McMahons Point on Wednesday 28 February 2018. Residents were informed about works starting at Henry Lawson Reserve in mid-2018, geotechnical and utility investigation works and some out-of-hours works for utility relocations.

5.4.2 Other noise control measures

The following standard noise control measures, in addition to those outlined in APPENDIX C, are recommended to reduce potential noise impacts:

Table 5.3: Site noise control measures

Control type	Control measure	Typical use
At-Source Control Measures	Noise control kits	Plant that is brought to site for regular use should meet the sound power limits identified in Table C1. Where plant are above limits then the plant may require installation of 'noise control kits' to comply with the noise limits in Table C1. Such 'noise control kits' comprise: • high performance 'residential-grade' exhaust mufflers, • additional engine cowling / enclosure lined inside with sound absorbent industrial-grade foam, and • air intake and discharge silencers / louvres. The need to fit 'noise control kits' onto the identified plant, will be confirmed once each plant item is tested prior to its regular use on site.
	Limit equipment in use	Only the equipment necessary during each stage of the OOHW will be used.
	Timing of equipment in use	Where practicable, activities and plant will be limited as outlined in Table C1 (APPENDIX C).
	Limit activity duration	Any equipment not in use for extended periods shall be switched off. For example, heavy vehicles should switch engines off when not in use.
	Use and siting of plant	Avoid/ limit simultaneous operation of noisy plant and equipment within discernible range of a sensitive receiver. Direct noise-emitting plant away from sensitive receivers where practicable. Locate fixed location plant items as far from sensitive receivers as practicable.
	Equipment selection	Use quieter and less noise/ vibration emitting construction methods where feasible and reasonable.
	Truck movements	Avoid the use of park air brakes outside the sheds at night. Set up relevant traffic management measures to minimise the use of air brakes when leaving the site. Air brake silencers are to be correctly installed and fully operational for any heavy vehicles (as per CNVMP). Minimise unnecessary acceleration on site.
	Non-tonal reversing alarms	Alternative reverse alarms, such as 'quackers' will be installed on all plant and equipment, where practicable.

Control type	Control measure	Typical use
Noise Management Measures	Site inductions & Toolbox Talks	All employees, contractors and subcontractors will receive a Project induction. The environmental component may be covered in toolboxes and should include: • location of nearest sensitive receivers • relevant project specific and standard noise and vibration mitigation measures; • permitted hours of work; • OOHW Procedure and Form • construction employee parking areas.
	Community consultation	Inform community of construction activity and potential impacts.
	Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
	Noise monitoring	Noise monitoring is to be carried out as detailed in Section 5.4.5.

5.4.3 Additional noise mitigation measures

Table 5.4 below should be used to advise the appropriate additional mitigation during construction, as outlined in Section 8.2 of the CNVMP. These measures are consistent with the approach outlined in the SMCSNVS [7].

Table 5.4: Additional airborne noise mitigation measures

When is the work being undertaken?	How much does the predicted noise level exceed the ANML by?	Identify additional management measures to be implemented
Standard Hours M-F 7am to 6pm Sat 8am to 1pm	0 dB(A)	- -
	≤ 10 dB(A)	- -
	10 to 20 dB(A)	LB, V [MM2]
	> 20 dB(A)	LB, V [MM2]
	Highly noise affected	LB, SN, IB, RO, V [MM4]
OOHW Period 1 M-F 6pm to 10pm Sat 1pm to 10pm Sun/ PH 8am to 10pm	< 5 dB(A)	- -
	5 to 15 dB(A)	LB [MM1]
	15 to 25 dB(A)	LB, V [MM2]
	> 25 dB(A)	LB, SN, IB, RO, V [MM4]
OOHW Period 2 M-F 10pm to 7am Sat 10pm to 8am Sun/ PH 6pm to 8am	< 5 dB(A)	LB [MM1]
	5 to 15 dB(A)	LB, V [MM2]
	15 to 25 dB(A)	LB, SN, IB, RO, V [MM4]
	> 25 dB(A)	LB, SN, IB, RO, AA, V [MM5]

Notes: Use the abbreviation codes in the table above to confirm management measures required
Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS

LB = Letter box drops
V = Verification monitoring
SN = Specific notifications
IB = individual briefing
RO = Project specific respite offer
AA = Alternative accommodation

APPENDIX E presents a summary of the additional noise mitigation measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, construction noise levels are still above the NMLs.

Prior to the commencement of works, residential receivers around the site, identified in APPENDIX E, will be notified to advise that noise from the works may at times be audible. All potentially impacted receivers will be kept informed of the nature of works to be carried out, expected noise levels and duration, as well as given appropriate enquiries and complaints contact details (see Section 5.4.6).

For long-term construction works, during the 8pm to 7am evening/night period, additional noise mitigation measures (i.e. respite offers or at-property treatments), determined in accordance with the SMCSNVS, will be considered at affected residential receivers where internal noise levels are predicted to be above the $L_{Aeq(15minute)}$ 45 dB(A) threshold between 8pm and 7am.

For short-term construction works (such as works carried out under ROL), during the 8pm to 7am evening/night period, additional noise mitigation measures determined in accordance with Table 5.4 will be offered to all affected residential receivers whether internal noise levels are predicted to be above or below the $L_{Aeq(15minute)}$ 45 dB(A) threshold between 8pm and 7am.

5.4.4 Residual impacts

Where there are no further reasonable and feasible mitigation measures that can be applied to achieve the NMLs, then at-property treatments may need to be considered if internal noise levels are above the NMLs specified in the PPA Conditions E41/ E42.

The requirement for at-property treatments will be reviewed once site access is gained and prior to the commencement of 24-hour operations. The review will include on site testing of equipment/plant to verify noise levels predicted by the noise model. Once the noise model is verified, properties predicted to be above the PPA Conditions E41/ E42 requirements will require further detailed assessment of at-property treatment or other mitigation / management measures.

5.4.5 Attended noise monitoring

Real time noise monitoring in accordance with PPA Condition C11 is not proposed to be undertaken for the Blues Point work site as this site has not been identified as high risk in the CNVMP, however attended noise monitoring will be undertaken as required by the CNVS and EPL, or as requested by the AA / Sydney Metro. Noise monitoring is subject to obtaining the property owner/occupier's consent to access the property (where required).

Attended noise monitoring will be undertaken during works at one of the representative residential receivers identified in the table below in the NCAs most impacted by the works (i.e. a minimum of one location for each NCA). Nominated attended measurement locations have been selected with the best opportunity to validate the predicted noise levels.

Table 5.5: Nominated verification monitoring locations

NCA	Nominated receiver address	Monitoring location at 1 m from
BP_01	14-28 BLUES POINT ROAD MCMAHONS POINT	Eastern façade

NCA	Nominated receiver address	Monitoring location at 1 m from
BP_02	1A HENRY LAWSON AVENUE MCMAHONS POINT	Western façade
	1 WARUNG STREET MCMAHONS POINT	Southern façade
Notes:	Monitoring on private property is subject to owner consent and where relevant, occupier consent	

If verification monitoring shows that the external noise levels from long-term construction works are consistently above external equivalent NMLs at night at the most sensitive noise receivers, more detailed analysis should be conducted to quantify the building façade loss and the potential of being above the internal NML of 45dB(A) $L_{Aeq,15min}$ specified in PPA Conditions E41/E42. If internal noise levels are found to be above 45dB(A) $L_{Aeq,15min}$, consideration will be given to the provision of at-property treatments, additional on-site measures or other management measures.

Periodic assessment of plant noise levels will be undertaken in accordance with Section 9.2.3 and Table 20 of the CNVMP to confirm the plant noise levels are within the APPENDIX C Table C1.

All noise monitoring will follow the procedures outlined in Appendix D of the CNVMP.

5.4.6 Complaints handling

Noise complaints received and responded to will be managed in accordance with the CNVMP and TSE Community Communication Strategy (SMCSWTSE-JCG-TPW-SH-PLN-002040).

Transport for NSW operate a 24-hour construction complaints line (1800 171 386). Enquiries/ complaints may also be received through the Sydney Metro project email (sydneymetro@transport.nsw.gov.au).

6 Construction vibration impacts

6.1 Minimum working distances for vibration intensive plant

From the plant and equipment listed in APPENDIX C, the dominant vibration generating plant and equipment include:

- Excavator with rock hammer (up to 50 tonnes);
- Vibratory roller;
- Piling rig (impact piling).

Potential vibration generated to receivers is dependent on separation distances, the intervening soil and rock strata, dominant frequencies of vibration, and the receiver structure.

The recommended minimum working distances for vibration intensive plant are presented in Table 6.1 and Table 6.2. These distances are conservatively based on excavation of hard rock. Site specific buffer distances for vibration intensive plant items must be measured on site where plant and equipment are likely to operate close to or within the minimum working distances for cosmetic damage (Table 6.1).

Unlike noise, vibration cannot be readily predicted. There are many variables from site to site, such as soil type and conditions, sub surface rock, building types and foundations, and actual plant on site.

The data relied upon in this assessment (tabulated below) is taken from a database of vibration levels measured at various sites or obtained from other sources (such as BS5228-2:2009). They are not specific to this project as final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver.

Table 6.1: Minimum working distances (m) for cosmetic damage (continuous vibration)

Plant item	Minimum working distance (m)		
	Reinforced or framed structures (e.g. commercial buildings)[1]	Unreinforced or light framed structures (e.g. residential buildings) [1]	Sensitive structures (e.g. heritage structures) [2]
Excavator with rock hammer (45T)	5	10	20
Piling rig (impact piling) – Upper range[4]	15	30	65
Piling rig (impact piling) – Typical[4]	10	15	35
Smooth drum roller (13t) – High vibration	5	10	15

Note 1: Initial screening test criteria reduced by 50% due to potential dynamic magnification in accordance with BS7385.

Note 2: In accordance with Section 5.8.1 of CNVMP, a site inspection should determine whether a heritage structure is structurally unsound.

Note 3: Minimum working distances are in 5m increments only to account for the intrinsic uncertainty of this screening method. Jackhammers and direction drills are likely to have minimum working distances smaller than 5 m (e.g. 1m in accordance with TfNSW CNS).

Note 4: Vibration levels from impact piling are highly dependent on ground conditions and power of the piling rig. In absence of this information, the classification between 'upper range' and 'typical' is based upon reference values obtained from US FTA Transport Noise and Vibration Impact Assessment (ref: FTA-VA-90-1003-06, May 2006).

Table 6.2: Minimum working distances (m) for human annoyance (continuous vibration)

Plant item	Minimum working distances, m				
	Critical areas[1,4]	Residences		Offices[3,4]	Workshops[4]
		Day[2]	Night[2]		
Excavator with rock hammer (45T)	55	35	50	25	15
Piling rig (impact piling) – Upper range	340	200	260	120	70
Piling rig (impact piling) – Typical	175	105	135	65	40
Smooth drum roller (13t) – High vibration[5]	75	40	60	25	15

Notes 1: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.
2: Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.
3: Examples include offices, schools, educational institutions and place of worship.
4: Applicable when in use.
5: Operating for 30% of the time in high vibration mode.

6.2 Vibration assessment

6.2.1 Structural damage

PPA Condition E29 requires owners of properties at risk of exceeding the screening criteria for cosmetic damage to be notified before the commencement of vibration-generating works.

A project-wide register of properties potentially impacted by construction activities is maintained by the JHCPBG. The closest known heritage item within the cosmetic damage impact zone is the bus shelter on Henry Lawson Avenue (BS061 Henry Lawson Avenue) which is immediately adjacent to the site. Based on the pre-construction engineering assessments of other nearby buildings and other detailed assessment undertaken by JHCPBG, the proposed construction equipment and vibration management controls present a negligible risk of exceeding the screening criteria for cosmetic damage at these buildings and structures. Monitoring will be undertaken to verify predictions and if screening criteria is likely to be exceeded different construction methods to lower vibration levels will be considered.

6.2.2 Human annoyance

The assessing vibration guideline [4] notes that inside dwellings, adverse comments often arise when occupants can perceive (feel) vibration, particularly when the vibration arises from a source located outside their home (or outside their control) and assume that the vibration has the potential to damage their building or contents.

However, it is noted that vibration levels required to cause minor cosmetic damage are typically 10 times higher than levels that will cause disturbance to building occupants. Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.

At properties near the worksite, it is likely that the nearest receivers will be able to feel vibration levels when vibration-generating equipment is being utilised. Properties where vibration levels may be above the vibration disturbance goals in Table 4.1 and there is a probability of adverse comment are shown in Table 6.3.

Table 6.3: Properties within minimum distances for human annoyance

Plant item	Activity	Properties	Land use
Excavator with rock hammer (50T)/	Park excavation	1 Warung Street	Residential
		3 Warung Street	Residential
		3a Warung Street	Residential
		5 Warung Street	Residential
		1a Henry Lawson Avenue	Residential
Piling rig (impact piling) – upper range	Wharf construction	14 to 62 Blues Point Road	Residential
		2 West Crescent Street	Residential
		28 to 30 Middle Street	Residential
		3 Parker Street	Residential
		2 to 12 East Crescent Street	Residential
		1 to 9 Warung Street	Residential
		1 to 8 Henry Lawson Avenue	Residential
Piling rig (impact piling) - typical	Wharf construction	14 to 40 Blues Point Road	Residential
		1 to 9 Warung Street	Residential
		1 to 1A Henry Lawson Avenue	Residential
Smooth drum roller (13t)	Wharf construction	3a Warung Street	Residential

From the above table, there are several buildings along Warung street, Henry Lawson Avenue and Blues Point Road that may experience vibration which can cause adverse comment when vibration-generating plant is operated nearby (impact piling, rockhammers and vibratory rollers). Properties are further identified in APPENDIX F.

The above assessment is based on vibration-generating equipment being operating at the closest location to nearby receivers. When vibration-generating equipment operates further from the closest point, the predicted vibration levels will reduce along with the probability of adverse comment.

Attended vibration measurements are proposed to be carried out proactively and in response to vibration complaints. If measurement results indicate exceedances of the vibration objectives for human annoyance at these locations, vibration control and management measures will be provided to reduce vibration impact (see Section 6.3.1).

After applying all feasible and reasonable vibration mitigation measures, if vibration monitoring still identifies that measured vibration levels are above the relevant vibration criteria for human annoyance, appropriate additional mitigation measures should be considered (see Section 6.3.2).

The properties within the potential human annoyance area due to the activities mentioned above are shown in Figure F1, Figure F2 and Figure F3.

6.2.3 Sensitive equipment

Currently there are no properties with sensitive usage or equipment around the worksite. Should such items be identified by JHCPBG, then relevant vibration criteria will be established for each item per Section 5.8.3 of the CNVMP [1], and any corresponding management or mitigation measures determined.

6.3 Vibration mitigation measures

6.3.1 Vibration control and management measures

In addition to the vibration control measures presented in the CNVMP, the following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers and to meet the relevant human comfort vibration and structural damage limits identified in Section 4.2.

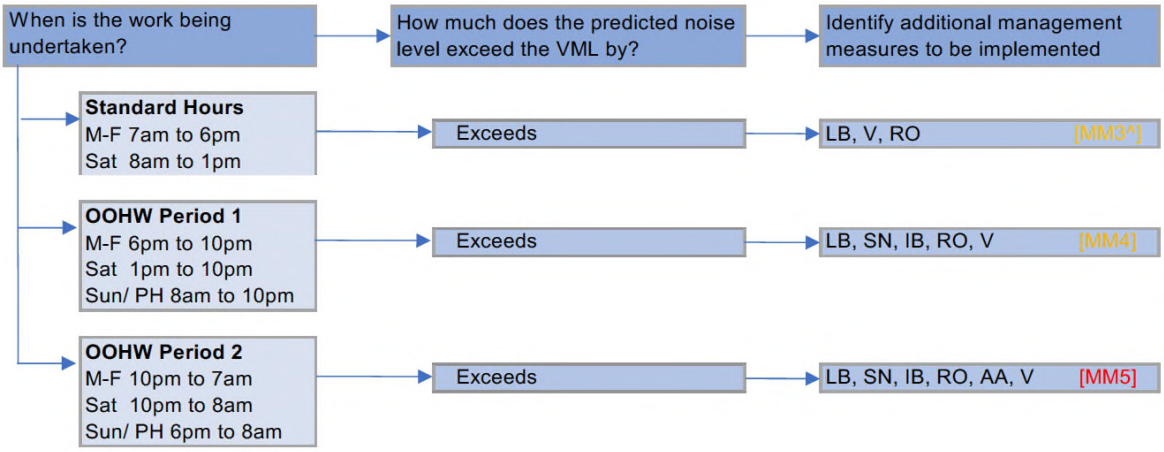
Table 6.4: Site vibration control measures

Control type	Control measure	Typical use
Construction Planning	Building condition surveys	Undertake building dilapidation surveys on all buildings located within the buffer zones established for cosmetic damage prior to commencement of activities with the potential to cause property damage (see Section 6.1).
	Community consultation	Implement community consultation measures – inform community of construction activity & potential impacts – inform community that the level of vibration at which people perceive it, or at which loose objects may rattle, is far lower than the level at which minor cosmetic damage is expected to occur
	Equipment selection/ construction method	Use less vibration emitting construction methods where feasible & reasonable, for example vibratory rollers can, where practicable, be operated with the vibratory mode switched off to reduce vibration impact.
	Plan work activities to minimise vibration.	Plan traffic flow, parking & loading/unloading areas to maximise distances between truck routes and sensitive receivers.
Complaints Management	Construction Complaints Management System	Complaints will be managed in accordance with the Construction Complaints Management System (see Section 6.3.4). Each complaint shall be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures shall be put in place to mitigate future occurrences. Management measures may include modification of construction methods such as using smaller equipment and establishment of safe buffer zones as mentioned above.

6.3.2 Additional vibration mitigation measures

After applying all feasible and reasonable mitigation measures identified in Table 6.4, if vibration monitoring at representative locations are still above relevant vibration objectives for human annoyance, the appropriate additional vibration mitigations measures, as outlined in Section 8.2 of the CNVMP.

Table 6.5: Additional vibration mitigation measures



Notes: Use the abbreviation codes in the table above to confirm management measures required
Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS

LB = Letter box drops
V = Verification monitoring
SN = Specific notifications
IB = individual briefing
RO = Project specific respite offer
AA = Alternative accommodation

6.3.3 Vibration monitoring

Attended vibration monitoring is to be undertaken to determine and verify site specific minimum working distances for cosmetic damage and human annoyance. Properties located within the minimum working distances for human annoyance are identified in Table 6.2.

As a minimum, it is recommended that attended monitoring is undertaken at the locations in Table 6.6 when vibration significant plant items operate close to or within the minimum working distances. Additional monitoring may also be required in response to vibration complaints.

Real-time vibration monitoring in accordance with PPA Condition C11 is not proposed for this site.

Table 6.6: Attended vibration monitoring - nominated representative locations

Plant	Activity	Address	Vibration objectives to check	
			Sensitive equipment (to inspect)	Human annoyance[1]
Excavator with rock hammer (50T	Park excavation	1 Warung Avenue	-	√
Piling rig (impact piling)	Wharf construction	14-28 Blues Point Road	-	√
Smooth drum roller (13t)	Wharf construction	3a Warung Street	-	√

Notes: 1: In the event of complaint related to vibration.
2. Monitoring on private property is subject to owner consent and where relevant, occupier consent

6.3.4 Management of complaints

Vibration complaints received and responded to will be managed in accordance with the CNVMP and TSE Community Communication Strategy (SMCSWTSE-JCG-TPW-SH-PLN-002040).

Transport for NSW operate a 24-hour construction complaints line (1800 171 386). Enquiries/ complaints may also be received through the Sydney Metro project email (sydneymetro@transport.nsw.gov.au).

7 Ground-borne noise assessment

7.1 Ground-borne noise prediction methodology

To assist in predicting ground-borne noise (GBN) levels at the Blues Point worksite, a 3-dimensional model of the shaft was developed. The following GBN significant activities were considered:

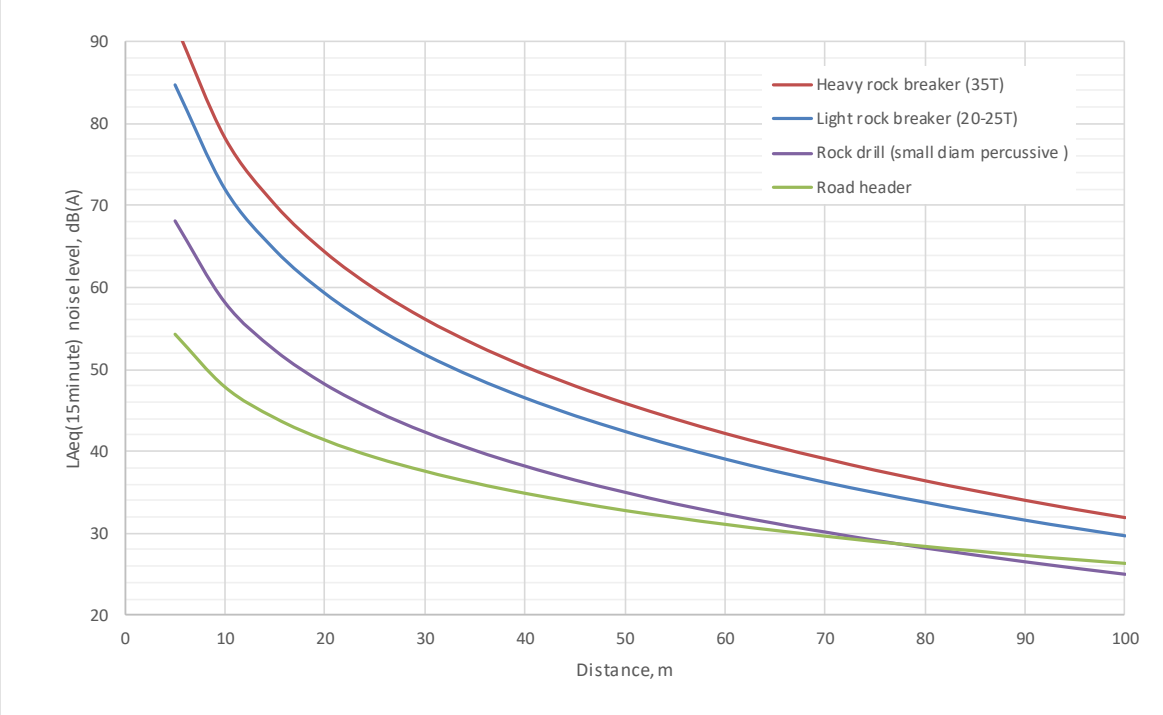
- Rock hammer excavation (35T) of the Blues Point shaft under acoustic cover
- Rock drilling of the Blues Point shaft under acoustic cover

The model included the following features:

- Ground-borne predictions for rockhammer excavation include 5dB penalty for human annoyance.
- Ground heights were derived from 1 m ground contours;
- The ground-height of each building was determined based on the ground surface height.

Based on the ground-borne noise levels versus distance prediction curves for each plant item, ground-borne noise levels are calculated at each building location. The algorithms used in the modelling (see Figure 2) have been developed from measurement data obtained from various Sydney projects, including the Cross City Tunnel (CCT), Lane Cove Tunnel (LCT), Epping to Chatswood Rail Link (ECRL), North West Rail Link (NWRL) and M4 East.

Figure 2 Indicative Ground-borne noise levels from shaft excavation



Source: GBN taken from recent Sydney tunnel projects, including CCT, LCT, ECRL, NWRL and M4E

7.2 Predicted ground-borne noise levels

GBN levels were determined by modelling the noise source, excavation location and receiver locations, based on the information presented in Section 7.1. Predictions below are representative of a typical worst-case scenario where construction activities are undertaken at the closest possible location to nearby receivers. They represent the typical maximum ground-borne noise levels that receivers may experience for a limited amount of time and will reduce as equipment moves further away.

GBN maps are provided in APPENDIX G for the following excavation activities:

- APPENDIX G Figure G1 Shaft excavation under acoustic cover – rock hammer excavation
- APPENDIX G Figure G2 Shaft excavation under acoustic cover – rock drilling

7.2.1 Rock hammer excavation

The estimated number of properties affected by GBN during the rockhammer excavation of the shaft are summarised in Table 7.1.

Table 7.1: Summary of the estimated number of potentially GBN affected properties during rockhammer excavation

Receiver type	>45 dB(A)	>60 dB(A)
Residential	4	2
Educational	0	0
Childcare	0	0
Place of Worship	0	0
Industrial	0	0
Commercial	0	0
Recording Studio	0	0
Hotel/Motel/Hostel	0	0
Medical	0	0
Theatre/Auditorium	0	0

The predicted GBN levels in APPENDIX G and the table above identify that there are potential GBN affected residential properties as a result of excavation of the Blues Point shaft using a heavy rockhammer (35T). Review of predicted GBN levels found that:

- 4 residential properties are exposed to GBN levels between 45 dB(A) and 60 dB(A);
- 2 residential properties are exposed to GBN levels above 60 dB(A).

Additional mitigation measures will be offered in accordance with Section 7.3.2 to the properties identified in APPENDIX G.

7.2.2 Rock drilling

The estimated number of properties affected by GBN during rock drilling of the shaft are summarised in Table 7.2.

Table 7.2: Summary of the estimated number of potentially GBN affected properties during rock drilling

Receiver type	>45 dB(A)	>60 dB(A)
Residential	1	0
Educational	0	0
Childcare	0	0
Place of Worship	0	0
Industrial	0	0
Commercial	0	0
Recording Studio	0	0
Hotel/Motel/Hostel	0	0
Medical	0	0
Theatre/Auditorium	0	0

The predicted GBN levels in APPENDIX G and the table above identify that there is only one potential GBN affected residential property (1 Warung Street) as a result of rock drilling activities in Blues Point shaft. The property is predicted to be exposed to GBN levels exceeding 45 dB(A).

Additional mitigation measures will be offered in accordance with Section 7.3.2 to the properties identified in APPENDIX G.

7.3 Noise mitigation and management

7.3.1 Noise control and management measures

The following at-source control and noise management measures are recommended to reduce potential ground-borne noise impacts.

Table 7.3: Noise control and management measures.

Control Type	Control Measure	Typical Use
At-Source Control Measures	Limit equipment in use	Only the equipment necessary during each stage of the tunnelling will be used.
	Equipment selection	Use quieter and less noise/ vibration emitting construction methods where feasible and reasonable.

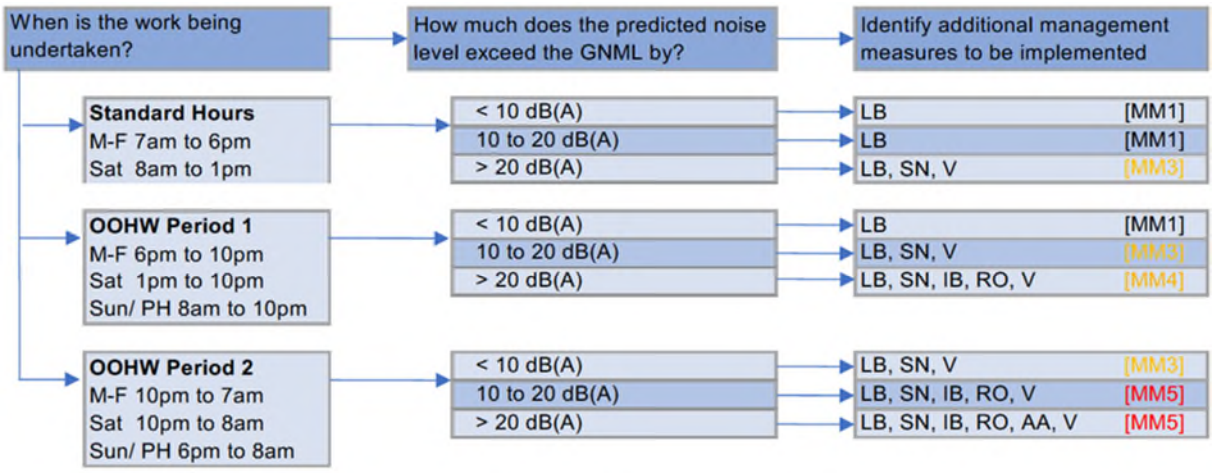
Control Type	Control Measure	Typical Use
Noise Management Measures	Site inductions & Toolbox Talks	All employees, contractors and subcontractors are to receive a Project induction. The environmental component may be covered in toolboxes and should include: • location of nearest sensitive receivers • relevant project specific and standard noise and vibration mitigation measures; • permissible hours of work; • OOHW Procedure and Form.
	Community consultation	Inform community of construction activity and potential impacts.
	Noise monitoring	Noise monitoring is to be carried out as detailed in Section 7.3.3

7.3.2 Additional ground-borne noise mitigation measures

In accordance with Section 8.2.2 of the CNVMP, in circumstances where, after application of all reasonable and feasible mitigation measures, the $L_{Aeq(15minute)}$ ground-borne construction noise levels are still predicted to be above the NMLs, additional ground-borne noise management measures can be applied to further limit the risk of annoyance from construction noise. This requirement is supplemental to the basic requirements in the ICNG.

The steps to be carried out to determine the additional management measures to be implemented are identified in Table 7.4.

Table 7.4: Additional ground-borne noise mitigation measures.



Notes: Use the abbreviation codes in the table above to confirm management measures required
Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS

LB = Letter box drops
SN = Specific notifications
RO = Project specific respite offer
V = Verification monitoring
IB = individual briefing
AA = Alternative accommodation

Prior to the commencement of works, receivers where maximum GBN levels are expected to be above GNMLs (identified in APPENDIX G) will be notified to advise that noise from the works may at times be clearly audible. All potentially impacted receivers will be kept informed of the nature of works to be

carried out, the expected noise levels and duration, as well as be given the project enquiries and complaints 1800 phone numbers (see Section 0).

7.3.3 Attended ground-borne noise monitoring

Attended noise monitoring is to be undertaken to validate the GBN model and to verify that GBN resulting from excavation works are in accordance with the levels predicted in this CNVIS and any EPL Condition, subject to obtaining the property owner/occupier's consent to access the property.

Attended noise monitoring will be conducted during excavation works at representative receivers in the NCAs most affected by the works. Noise measurements will be undertaken internally, ideally in rooms that are the most shielded from existing ambient noise to allow a higher signal to noise ratio to be obtained.

Table 7.5: Attended noise monitoring - nominated representative locations.

NCA	Work activity	Nominated Receiver Address	Monitoring Location
BP_02	Rockhammer excavation	1 Warung Street 3 Warung Street	Internal, within ground floor rooms situated away from the main road
BP_02	Rock drilling	1 Warung Street	Internal, within ground floor rooms situated away from the main road

Note: Monitoring on private property is subject to owner consent and where relevant, occupier consent.

In addition, additional vibration monitoring at the receivers identified in the table above should be considered in order to provide assurance to the residents that vibration levels are not potentially causing any cosmetic damages to the buildings.

7.3.4 Complaints handling

Noise complaints received and responded to will be managed in accordance with the CNVMP and TSE Community Communication Strategy (SMCSWTSE-JCG-TPW-SH-PLN-002040).

Transport for NSW operate a 24-hour construction complaints line (1800 171 386). Enquiries/ complaints may also be received through the Sydney Metro project email (sydneymetro@transport.nsw.gov.au).

8 Traffic noise assessment

8.1 Traffic sources

All heavy vehicles will access the Blues Point worksite via Blues Point Road, which is a sub-arterial road with moderate daytime and night-time flows. During the day, all heavy trucks will exit right on to Blues Point Road, eventually merging onto the Pacific Highway.

Details of projected heavy vehicle movements associated with the construction works were provided by JHCPBG and described in APPENDIX C Table C1. Light vehicle movements associated with construction were not considered to be significant.

To predict road traffic noise levels on the existing road network, the most recent available traffic count data for each road forming part of the site access route was obtained by reviewing the following reference source:

- Traffic counts for Blues Point Road over the week of 9 December 2017 to 15 December 2017 were provided by JHCPBG.

Traffic volumes are detailed in Table 8.1.

Table 8.1: Traffic noise modelling data - existing road network

Site	Road	Road category (RNP)	15-hour day period (7am-10pm)			
			Existing		Project	
			TOTAL	HV	TOTAL	HV
Chatswood	Blues Point Road	Sub - arterial	2795	398	240	240

8.2 Predicted construction traffic noise

The potential impact of construction road traffic noise to nearby residential receivers has been estimated using the United Kingdom Department of Environment's 'Calculation of Road Traffic Noise' (1988) method. The method uses the average 1-hour traffic volume for the 'assessment period' (i.e. day or night) to predict the $L_{10,\ 1hour}$ noise levels. A correction of -3dB(A) is applied to obtain the $L_{eq,\ 1\ hour}$ noise levels which equate to the L_{Aeq} noise levels for the 'assessment period'.

For this assessment, the model has taken into account:

- traffic volume and heavy vehicle forecasts;
- posted vehicle speed;
- road gradient;
- ground reference levels of the road and receivers;
- separation distances of the road to receivers;

- ground type between the road and receivers; and
- angles of view of the road from the receiver's position.

Table 8.2 below summarises the predicted construction traffic noise levels during the daytime period.

Table 8.2: Predicted traffic noise levels (with/ without construction)

Site	Road	Predicted noise level, dB(A) Day period (7am to 10pm)		
		Noise descriptor	No construction	With construction
Chatswood	Blues Point Road	LAeq(15h)	63.2	64.6

Note: **Bold text indicates more than 2dB(A) increase in traffic noise levels resulting from construction traffic.**

The predicted road traffic noise levels indicate a less than 2dB(A) increase in overall day $L_{Aeq(15h)}$ noise on nearby main roads and so construction traffic is predicted to have minimal impact on this road used to access/exit the site.

Predicted noise levels therefore comply with the traffic NMLs identified in Section 4.1.6.

8.3 Traffic noise mitigation and management

No mitigation or management measures are required when construction vehicles are on public roads, provided hourly traffic movements associated with construction are consistent with the assumptions outlined above. The Heavy Vehicle Code of Conduct [JHCPBG Report SMCSWTSE-JCG-TPW-CN-FRM-004218] also includes several measures, including limiting of compression braking, which will ensure that noise impacts of heavy vehicle traffic on surrounding streets are minimised.

9 Cumulative impacts

Currently there are no other unrelated construction activities within the vicinity of Sydney Metro works.

If other non-Sydney Metro construction works are likely to occur simultaneously with the works assessed in this CNVIS, then the cumulative noise and vibration impacts will be reviewed at that point in time on a works by works basis. Any necessary changes to the recommended mitigation and management measures will then be identified and adopted to sufficiently deal with the cumulative noise or vibration impacts.

10 Conclusion

Construction works associated with the construction and operation of the Blues Point worksite have been identified and described in this report. Potentially affected noise and vibration sensitive receivers and relevant construction noise and vibration objectives have been identified and discussed to allow the assessment of potential construction impacts.

Expected construction noise levels have been predicted and presented in Section 5.3 and APPENDIX D. The expected duration of construction activities is outlined in Table C1 of APPENDIX C.

During the day-time/evening period (from 7am to 8pm), the highest noise impacts are predicted to occur during site establishment up to the construction of the acoustic shed.

During the evening/night-time period (from 8pm to 7am), the majority of noise intensive activities will be undertaken within acoustic sheds (SPTM operation will occur external to the shed, for a total duration of approximately 16 nights.). Noise mitigation and management measures have been presented in Section 5.4 to aid in providing additional noise reduction benefits where predicted levels are above the NMLs.

Vibration and ground-borne noise (GBV&N) impacts have been presented in Section 6 and Section 7. Nearest receivers will be GBV affected during excavation of the shaft. Suitable management measures have been presented in Sections 6.3.

Construction traffic assessment indicates compliance with the construction-related road traffic noise objectives.

References

[1] Sydney Metro City & Southwest – TSE Works Construction Noise and Vibration Management Plan (SMCSTSE-JCG-TPW-EN-PLN-002012)

[2] SLR Consulting Australia Pty Ltd 2016 Sydney Metro Chatswood to Sydenham - Technical Paper 2: Noise and Vibration Report Number 610.14718R1 – 28 April 2016

[3] Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline (ICNG),

[4] Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline

[5] British Standard 7385 Part 2 1993, Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration

[6] British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)

[7] Transport for NSW Sydney Metro City & Southwest Construction Noise Strategy (ref: 610.14213-R3) 08 August 2016

[8] Transport for NSW Construction Noise Strategy (ref: 7TP-ST-157/2.0) April 2012

[9] Sydney Metro City & Southwest – TSE Works Construction Noise and Vibration Impact Statement: Site Establishment (TH511-02-1-12F01 SE CNVIS)

[10] NSW Department of Planning – Development near rail corridors and busy road – interim guideline 2008

[11] Eric Schreurs, Lex Browns and Deanna Tomerini – Maximum pass-by noise levels from vehicles in real road traffic streams: comparison to modelled levels and measurement protocol issues. Internoise 2011, Osaka Japan, September 4-7

[12]

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Nearest sensitive receivers and noise management levels

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETRES UNLESS STATED OTHERWISE.
2. ALL DETAILS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN CONFIRMATION.

Legend

- NCAs

Land Use

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium

FOR INFORMATION ONLY

RENZO TONIN & ASSOCIATES
inspired to achieve

REV.	BY	DATE	DESCRIPTION	APPD.
r0	MT	09/10/2017	Prepare figures	CW

SCALES: 10 0 10 20 30 40 m — 1:1,000 FULL SIZE A1

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

INDEPENDENT CERTIFIER CERTIFICATE

CLIENT: NSW GOVERNMENT Transport for NSW

SERVICE PROVIDERS

DRAWN	MT
DESIGNED	MT
DRG CHECK	MT
DESIGN CHECK	MT
APPROVED	CW

SYDNEY METRO
Local Areas and Utility Works (LAUW)
Land Use - Blues Point

STATUS: DRAFT | SHEET 1 OF 0 | ©

TSE Drg No. DRAFT | TSE REV.

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing.

0 10 20 30 40 50 60 70 80 m

Plot Date: 09/10/17 - 09:07 GIS File: R:/AssocSydProjects/TH531-TH550/TH531 pk Sydney Metro City & Southwest/00 GLOBAL/11 GIS/02 GIS/TH531-01 0 02 000 [r0] Base map - MT.qgs

Table B1: Noise Sensitive Receivers and Construction Noise Management Levels **BLUES POINT**

NCA	Receiver Type	Reference RBL	Rating Background Levels (RBLs)			Residential NMLs based on ICNG (to guide notifications and feasible and reasonable mitigation measures)					Residential External Noise Management Levels (NML - Condition E41/E42) $L_{Aeq(15\ min)}$	Sleep Dist. L_{Amax}		Comments
			Day	Evening	Night	Day (S)	Day (O)	Evening (6pm-10pm)	Shoulder (10pm - 12am)	Night (12am - 7am)	Night (8 pm to 7am)	Screening	Max	
BP_01	Residential apartments east of Blues Point Rd	EIS B.14	51	49	40	61	56	54	50	45	55*	55	65	combined NCAs A&B from EIS
BP_02	Residential apartments west of Blues Point Rd	EIS B.14	51	49	40	61	56	54	50	45	55*	55	65	combined NCAs C&D from EIS
BN_02	Residential buildings north of Argyle St and Bettington St	EIS B.12	50	45	40	60	55	50	47	45	55-65*	55	65	EIS Barangaroo Station_B
ID	**Other Sensitive Recievers**													
	Other sensitive receivers (Condition E34) - Only applies when in use and when predicted levels are above NMLs													
OSR	**Commercial premises**		**-**	**-**	**-**	**70**	**70**	**70**	**70**	**70**		**-**	**-**	
	2 HENRY LAWSON AVENUE MCMAHONS POINT													Sails on Lavender Bay
OSR	**Hotel**		**-**	**-**	**-**	**60**	**60**	**60**	**60**	**60**		**-**	**-**	
	2A Henry Lawson Ave, McMahons Point NSW 2060													Harbourside Serviced Apartments
	Other sensitive receivers (NMLs only apply when the premises is in use)													
OSR	Hotel (Sleeping areas: Hotels near major roads)	ICNG	-	-	-	60	60	60	60	60		-	65	NML of 60dB(A) is external equivalent of 40dB(A) internal goal for with windows closed with reference to AS2107
OSR	Classrooms at schools and other educational institutions	ICNG	-	-	-	55	55	55	55	55		-	-	Only applies when in use. NML of 55dB()A is external equivalent of 40dB(A) internal goal for with windows open, as outlined in CNVMP with reference to ICNG, p13
OSR	Places of worship	ICNG	-	-	-	55	55	55	55	55		-	-	Only applies when in use. NML of 55dB()A is external equivalent of 40dB(A) internal goal for with windows open, as outlined in CNVMP with reference to ICNG, p13
OSR	Hotel (bars and lounges)		-	-	-	60	60	60	60	60		-	-	NML of 60dB(A) is external equivalent of 50dB(A) internal goal for with windows open, as outlined in CNVMP with reference to AS2107
OSR	Cinema space, theatre, auditorium		-	-	-	55	55	55	55	55		-	-	NML of 55dB(A) is external equivalent of 35dB(A) internal goal for with windows closed, as outlined in CNVMP with reference to AS2107
OSR	Commercial premises	ICNG	-	-	-	70	70	70	70	70		-	-	Ref: ICNG p14
OSR	Industrial	ICNG	-	-	-	75	75	75	75	75		-	-	Ref: ICNG p14
Note:	*depending of building noise façade loss													

Table B2: Heritage listed building/structures **BLUES POINT**

Name	Address/Location	Significance
McMahons Point South	-	Local
Blues Point Tower	14 Blues Point Rd, Mcmahons Point NSW 2060, Australia	Local
Bus stop	1A Henry Lawson Ave, Mcmahons	Local
Slipway and site of former Holmes' residence	1 Henry Lawson Ave, Mcmahons Point NSW 2060, Australia	Local
Former tram turning circle and McMahons Point ferry wharf	Henry Lawson Avenue	Local
Seawall	2a Henry Lawson Avenue	Local
Blues Point Waterfront Group	2 Henry Lawson Avenue Mcmahons Point	Local

APPENDIX C Construction timetable/ activities/ management

Figure C1: Site layout showing indicative mitigation **BLUES POINT**

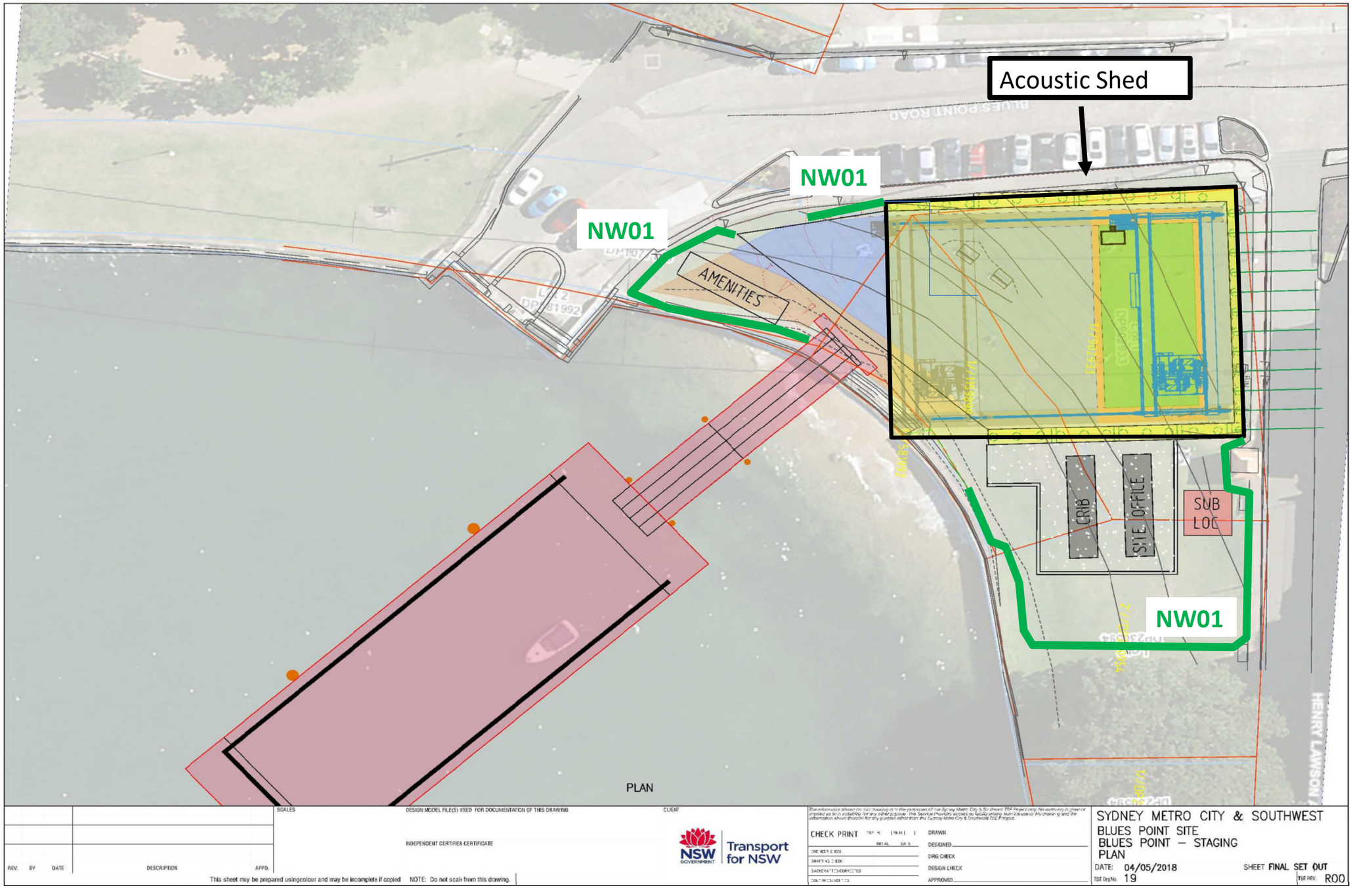


Table C1: Construction timetable/ activities/ equipment **BLUES POINT**

Activity/ Work Area	Aspect	Plant/ Equipment	Net Power kW	Operating Weight kg	Day	E1	E2 / Night	Timing of Activity (Approx. No. weeks)	Notes	Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)	
					7am - 6pm	6pm - 8pm	8pm - 7am			L_{Aeq}	
Construction Compound Establishment	Site Establishment	Light vehicle	80		4 per hour			Full duration	Busy on shift changes only	89	
		Excavator			1			Full duration		103	
		Concrete agitator trucks			1			Full duration		108	
	Accommodation Installation	Road truck (deliveries to site)			4 p.h.			Full duration		106	
		Compressor	110	2660	1			Full duration		102	
		Telehandler			1			Full duration	Surface	98	
		Workshop Hand Tools			3			Full duration		107	
		Welding equipment			1			Full duration	Mig welders required to setup site	99	
		Road sweeper truck			1			Full duration	keeping hardstand and local roads clean	108	
		Franna Crane	205	25 tonne	1			Full duration		99	
	Contamination & Heritage Investigation	Water cart		15kL	1 p.h.			Full duration		108	
		Excavator		9 tonne	2			3 months		103	
		Excavator		15 tonne	2			3 months		103	
		Franna Crane			1			3 months		99	
		Vacuum Truck			2 per day			3 months		108	
	Hoarding Installation	Bobcat			1			3 months		104	
		Tracked excavator w bucket		10 tonne	1			3 months		103	
		Flat-top truck			1			3 months		106	
		Hiab			1			3 months		96	
		Hand tools		5 tonne	1			3 months		107	
		Concrete agitator trucks			1			3 months		108	
	Deliveries & Substation Install	Delivery Truck		20 tonne	1			3 months		106	
		Telehandler			1			3 months		98	
		Mobile Cane 150t			1			3 months		103	
		Franna Crane			1			3 months		99	
Excavation of Park and Import Material for Piling Pad	Excavation of soil and rock; Hammering/rock breaking; Drilling; Loading; Haulage.	50t excavator loading			1			6 months	Surface	107	
		50t excavator hammering			2			6 months	Surface	122+5	
		Truck and dog haulage			8 p.h.			6 months	Surface	106	
		100kw dozer			1			6 months	Surface	116	
Piling and Capping Beam Construction	Piling Operation	Crawler Crane 100t		100 tonne	2			1 month	Surface	103	-
		Concrete Line Pump		15 tonne	1			1 month	Surface	103	-
		Delivery truck		20 tonne	3 p.h			1 month	Surface	106	-
		Excavator		23 tonne	2			1 month	Surface	103	
		Bogie truck			4 p.h.			1 month	Surface	106	
		Concrete Delivery Truck			1 p.h			1 month	Surface	106	-
		Piling rig (bored piling)		80 tonne	3			1 month	Surface	110	-
		Power Tools (drills)		N/A	1			1 month	Surface	104	-
		Hand Tools		N/A	1			1 month	Surface	107	-
	Concrete Works Capping Beam and Pile Breaking (After piling completion)	Crane 130t		130 tonne	1			1 month	Surface	103	-
		Jackhammer air powered			2			1 month	Surface	113+5	-
		Compressor 800 CFM			1			1 month	Surface	92	-
		Concrete Boom Pump			3			1 month	Surface	103	-
		Concrete vibrator pokers			8			1 month	Surface	100	-
		Concrete delivery truck			8 p.h			1 month	Surface	106	-
		Concrete helicopter float		N/A	1			1 month	Surface	100	-
		Hand tools concrete finishing		N/A	1			1 month	Surface	107	-
Construct Acoustic Shed		Crawler crane		200t	1			4 months	Surface	103	
		Franna crane		25t	1			4 months	Surface	99	
		Delivery trucks		20t	2 p.h.			4 months	Surface	106	
		Elevated works platforms			2			4 months	Surface	95	
		Power tools - table saw			2			4 months	Surface	106	
		Power tools - rotary drill			2			4 months	Surface	104	
		Power tools - 5" grinder			2			4 months	Surface	106	
		Telehandler			1			4 months	Surface	98	
		Air compressor		250cfm	1			4 months	Surface	102	
Excavate Blues Point Shaft		Excavator with hammer		45t	1			3 months	Note: inside Acoustic Shed	122+5	
		Excavator with hammer		30t	1			3 months	Note: inside Acoustic Shed	122+5	
		Gantry crane (electric)			1			3 months	Inside the shed	96	
		Concrete agitator trucks			2 p.h.			3 months	Inside the shed	108	
		Shotcrete rig			1			3 months	Inside the shed	104	
		Drilling jumbo			1			3 months	Inside the shed	120+5	
		Excavator with a diamond saw			1			3 months	Inside the shed	121+ 5	
		Excavator w bucket		35 tonne	2			3 months	Inside the shed	103	
		Vacuum Truck			2 per day			3 months	Inside the shed	108	
		Front End Loader			2			3 months	Front End Loader movements from the shed to the wharf outside and unloading onto barge	110	
		Barge & tug boat			1			3 months	At the wharf	100	
		Dust Scrubber Korfmann GAL14 - 1100/1100 w/ 2 silencer SDS14			1			3 months	Surface - inside shed or at the southern end of the eastern facade of acoustic shed.	113	
		Substation			1			3 months	Surface - East of shed near northern boundary	80	

Table C1: Construction timetable/ activities/ equipment **BLUES POINT**

Activity/ Work Area	Aspect	Plant/ Equipment	Net Power kW	Operating Weight kg	Day	E1	E2 / Night	Timing of Activity (Approx. No. weeks)	Notes	Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)
					7am - 6pm	6pm - 8pm	8pm - 7am			L_{Aeq}
Wharf (Ramp) Construction potentially concurrent with shed construction	Pile Driving	Driven Piling Rig Barge Mounted (BDA Pyrmont)			1			7 days		126+5
		Barge			1			7 days		100
	Ramp Placement	Crane			1			7 days		103
		Barge			1			7 days		100
		EWP			2			7 days		95
		Telehandler			2			7 days		98
		Tipper Truck		5 tonne	1			7 days		106
		Tipper Truck		8 tonne	1			7 days		106
		Roller			1			7 days		109+5
TBM Retrieval & Disassembly	TBM retrieval	SPMT			1	1	1	4 nights per TBM (16 nights in total)	TBM will be transferred to surface inside shed and will be loaded on barge using SPMT	116
		Gantry crane in acoustic shed - with visible alarms after 10:00pm			4 lifts/hr	4 lifts/hr	4 lifts/hr		220t rating (with/without alarm)	96/90
		Barge			1	1	1			100
		Site Forklift			1	1	1		forklift assists with timbers and bringing materials in the crane's reach	99
	TBM disassembly (bottom of the shaft and inside tunnel)	Hammering Steel			2 locations	1 location	-	16 weeks	Instantaneous noise level 115-120 dB(A). Assume hammering occurs for 1-2 min over 15 min period, - $L_{eq(15\ min)}$ 110 dB(A)	110 -
		Air/ hydraulic hand tools			2	2	2	16 weeks	Bottom of shaft (inside the shed)	107
		Oxy torch			1	1	1	16 weeks	On surface (inside the shed)	96
		Impact gun			2	2	2	16 weeks	On surface (inside the shed)	99
		EWP			1	1	1	16 weeks	On surface (inside the shed)	95
		HP washer			1	1	1	16 weeks	On surface (inside the shed)	97
		Grinder			2	2	2	16 weeks	On surface (inside the shed)	105
		Hydraulic Power Pack	45	60.3 hp	1	1	1	16 weeks	Bottom of shaft (with/ without acoustic attenuation)	63/76
		Welding Machines 400 amp			4	4	4	16 weeks	Bottom of shaft and inside tunnel.	99
		Site Forklift			1	1	1	16 weeks	Working on bottom of shaft / in tunnel	103
		Gantry crane in acoustic shed - with visible alarms after 10:00pm			4 lifts/hr	4 lifts/hr	4 lifts/hr	16 weeks	220t rating (with/without alarm)	96/90
		Substation			1	1	1	16 weeks	Surface - East of shed near northern boundary	80

APPENDIX D Detailed predicted noise levels

The impacts presented in the following table are identified by colour coding of the text.

For **Standard Hours:**

- XX Complies with NML
- **XX** < 10dB(A) above NML - construction noise clearly audible
- **XX** > 10dB(A) above NML - construction noise clearly moderately intrusive
- **XX** > 75dB(A) - highly noise affected

For **E1 (from 6pm to 8pm)**

- XX Complies with NML
- **XX** < 5 dB(A) above NML - construction noise noticeable
- **XX** 5 to 15 dB(A) above NML - construction noise clearly audible
- **XX** > 15 to 25 dB(A) above NML - construction noise moderately intrusive
- **XX** > 25 dB(A) above NML - construction noise highly intrusive

For **E2 (from 8pm to 10pm), Night:**

- XX Noise levels predicted to be below internal NMLs in PPA Condition E41/E42 (residential receivers)
- **XX** Noise levels predicted to be above internal NMLs in PPA Condition E41/E42 (residential receivers)

Predicted construction noise levels **Blues Point**

			Predicted noise levels, dB(A)										Predicted noise levels, dB(A)											
			Day (Standard)										Day (OOHW)			E1 (6pm to 8pm)			E2 (8pm to 10pm)			Night (OOHW)		
NCA ID	Assumed Façade loss dB(A)	Land use	NML	CCE	EP_H	EP_L	PC	ASC	WR	SE	TBM_D	TBM_R	NML	TBM_D	TBM_R	NML	TBM_D	TBM_R	External Equivalent NML	TBM_D	TBM_R	External Equivalent NML	TBM_D	TBM_R
BN_02-1559	10	Residential	60	13	30	17	11	9	45	34	15	23	55	15	23	50	14	23	55	14	23	55	14	23
BN_02-4516	10	Residential	60	28	46	31	25	14	54	43	24	37	55	24	37	50	23	37	55	23	37	55	23	37
BN_02-4515	10	Residential	60	19	35	21	11	9	40	33	14	24	55	14	24	50	13	24	55	13	24	55	13	24
BN_02-4514	10	Residential	60	21	38	24	21	14	46	41	22	30	55	22	30	50	21	30	55	21	30	55	21	30
BN_02-4510	10	Residential	60	24	42	27	21	12	50	41	23	32	55	23	32	50	21	32	55	21	32	55	21	32
BN_02-4508	10	Residential	60	22	39	25	20	12	45	39	20	29	55	20	29	50	19	29	55	19	29	55	19	29
BN_02-4506	10	Residential	60	25	41	27	23	13	49	43	24	33	55	24	33	50	22	33	55	22	33	55	22	33
BN_02-4505	10	Residential	60	22	39	24	20	13	47	41	23	31	55	23	31	50	21	31	55	21	31	55	21	31
BN_02-4504	10	Residential	60	31	48	33	28	21	57	46	28	38	55	28	38	50	25	38	55	25	38	55	25	38
BN_02-4360	10	Residential	60	30	46	31	27	15	55	45	26	37	55	26	37	50	24	37	55	24	37	55	24	37
BN_02-4362	10	Residential	60	33	49	35	29	22	62	46	27	39	55	27	39	50	26	39	55	26	39	55	26	39
BN_02-4363	10	Residential	60	15	31	18	14	12	39	35	16	24	55	16	24	50	15	24	55	15	24	55	15	24
BN_02-9703	10	Residential	60	41	56	41	33	23	66	51	31	46	55	31	46	50	30	46	55	30	46	55	30	46
BN_02-4523	10	Residential	60	38	54	39	33	24	61	49	29	44	55	29	44	50	26	44	55	26	44	55	26	44
BN_02-9796	10	Residential	60	12	27	14	10	7	36	32	13	21	55	13	21	50	12	21	55	12	21	55	12	21
BN_02-9870	10	Residential	60	19	32	16	10	8	34	30	10	20	55	10	20	50	9	20	55	9	20	55	9	20
BN_02-9867	10	Residential	60	8	25	10	7	6	32	26	7	17	55	7	17	50	6	17	55	6	17	55	6	17
BN_02-4331	10	Residential	60	11	27	14	10	6	35	33	13	20	55	13	20	50	12	20	55	12	20	55	12	20
BN_02-4332	10	Residential	60	10	27	13	9	6	34	32	13	20	55	13	20	50	12	20	55	12	20	55	12	20
BN_02-4355	10	Residential	60	25	42	27	21	13	52	41	22	35	55	22	35	50	20	35	55	20	35	55	20	35
BN_02-4354	10	Residential	60	23	40	25	22	12	50	40	20	32	55	20	32	50	18	32	55	18	32	55	18	32
BN_02-4373	10	Residential	60	27	43	29	21	13	51	41	22	34	55	22	34	50	19	34	55	19	34	55	19	34
BN_02-4372	10	Residential	60	27	43	29	18	12	52	40	21	34	55	21	34	50	19	34	55	19	34	55	19	34
BN_02-4371	10	Residential	60	29	45	30	22	12	54	41	21	36	55	21	36	50	19	36	55	19	36	55	19	36
BN_02-4370	10	Residential	60	31	47	32	26	14	55	43	24	37	55	24	37	50	21	37	55	21	37	55	21	37
BN_02-4369	10	Residential	60	30	46	31	22	13	54	42	23	36	55	23	36	50	21	36	55	21	36	55	21	36
BN_02-4368	10	Residential	60	28	45	31	23	13	53	43	24	36	55	24	36	50	22	36	55	22	36	55	22	36
BN_02-4367	10	Residential	60	31	48	33	27	16	55	45	26	38	55	26	38	50	23	38	55	23	38	55	23	38
BN_02-4366	10	Residential	60	31	48	33	28	15	54	45	26	38	55	26	38	50	23	38	55	23	38	55	23	38
BN_02-4365	10	Residential	60	32	47	33	27	16	56	46	27	39	55	27	39	50	24	39	55	24	39	55	24	39
BN_02-4364	10	Residential	60	33	48	33	27	16	57	46	27	40	55	27	40	50	24	40	55	24	40	55	24	40
BN_02-4361	10	Residential	60	32	47	32	27	17	58	45	27	39	55	27	39	50	25	39	55	25	39	55	25	39
BN_02-4517	10	Residential	60	20	33	19	11	9	51	36	16	32	55	16	32	50	15	32	55	15	32	55	15	32
BN_02-9863	10	Residential	60	17	34	21	16	11	42	38	19	27	55	19	27	50	18	27	55	18	27	55	18	27
BN_02-9869	10	Residential	60	17	35	21	16	11	42	38	19	27	55	19	27	50	18	27	55	18	27	55	18	27
BN_02-9860	10	Residential	60	25	29	14	24	10	36	36	18	26	55	18	26	50	13	26	55	13	26	55	13	26
BN_02-9859	10	Residential	60	25	42	27	23	10	49	37	18	32	55	18	32	50	17	32	55	17	32	55	17	32
BN_02-9845	10	Residential	60	19	32	17	16	9	37	35	16	22	55	16	22	50	15	22	55	15	22	55	15	22
BN_02-4537	10	Residential	60	17	31	18	16	9	43	36	17	26	55	17	26	50	16	26	55	16	26	55	16	26
BN_02-4538	10	Residential	60	30	47	32	27	26	52	42	23	36	55	23	36	50	21	36	55	21	36	55	21	36
BN_02-3085	10	Residential	60	46	57	42	46	39	69	56	36	52	55	36	52	50	34	52	55	34	52	55	34	52
BN_02-4375	10	Residential	60	41	51	36	40	27	65	53	33	48	55	33	48	50	31	48	55	31	48	55	31	48
BN_02-3084	10	Residential	60	44	53	39	43	38	66	53	33	50	55	33	50	50	31	50	55	31	50	55	31	50
BN_02-4374	10	Residential	60	35	50	36	34	30	58	47	28	42	55	28	42	50	26	42	55	26	42	55	26	42
BN_02-4519	10	Residential	60	33	49	34	34	29	57	46	28	41	55	28	41	50	25	41	55	25	41	55	25	41
BN_02-4518	10	Residential	60	33	49	34	32	26	57	46	27	40	55	27	40	50	24	40	55	24	40	55	24	40
BN_02-4503	10	Residential	60	32	49	34	30	28	54	44	25	38	55	25	38	50	23	38	55	23	38	55	23	38
BN_02-9938	10	Residential	60	17	32	19	16	17	42	35	16	27	55	16	27	50	15	27	55	15	27	55	15	27
BN_02-4333	10	Residential	60	13	30	17	7	6	38	31	11	21	55	11	21	50	10	21	55	10	21	55	10	21
BN_02-4334	10	Residential	60	13	30	17	12	9	38	34	14	23	55	14	23	50	13	23	55	13	23	55	13	23
BN_02-4335	10	Residential	60	25	43	28	24	12	50	41	22	34	55	22	34	50	20	34	55	20	34	55	20	34
BN_02-4336	10	Residential	60	27	42	28	26	14	52	42	23	35	55	23	35	50	20	35	55	20	35	55	20	35
BN_02-4337	10	Residential	60	13	30	17	12	10	38	34	15	23	55	15	23	50	14	23	55	14	23	55	14	23
BN_02-4338	10	Residential	60	22	38	24	21	13	48	40	21	31	55	21	31	50	19	31	55	19	31	55	19	31
BN_02-4339	10	Residential	60	21	39	25	21	12	47	39	20	31	55	20	31	50	19	31	55	19	31	55	19	31
BN_02-4341	10	Residential	60	26	40	26	25	14	51	41	23	35	55	23	35	50	20	35	55	20	35	55	20	35
BN_02-4344	10	Residential	60	26	42	27	25	14	51	40	21	35	55	21	35	50	20	35	55	20	35	55	20	35
BN_02-4349	10	Residential	60	25	36	22	18	9	47	38	19	32	55	19	32	50	18	32	55	18	32	55	18	32
BN_02-4351	10	Residential	60	23	41	27	19	9	49	39	20	31	55	20	31	50	19	31	55	19	31	55	19	31
BN_02-9940	10	Residential	60	32	49	34	29	28	54	44	25	38	55	25	38	50	23	38	55	23	38	55	23	38
BN_02-4343	10	Residential	60	26	41	26	25	14	51	40	21	35	55	21	35	50	19	35	55	19	35	55	19	35
BN_02-4342	10	Residential	60	27	44	29	26	14	51	41	22	35	55	22	35	50	20	35	55	20	35	55	20	35
BN_02-4345	10	Residential	60	24	41	27	22	12	49	40	21	32	55	21	32	50	19	32	55	19	32	55	19	32
BN_02-4346	10	Residential	60	24	41	27	23	12	49	40	21	32	55	21	32	50	19	32	55	19	32	55	19	32
BN_02-4347	10	Residential	60	24	42	27	23	13	49	40	21	33	55	21	33	50	19	33	55	19	33	55	19	33
BN_02-4348	10	Residential	60	28	43	29	25	13	51	41	22	35	55	22	35	50	20	35	55	20	35	55	20	35
BN_02-9937	10	Residential	60	32	49	34	29	28	54	45	26	39	55	26	39	50	24	39	55	24	39	55	24	39
BN_02-9950	10	Residential	60	32	49	34	29	28	54	44	25	38	55	25	38	50	23	38	55	23	38	55	23	38
BN_02-10303	10	Residential	60	9	25	12	8	6	34	29	10	18	55	10	18	50	9	18	55	9	18	55	9	18
BP_01-4079	10	Residential	61	68	85	73	74	68	86	74	57	70	56	57	70	54	52	70	55	52	70	55	52	70
BP_01-4084	10	Residential	61	70	86	75	77	70	85	68	49	54	56	49	54	54	49	54	55	49	54	55	49	54
BP_01-4085	10	Residential	61	66	81	70	71	65	81	63	44	46	56	44	46	54	44	46	55	44	46	55	44	46
BP_01-4088	10	Residential	61	62	77	65	67	61	77	60	41	43	56	41	43	54	41	43	55	41	43	55	41	43
BP_01-4091	10	Residential	61	64	78	66	68	62	75	59	40	42	56	40	42	54	40	42	55	40	42	55	40	42
BP_01-4093	10	Residential	61	63	77	66	68	62	76	60	41	43	56	41	43	54	40	43	55	40	43	55	40	43
BP_01-4094	10	Residential	61	56	71	59	60	54	71	55	36	40	56	36	40	54	36	40	55	36	40	55	36	40
BP_01-4096	10	Residential	61	58	72	61	62	55	72	58	39	41	56	39	41	54	39	41	55	39	41	55	39	41
BP_02-4082	10	Residential	61	55	70	58	59	53	70	57	38	48	56	38	48	54	38	48	55	38	48	55	38	48
BP_02-4081	10	Residential	61	57	72	60	60	55	74	58	39	49	56	39	49	54	39	49	55	39	49	55	39	49
BP_02-4080	10	Residential	61	57	72	61	61	54	76	59	41	52	56	41	52	54	40	52	55	40	52	55	40	52
BP_02-4306	10	Residential	61	64	78	67	67	60	79	64	44	59	56	44	59	54	44	59	55	44	59	55	44	59
BP_02-4176	10	Residential	61	63	78	66	65	59	80	65	45	62	56	45	62	54	44	62	55	44	62	55	44	62
BP_02-4300	10	Residential	61	76	92	81	83	76	88	72	52	59	56	52	59	54	51	59	55	51	59	55	51	59
BP_02-4304	10	Residential	61	59	74	62	63	58	70	60	41	50	56	41	50	54	41	50	55	41	50	55	41	50
BP_02-4301	10	Residential	61	61	76	65	71	64	76	61	42	44	56	42	44	54	42	44	55	42	44	55	42	44
BP_02-4303	10	Residential	61	74	88	77	80	73	84	71	51	67	56	51	67	54	50	67	55	50	67	55	50	67
BP_02-4305	10	Residential	61	71	85	74	72	66	83	68	47	66	56	47	66	54	47	66	55	47	66	55	47	66
BP_02-4302	10	Residential	61	70	84	73	69	63	81	66	45	65	56	45	65	54	45	65	55	45	65	55	45	65
BP_02-9700	10	Residential	61	76	90	79	79	72	85	72	51	68	56	51	68	54	51	68	55	51	68	55	51	68
BP_02-4307	10	Residential	61	68	82	71	69	62	84	67	45	67	56	45	67	54	45	67	55	45	67	55	45	67
BP_02-4179	10	Residential	61	53	67	55	56	51	72	59	41	50	56	41	50	54	38	50	55	38	50	55	38	50
BP_02-4181	10	Residential	61	52	70	59	54	49	73	58	40	53	56	40	53	54	38	53	55	38	53	55	38	53
BP_02-4182	10	Residential	61	35	50	37	36	31	52	49	31	35	56	31	35	54	30	35	55	30	35	55	30	35
BP_02-4180	10	Residential	61	47	63	49	47	43	68	57	39	47	56	39	47	54	38	47	55	38	47	55	38	47
BP_02-4178	10	Residential	61	36	51	39	37	33	56	51	32	38	56	32	38	54	32	38	55	32	38	55	32	38
BP_02-4216	10	Residential	61	36	52	40	39	34	53	48	28	38	56	28	38	54	28	38	55	28	38	55	28	38
BP_02-4217	10	Residential	61	44	60	47	46	43	72	58	38	53	56	38	53	54	37	53	55	37	53	55	37	53
BP_02-9701	10	Residential	61	64	73	60	63	57	70	61	41	51	56	41	51	54	41	51	55	41	51	55	41	51
BP_02-4213	10	Residential	61	74	84	73	76	69	88	70	48	72	56	48	72	54	48	72	55	48	72	55	48	72
BP_02-4175	10	Residential	61	63	78	66	67	61	81	65	43	66	56	43	66	54	43	66	55	43	66	55	43	66
BP_02-4308	10	Residential	61	69	83	72	70	64	82	68	46	66	56	46	66	54	45	66	55	45	66	55	45	66
OSR -1553	20	Commercial	70	27	44	29	26	14	51	42	23	35	70	23	35	70	20	35	70	20	35	70	20	35
OSR -4352	20	Hotel/Motel/Hostel	60	32	48	33	28	21	56	43	24	38	60	24	38	60	21	38	60	21	38	60	21	38
OSR -4536	20	Commercial	70	32	49	34	30	16	56	45	26	40	70	26	40	70	24	40	70	24	40	70	24	40
OSR -4379	20	Commercial	70	34	49	35	33	24	58	47	28	41	70	28	41	70	26	41	70	26	41	70	26	41
OSR -4329	20	Commercial	70	30	46	31	29	15	54	44	25	38	70	25	38	70	23	38	70	23	38	70	23	38
OSR -4432	20	Hotel/Motel/Hostel	60	20	38	24	19	10	45	39	20	29	60	20	29	60	19	29	60	19	29	60	19	29
OSR -9795	20	Commercial	70	9	25	12	8	7	33	30	10	18	70	10	18	70	9	18	70	9	18	70	9	18
OSR -10305	20	Commercial	70	9	25	12	8	6	33	29	10	18	70	10	18	70	9	18	70	9	18	70	9	18
OSR -1560	20	Commercial	70	36	50	36	34	24	66	49	31	43	70	31	43	70	29	43	70	29	43	70	29	43
OSR -4377	20	Commercial	70	44	54	39	40	27	68	54	34	51	70	34	51	70	31	51	70	31	51	70	31	51
OSR -4524	20	Commercial	70	35	50	36	32	17	56	46	27	40	70	27	40	70	25	40	70	25	40	70	25	40
OSR -4376	20	Theatre/Auditorium	50	33	50	35	32	20	57	47	28	41	50	28	41	50	25	41	50	25	41	50	25	41
OSR -4378	20	Commercial	70	36	50	35	33	18	61	47	28	43	70	28	43	70	24	43	70	24	43	70	24	43
OSR -10302	20	Commercial	70	23	36	22	21	10	44	39	20	30	70	20	30	70	19	30	70	19	30	70	19	30
OSR -10304	20	Commercial	70	9	25	12	8	6	34	29	10	18	70	10	18	70	9	18	70	9	18	70	9	18
OSR -4214	20	Commercial	70	53	66	54	49	45	74	55	34	56	70	34	56	70	33	56	70	33	56	70	33	56
OSR -4215	20	Hotel/Motel/Hostel	60	55	69	57	56	51	76	60	40	60	60	40	60	60	38	60	60	38	60	60	38	60

APPENDIX E Additional noise mitigation

The following table identifies the additional mitigation measures to be applied at construction noise affected receivers.

When is the work being undertaken?	How much does the predicted noise level exceed the ANML by?	Identify additional management measures to be implemented
Standard Hours M-F 7am to 6pm Sat 8am to 1pm	0 dB(A)	- -
	≤ 10 dB(A)	- -
	10 to 20 dB(A)	LB, V [MM2]
	> 20 dB(A)	LB, V [MM2]
	Highly noise affected	LB, SN, IB, RO, V [MM4]
OOHW Period 1 M-F 6pm to 10pm Sat 1pm to 10pm Sun/ PH 8am to 10pm	< 5 dB(A)	- -
	5 to 15 dB(A)	LB [MM1]
	15 to 25 dB(A)	LB, V [MM2]
	> 25 dB(A)	LB, SN, IB, RO, V [MM4]
OOHW Period 2 M-F 10pm to 7am Sat 10pm to 8am Sun/ PH 6pm to 8am	< 5 dB(A)	LB [MM1]
	5 to 15 dB(A)	LB, V [MM2]
	15 to 25 dB(A)	LB, SN, IB, RO, V [MM4]
	> 25 dB(A)	LB, SN, IB, RO, AA, V [MM5]

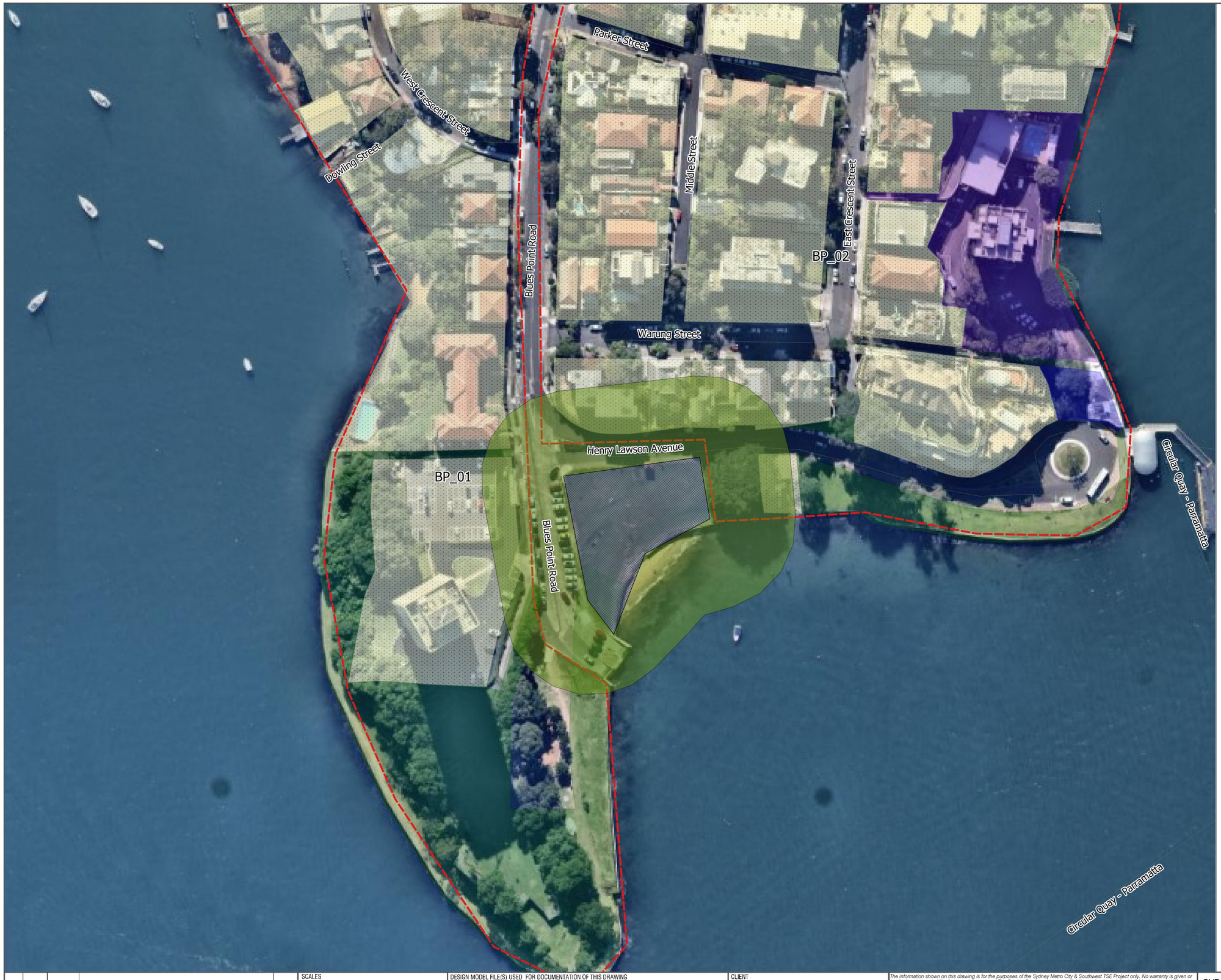
Notes: Use the abbreviation codes in the table above to confirm management measures required
Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS

LB = Letter box drops
V = Verification monitoring
SN = Specific notifications
IB = individual briefing
RO = Project specific respite offer
AA = Alternative accommodation

Table E1: Additional noise mitigation and receiver notifications **Blues Point**

Receiver		Additional noise mitigation and receiver notifications															
		Day (Standard)									Day (OOHW)		E1 (6pm to 8pm)		E2 (8pm to 10pm)		Night (OOHW)	
NCA	Address	CCE	EP_H	EP_L	PC	ASC	WR	SE	TBM_D	TBM_R	TBM_D	TBM_R	TBM_D	TBM_R	TBM_D	TBM_R	TBM_D	TBM_R
BN_02	2-18 DALGETY ROAD BARANGAROO																	MM1
BN_02	19 HICKSON ROAD DAWES POINT																	MM2
BN_02	21-21A HICKSON ROAD MILLERS POINT																	MM1
BN_02	17A HICKSON ROAD DAWES POINT																	MM1
BP_01	14-28 BLUES POINT ROAD MCMAHONS POINT		MM4	MM2	MM2		MM4	MM2				MM1		MM2		MM2	MM2	MM4
BP_01	40 BLUES POINT ROAD MCMAHONS POINT		MM4	MM2	MM4		MM4										MM1	MM2
BP_01	42 BLUES POINT ROAD MCMAHONS POINT		MM4				MM4											MM1
BP_01	46 BLUES POINT ROAD MCMAHONS POINT		MM4				MM4											
BP_01	50 BLUES POINT ROAD MCMAHONS POINT		MM4				MM2											
BP_01	52 BLUES POINT ROAD MCMAHONS POINT		MM4				MM4											
BP_01	58 BLUES POINT ROAD MCMAHONS POINT		MM2				MM2											
BP_02	37 BLUES POINT ROAD MCMAHONS POINT																	MM1
BP_02	35 BLUES POINT ROAD MCMAHONS POINT		MM2				MM2											MM1
BP_02	33 BLUES POINT ROAD MCMAHONS POINT		MM2				MM4											MM2
BP_02	6 WARUNG STREET MCMAHONS POINT		MM4				MM4											MM2
BP_02	2-4 EAST CRESCENT STREET MCMAHONS POINT		MM4				MM4					MM1		MM1		MM1		MM4
BP_02	1 WARUNG STREET MCMAHONS POINT	MM4	MM4	MM4	MM4	MM4	MM4	MM2									MM2	MM2
BP_02	4 WARUNG STREET MCMAHONS POINT		MM2															MM1
BP_02	2 WARUNG STREET MCMAHONS POINT		MM4				MM4											
BP_02	3 WARUNG STREET MCMAHONS POINT	MM2	MM4	MM4	MM4	MM2	MM4					MM1		MM1		MM1	MM1	MM4
BP_02	5 WARUNG STREET MCMAHONS POINT		MM4	MM2	MM2		MM4					MM1		MM1		MM1	MM1	MM4
BP_02	3A WARUNG STREET MCMAHONS POINT		MM4	MM2			MM4					MM1		MM1		MM1		MM4
BP_02	3A WARUNG STREET MCMAHONS POINT	MM4	MM4	MM4	MM4	MM2	MM4	MM2				MM1		MM1		MM1	MM2	MM4
BP_02	7 WARUNG STREET MCMAHONS POINT		MM4				MM4					MM1		MM1		MM1		MM4
BP_02	6 EAST CRESCENT STREET MCMAHONS POINT						MM2											MM1
BP_02	8-10 EAST CRESCENT STREET MCMAHONS POIN						MM2											MM2
BP_02	7 EAST CRESCENT STREET MCMAHONS POINT																	MM1
BP_02	8D HENRY LAWSON AVENUE MCMAHONS POINT						MM2											MM2
BP_02	1A HENRY LAWSON AVENUE MCMAHONS POINT		MM2															MM2
BP_02	1A HENRY LAWSON AVENUE MCMAHONS POINT	MM2	MM4	MM2	MM4		MM4	MM2			MM2	MM2	MM2	MM2	MM2	MM2	MM1	MM5
BP_02	1 EAST CRESCENT STREET MCMAHONS POINT		MM4				MM4				MM1	MM1	MM1	MM1	MM1	MM1		MM4
BP_02	9 WARUNG STREET MCMAHONS POINT		MM4	MM2			MM4				MM1	MM1	MM1	MM1	MM1	MM1		MM4
OSR	2A HENRY LAWSON AVENUE MCMAHONS POINT						MM2											

APPENDIX F Human annoyance impact maps



NOTES:

1. ALL DIMENSIONS ARE IN MILIMETRES UNLESS STATED OTHERWISE.
2. ALL DETAILS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN CONFIRMATION.

Legend

- Work area
- Human annoaynce impact zone for park excavation

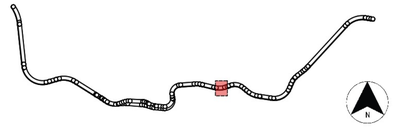
Land use

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium

Note:

- The assessment is based on vibration-generating equipment being operating at the closest location to nearby receivers.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.



FOR INFORMATION ONLY

RENZO TONIN & ASSOCIATES
inspired to achieve

REV.	BY	DATE	DESCRIPTION	APPD.
r0	SP	19.07.2018	Prepare figures	MT

SCALES: 10 0 10 20 30 40 m — 1:750 FULL SIZE A1

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

INDEPENDENT CERTIFIER CERTIFICATE

CLIENT: NSW GOVERNMENT Transport for NSW

The information shown on this drawing is for the purposes of the Sydney Metro City & Southwest TSE Project only. No warranty is given or implied as to its suitability for any other purpose. The Service Providers accept no liability arising from the use of this drawing and the information shown thereon for any purpose other than the Sydney Metro City & Southwest TSE Project.

SERVICE PROVIDERS: Sydney Metro | city & southwest; John Holland; CPB; Ghella

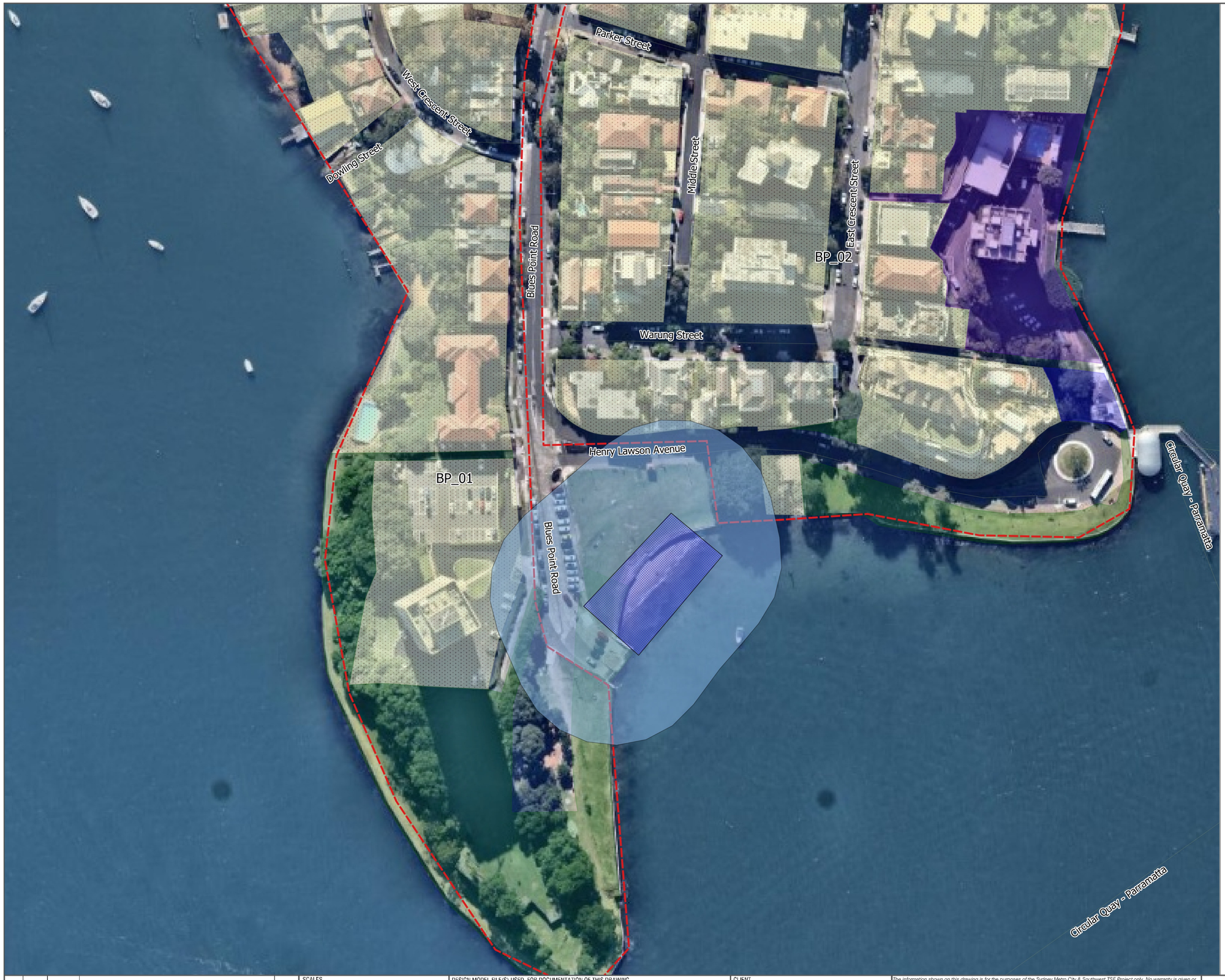
DRAWN	SP
DESIGNED	SP
DRG CHECK	SP
DESIGN CHECK	SP
APPROVED	MT

SYDNEY METRO
Blues Point CNVIS
Appendix F1 - Human annoyance impact zone during park excavation

STATUS: Final | SHEET 1 OF 0 | ©

TSE Drg No. Figure F1 | TSE REV.

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing.



NOTES:

1. ALL DIMENSIONS ARE IN MILIMETRES UNLESS STATED OTHERWISE.
2. ALL DETAILS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN CONFIRMATION.

Legend

- Work area
- Human annoaynce impact zone for vibratory rolling

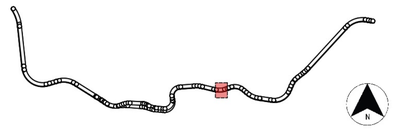
Land use

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium

Note:

- The assessment is based on vibration-generating equipment being operating at the closest location to nearby receivers.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.



FOR INFORMATION ONLY

RENZO TONIN & ASSOCIATES
inspired to achieve

REV.	BY	DATE	DESCRIPTION	APPD.
r0	SP	19.07.2018	Prepare figures	MT

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied

SCALES: 10 0 10 20 30 40 m — 1:750 FULL SIZE A1

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

INDEPENDENT CERTIFIER CERTIFICATE

NOTE: Do not scale from this drawing.

CLIENT: NSW GOVERNMENT Transport for NSW

SERVICE PROVIDERS: Sydney Metro | city & southwest | John Holland | CPB | Ghella | The Impregilo Group

DRAWN SP | DESIGNED SP | DRG CHECK SP | DESIGN CHECK SP | APPROVED MT

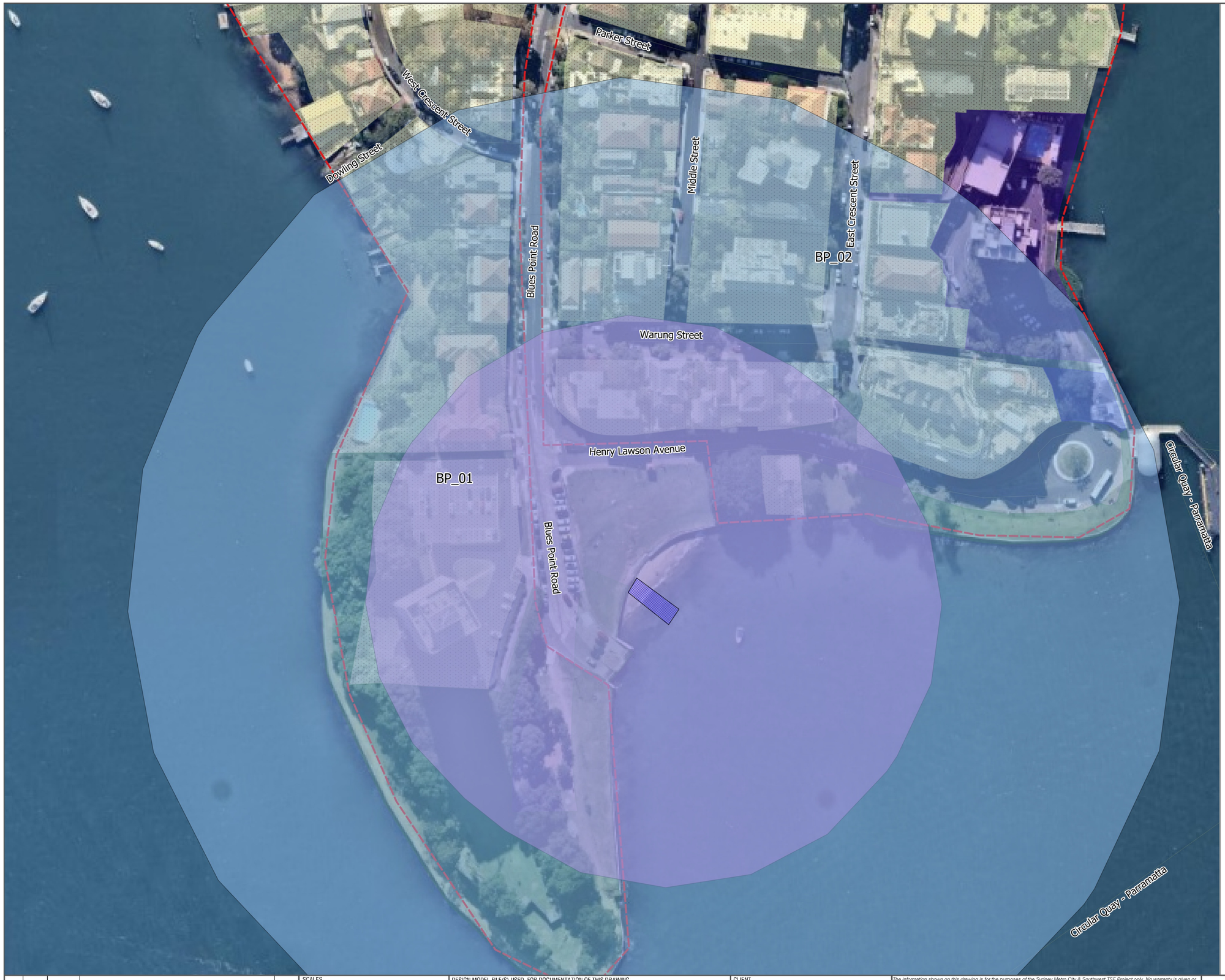
SYDNEY METRO

Blues Point CNVIS

Appendix F2 - Human annoyance impact zone during vibratory rolling

STATUS: Final | SHEET 1 OF 0 | ©

TSE Drg No. Figure F2 | TSE REV.



NOTES:

1. ALL DIMENSIONS ARE IN MILIMETRES UNLESS STATED OTHERWISE.
2. ALL DETAILS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN CONFIRMATION.

Legend

- Work area
- Human annoyance zone during imapct piling - Typical
- Human annoyance zone during impact piling - Upper range

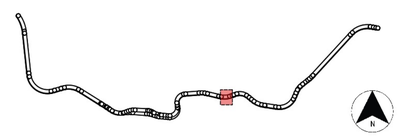
Land use

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium

Note:

- The assessment is based on vibration-generating equipment being operating at the closest location to nearby receivers.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.



FOR INFORMATION ONLY

RENZO TONIN & ASSOCIATES
inspired to achieve

REV.	BY	DATE	DESCRIPTION	APPD.
r0	SP	19.07.2018	Prepare figures	MT

SCALES: 10 0 10 20 30 40 m — 1:750 FULL SIZE A1

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

INDEPENDENT CERTIFIER CERTIFICATE

CLIENT: NSW GOVERNMENT Transport for NSW

SERVICE PROVIDERS: Sydney Metro City & Southwest; John Holland; CPB; Ghella; The Webber Group

DRAWN	SP
DESIGNED	SP
DRG CHECK	SP
DESIGN CHECK	SP
APPROVED	MT

SYDNEY METRO
Blues Point CNVIS
Appendix F3 - Human annoyance impact zone during impact piling

STATUS: Final | SHEET 1 OF 0 | ©

TSE Drg No. Figure F3 | TSE REV.

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing.

APPENDIX G Maximum predicted GBN level maps

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETRES UNLESS STATED OTHERWISE.
2. ALL DETAILS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN CONFIRMATION.

Legend

BP GBN rockdrill

- 45 dB - 60 dB
- > 60 dB
- Work area
- NCAs

Land Uses

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium
- Sydney Metro Construction site
- To be determined
- Under construction
- Ground inspection required
- Fire Brigade

NOTES:

- Predicted levels represent the typical maximum ground-borne noise levels that receivers may experience for a limited amount of time and will reduce as equipment moves further away.

- The predicted GBN levels are based on the near distance between the building and the excavation works. The calculated levels are positioned at the centroid of buildings for display purposes only.

- Predictions are shown for residential receivers only.

FOR INFORMATION ONLY

RENZO TONIN & ASSOCIATES
inspired to achieve

REV.	BY	DATE	DESCRIPTION	APPD.
r0	SP	09.07.2018	Prepare figures	MT

SCALES: 5 0 5 10 15 20 m — 1:500 FULL SIZE A1

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

INDEPENDENT CERTIFIER CERTIFICATE

CLIENT: NSW GOVERNMENT — Transport for NSW

The information shown on this drawing is for the purposes of the Sydney Metro City & Southwest TSE Project only. No warranty is given or implied as to its suitability for any other purpose. The Service Providers accept no liability arising from the use of this drawing and the information shown thereon for any purpose other than the Sydney Metro City & Southwest TSE Project

SERVICE PROVIDERS

DRAWN SP
DESIGNED SP
DRG CHECK MT
DESIGN CHECK MT
APPROVED MT

SYDNEY METRO
Blues Point CNVIS
Appendix G1 - Maximum predicted GBN levels due to rockhammering of Blues Point shaft

STATUS: DRAFT — SHEET 1 OF 0 — ©

TSE Drg No. DRAFT — TSE REV.

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing.

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETRES UNLESS STATED OTHERWISE.
2. ALL DETAILS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN CONFIRMATION.

Legend

BP GBN rockdrill
- 45 dB - 60 dB
- > 60 dB
- Work area
- NCAs

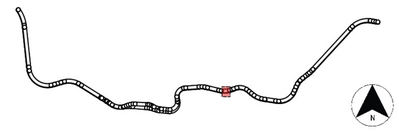
Land Uses
- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium
- Sydney Metro Construction site
- To be determined
- Under construction
- Ground inspection required
- Fire Brigade

NOTES:

- Predicted levels represent the typical maximum ground-borne noise levels that receivers may experience for a limited amount of time and will reduce as equipment moves further away.

- The predicted GBN levels are based on the near distance between the building and the excavation works. The calculated levels are positioned at the centroid of buildings for display purposes only.

- Predictions are shown for residential receivers only.



FOR INFORMATION ONLY

RENZO TONIN & ASSOCIATES
inspired to achieve

REV.	BY	DATE	DESCRIPTION	APPD.
r0	SP	09.07.2018	Prepare figures	MT

SCALES: 5 0 5 10 15 20 m — 1:500 — FULL SIZE A1

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

INDEPENDENT CERTIFIER CERTIFICATE

CLIENT: NSW GOVERNMENT Transport for NSW

SERVICE PROVIDERS: Sydney Metro | city & southwest | John Holland | CPB | Ghella

DRAWN	SP
DESIGNED	SP
DRG CHECK	MT
DESIGN CHECK	MT
APPROVED	MT

SYDNEY METRO
Blues Point CNVIS
Appendix G2 - Maximum predicted GBN levels due to rockdrilling of Blues Point shaft

STATUS: DRAFT | SHEET 1 OF 0 | ©

TSE Drg No. DRAFT | TSE REV.

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing.

Appendix F - Heritage Impact Assessment

MEMO 1

PROJECT: Sydney Metro City & Southwest Tunnel and Station Excavation Works **Worksite:** Blues Point Temporary Site	**DATE: 28 May 2018**
TO: Rober Muir, Project Environment Manager, JHCPBG JV	
FROM: Dr Mary Casey, Director, Casey & Lowe	
SUBJECT: Consistency of heritage impacts associated with relocation of the Blues Point temporary wharf and change to land area of the Blues Point temporary worksite	

This memo considers the consistency of heritage impacts associated with the:

- Relocation of the temporary wharf from the end of Blues Point Road to directly in front of the Blues Point Worksite and relocation of existing mooring points in Blues Bay.
- Minor changes to the land area of the Blues Point temporary worksite
- The temporary installation of an acoustic shed over the access shaft to provide noise mitigation.

BACKGROUND

The Sydney Metro City & Southwest Chatswood to Sydenham Metro was approved as a State Significant Development (SSD) on 9 January 2017. The Project Planning Approval Condition that are relevant to the protection of listed heritage items and archaeology is E10:

> The Proponent must not destory, modify or otherwise physically affect any Heritage item not identified in the documents referred to in Condition A1.

The Blues Point temporary site is located in the North Sydney Local Government Area (LGA) at the end of Blues Point Road, within the Blues Point Reserve (Figure 1). It includes public open space and a public road. It is bound by Blues Point Road to the west, Henry Lawson Avenue to the north, and Blues Bay to the south.

The *Sydney Metro City & Southwest Chatswood to Sydenham*, *Historical Archaeological Assessment & Research Design,* Appendix H of the Submissions and Preferred Infrastructure Report (SPIR) prepared by Artefact Heritage (Artefact, 2016), for Arcadis/RPS/Jacobs, as well as the *Sydney Metro City & Southwest Chatswood to Sydenham Environmental Impact Statement Technical Paper 4: Non-Aboriginal Heritage Impact Assessment,* prepared by Artefact Heritage (2016), for Jacobs/Arcadis/RPS, have identified areas of archaeological sensitivity within the site.

The EIS and SPIR assessed the use of Blues Point as a temporary worksite to be used to retrieve four Tunnel Boring Machines (TBMs). This involves the excavation of a temporary access shaft. To minimise road traffic impacts, the SPIR also assessed the use of barges to transport the TBMs which included the temporary installation and use of a wharf located at the end of Blues Point Road. With respect to heritage impacts Section 2.2 of the SPIR states:

> There would be no additional impact on Aboriginal or non-Aboriginal heritage items to that described and assessed in the Environmental Impact Statement. In particular, the work would be undertaken in a manner that would not have an impact on the waterfront wall, which forms part of the Blues Point Waterfront Group, a local heritage item under North Sydney Local Environmental Plan 2013.

The Construction Heritage Management Plan (SMCSWTSE-JCG-TPW-EM-PLN-002015-09) approved by the Department of Environment and Planning on the 22 December 2017 includes the following at Section 5.4.4 with respect to the protection of heritage items associated with the Blues Point wharf construction:

> Blues Point was one of the earliest areas to be settled on the North Shore of Sydney's harbour and where Billy Blue established his home in 1811. In 1817, Macquarie granted 80 acres on the point, which now bears his name, from where Billy expanded his ferry business to a fleet of ferries. Blues Point is an identified heritage area the subject of a number of listings on the North Sydney LEP 2013. The area has remained largely undeveloped since Billy Blue's period of occupation and as such has potential for archaeological remains associated with Billy Blue and the early history of settlement on the North Shore.
>
> Within the footprint are a number of identified heritage items including the Blues Point Waterfront Group comprising eight individual items (0423–0450), which appear to be located along or adjacent to the eastern shoreline, but are described in the inventory as:
>
> - Blues Point vehicular ferry dock (I0451)
> - World War II Observation Post and stone stairs (I0424)
> - Blues Point Foreshore Shelf (I0425)
> - Stone retaining wall (I0426)
> - Bollard (I0427)
> - Bollard with chain (I0428)
> - Excavation (archaeological site) (I0429)
> - Steps with bollards (I0450)
>
> The use of barges to transport plant and equipment including the Tunnel Boring Machines and spoil from the Blues Point Worksite will greatly reduce the impacts of works in this precinct including avoiding impacts on street furniture along Blues Point Road, which would have had to be removed and re-instated.
>
> JHCPBG will build a concrete footing at a suitable distance behind the historical wall so as to facilitate the use of a ramp that does not impact on the wall. The design purposely avoids the historical dock area due to risk on base load rating for TBM removal.
> A photographic recording of the local streetscape and landscape will be prepared in accordance with Section 5.2.
>
> An assessment of the potential for the jetty site and associated infrastructure will be included in the Archaeological Method Statement prepared for the Blues Point Shaft site.
>
> If required, AMBS will prepare a Statement of Heritage Impact to assess the potential for impacts arising from the works on the identified heritage values, in accordance with Condition E10, and which will include measures to protect this place during wharf construction.

PROPOSED CHANGE TO PROJECT BOUNDARY AND WHARF LOCATION

As noted above, JHCPBG propose that the location of the temporary wharf be moved to directly adjacent to the worksite. The existing boat mooring points in Blues Bay would also need to be removed for the duration of the temporary barging operation and this work would be undertaken by Roads and Maritime Services in accordance with their standard management protocols. The land boundary of the worksite has been amended to protect the bus stop on Henry Lawson Avenue and include small additional areas required to provide appropriate site area for the shaft construction. The temporary installation of an acoustic shed over the access shaft to provide noise mitigation is also assessed below.

These changes, result in an amended study area to that contained in the EIS and SPIR (Figure 1).

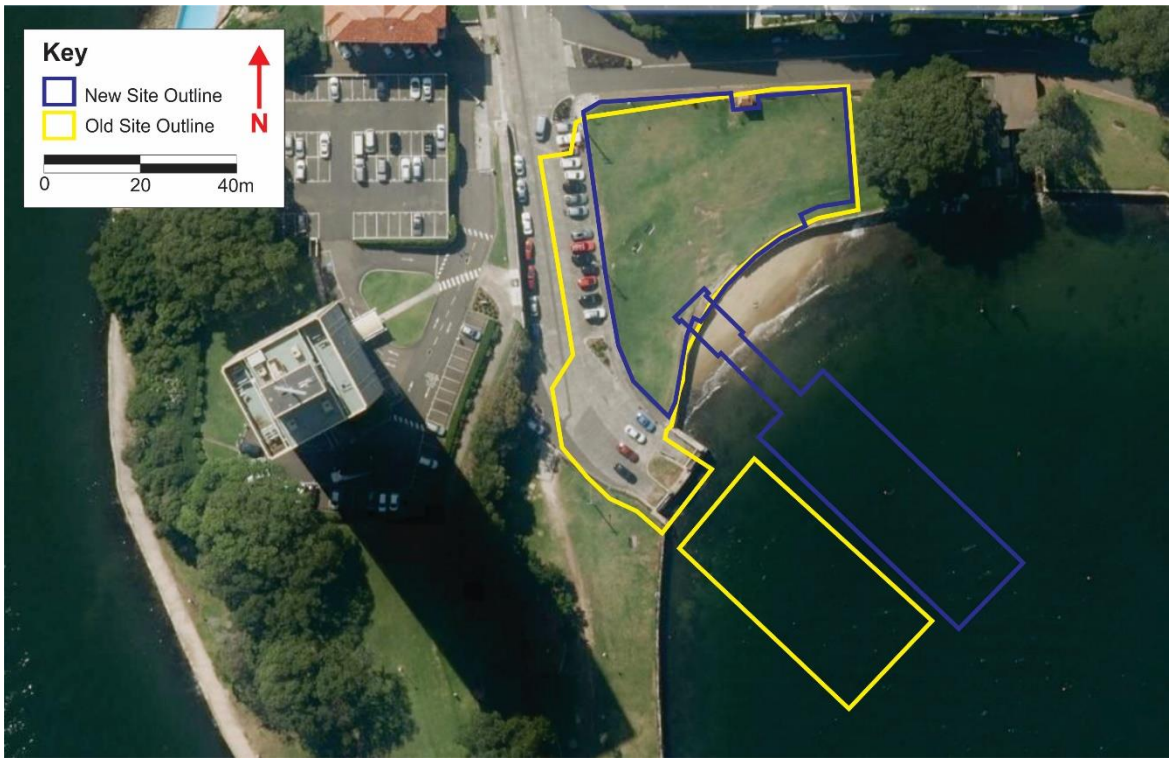


Figure 1: The present study area and barge infrastructure (red and yellow) in relation to the former site outline which included Blues Point Road (blue). SIX Maps 2018.

Consideration of heritage assessment included in the EIS and SPIR

The EIS/ SPIR identified that the study area is partially within a number of locally significant heritage areas and groups of items and contains several individually listed heritage items (Figure 2, Attachment A). The amended study area is largely contained within the original EIS/ SPIR study area. The footprint is reduced and therefore avoids any impacts to Blues Point Road, the vehicular ferry dock and a range of heritage items associated with the southern end of the road. The eastern and southern extent of the study area remains the same. The northern edge is realigned along Warung Street and excludes the bus stop. It extends to the line of the footpath along the northern and western sides. The southern line is along the seawall except for where the barge ramp projects out into the harbour.

The use of the barge eliminates the need to remove and reinstall street furniture along Blues Point Road. The impact to archaeology is considered to be consistent with the type of archaeological sites within the rest of the project area (19th century development of the ferry service and boatbuilding industry in Blues Point).

The proposed change has been considered and reviewed for consistency against the impacts and proposed mitigation measures for heritage items, including archaeology, identified in the EIS/SPIR the EIS/ SPIR. **Attachment A** contains the outcome of this consideration.

ARCHAEOLOGICAL POTENTIAL

The impact of the proposed works on potential archaeological remains within the study area, including McMahons Point South Conservation Area and the Blues Point Waterfront Group, will be

comprehensively considered and assessed in the Archaeological Method Statement (AMS) for Blues Point which is currently being prepared in accordance with Project Planning Approval Condition E17.

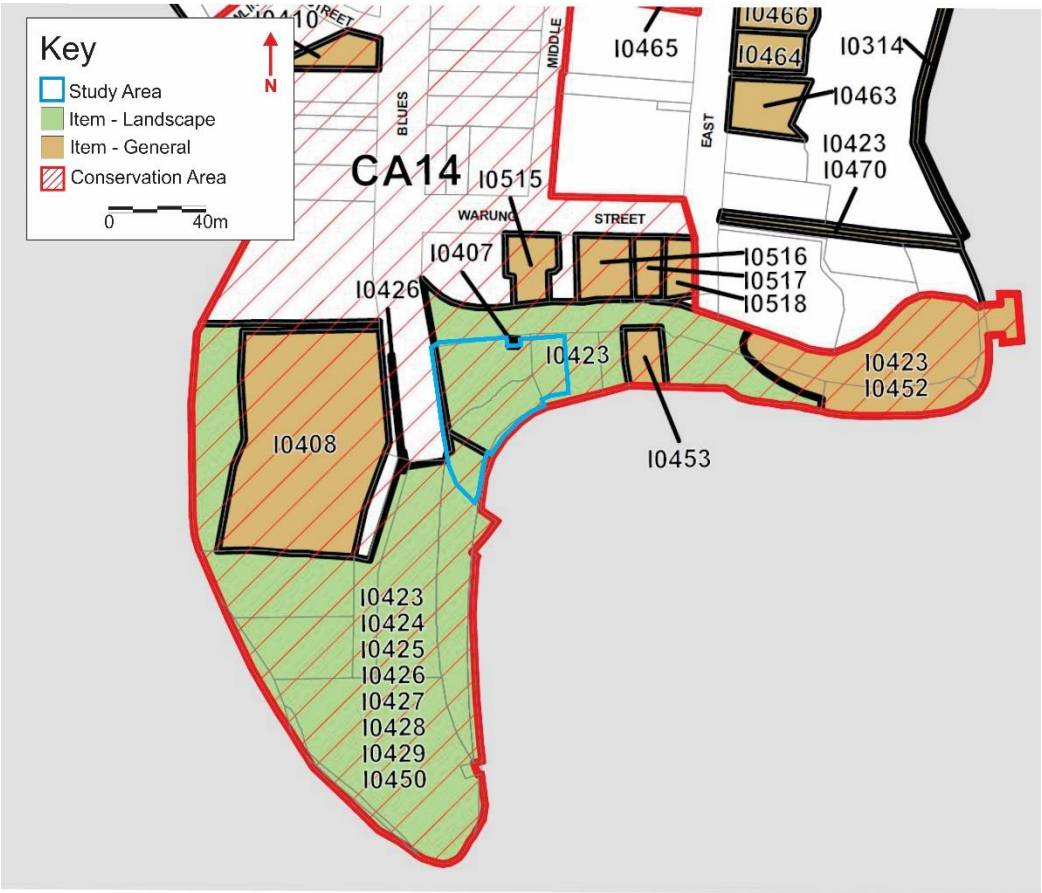


Figure 2: Plan showing the study area in relation to heritage listed items (numbers on map). North Sydney Local Environmental Plan 2013, Heritage Map – Sheet HER_002, last updated 5 May 2017.

Casey & Lowe have undertaken historic research into the proposed location of the concrete footing and barge and have concluded that the potential for locally significant archaeological remains in this location is high, but with appropriate mitigation measures the impact of the proposed works would be low. The construction of the concrete footing would have an impact on potential buried remains in this location, including reclamation fills and possible buried maritime infrastructure such as seawalls and jetties. This impact would be small in relation to the overall size of these structures and is therefore considered to be acceptable. Archaeological excavation of this area in accordance with Project Planning Approval Condition E17 prior to construction of the footing would ensure that any significant remains are appropriately recorded and salvaged before their removal. The road leading toward the ramp is also likely to impact any archaeological remains in its vicinity. Once again, archaeological excavation of this area would ensure appropriate documentation and salvage of any remains prior to destruction.

The temporary wharf to the relocated wharf is not located in the area of any jetties shown on historic plans (Figure 3). The piles of the ramp therefore have a very low potential to impact underwater remains of earlier jetties. The relocated wharf is partially within the footprint of the vehicular wharf ferry. It is not known if underwater remains of the superstructure survive below the water, however there is sufficient depth at the site to avoid the need for dredging. The barges

would float approximately 1m above the harbour floor at low tide and should therefore clear any potential archaeological remains (Figure 4). Underwater excavation of potential underwater remains is possible; however, it is not considered to be warranted since the presence of archaeological remains of significance is not likely.

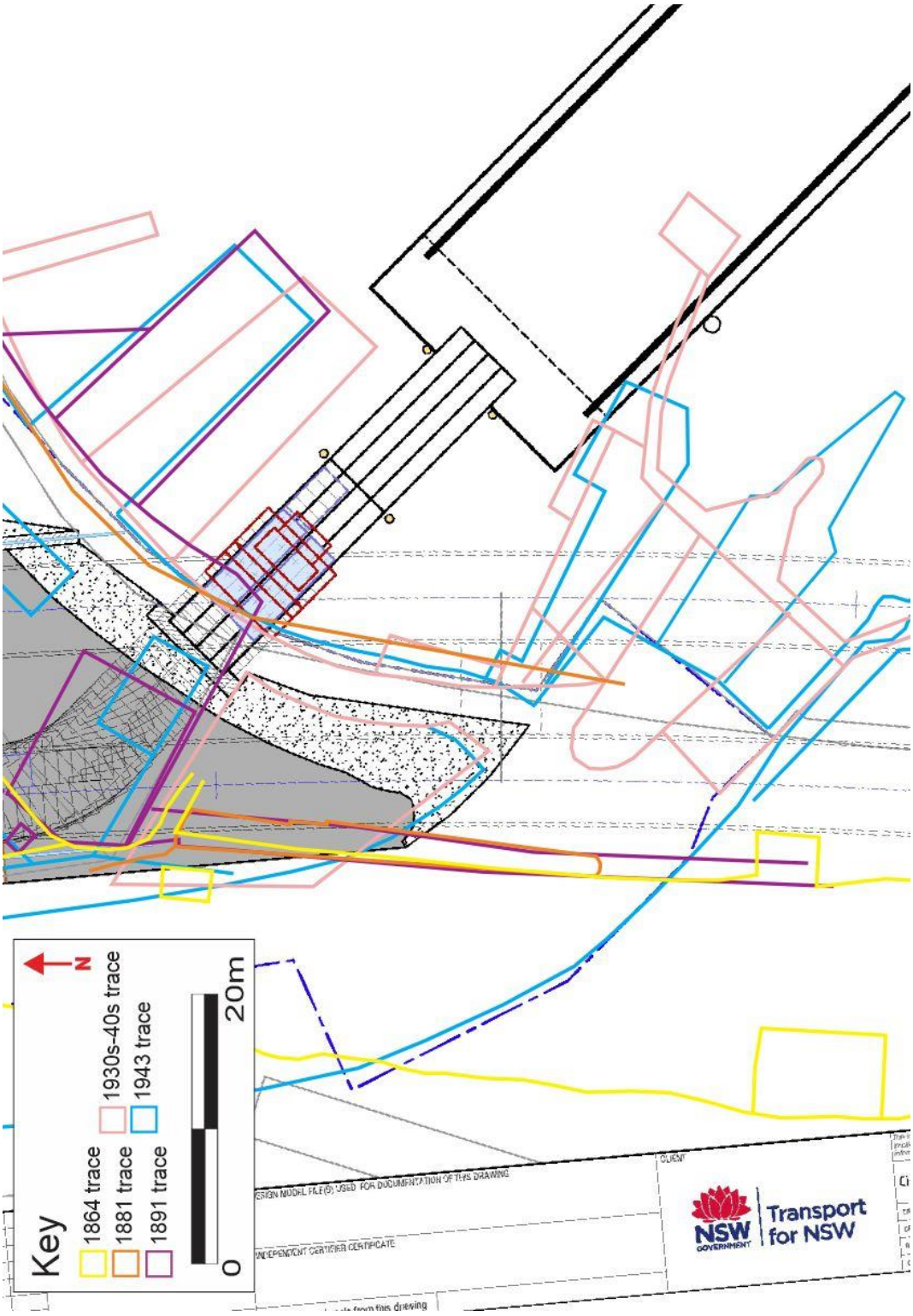


Figure 3: Outlines of historic structures in relation to the indicative proposed barge and ramp. Sydney Metro City & Southwest, Blues Point Site, Site Layout Overall Plan, 20/11/2017, Sheet 08, 16-001, R07, annotations by C&L. [To be updated when new design is available]

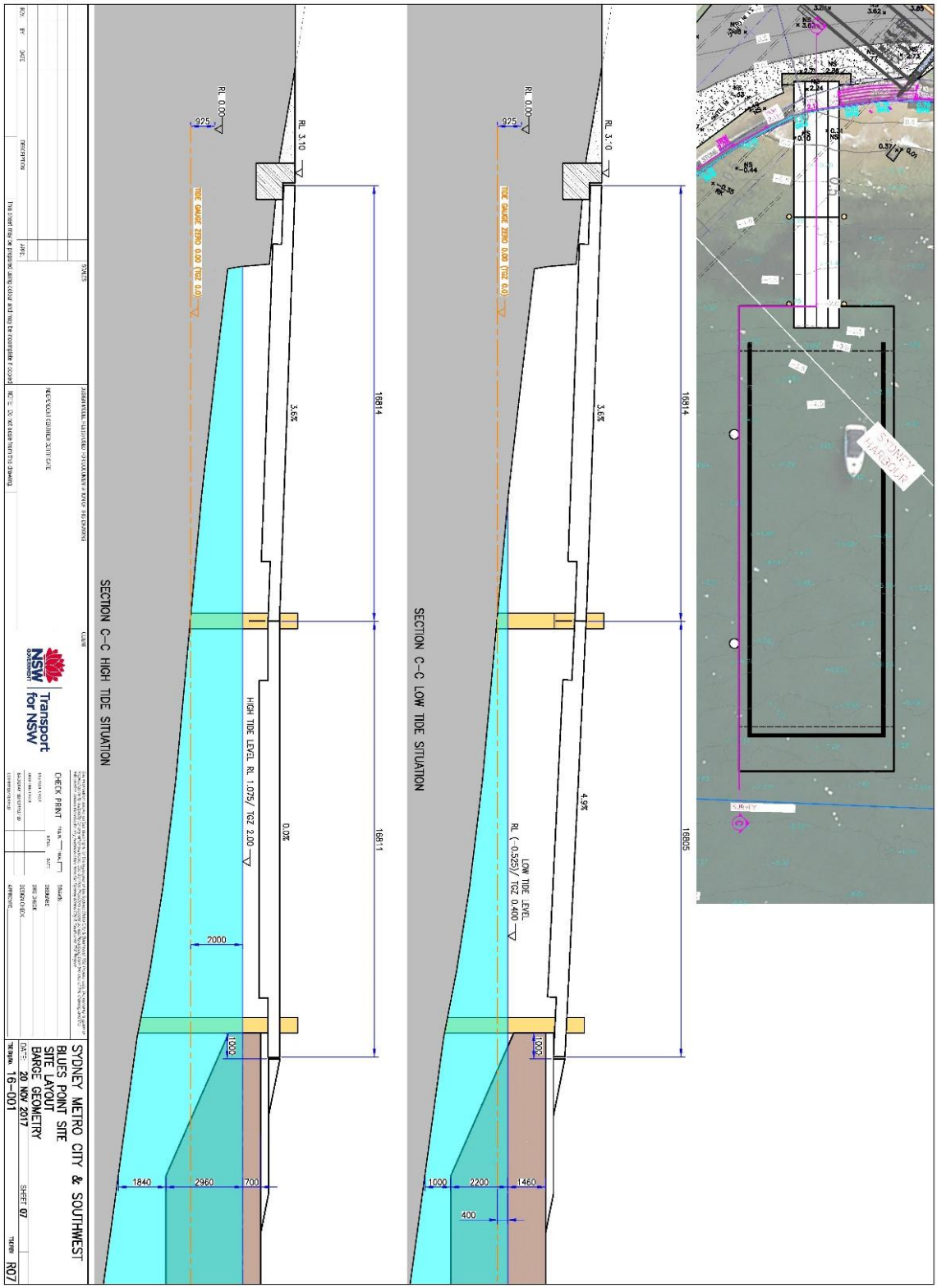


Figure 4: Indicative concept drawing of the proposed barge with ramp. Sydney Metro City & Southwest, Blues Point Site, Site Layout Overall Plan, 20/11/2017, Sheet 07, 16-001, R07 [To be updated when new design is available]

.

The existing mooring points to the north of the relocated temporary wharf are not located in an area known to have any archaeological potential and the unexpected finds protocol would be applied to these works.

The construction and presence of the temporary ramp, wharf and barge movements have the potential to temporarily change regular water currents. Roads and Maritime Service have confirmed that currents are strong in this section of the harbour and, as such, possible effects of changes in currents would be minor.

The construction of the temporary ramp and wharf to facilitate the barging operation is considered to have an acceptable level of impact on the identified potential archaeological remains. This impact would be mitigated through open area archaeological excavation to be detailed in the AMS currently being prepared in accordance with Project Planning Approval Condition E17.

POTENTIAL IMPACTS ON LISTED HERITAGE ITEMS

A concrete footing for the relocated temporary wharf is proposed to be built at a suitable distance behind the historical sea wall to facilitate the use of a ramp and ensure that it does not impact the sea wall. The ramp will be constructed and supported independently from the steps/seawall as it will span above the steps/seawall. The ramp above the seawall/steps acts like a bridge and adequate protection (crash barrier) will be provided on the structure to prevent trucks from driving off it. Six piles will be driven into the harbour to support the temporary ramp and wharf. A road would lead from the excavated shaft down to the barge (Figure 5).

It may be necessary to protect the existing seawall below the ramp and nearby steps from potential damage, such as heavy vehicles and loads falling from trucks (Figure 6, Figure 7). The form of protection needs to mitigate and potential impacts and would need to be developed once more details are known about the construction techniques. Steps should be taken to ensure the load of trucks on the road and ramp does not impact on the seawall or stairs. For example, sandbags covered with metal plates or similar. A suitable protection methodology needs to be provided by the site engineer and approved by Casey & Lowe.

It is noted that the site is also within the Buffer Zone of the Sydney Opera House, which is on the World Heritage List (Figure 8). The relocation of the temporary wharf from the location detailed in the SPIR at the end of Blues Point Road to in front of the temporary worksite represents a minor, if not negligible, change to the visual impact of the proposal on the Sydney Opera House relative to the approved project and no additional mitigation is required.

The temporary installation of an acoustic shed over the access shaft is required to provide noise mitigation. This structure is temporary and would be in place for approximately 2 years. Its temporary visual impact would be significant but the shed would also work to shield gantries and crane infrastructure required for both shaft excavation and the TBM retrieval operations. JHPCBG have confirmed that expert urban and landscape consultant KI Studio has been engaged to select a colour palette for the acoustic shed to reduce its visual impact. Impacts to the Buffer Zone of the Sydney Opera house and locally heritage listed property at 1A Henry Lawson Avenue (North Sydney Council I0453) would be short term and removed once the worksite is decommissioned and rehabilitated.

A Statement of Heritage Impact for the temporary works at Blues Point, including the proposed changes set out in this Memo, is not required given:

- The preparation of the AMS in accordance with the Project Planning Approval.

- The seawall would not be directly impacted by the relocated temporary wharf and suitable protection measures would be put in place.
- Visual impacts on surrounding heritage items including the Sydney Opera House would be significant but temporary and the selection of an appropriate colour palette would assist in reducing this impact.

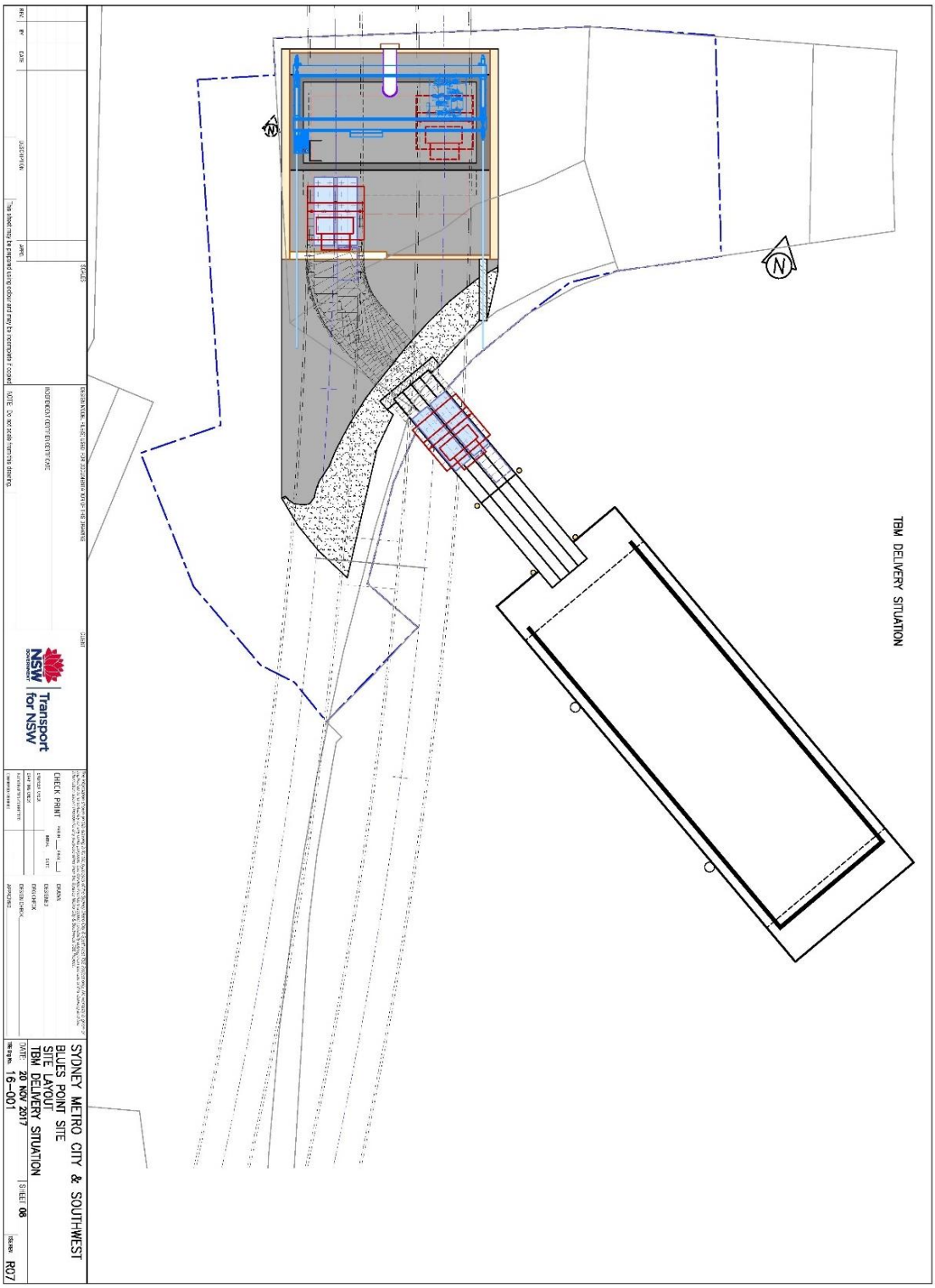


Figure 5: Indicative concept drawing of the proposed barge with ramp. Sydney Metro City & Southwest, Blues Point Site, Site Layout Overall Plan, 20/11/2017, Sheet 08, 16-001, R07. [To be updated when new design is available]

Figure 6: Photograph of the seawall showing the approximate location of the proposed ramp. The steps are in the background. Supplied by Andreas Mindt, Project Manager, JHCPBG, taken 20/12/2017.

Figure 7: Photograph of the seawall showing the approximate location of the proposed ramp to the immediate left of the steps. Supplied by Andreas Mindt, Project Manager, JHCPBG, taken 20/12/2017

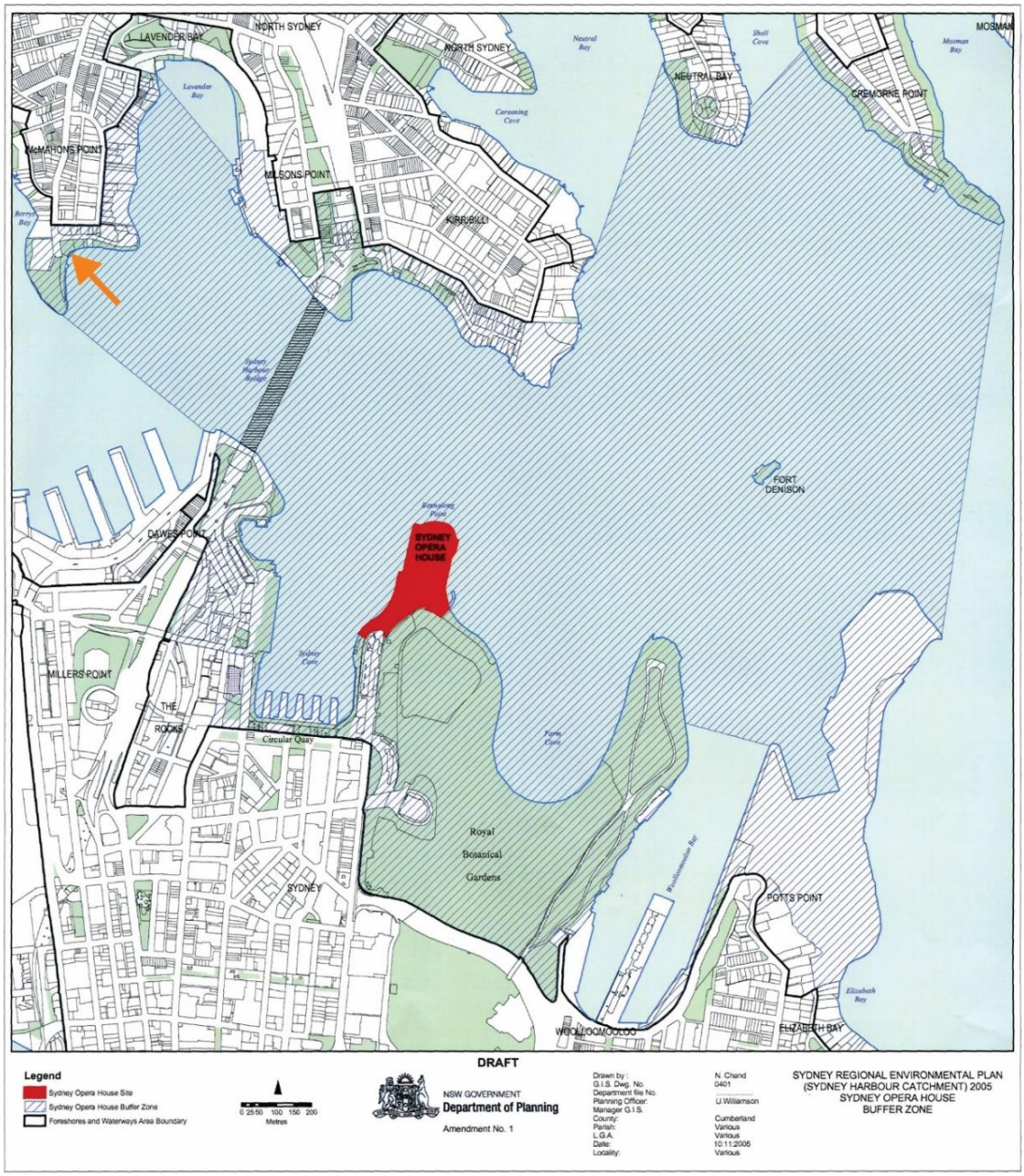


Figure 8: The study area (orange arrow) within the Sydney Opera House buffer zone. N. Chad, Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 Sydney Opera House Buffer Zone, 10/11/2005.

Attachment A: Consistency of Detail Design against SPIR and EIS Impacts and Mitigation

Item	Significance	EIS/ SPIR Proposed Impact	EIS/ SPIR Proposed Mitigation	Amended Design Impact	Amended Design Proposed Mitigation	Consistency
Bus stop (On Henry Lawson Avenue) Blues Point (I0407)	Local	Direct impact: Moderate	Removal and relocation	No impact (Outside of new study area)	No mitigation required (the bus stop will remain open and operational during the works)	Impact removed
Blues Point Waterfront Group consisting of (I0423):	All Local	G**eneral Impacts** Direct impact: Minor to moderate Archaeological impact – minor to major Temporarily indirect: Minor to moderate (views and vistas) The majority of these elements are located outside the study area	Archaeological excavation for shaft (no mitigation was proposed for temporary impacts)	Direct impact: Minor to moderate Archaeological impact – minor to major Temporarily indirect: Minor to moderate (views and vistas) The majority of these elements are located outside the study Impacts are the same just relocated to the northeast	Archaeological excavation for shaft No mitigation was proposed for temporary visual impacts	
- Blues Point Foreshore Shelf (I0425) (including sea wall) is partially within the study area. - Lot 7048, DP 1077149: northernmost tip within study area,	Local Local	See BP 2 and 3 below See BP 2 and 3 below Unclear from EIS/SPIR documents	See BP 2 and 3 below See BP 2 and 3 below	See BP 2 and 3 below See BP 2 and 3 below	See BP 2 and 3 below See BP 2 and 3 below	Consistent (See BP 2 and 3 below) Consistent (See BP 2 and 3 below)

Item	Significance	EIS/ SPIR Proposed Impact	EIS/ SPIR Proposed Mitigation	Amended Design Impact	Amended Design Proposed Mitigation	Consistency
(southern portion outside of the study area). -Lot 1, DP 209345, Lot 1007, 1132 and 1133, DP 752067, and Crown Land Reserve 944–690, are all outside of study area.			Unclear from EIS/PIR documents	No impact (Outside of the study area)	No mitigation required	
- Blues Point Vehicular Ferry Dock (I0451)	Local	Direct Impact	Unclear from EIS/SPIR documents	No impact (Outside of new study area)	No mitigation required	Impact removed
- World War II Observation Post and Stone Stairs (I0424).	Local	No Impact	No Mitigation required	No impact (Outside of new study area)	No mitigation required	Consistent
- Stone Retaining Wall (I0426)	Local	No impact	No Mitigation required	No impact (Outside of new study area)	No mitigation required	Consistent
- Bollard (I0427)	Local	No impact	No Mitigation required	No impact (Outside of new study area)	No mitigation required	Consistent
- Bollard with Chain (I0428)	Local	No impact	No Mitigation required	No impact (Outside of new study area)	No mitigation required	Consistent
- Excavation (archaeological site) (I0429), outside of study area.	Local	No Impact	No Mitigation required	No impact (Outside of new study area)	No mitigation required	Consistent
- Steps with Bollards (I0450)	Local	No Impact	No Mitigation required	No impact (Outside of new study area)	No mitigation required	Consistent
McMahons Point South Heritage Conservation Area	Local	Direct impact: Minor to moderate (impacts **to** park as a result of the construction site) Archaeological impact – minor to major	Reinstatement of park after construction	Direct impact: Minor to moderate	Reinstatement of park after construction	Consistent

Item	Significance	EIS/ SPIR Proposed Impact	EIS/ SPIR Proposed Mitigation	Amended Design Impact	Amended Design Proposed Mitigation	Consistency
		Temporarily indirect: Minor to moderate (views and vistas) The majority of these elements are located outside the study area	(no mitigation was proposed for temporary visual impacts)	Archaeological impact – minor to major Temporarily indirect: Minor to moderate (views and vistas) The majority of these elements are located outside the study area	No mitigation is proposed for temporary visual impacts	
ARCHAEOLOGY						
BP1 Moderate potential for locally significant archaeology associated with the 19th century occupation and development of the ferry service and boatbuilding industry in Blues Point	Local	Direct impact – retrieval shaft excavation Potential direct impact – landscaping (benching or cut/fill etc.) and construction of site amenities	AMS Test/Salvage in bulk excavation area Monitoring or Test/Salvage of other ground works	Direct impact – retrieval shaft excavation Potential direct impact – landscaping (benching or cut/fill etc.) and construction of site amenities including the impacts associated with the barge Impacts to west of original site boundary (Blues Point road) are removed	AMS Test/Salvage in bulk excavation area Monitoring or Test/Salvage of other ground works	Impacts consistent, just moved to the east of the study area (impacts to potential items of 19th century occupation and development of the ferry service and boatbuilding industry)
BP2 and 3	State and Local	Potential direct impact –landscaping and construction of site amenities	AMS	Potential direct impact –landscaping	AMS	Impacts consistent

Item	Significance	EIS/ SPIR Proposed Impact	EIS/ SPIR Proposed Mitigation	Amended Design Impact	Amended Design Proposed Mitigation	Consistency
Moderate-High potential for archaeological evidence associated with the 19th century development of the ferry service and boatbuilding industry in Blues Point			Monitoring or Test/Salvage	and construction of site amenities including the impacts associated with the barge	Monitoring or Test/Salvage	
BP4 Low potential for locally significant remains	Local	Potential direct impact –landscaping and construction of site amenities	Unexpected Finds Procedure	No impact (Outside of new study area)	No mitigation required	Impact removed

(Table based on original tables prepared by Artefact EIS technical paper 2016, SPIR 2016 Appendix H: iv, 319).

Heritage items which are near, but outside of the study area have not been included in the above list. See Artefact Heritage, May 2016, *Chatswood to Sydenham, Environmental Impact Statement, Technical Paper 4, Non-Aboriginal Heritage Impact Assessment*, report to Jacobs/Arcadis/RPS for further details.