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Roads & Maritime
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WESTCONNEX NEW M5

Addendum to the Submissions and Preferred Infrastructure Report - Temporary Construction Power Enabling Works

APRIL 2016

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Roads and Maritime Services

WestConnex New M5

Addendum to the Submissions and Preferred Infrastructure Report -
Temporary Construction Power Enabling Works

April 2016

Prepared for

Roads and Maritime Services

Prepared by

AECOM Australia

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1 Introduction

Roads and Maritime Services (Roads and Maritime) proposes to undertake works on behalf of Ausgrid which would involve the installation of temporary construction power supply (the works) for the New M5 project (the project). This supplementary assessment has been prepared to outline and assess the impact of the works.

The City of Sydney and Marrickville councils also expressed a concern that electricity used for the proposed works should be separated from any street lighting, so if there is an outage caused by WestConnex works it does not impact on street lighting (Section 4.12.9 of the Submissions and Preferred Infrastructure Report). As outlined in this addendum, the electricity supply for construction will be separated from street lighting.

1.1 The works

This proposal comprises installation of cabling and related fixtures to connect Ausgrid utilities from the existing network to the various proposed construction compounds along the alignment of the project.

1.1.1 Need for the works

There is currently no power infrastructure within the proposed site compounds that is suitable for the purpose of the New M5 construction works. The works would allow early establishment activities to occur for the proposed civil construction compounds following project approval and to facilitate the construction schedule of the project.

1.1.2 Location of the works

The works would be carried out in a highly urbanised environment, traversing a variety of geographical zones within the four Local Government Areas (LGAs) of Rockdale, Canterbury, Hurstville and Marrickville. Each route would be located within the road reserve and adjacent footpaths. **Table 1** provides a summary of each alignment and approximate lengths.

The location of each power alignment is shown in **Figures 1 to 5**.

1.2 Construction of the works

Prior to work commencing the following planning measures will be carried out by each site specific work crew:

- Obtain current Dial Before You Dig (DBYD) drawings for the work area
- Obtain a current Excavation/Penetration Permit for excavation work
- Assess the area for potential contamination
- Submit Traffic Control Plan (TCP) and Road Occupancy Licence (ROL) for approval where required
- Subcontractor's crew to conduct/attend prestart induction prior to any work commencing
- TCP to be implemented on site for work in close proximity to live traffic
- A SWMS will be prepared for each site and it will be compulsory for all work crew to sign on the SWMS before carrying out any work.

Works will be described in a Construction Area Plan (CAP), with detail listed in a Work Pack (WP) which will include Site Environment Plans (SEP) that outline applicable environmental controls on locality plans.

The works would generally involve the following construction methods:

- Trenching for installation of services
- Horizontal Directional Drilling (HDD)

- Pipe jacking
- Service protection
- Non-destructive excavation work including potholing and slit trenches
- Cut-overs.

Table 1 Proposed alignments

Alignment number	Alignment name	Route Details	Approx length
1	Rockdale zoning station (ZNS) to Kogarah Golf course	Alignment 1 would provide a 11kV feeder line from a 6MVA supply at Rockdale ZNS. The alignment would be from Rockdale ZNS along Bryant Street, William Street, Highclere Avenue, West Botany Street, Valda Avenue, Marsh Street, and into Kogarah Golf Course compound. Two locations are under consideration for the crossing of Marsh Street into Kogarah Golf Course, as shown on Figure 2 , with one potential location proposed at the end of Valda Avenue, and the other adjacent to the intersection of Flora Street and Marsh Street. The final location of this crossing would be subject to consultation with LDA JV Contractor, who will be undertaking works associated with the widening of Marsh Street	2.6 km
2a and 2b	2a: Commercial Road S10117 to Kingsgrove South Compound; 2b: Garema Circuit to Kingsgrove North Compound	Alignment 2a would provide a 11kV feeder line from a 3MVA supply on Commercial Road. Commercial Road is a two-lane road servicing a light industrial area in Kingsgrove, on the southern side of the M5 Motorway approximately 200 metres west of Kingsgrove Road. The proposed infrastructure would comprise only a short section of trench approximately 25 metres in length. Construction of the trench would temporarily obstruct a footpath adjacent to Commercial Road and a vehicular access that is shared by businesses at 30 and 32 Commercial Road. Alignment 2b would provide a 11kV feeder line from a 3MVA supply on Garema Circuit, which is a two-lane continuous loop road servicing a light industrial area in Kingsgrove, on the northern side of the M5 Motorway approximately 600 metres west of Kingsgrove Road. The proposed infrastructure would comprise only a short section of trench approximately 25 metres in length.	0.2 km
3	May St S660 to St Peters Site; Mary St S22 to Canal Road, St Peters	The alignment would provide 11kV feeder line from a 6MVA supply from May Street substation and Mary Street substation to the Canal Road compound. The alignment would run from Unwins Bridge Road, along Silver Street, Edith Lane, Edith Street, Princes Highway, then onto Canal Road compound. From Mary street substation the alignment would run along Robert Lane, into Roberts Street, Edith St, Princes Highway, then onto Canal Road compound.	1.1 km
4	Campsie ZNS to Poole St	The alignment would provide 11kV feeder line from a 6MVA supply within Campsie ZNS. The alignment would run from Campsie ZNS to Nicholas Avenue, Canterbury Road, Charlotte Street, Harp Street, Alfred Street, William Street, Rosemeath Avenue, Homer Street, Poole Street to Bexley Road North compound site on the Corner of Bexley Road and Poole Street.	3 km

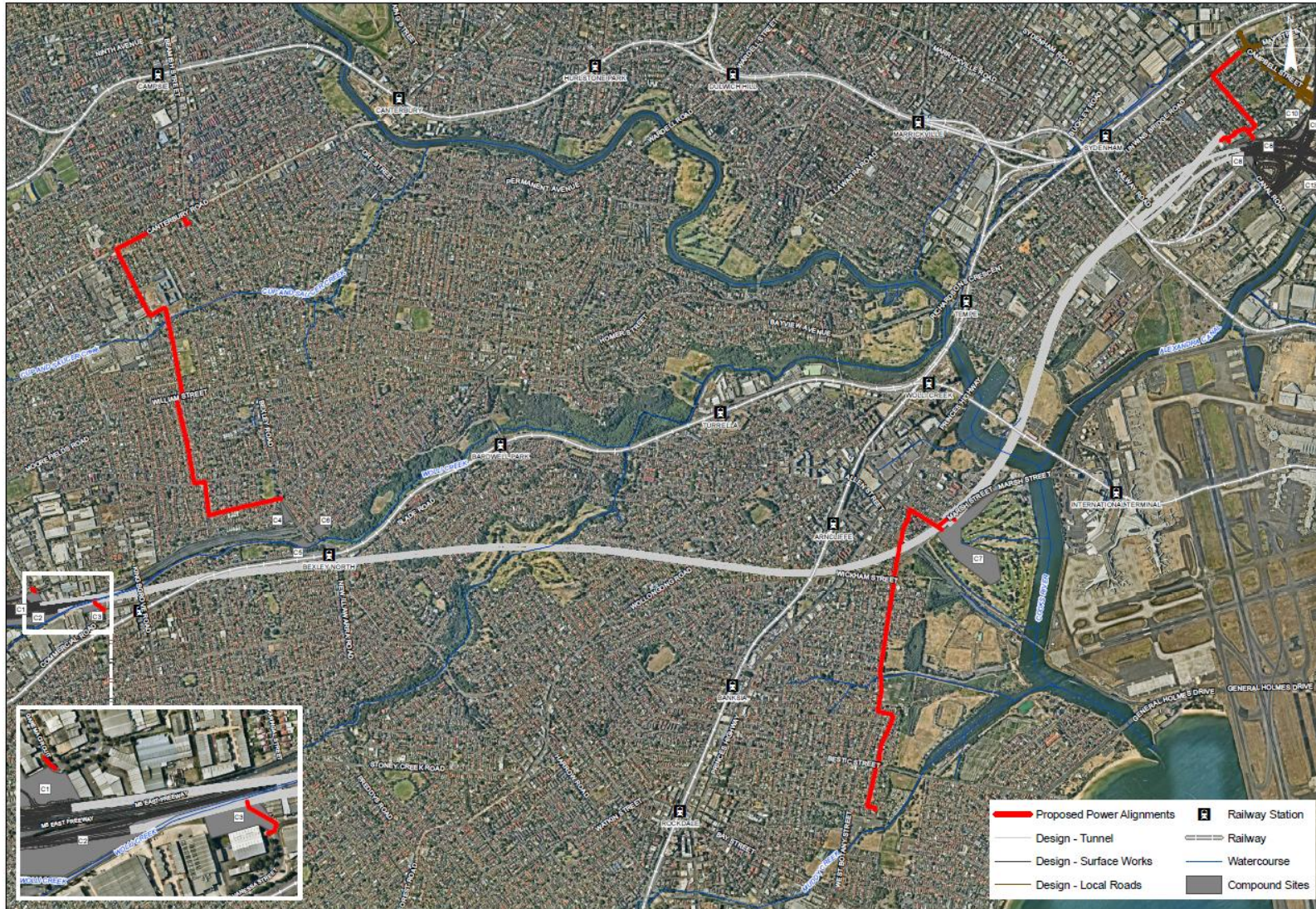


Figure 1 - Overview

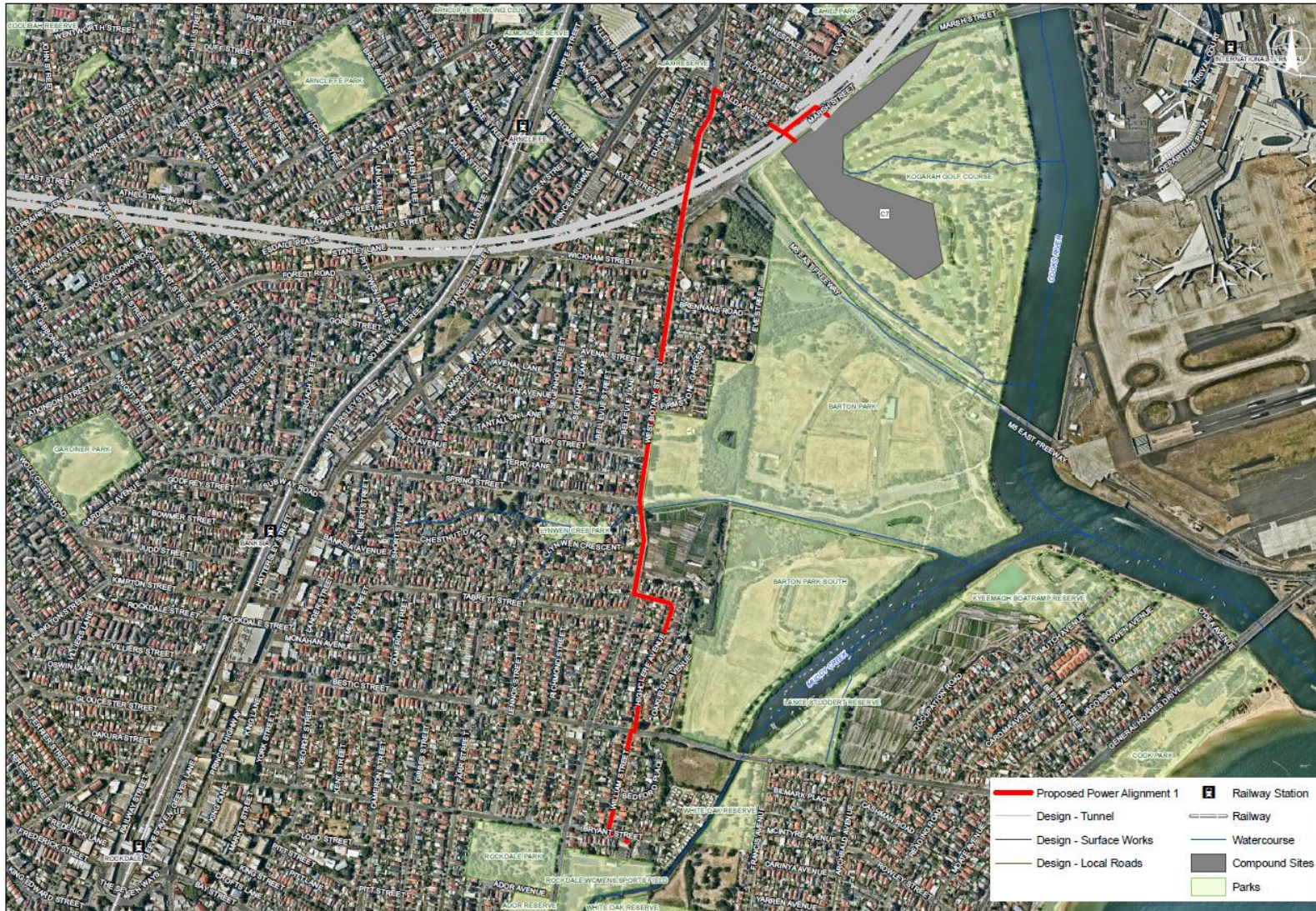


Figure 2 - Alignment 1 (Rockdale to Kogarah Golf Course)



Figure 3 - Alignment 2a (Commercial Road) & Alignment 2b (Gareema Circuit)

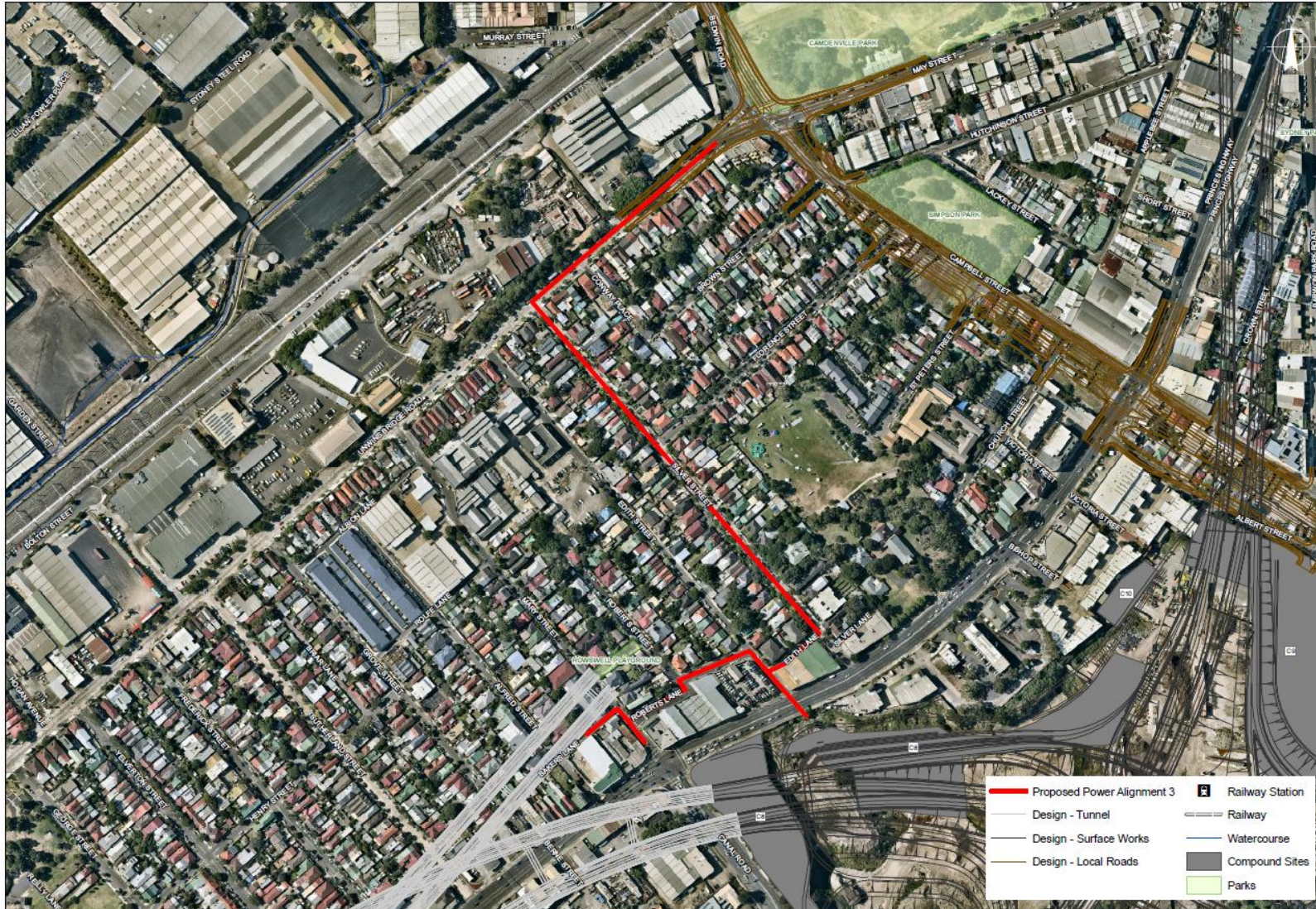


Figure 4 - Alignment 3 (Marrickville and St Peters Substation to St Peters)



Figure 5 - Alignment 4 (Campsie ZNS to Poole Street)

1.2.1 Program

Subject to approval, the proposed works are expected to commence in May 2016 and be completed by September 2016. The proposed construction dates are provided in **Table 2**.

Table 2 Indicative program

Alignment	Proposed start date	Proposed end date
1	May 2016	October 2016
2a	May 2016	July 2016
2b	May 2016	July 2016
3	May 2016	July 2016
4	May 2016	July 2016

1.2.2 Construction hours and duration

The construction work associated with this proposal would generally be carried out during standard daytime construction hours as follows:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and public holidays: No work.

Certain activities will need to occur out of hours, as directed by Traffic Management Centre and other road authorities to minimise traffic impacts, or by the utilities providers to minimise disruption to services. These works would include night and weekend works.

The affected community would receive appropriate notification in accordance with the Community Involvement Plan for the project.

1.2.3 Plant and equipment

An indicative list of plant and equipment associated with the proposal is:

- Excavator with attachments
- Vacuum truck
- Small truck
- Skidsteer (Bobcat) with bucket and profiler
- Vibratory Roller / Compactor
- Hand tools
- Power tools
- Water cart
- Lighting tower.

The list may change as construction progresses, and not every item of plant/equipment would be required at every work site.

1.2.4 Earthworks

The works would not require significant earthworks. The works would require small amounts of localised excavation for trenching/drilling activities, where the excavated material will be stockpiled adjacent to the trenches for use as backfill material at the completion of works. There will be no surface disturbance beyond the limits of the utility trenches. None of the proposed works will require the adjustment of surface levels or the movement of bulk materials from site to site.

1.2.5 Source and quantity of materials

The source and quantity of materials would be determined during the final design phase of the works and would consider the requirements of Infrastructure Sustainability Council of Australia (ISCA) Rating Scheme checklist. Materials would be sourced from local suppliers where practicable. Reuse of existing and recycled materials would be carried out where practicable.

Materials required for the works would include:

- Conduit
- Concrete
- Pre-cast concrete barriers
- Steel
- Asphalt
- Aggregate
- Water
- Timber
- Petrol
- Diesel

1.2.6 Ancillary facilities

No ancillary facilities are proposed in conjunction with the proposed works. Temporary fencing would be erected around the work site during works and would be removed once works in the area were completed. For the duration of the work program, plant and equipment would be left in-situ within the road reserve each night until works are completed.

1.2.7 Property acquisition

The land required for the proposal is owned by Roads and Maritime or the relevant Council. The works would be undertaken within the road reserve or the footpaths of various roads.

No additional property, beyond what is required for construction of the project is required to complete the works.

2 Environmental assessment

This review has concluded that the works would result in changes to:

- Construction traffic and transport impacts. Further assessment of the construction traffic and transport impacts has therefore been conducted and is included in **Section 2.1**
- Construction noise and vibration impacts. Further assessment of the construction noise and vibration impacts has therefore been conducted and is included in **Section 2.2**

The review has also considered the potential for the works to have the following impacts: air quality (dust and odour), land use and property, social and economic, soil and groundwater, biodiversity, non-Aboriginal heritage, Aboriginal heritage and resource use and waste minimisation. These matters have been considered in **Section 2.3**.

2.1 Traffic and transport

This section summarises the existing environment for traffic and transport along each alignment and outlines the impacts associated with construction of the works as they relate to traffic and transport. As the operation of the works would not generate additional traffic, an assessment of the operational traffic impacts has not been undertaken.

2.1.1 Existing environment

Road network and traffic

Alignment 1

Alignment 1 would cross Marsh Street, which currently has three eastbound lanes and two westbound lanes between Giovanni Brunetti Bridge and the M5 intersection. Marsh Street and West Botany Street are classified as State roads. Average daily traffic volumes on Marsh Street from 2014 counted 30,334 vehicles travelling eastbound and 28,794 vehicles travelling westbound (NGH Environmental, 2015; austraffic; 2015). All other roads affected by this alignment are local roads.

Alignment 2a and 2b

Only local roads would be affected by these alignments

Alignment 3

Alignment 3 crosses the Princes Highway, which is a State classified road and provides a key north-south corridor within the surrounding road network. The Princes Highway is six lanes wide, with three lanes in either direction used for traffic. Average (2012) daily traffic volumes along the Princes Highway were 34,800 vehicles travelling northbound and 32,800 vehicles travelling southbound (Roads and Maritime Services, 2014). All other roads affected by this alignment are local roads.

Alignment 4

Alignment 4 crosses Canterbury Road and Bexley Road which are state classified roads. Canterbury Road is 4 lanes wide with 2 lanes in each direction. Average (2012) daily traffic volumes along the Canterbury Road were 21,300 vehicles travelling both eastbound and westbound (Roads and Maritime Services, 2014). All other roads affected by this alignment are local roads.

Heavy and light vehicles

A review of the Road and Maritime Services Restricted Access Vehicle Map (v1.3) indicates that heavy vehicles are permitted on the following roads which intersect with the proposed alignments:

- Marsh Street
- West Botany Rd
- Princes Highway
- Canterbury Road

- Bexley Road (approved for B-double vehicles only).

All other affected roads are only used by light vehicles.

Public Transport

The works would fall within the Sydney metropolitan bus inner western and south-western suburbs region, which is operated by Sydney Buses. The bus network in the vicinity of the works includes buses servicing the inner western and south-western suburbs and the city. Consultation with Sydney Buses has been undertaken to advise them of the works. Consultation to date has included a meeting with the Traffic Service Manager of the Southern Region to discuss the works.

It is anticipated that works would intersect with the following bus routes:

- Alignment 1: 348, 422
- Alignment 3: 422, 400, 410
- Alignment 4: 492, 415, 473, 444, 445, 487, 490, 412, 423, L23, 400, M41.

The works would not require full road closures, however partial road closures would be required on some roads. Sydney Buses have advised that sufficient information has been provided regarding the proposed works, and requested that:

- Bus stops remain accessible, with roads needing to be accessible for buses to pull over and footpaths for passengers to get on and off the bus
- Notification be provided outlining when works will start and finish so that bus drivers on affected routes can be advised in advance.

Pedestrian Network

The nature of the pedestrian network in the vicinity of the project varies. Residential areas generally provide good local walking connections and footpaths, particularly in areas away from major roads. In total there are two signalised pedestrian crossings along the proposed alignments, both of which are on Alignment 1, at the Marsh Street/West Botany Street intersection, and West Botany Street/Wickham Street intersection.

Each of the proposed alignments would involve installation of services within footpaths and along public roads.

Emergency services

Emergency services operate throughout the areas impacted by the works. Alignment 1 intersects with Arncliffe Fire Station, which is located on West Botany Street between Eve Street and Brennans Road. Alignment 4 runs adjacent to Canterbury Hospital at the intersection of Canterbury Road and Charlotte Street. The other proposed alignments do not pass any emergency services.

2.1.2 Assessment of potential impacts

Road network and traffic

The works have the potential to result in short term, localised changes and disruptions to the existing road and transport network as a result of:

- The trenching and opening of the roadway and footpaths for service installation
- The movement of construction vehicles, particularly plant and equipment transporting materials, equipment, spoil and waste materials, to and from the work areas
- Temporary traffic diversions, road occupation, alterations to access, temporary lane closures, and alterations to speed limits.

Access

The works would require excavation of footpaths and roads. In some locations, works would temporarily affect access to residential properties and businesses, most notably where the alignments

pass through residential areas. These impacts would be short term as all areas would be reinstated as works progress along each alignment.

Notification (including letter box drops and door knocks) to residents and businesses directly affected by the works would be undertaken prior to works being undertaken. Access to properties will be maintained during construction, and contractors would have steel plates on site should cars need to be provided with access to or from driveways.

Heavy and Light Vehicles

Potential impacts to local traffic from construction vehicles would be minimal as work activities are short term in nature, ranging from six weeks to 16 weeks duration. The works are linear and transient in nature and therefore work activities would progress along the road alignment thereby minimising prolonged impacts in any one area within the local road network.

Light vehicle access and parking would have a minor impact on the affected streets as the works are minimal, of short duration, and do not require large work crews.

Public Transport

There are also several bus services that travel along sections of the proposed alignments. Consultation with Sydney Buses is being undertaken to confirm which routes may be affected by the proposed works and notify them of any upcoming works. It is not anticipated that any diversions to bus services would be required as a result of the proposed works.

No bus stops would be affected by the works. Where an alignment passes a bus shelter, the alignment would be located within the road corridor to prevent the need to remove any bus shelters. Where the alignment passes bus stops, public access would be provided from either side of the bus stops as works progress. Temporary barriers would be installed to separate the public from the works. Should public access to a bus stop not be feasible, due to limited areas being available on the footpath, a temporary alternative bus stop would be provided adjacent to the works.

Pedestrian and active transport network

Pedestrian movements may be impacted at times due to the location of the services work being carried out, most notably for works affecting signalised pedestrian crossings on Alignment 1. Appropriate traffic control and pedestrian movement plans will be developed in accordance with the Roads and Maritime guidelines.

Works are not anticipated to impact on any shared pathways or dedicated cycle lanes, and works would not involve any full road closures. As such active transport networks are unlikely to be affected by the proposed works.

A review of Sydney Cycleways mapping identified that there are separate dedicated cycleways located on Marsh Street (associated with alignment 1) and Charlotte Street (associated with alignment 4). Works would not be undertaken within these dedicated cycleways and so no impacts to the active transport network are anticipated.

Silver Street, Edith Lane, Roberts Lane (associated with alignment 3) and Alfred Street and Poole Street (associated with alignment 4) are also identified as 'bicycle-friendly roads', so may experience a higher number of cyclists using these roads. Works would not require full closure of these, or any roads, so no impacts to the wider cycling network is expected.

Emergency services

Emergency services operate throughout the area affected by the works and so have the potential to be impacted by construction of the proposal.

Consultation with Canterbury Hospital and Arncliffe Fire Station has been undertaken, and the NSW SES has been notified of the proposed works and affected road network. Access for emergency vehicles to Canterbury Hospital and Arncliffe Fire Station will be maintained at all times during construction.

2.1.3 Environmental management measures

Based on the outcomes of this assessment, provided the management measures outlined in **Chapter 8** (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report are implemented, no significant impact on the local road network is anticipated. These include:

- TT01 – Construction Traffic Management and Safety Plan (CTMSP) would be prepared. The CTMSP would include the guidelines, general requirements and principles of traffic management to be implemented during construction, including
 - Signage requirements (eg temporary speed restrictions, changes to the road environment, traffic management controls)
 - Traffic control devices such as traffic signals
 - A local and regional communications strategy, including methods to provide advanced notice of any major or prolonged impacts (eg leaflets and local media), and real-time information regarding current impacts (eg variable message signs, radio traffic news)
 - Details of both the general approach to be used for access and egress to construction compounds and the specific controls required at specific locations
- TT08 – Impacts on pedestrian paths and cycle lanes would be minimised, and alternatives provided during construction where practical and safe to do so
- TT12 – A road dilapidation report(s) would be prepared identifying existing conditions of local roads and mechanisms to repair damage to the road network caused by heavy vehicle movements associated with the project.

No additional environmental management measures are considered necessary to mitigate the potential traffic and transport impacts.

2.2 Noise and vibration

A Technical working paper: Noise and vibration was prepared to assess the noise and vibration impacts of the project (Appendix J of the EIS). The study area for that assessment incorporated some but not all of the proposed temporary power supply alignments. A supplementary noise and vibration assessment has been completed for the works (Appendix A to this Addendum).

The following elements of the proposal extend beyond the boundary of the existing assessment undertaken for the EIS (Appendix J of the EIS), as shown in **Figure 6**.

- Alignment 1: all of Alignment 1 south from the intersection of West Botany Street and Tantallon Avenue, is outside of the boundary of the previous assessment
- Alignment 2: Within the boundary of the previous assessment
- Alignment 3: Within the boundary of the previous assessment
- Alignment 4: All of alignment 4 north from the intersection of Rosemeath Avenue and Olive Street, is outside the boundary of the previous assessment.

The ICNG describes two methods of assessing noise impacts from construction activities: the quantitative method, which is suited to major and complex construction projects; and the qualitative method, suited to short-term (less than three weeks) works undertaken during standard construction hours. Owing to the expected duration of the works, a quantitative approach has been considered for this assessment. Where the proposed alignments intersect with the existing assessment boundary (Appendix J of the EIS), background noise conditions and NCAs have been incorporated into this assessment, as outlined in **Table 3** below.

To determine background noise conditions along sections of Alignments 1 and 4 which had not previously been characterised, the 'short-term' method of the *NSW Industrial Noise Policy* (INP), (NSW Environment Protection Authority, 2000) was applied. This involved the collection of 15 minute attended noise measurements during day, evening and night time periods. Measurements were collected at four locations as displayed below in **Figure 7** and **8**. Monitoring was completed using an

SVAN 979 Class 1 sound level meter (SLM) and was carried out on 18 February 2016. **Figure 7** and **8** also show the boundaries of NCAs identified in the New M5 NVIA relevant to Alignments 1 and 4.

2.2.1 Existing environment

The four alignments are set within highly urbanised areas across the LGAs of Sydney, Rockdale, Canterbury and Marrickville. There are several main roads within the vicinity of the proposal area including the M5 East Motorway and the A36 Princes Highway. The T2 Airport, Inner West rail line is also located nearby.

Noting that each of the alignments are generally located within existing road reserves and footpaths; the nearest residential receivers are generally close by, with the first row of houses typically set at a distance of around five to fifteen metres.

Table 3 below summarises background noise levels applicable to each section of the proposed alignments. Day time background noise levels around the four new NCAs (Measured NCA 01, 02 03 and 04) have been estimated based on trends observed during attended monitoring completed in similar, nearby locations on 27 and 28 January 2016 where day time levels were typically up to around 3 dB(A) higher than evening levels.

The existing noise environment is typical of noise levels experienced in suburban environments with daytime noise levels between around 45 dB(A) to 67 dB(A), and in most cases several decibels quieter during the evening period. Night time background noise levels are variable, from around 39 dB(A) to 51 dB(A) depending on the proximity of receiver locations to 24 hour noise sources such as major transport corridors and industrial developments (EIS, p12-27).

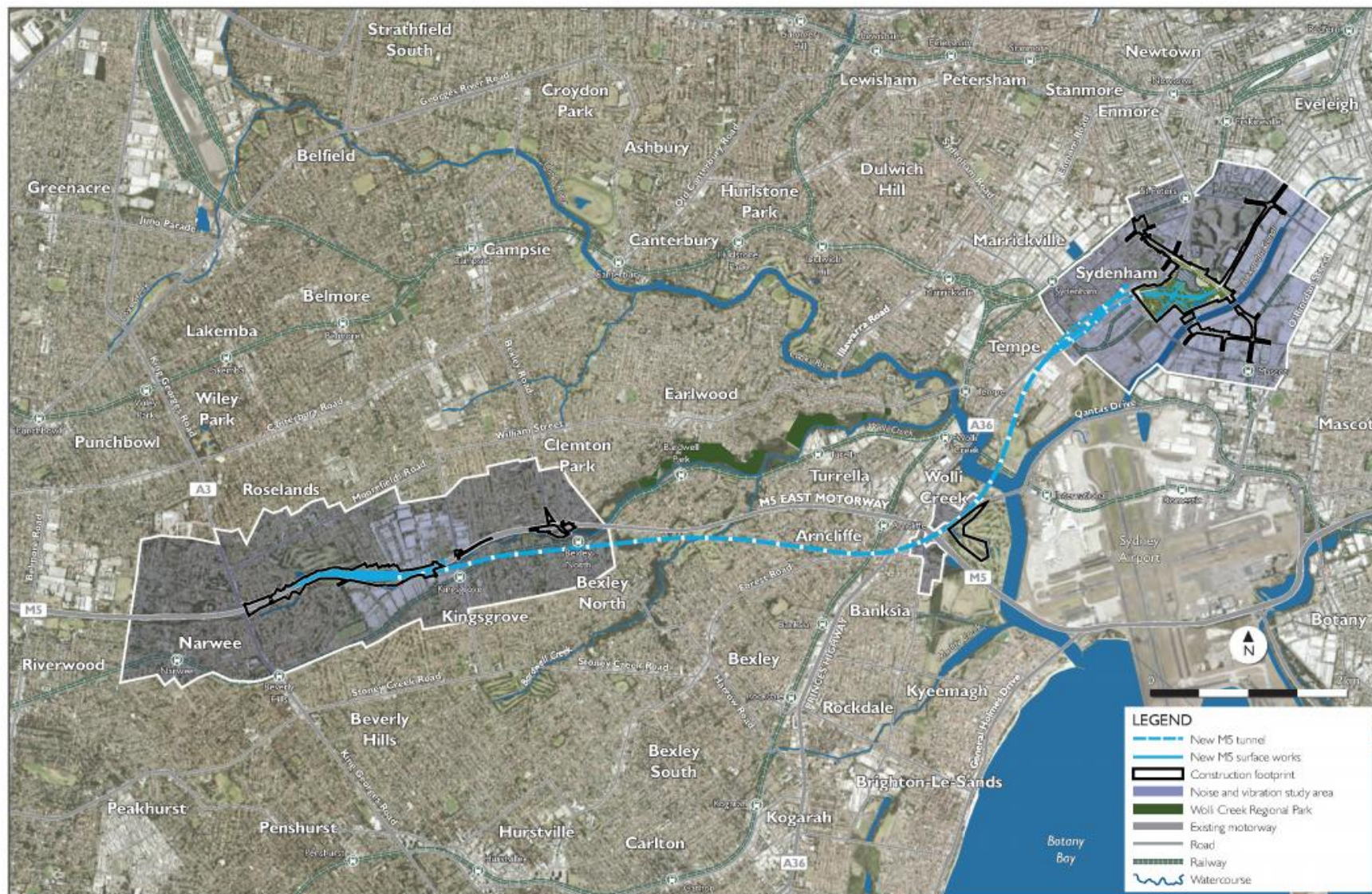
A range of noise sensitive receivers are located adjacent to the proposed alignment corridors. All residences (including hotels, motels, hostels and serviced apartments) are considered to be sensitive receivers during the works. All commercial receivers are considered to be sensitive to construction noise and vibration impacts. Other receivers sensitive to noise and vibration during construction include educational institutions, child care centres, hospitals and medical centres, aged care facilities, places of worship, local heritage items and open space.

Table 3 Applicable background noise levels determined for each section of the four alignments

Alignment	Section(s)	NCA	Background noise level (L _{A90}) dB(A)		
			Day	Evening	Night
Alignment 1	Bryant Street, Williams Street, Highclere Avenue	Measured NCA 02	50#	47	39
	West Botany Street – south of Tantallon Avenue	Measured NCA 01	59#	56	41
	West Botany Street between Tantallon Avenue and Wickham Street	EIS NCA 14	50	50	42
	West Botany Street between Wickham Street and Valda Avenue	EIS NCA 13	67	67	51
	Valda Avenue and Marsh Street	EIS NCA 12	45	45	43
Alignment 2a	Commercial Road	EIS NCA19	60	54	43
Alignment 2b	Gareema Circuit	EIS NCA19	60	54	43
Alignment 3	Unwins Bridge Road, Silver Street and Bakers Lane, Mary Street, Roberts Lane	EIS NCA 06	58	56	49

Alignment	Section(s)	NCA	Background noise level (L _{A90}) dB(A)		
			Day	Evening	Night
	Edith Lane, Edith Street, Princes Highway and Edith Street, Princes Highway	EIS NCA 07	54	54	40
Alignment 4	Nicholas Avenue, Canterbury Road, Charlotte Street north of Sunbeam Street	Measured NCA 04	55#	52	49
	Charlotte Street south of Sunbeam Street, Harp Street, Alfred Street, William Street, Rosemeath Avenue north of Olive Street	Measured NCA 03	48#	45	45
	Rosemeath Avenue south of Olive Street, Homer Street, Lundy Avenue and Poole Street	EIS NCA 17	49	49	42

Day time background noise levels around the four new NCAs (Measured NCA 01, 02 03 and 04) were estimated based on trends observed during attended monitoring completed in similar, nearby locations on the 27th and 28th January 2016 where day time levels were typically up to around 3 dB(A) higher than evening levels.



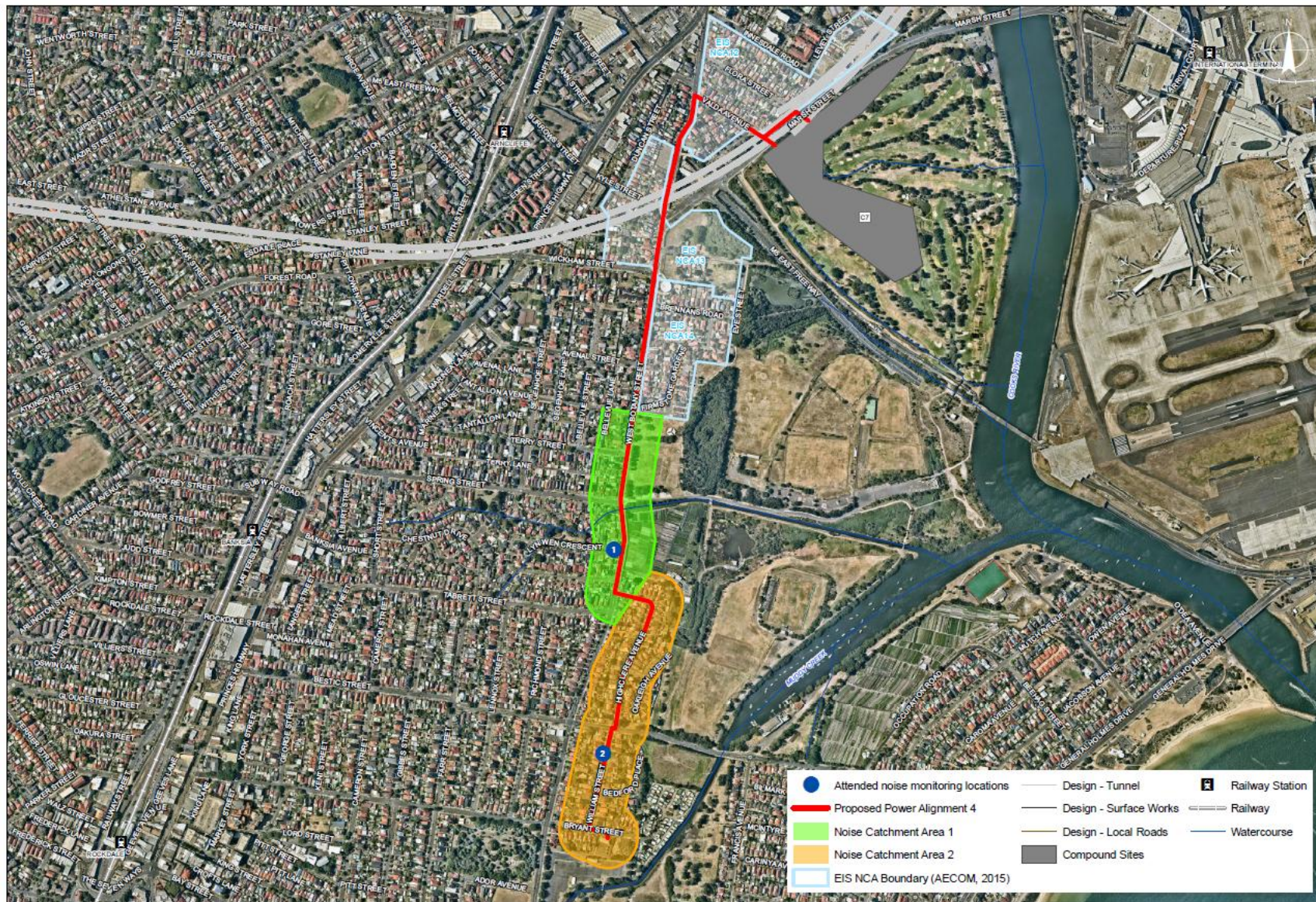
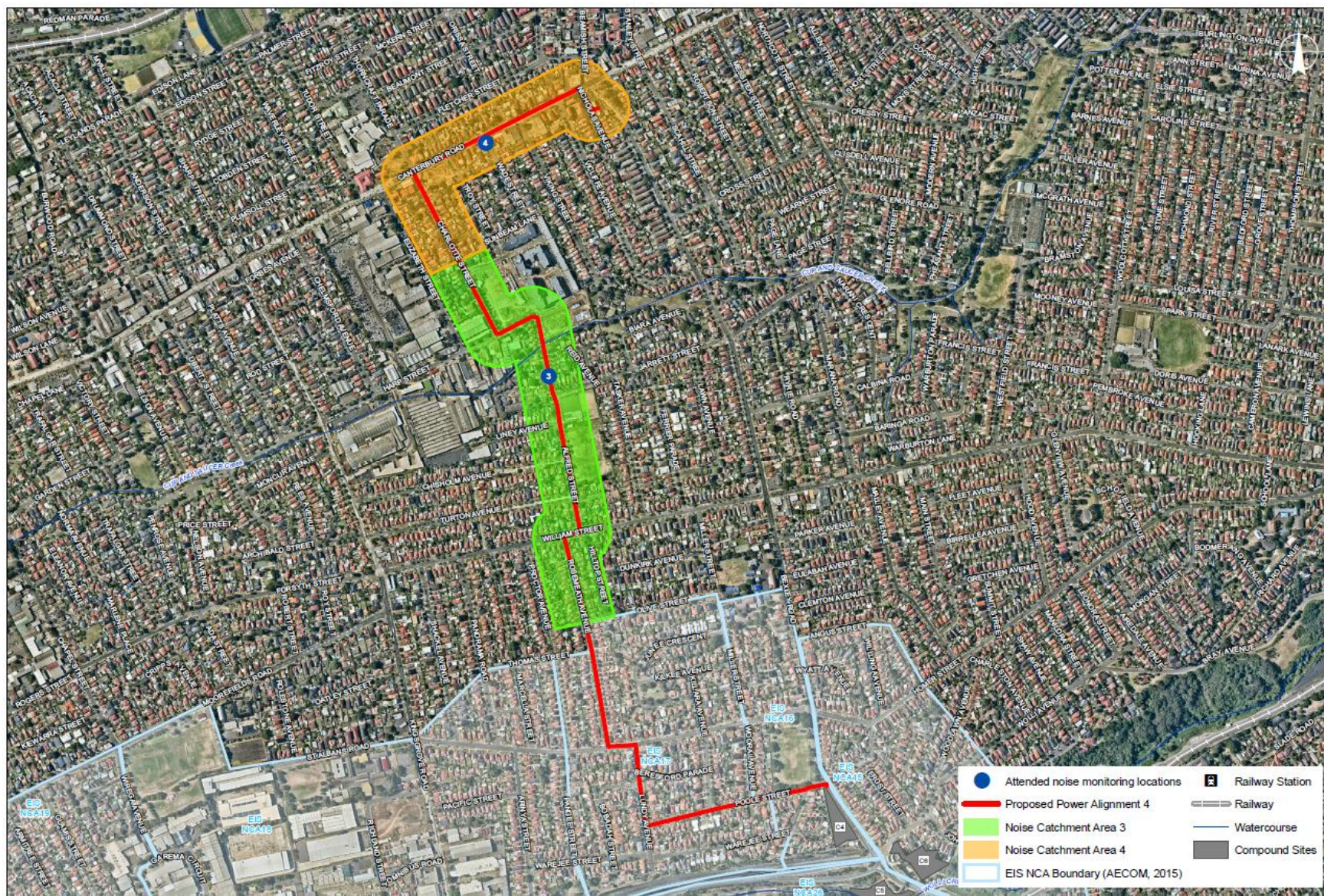


Figure 7 - Noise Monitoring Locations Alignment 1 - Rockdale to Kogarah



2.2.2 Assessment of potential impacts

Noise

The typical plant and equipment likely to be used during each phase for the proposed works are outlined in **Section 1.2.3**. Overall sound power levels (SWLs) were predicted for each activity and phase of construction associated with the works. Usage factors were applied to plant and equipment which was only expected to be used for a portion of the time, during any 15 minute period.

Table 4 Estimated sound power levels for each activity

Activity	ID	Phase	Plant/equipment	Overall SWL dB(A)
General	01	Site establishment and demobilisation	2 x Lighting tower 2 x Light vehicle	97
	02	Pot holing	1 x Pot holing truck 2 x Lighting tower	107
	03	Saw cutting to access sub-base materials and/or expose connection points	1 x Road saw	114
Trenching	04	Trench excavation, shoring and installation of bedding materials	1 x Skidsteer 1 x Excavator 2 x Lighting tower	108
	05	Installation of conduct and trench backfilling	2 x Hand tools 1 x Excavator 2 x Lighting tower	102
	06	Compaction	2 x Compactor 2 x Lighting tower	110
	07	Asphalting (as required)	1 x Asphalting supply / spray truck 2 x Lighting tower	106
Horizontal directional drilling	08	Horizontal drilling and installation of conduct	1 x Horizontal drill rig 1 x Excavator 1 x Mud collection unit 2 x Lighting tower	113
Pipe jacking	09	Pipe and conduct installation	1 x Pipe jacking machine 1 x Excavator 2 x Lighting tower 1 x Vacuum truck	111

To assess potential impacts associated with the proposal, noise levels were predicted at varying distances from each construction activity. These results are displayed below in **Table 5**. Levels were calculated based on the distance from the source. Attenuation factors such as air and ground absorption have not been considered and no correction for topographical or structural screening has been given. Hence results are conservative.

Table 5 Predicted construction noise levels (un-mitigated)

Activity ID	Overall SWL dB(A)	Approximate construction noise level dB(A) at distances from the activity				
		5 metres	10 metres	15 metres	25 metres	50 metres
01	97	75	69	65	61	55
02	107	85	79	75	71	65
03	114	92	86	82	78	72
04	108	86	80	76	72	66
05	102	80	74	70	66	60
06	110	88	82	78	74	68
07	106	84	78	74	70	64

Activity ID	Overall SWL dB(A)	Approximate construction noise level dB(A) at distances from the activity				
		5 metres	10 metres	15 metres	25 metres	50 metres
08	113	91	85	81	77	71
09	111	89	83	79	75	69

Red bolded values indicate levels exceeding ICNG 'Highly noise affected' management levels

Bolded values indicate levels sleep disturbance awakening criterion

The results presented above indicate that noise levels are expected to exceed the ICNG 'highly noise affected' management levels at nearby receivers during most phases of the proposed works. Activities 3 (saw cutting) and 8 (horizontal drilling) present the greatest risk, with levels expected to exceed ICNG 'highly noise affected' management levels up to a distance of around 30 meters.

The levels predicted at 10 metres from each activity above in **Table 5** exceed the NMLs for each time of the day (i.e. day, evening and night) for all sections of each of the four alignments except the day time NMLs for the section of Alignment 1 along West Botany Street between Wickham Street and Valda Avenue.

The predicted levels indicate that sleep disturbance awakening criterion may be exceeded at receivers set at distances of up to around 50 meters from the proposed works. This prediction considers the correction of values presented in **Table 5** from an $L_{Aeq\ 15\ minute}$ dB(A) to a $L_{A1, (1\ minute)}$ level. This being said, this prediction is conservative, noting that no screening or shielding attenuation effects have been considered, and the sleep disturbance awakening criterion is based on a 'worst-case' façade transmission loss of 10 dB(A), which in reality may be higher. Still, mitigation and management measures should be developed with the aim of limiting any sleep disturbance impacts during the proposal.

Overall, the results indicate that nearby receivers would experience short-term, elevated noise levels during the proposal which would require the implementation of mitigation and management controls to effectively limit the level of impacts during the works. The majority of the works will be carried out in accordance with the *Interim Construction Noise Guideline* (DECC, 2009) during the standard working hours.

Out of hours work

The majority of the works are proposed to be carried out during standard construction hours. However, out of hours work may be required in the following instances:

- Utility cut-over works may have to be carried out outside of standard construction hours, as utility providers dictate that cutovers can only occur when demand on the asset is at its lowest to ensure minimal disruption to the service for customers (commercial, industrial and residential)
- The road asset owner (Council or Traffic Management Centre) may condition a ROL for the works to be carried out outside standard construction hours. Where this occurs, SMC would undertake the works according to the conditions attached to the ROL.

In these instances, the predicted levels indicate that sleep disturbance screening and awakening criteria may be exceeded at receivers set at distances of up to around 50 metres from the proposed works. This prediction considers the correction of values presented in **Table 5** from an $L_{Aeq\ 15\ minute}$ dB(A) to a $L_{A1, (1\ minute)}$ level. This prediction is conservative, noting that no screening or shielding attenuation effects have been considered, and the sleep disturbance awakening criterion is based on a 'worst-case' façade transmission loss of 10 dB(A), which in reality may be higher. However, mitigation and management measures should be developed with the aim of limiting any sleep disturbance impacts during the proposal.

Overall, the results indicate that nearby receivers would experience short-term, elevated noise levels during the proposal which would require the implementation of mitigation and management controls to effectively limit the level of impacts during the works.

Vibration

Certain phases of the proposal (horizontal drilling, pipe jacking and compaction) will involve the use of plant and equipment with the potential to generate low-level localised vibrations. Considering the nature of the plant and equipment proposed, and the typical setback distances to the surrounding receivers, it is unlikely that building cosmetic and human comfort vibration criteria would be exceeded. Vibration levels are also not expected to be of a magnitude which would lead to the damage of buried pipework.

The nearest vibration-sensitive structures are set at distances as near as 10 metres from the proposal (such as the Former hospital for women - Alignment 1). Where horizontal drilling, pipe jacking or compaction activities are required to be completed within 10 metres of the structures identified in this assessment, there is the potential that vibration velocities may exceed 3 mm/s.

2.2.3 Environmental management measures

Noise impacts associated with the works are likely to temporarily impact surrounding receivers. However, impacts would be temporary, localised and would be largely limited to the standard working hours (Monday to Friday 7am to 6pm, Saturday 8am to 1pm).

Noise impacts would be managed through the implementation of the environmental management measures outlined in the Construction Area Plan (CAP), with detail listed in a Work Pack (WP) which will include Site Environment Plans (SEP), as well as the measure outlined in Chapter 8 (Revised environmental management measures) of the New M5 Submissions Report. These include:

- NV9 (Where feasible and reasonable, equipment with directional noise emissions will be orientated away from sensitive receivers): Noise associated with the construction site would primarily result from the operation of fixed and mobile plant and truck movements. Consideration would be given to the layout of the site in order to maximise distance and shielding to nearby receivers
- NV11 (Construction noise monitoring): A noise monitoring program would be implemented to assist in confirming and controlling the site specific potential for disturbance at particularly sensitive localities at the commencement of activities and periodically during the construction program as the works progress. This would form part of the Construction Noise and Vibration Management Plan
- NV16 (Respite periods for high noise impact works where possible): Respite measures may include the restriction to the hours of construction activities resulting in impulsive or tonal noise (such as shredding or stump grinding), or other appropriate measures agreed between the contractor and residential receiver. The protocol would form part of the Construction Noise and Vibration Management Plan
- NV17 (Designated vehicle routes, parking and queuing locations, acceptable delivery hours and other relevant practices)
- NV18 (Deliveries and spoil removal will be planned to avoid queuing of trucks around sites)
- NV20 (Safe working distances)
- NV30 (Community consultation) in addition to commitments within the New M5 Draft Community Consultation Framework (Appendix E of the EIS).

2.3 Other environmental issues

2.3.1 Air quality

The proposed alignments are all located in disturbed, urban environments comprising roads, residential areas and light industrial areas. Air quality would therefore be subject to urban influences and emissions typically associated with road traffic, including dust and exhaust emissions.

Potential air quality impacts during construction of the Proposal would be temporary impacts associated with the generation of dust. Anticipated sources of dust and dust generating activities include:

- Trenching and excavation works
- Removal/trimming of street trees and/or garden beds
- Loading and transfer of materials from trucks
- General construction works
- Emissions of CO, NOx, SO2, PM10, Volatile Organic Carbons (VOCs) and Polycyclic Aromatic Hydrocarbon (PAH) compounds associated with the combustion of diesel fuel and petrol from general traffic, construction plant and equipment.

The proposed service installation works will not have an adverse impact on long-term air quality as the proposal would not involve extensive excavation or other land disturbance with the potential to generate significant quantities of dust.

The operation of plant, machinery and trucks may also lead to increases in exhaust emissions in the area. However, these impacts would be localised and limited to a very short term construction period.

Overall, potential impacts from construction activities on air quality are anticipated to be minor and would be managed via the implementation of environmental management measures outlined in **Chapter 8** (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report, which would also be stipulated in the Site Environment Plans (SEP).

2.3.2 Land use and property

The proposal is located within the Rockdale, Canterbury, Hurstville and Marrickville LGAs. The land adjacent to each alignment comprises residential, commercial, industrial and recreational land uses. The proposed alignments will be located through densely populated areas and in the vicinity of a number of non-residential receivers including the following:

- Riverine Park (Alignment 1)
- Barton Park (Alignment 1)
- Kogarah Golf Course (Alignment 1)
- St Dominic Savio School, West Botany Street (Alignment 1)
- Camdenville Park, St Peters (Alignment 3)
- May Street Reserve, St Peters (Alignment 3)
- Yatama Park, Campsie South (Alignment 4)
- Beaumont Park, Bexley North (Alignment 4).

The proposed alignments impact on the following land zones:

Alignment	Land zones
Alignment 1	R2 Low Density Residential; R3 Medium Density Residential; RE1 Public Recreation; SP2 Infrastructure – Classified Road
Alignment 2	IN2 Light Industrial; SP2 Infrastructure – Electricity Generating Works
Alignment 3	R2 Low Density Residential; R3 medium Density Residential; IN1 General Industrial; B6 Enterprise Corridor; SP2 Infrastructure – Classified Road
Alignment 4	R3 Medium Density Residential; R4 High Density Residential; IN2 Light Industrial; RE1 Public Reserve; B5 Business Development; SP2 Infrastructure – Classified Road, SP2 Infrastructure – Electricity Generating Works

The land required for the proposal is owned by Roads and Maritime or the relevant Council. Works would be undertaken within the road reserve or the footpaths of various roads. No additional property, beyond what is required for construction of the project is required for this proposal.

Once completed, the works would not restrict access to recreational space, public thoroughfares, commercial, industrial or residential development and would comply with all relevant guidelines applicable to these land uses.

These impacts would be short-term and minimised as far as practical given the implementation of appropriate management measures outlined in **Chapter 8** (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report, which would be incorporated into the Construction Area Plan (CAP) and Site Environment Plans (SEP). A significant impact on the local community is not anticipated.

2.3.3 Social and economic

The proposal area is a heavily urbanised area with a mixture of residential, commercial and industrial land uses within the proposal footprint. There are also a large number of parks within the area as well as main arterial and local roads which would be potentially affected by the proposed works.

There would be some localised disturbance during the works, and there would be no immediate benefit to residents or businesses adjacent to construction works. After completion of the project however, the electricity infrastructure would become available to supplement local supply. Given that local demand for the infrastructure may not exist currently, the works would provide some future-proofing of infrastructure to accommodate future population growth and development.

The long term physical impact of the proposal would be negligible in that the infrastructure would be hidden from view, will not cause any disturbance in terms of noise or air pollution, or impact on any natural systems. It will not result in any long term loss of amenity or access to public facilities or social infrastructure. Operation and maintenance requirements will be minimal, and confined to infrequent low-impact activity at isolated locations such as junction pits and existing substations.

Amenity impacts relating to noise and vibration and visual impacts may affect the way local residents and workers experience their environment. These impacts would also be experienced by local businesses and residents. Amenity impacts would be relatively minor and of short duration.

The works would also include temporary impact on traffic and access where works are carried out adjacent to or within the road corridor. Temporary impacts are likely to include:

- Pedestrian access and movement around the site
- Indirect impacts on local roads and intersections due to vehicles avoiding work site areas
- Travel times due to traffic delays
- Access to business and private property and car parking areas
- Reductions in car parking availability

The majority of the social and economic impacts of the works relate to impacts assessed in other sections of this assessment, including air quality, traffic and access, noise and vibration, and visual amenity. These impacts would be short-term and minimised as far as practical given the implementation of appropriate management measures outlined in **Chapter 8** (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report, which would be incorporated into the Construction Area Plan (CAP) and Site Environment Plans (SEP). A significant impact on the local community is not anticipated.

2.3.4 Soil and water

Soils

The *Soil Landscapes of the Sydney 1:100,000 Sheet 9130* (1989) indicates that the works would be underlain by seven soil landscape groupings, within which there are seven soil landscapes. The Gymea soil landscape covers the majority of the works in the west, with smaller areas of the

Hawkesbury, Blacktown, Birrong, Warriewood and Oxford Falls soil landscapes. The eastern extent of the works would be largely covered by land identified as being disturbed terrain associated with the channelisation of the Cooks River and industrial land uses around Sydney Airport.

The majority of the works would be carried out in already disturbed areas associated with the road reserves and footpaths.

A search of the Australian Soils Resource Information System indicated there is a low to extremely low probability of occurrence of acid sulphate soils for all of the proposed temporary power supply alignments; with the exception of Alignment 1 which intersects partially with land identified as having a high probability of being acid sulphate soils.

None of the proposed alignments intersect with sites which have been declared under the *Contaminated Lands Management Act 1997* as being significantly contaminated. Each of the alignments is located within or adjacent to road reserves, which is land that has been subject to historic disturbance. As such during construction there is the potential to encounter contamination around surface disturbance areas.

Soil salinity is possible within the landscape affected by the proposal footprint. Given that the majority of this proposal involves disturbing only the top layer of fill material, and given that the area is already highly urbanised, there is no risk that soil salinity will impact on construction works, rehabilitation or on discharges of surface water as part of erosion and sediment control.

Excavation and trenching works would disturb and expose soils which could potentially lead to erosion and sedimentation. There is a risk that works may also expose acid sulphate soils, most notably during works to install power supply to Kogarah Golf Course compound (Alignment 1), as the proposed alignment intersects with an area that has been mapped as having a high probability of containing acid sulphate soils. If encountered, acid sulphate soils would be managed through an Acid Sulphate Soil Procedure in accordance with the *Acid Sulphate Soil Manual* (Acid Sulphate Soil Management Advisory Committee, 1998).

Given the past land uses there is a risk of exposing contaminants which, if not appropriately managed, can present a health risk to construction workers and the community. Contaminates would also pose an environmental risk if they were to enter nearby waterways through the stormwater infrastructure. Excavated spoil that cannot be reused during the works will require removal and disposal offsite. Any contaminated spoil would need to be classified and transported to an appropriate licensed waste facility. During construction, there is also a potential for soil to become contaminated as a result of accidental fuel or chemical leaks from construction equipment. All spills would be immediately reported to the environment team and cleaned up using spill kits available in each work area.

These impacts would be short-term and confined to the construction stage of the project and are considered minor following the implementation of appropriate management measures for the duration of the construction activities. The appropriate management measures would form part of the Construction Area Plan (CAP) and Site Environment Plans (SEP). No additional environmental management measures are considered necessary.

Groundwater

Groundwater levels within the study area are influenced by topography, creeks, rainfall, recharge and manmade structures. Natural groundwater levels are expected to generally reflect a subdued shape of the topography; the groundwater being deeper beneath hills and shallowest beneath creeks or gullies. Across the study area, the topography consists broadly of:

- relatively flat and low lying land with gentle undulating hills ranging between 30 metres Australian height datum (AHD) and 40 metres AHD in the vicinity of Kingsgrove
- elevations of between 40 metres AHD to 50 metres AHD around Bexley North
- relatively flat and low-lying (around five metres AHD to 10 metres AHD) topography near Cooks River, which gradually declines towards Botany Bay and

- former brick pits beneath nearby St Peters, which have been infilled and re-contoured forming an irregular, man-made landform varying in elevation from 5 metres AHD to 25 metres AHD.

The groundwater elevation recorded at monitoring sites across the study area is highly variable and dependent upon the topographical expression. Groundwater levels within the Hawkesbury Sandstone vary from 1.5 metres to 35 metres below ground level and from -1 to 24.2 metres AHD (AECOM, 2015: 19-16).

The majority of the proposed works would involve excavation in depths of between 0.2 metres and two metres and as such it is unlikely that the works would significantly impact upon groundwater.

The interception of groundwater would be managed via the implementation of environmental management measures outlined in Chapter 8 (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report. No additional environmental management measures are considered necessary.

Surface water

The project alignments are located within urbanised and residential areas that are not in proximity to waterways, with the exception of Alignment 4, which crosses one stormwater drainage line, Cup and Saucer Creek on Alfred Street approximately 70 metres south of Harp Street. This waterway is shown below. The alignment would be underbored beneath the stormwater channel, using existing service conduits. No impact to this channel is anticipated. A review of Sydney Water databases has indicated that Cup and Saucer Creek is a Sydney Water owned asset.



Photo 1: Stormwater channel (on Alfred Street (looking east) (Source: Google Maps, 2016)

Work sites have the potential to be inundated during wet weather events, including trenches and areas of ground disturbance. This has the potential to generate dirty construction water which may lead to erosion and sedimentation impacts and pollution of downstream waterways, or require pumping, treatment and disposal.

The works would not impact on waterway or catchment hydrology, as the works would be localised, temporary and would involve minimal areas of disturbance at any one time. There would be no impact on long-term flooding and drainage patterns as work sites would be reinstated to a pre-construction condition at the completion of the works.

Potential impacts to waterways and drainage would be managed via the implementation of environmental management measures outlined in Chapter 8 (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report. No additional environmental management measures are considered necessary.

2.3.5 Biodiversity (flora and fauna)

The area that would be affected by the works is largely characterised as urban and industrial. The proposed alignments would be predominately located within or adjacent to the road corridor. As a result, works would generally be limited to being carried out on the road surface, footpaths or adjacent grassed areas, comprising of planted vegetation, shrubs and trees.

No threatened ecological communities were identified as being present within the footprint of the works, and the works are not expected to have an impact on downstream wetlands.

One fauna species of note, the Green and Golden Bellfrog (*Litoria aurea*), is known to inhabit ponds at the Kogarah Golf Course, which is the location for one of the construction compounds being served by the proposed power supply upgrade Alignment 1. The significance of Green and Golden Bell frog habitat has been assessed in the EIS. In regard to the frog habitat at the Kogarah Golf Course, the works would terminate at the construction compound but will result in no additional impacts over and above what has already been assessed for the EIS.

There are likely to be isolated locations where street trees or other plantings are potentially impacted by proposed trenching works. While the removal of street trees will be avoided wherever possible, the trenching works are likely to impact on root zones at some locations.

Alignment 1:

Alignment 1 is also located primarily within the road reserve, in an area that is predominately residential. No impacts on vegetation or fauna habitat are considered likely as a result of the proposed new works to construct Alignment 1. Existing works in Kogarah Golf Course/Marsh Street will be carried out under another prior contract (NGH Environmental, 2015).

Alignment 2:

Alignment 2, while only approximately 25 metres in length, will potentially impact on two large mature casuarina trees that stand adjacent to the footpath in front of the light industrial property at 31 Garema Circuit.

The section of Alignment 2 in Commercial Road is also approximately 25 metres in length, within the footpath in front of the light industrial property. This section of the alignment will not impact

Alignment 3:

Alignment 3 is also located primarily within the road reserve, in an area that is predominately residential. No impacts on vegetation or fauna habitat are considered likely as a result of the proposed works to construct Alignment 3.

Alignment 4:

Alignment 4 is not likely to impact on any vegetation. This alignment terminates at the proposed Bexley North compound, which is colonised by vegetation identified by OEH as being 'urban exotic/native'. No additional clearing of this vegetation, over and above that which has been assessed under the WestConnex New M5 EIS, is proposed or considered.

Potential impacts associated with the works would be mitigated and managed through the implementation of the biodiversity environmental management measures for the project, as provided in Chapter 8 (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report.

In addition, in accordance with feedback received from Canterbury Council, all excavation works should avoid the critical root zone of street trees (i.e. within three metres of trees). Where this is not possible, due care would be taken to avoid physical damage to the trees and their root system. An environmental advisor would be contactable and on call if excavation works are within the critical root zone to confirm if an arborist is required. For each proposed alignment, the potential impacts are discussed in the following sections.

2.3.6 Non-Aboriginal heritage

The works would cover an area which exhibits numerous items identified as having historic significance at the local level or, in some cases, as being of historic significance to the State. **Table 6** identifies the items and areas of heritage significance recorded along the alignments of the works.

The locations of the heritage items and conservation areas referenced in **Table 6** that are of relevance to the proposal are shown in **Figure 9** to **Figure 12**.

Table 6 Heritage items and conservation areas

Item name	Address	Listing	Impact type due to the works
Alignment 1 Rockdale ZNS to Kogarah Golf Course			
Former hospital for women	112 West Botany Street	Rockdale LEP 2011 I57	No direct impact. Alignment approximately 10 metres from item on West Botany Street
Western Outfall Main Sewer (part of SWSOOS)	Valda Avenue to Homebush Rockdale to Homebush	Sydney Water s. 170 item 4571738 SHR 01647	No direct impact. The item runs south from Valda Avenue under the road overpass at Marsh Street to SWSOOS 1. *
House	73 West Botany Street	Rockdale LEP 2011 I56	No direct impact. Alignment approximately 10 metres from item on West Botany Street
Arncliffe Market Gardens	212 West Botany Street Arncliffe	SHR 01395 Rockdale LEP 2011 I93	No direct impact. Item set back approximately 10 metres from West Botany Street.
Sewer vent	20A West Botany Street	Rockdale LEP 2011 I55	No direct impact. Item set back approximately 15 metres from West Botany Street.
House	31 Kyle Street	Rockdale LEP 2011 I35	No direct impact. Alignment approximately 50 metres from item on Kyle Street.
* Note: the curtilage of Western Outfall Main Sewer is shown at southern intersection of Marsh Street and Valda Avenue. This item is listed on Sydney Water's section 170 register. It forms part of the Southern and Western Suburbs Ocean Outfall Sewer 1 (SWSOOS 1), and is of state significance. This section of the sewer consists of three 1.83m diameter brick barrels which are hidden by concrete and masonry encasement. The southerly end of this section of the sewer is supported on concrete arches, which now are completely obscured by fill and encasement (Roads and Maritime, 2015).			
Alignment 2 Kingsgrove Garema Circuit. and Commercial Road.			
No listings			

Item name	Address	Listing	Impact type due to the works
Alignment 3: May Street and Mary Street to St Peters Site			
Victorian Filigree style mansion 'Claraville' including interiors	21-23 Silver Street St Peters	Marrickville LEP 2011 I278	No direct impact. Property set back about 15 metres from road reserve.
St Peter's Public School including interiors	93A Church Street, St Peters	Marrickville LEP 2011 I271	No direct impact. Curtilage extends to Silver Street, about 5 metres from the proposed works. However, the school is located about 160 from works.
St Peter's Anglican Church	187-209 Princes Highway St. Peters	SHR Item 00032 Marrickville LEP 2011 I275 RNE #1716	No direct impact. 60 metres from the proposed works on Silver Street
Service garage	316 Princes Highway, St Peters	Marrickville LEP 2011 I312	No direct impact. Alignment approximately 45 metres from item
Southern Cross Hotel	340 Princes Highway (corner Canal Road), St Peters	Marrickville LEP 2011 I277	No direct impact. Alignment approximately 45 metres from item
Town and Country Hotel, including interiors	2 Unwins Bridge Road (corner Campbell Road), St Peters	Marrickville LEP 2011 I281	No direct impact. Alignment approximately 15 metres from item.
Group of Victorian Filigree and Victorian Italianate terrace houses – 'Narara', including interiors	4–18 Unwins Bridge Road, St Peters	Marrickville LEP 2011 I282	No direct impact. Alignment approximately 15 metres from item.
Waugh & Josephson industrial buildings former, showroom, offices and workshop, including interiors	1–7 Unwins Bridge Road, St Peters	Marrickville LEP 2011 I280	No direct impact. Alignment approximately 15 metres from item.
Goodsell Estate conservation area	North of May Street, within Camdenville Park	Marrickville LEP 2011 C16	No direct impact. Alignment approximately 45 metres from conservation area.

Item name	Address	Listing	Impact type due to the works
Alignment 4 Campsie ZNS to Poole St.			
Inter war shop and motor garage—Dan's Corner	485–493 Canterbury Road	Canterbury LEP 2012 I45	No direct impact. Item 20 metres from the proposed works at intersection of Canterbury Road and Charlotte Street
Inter war hospital building—Canterbury Hospital	575 Canterbury Road (also known as 26–50 Tudor Street)	Canterbury LEP 2012 I46	No direct impact. Item 55 metres from the proposed works.

The majority of these items are houses, buildings or structures which are within property boundaries. It is not anticipated that the installation of below ground power infrastructure would result in any substantial impacts beyond temporary disturbance within the road reserve. The location of each heritage item would be identified in the Construction Area Plans for the works.

Short term indirect impacts may include visual disturbance and vibration. The work site would be kept in a clean and orderly condition. Separation distances between the proposed works and heritage items would be maximised where possible, and low vibration inducing machinery and techniques would be used to minimise the risk of vibration impacts on heritage items.

Overall, it is not anticipated that the proposed works would have a long term impact on any identified heritage items or conservation areas, as the works are primarily within the road reserves or footpaths which would be reinstated to their existing condition after the works are complete. Indirect impacts would be minor and temporary.

Given the minor and temporary nature of the works and the historical disturbance of this area by past projects, impacts to historic heritage items are not expected. Environmental management measures outlined in Chapter 8 (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report would be implemented in the event that any non-Aboriginal relics are discovered or encountered during construction. No additional environmental management measures are considered necessary.

2.3.7 Aboriginal heritage

The following section is based on the reported findings of the EIS, as well as a review of the AHIMS database, which was carried out to identify if any of the proposed alignments that extend beyond the WestConnex study area would impact on recorded Aboriginal heritage.

The southern section of Alignment 1 and the northern section of Alignment 4 extend beyond the boundary of the assessment undertaken as part of the EIS. AHIMS searches were undertaken for Alignments 1 and 4 to identify if there are items of known Aboriginal heritage along these alignments.

No Aboriginal heritage items were identified in proximity to alignments 1, 2, 3, and 4, and no known Aboriginal heritage would be impacted by the proposal.

The potential of the works to impact on unidentified Aboriginal heritage is considered low along Alignments 1 and 4 due to the highly disturbed and urbanised nature of the project area. Based on the findings of the EIS, a review of the AHIMS database and the likely areas of disturbance, impacts to Aboriginal heritage are not anticipated as a result of the works.

It is anticipated that there is a low likelihood that Aboriginal objects would occur within the alignments due to past disturbance. It is recommended that the proposed works proceed with caution, with the implementation of environmental management measures outlined in Chapter 8 (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report should any unexpected finds be encountered. No additional environmental management measures are considered necessary.

2.3.8 Resource use and waste minimisation

Activities associated with the works have the potential to generate waste materials. The nature and volume of waste generated during construction would be predominantly non-hazardous and relatively minor. However, there is potential for impacts on the local environment if waste is not managed appropriately.

The following waste sources are likely to be generated during the works:

- Vegetation Waste
- Hazardous waste discovered during excavation (potentially including asbestos and other contaminated spoil)
- General construction waste

Waste management practices would be managed in accordance with the *Waste Avoidance and Resource Recovery Act 2001* by adopting the resource management hierarchy principles (in order of priority) of avoidance, resource recovery and disposal.

Providing waste is managed appropriately in accordance with the management measures outlined in Chapter 8 (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report and the *Waste Classification Guidelines* (DECCW, 2009), construction and operational wastes are not anticipated to have a significant adverse impact on the local environment. No additional environmental management measures are considered necessary.

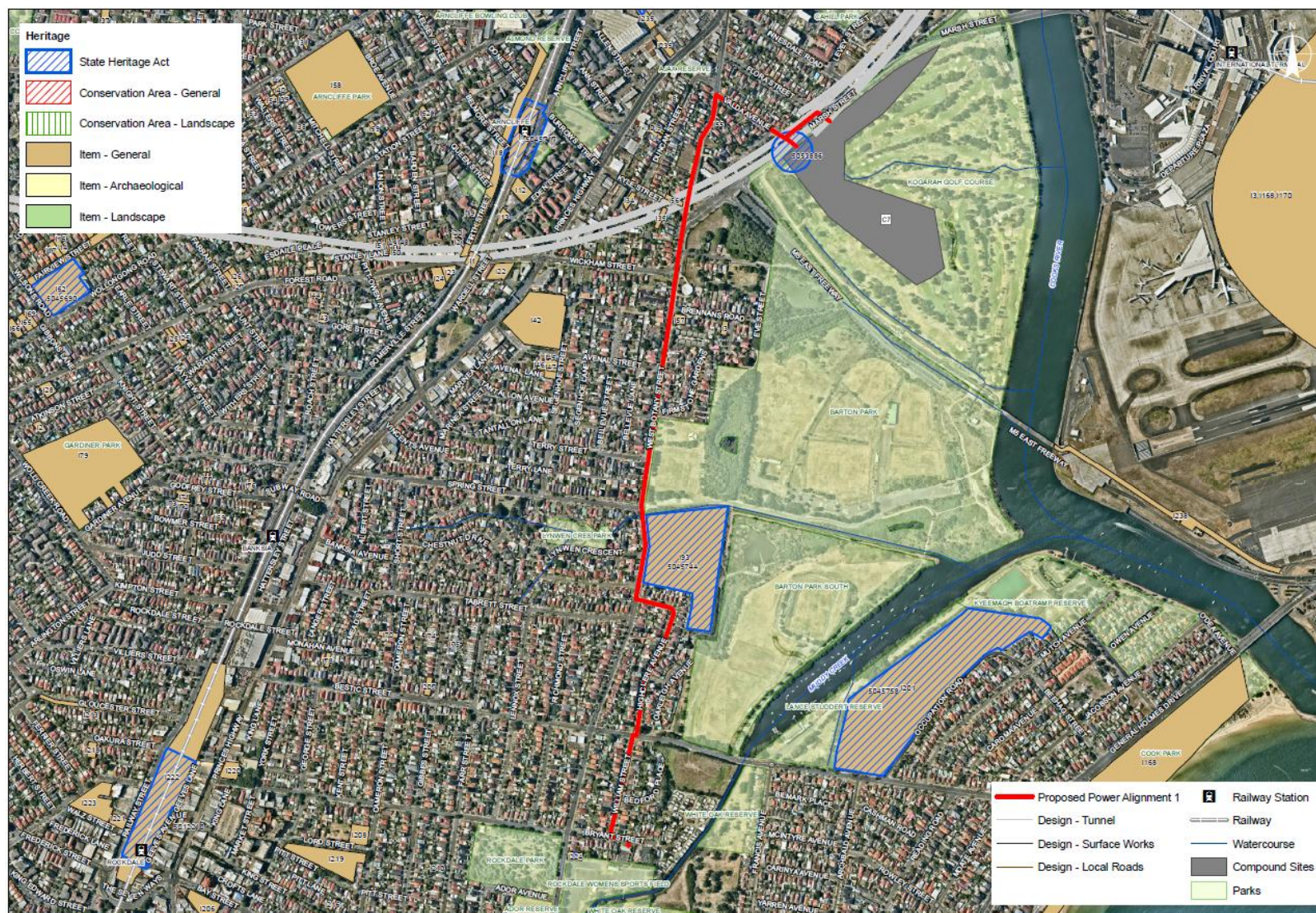


Figure 9 Alignment 1 – Non Aboriginal heritage



Figure 10 Alignment 2a and 2b – Non Aboriginal heritage



Figure 11 Alignment 3 – Non Aboriginal heritage

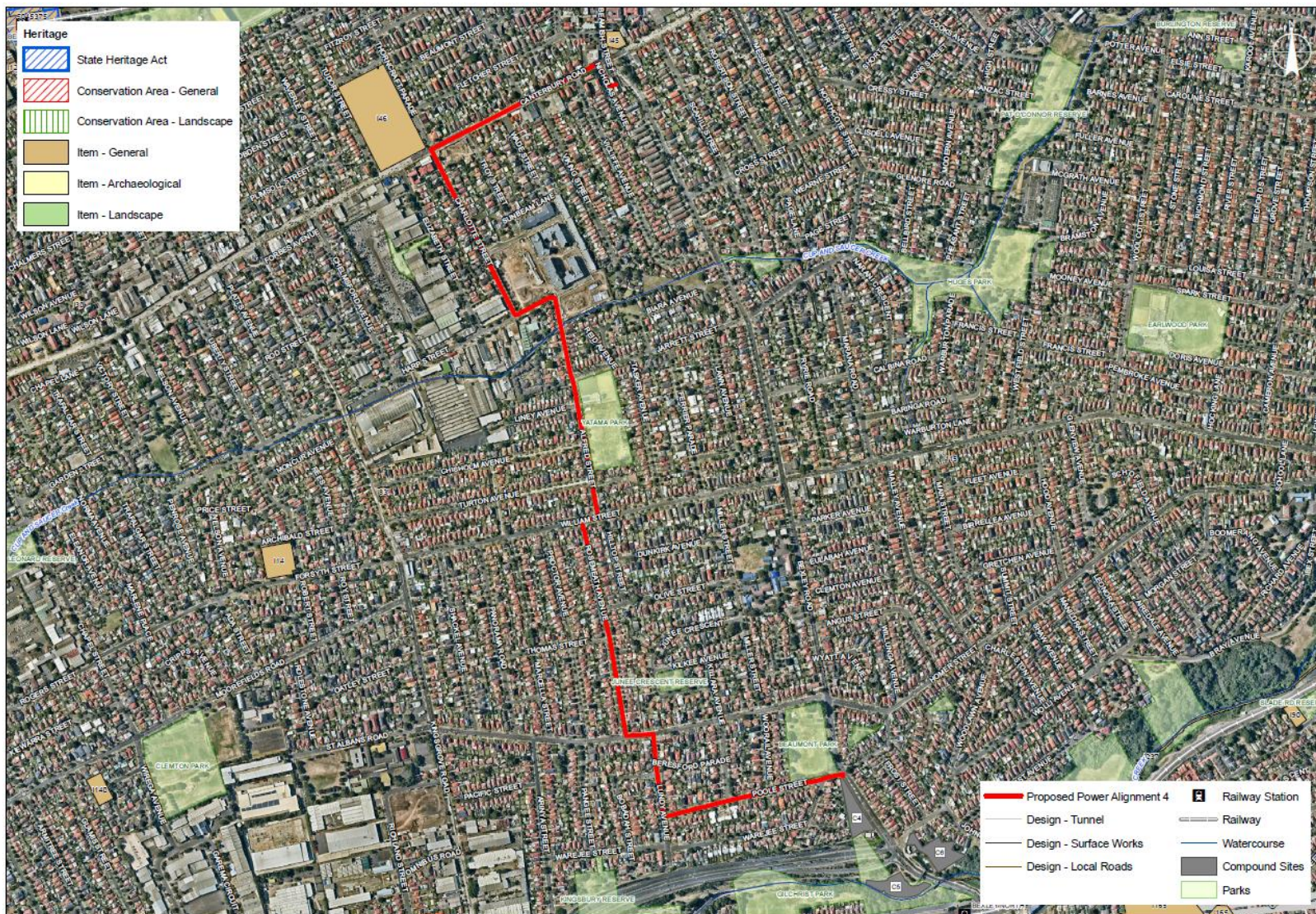


Figure 15 - Alignment 4 Non-Aboriginal Heritage

Figure 12 Alignment 4 – Non Aboriginal heritage

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3 Summary and justification

The works as outlined in this Addendum are integral and ancillary to the construction of the project. A failure to supply power to the proposed construction compounds would result in impacts to the program, quality and cost of the project throughout construction.

The key beneficial outcomes of the proposed power supply works include:

- Ensuring that a dedicated, efficient power supply is provided for the construction of the WestConnex New M5 Motorway, and which therefore will not compromise the reliability of supply to homes and businesses in the surrounding area.
- The provision of power supply infrastructure that will help to 'future-proof' the local area by contributing to meeting future demand for power in the surrounding area, after construction of the WestConnex New M5 Motorway is complete.

The key potential adverse impacts of the proposal include:

- Noise and vibration impacts on nearby sensitive receivers, most notably where the proposed alignments are within residential areas, require night works due to ROL conditions, or are near (within 10 metres) to vibration sensitive structures including heritage items;
- Traffic and pedestrian impacts during construction works due to partial road closures or works being undertaken within footpaths; and
- Discovery of unexpected contamination due to works being undertaken within or adjacent to road reserves, which is land that has been subject to historic disturbance. As such during construction there is the potential to encounter contamination around surface disturbance areas.

With the implementation of management measures outlined in Chapter 8 (Revised environmental management measures) of the New M5 Submissions and Preferred Infrastructure Report, impacts on surrounding receivers of the environment are not expected to be significant.

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Appendix A Noise and vibration assessment



WestConnex New M5 Temporary Construction Power Enabling Works

Noise and Vibration Assessment

F0 | v3

15 March 2016



WestConnex New M5 Temporary Construction Power Enabling Works

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Document history and status

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F0v0	01/02/2016	Final issued to Project Manager	L Spencer		
F0v1	15/02/2016	Updated to add alignment 5 (Garema Circuit, Kingsgrove)	L Spencer		
F0v2	23/02/2016	Updated to address changes to proposed alignment routes	L Spencer		
F0v3	15/03/2016	Updated to address NSW Roads and Maritime Services comments	L Spencer		

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1. Introduction

On behalf of the Sydney Motorway Corporation (SMC), the Leighton Dragados Samsung joint venture (LDS JV) is proposing to provide temporary power supply for the operation of construction compounds associated with the New M5 Project. The purpose of this report is to provide an assessment of potential noise and vibration impacts associated with this proposal. This report is intended to support a *Review of Environmental Factors* being prepared to assess the overall environmental impacts associated with the proposal.

In achieving this purpose, the main objectives of this assessment were to:

- Identify nearby noise and vibration sensitive receivers in relation to the proposal.
- Characterise background noise conditions around the proposal areas.
- Develop appropriate construction noise and vibration assessment criteria in accordance with relevant policy and guidelines.
- Quantitatively assess potential noise and vibration-related impacts associated with the construction phase of the proposal.
- Develop suitable management measures, as appropriate, to minimise impacts during construction.

In summary, this report provides information on the following:

- Details and background information on the proposal and local setting (Section 2).
- The existing environment including ambient noise conditions (Section 3).
- Applicable noise and vibration criteria (Section 4).
- Quantitative assessment noise and vibration impacts including methodology and results (Section 5).
- Suitable noise and vibration mitigation measures to be implemented as required to potential manage impacts (Section 6).

2. Project description

2.1 Overview

The SMC is responsible for WestConnex, including the Stage 2 new M5 project between Beverly Hills and St Peters. The project will require the establishment of a number of temporary compound facilities. In order to provide power to these facilities, additional Ausgrid utilities are required to connect these compound sites to the existing network. The proposal involves the installation of four utilities to facilitate these connections.

New power utilities are to be placed along four alignments over the local government areas (LGAs) of Hurstville, Rockdale, Canterbury and Marrickville. Each alignment is generally located within existing road reserves and footpaths. Details of each of the four alignments is summarised below in Table 2-1.

Table 2-1 Proposed power utility alignments

Alignment ID	Alignment Name	Route details	Approximate length (km)
Alignment 1	Rockdale ZNS to Kogarah Golf Course	From Kogarah ZNS along Bryant Street, Williams Street, Highclere Avenue, West Botany Street, Valda Avenue and Marsh Street into Kogarah Golf Course Compound.	2.3 km
Alignment 2a	Commercial Road S10117 to Kingsgrove South Compound	From Commercial Road S10117 down Commercial Road approximately 50m to Kingsgrove South Compound.	0.05 km
Alignment 2b	Garema Circuit to Kingsgrove North Compound	Garema Circuit to Kingsgrove North Compound	0.025 km
Alignment 3	May Street S660 to St. Peters Site.	May Street component – Unwins Bridge Road, Silver Street, Edith Lane, Edith Street, Princes Highway.	0.75 km
	Mary Street S22 to St. Peters Site	Mary Street component – Bakers Lane, Mary Street, Roberts Lane, Edith Street, Princes Highway.	0.28 km
Alignment 4	Campsie ZNS to Poole Street	From Campsie ZNS along Nicholas Avenue, Canterbury Road, Charlotte Street, Harp Street, Alfred Street, William Street, Rosemeath Avenue, Homer Street, Lundy Avenue and Poole Street to the proposed Bexley North Compound.	3 km

2.2 Construction methodology and program

The proposal is expected to take several months to complete with works intended to commence in the first or second quarter of 2016. Utilities would be installed using a range of different construction methods including:

- Trenching.
- Horizontal directional drilling.
- Pipe jacking.

Pot holing and slit trenching activities will also be completed to protect and cut-over existing services as required.

The construction work associated with this proposal would generally be undertaken during the standard hours of construction outlined below:

- Monday to Friday: 7am to 6pm.
- Saturday: 8am to 1pm.
- Sunday and public holidays: No work.

Certain activities will need to occur out of hours, as directed by the NSW Roads and Maritime Services and other road authorities to minimise traffic impacts, or by the utilities providers to minimise disruption to services. These works would include night and weekend works as directed by requirements of Road Occupancy Licences (ROLs) and utility providers.

The following plant and equipment is expected to be used during the proposal:

- Excavator with attachments.
- Horizontal drilling plant
- Vacuum truck.
- Pot holing truck
- Materials truck.
- Skidsteer (Bobcat) with bucket and profiler.
- Compaction equipment.
- Hand tools.
- Water cart.
- Lighting Tower.

3. Existing environment

3.1 Surrounding land use and nearby receivers

The four alignments are set within highly urbanised areas across the LGAs of Hurstville, Rockdale, Canterbury and Marrickville. There are several main roads within the vicinity of the proposal area including the M5 East Motorway and the A36 Princes Highway. The T2 Airport, Inner West rail line is also located nearby.

Noting that each of the alignments are generally located within existing road reserves and footpaths; the nearest residential receivers are generally close by, with the first row of houses typically set at a distance of around five to fifteen metres.

3.2 Background noise levels

Background noise conditions around the locality of the proposed alignments were partially determined as part of the WestConnex New M5 Environmental Impact Statement (EIS). Relevant sections of each alignment covered by a noise catchment area (NCA) identified in *WestConnex The New M5 Technical working paper: Noise and Vibration*, (AECOM, November 2015) have been listed below. Alignments 2 and 3 are wholly set within NCAs previously characterised as part of the New M5 EIS.

- Alignment 1 – Measured NCA 02 (Bryant Street, Williams Street, Highclere Avenue), Measured NCA 01 (West Botany Street – south of Tantallon Avenue), EIS NCA 14 (West Botany Street between Tantallon Avenue and Wickham Street), EIS NCA 13 (West Botany Street between Wickham Street and Valda Avenue), EIS NCA 12 (Valda Avenue and Marsh Street).
- Alignment 2 – EIS NCA 19.
- Alignment 3 – May Street component: EIS NCA 06 (Unwins Bridge Road, Silver Street), EIS NCA 07 (Edith Lane, Edith Street, Princes Highway), Mary Street component: EIS NCA 06 (Bakers Lane, Mary Street, Roberts Lane), EIS NCA 07 (Edith Street, Princes Highway).
- Alignment 4 – Measured NCA 04 (Nicholas Avenue, Canterbury Road, Charlotte Street north of Sunbeam Street), Measured NCA 03 (Charlotte Street south of Sunbeam Street, Harp Street, Alfred Street, William Street, Rosemeath Avenue north of Olive Street), EIS NCA 17 (Rosemeath Avenue south of Olive Street, Homer Street, Lundy Avenue and Poole Street).

To determine background noise conditions along sections of Alignments 1 and 4 which had not previously been characterised, the 'short-term' method outlined in Table 3.1 of the *NSW Industrial Noise Policy* (INP), (NSW Environment Protection Agency, 2000) was applied. This involved the collection of 15 minute attended noise measurements during evening and night time periods. Measurements were collected at four locations as displayed below in Figure 3-1 and Figure 3-2. Monitoring was completed using an SVAN 979 Class 1 sound level meter (SLM) and was undertaken Thursday 18th February 2016.

Results are shown below in Table 3-1. It is noted that the term ' L_{A90} ' refers to the noise level exceeded 90 per cent of the time during the monitoring period. It is commonly used to define the background noise level. ' L_{Aeq} ' is the equivalent continuous sound level or energy-time average for the period of monitoring.

Evening is considered to be from 6pm to 10pm, and Night from 10pm to 7am. Where night time background noise levels were measured to be below evening levels, night time levels were corrected to be equal to evening levels.

Table 3-1 Attended noise monitoring results

Location	Background noise level (L_{A90}) dB(A)		Ambient noise level (L_{Aeq}) dB(A)	
	Evening	Night	Evening	Night
1 – Alignment 1	56	41	65	58

Location	Background noise level (L _{A90}) dB(A)		Ambient noise level (L _{Aeq}) dB(A)	
	Evening	Night	Evening	Night
2 – Alignment 1	47	39	56	45
3 – Alignment 4	45	48 (45)	59	56
4 – Alignment 4	52	49	66	64

Using these measured results, four additional NCAs were formed (as displayed in Figure 3-1 and Figure 3-2).

Table 3-2 below summarises background noise levels applicable to each section of the proposed alignments. Day time background noise levels around the four new NCAs (Measured NCA 01, 02 03 and 04) have been estimated based on trends observed during attended monitoring completed in similar, nearby locations on the 27th and 28th January 2016 where day time levels were typically up to around 3 dB(A) higher than evening levels.

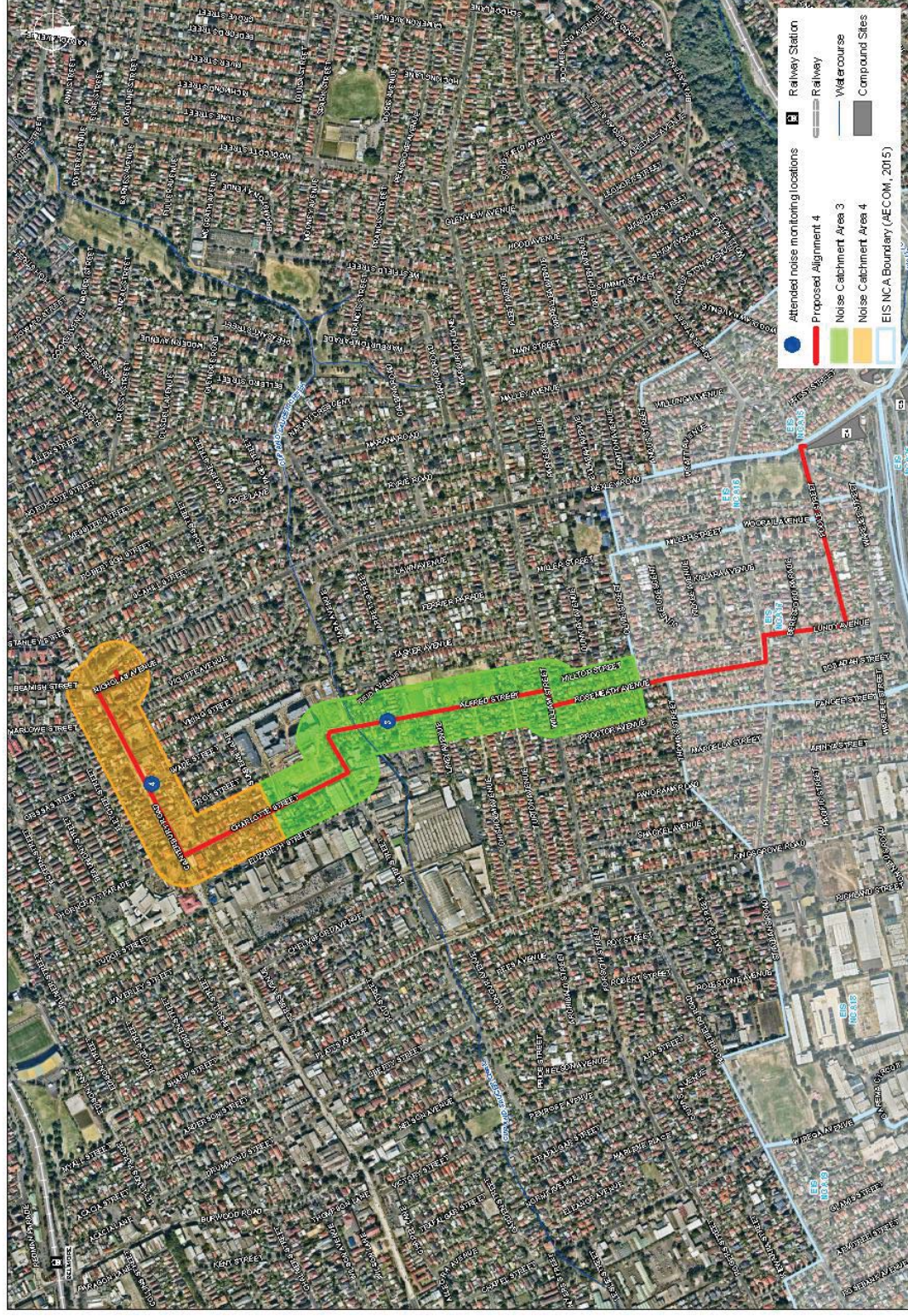
Table 3-2 Applicable background noise levels determined for each section of the four alignments

Alignment	Section(s)	NCA	Background noise level (L _{A90}) dB(A)		
			Day	Evening	Night
Alignment 1	Bryant Street, Williams Street, Highclere Avenue	Measured NCA 02	50 [#]	47	39
	West Botany Street – south of Tantallon Avenue	Measured NCA 01	59 [#]	56	41
	West Botany Street between Tantallon Avenue and Wickham Street	EIS NCA 14	50	50	42
	West Botany Street between Wickham Street and Valda Avenue	EIS NCA 13	67	67	51
	Valda Avenue and Marsh Street	EIS NCA 12	45	45	43
Alignment 2	Garema Circuit and Commercial Road	EIS NCA19	60	54	43
Alignment 3	Unwins Bridge Road, Silver Street and Bakers Lane, Mary Street, Roberts Lane	EIS NCA 06	58	56	49
	Edith Lane, Edith Street, Princes Highway and Edith Street, Princes Highway	EIS NCA 07	54	54	40
Alignment 4	Nicholas Avenue, Canterbury Road, Charlotte Street north of Sunbeam Street	Measured NCA 04	55 [#]	52	49
	Charlotte Street south of Sunbeam Street, Harp Street, Alfred Street, William Street, Rosemeath Avenue north of Olive Street	Measured NCA 03	48 [#]	45	45
	Rosemeath Avenue south of Olive Street, Homer Street, Lundy Avenue and Poole Street	EIS NCA 17	49	49	42

[#] denotes estimated day time background noise levels based on recent, nearby observed trends



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Alignment 4 - Carpsie ZNS to Poole Street - Noise Monitoring Locations

Figure 3-2 Proposed alignment four including attended noise monitoring locations and noise catchment areas

4. Assessment criteria

The methods and criteria for assessing construction noise and vibration are covered over several documents and guidelines. This section outlines criteria which are relevant to this proposal.

4.1 Noise

Construction noise impacts in NSW are managed under the *Interim Construction Noise Guideline* (ICNG), (DECC, 2009). The guideline has been developed to assist with the management of noise impacts, rather than to present strict numeric noise criteria for construction activities.

The ICNG describes two methods of assessing noise impacts from construction activities: the quantitative method, which is suited to major and complex construction projects; and the qualitative method, suited to short-term (less than three weeks) works undertaken during standard construction hours. Owing to the expected duration of the works, a quantitative approach has been considered for this assessment.

The ICNG recommends establishing noise management levels (NMLs) at receiver locations adjacent to the works, using information on the existing background noise level (measured using a descriptor known as the rating background level [RBL]) at these locations. Where the NML may be exceeded as a result of the proposed works and there is potential for adverse noise impacts to occur, appropriate management measures should be implemented.

Table 4-1 details the method for determining NMLs for residential receivers potentially affected by a proposal. Often works that may cause inconvenience within the community (e.g. traffic congestion) or safety concerns are done outside standard hours. NMLs during these periods are presented in the table for works 'Outside recommended standard hours'.

Table 4-1 Procedure for establishing construction NMLs at residential receivers, (ICNG, DECC 2009)

Time of day	Management level L_{Aeq} (15 min)	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected (RBL + 10 dB)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured L_{Aeq} (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and the duration, as well as contact details.
No work on Sundays or public holidays	Highly noise affected (75 dB(A))	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected (RBL + 5 dB)	A strong justification would typically be required for works outside the recommended standard hours The proponent should apply all feasible and reasonable work practices to meet the noise affected level Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community For guidance on negotiating agreements see Section 7.2.2 of the ICNG (DECC, 2009).

Considering the background noise levels presented in Table 3-2 and the guidance from the ICNG above in Table 4-1, the following NMLs have been established to manage noise impacts during construction. Where NMLs were found to exceed the ICNG 'highly affected' criterion they were adjusted to be equal to 75 dB(A).

Table 4-2 Construction noise management levels for nearby residential receivers

Alignment	Section(s)	NCA	Period	Background noise level (L _{A90}) dB(A)	Noise management level (NML) L _{Aeq} 15 minute dB(A)	Highly noise affected management level L _{Aeq} 15 minute dB(A)
Alignment 1	Bryant Street, Williams Street, Highclere Avenue	Measured NCA 02	Day	50	60	75
			Evening	47	52	75
			Night	39	44	75
	West Botany Street – south of Tantallon Avenue	Measured NCA 01	Day	59	64	75
			Evening	56	61	75
			Night	41	46	75
	West Botany Street between Tantallon Avenue and Wickham Street	EIS NCA 14	Day	50	60	75
			Evening	50	55	75
			Night	42	47	75
	West Botany Street between Wickham Street and Valda Avenue	EIS NCA 13	Day	67	77(75)	75
			Evening	67	72	75
			Night	51	56	75
	Valda Avenue and Marsh Street	EIS NCA 12	Day	45	55	75
			Evening	45	50	75
			Night	43	48	75
Alignment 2	Garema Circuit and Commercial Road	EIS NCA 19	Day	60	70	75
			Evening	54	59	75
			Night	43	48	75
Alignment 3	Unwins Bridge Road, Silver Street and Bakers Lane, Mary Street, Roberts Lane	EIS NCA 06	Day	58	68	75
			Evening	56	61	75
			Night	49	64	75
	Edith Lane, Edith Street, Princes Highway and Edith Street, Princes Highway	EIS NCA 07	Day	54	64	75
			Evening	54	59	75
			Night	40	45	75
Alignment 4	Nicholas Avenue, Canterbury Road, Charlotte Street north of Sunbeam Street	Measured NCA 04	Day	55	65	75
			Evening	52	57	75
			Night	49	54	75
	Charlotte Street south of Sunbeam	Measured NCA 03	Day	48	58	75
			Evening	45	50	75

Alignment	Section(s)	NCA	Period	Background noise level (L_{A90}) dB(A)	Noise management level (NML) L_{Aeq} 15 minute dB(A)	Highly noise affected management level L_{Aeq} 15 minute dB(A)
	Street, Harp Street, Alfred Street, William Street, Rosemeath Avenue north of Olive Street		Night	45	50	75
	Rosemeath Avenue south of Olive Street, Homer Street, Lundy Avenue and Poole Street	EIS NCA 17	Day	49	59	75
			Evening	49	54	75
			Night	42	47	75

The ICNG also provides guidance for other types of receivers. Recommended management levels for relevant receiver types within the vicinity of the proposed alignments have been reproduced below.

Table 4-3 Noise management levels for non-residential land uses

Land use	Management level L_{Aeq} 15 minute dB(A) (when in use)
Classrooms, educational facilities	45 dB(A) internal noise level
Places of worship	45 dB(A) internal noise level
Active recreational areas	65 dB(A) external noise level
Passive recreational areas	60 dB(A) external noise level
Commercial premises	70 dB(A) external noise level
Industrial premises	75 dB(A) external noise level

4.1.1 Sleep disturbance

Noise impacts or events that can cause interruptions to sleeping patterns are considered separately to noise levels during works outside standard hours. The ICNG does not provide a specific method for assessment of potential sleep disturbance noise impacts; and guidance on the acceptability of these events is taken from the *NSW Road Noise Policy* (RNP), (DECCW, 2011).

The RNP provides two criteria:

- Sleep disturbance screening criterion – used to identify situations where there is the potential for sleep disturbance.
- Sleep disturbance awakening criterion – levels below which awakening is unlikely to occur.

The sleep disturbance screening criterion recommends that where the L_{A1} (1 minute) does not exceed the L_{A90} (15 minute) by 15 dB(A) or more, sleep disturbance impacts are likely to be maintained at an acceptable level. The L_{A1} (1 minute) descriptor is meant to represent a maximum noise level when measured using a 'fast' time response.

The sleep disturbance awakening criterion is the threshold at which an awakening reaction is likely to occur. Research discussed in the RNP identified this threshold to be an internal bedroom noise level of around 50 to 55 dB(A).

Windows often allow the greatest amount of sound transmission from outside to inside across a building façade. Table B4 in *Australia Standard AS2436-2010 Guide to noise and vibration control on construction, demolition*

and maintenance sites [AS2436-2010] provides indicative total A-weighted noise reduction levels across different types of windows.

Table 4-4 AS2436-2010 indicative outside to inside window transmission losses

Building type	Window type	Outside to inside reduction I total A-weighted sound pressure level dB
All	Open	10
Light frame	Single glazed (closed)	20
Masonry	Single glazed (closed)	25
	Double glazed (closed)	35

Where bedrooms are ventilated by an opened window, a sleep disturbance awakening criterion measured outside the bedroom window of 60 to 65 dB(A) would generally apply.

Sleep disturbance screening and awakening criterion applicable for this assessment are listed below. Where sleep disturbance screening criteria exceed sleep disturbance awakening criteria, they have been adjusted to be equal.

Table 4-5 Sleep disturbance criteria

Alignment	Section(s)	NCA	Night time Background noise level (L_{A90}) dB(A)	Sleep disturbance screening criteria L_{A1} , (1 minute)	Sleep disturbance awakening criteria L_{A1} , (1 minute)
Alignment 1	Bryant Street, Williams Street, Highclere Avenue	Measured NCA 02	39	54	65
	West Botany Street – south of Tantallon Avenue	Measured NCA 01	41	56	65
	West Botany Street between Tantallon Avenue and Wickham Street	EIS NCA 14	42	57	65
	West Botany Street between Wickham Street and Valda Avenue	EIS NCA 13	51	66 (65)	65
	Valda Avenue and Marsh Street	EIS NCA 12	43	58	65
Alignment 2	Garema Circuit and Commercial Road	EIS NCA 19	43	58	65
Alignment 3	Unwins Bridge Road, Silver Street and Bakers Lane, Mary Street, Roberts Lane	EIS NCA 06	49	64	65
	Edith Lane, Edith Street, Princes Highway and Edith Street, Princes Highway	EIS NCA 07	40	55	65

Alignment	Section(s)	NCA	Night time Background noise level (L _{A90}) dB(A)	Sleep disturbance screening criteria L _{A1s} (1 minute)	Sleep disturbance awakening criteria L _{A1s} (1 minute)
Alignment 4	Nicholas Avenue, Canterbury Road, Charlotte Street north of Sunbeam Street	Measured NCA 04	49	64	65
	Charlotte Street south of Sunbeam Street, Harp Street, Alfred Street, William Street, Rosemeath Avenue north of Olive Street	Measured NCA 03	45	60	65
	Rosemeath Avenue south of Olive Street, Homer Street, Lundy Avenue and Poole Street	EIS NCA 17	42	57	65

4.2 Vibration

Vibration arising from construction activities can result in impacts on human comfort or the damage of physical structures such as dwellings. These two outcomes have different criteria levels, with the effects of vibration on human comfort having a lower threshold. A discussion on the human comfort and building damage criteria has been presented below; and includes assessment criteria for different receiver types and time of day.

4.2.1 Human comfort

With respect to human comfort, vibration arising from construction activities must comply with criteria presented in *Assessing Vibration: a technical guideline*, (DECC, February 2006) and *British Standard 6472-1: 2008 Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting* [BS 6472-1: 2008]. DECC, 2006 identifies three different forms of vibration associated with construction activities:

- Continuous: uninterrupted vibration occurring over a defined period.
- Impulsive: short-term (typically less than two seconds) bursts of vibration which occurs up to three times over an assessment period.
- Intermittent: interrupted periods of continuous or repeated impulsive vibration, or continuous vibration that varies significantly in magnitude.

Continuous vibration may result from steady road traffic or steady use of construction equipment (e.g. generator). Impulsive vibration may arise during the loading or unloading of heavy equipment or materials or infrequent use of hammering equipment. Intermittent vibration may arise from the varied use of construction equipment (i.e. a dump truck moving around a site, idling while being loaded with materials, and then dumping the materials) or repeated high-noise activities such as hammering, piling or cutting.

Preferred and maximum values of human exposure for continuous and impulsive vibrations are listed in *Assessing Vibration: a technical guideline*, (DECC, February 2006) as outlined below.

Table 4-6 Preferred and maximum values for continuous and impulsive vibration (m/s²) 1-80 Hz (DECC, 2006)

Location	Assessment period ¹	Preferred values		Maximum values	
		z-axis	X and y axis	z-axis	X and y axis
Continuous vibration					
Critical areas ²	Day or night	0.0050	0.0036	0.010	0.0072
Residences	Day	0.010	0.0071	0.020	0.014
	Night	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night	0.020	0.014	0.040	0.028
Workshops	Day or night	0.04	0.029	0.080	0.058
Impulsive vibration					
Critical areas ²	Day or night	0.0050	0.0036	0.010	0.0072
Residences	Day	0.30	0.21	0.60	0.42
	Night	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night	0.64	0.46	1.28	0.92
Workshops	Day or night	0.64	0.46	1.28	0.92

¹ Daytime is 7am to 10pm. Night-time is 10pm to 7am

² Refers to hospital operating theatres or precision laboratories.

Intermittent vibration is assessed differently; using vibration dose values (VDV). Preferred and maximum VDV values are also provided in *Assessing Vibration: a technical guideline*, (DECC, February 2006) and have been reproduced below.

Table 4-7 Preferred and maximum VDV values for intermittent vibration (ms^{-1.75}), (DECC, 2006)

Location	Day time (7 am to 10 pm)		Night time (10 pm to 7 am)	
	Preferred VDV	Maximum VDV	Preferred VDV	Maximum VDV
Critical areas ¹	0.10	0.20	0.10	0.2
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

¹ Includes operating theatres, precision laboratories and other areas where vibration-sensitive activities may occur.

4.2.2 Buildings and structures

Section J4.4.3 of *Australian Standard AS2187.2 – 2006 Explosives – Storage and use Part 2: Use of explosives* provides frequency-dependent guide levels for cosmetic damage to structures arising from vibration. These levels are adopted from *British Standard BS7385: 1990 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundbourne vibration* [BS7385-2:1993] and are shown below in Table 4-8.

Table 4-8 Vibration guide values for cosmetic building damage, (BS7385-2: 1993)

Line	Type of building	Peak particle velocity (PPV) mm/s		
		4 to 15 Hz	15 to 40 Hz	40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50		
2	Un-reinforced or light-framed structures Residential or light commercial type buildings	15 to 20	20 to 50	50

Guidance for more sensitive structures is presented in the German Guideline, *DIN 4150-3 Structural vibration Part 3: Effects of vibration on structures* (DIN 4150-3:1999-02). Vibration velocities not exceeding 3 mm/s at 1 to 10 Hz are recommended to avoid potential structural impacts. Nearby vibration-sensitive structures in relation to the proposed alignments are summarised below.

Table 4-9 Nearby vibration-sensitive structures

Name	Address	Listing	Approximate distance from proposal (m)
Alignment 1			
Former hospital for women	112 West Botany Street	Rockdale LEP 2011 I57	No direct impact. Alignment approximately 10 metres from item on West Botany Street
House	73 West Botany Street	Rockdale LEP 2011 I56	No direct impact. Alignment approximately 10 metres from item on West Botany Street
Arncliffe Market Gardens	212 West Botany Street Arncliffe	SHR 01395 Rockdale LEP 2011 I93	No direct impact. Item set back approximately 10 metres from West Botany Street.
Sewer vent	20A West Botany Street	Rockdale LEP 2011 I55	No direct impact. Item set back approximately 15 metres from West Botany Street.
House	31 Kyle Street	Rockdale LEP 2011 I35	No direct impact. Alignment approximately 50 metres from item on Kyle Street
Alignment 2 – No listings			
Alignment 3			
Victorian Filigree style mansion 'Claraville' including interiors	21-23 Silver Street St Peters	Marrickville LEP 2011 I278	No direct impact. Property set back about 15 metres from road reserve.
St Peter's Public School including interiors	93A Church Street, St Peters	Marrickville LEP 2011 I271	No direct impact. Curtilage extends to Silver Street, about 5 metres from the proposed works. However, the school is located about 160 metres from works.
St Peter's Anglican Church	187-209 Princes Highway St. Peters	SHR Item 00032 Marrickville LEP 2011 I275 RNE #1716	No direct impact. 60 metres from the proposed works on Silver Street
Service garage	316 Princes Highway, St Peters	Marrickville LEP 2011 I312	No direct impact. Alignment approximately 45 metres from

Name	Address	Listing	Approximate distance from proposal (m)
			item
Southern Cross Hotel	340 Princes Highway (corner Canal Road), St Peters	Marrickville LEP 2011 I277	No direct impact. Alignment approximately 45 metres from item
Town and Country Hotel, including interiors	2 Unwins Bridge Road (corner Campbell Road), St Peters	Marrickville LEP 2011 I281	No direct impact. Alignment approximately 15 metres from item.
Group of Victorian Filigree and Victorian Italianate terrace houses – 'Narara', including interiors	4–18 Unwins Bridge Road, St Peters	Marrickville LEP 2011 I282	No direct impact. Alignment approximately 15 metres from item.
Waugh & Josephson industrial buildings former, showroom, offices and workshop, including interiors	1–7 Unwins Bridge Road, St Peters	Marrickville LEP 2011 I280	No direct impact. Alignment approximately 15 metres from item.
Goodsell Estate conservation area	North of May Street, within Camdenville Park	Marrickville LEP 2011 C16	No direct impact. Alignment approximately 45 metres from conservation area.
Alignment 4			
Inter war shop and motor garage—Dan's Corner	485–493 Canterbury Road	Canterbury LEP 2012 I45	No direct impact. Item 20 metres from the proposed works at intersection of Canterbury Road and Charlotte Street
Inter war hospital building—Canterbury Hospital	575 Canterbury Road (also known as 26–50 Tudor Street)	Canterbury LEP 2012 I46	No direct impact. Item 55 metres from the proposed works.

4.2.3 Transport for NSW Construction Noise Strategy guidance

Section 6.3 of the Transport for NSW (TfNSW) guidance document *Construction Noise Strategy 7TP-ST-157/2.0* [CNS], (TfNSW, April 2012) recommends safe working distances for achieving human comfort (DECC, 2006) and cosmetic building damage (BS7385-2:1993) criteria for a range of different plant and equipment. These distances are indicative and will vary depending on local geotechnical conditions; however these offsets may be used when initially considering vibration generating activities and their proximity to residences and other structures.

Table 4-10 CNS recommended safe working distances, (TfNSW, 2012)

Plant item	Rating/description	Safe working distance	
		Cosmetic damage (BS7385-2:1993)	Human Response (DECC, 2006)
Vibratory roller	<50 kN (typically 1-2 t)	5 metres	15 m to 20 metres
	<100 kN (typically 2-4 t)	6 metres	20 metres
	<200 kN (typically 4-6 t)	12 metres	40 metres
	<300 kN (typically 7-13 t)	15 metres	100 metres
	>300 kN (typically 13-18 t)	20 metres	100 metres
	>300 kN (> 18 t)	25 metres	100 metres
Small hydraulic hammer	300 kg – 5 to 12 t excavator	2 metres	7 metres
Medium hydraulic hammer	900 kg – 12 to 18t excavator	7 metres	23 metres
Large hydraulic hammer	1600 kg – 18 to 34 t excavator	22 metres	73 metres

Plant item	Rating/description	Safe working distance	
		Cosmetic damage (BS7385-2:1993)	Human Response (DECC, 2006)
Vibratory pile driver	Sheet piles	2 to 20 metres	20 metres
Pile boring	≤800 mm	2 metres	n/a
Jackhammer	Hand held	1 metres	Avoid contact with structure

4.2.4 Buried pipework

Noting the likelihood of interactions with existing buried services, guidance presented in the German standard, *DIN 4150-3 Structural vibration Part 3: Effects of vibration on structures* (DIN 4150-3:1999-02) is also relevant to this proposal. DIN 4150-3:1999-02 provides guidance for evaluating the effects of short-term vibration on buried services. This guidance has been reproduced below.

Table 4-11 DIN 4150-3: 1999-02 guidance for evaluating effects of short-term vibration on buried services

Pipe material	Guideline value for velocity measured on the pipe (mm/s)
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
Masonry, plastic	50

5. Quantitative assessment

5.1 Noise

5.1.1 Sources

Overall sound power levels (SWLs) were predicted for each activity and phase of construction associated with the proposal. These SWLs were prepared with reference to the following standards for individual plant and equipment SWLs:

- *Australian Standard AS2436-2010: Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436-2010).
- *British Standard 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* (BS 5228-1:2009).
- *Construction Noise Strategy 7TP-ST-157/2.0* (CNS), (TfNSW, April 2012).
- United Kingdom Department for Environment, Food and Rural Affairs (DEFRA) *Noise database for prediction of noise on construction and open sites*.

Usage factors were applied to plant and equipment which was only expected to be used for a portion of the time, during any 15 minute period.

Table 5-1 Estimated sound power levels for each activity

Activity	ID	Phase	Plant/equipment	Overall SWL dB(A)
General	01	Site establishment and demobilisation	2 x Lighting tower 2 x Light vehicle	97
	02	Pot holing	1 x Pot holing truck 2 x Lighting tower	107
	03	Saw cutting to access sub-base materials and/or expose connection points	1 x Road saw	114
Trenching	04	Trench excavation, shoring and installation of bedding materials	1 x Skidsteer 1 x Excavator 2 x Lighting tower	108
	05	Installation of conduct and trench backfilling	2 x Hand tools 1 x Excavator 2 x Lighting tower	102
	06	Compaction	2 x Compactor 2 x Lighting tower	110
	07	Asphalting (as required)	1 x Asphalting supply / spray truck 2 x Lighting tower	106
Horizontal Directional drilling	08	Horizontal drilling and installation of conduct	1 x Horizontal drill rig 1 x Excavator 1 x Mud collection unit 2 x Lighting tower	113
Pipe jacking	09	Pipe and conduct installation	1 x Pipe jacking machine 1 x Excavator 2 x Lighting tower 1 x Vacuum truck	111

5.1.2 Potential noise levels

To assess potential impacts associated with the proposal, noise levels were predicted at varying distances from each construction activity. These results are displayed below in Table 5-2. Levels were calculated based on the distance from the source. Attenuation factors such as air and ground absorption have not been considered and no correction for topographical or structural screening has been given. Hence results are conservative.

Table 5-2 Predicted construction noise levels (un-mitigated)

Activity ID	Overall SWL dB(A)	Approximate construction noise level dB(A) at distances from the activity				
		5 meters	10 meters	15 meters	25 meters	50 meters
01	97	75	69	65	61	55
02	107	85	79	75	71	65
03	114	92	86	82	78	72
04	108	86	80	76	72	66
05	102	80	74	70	66	60
06	110	88	82	78	74	68
07	106	84	78	74	70	64
08	113	91	85	81	77	71
09	111	89	83	79	75	69

Red bolded values indicate levels exceeding ICNG 'Highly noise affected' management levels

Bolded values indicate levels sleep disturbance awakening criterion

The results presented above indicate that noise levels are expected to exceed the ICNG 'highly noise affected' management levels at nearby receivers during most phases of the proposed works. Activities 3 (saw cutting) and 8 (horizontal drilling) present the greatest risk, with levels expected to exceed ICNG 'highly noise affected' management levels up to a distance of around 30 meters.

The levels predicted at 10 meters from each activity above in Table 5-2 exceed the NMLs for each time of the day (i.e. day, evening and night) for all sections of each of the four alignments except the day time NMLs for section of Alignment 1 along West Botany Street between Wickham Street and Valda Avenue.

The predicted levels indicate that sleep disturbance screening and awakening criterion may be exceeded at receivers set at distances of up to around 50 meters from the proposed works. This prediction considers the correction of values presented in Table 5-2 from an $L_{Aeq\ 15\ minute}$ dB(A) to a $L_{A1, (1\ minute)}$ level. This being said, this prediction is conservative, noting that no screening or shielding attenuation effects have been considered, and the sleep disturbance awakening criterion is based on a 'worst-case' façade transmission loss of 10 dB(A), which in reality may be higher. Still, mitigation and management measures should be developed with the aim of limiting any sleep disturbance impacts during the proposal.

Overall, the results indicate that nearby receivers would experience short-term, elevated noise levels during the proposal which would require the implementation of mitigation and management controls to effectively limit the level of impacts during the works. Recommended measures are discussed below in Section 6.

5.2 Vibration

Certain phases of the proposal (horizontal drilling, pipe jacking and compaction) will involve the use of plant and equipment with the potential to generate low-level localised vibrations. Considering the nature of the plant and equipment proposed, and the typical setback distances to the surrounding receivers, it is unlikely that building cosmetic and human comfort vibration criteria would be encroached at surrounding residential receivers. Vibration levels are also not expected to be of a magnitude which would lead to the damage of buried pipework.

As described above in Table 4-9, the nearest vibration-sensitive structures are set at distances as near as 10 metres from the proposal. Where horizontal drilling, pipe jacking or compaction activities are required to be completed within 10 metres of the structures identified in Table 4-9, there is the potential that vibration velocities may exceed 3 mm/s. Further management measures would be necessary in these instances, which are described below in Section 6.

6. Recommended mitigation measures

To limit the level of noise impacts during the proposal, mitigation and management controls have been developed.

Techniques for controlling noise impacts have been developed with reference to guidance presented in the ICNG, *Assessing Vibration: a technical guideline*, (DECC, February 2006) and the *Environmental Handbook for Construction and Maintenance* (NS 174C), (Ausgrid, July 2014).

Table 6-1 Recommended standard mitigation measures (ICNG and NS 174C)

Control measure	Details
Equipment selection	Wherever possible and practical, select low noise plant and equipment.
	Operate and maintain plant and equipment in an efficient and proper manner.
Construction methods and behaviours	Consider the application of alternative, low-impact construction techniques.
	Avoid dropping materials from a height.
	Avoid dragging equipment and materials.
	Dampen or line metal trays as necessary.
	If possible, undertake loading and unloading operations away from receivers.
	Shut down or throttle down machinery when not in operation.
	Ensure that road plates are installed as per specifications
	Induct workers on noise sensitivities associated with the proposal and management measures to be implemented
	Choose alternative, lower vibration impact equipment or methods wherever possible
Consultation	Provide at least four clear business days' notice to affected receivers prior to starting works.
	Provide signage detailing who is undertaking the works and a 24 hour contact number.
	Provide additional notification for works outside standard hours of construction.
	Where there are complaints about noise from an identified work activity, review and implement, where feasible and reasonable, action additional control measures.
Scheduling	Where possible, conduct works during standard hours of construction.
	Avoid noisy work during sensitive time periods (e.g. school exam periods, times of worship).
	Provide respite periods for affected receivers:
	- One hour respite after every three consecutive hours of high impact activities.
	- One day respite after three consecutive days of high impact activities.
	Ensure that out of hours works do not affect a receiver for a period of more than two nights in a one week period.
	Avoid high impact activities after 11pm.
	Use broadband reversing alarms during out of hour's activities.
Inspections and monitoring	Schedule the use of vibration-causing equipment at the least sensitive time of day.
	Sequence operations so that vibration causing activities do not occur simultaneously.
Inspections and monitoring	Where horizontal drilling, pipe jacking or compaction activities are proposed within 10 metres of a vibration-sensitive structure, conduct detailed inspections including the preparation of a written and photographic report to document the structural condition prior to and after the completion of the activities.
	Where horizontal drilling, pipe jacking or compaction activities are proposed within 10 metres of a vibration-sensitive structure, conduct vibration monitoring to verify that the 3 mm/s vibration velocity criterion is not being exceeded. Modify works should it be found that this criterion is being exceeded.

Control measure	Details
Damage rectification	If inspections identify that damage to a structure has occurred, rectify any such damages with consideration to relevant structural and heritage guidance.

In addition to the standard measures outlined above, further mitigation measures should be implemented during high impact activities 3, 8 and 9.

Wherever possible and practical, works involving the use of saw cutting equipment, horizontal drilling rig or pipe jacking plant should be completed before 11pm. If the use of this plant and equipment is localised over a work period, levels could be reduced through the application of temporary screens. Table C3 of AS 2436-2010 indicates a nominal expected noise reduction of 5 to 10 dB(A) and up to 15 dB(A) using screens around a noise source. Though it is noted that effectiveness and resulting level of reduction is dependent on the properties of the screen (i.e. height, composition) and its position in relation to the source and surrounding receivers; temporary screening is viewed as a practical means of reducing noise impacts associated with the use of these equipment, should their used be localised (i.e. restricted to a small area) over a work period.

Indicative noise levels with the application of temporary screens around these activities (assuming a nominal reduction of 10 dB(A)) are provided below. This shows that the distance to receivers likely to exceed the ICNG 'highly noise affected' management levels would decrease to a distance of around 10 metres.

Table 6-2 Predicted noise levels from high impact construction activities considering the application of temporary screens

Activity ID	Overall SWL dB(A)	Approximate construction noise level dB(A) at distances from the activity				
		5 meters	10 meters	15 meters	25 meters	50 meters
03	114	82	76	72	66	62
08	113	81	75	71	65	61
09	111	79	73	69	63	59

Red bolded values indicate levels exceeding ICNG 'Highly noise affected' management levels

Bolded values indicate levels sleep disturbance awakening criterion

Owing to the temporal nature of the project, alternative accommodation is not expected to be necessary, provided that the standard and additional mitigation measures recommended above are applied. A construction noise and vibration management plan (CNVMP) should be prepared during construction which considers these measures.

7. Conclusion

A quantitative assessment was completed to determine potential construction noise and vibration impacts associated with a proposal to provide additional Ausgrid utilities to connect compound sites to be used during the Stage 2 new M5 project to the existing network.

Regarding construction noise, calculations predicted that NMLs and ICNG 'highly noise affected' would be exceeded during typical construction activities. Standard and additional measures were recommended in line with guidance presented in the ICNG and NS 174C to limit noise impacts during the proposal including advice relating to equipment selection, construction methods and behaviours, community consultation and engagement, scheduling and the application of temporary screening around high impact activities.

Vibration levels expected to be generated during construction were evaluated against the safe setback distances recommended in the CNS. This assessment identified that vibrations generated during construction were not expected to be an issue at nearby residential receivers, but that there were some risks during horizontal drilling, pipe jacking or compaction activities that the relevant criterion at nearby vibration-sensitive structures may be exceeded. Standard management measures were proposed regarding equipment selection and staging, with additional monitoring and inspection measures recommended during the completion of horizontal drilling, pipe jacking or compaction activities within 10 metres of vibration-sensitive structures.

8. References

- *WestConnex The New M5 Technical working paper: Noise and Vibration*, (AECOM, November 2015)
- *NSW Industrial Noise Policy*, (NSW Environment Protection Agency, 2000)
- *Interim Construction Noise Guideline*, (NSW Department of Environment and Climate Change, 2009)
- *NSW Road Noise Policy (RNP)*, (NSW Department of Environment , Climate Change and Water, 2011)
- *Australia Standard AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites*
- *Assessing Vibration: a technical guideline*, (NSW Department of Environment and Climate Change, February 2006)
- *British Standard 6472-1: 2008 Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting*
- *Australian Standard AS2187.2 – 2006 Explosives – Storage and use Part 2: Use of explosives*
- *British Standard BS7385: 1990 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundbourne vibration*
- *Construction Noise Strategy 7TP-ST-157/2.0*, (Transport for NSW, April 2012)
- *DIN 4150-3 Structural vibration Part 3: Effects of vibration on structures*
- *British Standard 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*
- *Noise database for prediction of noise on construction and open sites*, (United Kingdom Department for Environment, Food and Rural Affairs)
- *Environmental Handbook for Construction and Maintenance*, (Ausgrid, July 2014)