



Temporary Noise Barrier Strategy - Kingsgrove

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Details of Revision Amendments

Document Control

The Project Director is responsible for ensuring that this Strategy is reviewed and approved. The Engineering and Design Director is responsible for updating this Strategy to reflect changes to the Project, legal and other requirements, as required.

Amendments

Any revisions or amendments must be approved by the Project Director before being distributed or implemented.

Revision Details

Revision	Details
00	Prepared for Secretary Approval
01	Revised report taking into account DPE comments
02	Revised report taking into account DPE comments
03	Revised due to addition of SWC

Temporary Noise Barrier Strategy - Kingsgrove



Contents

1. Introduction	4
1.1. Project Description	4
1.2. Purpose of this Plan	5
1.3. Scope of this Document and Compliance with D20.....	5
2. Temporary Noise Barrier Strategy.....	10
2.1. Temporary Barrier Overview	10
2.2. Identify Sensitive Receivers	10
2.3. Noise Objectives	12
2.4. Construction Noise Assessment.....	12
2.5. Traffic Noise Assessment.....	14
2.6. Noise Barrier Design	14
2.7. Noise Barrier Installation	15
2.8. Noise Mitigation Development.....	16
3. Stakeholder Consultation.....	18
3.1. Consultation	18
3.2. Aim	18
3.3. Affected stakeholders.....	18
3.4. Communication and Consultation Activities	20
3.5. Decision Making Process	21
3.6. Monitoring and reporting	22
4. Ongoing Monitoring.....	23
5. Conclusion.....	24
Appendix A: Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)	25
Appendix A1: WESTCONNEX NEW M5 - Operational Traffic Noise Assessment: Kingsgrove noise wall removal and replacement with temporary shipping container wall.....	26
Appendix B: Community Consultation Records.....	27
Appendix C: Department Review of Temporary Noise Barrier Strategy – Comments and Responses	28
Appendix D: RMS Meeting Minutes and General Correspondence – Proposed Barrier Mounted Screen.....	29
Appendix E: Consultation Materials.....	30

Temporary Noise Barrier Strategy - Kingsgrove

1. Introduction

1.1. Project Description

WestConnex is one of the NSW Government's key infrastructure projects which aims to ease congestion, create jobs and connect communities. It is the largest integrated transport and urban revitalisation project in Australia.

The 33 kilometre project was a key recommendation of the State Infrastructure Strategy released in October 2012. It brings together a number of important road projects which together form a vital link in Sydney's Orbital Network. They include a widening of the M4 east of Parramatta, a duplication of the M5 East and new sections of motorway to provide a connection between the two key corridors.



Figure 1.1: WestConnex Project Map

WestConnex will support Sydney's long term growth and boost the city's economic productivity. It will:

- Provide quicker, more reliable trips between Western Sydney and the Port Botany/Sydney Airport precinct to support Sydney's urban freight task
- Help distribute traffic across the wider road network, removing bottlenecks and relieving congestion for local trips
- Provide better connections along the M4 and M5 corridors to cater for the forecast growth in employment and population along these routes
- Allow urban revitalisation and increase opportunities for active and public transport along and across Parramatta Road.

The WestConnex project includes a number of stages:

- Stage 1a – M4 Widening
- Stage 1b – M4 East
- Stage 2 – New M5
- Stage 3 – M4-M5 Link

In November 2015, the Sydney Motorway Corporation (SMC) awarded the CPB Contractors Dragados Samsung Joint Venture (CDS JV) the contract for the design and construction of Stage 2 –

Temporary Noise Barrier Strategy - Kingsgrove



New M5. The New M5 will run from the existing M5 East corridor at Beverly Hills via a tunnel to St Peters, providing improved access to the airport, south Sydney and Port Botany precincts.

Key features of the New M5 include:

- New twin tunnels which are higher, wider and flatter. These will more than double capacity along the M5 East corridor and provide motorway access to north of Sydney Airport
- A new interchange at an industrial site at St Peters, which reduces the impact on nearby residential areas
- Connections from the interchange to key roads in the area, including Campbell Road/Street, Euston Road and across the canal to Bourke Road
- Widening of Campbell Road/Street and Euston Road through existing road widening reservations
- Western tunnel entry and exit points at Kingsgrove.

Stage 2 of WestConnex is being accelerated following an historic funding agreement signed by the Australian and New South Wales Governments in May 2014.

This has allowed work to start on the M5 - King Georges Road Interchange upgrade.

The duplication of the M5 East corridor will improve travel times and reliability for the 100,000 motorists which use this key route every day.

It will allow for improved movement of freight to and from the Port Botany area and provide an express route between Western Sydney and Sydney Airport once WestConnex is completed.

1.2. Purpose of this Plan

The CDS JV has prepared this Temporary Noise Barrier Strategy (TNBS) in accordance with the Conditions of Approval (CoA), in particular condition D20.

The TNBS for Kingsgrove which take into account works to be completed incorporating construction compounds C1, C2 and C3 is being provided to the Secretary for approval to detail the strategy that CDS JV will employ to mitigate and manage construction and traffic noise.

This TNBS sets the approach to the management of construction and traffic noise.

1.3. Scope of this Document and Compliance with D20

This document provides the structure and details of the TNBS required for the project as prescribed in CoA D20. This strategy focuses on the Kingsgrove area, specifically in the vicinity of Beverly Grove Park considering highly effected residents on both the northern and southern sides of the existing M5 Motorway. Revision 2 of this TNBS was approved by DPE on 23/06/2016. The current Revision (03) includes an additional temporary noise barrier on the southern side of the existing M5 Motorway. Separate TNBS's have been developed to address the management and mitigation of construction noise for other construction compounds across the project. This TNBS forms part of the project wide TNBS as detailed in the New M5 Staging Report.

Table 1.1 shows where compliance with CoA D20 is addressed within this document.

Temporary Noise Barrier Strategy - Kingsgrove



Table 1.1: Compliance with D20

D20 Requirements	Compliance
<p>The Proponent must develop and implement a Temporary Noise Barrier Strategy which includes:</p>	
<p>a) identification and confirmation of all temporary noise barriers including -</p>	<p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <ul style="list-style-type: none"> • Appendix B – Nearest Sensitive Receivers and Noise Management Levels - Figure B.1 & B.2 • Appendix C – Construction Timetable / Activities / Management – Table C3 <p>Appendix A1 - WESTCONNEX NEW M5 - Operational Traffic Noise Assessment: Kingsgrove noise wall removal and replacement with temporary double stacked shipping container wall (SCW)</p>
<p>(i) the provision of a temporary noise barrier on the northern side of the Kingsgrove North construction compound to provide noise mitigation to highly affected residents at a level greater than that identified in the documents referred to in condition A2(b),</p>	<p>Northern temporary noise barrier heights in this vicinity have been increased (NB02, 3m to 4.5m).</p> <ul style="list-style-type: none"> - Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) – <ul style="list-style-type: none"> - Appendix B – Nearest Sensitive Receivers and Noise Management Levels - Figure B.1 & B.2 - Appendix C – Construction Timetable / Activities / Management – Table C3 - Appendix D – Comparison of EIS Predictions to Detailed Design – Table D.1 & D.2 <p>Strategies are being developed to install a temporary noise mound in the vicinity of Beverly Grove Park behind NB02 in addition to the EIS. Refer Section 2.5 of this TNBS.</p>
<p>(ii) consideration of the installation of temporary noise barriers on the southern and northern side of the M5 East Motorway during the relocation of the existing permanent noise barriers (or detail on why these noise barriers are not considered feasible and reasonable),</p>	<p>Provision of temporary noise barriers are detailed for both the southern and northern side of the M5 motorway, these are proposed in addition to the EIS.</p>

Temporary Noise Barrier Strategy - Kingsgrove



D20 Requirements	Compliance
	<ul style="list-style-type: none"> • Northern temporary noise barrier heights have been increased (NB02, 3m to 4.5m) and additional barriers positioned on top of roadside concrete barriers (NB03). <ul style="list-style-type: none"> - Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) – <ul style="list-style-type: none"> - Appendix B – Nearest Sensitive Receivers and Noise Management Levels - Figure B.1 & B.2 - Appendix C – Construction Timetable / Activities / Management – Table C3 NB03 & NB02 – 3m to 4.5m high - Section 5.3.1 – Northern Side of the M5 - Consultation has commenced with RMS regarding purpose made noise barriers mentioned in section 5.3.1 being fitted to roadside concrete barriers, barriers have been submitted to RMS for approval • A Southern temporary noise barrier has been added (NB04) <ul style="list-style-type: none"> - Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) – <ul style="list-style-type: none"> - Appendix B – Nearest Sensitive Receivers and Noise Management Levels - Figure B.1 & B.2 - Appendix C – Construction Timetable / Activities / Management – Table C3 NB04 – 4.5m high - Section 5.3.2 – Southern Side of the M5 • An additional southern temporary noise barrier has been added (double stacked Shipping Container Wall, SCW) <ul style="list-style-type: none"> - Appendix A1 - WESTCONNEX NEW M5 - Operational Traffic Noise Assessment: Kingsgrove noise wall removal and replacement with temporary double stacked shipping container wall • Pre-Construction Compliance Report M5N-ES-RPT-PWD-0003 rev00 details project staging under Section 1.2. • Permanent noise barriers will be installed and developed following the project design development process which involves stakeholder consultation. During resident consultation this process was discussed. Permanent noise walls to address the replacement of

Temporary Noise Barrier Strategy - Kingsgrove



D20 Requirements	Compliance
	existing noise barriers along the motorway is managed within design package M5N-AJV-DPK-200-400-NW-2115.
(iii) consideration of the installation of temporary noise barriers along Campbell Road, Campbell Street and Euston Road (or detail on why these noise barriers are not considered feasible and reasonable),	Section 1.3 - A separate TNBS will be developed to address the management and mitigation of construction noise along Campbell Road, Campbell Street and Euston Road, CoA D20 (a) (iii) is not addressed within this TNBS
(iv) temporary noise barriers around construction compounds;	This TNBS covers noise barriers for construction compounds C1, C2 and C3. Separate TNBS will be developed in accordance with Pre-Construction Compliance Report M5N-ES-RPT-PWD-0003 rev00 for other construction compounds.
b) the consultation and decision-making process for all temporary noise barriers; and	<p>Section 3.2 & 3.2 - These sections detail objectives of the consultation process.</p> <p>Section 3.3 - This section details how highly affected residents were identified along with other key stakeholders.</p> <p>Section 3.4 - This section details how highly affected residents and stakeholders were consulted.</p> <p>Section 3.5 & 3.6 - These sections detail the decision making process which accounts for key stakeholder feedback prior to adopting the final design.</p>
c) an acoustic report detailing the final barrier heights, material analysis and predicted benefits.	<p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <p>This acoustic report will be continuously updated as required to account for design development and finalisation of construction methodologies.</p>
The temporary barrier options must be developed in consultation with the landowners adjacent to the barrier locations prior to the adoption of a final design.	<p>Section 3.4 & 3.5 - These sections detail key stakeholder feedback received through one on one briefings and how feedback trends have been incorporated into final designs.</p> <p>Figure 3.1 – Kingsgrove North - Identified Properties Consulted – Adjacent to NB01 & NB02</p> <p>Figure 3.2 – Kingsgrove South – Identified Properties Consulted – Adjacent to NB04</p> <p>Appendix C - Community Consultation Records</p>

Temporary Noise Barrier Strategy - Kingsgrove



D20 Requirements	Compliance
<p>The Temporary Noise Barrier Strategy must be approved by the Secretary prior to site establishment works or construction works at the Kingsgrove North construction compound, the permanent noise barriers on the northern and southern side of the M5 East Motorway are removed, and/or road widening works are undertaken along Campbell Road, Campbell Street or Euston Road.</p>	<p>Revision 2 of this TNBS was approved on 23/06/2016. This TNBS has been revised to include an additional temporary noise barrier on the southern side of the M5 East Motorway (SCW) and will be submitted to the Secretary for approval. Upon approval, final design will be documented and communicated to consulted residents.</p>

Temporary Noise Barrier Strategy - Kingsgrove

2. Temporary Noise Barrier Strategy

2.1. Temporary Barrier Overview

The overall approach of the TNBS is to ensure that reasonable and feasible temporary noise barrier solutions are developed and implemented in accordance with CoA whilst specifically consulting with stakeholders and highly effected landowners to address their concerns.

An overarching approach during construction will target the installation of temporary noise barriers identified in the Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) found in Appendix A prior to existing barriers being removed.

2.2. Identify Sensitive Receivers

A key component of the TNBS is to identify sensitive receivers based on the proposed construction footprint. Sensitive receivers are detailed in the Construction Noise and Vibration Management Plan (CNVMP). Sensitive receivers are reviewed considering CoA D20 and specifically identified for consultation, especially landowners and residents directly adjacent to proposed temporary noise barriers. Reference Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) Figure B.1 and B.2 for identified sensitive receivers. Also reference figures 3.1 and 3.2 of this TNBS for identified sensitive receivers adjacent to proposed temporary noise barriers.

Figure 2.2 – Extract from Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) NCA19 to NCA24

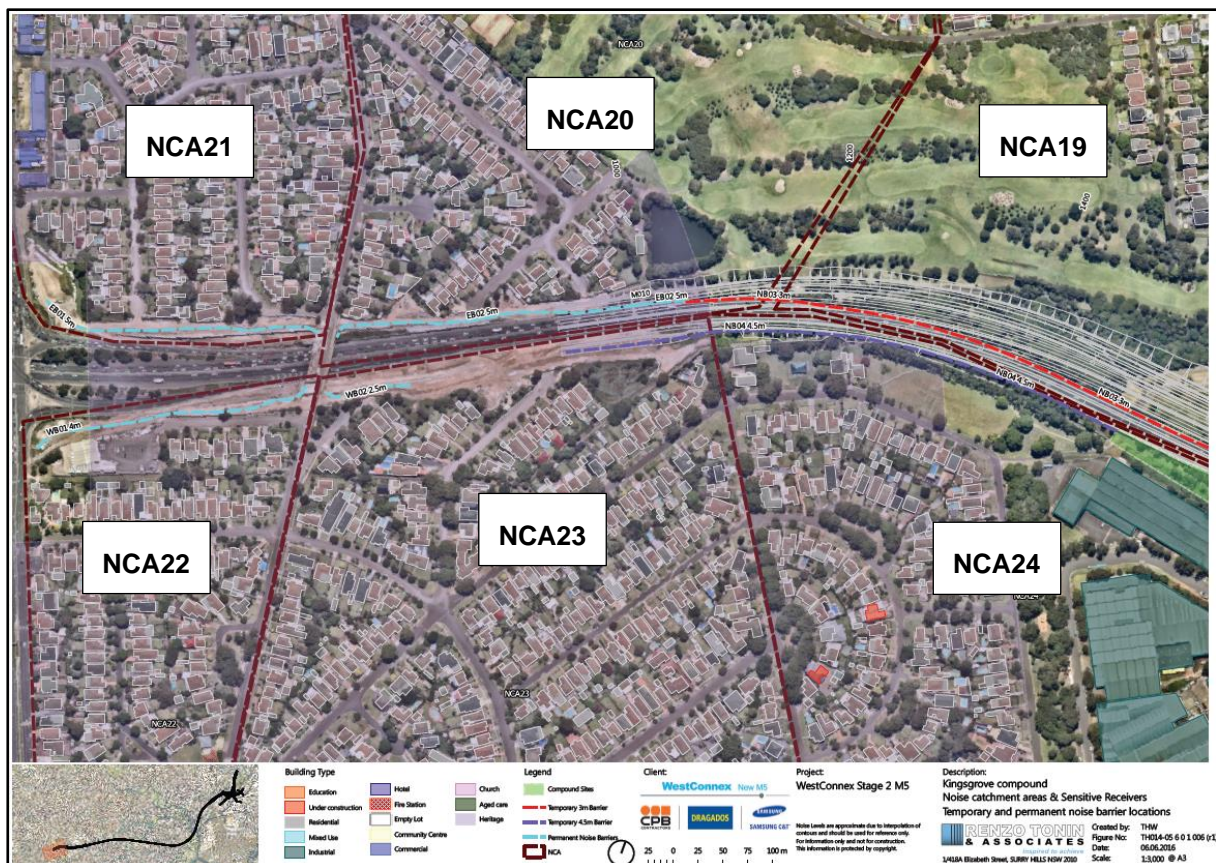
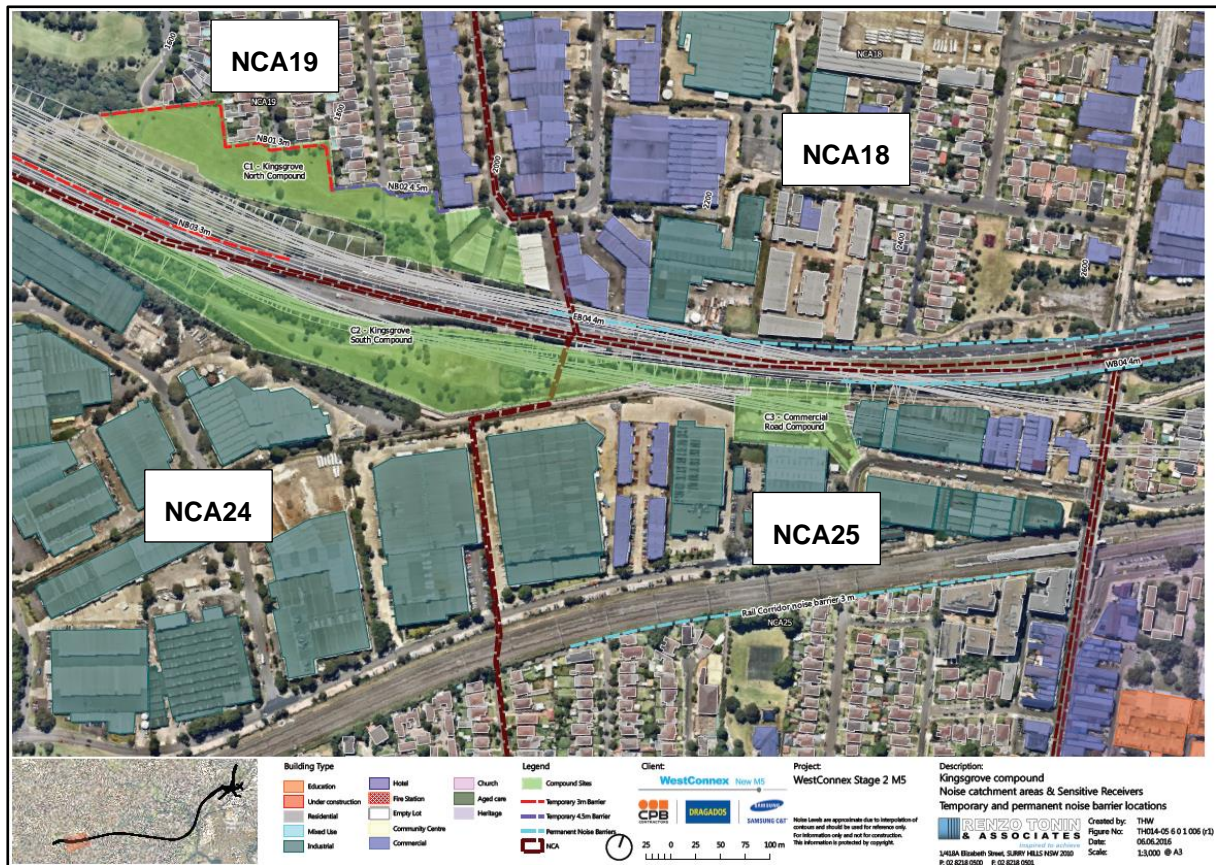


Figure 2.3 – Extract from Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) NCA19 to NCA25



Noise barriers have been strategically positioned to account for optimum acoustic performance, key considerations were also given to minimize the visual impact to residents, especially those in the vicinity of Beverly Grove Park. Other key considerations were given to managing the realignment of the shared path in the vicinity of Beverly Grove Park which ultimately resulted in a significant noise offset being provided in the vicinity of 10m, this was well received during community consultation. The location of temporary barriers with respect to residents is provided in Table 2.1 – Noise Barrier Distance to nearest Resident.

Table 2.1 – Noise Barrier Distance to Nearest Resident

Noise Barrier	Location	Barrier Height	Distance to Nearest Resident
NB01	Kingsgrove North Compound Northern Boundary Compound	3m	Approximately 10m
NB02	Kingsgrove North Compound Section of northern boundary adjacent to bottom of Glamis St	4.5m	Approximately 10m
NB03	Kingsgrove Site – M5 Motorway along northern side of M5 eastbound carriageway (where feasible)	2-3m	Approximately 25m
NB04	Kingsgrove Site – M5 Motorway along southern side of M5 westbound carriageway	3-4m	Approximately 15m

Noise Barrier	Location	Barrier Height	Distance to Nearest Resident
SCW	Kingsgrove Site – M5 Motorway along southern side of M5 westbound carriageway	4.7m	Approximately 35m

2.3. Noise Objectives

Construction noise management levels have been developed using NSW Interim Construction Noise Guideline (ICNG), in accordance with CoA D16(a). Objectives have been set in the form of Construction Noise Management Levels and Road Traffic Noise Objectives.

Residential receivers are considered noise affected where construction noise levels are greater than the noise management levels (NMLs) as determined above, NMLs are detailed in Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds). Noise affected levels represent the point above which there may be some community reaction to noise, where this scenario is anticipated predicted and/or measured construction noise levels exceed NMLs, all feasible and reasonable work practices will be applied to meet NMLs.

During standard construction hours a highly affected noise objective of LAeq(15min) 75 dB(A) applies at all receivers.

Reference Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) Sections 3.1 and 3.2 for further details.

2.4. Construction Noise Assessment

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

The model is used to determine the impact of construction noise from construction compounds C1, C2 and C3 for various construction stages, identified as V01 through to V08 below in Table 2.2. Timing of stages is indicative and used as a guide for modeling purposes. Note that Installation of environmental controls includes the installation of temporary noise barriers, a key component of early site mobilization works is to enable the erection of temporary noise barriers. Table 2.2 below shows modeling assumptions, further details can be found in Appendix A Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) Sections 4.3.

Temporary Noise Barrier Strategy - Kingsgrove



Table 2.2 – Noise Modeling Assumptions

Activity/ Work Area	Aspect	Includes OOHW?	Approx. timing	Modelled construction stage									
				V01	V02	V03	V04	V05	V06	V07	V08		
Kingsgrove Road Civil compound C2 Civil Works Site Establishment	Power Generator	No	07-09 2016	■	■	■							
	Installation of enviro controls	No	07-09 2016	■									
	Demolition of existing structures	No	07-09 2016	■									
	Crushing & Screening	No	07-09 2016	■									
	Vegetation Clearing	No	07-09 2016	■									
	Establishment of construction facilities	No	07-09 2016		■								
	Road and intersection modifications and installation of traffic controls	Yes	07-09 2016			■							
	Removal of earth mound on northern side of M5	No	09-10 2016					■					
	Portal surface site (piling)	No	10-12 2016						■				
	Portal surface site (earthworks)	No	2017-2018						■				
	Portal surface site (roadworks)	No	2017-2018							■			
	Western surface site (earthworks)	No	2017-2018							■			
	Western surface site (roadworks)	No	2017-2018								■		
	Kingsgrove Road and Commercial Road Tunnel Support Site Compounds C1 & C3 Tunnelling Support Site Establishment	Installation of enviro controls	No	07-09 2016	■								
Demolition of existing structures		No	07-09 2016	■									
Vegetation Clearing		No	07-09 2016	■									
Establishment of construction facilities		No	07-09 2016		■								
Road and intersection modifications and installation of traffic controls		No	07-09 2016			■							
Piling; Excavation of shaft		No	08-09 2016					■					
Shaft Excavation & Construction		No	08-09 2016					■					
Tunnel support works		Yes	2016-2018						■	■	■	■	■

Impacts to sensitive receivers have been determined and will be continually assessed during design development and construction, noise mitigation measures in the form of temporary noise barriers have been developed to address predicted noise levels for both standard hours and evening/night works, noise levels are detailed in Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) Sections 4.3.1 and 4.3.2.

Construction methods will be incorporated which will reduce noise levels, specifically jack hammering and rock breaking which have been identified as high noise impact activities. The Elliot method of pile braking will be utilized which will reduce jackhammering by up to 90%, terrain levelers will also be considered subject to geotechnical conditions to significantly reduce rock breaking requirements.

To mitigate the impact of high impact activities in accordance with CoA D16 high impact activities will be subject to respite periods and maximum durations.

Mitigation measures will be continually developed as design and construction methods are finalised, mitigation measures will be detailed in the Construction Noise and Vibration Impact Statement for the Kingsgrove Road site.

2.5. Traffic Noise Assessment

Modeling and assessment of traffic noise impacts have been determined using SoundPLAN v7.3 software, the modeling considers three different source heights to account for the different vehicle noise sources such as car exhaust/engine noise, tyre noise, truck engine noise, and high truck exhausts.

For the purpose of this assessment the model has taken into account:

- traffic volume and heavy vehicle forecasts;
- vehicle speed;
- road gradient;
- location of the noise sources on the two carriageways;
- ground reference levels of the road and receivers;
- separation distances of the road to receivers;
- ground type between the road and receivers; and
- angles of view of the road from the receiver's position.

A noise management schedule has been prepared for the site identifying the noise mitigation strategies that are to be incorporated into the site design to minimise noise impact where it may occur. Predicted traffic noise impacts have been determined taking into account the removal of existing noise barriers, different temporary noise barrier combinations were considered to assist in reducing road traffic noise to receivers, especially as a result of the removal of earth mounds in the vicinity of Beverly Grove Park. The impact from the removal of permanent noise barriers along the existing M5 was also assessed and temporary noise mitigation measures to reduce impacts during the construction phase were reviewed. This analysis forms the basis of proposed options which were consulted on with highly effected landowners and residents.

The greatest impact to receivers comes as a result of the removal of earth mounds in the vicinity of Beverly Grove Park, strategies will be continually developed to enable a temporary noise mound to be constructed in this location subject to design development. This was a key topic of discussion for local residents as detailed in Section 3 below. It is anticipated that temporary noise barriers will be constructed as detailed within this TNBS and a temporary earth mound be constructed behind the noise barriers upon design development and site based materials becoming available. Refer Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) Table 5.3 for the predicted benefits of proposed temporary noise barriers considering traffic noise impacts.

A section of existing King Georges Road Interchange and M5 East permanent noise barriers on the southern side of the M5 Motorway is required to be removed prior to the installation of the final New M5 permanent noise barriers in this location. This has prompted an update to the traffic noise assessment to ensure predicted traffic noise levels at sensitive receivers continue to comply with the relevant criteria. With the installation of the SCW temporary barrier in the interim period between removal of the existing barriers and installation of the final New M5 barriers, there is predicted to be no change in the operational (M5 East) traffic noise for residential properties on the southern side of the M5. Appendix A1 details the operational (M5 East) traffic noise assessment undertaken for the replacement of the permanent barrier with the temporary SCW until the final New M5 noise barriers are in place.

2.6. Noise Barrier Design

The strategy focuses on modeling impacts based on proposed construction methodologies, determining the noise impacts of such methodologies, identifying sensitive receivers, consultation with

sensitive receivers to help develop and finalize temporary noise barrier options based on Sections 2.4 and 2.5 above. Barrier options have been developed considering a variety of acoustic ratings and noise wall performance levels, options have been subsequently matched to required Rw ratings determined from the modeling process. Noise barrier design specifications have been classified using the below performance criteria;

- Low – Rw 10 to 15
- Medium – Rw 15 to 20
- Medium to High – Rw 20 to 25
- High – Rw 25 to 30
- Very High – Rw > 30

Noise barriers are specified below in Table 2.3 which is derived from Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) Appendix C Table C3, refer appendix A for further details. Barriers are specified by location and required Rw rating as determined by noise modeling, a variety of barrier options were considered where chosen barrier options were based on ensuring actual barrier acoustic ratings are greater than specified Rw ratings. In all instances traditional plywood hoardings meet required Rw ratings as detailed below.

Table 2.3 – Noise Barrier Specifications

Noise Barrier	Location	Barrier Height	Required Rw	Proposed Construction	Acoustic Rating Rw
NB01	Kingsgrove North Compound Northern Boundary Compound	3m	Rw 15-20	17mm plywood Speedwall panel 150mm hebel	Rw 24 Rw 41 Rw 40
NB02	Kingsgrove North Compound Section of northern boundary adjacent to bottom of Glamis St	4.5m	Rw 25	17mm plywood sandwich Speedwall panel 150mm hebel	Rw 28 Rw 41 Rw 40
NB03	Kingsgrove Site – M5 Motorway along northern side of M5 eastbound carriageway (where feasible)	2-3m	Rw 15-20	17mm plywood 17mm plywood on barrier 0.48mm steel on barrier	Rw 24 Rw 22 Rw 22
NB04	Kingsgrove Site – M5 Motorway along southern side of M5 westbound carriageway	3-4m	Rw 15-20	17mm plywood 17mm plywood on barrier 0.48mm steel on barrier	Rw 24 Rw 22 Rw 22
SCW	Kingsgrove Site – M5 Motorway along southern side of M5 westbound carriageway	4.7m	Rw 15-20	Double stacked shipping containers	Rw 24+
-	Kingsgrove South compound Commercial Road compound	0m	-	Chain mesh or equivalent	-

2.7. Noise Barrier Installation

The overarching approach during construction as detailed above is to ensure that the installation of temporary noise barriers occurs prior to existing barriers being removed or as early as practicable subject to enabling access for noise barrier installation itself. Barriers will be constructed as detailed in Table 2.4 below.

Table 2.4 – Noise Barrier Installation

Temporary Noise Barrier Strategy - Kingsgrove



Noise Barrier	Location	Commence Installation	Complete Installation	Comments
NB01	Kingsgrove North Compound Northern Boundary Compound	- Immediately post shared path construction and installation of erosion and sediment controls - During AFMP works	Prior to commencement of Construction under CEMP	- Prior to the removal of the northern noise mound - Shared path and sediment and erosion controls must be installed prior to noise wall construction
NB02	Kingsgrove North Compound Section of northern boundary adjacent to bottom of Glamis St	- Immediately post shared path construction and installation of erosion and sediment controls - During AFMP works	Prior to commencement of Construction under CEMP	- Prior to the removal of the northern noise mound - Shared path and sediment and erosion controls must be installed prior to noise wall construction
NB03	Kingsgrove Site – M5 Motorway along northern side of M5 eastbound carriageway (where feasible)	During the establishment of traffic switch 1	- Upon the completion of traffic switch 1 - Prior to the removal of existing concrete noise walls in the vicinity of the wall	Barrier screen subject to on-going RMS approval
NB04	Kingsgrove Site – M5 Motorway along southern side of M5 westbound carriageway	Prior to road widening works impacting existing noise barriers in the vicinity of the wall	Prior to the removal of existing concrete noise walls in the vicinity of the wall	Sediment and erosion controls must be installed prior to noise wall construction
SCW	Kingsgrove Site – M5 Motorway along southern side of M5 westbound carriageway	Immediately	Prior to the removal of existing concrete noise walls in the vicinity of the wall	N/A

2.8. Noise Mitigation Development

As detailed design development continues it is evident that currently proposed noise mitigation measures are achieving superior noise mitigation outcomes than those previously proposed within the EIS. This is demonstrated in the below comparison where predicted impacts presented in the EIS are compared to current detailed design predicted impacts. Predicted impacts have been broken down into those that fall within standard hours and those outside standard hours as below.

Impacts are presented as follows for standard hours (Day):





-  Complies with NML
-  Exceeds NML by less than 10 dB(A) - Noise Effected
-  Exceeds NML by more than 10 dB(A) - Noise Effected
-  > 75 dB(A) - Highly Noise Effected

Table 2.5 – Summary of Noise Construction Noise Impacts (Standard Hours)

Temporary Noise Barrier Strategy - Kingsgrove



NCA	Level of compliance with NML for construction stage															
	V01		V02		V03		V04		V05		V06		V07		V08	
	EIS	DD*	EIS	DD	EIS	DD	EIS	DD	EIS	DD	EIS	DD	EIS	DD	EIS	DD
NCA18																
Level above NML, dB(A)	5	0	0	0	0	0	0	12	1	0	0	31	0	0	0	0
NCA19																
Level above NML, dB(A)	60	24	37	9	37	24	28	21	51	24	29	24	52	16	21	0
NCA20																
Level above NML, dB(A)	0	0	0	0	0	0	0	0	0	0	39	5	31	10	0	0
NCA23																
Level above NML, dB(A)	0	0	0	0	0	0	0	0	0	0	29	0	21	2	0	0
NCA24																
Level above NML, dB(A)	16	0	0	0	5	0	5	0	10	0	35	4	27	7	0	0
NCA25																
Level above NML, dB(A)	20	1	0	0	0	0	15	13	9	0	16	0	10	0	0	0

Notes: All works to be undertaken during Standard construction hours (7am to 6pm Monday to Friday; 8am to 1pm Saturday). EIS refers to results presented in EIS noise and vibration assessment report. DD refers to detailed design noise assessment. Number in brackets refers to noise predictions without temporary noise barriers. # Predicted noise levels include existing permanent noise walls and earth mounds as these will not have been removed at the time of the works. No temporary noise barriers were included in the noise model. OSR = Other sensitive receiver surrounding work area. Worst affected OSR noted.

Impacts are presented as follows for nonstandard hours (Evening and Night):

- Complies with NML
- < 5 dB(A) above NML - Construction Noise Noticeable
- 5 to 15 dB(A) above NML - Construction Clearly Noise Noticeable
- > 15 to 25 dB(A) above NML - Construction Noise Moderately Intrusive
- > 25 dB(A) above NML - Construction Noise Highly Intrusive

Table 2.6 – Summary of Noise Construction Noise Impacts (Non Standard Hours)

NCA	Level of compliance with NML for construction stage																
	V01		V02		V03		V04		V05		V06		V07		V08		
	EIS	DD	EIS	DD	EIS	DD*	EIS	DD	EIS	DD	EIS	DD	EIS	DD	EIS	DD	
NCA18	-	-	-	-	**		-	-	-	-	-	-	-	-	-		
Level above NML, dB(A)						0										2	
NCA19	-	-	-	-	**		-	-	-	-	-	-	-	-	-		
Level above NML, dB(A)						0										14	4
NCA20	-	-	-	-	**		-	-	-	-	-	-	-	-	-		
Level above NML, dB(A)						10										0	
NCA23	-	-	-	-	**		-	-	-	-	-	-	-	-	-		
Level above NML, dB(A)						8										0	
NCA24	-	-	-	-	**		-	-	-	-	-	-	-	-	-		
Level above NML, dB(A)						7										0	
NCA25	-	-	-	-	**		-	-	-	-	-	-	-	-	-		
Level above NML, dB(A)						0										5	

Notes: All works to be undertaken during OOHV Evening 6pm to 10pm Monday to Sunday; or OOHV Night 10pm to 7am Monday to Friday and 10pm to 8am Saturday, Sunday and public holidays; OOHV Day 1pm to 6pm Saturday and 8am to 6pm Sundays and public holidays. Level of compliance reported is based on worst case impact for OOHV period (typically night period). EIS refers to results presented in EIS noise and vibration assessment report. DD refers to detailed design noise assessment. Number in brackets refers to noise predictions without temporary noise barriers. # Predicted noise levels include existing permanent noise walls and earth mounds as these will not have been removed at the time of the works. ** Activity not modelled as OOHV in EIS. OSR = Other sensitive receiver surrounding work area. Worst affected OSR noted.

The comparison in Tables 2.5 & 2.6 clearly show that through detailed design development and design modeling that noise mitigation measures currently being adopted are providing an improved outcome over what was proposed in the EIS.

3. Stakeholder Consultation

3.1. Consultation

CDS JV has adopted a well-coordinated, targeted and personalised approach to consult with highly effected landowners and other key stakeholders regarding the TNBS following the principles and processes outlined in the Community Communication Strategy. Consultation has been carried out with landowners directly adjacent to proposed temporary barrier locations to the north of the construction compound (C1) at and to the south of Construction compound (C2) at Kingsgrove in preparation for the installation of temporary noise barriers. Consultation will continue as required subject to design development.

3.2. Aim

Consultation has been completed and will be ongoing as required subject to project works design development with the aim of:

- Providing an overview of project works in the area, including construction compound layout, shared user path location, construction activities and program.
- Explaining the purpose of the temporary noise barriers and options considered.
- Presenting the design of the barriers, including location, height, material and colour.
- Providing an opportunity for landowners and stakeholders to provide feedback on the proposed options.
- Outline the construction methodology and timing.
- Communicate the final barrier design following consultation.

3.3. Affected stakeholders

During temporary noise barrier design development and optioning phases landowners adjacent to proposed noise barrier locations were identified via desktop analysis and verified by site assessments. Identified landowners were consulted as above and where possible feedback was included in designs of the temporary noise barriers. Further information will be provided just prior to the commencement of temporary noise barrier construction. Landowners adjacent to proposed temporary noise walls were consulted, a report detailing the consultation is attached as Appendix B.

Consultation was undertaken with 22 residential and commercial property residents located directly adjacent to proposed temporary noise barriers. Note that 3 out of the residents consulted occupied commercial properties and that they owned multiple commercial properties. Figure 3.1 & Figure 3.2 show residents consulted.

Figure 3.1 – Kingsgrove North - Identified Properties Consulted – Adjacent to NB01 & NB02

Temporary Noise Barrier Strategy - Kingsgrove

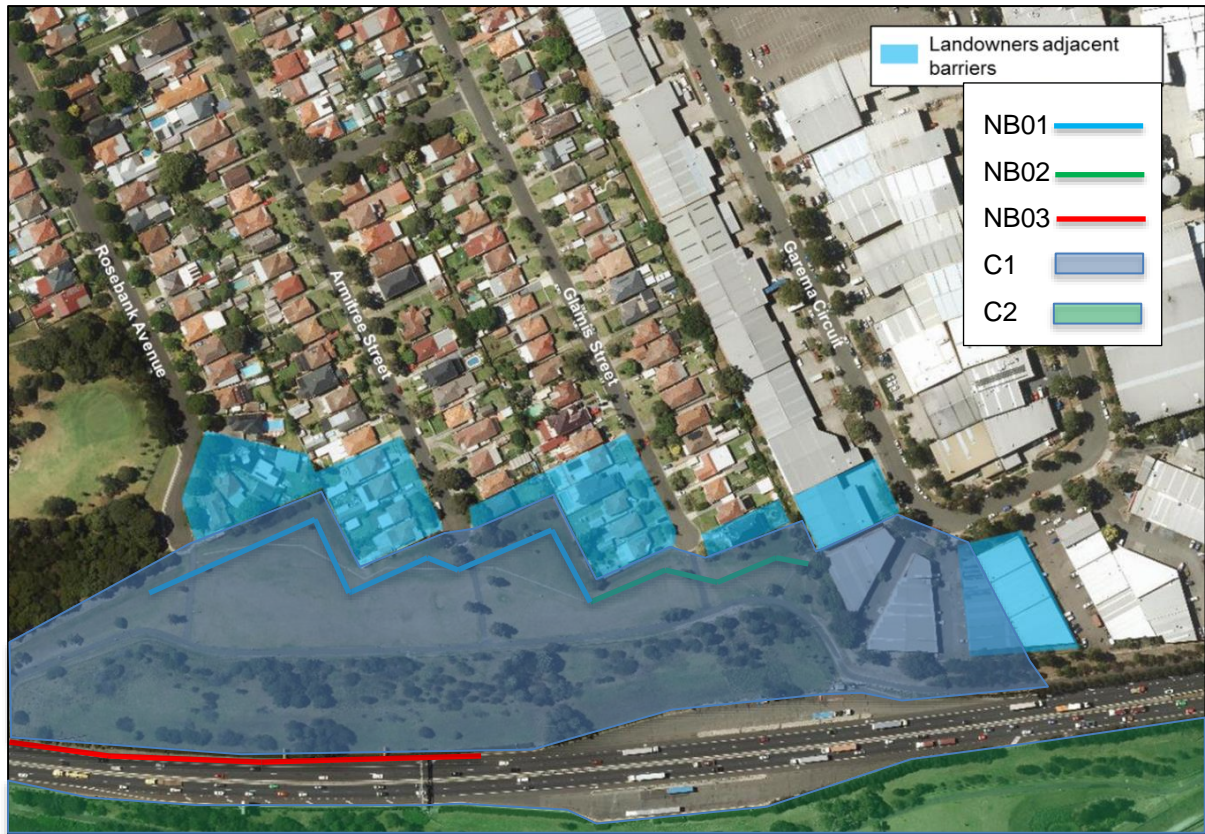


Figure 3.2 – Kingsgrove South – Identified Properties Consulted – Adjacent to NB04



In addition to consulting with residents adjacent to proposed temporary noise barriers, CDS JV also consulted with the following key stakeholders:

- City of Canterbury-Bankstown Council
- Georges River Council
- Group Submissions Coordinator for Kingsgrove North
- RMS
- Existing M5 Operations

Recognising the close proximity of 33 and 25 Garema Circuit to the proposed temporary noise barriers and construction compound, these landowners were also consulted.

Following approval of Revision 2 of this Temporary Noise Barrier Strategy, further consultation was undertaken with 28 residential properties in August 2018. These residential properties are located directly adjacent to the proposed temporary SCW noise barrier and consultation was undertaken to discuss the change in design and afford residents the opportunity to raise any concerns with the project team. Figure 3.3 show residents consulted in August 2018. Details can be found in Appendix B.

Figure 3.3- Kingsgrove South - Identified properties consulted in regards to SCW



3.4. Communication and Consultation Activities

CDS JV has consulted residents adjacent to proposed temporary noise barriers utilising a suite of specific TNBS targeted communications and engagement activities, including one-on-one briefings, council interface meetings, M5 operations interface meetings and notifications.

- One-on-one briefings

Briefings were conducted with each landowner adjacent to proposed barriers and the Group (EIS) Submissions Coordinator for Kingsgrove North. The purpose of these briefings is to consult with impacted stakeholders prior to the adoption of a final design.

These briefings were undertaken by a door-knock and arranged via phone and undertaken by the Community Relations Manager and Construction Manager for the area.

The following tools were used during these briefings to facilitate stakeholder's understanding of the proposed barriers options:

- Maps and plans to illustrate proposed barrier locations, compound layout and project design.
- Barrier material and colour samples
- Survey rod to demonstrate the proposed height of the barriers
- Measuring tape to indicate the distance of the barriers from property boundaries
- Kingsgrove fact sheet, community update and other relevant project communications
- Council Interface Meetings

Regular interface meetings are being held with Councils on a recurring basis. Meetings have been held with the City of Canterbury-Bankstown Council and Georges River Council. These forums have been organised to enable Councils to be kept informed and engaged on a one-on-one basis covering a range of project matters, including proposed temporary noise barrier options.

Temporary noise barrier options have been presented at council interface meetings and/or sent to councils in the interim period, providing council representatives with an opportunity to provide feedback. The final barrier design will be tabled at a subsequent meeting.

- Notification

Notifications will be sent to affected stakeholders to inform them of final temporary noise barrier designs subject to secretary approval. CDS JV recognizes the importance of closing out the consultation process regarding temporary noise barrier options to ensure that further consultation and feedback is forthcoming.

Upon secretary approval of the TNBS notifications will be sent to residents detailing the design of noise barriers, including a map, and also include information about associated construction timing and impacts. Ongoing notifications and project updates will be provided as works progress.

3.5. Decision Making Process

All residents consulted engaged proactively in open discussions regarding proposed temporary noise barriers, at the time of the consultation it was clear there were several key design elements which residents desired and that there were no significant issues raised regarding proposed options. Key trends are evident in the feedback received as detailed in Appendix B and are summarized below;

- Existing trees adjacent to boundaries to be retained
- Preferred colours were greys, those being Windspray and Dune, Pale Eucalypt (green) was not favoured
- Noise barriers to be set back from boundary fencing, ie not sitting directly adjacent to boundary fencing to enable shared path to be set back
- A noise mound similar to the existing mound be incorporated into the final design and temporary design if possible
- No preference towards noise barrier type finish other than colour
- No objection to proposed height of 4.5m subject to sufficient setback

The above key trends have been considered and will be accounted for in the final design as below;

- Existing trees will be retained along boundary fencing in the vicinity of Beverly Grove Park.
- A grey tone will be incorporated
- An approximate setback of 10m will be adopted with the shared path sweeping through the available corridor

- Optioneering for a permanent noise mound will be included in detailed design development, a temporary noise mound will be positioned behind the temporary noise barrier subject to material availability and timing of the existing mound material being moved
- A plywood finish noise wall will be incorporated with steel posts on piled foundations.
- Proposed heights will be incorporated into final design.

Through further consultation undertaken for the SCW in August 2018, a resident asked if the permanent noise wall could be made of timber. The community team member directed the resident to the consultation undertaken as part of the Urban Design and Landscape Plan and the Noise Barrier Design Sub-plan, which details the approved design of the permanent barriers (i.e. not timber). No further issues or preferences were raised during the additional consultation. This is summarised in Appendix B.

The above demonstrates that residents adjacent to proposed temporary noise barriers have been consulted and feedback received has been incorporated in the development of final barrier designs, subject to secretary approval the above will be communicated to consulted residents.

3.6. Monitoring and reporting

All stakeholder interactions regarding the implementation of the TNBS with landowners and community representatives has been recorded in the project's community contact database and included in monthly and quarterly progress reports. Appendix C outlines the report for consultation associated with this TNBS for the Kingsgrove North and Beverly Hills area.

4. Ongoing Monitoring

The strategy sets the overall approach to how construction and traffic noise will be mitigated during construction. The effectiveness of the strategy will rely on multiple iterations of implementation of the strategy principles as design and construction methodologies are refined and implemented. The TNBS will be assessed for effectiveness and site based compliance, the first review will be 2 months after the erection of temporary noise barriers in line with the Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds), 6 monthly reviews will then follow. The TNBS will be updated as required to account for key learning's as they are identified and in accordance with the reviews detailed above.

5. Conclusion

The CDS JV has prepared this TNBS in accordance with the Conditions of Approval (CoA), in particular condition D20.

The strategy sets the overall approach to how construction and traffic noise will be mitigated during construction. The strategy focuses on modeling impacts based on proposed construction methodologies, determining the noise impacts of such methodologies, identifying sensitive receivers, consultation with sensitive receivers to help develop and finalize temporary noise barrier options and ongoing monitoring of the overall effectiveness of the strategy. This strategy demonstrates that optimum barrier solutions have been developed utilizing sound analytical modeling which demonstrates the benefit of proposed solutions and at the same time is a desired solution for highly effected residents as the consultation process demonstrates.

A key component of the implementation of the overall strategy is the Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) found in Appendix A.



Appendix A: Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)

WESTCONNEX NEW M5

Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove compounds)

17 June 2016

CPB Dragados Samsung Joint Venture

TH014-05 01F08 WCX_NM5 Temp Barrier Nse Rep_WEST (r5)

Document details

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Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
22.04.2016	Draft report	0	1	█	█	█
03.06.2016	Final report	2	3	█	█	█
06.06.2016	Minor edits	-	4	█	█	█
17.06.2016	Update Table D to include level of exceedance in dB(A)	-	5	█	█	█

Important Disclaimer:

The work presented in this document was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

This document is issued subject to review and authorisation by the Team Leader noted by the initials printed in the last column above. If no initials appear, this document shall be considered as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.

This document is prepared for the particular requirements of our Client referred to above in the 'Document details' which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Renzo Tonin & Associates. The information herein should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

In preparing this report, we have relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, we have not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

We have derived data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination and re-evaluation of the data, findings, observations and conclusions expressed in this report.

We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

The information contained herein is for the purpose of acoustics only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics engineering including and not limited to structural integrity, fire rating, architectural buildability and fit-for-purpose, waterproofing and the like. Supplementary professional advice should be sought in respect of these issues.

Contents

1	Introduction	5
1.1	Relevant requirements and purpose of this report	5
1.2	Structure of this report	6
1.3	Quality assurance	6
2	Work area and sensitive receivers	7
2.1	Description of work area	7
2.2	Sensitive receivers	7
3	Noise Objectives	9
3.1	Construction Noise Management Levels	9
3.2	Road Traffic Noise Objectives	9
4	Construction Noise Assessment	10
4.1	Noise prediction methodology	10
4.2	Preliminary detailed Design outcomes	10
4.3	Predicted noise levels	11
4.3.1	Predicted noise levels for standard hours works	12
4.3.2	Predicted noise levels for OOHW	13
4.4	Noise Mitigation and Management	14
4.4.1	High noise impact activities	14
4.4.2	Other noise control measures	14
5	Traffic Noise Assessment	16
5.1	Noise prediction methodology	16
5.2	Preliminary detailed design outcomes	17
5.3	Predicted traffic noise impacts	17
5.3.1	Northern side of M5 Motorway	18
5.3.2	Southern side of M5 Motorway	19
5.4	Further traffic noise mitigation and management	19
6	Conclusion	20
	References	21
APPENDIX A	Glossary of terminology	22
APPENDIX B	Nearest Sensitive Receivers and Noise Management Levels	27
APPENDIX C	Construction Timetable/ Activities/ Management	31
APPENDIX D	Comparison of EIS predictions to detailed design	42

List of tables

Table 2.1	Nearest Residential Noise and Vibration Sensitive Receivers	7
Table 4.1	Noise modelling assumptions - Kingsgrove Road civil and tunnelling support sites	11
Table 4.2	Summary of noise construction noise impacts (standard hours)	12
Table 4.3	Summary of noise construction noise impacts (OOHW)	13
Table 5.1	Summary of Noise Modelling Inputs	16
Table 5.2	Traffic noise modelling data – existing road network (from ONMR Appendix B)	17
Table 5.3	Predicted change in traffic noise levels with/ without temporary noise barriers	18
Table D.1	Summary of noise construction noise impacts (standard hours)	42
Table D.2	Summary of noise construction noise impacts (OOHW)	43

List of figures

Figure B1:	Locality map showing NCAs, other sensitive receivers, temporary and permanent noise barriers	28
Figure B2:	Locality map showing NCAs, other sensitive receivers, temporary and permanent noise barriers	29

1 Introduction

1.1 Relevant requirements and purpose of this report

This Construction Noise and Vibration Temporary Noise Barrier Acoustic Report (TNBAR) has been prepared to address the Conditions of Approval for the WestConnex New M5 Project (New M5 or Project), more specifically Condition D20.

D20 The Proponent must develop and implement a Temporary Noise Barrier Strategy which includes:

(a) identification and confirmation of all temporary noise barriers including -

(i) the provision of a temporary noise barrier on the northern side of the Kingsgrove North construction compound to provide noise mitigation to highly affected residents at a level greater than that identified in the documents referred to in condition A2(b),

(ii) consideration of the installation of temporary noise barriers on the southern and northern side of the M5 East Motorway during the relocation of the existing permanent noise barriers (or detail on why these noise barriers are not considered feasible and reasonable),

(iii) consideration of the installation of temporary noise barriers along Campbell Road, Campbell Street and Euston Road (or detail on why these noise barriers are not considered feasible and reasonable),

(iv) temporary noise barriers around construction compounds;

(b) the consultation and decision-making process for all temporary noise barriers; and

(c) an acoustic report detailing the final barrier heights, material analysis and predicted benefits.

The temporary barrier options must be developed in consultation with the landowners adjacent to the barrier locations prior to the adoption of a final design.

The Temporary Noise Barrier Strategy must be approved by the Secretary prior to site establishment works or construction works at the Kingsgrove North construction compound, the permanent noise barriers on the northern and southern side of the M5 East Motorway are removed, and/or road widening works are undertaken along Campbell Road, Campbell Street or Euston Road. This identifies the temporary noise walls to be installed at the Kingsgrove Road site, at the Western end of the M5N.

This TNBAR forms part of the Temporary Noise Barrier Strategy and has been prepared to address the temporary noise barriers associated with the Kingsgrove Road compounds C1, C2 and C3 and surface

works at the western end of the Project. Separate acoustic reports have been prepared to address the temporary noise barriers at other compounds associated with the Project, including:

- Temporary Noise Barrier Acoustic Report - Bexley compounds C4, C5 and C6
- Temporary Noise Barrier Acoustic Report - Arncliffe compound C7
- Temporary Noise Barrier Acoustic Report - St Peters Interchange compounds C8, C9 and C10
- Temporary Noise Barrier Acoustic Report - Local Roads compounds C11, C12, C13 and C14.

This report will be submitted to the Department of Environment and Planning (DEP) as part of the Temporary Noise Barrier Strategy required by Condition D20.

1.2 Structure of this report

This report is structured as follows:

- **Section 2** Description of work area and noise sensitive receivers surrounding the site;
- **Section 3** Noise objectives;
- **Section 4** Construction Noise Assessment; and
- **Section 5** Traffic Noise Assessment.

1.3 Quality assurance

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

2 Work area and sensitive receivers

2.1 Description of work area

This TNBAR provides information on the temporary noise barriers associated with the western end of the M5N Project, more specifically in relation to:

- Temporary noise barriers to mitigate construction noise associated with the Kingsgrove North construction compound C1, located on the northern side of the M5 Motorway, west of Garema Circuit
- Temporary noise barriers on the southern and northern side of the existing M5 Motorway to mitigate road traffic noise during the relocation of existing permanent noise barriers.
- Temporary noise barriers around construction compounds (other than Kingsgrove Road North) at the western end of the Project, including:
 - Kingsgrove Road South compound C2
 - Commercial Road compound C3.

Figure B1 in Appendix B shows the construction work area addressed in this report.

2.2 Sensitive receivers

In order to assess and manage construction noise impact, the residential areas surrounding the Project have been divided into Noise Catchment Areas (NCAs) based on each area's similar acoustic environment prior to the commencement of construction works. The NCAs have been based on those established in the EIS, with some modifications to allow for site specific characteristics identified during the detailed assessment and delivery phase. The NCAs are identified in more detail in the Construction Noise and Vibration Management Plan (CNVMP) prepared for the Project.

An indicative list of the nearest and potentially worst affected noise and vibration sensitive receivers and their respective NCAs are summarised in Table 2.1 below.

Table 2.1 Nearest Residential Noise and Vibration Sensitive Receivers

NCA	Receiver Type	Nearest construction work area	Distance from receiver to works
NCA18	Residential Commercial/ Industrial	M5 East surface works	40 to 750 m
NCA19	Residential Active recreation	M5 East tunnel portals, Kingsgrove compound	10 to 750 m
NCA20	Residential Active Recreation	M5 East surface works	20 to 700 m
NCA23	Residential	M5 East surface works	30 to 750 m
NCA24	Residential	M5 East surface works	20 to 650 m

NCA	Receiver Type	Nearest construction work area	Distance from receiver to works
NCA25	Residential Active recreation	M5 East surface works	120 to 500 m

All relevant residential sensitive receivers in the vicinity of the worksites are identified on aerial photographs located in APPENDIX B.

3 Noise Objectives

3.1 Construction Noise Management Levels

Construction noise management levels have been determined using the NSW Interim Construction Noise Guideline (ICNG), in accordance with Condition D16(a).

Figure B1 and Table B1 in APPENDIX B identify the adopted construction noise management levels (NMLs) for the nearest noise sensitive receivers to the worksite. The NMLs for residential receivers are based on long-term noise monitoring conducted by AECOM on behalf of SMC to quantify ambient noise levels for the Environmental Impact Statement (EIS) as noted in the CNVMP. The NMLs are derived from the lowest measured RBLs within each NCA and are generally considered to be conservative.

The NMLs for 'other' sensitive receivers are from the ICNG, as reported in Section 3.1.1 of the CNVMP.

Residential receivers are considered 'noise affected' where construction noise levels are greater than the NMLs identified in APPENDIX B. The noise affected level represents the point above which there may be some community reaction to noise. Where predicted and/or measured construction noise levels exceed NMLs, all feasible and reasonable work practices will be applied to meet the NMLs.

During standard construction hours a highly affected noise objective of $L_{Aeq(15min)} 75$ dB(A) applies at all receivers.

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

3.2 Road Traffic Noise Objectives

The ICNG does not set out specific noise criteria to address the noise impact associated with any proposed changes to road traffic conditions, such as for example on this Project the removal of the earth mound of the northern side of the M5 Motorway. It instead refers to the EPA's policy on road traffic noise, the Road Noise Policy (RNP 2011).

Noise impact from the existing road network generated by construction activity is also not directly addressed by the RNP. Nonetheless, guidance is taken from the RNP in that the Project should adopt all reasonable and feasible noise mitigation and management measures, with the aim to limit any increase in existing road traffic noise levels to no more than 2 dB(A) and to minimise any sleep disturbance impacts.

It is noted that any additional noise impact would be limited only to the periods and duration of the subject construction works.

4 Construction Noise Assessment

4.1 Noise prediction methodology

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

The noise prediction models take into account:

- Location of noise sources and sensitive receiver locations;
- Height of sources and receivers referenced to one metre digital ground contours for the site area and surrounding area;
- Sound Power Levels (L_w) of plant and equipment likely to be used during the various construction activities are included in Table C2 in Appendix C - Construction Timetable/ Activities/ Equipment. Table C2 also identifies the plant and equipment that will be operating during standard construction hours and outside of standard construction hours.
- Separation distances between sources and receivers;
- Ground type between sources and receivers; and
- Attenuation from barriers (natural and purpose built).

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

4.2 Preliminary detailed Design outcomes

During the development of the site design, Renzo Tonin & Associates are playing a key role in assisting CDS JV to determine the physical noise mitigation measures required to reduce noise impact from the operation of the site. The following sections describe briefly the noise design methodology and outcomes, including the location of acoustic sheds and the length, height and location of noise walls required around the site. To ensure the timely and efficient provision of inputs to the design process, these mitigation measures were documented in the Noise Design Report.

A noise management schedule has been prepared for the site identifying the noise mitigation strategies that are to be incorporated into the site design to minimise noise impact where it may occur. The schedule is presented in Table C2 in APPENDIX C. Further to this, Table C3 sets out the noise wall schedule in relation to temporary noise barriers for the construction phase of the Project

Figure B1 and Figure B2 in APPENDIX B identifies noise wall/ hoarding locations around the site.

4.3 Predicted noise levels

The stages/operations considered in the noise model are summarised in the table below. For more detail on specific works being undertaken for each modelling scenario see the activity and timing Table C.1 in APPENDIX C.

Table 4.1 Noise modelling assumptions - Kingsgrove Road civil and tunnelling support sites

Activity/ Work Area	Aspect	Includes OOHW?	Approx. timing	Modelled construction stage									
				V01	V02	V03	V04	V05	V06	V07	V08		
Kingsgrove Road Civil compound C2 Civil Works Site Establishment	Power Generator	No	07-09 2016	Green	Yellow	Purple							
	Installation of enviro controls	No	07-09 2016	Green									
	Demolition of existing structures	No	07-09 2016	Green									
	Crushing & Screening	No	07-09 2016	Green									
	Vegetation Clearing	No	07-09 2016	Green									
	Establishment of construction facilities	No	07-09 2016		Yellow								
	Road and intersection modifications and installation of traffic controls	Yes	07-09 2016			Purple							
	Removal of earth mound on northern side of M5	No	09-10 2016						Blue				
	Portal surface site (piling)	No	10-12 2016							Blue			
	Portal surface site (earthworks)	No	2017-2018							Blue			
	Portal surface site (roadworks)	No	2017-2018								Blue		
	Western surface site (earthworks)	No	2017-2018							Blue			
	Western surface site (roadworks)	No	2017-2018								Blue		
Kingsgrove Road and Commercial Road Tunnel Support Site Compounds C1 & C3 Tunnelling Support Site Establishment	Installation of enviro controls	No	07-09 2016	Green									
	Demolition of existing structures	No	07-09 2016	Green									
	Vegetation Clearing	No	07-09 2016	Green									
	Establishment of construction facilities	No	07-09 2016		Yellow								
	Road and intersection modifications and installation of traffic controls	No	07-09 2016			Purple							
	Piling; Excavation of shaft	No	08-09 2016						Cyan				
	Shaft Excavation & Construction	No	08-09 2016						Cyan				
	Tunnel support works	Yes	2016-2018							Blue	Blue	Blue	Blue

Sections 4.3.1 and 4.3.2 below summarise the impacts for each construction stage in each NCA in terms of compliance with the NMLs during standard construction hours and for OOHW respectively. The colours in the table indicate whether or not receivers in the NCA comply with the NML and, where exceedance of the NML occurs, the perceived impact of the exceedance.

APPENDIX D provides a summary, for comparative purposes of the predicted noise levels from:

- the EIS Technical working paper: Noise and vibration;
- the detailed design without noise mitigation; and
- the detailed design incorporating the design noise mitigation.

4.3.1 Predicted noise levels for standard hours works

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

- ◆ Complies with NML
- ◆ Exceeds NML by less than 10 dB(A) – noise affected
- ◆ Exceeds NML by more than 10 dB(A) – noise affected
- ◆ > 75 dB(A) – highly noise affected

Table 4.2 Summary of noise construction noise impacts (standard hours)

NCA	Level of compliance with NML for construction stage							
	V01	V02	V03	V04	V05	V06	V07	V08
NCA18	◆	◆	◆	◆	◆	◆	◆	◆
NCA19	◆	◆	◆	◆	◆	◆	◆	◆
NCA20	◆	◆	◆	◆	◆	◆	◆	◆
NCA23	◆	◆	◆	◆	◆	◆	◆	◆
NCA24	◆	◆	◆	◆	◆	◆	◆	◆
NCA25	◆	◆	◆	◆	◆	◆	◆	◆

Notes All works to be undertaken during Standard construction hours (7am to 6pm Monday to Friday; 8am to 1pm Saturday)
OSR = Other sensitive receiver surrounding work area. Worst affected OSR noted.

When site establishment construction works are underway at the Kingsgrove Road compounds, the nearest affected receivers in NCA 18, 19 and 25 (including adjacent commercial/ industrial premises) closest to the site will be noise affected during the site establishment works. Some receivers in NCA 19 will be highly noise affected as a result of vegetation clearing and demolition of structures during site establishment. Vegetation clearing will generate higher noise impact, mainly because these works need to be completed to enable the installation of environmental controls, including noise walls and construction hoardings. It is not possible to install noise walls or construction hoarding prior to these activities being completed.

The early stages of the excavation works associated with the tunnelling support shafts will also generate noise levels that will be clearly audible to highly intrusive, again to the nearest receivers in NCA 19 (including adjacent commercial/ industrial premises). Activities such as rock hammering during excavation works and piling works are likely to cause receivers in NCA 19 to be highly noise affected. Noise from these activities may also be clearly audible at the nearest affected receivers in only NCA 18

and 25. It is noted that construction noise barriers will be installed prior to the commencement of shaft excavation works.

During the early stages of the Kingsgrove civil works, including earthworks and removal of the earth mound, the nearest receivers in NCA 19 will be highly noise affected. Noise walls and construction hoarding will be installed as outlined in APPENDIX C to reduce noise levels during the construction phase. Piling works and excavation to the portal will also generate noise levels that will be clearly audible to moderately intrusive until earthworks are well below surface level. Noise walls and construction hoardings will be in place, as outlined in Table C2, to assist in reducing impacts to receivers. Nonetheless activities such as piling works, jackhammering to trim the tops of piles, rock hammering during excavation works and surface excavation (in particular surface mining), are likely to cause highly intrusive noise levels to the nearest affected receivers.

Construction noise impacts from the tunnelling support operations are predicted to comply with the NMLs during standard construction hours.

Measures for managing the noise impacts outlined in Section 4.4.

4.3.2 Predicted noise levels for OOHW

The impacts presented are as follows for **OOHW Evening and Night**:




















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

Table 4.3 Summary of noise construction noise impacts (OOHW)

NCA	Level of compliance with NML for construction stage							
	V01	V02	V03	V04	V05	V06	V07	V08
NCA18	-	-		-	-	-	-	
NCA19	-	-		-	-	-	-	
NCA20	-	-		-	-	-	-	
NCA23	-	-		-	-	-	-	
NCA24	-	-		-	-	-	-	
NCA25	-	-		-	-	-	-	
OSR	-	-		-	-	-	-	

NCA	Level of compliance with NML for construction stage							
	V01	V02	V03	V04	V05	V06	V07	V08
Notes	<p>All works to be undertaken during OOHW Evening 6pm to 10pm Monday to Sunday; or OOHW Night 10pm to 7am Monday to Friday and 10pm to 8am Saturday, Sunday and public holidays; OOHW Day 1pm to 6pm Saturday and 8am to 6pm Sundays and public holidays.</p> <p>Level of compliance reported is based on worst case impact for OOHW period (typically night period)</p> <p># Predicted noise levels include existing permanent noise walls and earth mounds as these will not have been removed at the time of the works.</p> <p>OSR = Other sensitive receiver surrounding work area. Worst affected OSR noted.</p>							

The OOHW site establishment works include the installation of traffic barriers on the existing M5 Motorway. Predicted noise levels from these activities were found to comply in NCA18 and NCA25 and at other sensitive receivers. Noise levels may be clearly audible [within 15 dB(A) of the NML] at the nearest receivers in NCA19, NCA20, NCA23 and NCA24.

Construction noise impacts from the tunnelling support operations are predicted to comply with the NMLs during the OOHW period. There is a marginal exceedance [within 2 dB(A)] at 1 receiver in NCA19 during the night period, caused by spoil haul trucks moving on site.

Measures for managing the noise impacts outlined in Section 4.4.

4.4 Noise Mitigation and Management

4.4.1 High noise impact activities

To limit the potential impact from high noise impact activities such as piling, jack hammering and rock hammering, the works will be carried out with respite periods as set out in condition of approval D16, such that:

- High noise impact activities (including jackhammering and rock breaking) are only carried out between:
 - 8 am and 6pm Monday to Friday; and
 - 8 am and 1 pm Saturday;
- High noise impact activities are carried out in continuous blocks of up to 3 hours. Respite from high noise impact activities will be provided between each block for at least 1 hour. No high noise impact activities will be carried out during this 1 hour respite period.

4.4.2 Other noise control measures

Other noise mitigation measures and noise monitoring requirements will be addressed in the following documents:

- Construction Noise and Vibration Impact Statement: Site Establishment (Project Wide) [ref: TH014-05 01F02 WCX_NM5]

- Construction Noise and Vibration Impact Statement: Kingsgrove Road Site Establishment OOHW [ref: TH014-05 01F09 WCX_NM5]
- Construction Noise and Vibration Impact Statement: Kingsgrove Road Civil site [ref: TH014-05 01F—TBC]
- Construction Noise and Vibration Impact Statement: Kingsgrove Road Tunnel Support site [ref: TH014-05 01F—TBC].

5 Traffic Noise Assessment

5.1 Noise prediction methodology

Noise predictions are based on a method developed by the UK Department of Environment entitled "Calculation of Road Traffic Noise (1988)" known as the CoRTN (1988) method. This method has been adapted to Australian conditions and extensively tested by the Australian Road Research Board and as a result it is recognised and accepted by the NSW EPA. The modelling software package used was SoundPLAN v7.3. The model has been setup to incorporate three different source heights to account for the different vehicle noise sources such as car exhaust/engine noise, tyre noise, truck engine noise, and high truck exhausts.

The CoRTN method uses the average 1-hour traffic volume for the 'assessment period' (i.e. day or night) to predict the $L_{10, 1\text{hour}}$ noise levels. A correction of -3dB(A) is applied to obtain the $L_{\text{eq}, 1\text{hour}}$ noise levels which equate to the L_{Aeq} noise levels for the 'assessment period'.

For the purpose of this assessment the model has taken into account:

- traffic volume and heavy vehicle forecasts;
- vehicle speed;
- road gradient;
- location of the noise sources on the two carriageways;
- ground reference levels of the road and receivers;
- separation distances of the road to receivers;
- ground type between the road and receivers; and
- angles of view of the road from the receiver's position.

The road traffic noise model has been established as part of the operational noise assessment for the Project. More details regarding the inputs parameters, settings used and noise model validation is provided in the Operational Noise Management Report (ONMR). A summary of the critical noise model inputs is provided below.

Table 5.1 Summary of Noise Modelling Inputs

Parameters	Inputs
Model geometry	
Ground topography at receiver and road:	1 metre digital ground contours within the construction site area and outside the construction site area.
Road geometry:	Existing road geometry design provided in the 1 metre digital ground contours

Parameters	Inputs
Source height:	0.5m for car exhausts/engines and car/truck tyre noise, 1.5m for truck engines and 3.6m for truck exhausts
Noise sensitive receiver locations	From aerial photography supplemented by ground truth surveys
Receiver heights:	1.5m for ground floor 4.5m for first floor
Noise barriers:	See APPENDIX C for details. In summary - 3m temporary hoarding along the northern boundary of Kingsgrove north compound 4.5m temporary hoarding along the northern boundary of Kingsgrove north tunnel support compound 4m temporary hoarding along the southern edge of M5 westbound carriageway 2-3m relocatable noise barrier along the northern edge of M5 eastbound carriageway
Road pavement surface:	N/A as investigating relative difference only
Traffic Parameters	
Traffic Volumes and Mix:	See Table 5.2.
Vehicle Speeds:	M5 Motorway 110 km/h.

The assumed traffic data for the traffic noise modelling has been taken from the ONMR.

Table 5.2 Traffic noise modelling data – existing road network (from ONMR Appendix B)

Road	Direction	Opening year 2021 (no build)			
		15 Hour Day Period (7am-10pm)		9 Hour Night Period (10pm-7am)	
		TOTAL	HV	TOTAL	HV
M5 main carriageway east of KGR	EB	47127	8682	9172	1796
	WB	45468	9086	11107	1752
EB on ramp from KGR	EB	18089	4340	4916	1062
WB off ramp to KGR	WB	19011	4489	5298	1103

5.2 Preliminary detailed design outcomes

A noise management schedule has been prepared for the site identifying the noise mitigation strategies that are to be incorporated into the site design to minimise noise impact where it may occur. The schedule is presented in Table C2 in APPENDIX C. Further to this, Table C3 sets out the noise wall schedule in relation to temporary noise barriers for the construction phase of the Project

Figure B1 and Figure B2 in APPENDIX B identifies noise wall/ hoarding locations around the site.

5.3 Predicted traffic noise impacts

The table below summarises the predicted construction traffic noise impacts resulting from the removal of the earth mound on the northern side of Kingsgrove Road. Note that the review found that the change in traffic noise was the same for the day and night periods, hence only one set of results is

presented below. Different temporary noise wall combinations were considered to assist in reducing road traffic noise to receivers in NCA19 following the removal of the earth mound. The impact from the removal of permanent noise barriers along the existing M5 was also assessed and temporary noise mitigation measures to reduce impacts during the construction phase were reviewed.

It is understood that the nature of the construction works is such that it is unlikely that permanent operational noise walls will be able to be constructed until late in the construction phase. However, the permanent walls will be installed as early as practicable to assist in reducing construction noise.

Table 5.3 Predicted change in traffic noise levels with/ without temporary noise barriers

NCA	Change in traffic conditions/ Temporary mitigation during construction	Predicted change in traffic noise levels compared with existing road traffic noise	Noise benefit from temporary barrier compared with no barrier
NCA19	Removal of mound	Up to 10 dB(A) increase	
	Install temporary barriers (see Appendix C)	Up to 7 dB(A) increase	3 dB(A) reduction
NCA20	Removal of existing noise wall	Up to 7 dB(A) increase	
	Install temporary barriers (see Appendix C)	Up to 3 dB(A) increase	4 dB(A) reduction
NCA24	Removal of existing noise wall	Up to 6 dB(A) increase	
	Install temporary barriers (see Appendix C)	Up to 2 dB(A) increase	4 dB(A) reduction

5.3.1 Northern side of M5 Motorway

A sensitivity analysis was carried out on the height of the temporary noise barrier on the northern side of the Kingsgrove North construction compound. The analysis reviewed barrier heights from 1.8m to over 6m. The sensitivity analysis found that increasing the height of the barrier from 1.8m to over 6m at this location had little noise benefit in terms of mitigation of road traffic noise (< 2 dB(A)) due to the natural topography relative to the motorway.

As a temporary barrier on northern side of the Kingsgrove North construction compound was found to have minimal noise benefit in terms of road traffic noise, a review of relocatable roadside noise barriers on the northern side of the M5 East Motorway was undertaken with the view that these barriers could be moved to suit the required traffic switching during the construction phase, whilst still providing a (small) road traffic noise (and construction) noise benefit. Concrete jersey barriers with plywood hoarding mounted above were considered. These systems have a height limitation of approx. 3 m with minimal bracing being required. A higher noise barrier would require more space for bracing and due to the significant space constraints along the motorway works area, barriers higher than 3 m are not feasible.

It is understood that barrier mounted hoarding does not comply with RMS Safety Barrier System Acceptance Conditions where there is insufficient clear zone / offset to the travel lane or where the hazard free deflection zone behind barrier does not provide space for a separate safety barrier and hoarding/ noise barrier. This is often the case for work zones where road widening is occurring, making barrier mounted hoarding not feasible. This issue will require review by the construction design team for the relocatable roadside noise barrier on the northern side of the M5 East Motorway.

5.3.2 Southern side of M5 Motorway

Part of the permanent noise barrier on the southern side of the M5 Motorway will be removed during the Project to allow for the widening works. A sensitivity analysis was carried out on the height of the temporary noise barrier on the southern side of the M5 Motorway following the removal of the permanent noise wall. The reasonable and feasible barrier height was determined to be 4 m high. The barrier provided noise benefit from both construction and road traffic noise.

At the time of this assessment it was understood that there was sufficient space on the southern side of the M5 Motorway to install a temporary noise wall (with footings) in this location, which allows the wall to be higher. This will require review by the construction design team.

5.4 Further traffic noise mitigation and management

It is recommended that at-property treatment required to mitigate operational road traffic noise impact be installed as early as possible following construction commencement so that the property treatment benefits the resident during the construction phase.

Furthermore, reducing traffic speed through the construction zone will result in a further reduction in road traffic noise level, as follows:

- 110 km/h to 80 km/h 2 dB(A) reduction
- 110 km/h to 60 km/h 3.5 dB(A) reduction
- 110 km/h to 40 km/h 5 dB(A) reduction

6 Conclusion

This Construction Noise and Vibration Temporary Noise Barrier Acoustic Report has been prepared to identify and confirm:

- Temporary noise barriers to mitigate construction noise associated with the Kingsgrove North construction compound, located on the northern side of the M5 Motorway, west of Garema Circuit
- Temporary noise barriers on the southern and northern side of the existing M5 Motorway to mitigate road traffic noise during the relocation of existing permanent noise barriers.
- Temporary noise barriers around construction compounds (other than Kingsgrove Road North) at the western end of the Project, including:
 - Kingsgrove Road South compound
 - Commercial Road compound.

Impacts predicted as a result of construction activity following the installation of temporary noise barriers have been quantified and reported in:

- Section 4, in relation to construction noise impact; and
- Section 5, in relation to road traffic noise impact following the removal of existing permanent operational noise mitigation.

Noise management schedules for the site have been developed identifying the noise mitigation strategies that are to be incorporated into the site design to minimise noise impact where it may occur. The schedules are:

- Table C2 in APPENDIX C setting out the Construction Noise Management schedule
- Table C3 in APPENDIX C setting out the Noise Wall / Hoarding Design specifications
- Table C4 in APPENDIX C setting out the Noise Shed/ Enclosure Design specifications
- Figure B1 in APPENDIX B identifying noise walls and hoarding locations around the site.

References

1. Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline (ICNG),
2. Environment Protection Authority 1999 NSW Environmental Criteria for Rd Traffic Noise
3. Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline
4. British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
5. British Standard BS 7385 Part 2-1993, Evaluation and measurement for vibration in buildings
6. German Standard DIN 4150-3 : 1999-02, Structural vibration - Effects of vibration on structures, February 1999
7. ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control, pp47.39-47.40
8. Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration, p16
9. Australian Standard AS/NZS 2107:2000 *Acoustics - Recommended design sound levels and reverberation times for building interiors*
10. Roads and Maritime Services 2014 QA Specification G36 Environmental Protection Edition 4 / Revision 3
11. AECOM Australia Pty Ltd 2015 WestConnex The New M5 – Technical Working Paper: Noise and Vibration Report Revision 8 – 20-Nov-2015
12. Renzo Tonin & Associates WestConnex Stage 2 M5 East Operational Noise Management Report (ONMR), 8 July 2015 [ref: TH014-01 01BF01 ONMR (r5)]
13. Transport for NSW Construction Noise Strategy (ref: 7TP-ST-157/2.0) April 2012
14. Minister for Planning Infrastructure approval SSI 6788 dated 20 April 2016

APPENDIX A Glossary of terminology

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

Absorption Coefficient α	The absorption coefficient of a material, usually measured for each octave or third-octave band and ranging between zero and one. For example, a value of 0.85 for an octave band means that 85% of the sound energy within that octave band is absorbed on coming into contact with the material. Conversely, a low value below about 0.1 means the material is acoustically reflective.
Adverse weather	Weather effects that enhance noise (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of nights in winter.
Active recreation	Active recreation area, characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion, e.g. school playground, golf course
Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
Alternate Solution	An Alternative Solution is a design that complies with the relevant Performance Requirements of the National Construction Code other than by using Deemed-to-Satisfy Provisions.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Amenity	A desirable or useful feature or facility of a building or place.
AS	Australian Standard
Assessment period	The time period in which an assessment is made. e.g. Day 7am-6pm, Evening 6pm-10pm, Night 10pm-7am.
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Barrier (Noise)	A natural or constructed physical barrier which impedes the propagation of sound and includes fences, walls, earth mounds or berms and buildings.
Berm	Earth or overburden mound.
Buffer	An area of land between a source and a noise-sensitive receiver and may be an open space or a noise-tolerant land use.
Bund	A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound.
BS	British Standard
CoRTN	United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)"

Decibel [dB]	<p>The units of sound measurement. The following are examples of the decibel readings of every day sounds:</p> <p>0dB The faintest sound we can hear, defined as 20 micro Pascal</p> <p>30dB A quiet library or in a quiet location in the country</p> <p>45dB Typical office space. Ambience in the city at night</p> <p>60dB CBD mall at lunch time</p> <p>70dB The sound of a car passing on the street</p> <p>80dB Loud music played at home</p> <p>90dB The sound of a truck passing on the street</p> <p>100dB The sound of a rock band</p> <p>115dB Limit of sound permitted in industry</p> <p>120dB Deafening</p>
dB(A)	A-weighted decibel. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. The dB(C) level is not widely used but has some applications.
Diffraction	The distortion of sound waves caused when passing tangentially around solid objects.
DIN	German Standard
DnT,w	<p>Weighted Standardised Field Level Difference</p> <p>A measure of sound insulation performance of a building element. It is characterised by the difference in noise level on each side of a wall or floor. It is measured in-situ.</p> <p>It is a field measurement that relates to the Rw laboratory measured value but is not equal to it because an in-situ space is not of the same quality as a laboratory space.</p> <p>The value is indicative of the level of speech privacy between spaces. The higher its value the better the insulation performance.</p>
ECRTN	Environmental Criteria for Road Traffic Noise, NSW, 1999
EPA	Environment Protection Authority
Field Test	<p>A test of the sound insulation performance in-situ. See also 'Laboratory Test'</p> <p>The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion.</p> <p>A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.</p>
Fluctuating Noise	Noise that varies continuously to an appreciable extent over the period of observation.
Free-field	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.

Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
Heavy Vehicle	A truck, transporter or other vehicle with a gross weight above a specified level (for example: over 8 tonnes).
Impact Noise	The noise in a room, caused by impact or collision of an object onto the walls or the floor. Typical sources of impact noise are footsteps on the floor above a tenancy and the slamming of doors on cupboards mounted on the common wall between tenancies.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
INP	NSW Industrial Noise Policy, EPA 1999
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
ISEPP	State Environmental Planning Policy (Infrastructure), NSW, 2007
ISEPP Guideline	Development Near Rail Corridors and Busy Roads - Interim Guideline, NSW Department of Planning, December 2008
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L10(1hr)	The L10 level measured over a 1 hour period.
L10(18hr)	The arithmetic average of the L10(1hr) levels for the 18 hour period between 6am and 12 midnight on a normal working day.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq or Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a fluctuating sound level. When A-weighted, this is written as the LAeq.
LAeq(1hr)	The LAeq noise level for a one-hour period. In the context of the NSW EPA's Road Noise Policy it represents the highest tenth percentile hourly A-weighted Leq during the period 7am to 10pm, or 10pm to 7am (whichever is relevant).
LAeq(8hr)	The LAeq noise level for the period 10pm to 6am.
LAeq(9hr)	The LAeq noise level for the period 10pm to 7am.
LAeq(15hr)	The LAeq noise level for the period 7am to 10pm.
LAeq (24hr)	The LAeq noise level during a 24 hour period, usually from midnight to midnight.
Lmax	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the L _{Amax} .
Lmin	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the L _{Amin} .
Ln,w	Weighted Normalised Impact Sound Pressure Level A measure of the sound level transmitted from impacts on a floor to a tenancy below. It is measured in very controlled conditions in a laboratory and is characterised by how much sound reaches the receiving room from a standard tapping machine. A lower value indicates a better performing floor.

LnT,w	<p>Weighted Standardised Field Impact Sound Pressure Level</p> <p>As for Ln,w but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement.</p> <p>The equivalent measurement in a laboratory is the Ln,w.</p> <p>A lower value indicates a better performing floor.</p>
Laboratory Test	<p>The performance of a building element when measured in a laboratory. The sound insulation performance of a building element installed in a building however can differ from its laboratory performance for many reasons including the quality of workmanship, the size and shape of the space in which the measurement is conducted, flanking paths and the specific characteristics of the material used which may vary from batch to batch.</p>
Loudness	<p>A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on. That is, the sound of 85 dB is four times or 400% the loudness of a sound of 65 dB.</p>
Microphone	<p>An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.</p>
NCA	<p>Noise Catchment Area. An area of study within which the noise environment is substantially constant.</p>
Noise	<p>Unwanted sound</p>
NRC	<p>Noise Reduction Coefficient.</p> <p>A measure of the ability of a material to absorb sound. The NRC is generally a number between 0 and 1 but in some circumstances can be slightly greater than 1 because of absorption at the edges of the material. A material with an NRC rating of 1 absorbs 100% of incoming sound, that is, no sound is reflected back from the material.</p> <p>The NRS is the average of the absorption coefficient measured in the octave bands 250Hz, 500Hz, 1kHz & 2kHz which correspond to the predominant frequencies associated with the human voice.</p>
Passive recreation	<p>Area specifically reserved for passive recreation, characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion e.g. reading, meditation</p>
Reflection	<p>Sound wave reflected from a solid object obscuring its path.</p>
Reverberation Time	<p>The time (in seconds) it takes for a noise signal within a confined space to decay by 60dB. The longer the reverberation time (usually denoted as RT60), the more echoic a room. Longer reverberation times generally result in higher noise levels within spaces.</p>
RMS	<p>Root Mean Square value representing the average value of a signal.</p>
Rw	<p>Weighted Sound Reduction Index</p> <p>A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory.</p> <p>The term supersedes the value STC which was used in older versions of the Building Code of Australia. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w.</p> <p>The higher the value the better the acoustic performance of the building element.</p>
R'w	<p>Weighted Apparent Sound Reduction Index.</p> <p>As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement.</p> <p>The higher the value the better the acoustic performance of the building element.</p>
RNP	<p>Road Noise Policy, NSW, March 2011</p>
SEL	<p>Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.</p>
Sound	<p>A fluctuation of air pressure which is propagated as a wave through air.</p>

Sound absorption	The ability of a material to absorb sound energy by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the R_w and the sound insulation between two rooms can be described by the D_nT,w .
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 micro Pascal.
Spoil	Soil or materials arising from excavation activities.
Standardised	A method of adjusting the measured noise indices in-situ so that they are independent of the measuring space. The noise level in a room is affected by reverberation in the room. For example, the $L'_{n,w}$ impact sound pressure level measured in a room is dependent upon the amount of absorptive material in the receiving room. The value is adjusted to what would be measured if the reverberation time in the receiving room is set at 0.5 seconds. This enables the same value to be reported independent of whether the room contains carpet and furnishings and the like. See also 'Normalised'.
STC	Sound Transmission Class A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory. The term has been superseded by R_w .
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Tonal Noise	Sound containing a prominent frequency and characterised by a definite pitch.
Transmission Loss	The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also the vibration level difference between one point and another. For example, if the sound level on one side of a wall is 100dB and 65dB on the other side, it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the R_w or $R'w$ or D_nT,w .

APPENDIX B **Nearest Sensitive Receivers and Noise Management Levels**

Table B1: Noise Sensitive Receivers and Construction Noise Management Levels **Kingsgrove Civil and Tunnel Support Works**

NCA	Receiver Type	Reference RBL	Rating Background Levels (RBLs)			Residential Noise Management Levels (NMLs) <small>L_{Aeq}(15 min)</small>				Sleep Dist. <small>L_{Amax}</small>		Comments
			Day	Evening	Night	Day (S)	Day (O)	Evening	Night	Screening	Max	
NCA18	Residential Active recreation	NL09	48	48	43	58	53	53	48	58	65	Based on NCAs and NMLs presented in the EIS.
NCA19		NL12	45	45	43	55	50	50	48	58	65	Based on NCAs and NMLs presented in the EIS.
NCA20	Commercial	NL18	50	49	40	60	55	54	45	55	65	Based on NCAs and NMLs presented in the EIS.
NCA23	Industrial											
NCA23	Residential	NL17	49	49	42	59	54	54	47	57	65	Based on NCAs and NMLs presented in the EIS.
NCA24	Residential	NL14	50	50	42	60	55	55	47	57	65	Based on NCAs and NMLs presented in the EIS.
NCA25	Active recreation											
NCA25	Residential	NL24	47	47	41	57	52	52	46	56	65	Based on NCAs and NMLs presented in the EIS.
ID	Other Sensitive Receivers											
OSR	Clemton Park	ICNG	-	-	-	65	65	65	65	-	-	Ref: ICNG p13
OSR	Masjid Arrahman	ICNG	-	-	-	55	55	55	55	-	-	NML of 55dB(A) is external equivalent of 45dB(A) internal goal for places of worship with windows open, when in use. Ref: ICNG p13
OSR	Kingsgrove North High School	ICNG	-	-	-	55/ 60	55/ 60	55/ 60	55/ 60	-	-	Daytime NML of 55dB(A) is external equivalent of 45dB(A) internal goal for classrooms with windows open. NML for passive recreation areas (outdoor play area) is 60dB(A)
OSR	Forrester Reserve	ICNG	-	-	-	65	65	65	65	-	-	Ref: ICNG p13
OSR	Kingsbury Reserve	ICNG	-	-	-	65	65	65	65	-	-	Ref: ICNG p13
OSR	McCallums Hill Public School	ICNG	-	-	-	55	-	55	55	-	-	Daytime NML of 55dB(A) is external equivalent of 45dB(A) internal goal for classrooms with windows open. NML for passive recreation areas (outdoor play area) is 60dB(A)
OSR	Barfa Bear Child Care Centre	ICNG	-	-	-	55/ 60	55/ 60	55/ 60	55/ 60	-	-	Daytime NML of 55dB(A) is external equivalent of 45dB(A) internal goal for classrooms with windows open. NML for passive recreation areas (outdoor play area) is 60dB(A)
OSR	Coolabah Street Tennis Courts	ICNG	-	-	-	65	65	65	65	-	-	Ref: ICNG p13
OSR	Hurstville City Council Family Day Care Scheme	ICNG	-	-	-	55/ 60	55/ 60	55/ 60	55/ 60	-	-	Daytime NML of 55dB(A) is external equivalent of 45dB(A) internal goal for classrooms with windows open. NML for passive recreation areas (outdoor play area) is 60dB(A)
OSR	Beverly Hills Park	ICNG	-	-	-	65	65	65	65	-	-	Ref: ICNG p13
OSR	Tallawalla Street Reserve	ICNG	-	-	-	65	65	65	65	-	-	Ref: ICNG p13
OSR	Beverly Grove Park	ICNG	-	-	-	65	65	65	65	-	-	Ref: ICNG p13
OSR	Kingsgrove Early Childhood Health Centre	ICNG	-	-	-	55/ 60	55/ 60	55/ 60	55/ 60	-	-	Daytime NML of 55dB(A) is external equivalent of 45dB(A) internal goal for classrooms with windows open. NML for passive recreation areas (outdoor play area) is 60dB(A)
OSR	Anglican Church Sydney Diocese	ICNG	-	-	-	55	55	55	55	-	-	NML of 55dB(A) is external equivalent of 45dB(A) internal goal for places of worship with windows open, when in use. Ref: ICNG p13
OSR	Canterbury Municipal Golf Course	ICNG	-	-	-	65	65	65	65	-	-	Ref: ICNG p13
OSR	Eloura Street Reserve	ICNG	-	-	-	65	65	65	65	-	-	Ref: ICNG p13
OSR	Commercial Receivers/ Offices	ICNG	-	-	-	70	70	70	70	-	-	When premise is in use. External.
OSR	Industrial Receivers	ICNG	-	-	-	75	75	75	75	-	-	When premise is in use. External.



Building Type		Legend	
Education	Hotel	Church	Compound Sites
Under construction	Fire Station	Aged care	Permanent Noise Barriers
Residential	Empty Lot	Heritage	Temporary Noise Barriers
Mixed Use	Community Centre	NCA	
Industrial	Commercial		

Client: **WestConnex New M5**

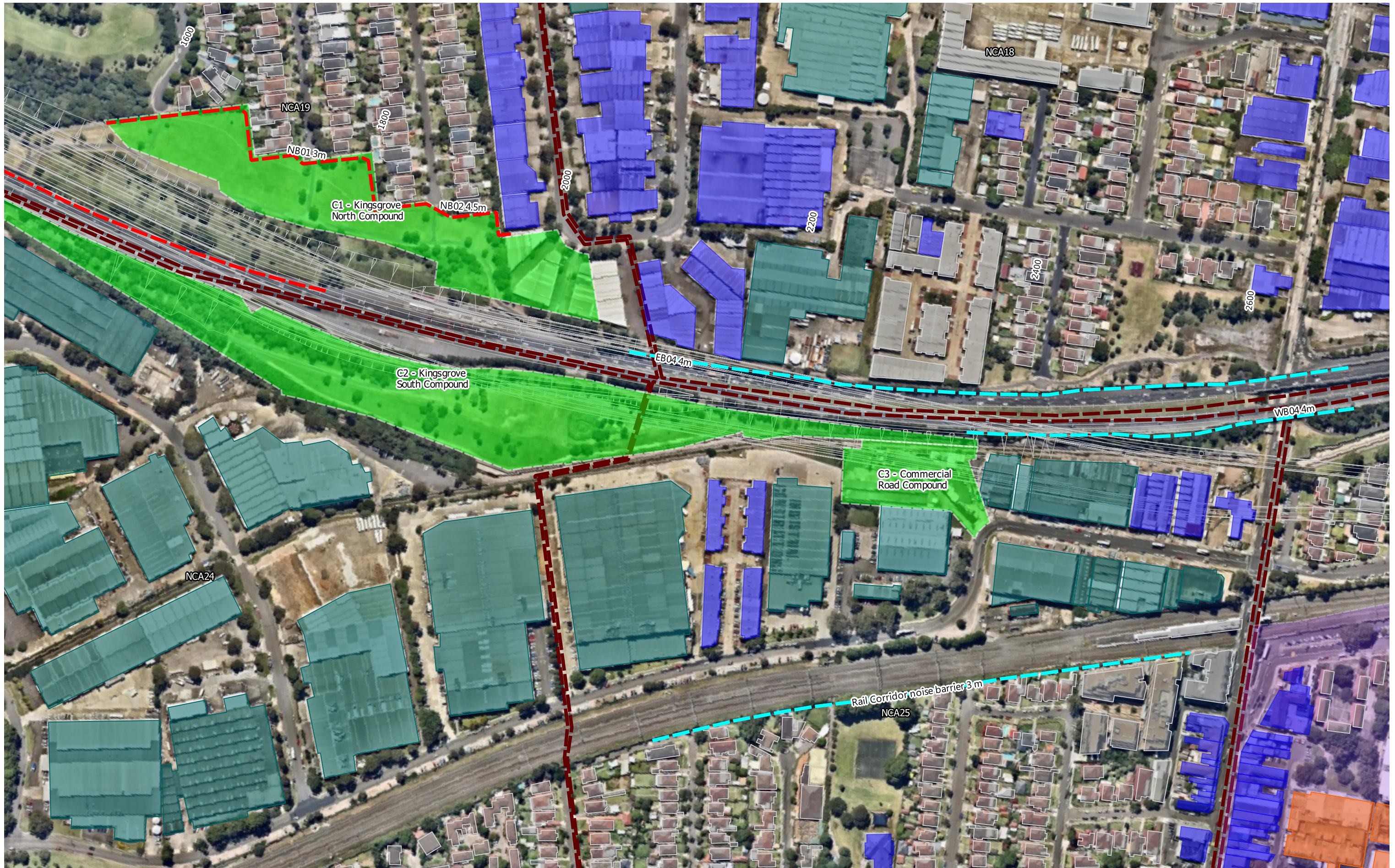
Project: **WestConnex Stage 2 M5**

Description:
 Kingsgrove compound
 Noise catchment areas & Sensitive Receivers
 Temporary and permanent noise barrier locations

Noise Levels are approximate due to interpolation of contours and should be used for reference only. For information only and not for construction. This information is protected by copyright.

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 Scale: 1:3,000 @ A3

1/418A Elizabeth Street, SURRY HILLS NSW 2010
 P: 02 8218 0500 F: 02 8218 0501



Building Type		Legend	
Education	Hotel	Compound Sites	Permanent Noise Barriers
Under construction	Fire Station	Permanent Noise Barriers	Temporary Noise Barriers
Residential	Empty Lot	Temporary Noise Barriers	NCA
Mixed Use	Community Centre		
Industrial	Commercial		
	Church		
	Aged care		
	Heritage		

Client: **WestConnex New M5**

Project: **WestConnex Stage 2 M5**

Partners: **CPB CONTRACTORS**, **DRAGADOS**, **SAMSUNG SAMSUNG C&T**

Scale: 0 25 50 75 100 m

Description: Kingsgrove compound
Noise catchment areas & Sensitive Receivers
Temporary and permanent noise barrier locations

Created by: THW
Figure No: TH014-05 6 0 1 006 (r0)
Date: 31.05.2016
Scale: 1:3,000 @ A3

1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

RENO TONIN & ASSOCIATES
inspired to achieve

Noise Levels are approximate due to interpolation of contours and should be used for reference only. For information only and not for construction. This information is protected by copyright.

APPENDIX C Construction Timetable/ Activities/ Management

Table C.1: Construction Timetable/ Activities/ Equipment

Kingsgrove Compound Roadheader Support Works

Activity/ Work Area	Aspect	Plant/ Equipment	Net Power kW	Operating Weight kg	Day	Evening	Night	Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)		Database code	Notes		
					7am - 6pm	6pm - 10pm	10pm - 7am	L _{Aeq}	L _{A1}				
SITE ESTABLISHMENT													
General Site Establishment	Installation of enviro controls	Excavator w bucket	120	35 tonne	2	-	-	103		GLRL_EX06	Surface		
		Franna Crane	205	20 tonne	1			99		CRANE_004_Leq	Surface		
		Small Truck		<20 tonne	4 p.h.			107		TRUCK_070	Surface		
	Demolition of existing structures	Excavator w bucket	120	35 tonne	2	-	-	103		GLRL_EX06	Surface		
		Excavator w rockhammer		30 tonne	2			121		EXCAVATOR_004_Le	Surface		
		Truck & Dog	120		4 p.h.			108		TRUCK_022	Surface		
	Vegetation Clearing	Excavator w bucket	120	35 tonne	2	-	-	103		GLRL_EX06	Surface		
		Chainsaw			1			116		TOOLS_047	Surface		
		Tub grinder/ mulcher			1			120		TOOLS_047	Surface		
	Establishment of construction facilities	Small Truck		<20 tonne	4 p.h.			107		TRUCK_070	Surface		
		Excavator w bucket	120	35 tonne	2	-	-	103		GLRL_EX06	Surface		
		Franna Crane	205	20 tonne	1			99		CRANE_004_Leq	Surface		
		Small Truck		<20 tonne	4 p.h.			107		TRUCK_070	Surface		
		Concrete Agl	120		6 p.h.			108		TRUCK_037	Surface		
		Pneumatic vibrator	30		1			98		COMPAC_001	Surface		
		Compressor trailer mounted diesel	110	2660	1			109		COMPRESS_001_Leq	Surface		
		Concrete pump	130		1			99		PUMP_007	Surface		
		Mobile crane		100T	1			105		CRANE_025	Surface		
		Hand tools			3			107		TOOLS_015	Surface		
		EWP 30ft			2			106		CRANE_034	Surface		
		Generator 18V			2			93		GENERATOR_015	Surface		
		Road and intersection modifications and installation of traffic controls.	Truck	205	20 tonne	1			99		TRUCK_045	Surface	
			Scissor Lift			1			95		CRANE_035	Surface	
			Franna Crane	205	20 tonne	1			99		CRANE_004_Leq	Surface	
	Line marking truck				1			108		TRUCK_045	Surface		
	Piling Rig				2			125		PILING_010	Surface		
	Concrete pump		130		1			99		PUMP_007	Surface		
	Tunnelling Support Establishment	Piling; Excavation of shaft	Excavator w bucket	150	35T	1	-	-	103		GLRL_EX06	Surface	
			Concrete Agl	120		4 p.h.	4 p.h.		108		TRUCK_037	Surface	
			Concrete Agl	120		12 p.h.	4 p.h.		108		TRUCK_037	Surface	
Shaft Excavation & Construction Excavation of soil and rock; Hammering/rock breaking;		Excavator w bucket	120	35T	2	-	-	103		GLRL_EX06	Surface		
		Excavator w rockhammer	150+	45T	1	-	-	128		EXCAVATOR_004_Le	Surface		
		Drilling machine Diesel	205		1	-	-	125		NWRL_DR02	Surface		
		Pneumatic Hammer			1	-	-	115		TOOLS_029	Surface		
		Truck & Dog (spoil haulage)	120		20 p.h.			108		TRUCK_022	Surface		
		Shotcrete Rig Diesel			1	1		104		NWRL_AC03	Surface		
		Road truck (deliveries to site)			2 p.h.			108		TRUCK_022	Surface		
		Franna Crane	205	20 tonne	1			99		CRANE_004_Leq	Surface		
		Concrete pump	130		1			99		PUMP_007	Surface		
		TUNNELLING SUPPORT											
		Construction Compound & Car Park (north of M5)	General worksite and Car parking	Light vehicle	80		20 per hour	12 p.h.	12 p.h.	89		VEHICLE_001_Leq	Surface; Compound and car park will operate for the entire duration of construction works.
				Water treatment plant pumps	10		2	2	2	87		PUMP_008	Busy on shift changes only.
Site sheds, workshop, car parking & laydown areas	Workshop; Deliveries; Maintenance; Storage		Road truck (deliveries to site)			4 p.h.			108		TRUCK_022	Surface	
			Compressor	110	2660	2	2	2	70		COMPRESS_003_ADI	Surface - inside container control room	
			Workshop Hand Tools			1	1	1	107		TOOLS_015	Surface	
			Franna Crane	205	20 tonne	1	1		99		CRANE_004_Leq	Surface	
			Water cart		15kl	4 p.h.	4 p.h.		104		TRUCK_009_Leq	Surface	
			Road Header 1,000V Electric	350		2	2	2	111		-	Underground	
			Dust Scrubber			2	2	2	110 (no attenuator)		-	Underground; Details to be confirmed	
			Ventilation fan (with attenuation)	600		1	1	1	102		FAN_ZIT_2xZVN_118	Surface - see Schedule C5	
Water treatment plant pumps	10		2	2	2	87		PUMP_008	Surface - see Schedule C5				
Tunnelling Support Site (Kingsgrove North)	Tunnelling & Support	Concrete pump	130		1	-	-	99		-	Underground		
		Drilling machine Diesel	205		1	-	-	125		-	Underground		
		Moxie (spoil out of tunnel)	95	38T	10 p.h.	10 p.h.	8 p.h.	110		-	Underground		
	Spoil Handling	Truck & Dog (spoil haulage)^			8 p.h.	8 p.h.	4 p.h.	108		TRUCK_022	Surface		
		FE Loader in spoil loading shed	130		1	1	1	105		CadnaR (LOADER_02 At surface within spoil shed. See C5 for details			
		Concrete pump	130		1	-	-	N/A		-	Underground		
	Tunnel Lining (concreting)	Compressor	90		1	1	1	N/A		-	Underground		
		Concrete truck	120		4 p.h.	4 p.h.	4 p.h.	108		TRUCK_037	Surface; No concrete trucks at night.		
		Pneumatic vibrator	30		2	-	-	N/A		-	Underground		
		Road Header 1,000V Electric	350		2	2	2	111		-	Underground		
		Dust Scrubber			2	2	2	110 (no attenuator)		-	Underground; Details to be confirmed		
		Ventilation fan (with attenuation)	600		1	1	1	102		FAN_ZIT_2xZVN_118	Surface - see Schedule C5		
	Tunnelling Support Site (Kingsgrove South)	Tunnelling & Support	Water treatment plant pumps	10		2	2	2	87		PUMP_008	Surface - see Schedule C5	
			Concrete pump	130		1	-	-	99		-	Underground	
			Drilling machine Diesel	205		1	-	-	125		-	Underground	
Spoil Handling		Moxie (spoil out of tunnel)	95	38T	10 p.h.	10 p.h.	8 p.h.	110		-	Underground		
		Truck & Dog (spoil haulage)^			8 p.h.	8 p.h.	4 p.h.	108		TRUCK_022	Surface		
		FE Loader in spoil loading shed	130		1	1	1	110 (without silencer kit)		CadnaR (LOADER_02 At surface within spoil shed. See C5 for details			
Tunnel Lining (concreting)		Concrete pump	130		1	-	-	N/A		-	Underground		

Table C.2: Construction Timetable/ Activities/ Equipment

Kingsgrove Compound Roadheader Support Works

Activity/ Work Area	Aspect	Plant/ Equipment	Net Power kW	Operating Weight kg	Day	Evening	Night	Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)		Database code	Notes
					7am - 6pm	6pm - 10pm	10pm - 7am	L _{Aeq}	L _{A1}		
		Compressor	90		1	1	1	N/A		-	Underground
		Concrete truck	120		4 p.h.	4 p.h.	4 p.h.	108		TRUCK_037	Surface
		Pneumatic vibrator	30		2	-	-	N/A		-	Underground
CIVIL/ SURFACE WORKS											
Construction Compound & Car Park	General worksite and Car parking	Light vehicle	80		20 p.h.	12 p.h.	12 p.h.	89			Operates for entire duration of construction works.
		Water treatment plant pumps	10		2	2	2	97			
Site sheds, workshop, car parking & laydown areas	Workshop; Deliveries; Maintenance; Storage	Road truck (deliveries to site)			1 p.h.	-	-	108			Operates for entire duration of construction works.
		Compressor	110	2660	2	2	-	70			
		Workshop Hand Tools			1	1	-	107			
		Franna Crane	205	20 tonne	1	1	-	99	106		
		Water cart		15kL	4 p.h.	4 p.h.	-	104			
Portal Surface Site	Piling; Excavation of decline	Piling Rig (bored)			4	-	-	110			Note: Sheet piling is not expected to be required for these works. TBC at detailed design.
		Concrete pump	130		1	-	-	99			
		Excavator w bucket	150	35T	1	-	-	103			
		Jack Hammer		20 kg	1	-	-	114			Jackhammer top of piles
		Concrete Agi	120		4 p.h.	4 p.h.	-	108			
	Earthworks	Excavator w bucket	120	35T	2	-	-	103			
		Excavator w rockhammer	150+	45T	1	-	-	128			
		Drilling machine Diesel	205		1	-	-	125			
		Pneumatic Hammer			1	-	-	115			
		Bulldozer D7		D7	1	-	-	115			
		Grader		25 tonne	1	-	-	114			
		Truck & Dog (spoil haulage)	120		20 p.h.	4 p.h.	-	108			
		Shotcrete Rig Diesel			1	1	-	104			
		Concrete Agi	120		4 p.h.	4 p.h.	-	108			
	Road tie-in works	Paver			2	-	-	103			
		Daymakers		900kg	3	3	-	70			
		Franna Crane		20 tonne	2	1	-	99			
		Road truck			4 p.h.	-	-	108			
		Road profiler		17 tonne	1	-	-	110			
		Asphalt truck & sprayer			1	-	-	128			
		Roller		12 tonne	1	-	-	101			
		Concrete saw	22 hp		1	-	-	119			
		Line marking truck			1	-	-	108			
		Water cart		15kL	4 p.h.	4 p.h.	-	104			
Western Surface Site	Earthworks	Excavator w bucket	120	35T	2	-	-	103			
		Excavator w rockhammer	150+	45T	1	-	-	128			
		Drilling machine Diesel	205		1	-	-	125			
		Pneumatic Hammer			1	-	-	115			
		Bulldozer D7		D7	1	-	-	115			
		Grader		25 tonne	1	-	-	114			
		Truck & Dog (spoil haulage)	120		20 p.h.	4 p.h.	-	108			
		Shotcrete Rig Diesel			1	1	-	104			(concrete pump 102 + compressor 99)
		Concrete Agi	120		4 p.h.	4 p.h.	-	108			
	Road tie-in works	Paver			2	-	-	103			
		Daymakers		900kg	3	3	-	70			
		Franna Crane		20 tonne	2	1	-	99			
		Road truck			4 p.h.	-	-	108			
		Road profiler		17 tonne	1	-	-	110			
		Asphalt truck & sprayer			1	-	-	128			
		Roller		12 tonne	1	-	-	101			
		Concrete saw	22 hp		1	-	-	119			
		Line marking truck			1	-	-	108			
		Water cart		15kL	4 p.h.	-	-	104			
VENTILATION STATION											
Construction Compound & Car Park	General worksite and Car parking	Light vehicle	80		20 p.h.	-	12 p.h.	89			Surface; Compound and car park will operate for the entire duration of construction works.
		Water treatment plant pumps	10		2	2	2	97			Busy on shift changes only.
Site sheds, workshop, car parking & laydown areas	Workshop; Deliveries; Maintenance; Storage	Road truck (deliveries to site)			4 p.h.	-	-	108			Surface
		Compressor	110	2660	2	-	-	70			Surface
		Workshop Hand Tools			1	-	-	107			Surface
		Franna Crane	205	20 tonne	1	-	-	99	106		Surface
		Water cart		15kL	4 p.h.	-	-	104			Surface
Ventilation Station works	Construction of Vent Stack	Crane - wheeled		100T	1	-	-	105			Surface
		Saw Cutting Reo			1	-	-	119			Surface
		Saw Cutting Formwork			1	-	-	104			Surface
		Concrete pump	130		1	-	-	99			Surface
		Concrete Vibrator			2	-	-	97			Surface
		Concrete Grinding Machine			1	-	-	117			Surface

Table C.1: Construction Timetable/ Activities/ Equipment

Kingsgrove Compound Civil Works

Activity/ Work Area	Aspect	Plant/ Equipment	Net Power kW	Operating Weight kg	Day	Evening	Night	Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)		Notes	
					7am - 6pm	6pm - 10pm	10pm - 7am	L _{Aeq}	L _{A1}		
SITE ESTABLISHMENT											
Site Establishment	Power Generator	Generator	25 kVA		1	1	1	95		Power generator may be required during site establishment	
	Installation of enviro controls	Excavator w bucket Franna Crane	120 205	35 tonne 20 tonne	2 1	- -	- -	103 99			
Demolition of existing structures		Small Truck		<20 tonne	4 p.h.	-	-	107			
		Excavator w bucket	120	35 tonne	2	-	-	103			
		Excavator w rockhammer		30 tonne	2	-	-	121			
Crushing & Screening		Truck & Dog	120		8 p.h.	-	-	108			
		Norberg Lototrack LT100R Crushing & Grinding Mobile Plant	100		1	-	-	117			
Vegetation Clearing		Excavator w bucket	120	35 tonne	2	-	-	103			
		Truck & Dog	120		4 p.h.	-	-	108			
		Excavator w bucket	120	35 tonne	2	-	-	103			
Establishment of construction facilities		Chainsaw			1	-	-	116			
		Tub grinder/ mulcher			1	-	-	120			
		Small Truck	120	<20 tonne	4 p.h.	-	-	107			
Road and intersection modifications and installation of traffic controls.		Excavator w bucket	120	35 tonne	2	-	-	103			
		Franna Crane	205	20 tonne	1	-	-	99			
		Small Truck		<20 tonne	4 p.h.	-	-	107			
		Truck	205	20 tonne	1	-	-	99			
		Scissor Lift	205		1	-	-	95			
		Franna Crane	205	20 tonne	1	-	-	99			
		Line marking truck			1	-	-	108			
CIVIL/ SURFACE WORKS											
Construction Compound & Car Park	General worksite and Car parking	Light vehicle	80		20 p.h.	12 p.h.	12 p.h.	89		Operates for entire duration of construction works.	
		Water treatment plant pumps	10		2	2	2	97			
Site sheds, workshop, car parking & laydown areas	Workshop, Deliveries; Maintenance; Storage & laydown areas	Road truck (deliveries to site)			1 p.h.	-	-	108		Operates for entire duration of construction works.	
		Compressor	110	2660	2	2	-	70			
		Workshop Hand Tools			1	1	-	107			
		Franna Crane	205	20 tonne	1	1	-	99	106		
		Water cart		15kL	4 p.h.	4 p.h.	-	104			
Portal Surface Site	Piling; Excavation of decline	Piling Rig (bored)			4	-	-	110		Note:Sheet piling is not expected to be required for these works. TBC at detailed design.	
		Concrete pump	130		1	-	-	99			
		Excavator w bucket	150	35T	1	-	-	103			
		Jack Hammer		20 kg	1	-	-	114			
	Earthworks		Concrete Agi	120		4 p.h.	4 p.h.	-	108		Jackhammer top of piles
			Excavator w bucket	120	35T	2	-	-	103		
			Excavator w rockhammer	150+	45T	1	-	-	128		
			Drilling machine Diesel	205		1	-	-	125		
			Pneumatic Hammer			1	-	-	115		
			Bulldozer D7		D7	1	-	-	115		
			Grader		25 tonne	1	-	-	114		
			Truck & Dog (spoil haulage)	120		20 p.h.	4 p.h.	-	108		
	Road tie-in works		Shotcrete Rig Diesel			1	-	-	104		(concrete pump 102 + compressor 99)
			Concrete Agi	120		4 p.h.	4 p.h.	-	108		
			Paver			2	-	-	103		
			Daymakers		900kg	3	3	-	70		
			Franna Crane		20 tonne	2	1	-	99		
			Road truck			4 p.h.	-	-	108		
			Road profiler		17 tonne	1	-	-	110		
			Asphalt truck & sprayer			1	-	-	128		
Roller				12 tonne	1	-	-	101			
Concrete saw			22 hp		1	-	-	119			
Line marking truck					1	-	-	108			
				Water cart		15kL	4 p.h.	4 p.h.	-	104	
Western Surface Site	Earthworks	Excavator w bucket	120	35T	2	-	-	103		No OOHW anticipated, with the exception of excavation support works, where required for safety (concrete lining - possibility of OOHW pours) or ongoing maintenance of site (water pumps). OOHW, including concrete and spoil truck movement to be managed to ensure compliance with the OOHW NMLS.	
		Excavator w rockhammer	150+	45T	1	-	-	128			
		Drilling machine Diesel	205		1	-	-	125			
		Pneumatic Hammer			1	-	-	115			
		Bulldozer D7		D7	1	-	-	115			
		Grader		25 tonne	1	-	-	114			
		Truck & Dog (spoil haulage)	120		20 p.h.	4 p.h.	-	108			
		Shotcrete Rig Diesel			1	1	-	104			
	Road tie-in works		Concrete Agi	120		4 p.h.	4 p.h.	-	108		(concrete pump 102 + compressor 99)
			Paver			2	-	-	103		
			Daymakers		900kg	3	3	-	70		

Table C.2: Construction Timetable/ Activities/ Equipment

Kingsgrove Compound Civil Works

Activity/ Work Area	Aspect	Plant/ Equipment	Net Power kW	Operating Weight kg	Day	Evening	Night	Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)		Notes
					7am - 6pm	6pm - 10pm	10pm - 7am	L _{Aeq}	L _{A1}	
		Franna Crane		20 tonne	2	1	-	99		
		Road truck			4 p.h.	-	-	108		
		Road profiler		17 tonne	1	-	-	110		
		Asphalt truck & sprayer			1	-	-	128		
		Roller		12 tonne	1	-	-	101		
		Concrete saw	22 hp		1	-	-	119		
		Line marking truck			1	-	-	108		
		Water cart		15kL	4 p.h.	4 p.h.	-	104		
VENTILATION STATION										
Construction Compound & Car Park	General worksite and Car parking	Light vehicle	80		20 p.h.	-	12 p.h.	89		
		Water treatment plant pumps	10		2	2	2	97		
Site sheds, workshop, car parking & laydown areas	Workshop; Deliveries; Maintenance; Storage	Road truck (deliveries to site)			4 p.h.	-	-	108		
		Compressor	110	2660	2	-	-	70		
		Workshop Hand Tools			1	-	-	107		
		Franna Crane	205	20 tonne	1	-	-	99	106	
		Water cart		15kL	4 p.h.	-	-	104		
Ventilation Station works	Construction of Vent Stack	Crane - wheeled		100T	1	-	-	105		
		Saw Cutting Reo			1	-	-	119		
		Saw Cutting Formwork			1	-	-	104		
		Concrete pump	130		1	-	-	99		
		Concrete Vibrator			2	-	-	97		
		Concrete Grinding Machine			1	-	-	117		

Table C2: Construction Noise Management Schedule

Kingsgrove Civil and Tunnel Support Works

Area to be Managed	Mitigation/ Management Measure	Typical Details	Comments
Tunnel and Civil site establishment			
1	Noise Barrier	NB01: 3m noise barrier NB02: 4.5m noise barrier NB03: 2-3m relocatable noise barrier NB04: 4m temporary noise barrier	see Table C3 for details see Table C3 for details see Table C3 for details see Table C3 for details
		No noise barrier required around Kingsgrove South or Commercial Road compound	Noise walls to be constructed as early as practicable. Noise walls to be constructed as early as practicable. Noise walls to be constructed as early as practicable. Noise walls to be constructed as early as practicable.
2	At-property treatment (operational noise)	Residences identified for at-property treatment as a result of operational noise (Project complete) should be treated ASAP during construction phase, where practicable	see Table C3 for details Details to be confirmed as part of ONMR and CNVMP
			- Treatment installed as early as practicable
3	Work outside Standard Construction Hours	None	
4	High noise impact works	Respite periods for high noise activities.	Some 'Highly Noise Affected' Receivers during standard hours (initial excavation works).
Tunnel shaft excavation			
1	Noise Barrier	As above	
2	Work outside Standard Construction Hours	No OOHW anticipated, with the exception of excavation support works, where required for safety (concrete lining - possibility of OOHW pours) or ongoing maintenance of site (water pumps).	
3	Truck movement restrictions for OOHW period	Evening: ≤ 4 concrete trucks per hour Night: 0 trucks per hour	Contingency concrete pour during tunnel lining works
4	High noise impact works	Respite periods for high noise activities.	Some 'Highly Noise Affected' Receivers during standard hours (shaft excavation works).
Tunnel RH Support, Spoil Handling and Tunnel Lining (Northern compound)			
1	Noise Barrier	As above	
2	Work outside Standard Construction Hours	EVE works (6 pm to 10 pm): Restricted as outlined below NIGHT works (10 pm to 7 am): Restricted as outlined below	
3	Workshop	Partial acoustic enclosure: 3 walls + roof, open side oriented away from receivers	see Table C4 for details
4	Spoil bin area	EVE/ NIGHT: 1 handtool only NIGHT: Limit use of franna crane Acoustic shed DAY/ EVE: 1 Front End Loaders (FEL); NIGHT: 1 FEL.	see Table C5 for performance requirements see Table C4 for details see Table C5 for performance requirements
5	Water Treatment Plant Pumps	Roller door to be partly closed during EVE/ NGT period to the minimum height required to allow trucks to access the shed	see Table C5 for performance requirements
6	Compressors	Partial acoustic enclosure	see Table C5 for performance requirements
7	Ventilation Fan	Partial acoustic enclosure	see Table C5 for performance requirements
8	Concrete Truck restrictions for OOHW period	Ventilation fans with silencer + additional attenuation (duct lining/ inlet attenuator). Intake to be orientated away from receivers. EVE: ≤ 4 trucks per hour NIGHT: 0 trucks per hour	
9	Spoil Truck restrictions for OOHW period	EVE: ≤ 8 trucks per hour NIGHT: ≤ 4 trucks per hour	Compression braking and air brake release will be managed on site
10	Water Cart restrictions for OOHW period	EVE: ≤ 4 trucks per hour NIGHT: 0 trucks per hour	
11	Residual impacts	Properties where (after application of the above) noise levels exceed NML DAY: NCA19 - N/A EVE: NCA19 - 1 property by up to 6 dB(A) NIGHT: NCA19 - 1 property by up to 5 dB(A)	At some receiver locations noise levels may exceed the NMLs and there are no physical mitigation measures that can be applied to achieve the NMLs. Therefore, after all reasonable and feasible noise mitigation measures have been applied, the way forward is to seek a negotiated agreement with the affected receiver
Tunnel RH Support, Spoil Handling and Tunnel Lining (Southern compound)			
1	Noise Barrier	As above	
2	Work outside Standard Construction Hours	EVE works (6 pm to 10 pm): Restricted as outlined below	
3	Workshop	Partial acoustic enclosure: 3 walls + roof EVE/ NIGHT: 1 handtool only	see Table C4 for details
4	Spoil bin area	NIGHT: Limit use of franna crane Acoustic shed DAY/ EVE: 1 Front End Loaders (FEL);	see Table C5 for performance requirements see Table C4 for details

Table C2: Construction Noise Management Schedule**Kingsgrove Civil and Tunnel Support Works**

Area to be Managed	Mitigation/ Management Measure	Typical Details	Comments
	NIGHT: 1 FEL.	see Table C5 for performance requirements	
	Roller door to be partly closed during EVE/ NGT period to the minimum height required to allow trucks to access the shed		
5 Water Treatment Plant Pumps	Partial acoustic enclosure	see Table C5 for performance requirements	
6 Compressors	Partial acoustic enclosure	see Table C5 for performance requirements	
7 Ventilation Fan	-	see Table C5 for performance requirements	
8 Concrete Truck restrictions for OOHW period	EVE/ NIGHT: ≤ 4 trucks per hour		
9 Spoil Truck restrictions for OOHW period	EVE: ≤ 8 trucks per hour NIGHT: ≤ 4 trucks per hour		Compression braking and air brake release will be managed on site
10 Water Cart restrictions for OOHW period	EVE: ≤ 4 trucks per hour NIGHT: 0 trucks per hour		
Civil and surface works (Portal Construction - Piling, Earthworks, Road Tie-In Works)			
1 Hoardings/ Noise Walls	As above		
2 Work outside Standard Construction Hours	EVE works (6 pm to 10 pm): Restricted as outlined below. NIGHT works (10 pm to 7 am): None		
3 Workshop	Partial acoustic enclosure: 3 walls + roof, open side oriented away from receivers EVE: 1 handtool only	see Table C4 for details	
4 Compressors	Partial acoustic enclosure	see Table C5 for performance requirements	
5 Truck movement restrictions for OOHW period	Evening: ≤ 4 trucks per hour		
6 Shotcreting for OOHW period	EVE: Shotcrete pump and compressor		
4 High noise impact works	Respite periods for high noise activities.	Some 'Highly Noise Affected' Receivers during standard hours (shaft excavation works).	
Civil Works Western Site - Earthworks, Road tie-in Works			
1 Hoardings	As above		
2 Work outside Standard Construction Hours	EVE works (6 pm to 10 pm): Restricted as outlined below.		EVE: over-run works as required (concreting etc.)
3 Workshop	Partial acoustic enclosure: 3 walls + roof, open side oriented away from receivers EVE: 1 handtool only	Type 1 Shed	see Table E.5 for details (TBC at detailed design)
4 Compressors	Partial acoustic enclosure	see Table C5 for performance requirements	see Table E.5 for details (TBC at detailed design)
5 Truck movement restrictions for OOHW period	Evening: ≤ 8 trucks per hour		
6 Shotcreting for OOHW period	EVE: Shotcrete pump and compressor NIGHT: None		
Ventilation Station Works			
1 Hoardings	As above		
2 Work outside Standard Construction Hours	None		
3 Workshop	As above		
4 Compressors	As above		

Table C3: Noise Barrier Design Specifications**Kingsgrove Civil and Tunnel Support Works**

Noise barrier reference	Location	Noise barrier height	Required Rw	Proposed Construction	Acoustic Rating of Construction*
NB01	Kingsgrove North compound Northern boundary	3m	Rw 15-20	17 mm plywood hoarding	Rw 24
			Medium	Speedwall panel; OR	Rw 41
				150mm Hebel	Rw 40
NB02	Kingsgrove North compound Section of northern boundary adjacent to bottom of Glamis St (Ref Site Layout)	4.5m	Rw 25	Sandwich construction of 17mm plywood on either side of 45mm frame (45mm air gap between plywood sheets); <u>OR</u>	Rw 28
			High	Speedwall panel; <u>OR</u>	Rw 41
				150mm Hebel	Rw 40
NB03	Kingsgrove site - M5 Motorway along northern side of M5 eastbound carriageway (where feasible to do so)	4.5m	Rw 15-20	17 mm plywood hoarding; OR	Rw 24
			Medium	17 mm plywood hoarding on top of concrete barrier (Type F or Jersey Kerb); OR	Rw 22
				Single skin sheet steel (colorbond) 0.48 mm sheet steel (no gaps)	Rw 22
NB04	Kingsgrove site - M5 Motorway along southern side of M5 westbound carriageway work area	2-3m [#]	Rw 15-20	17 mm plywood hoarding; OR	Rw 24
			Medium	17 mm plywood hoarding on top of concrete barrier (Type F or Jersey Kerb); OR	Rw 22
				Single skin sheet steel (colorbond) 0.48 mm sheet steel (no gaps)	Rw 22
	Kingsgrove South compound Commercial Road compound	0m	-	Chain mesh or equivalent	-

Notes:

Noise wall performance: Low - Rw 10-15; Medium - Rw 15-220; Medium-High - Rw 20-25; High - Rw 25; Very High - Rw 30

* estimated by calculations and/or reference to other similar wall type data

Subject to feasibility review. Barrier mounted hoarding does not comply with RMS Safety Barrier System Acceptance Conditions where there is insufficient clear zone / offset to the travel lane or where the hazard free deflection zone behind barrier does not provide space for a separate safety barrier and hoarding/ noise barrier. This is often the case for workzones where road widening is occurring, making barrier mounted hoard not feasible. This issue will require review by the construction design team for the relocatable roadside noise barrier on the northern side of the M5 East Motorway

GENERAL

- The specified 'required rating' must be achieved by the product selected.
- By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the assembly, a higher rating implying a higher sound reduction performance.
- Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.
- The sealing of all gaps is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
- Check design of all junction details with acoustic consultant prior to construction.
- Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
- The information provided in this table is subject to modification and review without notice.
- The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

Table C4: Noise Shed / Enclosure Design Specifications

Kingsgrove Civil and Tunnel Support Works

Area to be Mitigated	Construction component	Acoustic element type
1. Northern Workshop	Walls	Form A
	Roof	Form A
	Acoustic lining	Underside of roof to be lined with roofing blanket with perforated foil e.g. Permastop building blanket 55mm Sisilation Light Duty
	Doors	Not required. Potentially open on one (or more) side/s.
	Ventilation Openings	Any openings should face away from neighbours so that noise walls can effectively shield them from neighbours.
2. Southern Workshop	Walls	Form A
	Roof	Form A
	Acoustic lining	Underside of roof to be lined with roofing blanket with perforated foil e.g. Permastop building blanket 55mm Sisilation Light Duty
	Doors	Not required. Potentially open on one (or more) side/s.
	Ventilation Openings	Any openings should face away from neighbours so that noise walls can effectively shield them from neighbours.
3. Northern Spoil Shed	Walls	Form B or Form C
	Roof	Form B or Form C
	Acoustic lining	Acoustic lining with roofing blanket with perforated foil e.g. Permastop building blanket 55mm Sisilation Light Duty on inner skin facing inside shed of: - upper section of south & west facing walls; - above 2.5 m of north facing & east facing walls; and - Underside of roof
	Doors	oversized roller door (larger than wall opening) and rubber seals side and bottom
	Ventilation Openings	Any necessary ventilation openings should face away from neighbours, placed down low so that noise walls can effectively shield them from neighbours, and also fitted with acoustic louvres / attenuators.
4. Southern Spoil Shed	Walls	Form A
	Roof	Form A
	Acoustic lining	Acoustic lining with roofing blanket with perforated foil e.g. Permastop building blanket 55mm Sisilation Light Duty on inner skin facing inside shed of: - upper section of south & west facing walls; - above 2.5 m of north facing & east facing walls; and - Underside of roof
	Doors	oversized roller door (larger than wall opening) and rubber seals side and bottom
	Ventilation Openings	Any necessary ventilation openings should face away from neighbours, placed down low so that noise walls can effectively shield them from neighbours, and also fitted with acoustic louvres / attenuators.

Notes:
 LEGEND * estimated by calculations and/or reference to other similar wall type data. The client is advised not to commit to materials which have not been tested in an approved laboratory or for which an opinion only is available. Testing materials is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested materials, estimates or opinions.

GENERAL

- The underside of the roof and (where possible) internal walls should be lined with acoustic insulation to reduce the build-up of sound inside the shed
- The specified performances must be achieved by the product selected.
- The sealing of all gaps is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
- Check design of all junction details with acoustic consultant prior to construction.
- Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
- The information provided in this table is subject to modification and review without notice.
- The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

Table C4a: Specification for acoustic elements of noise sheds/ acoustic enclosures

Wall/ roof type	Sound transmission loss per octave spectrum dB						
	63	125	250	500	1000	2000	4000
FORM A	8	10	14	18	18	21	25
FORM B	8	10	25	38	50	60	69
FORM C	16	20	24	29	33	35	41
FORM D	20	24	29	33	38	41	46

Table C5: Plant and Equipment Specifications**Kingsgrove Civil and Tunnel Support Works**

Building/ Area to be Mitigated	Item	Acoustic Requirement	Octave spectrum dB								Lw dB(A)
			31.5	63	125	250	500	1000	2000	4000	
<i>Kingsgrove North compound</i>											
Tunnel ventilation	Ventilation fan #	Sound power level - surface inlet (includes fan + attenuation)	106	108	104	88	77	76	93	100	102
Plant item	Front end loader 25 t - Kingsgrove North + high grade muffler	Plant sound power level to be confirmed in accordance with CNVMP	110	102	101	100	99	97	97	88	105
Plant item	Workshop Franna Crane 20 t	Plant sound power level to be confirmed in accordance with CNVMP	112	105	97	94	95	91	91	85	98
Plant item	Water Treatment Plant Pumps	Plant sound power level to be confirmed in accordance with CNVMP	88	83	84	82	82	81	74	64	87
Plant item	Compressor inside container control room	Plant sound power level to be confirmed in accordance with CNVMP	51	63	52	57	66	67	59	61	70
<i>Kingsgrove South compound</i>											
Tunnel ventilation	Ventilation fan #	Sound power level - surface inlet (includes fan + attenuation)	106	108	104	88	77	76	93	100	102
Plant item	Front end loader 25 t	Plant sound power level to be confirmed in accordance with CNVMP	120	112	111	105	104	102	99	99	110
Plant item	Workshop Franna Crane 20 t	Plant sound power level to be confirmed in accordance with CNVMP	112	105	97	94	95	91	91	85	98
Plant item	Water Treatment Plant Pumps	Plant sound power level to be confirmed in accordance with CNVMP	98	93	94	92	92	91	84	74	97
Plant item	Compressor inside container control room	Plant sound power level to be confirmed in accordance with CNVMP	51	63	52	57	66	67	59	61	70

Notes:

LEGEND * estimated by calculations and/or reference to other similar plant type data. The client is advised not to commit to fans which have not been tested in an approved laboratory. Testing plant is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested materials, estimates or opinions. The advice provided here is in respect of acoustics only.

Fans require detailed design once fan detail available.

GENERAL

- Sound power level of plant assumed based on sound power level of similar plant type, incorporating attenuation (acoustic attenuator/ muffler/ duct lining as required)
- The specified performances must be achieved by the product selected.
- Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
- The information provided in this table is subject to modification and review without notice.
- The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

Table C6: Managing Residual Impacts during 'out of standard hours' work

Kingsgrove Civil and Tunnel Support Works

ID	Noise Mitigation/ Management Measure																
1	At some receiver locations noise levels may exceed the NMLs and there are no physical mitigation measures that can be applied to achieve the NMLs. Therefore, after all reasonable and feasible noise mitigation measures have been applied, the way forward is to seek a negotiated agreement with the affected receiver.																
2	The Construction Noise and Vibration Management Plan (CNVMP) identifies the management measures that can be applied to deal with residual impacts, including noise monitoring, letter box drops, phone calls, individual briefings, respite offers and alternative accommodation. Further mitigation measures may include changing operational procedures at night in order to reduce noise impacts, e.g. reduce the number of trucks on site during the night period (10 pm to 7am). The appropriate management measure would be determined by the degree of exceedance of the NML.																
3	Where, after the application of all reasonable and feasible mitigation measures, noise levels still exceed the NML, then at-property treatments may need to be considered. The following provides guidance on the level of treatment required in relation to the exceedance above the external NML.																
	<table border="1"> <thead> <tr> <th>Treatment 1</th> <th>Mechanical ventilation only</th> </tr> </thead> <tbody> <tr> <td><5dB(A) reduction</td> <td>Where external noise levels are less than 5dB(A) above the external assessment criteria, the internal noise goals may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 15dB(A) from outside to inside when windows are closed. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation should be considered to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia.</td> </tr> <tr> <th>Treatment 2</th> <th>Mechanical ventilation and sealing of wall vents</th> </tr> <tr> <td>5-10 dB(A) reduction</td> <td>Where external noise levels are less than 10dB(A) above the external assessment criteria, the internal noise goals may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 20dB(A) from outside to inside (ENMM p20) when windows are closed and wall vents are sealed. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation should be considered to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia. It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring residential premises.</td> </tr> <tr> <th>Treatment 3</th> <th>Upgraded seals for windows and doors</th> </tr> <tr> <td>10-12dB(A) reduction</td> <td>Where external noise levels are only slightly greater than 10dB(A) above the external assessment criteria, then in addition to installing mechanical ventilation (Treatment 1) and sealing of wall vents (Treatment 2), special acoustic grade seals should be installed on windows and perimeter doors exposed to road traffic noise to enable the internal noise criteria to be achieved with windows and doors shut.</td> </tr> <tr> <th>Treatment 4</th> <th>Upgraded windows, glazing and doors</th> </tr> <tr> <td>>12 dB(A) reduction</td> <td>Where the predicted external noise level exceeds the external assessment criteria by significantly more than 10dB(A), then upgraded windows and glazing and the provision of solid core doors would be required on the facades exposed to the works, in addition to the mechanical ventilation, sealing of wall vents and acoustic seals for windows and doors described in Treatments 1, 2 and 3, respectively. Note that these upgrades are only suitable for masonry type buildings. It is unlikely that this degree of upgrade would provide significant benefits to light framed structures should there be no acoustic insulation in the walls.</td> </tr> </tbody> </table>	Treatment 1	Mechanical ventilation only	<5dB(A) reduction	Where external noise levels are less than 5dB(A) above the external assessment criteria, the internal noise goals may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 15dB(A) from outside to inside when windows are closed. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation should be considered to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia.	Treatment 2	Mechanical ventilation and sealing of wall vents	5-10 dB(A) reduction	Where external noise levels are less than 10dB(A) above the external assessment criteria, the internal noise goals may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 20dB(A) from outside to inside (ENMM p20) when windows are closed and wall vents are sealed. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation should be considered to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia. It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring residential premises.	Treatment 3	Upgraded seals for windows and doors	10-12dB(A) reduction	Where external noise levels are only slightly greater than 10dB(A) above the external assessment criteria, then in addition to installing mechanical ventilation (Treatment 1) and sealing of wall vents (Treatment 2), special acoustic grade seals should be installed on windows and perimeter doors exposed to road traffic noise to enable the internal noise criteria to be achieved with windows and doors shut.	Treatment 4	Upgraded windows, glazing and doors	>12 dB(A) reduction	Where the predicted external noise level exceeds the external assessment criteria by significantly more than 10dB(A), then upgraded windows and glazing and the provision of solid core doors would be required on the facades exposed to the works, in addition to the mechanical ventilation, sealing of wall vents and acoustic seals for windows and doors described in Treatments 1, 2 and 3, respectively. Note that these upgrades are only suitable for masonry type buildings. It is unlikely that this degree of upgrade would provide significant benefits to light framed structures should there be no acoustic insulation in the walls.
Treatment 1	Mechanical ventilation only																
<5dB(A) reduction	Where external noise levels are less than 5dB(A) above the external assessment criteria, the internal noise goals may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 15dB(A) from outside to inside when windows are closed. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation should be considered to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia.																
Treatment 2	Mechanical ventilation and sealing of wall vents																
5-10 dB(A) reduction	Where external noise levels are less than 10dB(A) above the external assessment criteria, the internal noise goals may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 20dB(A) from outside to inside (ENMM p20) when windows are closed and wall vents are sealed. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation should be considered to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia. It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring residential premises.																
Treatment 3	Upgraded seals for windows and doors																
10-12dB(A) reduction	Where external noise levels are only slightly greater than 10dB(A) above the external assessment criteria, then in addition to installing mechanical ventilation (Treatment 1) and sealing of wall vents (Treatment 2), special acoustic grade seals should be installed on windows and perimeter doors exposed to road traffic noise to enable the internal noise criteria to be achieved with windows and doors shut.																
Treatment 4	Upgraded windows, glazing and doors																
>12 dB(A) reduction	Where the predicted external noise level exceeds the external assessment criteria by significantly more than 10dB(A), then upgraded windows and glazing and the provision of solid core doors would be required on the facades exposed to the works, in addition to the mechanical ventilation, sealing of wall vents and acoustic seals for windows and doors described in Treatments 1, 2 and 3, respectively. Note that these upgrades are only suitable for masonry type buildings. It is unlikely that this degree of upgrade would provide significant benefits to light framed structures should there be no acoustic insulation in the walls.																
4	All reasonable and feasible mitigation has been explored for the site. Exceedance of the sleep disturbance NML is predicted to occur at up to 15 receivers in NCA 15 in the area opposite the driveway exit from the site. The following at-property treatment may be required to reduce noise impact from the site:																
	<table border="1"> <thead> <tr> <th>Treatment Type</th> <th>No. Residences</th> <th>No. Apartment Blgs</th> </tr> </thead> <tbody> <tr> <td>Treatment 1</td> <td>1</td> <td>-</td> </tr> <tr> <td>Treatment 2</td> <td>1</td> <td>-</td> </tr> <tr> <td>Treatment 3</td> <td>-</td> <td>-</td> </tr> <tr> <td>Treatment 4</td> <td>-</td> <td>-</td> </tr> </tbody> </table>	Treatment Type	No. Residences	No. Apartment Blgs	Treatment 1	1	-	Treatment 2	1	-	Treatment 3	-	-	Treatment 4	-	-	
Treatment Type	No. Residences	No. Apartment Blgs															
Treatment 1	1	-															
Treatment 2	1	-															
Treatment 3	-	-															
Treatment 4	-	-															
5	At property treatment requirements will be reviewed once site access is gained and prior to the commencement of 24 hour operations. The review will include on site testing of trucks driving on site and entering/existing the site to verify noise levels predicted by the noise model. Once the noise model is verified, properties likely to exceed the OOHW (Night) NML and the sleep disturbance NML will be identified for consideration of at-property treatment.																

APPENDIX D Comparison of EIS predictions to detailed design

The noise modelling assumptions for Kingsgrove Road civil and tunnelling support sites (C1, C2 and C3) are as follows:

- V01
 - Power Generator
 - Installation of enviro controls
 - Demolition of existing structures
 - Crushing & Screening
 - Vegetation Clearing
- V02
 - Power Generator
 - Establishment of construction facilities
- V03
 - Power Generator
 - Road and intersection modifications and installation of traffic controls (includes OOHW)
- V04
 - Piling; Excavation of shaft (C1 and C3 only)
 - Shaft Excavation & Construction (C1 and C3 only)
- V05
 - Removal of earth mound on northern side of M5
 - Tunnel support works (C1 and C3 only - includes OOHW)
- V06
 - Portal surface site – piling (C2)
 - Portal surface site - earthworks (C2)
 - Western surface site -earthworks (C2)
 - Tunnel support works (C1 and C3 only - includes OOHW)
- V07
 - Portal surface site – roadworks (C2)
 - Western surface site - roadworks (C2)
 - Tunnel support works (C1 and C3 only - includes OOHW)
- V08
 - Tunnel support works (C1 and C3 only - includes OOHW)

The impacts presented in the following tables show a comparison between the predicted impacts presented in the EIS compared with the detailed design. Note that Renzo Tonin & Associates did not prepare the EIS for the New M5. The results presented for the EIS noise predictions are therefore based on our best interpretation of the results presented in the EIS.

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

- ◆ Complies with NML
- ◆ Exceeds NML by less than 10 dB(A) – noise affected
- ◆ Exceeds NML by more than 10 dB(A) – noise affected
- ◆ > 75 dB(A) – highly noise affected

The impacts presented are as follows for **OOHW Evening and Night**:

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

Table D.1 Summary of noise construction noise impacts (standard hours)

NCA	Level of compliance with NML for construction stage															
	V01		V02		V03		V04		V05		V06		V07		V08	
	EIS	DD#	EIS	DD	EIS	DD	EIS	DD	EIS	DD	EIS	DD	EIS	DD	EIS	DD
NCA18				[[[[[[[
Level above NML, dB(A)	5	0	0	0	0	0	12	1	0	0	31	0	0	0	0	0
NCA19				[[[[[[[
Level above NML, dB(A)	60	24	37	9	37	24	28	21	51	24	29	24	52	16	21	0
NCA20				[[[[[[[
Level above NML, dB(A)	0	0	0	0	0	0	0	0	0	0	39	5	31	10	0	0
NCA23				[[[[[[[
Level above NML, dB(A)	0	0	0	0	0	0	0	0	0	0	29	0	21	2	0	0
NCA24				[[[[[[[
Level above NML, dB(A)	16	0	0	0	5	0	5	0	10	0	35	4	27	7	0	0
NCA25				[[[[[[[
Level above NML, dB(A)	20	1	0	0	0	0	15	13	9	0	16	0	10	0	0	0

Notes

All works to be undertaken during Standard construction hours (7am to 6pm Monday to Friday; 8am to 1pm Saturday)

EIS refers to results presented in EIS noise and vibration assessment report

DD refers to detailed design noise assessment. Number in brackets refers to noise predictions without temporary noise barriers.

Predicted noise levels include existing permanent noise walls and earth mounds as these will not have been removed at the time of the works. No temporary noise barriers were included in the noise model.

OSR = Other sensitive receiver surrounding work area. Worst affected OSR noted.

Table D.2 Summary of noise construction noise impacts (OOHW)

NCA	Level of compliance with NML for construction stage															
	V01		V02		V03		V04		V05		V06		V07		V08	
	EIS	DD	EIS	DD	EIS	DD#	EIS	DD	EIS	DD	EIS	DD	EIS	DD	EIS	DD
NCA18	-	-	-	-	**		-	-	-	-	-	-	-	-		[]
Level above NML, dB(A)						0									2	
NCA19	-	-	-	-	**		-	-	-	-	-	-	-	-		[]
Level above NML, dB(A)						0									14	4
NCA20	-	-	-	-	**		-	-	-	-	-	-	-	-		[]
Level above NML, dB(A)						10									0	
NCA23	-	-	-	-	**		-	-	-	-	-	-	-	-		[]
Level above NML, dB(A)						8									0	
NCA24	-	-	-	-	**		-	-	-	-	-	-	-	-		[]
Level above NML, dB(A)						7									0	
NCA25	-	-	-	-	**		-	-	-	-	-	-	-	-		[]
Level above NML, dB(A)						0									5	

Notes

All works to be undertaken during OOHW Evening 6pm to 10pm Monday to Sunday; or OOHW Night 10pm to 7am Monday to Friday and 10pm to 8am Saturday, Sunday and public holidays; OOHW Day 1pm to 6pm Saturday and 8am to 6pm Sundays and public holidays.

Level of compliance reported is based on worst case impact for OOHW period (typically night period)

EIS refers to results presented in EIS noise and vibration assessment report

DD refers to detailed design noise assessment. Number in brackets refers to noise predictions without temporary noise barriers.

Predicted noise levels include existing permanent noise walls and earth mounds as these will not have been removed at the time of the works.

** Activity not modelled as OOHW in EIS

OSR = Other sensitive receiver surrounding work area. Worst affected OSR noted.



Appendix A1: WESTCONNEX NEW M5 - Operational Traffic Noise Assessment: Kingsgrove noise wall removal and replacement with temporary shipping container wall

29 August 2018

TH014-10.25F01 (r1) WCX_NM5 Kingsgrove temporary shipping container wall

CPB Dragados Samsung Joint Venture

WESTCONNEX NEW M5 - Operational Traffic Noise Assessment: Kingsgrove noise wall removal and replacement with temporary shipping container wall

1 Introduction

This Operational Traffic Noise Assessment has been prepared on behalf of CPB Contractors Dragados Samsung Joint Venture (CDS JV) for the removal of approximately 50 metres of an existing noise wall on the southern side of the M5 Motorway at Kingsgrove and replacement with a temporary shipping container noise wall. The section of noise wall is required to be removed to allow construction works in the M5 Motorway corridor to continue.

This report has been prepared to assess the operational traffic noise impacts for residences on the southern side of the M5 Motorway at Kingsgrove for the proposed noise wall modifications, including the removal of an existing noise wall and replacement with a temporary shipping container wall.

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

2 Description of works

2.1 Overview

It is proposed to remove approximately 50 metres of an existing noise wall on the southern side of the M5 Motorway at Kingsgrove, adjacent to Kooemba Road. To mitigate potential traffic noise impacts, a 60 metre long shipping container wall would be constructed in front of the section of noise wall that is proposed to be removed. Figure 1 below displays the location of the proposed existing noise wall removal and the temporary shipping container wall replacement.

2.2 Existing noise wall

The existing noise wall to be removed is two separate noise walls that overlap on the southern side of the M5 Motorway at Kingsgrove. A portion of the noise wall removal would include the eastern end of the recently constructed noise wall built as part of the Kings Georges Road Upgrade Project. The other section to be removed is the western end of the existing noise wall near Kooemba Road.

The noise walls at these locations are constructed on an existing mound with the heights of the walls being approximately one to two metres. However, their effective heights including the mounding are approximately three to four metres.

2.3 Temporary shipping container replacement wall

The proposed temporary shipping container noise wall is 60 metres in length. The shipping container would be double stacked with a total height of 4.7 metres. The location of the proposed shipping container wall is shown in Figure 1 below.

Figure 1: Location of proposed noise wall removal and temporary shipping container wall replacement

Temporary Noise Mitigation - Western Surface Works



3 Noise Catchment Area

The Noise Catchment Areas for the Project are detailed in the Project Operational Noise and Vibration Review (ONVR) [ref: TH014-05F07 ONVR]. The nearest affected receivers are located in NCA 23 and NCA 24. These relevant noise catchment areas are detailed in Table 1 below and shown on the maps in APPENDIX B.

Table 1: Noise Catchment Areas

NCA	Description
Kingsgrove	
NCA 23	<p>Receivers within NCA 23 are primarily residential, comprising single and double storey detached houses.</p> <p>The existing acoustic environment is considered as suburban and is dominated by road traffic travelling along the M5 East Motorway and rail traffic on the East Hills and Airport railway line.</p>
NCA 24	<p>NCA 24 comprises residential and industrial receivers. The residential receivers include single and double storey detached houses</p> <p>The existing acoustic environment is considered as suburban and is dominated by road traffic travelling along the M5 East Motorway.</p>

4 Road traffic noise assessment

4.1 Operational traffic noise criteria

A summary of the applicable traffic noise criteria for residential receivers in accordance with the NCG for residential receivers is presented in the table below. Additional information is provided in Section 5 of the Project ONVR.

A key measure when assessing traffic noise impact and the likelihood of disturbance is a change of more than 2dB(A), which is the basis of this assessment.

4.2 Operational traffic data

The operational traffic data used for this assessment has been taken Appendix D of the ONVR. The opening year (2021) 'no build' (without the proposal) traffic data has been used for all scenarios.

4.3 Road traffic noise assessment

4.3.1 Noise model methodology

Details of the noise modelling methodology and noise model inputs is presented in Section 8 of the ONVR.

4.3.2 Noise modelling scenarios

The assessment considers the existing configuration of the M5 Motorway with the road alignment relocated to the north for current construction works that are occurring in the road corridor as part of New M5 works. This is known as the "Existing Interim" scenario. The scenario with the noise wall removal and stacked shipping containers is the "Proposed Interim" scenario.

To conduct the noise assessment four separate traffic scenarios have been used. The four scenarios are detailed in Table 2 below.

Table 2: Modelled scenarios

Modelled scenario	Label	Description
1a	Existing interim - day	Existing interim M5 Motorway configuration with existing noise walls. Daytime based on 2021 'No build' scenario
1b	Existing interim - night	Existing interim M5 Motorway configuration with existing noise walls Night-time based on 2021 'No build' scenario
2a	Proposed interim - day	Existing interim M5 Motorway configuration with proposed removal of existing noise wall and temporary shipping container noise wall replacement. Daytime based on 2021 'No build' scenario

Modelled scenario	Label	Description
2b	Proposed interim - night	Existing interim M5 Motorway configuration with proposed removal of existing noise wall and temporary shipping container noise wall replacement. Night-time based on 2021 'No build' scenario

As detailed in Section 9.1 of the Project ONVR, there are no receivers at Kingsgrove that qualify for consideration of additional noise mitigation. Therefore, this assessment will consider only the relative change in traffic noise level between the existing interim and proposed interim scenarios.

4.3.3 Results

Traffic noise modelling has been conducted for the four scenarios detailed in Table 2. The results of the noise modelling are shown on the noise contour maps in APPENDIX B. The outcomes are as follows:

- Predicted traffic noise levels for the interim stage with the proposed container wall do not increase by more than 2dB(A) when compared with the existing interim stage with existing noise walls. A change of 2dB(A) or less is considered barely perceptible to the human average person.
- The temporary container noise wall provides a similar level of traffic noise reduction for all residences when compared to the existing noise walls. Traffic noise levels generally do not increase by more than 0.2dB(A).
- No additional traffic noise mitigation is required under the proposed interim scenario (other than the described shipping container wall replacement).

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
29.08.2018	Issued to client	0	1	■	■	■

Important Disclaimer:

The work presented in this document was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

This document is issued subject to review and authorisation by the Team Leader noted by the initials printed in the last column above. If no initials appear, this document shall be considered as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.

This document is prepared for the particular requirements of our Client which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Renzo Tonin & Associates. The information herein should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

In preparing this report, we have relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, we have not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

We have derived data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination and re-evaluation of the data, findings, observations and conclusions expressed in this report.

We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

The information contained herein is for the purpose of acoustics only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics engineering including and not limited to structural integrity, fire rating, architectural buildability and fit-for-purpose, waterproofing and the like. Supplementary professional advice should be sought in respect of these issues.

References

1. WestConnex New M5 Operational Noise and Vibration Review (TH014-05F07 ONVR)
2. Road Noise Policy (RNP), NSW EPA, March 2011
3. Noise Criteria Guideline (NCG), NSW Roads and Maritime Services, April 2015
4. Noise Mitigation Guideline (NMG), NSW Roads and Maritime Services, April 2015

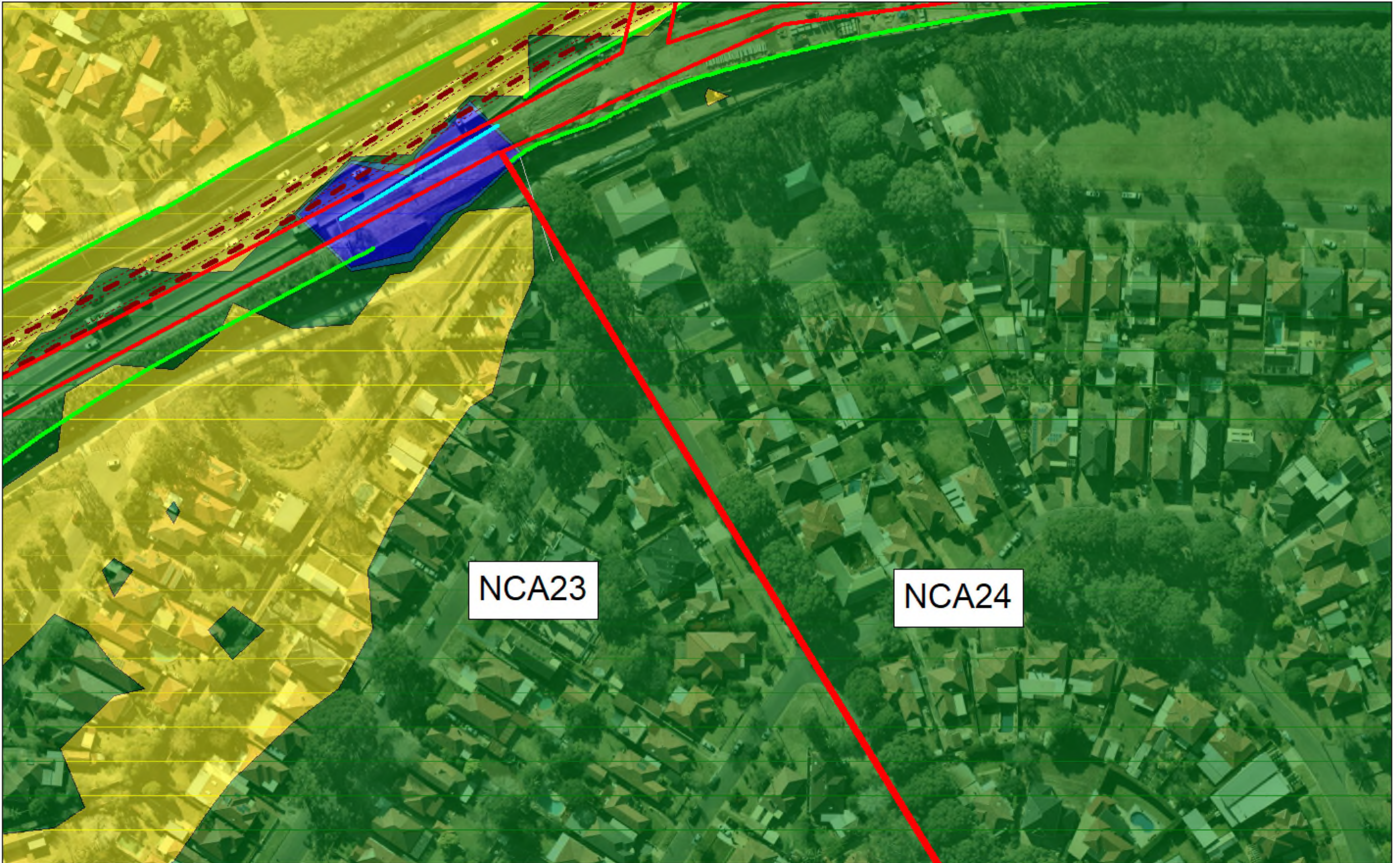
APPENDIX A Glossary of terminology

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

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

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

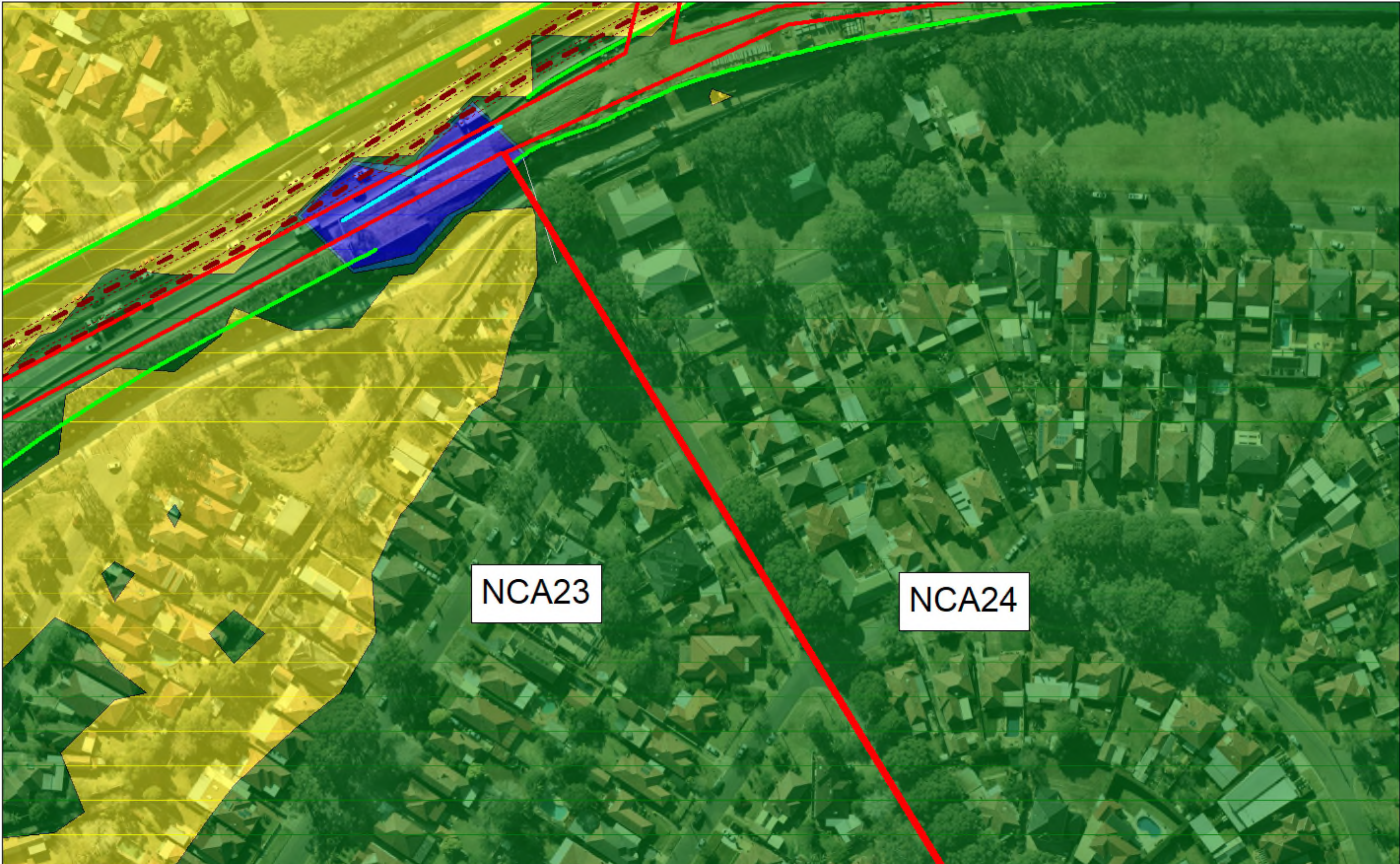
APPENDIX B Noise contour maps



NCA23

NCA24

<p>Legend:</p> <ul style="list-style-type: none"> Existing noise wall Shipping container wall 	<p>Change in noise level - dB(A)</p> <ul style="list-style-type: none"> ... < -2 -2 <= ... < -1 -1 <= ... < 0 0 <= ... < 1 1 <= ... < 2 2 <= ... 	<p>Consultant:</p> <p>RENZO TONIN & ASSOCIATES <i>Inspired to achieve</i> Acoustics, Vibration & Structural Dynamics Sydney Melbourne Brisbane Gold Coast Kuwait 1/418A Elizabeth Street, SURRY HILLS NSW 2010 P: 02 8218 0500 F: 02 8218 0501</p>	<p>Client:</p> <p>WestConnex New M5</p> <p>CPB CONTRACTORS DRAGADOS SAMSUNG SAMSUNG C&T</p>	<p>Project:</p> <p>WESTCONNEX STAGE 2 M5 WESTERN CONNECTION</p> <p>Noise levels are approximate due to interpolation of contours and should be used for reference only. For information only and not for construction. This information is protected by copyright.</p>	<p>Description:</p> <p>REMOVAL OF EXISTING NOISE WALL AND REPLACEMENT WITH TEMPORARY SHIPPING CONTAINER WALL CHANGE IN NOISE LEVEL - LAEQ, 15H DAY</p> <table border="1"> <tr> <td>Project No.: TH014-10.25</td> <td>Created by: RP</td> </tr> <tr> <td>Fig Ref: TH014-5.1.7.4.01 (R0)</td> <td>Grid: 05</td> </tr> <tr> <td>Date: 2018.08.29</td> <td>Scale: 1: 1200 A3</td> </tr> </table>	Project No.: TH014-10.25	Created by: RP	Fig Ref: TH014-5.1.7.4.01 (R0)	Grid: 05	Date: 2018.08.29	Scale: 1: 1200 A3
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Date: 2018.08.29	Scale: 1: 1200 A3										



NCA23

NCA24

<p>Legend:</p> <ul style="list-style-type: none"> Existing noise wall Shipping container wall 	<p>Change in noise level - dB(A)</p> <ul style="list-style-type: none"> ... < -2 -2 <= ... < -1 -1 <= ... < 0 0 <= ... < 1 1 <= ... < 2 2 <= ... 	<p>Consultant:</p> <p>RENZO TONIN & ASSOCIATES <i>Inspired to achieve</i></p> <p>Acoustics, Vibration & Structural Dynamics Sydney Melbourne Brisbane Gold Coast Kuwait 1/418A Elizabeth Street, SURRY HILLS NSW 2010 P: 02 8218 0500 F: 02 8218 0501</p>	<p>Client:</p> <p>WestConnex New M5</p> <p>CPB CONTRACTORS DRAGADOS SAMSUNG SAMSUNG C&T</p>	<p>Project:</p> <p>WESTCONNEX STAGE 2 M5 WESTERN CONNECTION</p> <p>Noise levels are approximate due to interpolation of contours and should be used for reference only. For information only and not for construction. This information is protected by copyright.</p>	<p>Description:</p> <p>REMOVAL OF EXISTING NOISE WALL AND REPLACEMENT WITH TEMPORARY SHIPPING CONTAINER WALL CHANGE IN NOISE LEVEL - LAEQ,9H NIGHT</p> <table border="1"> <tr> <td>Project No.:</td> <td>TH014-10.25</td> <td>Created by:</td> <td>RP</td> </tr> <tr> <td>Fig Ref:</td> <td>TH014-5.1.7.4.02 (R0)</td> <td>Grid:</td> <td>05</td> </tr> <tr> <td>Date:</td> <td>2018.08.29</td> <td>Scale:</td> <td>1: 1200 A3</td> </tr> </table>	Project No.:	TH014-10.25	Created by:	RP	Fig Ref:	TH014-5.1.7.4.02 (R0)	Grid:	05	Date:	2018.08.29	Scale:	1: 1200 A3
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Fig Ref:	TH014-5.1.7.4.02 (R0)	Grid:	05														
Date:	2018.08.29	Scale:	1: 1200 A3														



Appendix B: Community Consultation Records

Stage 2 Beverly Hills-St Peters Snapshot Report

Door knock: 27 May 2016

<i>Event Type</i>	Door knock
<i>Event Date</i>	27 May 2016 9:06 AM (GMT +10)
<i>Event End Date</i>	27 May 2016 9:06 AM (GMT +10)
<i>Location</i>	Kingsgrove
<i>Summary</i>	Door knock to consult about Temporary Noise Barriers - West.
<i>Team Response</i>	Left slip asking to call back before 31 May 2016. Those at home showed the height, location and colours (Pale Eucalypt, Dune or Windspray) proposed for the temporary noise barriers. General consensus on colours Windspray or Dune. Pale Eucalypt was not favoured. 22 properties consulted.
<i>Issues</i>	Consultation: WestConnex Initiated Information
<i>Address</i>	
	AUSTRALIA
<i>Projects</i>	Stage 2 Beverly Hills-St Peters
<i>Restricted to</i>	Selected Projects Only

Stakeholders:

<i>Full Name</i>	<i>Address</i>	<i>Comments or discussion</i>
[REDACTED]	[REDACTED]	Property only used for storage.
[REDACTED]	[REDACTED]	
[REDACTED]	[REDACTED]	Appreciative of information provided.
[REDACTED]	[REDACTED]	
[REDACTED]	[REDACTED]	Appreciative of information provided, likes the fact that trees are going to be retained. No issues with the height and location of the temporary noise barrier. Would like mound to be retained at completion of project, but also wants a bit of park. Does not want mound to be with picnic/barbecue areas.

Stage 2 Beverly Hills-St Peters Snapshot Report

<i>Full Name</i>	<i>Address</i>	<i>Comments or discussion</i>
[REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Slip left asking to call back. Follow up email sent asking resident to call for information about the temporary noise barriers.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Appreciative of information provided, likes the fact that trees are going to be retained. No issues with the height and location of the temporary noise barrier, prefer colour Windspray. Would like a mound to be retained at completion of project.
[REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Appreciative of information provided, likes the fact that trees are going to be retained. No issues with the height and location of the temporary noise barrier, prefer colour Windspray. Do not like green. Would like a mound to be retained at completion of project.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]	Group Submission Co-ordinator for Kingsgrove North. Submission Number PCU063881. Appreciated the update and all changes done to the design during EIS. Preferred Windspray or Dune colours. Would like a mound to be retained at completion of project.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]	Left slip with reception. Follow up email explaining site establishment and noise barriers.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Spoke to business owner, explained the site establishment, pedestrian access, truck access and timing. Happy with the information given.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Had some bad experiences during the M5 construction. Appreciate the fact that the temporary noise barrier will be around 10m away from their fence and trees would be retained. Prefer Dune or Windspray. Would like a mound to be retained at completion of project.
[REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Left a slip with translation information.

Stage 2 Beverly Hills-St Peters Snapshot Report

<i>Full Name</i>	<i>Address</i>	<i>Comments or discussion</i>
[REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]	Appreciate the fact that the temporary noise barrier will be around 10m away from their fence and trees would be retained. Prefer Dune or Windspray. Would like a mound to be retained at completion of project.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]	Left a slip. Called and left a message 02/06, send an email explaining the nature of the noise wall.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Appreciate the fact that the temporary noise barrier will be around 10m away from their fence and trees would be retained. Prefer Dune or Windspray. Would like a mound to be retained at completion of project.
[REDACTED] [REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]	Met house owner. She has asked for slip to be left and someone would call back.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]	Slip left asking to call back
[REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]	Slip left asking to call back
[REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Appreciate the fact that the temporary noise barrier would be a distance away from their fence and some trees would be retained. Prefer Dune or Windspray. Have sold house.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Left slip and resident called back on 30 May 2016. Satisfied with the temporary noise barriers proposed.

Stage 2 Beverly Hills-St Peters Snapshot Report

<i>Full Name</i>	<i>Address</i>	<i>Comments or discussion</i>
[REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]	As above
[REDACTED]	[REDACTED] [REDACTED]	Appreciate the fact that the temporary noise barrier will be around 10m away from their fence and trees would be retained. Prefer Dune or Windspray. Would like a mound to be retained at completion of project.
[REDACTED]	[REDACTED] [REDACTED] [REDACTED]	Left slip asking to call back. Called and left a message on 2/06/16
[REDACTED]	[REDACTED] [REDACTED] [REDACTED] [REDACTED]	Appreciate the fact that the temporary noise barrier will be around 10m away from their fence and trees would be retained. Prefer Dune or Windspray. Would like a mound to be retained at completion of project.

Team Members:

<i>Full Name</i>	<i>Organisation</i>	<i>Phone</i>	<i>Mobile</i>	<i>Email</i>	<i>Projects</i>
[REDACTED]				[REDACTED]	Stage 2 Beverly Hills-St Peters (Data Editor)

KGRIU and New M5 (Beverly Hills to St Peters) Snapshot Report

72079: Community Update / Notification (bulk email / mail): 31 Aug 2018

<i>Event Type</i>	Community Update / Notification (bulk email / mail)
<i>Event Date</i>	31 Aug 2018 12:55 PM (GMT +10)
<i>Event End Date</i>	31 Aug 2018 12:55 PM (GMT +10)
<i>Location</i>	Beverly Hills
<i>Summary</i>	Doorknock/Calling Card drop re Container Wall
<i>Team Response</i>	<p>CDS JV [REDACTED] door knocked and spoke with residents at:</p> <p>64 Tallawalla Street 74 Tallawalla Street 76 Tallawalla Street 89 Tallawalla Street 73 Tallawalla Street 56 Tallawalla Street 23a Kooemba Road</p> <p>CDS JV [REDACTED] dropped calling card to properties where there was no answer:</p> <p>Dear Resident</p> <p>I visited you today to advise a section of the noise wall on the M5 East at the end of Kooemba Road will be replaced with shipping containers until the new noise wall is completed. The shipping containers will be stacked along work site boundary to form noise barriers between residents and motorway.</p> <p>The work will begin the first week of September and the duration of the work will be approximately 4 months.</p>
<i>Issues</i>	Consultation: WestConnex Initiated Information
<i>Address</i>	
<i>Projects</i>	AUSTRALIA KGRIU and New M5 (Beverly Hills to St Peters)
<i>Restricted to</i>	Selected Projects Only

KGRIU and New M5 (Beverly Hills to St Peters) Snapshot Report

Stakeholders:

<i>Full Name</i>	<i>Organisation</i>	<i>Address</i>	<i>BH Phone</i>	<i>Mobile</i>	<i>Email</i>	<i>Linked Projects</i>
The Resident		[REDACTED] [REDACTED] [REDACTED]				KGRIU and New M5 (Beverly Hills to St Peters)
The Resident		[REDACTED] [REDACTED] [REDACTED]				KGRIU and New M5 (Beverly Hills to St Peters)
The Resident		[REDACTED] [REDACTED] [REDACTED]				KGRIU and New M5 (Beverly Hills to St Peters)
The Resident		[REDACTED] [REDACTED] [REDACTED]				KGRIU and New M5 (Beverly Hills to St Peters)
The Resident		[REDACTED] [REDACTED] [REDACTED]				KGRIU and New M5 (Beverly Hills to St Peters)
The Resident		[REDACTED] [REDACTED] [REDACTED]				KGRIU and New M5 (Beverly Hills to St Peters)
		Comment: Happy with the change and understands it is temporary.				
The Resident		[REDACTED] [REDACTED] [REDACTED]				KGRIU and New M5 (Beverly Hills to St Peters)
		Comment: Happy with the change and understands it is temporary.				
The Resident		[REDACTED]				KGRIU and New M5

KGRIU and New M5 (Beverly Hills to St Peters) Snapshot Report

<i>Full Name</i>	<i>Organisation</i>	<i>Address</i>	<i>BH Phone</i>	<i>Mobile</i>	<i>Email</i>	<i>Linked Projects</i>
		[Redacted]				(Beverly Hills to St Peters)
The Resident		[Redacted]				KGRIU and New M5 (Beverly Hills to St Peters)
The Resident		[Redacted]				KGRIU and New M5 (Beverly Hills to St Peters)
The Resident		[Redacted]				KGRIU and New M5 (Beverly Hills to St Peters)
		Comment: Happy with the change and understands it is temporary.				
[Redacted]		[Redacted]		[Redacted]		KGRIU and New M5 (Beverly Hills to St Peters)
[Redacted]		[Redacted]		[Redacted]	[Redacted]	KGRIU and New M5 (Beverly Hills to St Peters)
[Redacted]		[Redacted]		[Redacted]	[Redacted]	KGRIU and New M5 (Beverly Hills to St Peters)
[Redacted]		[Redacted]		[Redacted]	[Redacted]	
		Comment: Happy with the change and understands it is temporary.				
[Redacted]		[Redacted]		[Redacted]		KGRIU and New M5

KGRIU and New M5 (Beverly Hills to St Peters) Snapshot Report

Full Name	Organisation	Address	BH Phone	Mobile	Email	Linked Projects
		[Redacted]				(Beverly Hills to St Peters)
[Redacted]		[Redacted]	[Redacted]	[Redacted]	[Redacted]	KGRIU and New M5 (Beverly Hills to St Peters)
		Comment: Happy with the change and understands it is temporary.				
[Redacted]		[Redacted]	[Redacted]			KGRIU and New M5 (Beverly Hills to St Peters)
[Redacted]		[Redacted]		[Redacted]	[Redacted]	KGRIU and New M5 (Beverly Hills to St Peters)
[Redacted]		[Redacted]			[Redacted]	
		Comment: Resident asked for a wooden noise wall to be installed.				
[Redacted]		[Redacted]		[Redacted]	[Redacted]	KGRIU and New M5 (Beverly Hills to St Peters)
[Redacted]		[Redacted]		[Redacted]	[Redacted]	KGRIU and New M5 (Beverly Hills to St Peters)
[Redacted]		[Redacted]			[Redacted]	

KGRIU and New M5 (Beverly Hills to St Peters) Snapshot Report

Full Name	Organisation	Address	BH Phone	Mobile	Email	Linked Projects
[REDACTED]		[REDACTED]				
[REDACTED]		[REDACTED]	[REDACTED]			KGRIU and New M5 (Beverly Hills to St Peters)
[REDACTED]		[REDACTED]			[REDACTED]	KGRIU and New M5 (Beverly Hills to St Peters)
[REDACTED]		[REDACTED]		[REDACTED]	[REDACTED]	KGRIU and New M5 (Beverly Hills to St Peters)

Team Members:

Full Name	Organisation	Phone	Mobile	Email	Projects
[REDACTED]	CPB Contractors Dragados Samsung			[REDACTED]	KGRIU and New M5 (Beverly Hills to St Peters) (Data Editor)

Documents:

Document Folders	Document Name	Description	Size (kb)	Projects
	Calling Card_Containers - August 2018		2796	KGRIU and New M5 (Beverly Hills to St Peters)
	Doorknock Map		1744	KGRIU and New M5 (Beverly Hills to St Peters)



Appendix C: Department Review of Temporary Noise Barrier Strategy – Comments and Responses

Table: Department Review of Temporary Noise Barrier Strategy Rev 1 – submitted under condition D20 of SSI 6788 (Carl Dumpleton email dated Tuesday, 14 June 2016 5:24 PM)

Item #	DPE Review Comment	CDS JV Response
1.	The details from Table C3 from Appendix C of the Renzo Tonin report needs to be included in the main body of the Strategy. Also the timing of the installation of each barrier as well as a clear commitment regarding the completion times needs to be included. A table format for this information would be appropriate. Also please include some discussion on the reasons for the design which relates to the table to give it some relevance.	<p>Section 2.6 – Details noise barrier options and proposed barrier acoustic ratings. Table C3 from appendix C of the Renzo Tonin report has been summarised within the main body of the report.</p> <p>Section 2.7 – Details proposed construction timing for nominated noise walls, refer Table 2.7 – Noise Barrier Installation</p>
2.	The Figures from Appendix B of the Renzo Tonin report need to be included in the main body of the Strategy. Also the labels for the NCA need to be made clearer. Also some discussion on the locality of the compound noise walls, such as distance from property boundaries needs to be included in a discussion of the figures	<p>Section 2.2 – Details identified sensitive receivers and nominates NCSs in Figure 2.2 and Figure 2.3. Details regarding the location of noise barriers with reference to the nearest resident are provided in Table 2.1.</p>
3.	The Table from Appendix D of the Renzo Tonin Report needs to be included in the main body of the report along with a relevant discussion. Also the change in dB needs to be shown for the DD column, as the broad summary colour indicates virtually no change what so ever, which is unlikely	<p>Section 2.8 – Details a comparison of predicted impacts within the EIS to current detailed design modelled impacts. Refer Tables 2.5 and Table 2.6.</p> <p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds) - Appendix D</p>
4.	It needs to be made explicitly clear that the final design of the temporary barriers to replace the existing permanent motorway noise walls will be supplied in a different Strategy as per the staging report or by whatever approval mechanism is sought	<p>Table 2.7 – Noise Barrier Installation details noise walls to temporarily replace existing motorway noise walls.</p>
5.	The presentation material regarding the barrier design supplied to residents needs to be included as an appendix to the Strategy.	<p>Appendix E – Details have been added to show material presented during consultation.</p>
6.	Edits	

6a	Table 1.1 – Row CoA A(ii) and (iv) – please reference the staging report where relevant in regards to timing of final design for replacement motorway noise walls. Also reference the additional Strategies that would be submitted as per staging report.	Reference to Pre-Construction Compliance Report M5N-ES-RPT-PWD-0003 rev00 has been added, details regarding project staging are found in Section 1.2. Reference is provided to the permanent design package that will document permanent noise walls to replace existing barriers, package M5N-AJV-DPK-200-400-NW-2115.
6b	Page 10 – ‘Figure 2.1’ is a table. Please reference as a table and move title above the table. Please change all reference in the document to Table 2.1	Table reference has been amended.
6c	Section 2.5 - This relates to construction works, specially widening works. The last paragraph discusses further investigations to be undertaken. Please amend this section to reference the staging report and when the actual relevant revised Temp Noise Wall Strat would be developed to address this construction related impact. This is to differentiate out establishment/ compound temp walls vs construction temp walls.	The last paragraph of Section 2.5 refers to the temporary relocation of the existing noise mound material, it is anticipated that this material will be temporarily stored behind temporary noise barrier NB01. Modelling within the acoustic report does not require this to occur, should it occur it would only provide a benefit.
6d	Section 3.3 (last sentence) specify how many residents vs commercial properties were consulted.	Section 3.3 – This section has been amended to include a split of domestic vs commercial residents consulted
6e	Figures 3.1 and 3.2 label with compounds and show the location of barriers	Temporary noise barriers location have been added along with construction compounds.

Table: Department Review of Temporary Noise Barrier Strategy Rev 0 – submitted under condition D20 of SSI 6788 (document dated 13/05/2016, revision 00)

Item #	DPE Review Comment	CDS JV Response
7.	Main report, Section 3 – while future consultation for both involvement and notification purposes is outlined, with the Strategy currently proposing that consultation on the options is to occur in the future (and prior to the adoption of a final design), the Strategy needs to present noise barrier options that have been developed in consultation with the landowners adjacent to the barrier locations.	<p>Section 3 – Details the consultation process which has now been executed.</p> <p>Appendix B – Details records of consultation process.</p> <p>Section 3.5 – details how feedback received during the consultation process has been included in final barrier designs included in the TNBS.</p>
8.	Appendix A, section 2.2, page 7 – clear maps need to be included showing the NCAs and how they correspond with the noise barriers proposed in the report.	<p>Updated figures provided as below.</p> <p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <ul style="list-style-type: none"> - Appendix B – Nearest Sensitive Receivers and Noise Management Levels - Figure B.1 & B.2
9.	Appendix A – Figure B.2 is not entirely legible and does not include a legend/key.	<p>A legend is provided on updated figures as below.</p> <p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <ul style="list-style-type: none"> - Appendix B – Nearest Sensitive Receivers and Noise Management Levels - Figure B.1 & B.2
10.	Appendix A, section 2.2, page 8 – further to immediate point above, whilst Appendix B is intended to show all residential receivers in the vicinity of the subject worksites, the figure is not clear and separate, magnified, sections of the worksites plus residential receivers should be shown to achieve this.	<p>Updated figures provided as below.</p> <p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <ul style="list-style-type: none"> - Appendix B – Nearest Sensitive Receivers and Noise Management Levels - Figure B.1 & B.2 <p>Residents identified to be adjacent to proposed temporary noise barriers are identified in Section 3.3, refer figures as below.</p> <ul style="list-style-type: none"> - Figure 3.1 – Kingsgrove North - Identified Properties Consulted – Adjacent to NB01 & NB02

		<ul style="list-style-type: none"> - Figure 3.2 – Kingsgrove South – Identified Properties Consulted – Adjacent to NB04
11.	Appendix A, section 4.4, page 11 – the naming and numbering convention (C1 for example) of the compounds should be consistent with that in the EIS/RTS.	<p>Compound terminology has been added for C1/C2/C3 along with construction staging.</p> <p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <ul style="list-style-type: none"> - Section 4.3 – Predicted Noise Levels – Table 4.1.
12.	Appendix A, section 4.4, page 11, Kingsgrove North compound – are environmental controls inclusive of noise walls? Please clearly state this. What about Kingsgrove South construction compound?	<p>Section 2.4 - Environmental controls are considered to include the erection of temporary noise barriers.</p> <p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <ul style="list-style-type: none"> - Section 4.3 – Predicted Noise Levels – Table 4.1.
13.	Appendix A, Section 4.4, including Table 4.1, page 12 – how do these levels compare with Table 13 (page 60) and Appendix H of the Secretary’s Environmental Assessment Report?	<p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <ul style="list-style-type: none"> - Appendix D - Provides a comparison of predicted detailed design construction noise levels with those presented in the EIS and Table 13 of the Secretary’s Environmental Assessment Report.
14.	Appendix A, Section 4.5.1 – need to include noise reductions to be achieved by noise walls, with clearly listed predicted pre-noise wall noise levels, can link to Table B1 for those if applicable, (and NML exceedance in brackets), against modelled post noise wall noise levels.	<p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <ul style="list-style-type: none"> - Table 5.3 – Predicted benefit of noise walls 3 to 4dB(A) reduction - Section 5.4 – noise reduction of 2dB(A) due to speed reduction of 110km/h to 80km/h - Appendix D – Table D.1 and Table D.2 show

		<p>noise prediction analysis comparing EIS to detailed design, also shows predictions with no temporary noise barriers</p> <ul style="list-style-type: none"> - Table C6 – Managing residual impacts
15.	Appendix A, Section 5.3, Table 5.3 – the table should be consolidated - need additional columns to identify traffic noise (dB(A)) without noise walls, and the dB(A) with noise walls.	<p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <p>Table 5.3 – Predicted benefit of noise walls 3 to 4dB(A) reduction</p>
16.	Appendix A, Section 5.3.1, last paragraph – please provide any updates on the stated ongoing consultation.	<p>Appendix D - RMS Meeting Minutes and General Correspondence – Proposed Barrier Mounted Screen Discussions are ongoing with RMS and barrier mounted screens are included in our Traffic Management Plan which is in the final stages of approval with RMS.</p>
17.	The Strategy needs to assess temporary noise barriers at all construction compounds where noise levels are predicted to exceed the <i>Interim Construction Noise Guideline</i> criteria at sensitive residential receivers. The Strategy is to provide justification where barriers would not be erected.	<p>This TNBS details all temporary noise barriers required for C1, C2 and C3. A staging plan will be developed to address other TNBS for other project compounds.</p>
18.	Appendix A, Tables C2 – the estimate works period (month to month) should be included to understand any potential for overlap between the different works.	<p>Section 2.4 – Construction Noise assessment considers construction staging, V01 to V08.</p>
19.	Appendix A, Table C3 – whilst plywood is proposed at all locations for the Kingsgrove site, the effectiveness of this material in adequately reducing the noise levels needs to be provided.	<p>Appendix A - Construction Noise and Vibration: Temporary Noise Barrier Acoustic Report (Kingsgrove Compounds)</p> <ul style="list-style-type: none"> - Appendix C – Table C3 details noise barrier design specifications and required Rw ratings required, options including various Rw ratings are provided, the Rw rating of the plywood option exceeds that recommended by the analysis.
20.	Main report, Section 3.3, second paragraph – noting an example only is provided but are those listed the only ones subject to exceedances	<p>Section 3.3 – Details how landowners were assessed as being adjacent. Our assessment is based on discussions</p>

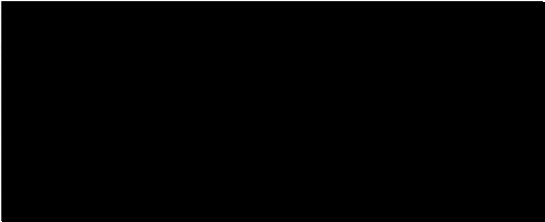
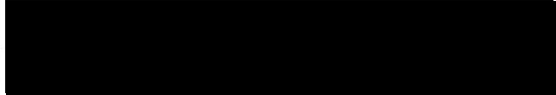

	of the NMLs with respect to Kingsgrove North Construction Compound in the vicinity of the Beverly Grove Park? For example, the receivers behind the blue marked ones.	which occurred during the draft CoA process with DPE representatives where it was agreed that landowners directly adjacent to site boundaries where temporary noise barriers are proposed would be considered as adjacent and required consultation. This approach has been adopted and executed. New figures are provided showing residents which have been consulted. Figure 3.1 and Figure 3.2 .
21.	Main report, Section 5 – a statement to address whether the proposed barriers are the optimum height or built using materials to deliver an optimum level of mitigation should be made in the Conclusion.	Section 5 – Conclusion has been amended to account for resident consultation which has now been executed.
22.	Editorial Comments: <ul style="list-style-type: none"> • Main report, Section 1.1, page 4 – ‘kilometer’ to be kilometre. • Appendix A – the naming convention and numbering for all construction compounds need to be consistent with the EIS/RTS. • Main report, Section 3.4, first dot point – ‘of these briefings is <i>the</i>’ to be is ‘<i>to</i>’. 	<ul style="list-style-type: none"> • Correction made. • Naming convention has been amended to account for compounds C1, C2 and C3. • Correction made.



Appendix D: RMS Meeting Minutes and General Correspondence – Proposed Barrier Mounted Screen



MEETING MINUTES WestConnex New M5

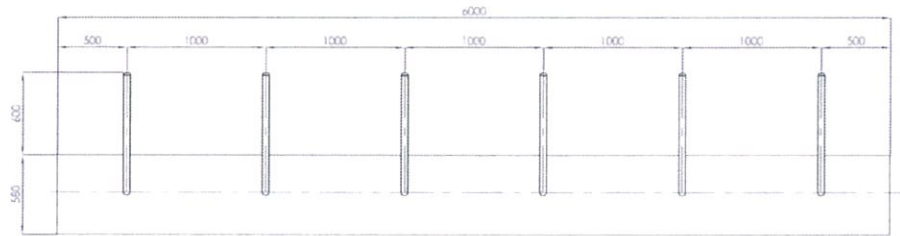
Subject /Purpose	Proposed Barrier Mounted Screen - RMS		
Date	Tuesday, 09 May 2016	Time Started: 15:00	Time Finished: 16:00
Location / Area	Octagon Building: 110 George Street, Parramatta - Level 5		
Attendees			
Functional Area	Construction – Civil West		
Apologies	Nil		
Chaired by			
Minuted by			
Other Distribution	(NA)		



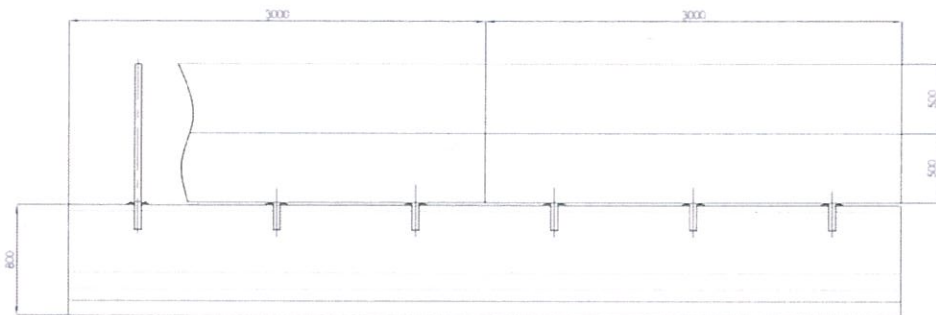
ITEM	Description	Action By	Date Required	Date Closed
1.	<p>██████████</p> <ul style="list-style-type: none"> Introduced RMS participants. 	(NA)	Note	
2.	<p>██████████</p> <ul style="list-style-type: none"> Introduced CDS-JV /Fortress Fencing participants. 			
3.	<ul style="list-style-type: none"> ██████████ Provided General project overview and planned staging for Western 			
4.	Surface works.			
5.	<ul style="list-style-type: none"> ██████████ discussed conditions of approval, condition D20. (Noise Management Strategy) 			
6.	<ul style="list-style-type: none"> <ul style="list-style-type: none"> Barrier mounted screens proposed as part of the Temp Noise 			
7.	<ul style="list-style-type: none"> <ul style="list-style-type: none"> management Strategy. COA D20 requires CDS to provide noise 			
8.	<ul style="list-style-type: none"> <ul style="list-style-type: none"> mitigation greater than EIS controls. Explained site topography and 			
9.	<ul style="list-style-type: none"> <ul style="list-style-type: none"> value of screens in addition to site noise walls placed along site 			
10.	<ul style="list-style-type: none"> <ul style="list-style-type: none"> boundary. 			
11.	<ul style="list-style-type: none"> ██████████ Discussed other Benefits of screens such as protection of workers from road 			
12.	<ul style="list-style-type: none"> debris, objects falling of trucks, physical barrier for site not to oversail during works, gawk 			
13.	<ul style="list-style-type: none"> benefits not distracting drivers while driving past site. <p>██████████</p>	██████████	Pending TMP	
14.	<ul style="list-style-type: none"> Discussed RMS position on gawk screens 		Approval	
15.	<ul style="list-style-type: none"> <ul style="list-style-type: none"> Concerned for workers safety as screens create debris on impact. 			
16.	<ul style="list-style-type: none"> <ul style="list-style-type: none"> Concerned for road user safety when screens becomes dislodged when hit 			
17.	<ul style="list-style-type: none"> <ul style="list-style-type: none"> by traffic 			
18.	<ul style="list-style-type: none"> <ul style="list-style-type: none"> Impact tests on one system showed significant debris on impact. 			
19.	<ul style="list-style-type: none"> Will forward report on crash investigations. <p>██████████</p>			
19.	<ul style="list-style-type: none"> System (barrier and screen) need to increase net safety or at least not decrease the 			
	<ul style="list-style-type: none"> current standard. 			
	<ul style="list-style-type: none"> CDS-JV to submit a report addressing concerns outlined in crash report. 			



ITEM	Description	Action By	Date Required	Date Closed
[REDACTED]	<ul style="list-style-type: none"> • Explained time and cost implications if CDS-JV cannot meet condition D20. • Discussed feasibility and inefficiency of a higher noise wall next to properties due to topography of site. 			
[REDACTED]	<ul style="list-style-type: none"> • Gave an overview of proposed “Eco Hoarding” barrier mounted screen provided by Fortress Fencing: <ul style="list-style-type: none"> ➤ Noise attenuation benefits ➤ Safety in design with tailor made clips and individual screens for each barrier ➤ Fitmento of the vertical post ➤ (See attached drawings discussed at meeting) • Discussed option of loose standing hoarding behind barrier. 			
[REDACTED]	<ul style="list-style-type: none"> • Provided additional information of the “Eco Hoarding” and projects currently in use. • Requested specific details of system crash tested in order to address the concers. 			

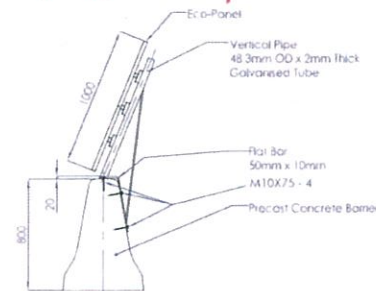


PLAN



ELEVATION

- * No horizontal steel members.
- * Eco-Panel to span across a single barrier to ensure hoarding articulate with barriers.
- * Brackets will be braced to the vertical to ensure pole stays in place with impact.
- * IF Eco-Panel shatter it break up in small pieces, due to the light weight and low freeway speeds + possible angle of impact the possible projectile pose a minimal risk.



SIDE VIEW

Notes:

1. All Welds to be AS 1554.1 Sp Unless Otherwise Specified.
2. Fabrication to be Free of Distortion
3. All Sharp Corners and Burs to be Removed
4. Frame to be Galvanised after Fabrication.

Item No	Qty	Size	Length	Width	Material	Mass in Kg/Item	Remarks
4	1						
3	1						
2	1						
1	1						

Rev	Description	Drawn	Checked	Appd
0	Issued for review	3YN		

TOLERANCES UNLESS SPECIFIED OTHERWISE:
 FABRICATION ±2mm
 MACHINING ±0.25mm
 ANGULAR ±0.25°
 SURFACE FINISH 3.2µ

DEBURR ALL SHARP EDGES

ALL DIMENSIONS IN MILLIMETRES UNLESS SPECIFIED OTHERWISE

DO NOT SCALE

SCALE 1:25 A2

The design, fabrication and erection shall be in accordance with the specifications and standards of the relevant authorities and shall be subject to the approval of the relevant authorities.

FORTRESS

Sheet 1 of 1 Rev 0

FF-052

DRG No

JOB No

DATE

TITLE 1	TITLE 2	TITLE 3	TITLE 4

Subject: Discussion of attachment to PCBs (M5 and Westconnex)
Location: Octagon Building: 110 George Street, Parramatta - Level 5

Start: Mon 9/05/2016 3:00 PM
End: Mon 9/05/2016 4:00 PM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [REDACTED]

[REDACTED]

Please go to Security on ground level first. They will then call me to come and get you.
Thanks



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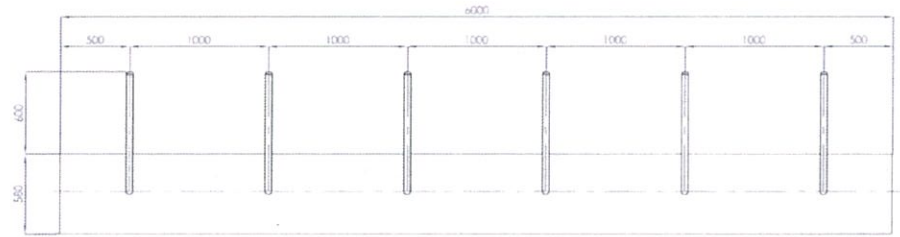
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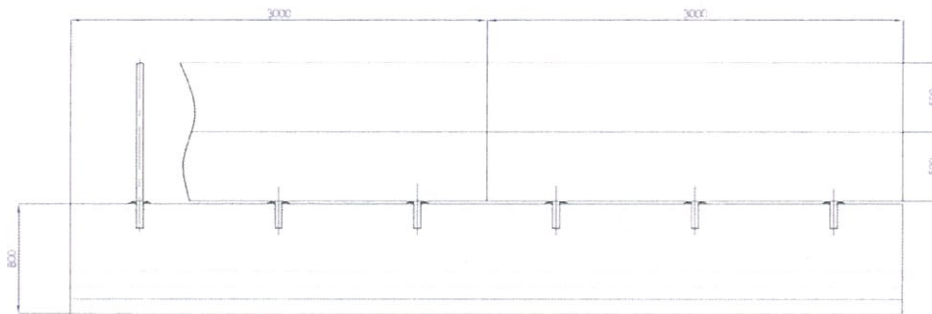
Barrier

Hoarding.pdf



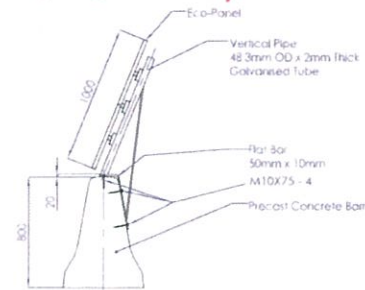


PLAN



ELEVATION

- * No horizontal steel members.
- * Eco-Panel to span across a single barrier to ensure hoarding articulate with barriers.
- * Brackets will be braced to the vertical to ensure pole stays in place with impact.
- * IF Eco-Panel shatter it break up in small pieces, due to the light weight and low freeway speeds + possible angle of impact the possible projectile pose a minimal risk.



SIDE VIEW

Notes:

1. All Welds to be AS 1554.1 Sp Unless Otherwise Specified.
2. Fabrication to be Free of Distortion
3. All Sharp Corners and Burs to be Removed
4. Frame to be Galvanized after Fabrication.

Item No	Qty	Size	Length	Width	Material	Mass (kg/item)	Remarks
4	1						
3	1						
2	1						
1	1						

Rev	Description	Drawn	Checked	Appd	Date
0	Issued for review				

TOLERANCES UNLESS SPECIFIED OTHERWISE: FABRICATION ±2mm MAX FINISH TO SURFACE ANGULAR TO 25° SURFACE FINISH 3.2µ	Drawn: [] Date: [] Checked: [] Date: [] Appd: [] Date: []	Scale: 1:25 A2	FORTRESS FENCE <small>The design, fabrication and detail construction of this fence shall be in accordance with the specifications and shall not be deviated from or modified in whole or in part or any part thereof without the written consent of the client.</small>	TITLE 1 TITLE 2 TITLE 3 TITLE 4	Eco-Panel APB Creek Road at Zilligrae Start on DeBurgh (D88) on Concrete Barrier
---	--	-------------------	--	--	--

JOB No	DRG No	FF-052	Sheet 1 of 1	Rev 0
--------	--------	--------	--------------	-------

[REDACTED]

From: [REDACTED]
Sent: Tuesday, 24 May 2016 3:23 PM
To: [REDACTED]
Cc: [REDACTED]
Subject: RE: Barrier Mounted Hoarding

[REDACTED]

In response to your email please note that you are not being asked to compare your system to a product that was produced and tested by another company. You are being asked to design a system that is demonstrated to adequately perform when impacted as intended (or as a minimum understand and document the risks). We have just provided you information of a particular risk that we know exists.

To reiterate, the system tested was a proprietary product with proprietary connections which are protected by patent and copyright. Therefore I cannot issue any further information provided to Roads and Maritime Services by that proprietor as 'Commercial in Confidence' information.

However, I can advise the following:

- A 4-12 test was undertaken, which is an 8T vehicle at 80 km/h at 15°
- steel posts sections were impacted by the 8T vehicle and sheared off by the impact causing 2 separate posts to travel 11m into the adjacent workzone (a total of 34m from their original location)
- any system you develop should be able to demonstrate that it can adequately perform when impacted by a vehicle that is normally expected to exist in the adjacent roadway and at a speed equivalent to that of normal traffic flow

It should be noted that any risks associated with your proposal should be identified and documented and appropriate mitigation measures implemented to address those risks.

[REDACTED]

www.rms.nsw.gov.au
Every journey matters

Roads and Maritime Services
Level 5, Pod B, 99 Phillip Street Parramatta NSW 2151

From: [REDACTED]
Sent: Tuesday, 24 May 2016 12:07 PM
To: [REDACTED]
Cc: [REDACTED]
Subject: RE: Barrier Mounted Hoarding

Thanks [REDACTED]

Which way did the screens "hook" into/onto the barrier or how were they fixed to the barrier. To make a valuable assessment I need to understand what was tested and how? If I cannot compare apples with

apples I won't know if my recommendations have any value or not? Surely if this is a risk to safety there must be transparency in the information we are dealing with?

If a third-party / private company was involved can you do a hand drawn sketch of the set-up for me? That will really help me understand what went wrong.

I am also looking for test specific information, at what speeds and at angles were the tests conducted?

Thanks for your help [REDACTED]

Appreciated

[REDACTED]
Project Engineer

WestConnex New M5



[REDACTED]
www.westconnex.com.au

From: [REDACTED]
Sent: Tuesday, 24 May 2016 9:26 AM
To: [REDACTED]
Cc: [REDACTED]
Subject: RE: Barrier Mounted Hoarding

[REDACTED]

Unfortunately the tests were undertaken on a proprietary product and design. Therefore the tests are commercial in confidence and cannot be provided.

I can say the following which should provide the guidance required:

- Barrier was precast type F shape
- screens inserted into the barrier and connected using steel post sections which hooked into the barrier units
- Total height of system = 2.2m
- 4-12 test undertaken
- Posts observed to break away/shear and land 11m behind the traffic face (and 34m from its original position). Post fragments weighed 10kg

[REDACTED]
www.rms.nsw.gov.au
Every journey matters

Roads and Maritime Services
Level 5, Pod B, 99 Phillip Street Parramatta NSW 2151

From: [REDACTED]
Sent: Monday, 23 May 2016 4:26 PM
To: [REDACTED]
Cc: [REDACTED]
Subject: RE: Barrier Mounted Hoarding

Hi [REDACTED]

Trust you are well?

Just to give you a heads up, we are working on a proposal to submit for consideration soon. You mentioned below that some crash testing was done on barriers with anti-gawk screens attached to them. Is it possible to send me the video footage / test results. To ensure our recommendations are sound I need to evaluate / see what was tested. What type of barrier was used, what type of screen was used, how was it fixed to the barrier, speed of impact, angle of impact, configuration of panels, panel material, post material and any other information which I can use to evaluate our proposal. It would be very helpful to see the tests and the effect of the impact.

Thank you for your assistance.

[REDACTED]

Project Engineer

WestConnex New M5



[REDACTED]

www.westconnex.com.au

From: [REDACTED]
Sent: Tuesday, 10 May 2016 3:56 PM
To: [REDACTED]
Cc: [REDACTED]
Subject: Barrier Mounted Hoarding

[REDACTED]

Thank you for meeting with us yesterday to discuss the proposed barrier mounted hoarding for the M5 and M4 projects.

As discussed yesterday, the Austroads Safety Barrier Assessment Panel recently considered the application of anti-gawk screens to safety barriers and recommended to the constituent road agencies that such screens not be attached to road safety barriers. This was following the results of undertaken crash testing and the resultant significant debris that was considered hazardous to construction workers as a minimum. The Panel recommended that any screens would should be separate fences provided outside the deflection requirements of the adjacent road safety barrier system.

The attachment of any screen to a road safety barrier should provide a net increase in safety for all road users (or at least no decrease).

Therefore, to consider your proposal further it is necessary to adequately address the following items:

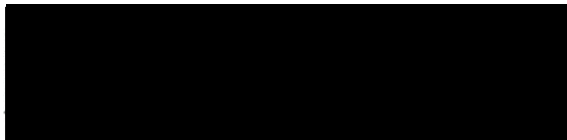
- Clearly define the problems/concerns the attachment of the screen is trying to solve
- Has the safety of road users (including construction workers) been increased (or at least not decreased)?
- What engineering calculations have been undertaken to verify the strength of the brackets and connections/posts etc?
- What testing has been conducted to verify the safety performance of the overall barrier and screen combination?

It is also necessary to demonstrate that the attachment of the screen:

- Does not affect the performance of the barrier,
- When impacted, does not enter the work zone and/or create a hazard to workers,
- When impacted, an exclusion zone between the back of the barrier and the work zone should be provided to contain the resultant significant debris.
-

Further, if consideration is to be made on the issue of a separate screen then it must be shown that the screen and associated footing/bracing does not impinge on the deflection associated with the adjacent road safety barrier.

Please let me know if you need any further information.



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Every journey matters

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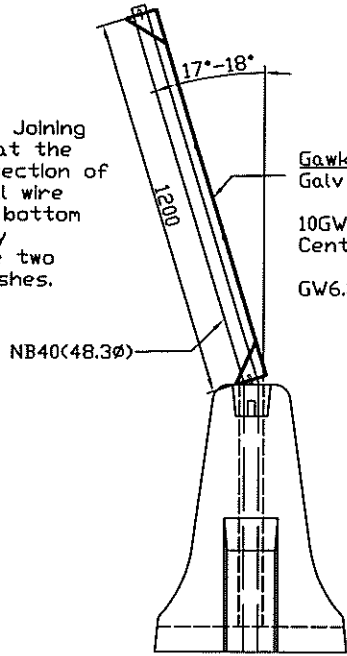


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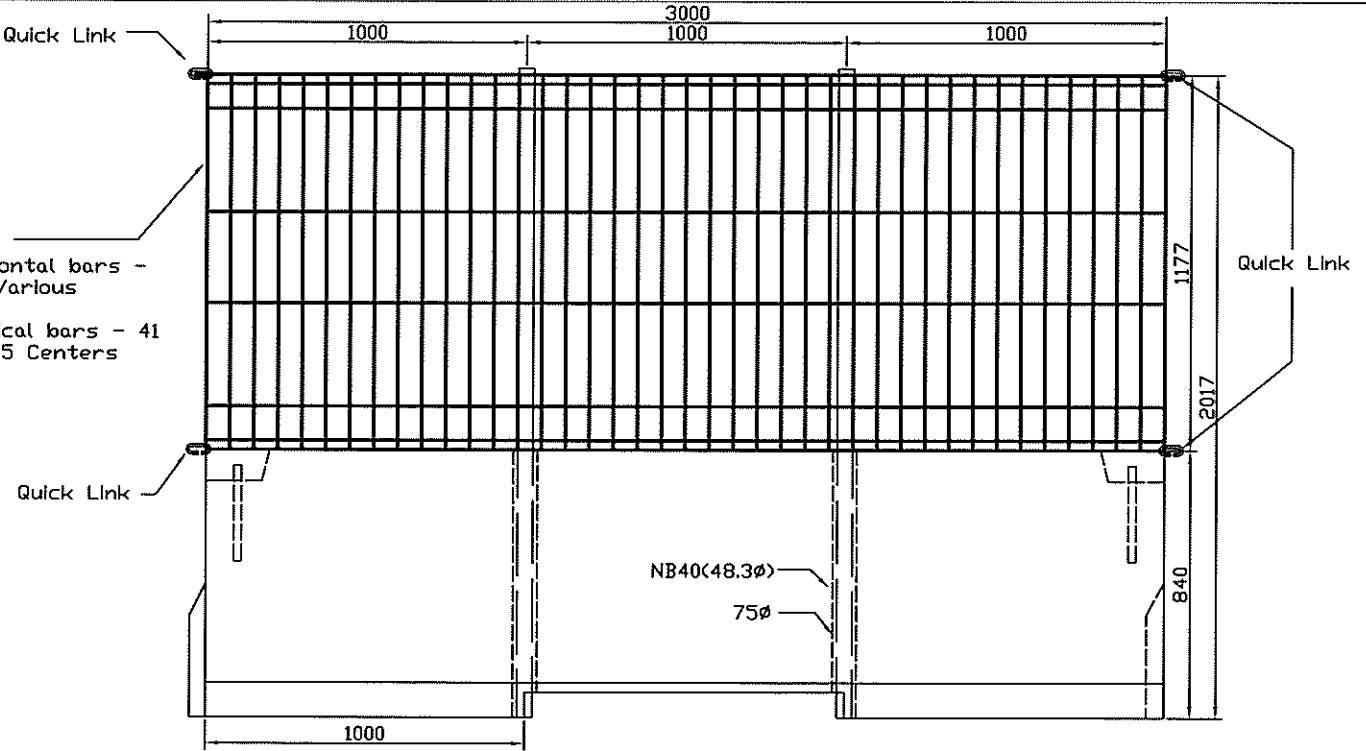


NOTE:
 Quick Link - Joining link placed at the horizontal section of last vertical wire both top & bottom to physically connect the two adjoining meshes.

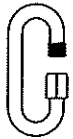


END ELEVATION

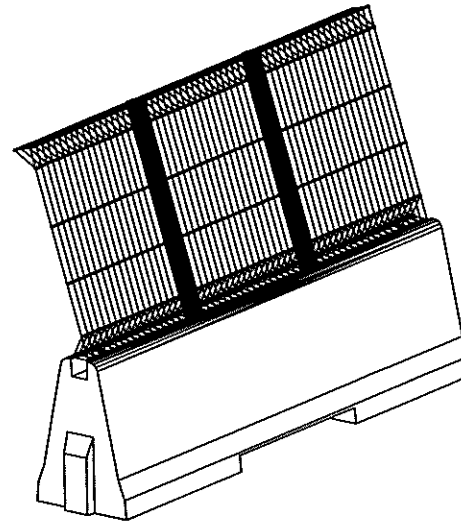
Gawking
 Galv mesh
 Horizontal bars -
 10GW5 @ Various
 Centers
 Vertical bars - 41
 GW6.3 @ 75 Centers



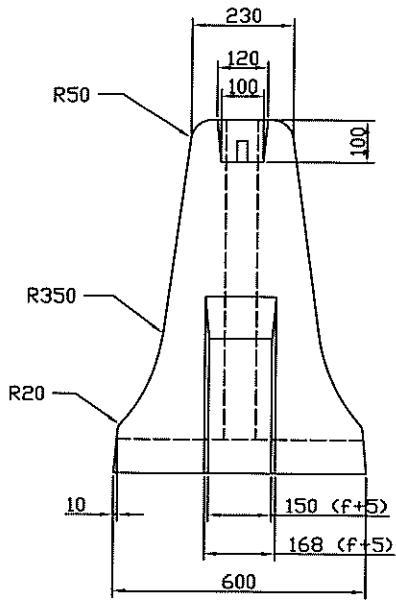
ELEVATION



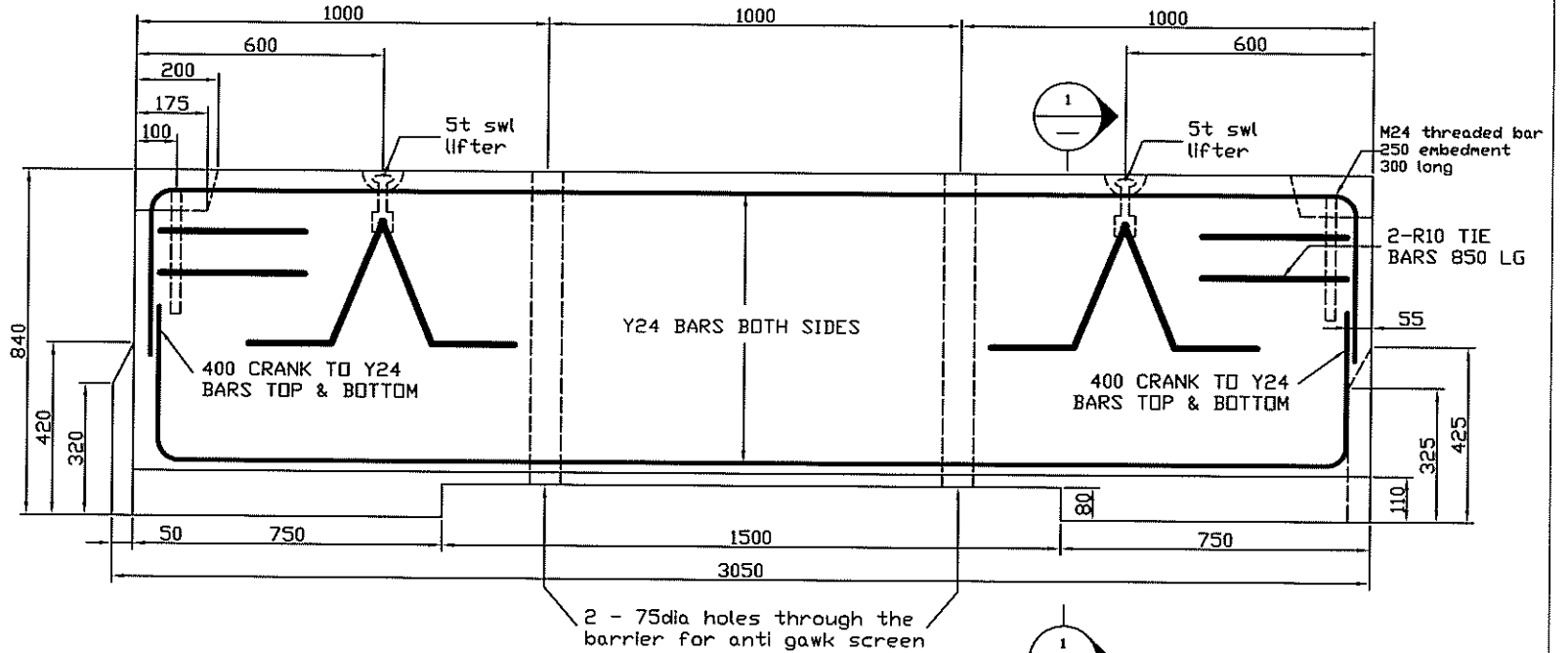
4 off Joining Link 2 - each end
 of gawk screen Top & Bottom



ISOMETRIC LAYOUT

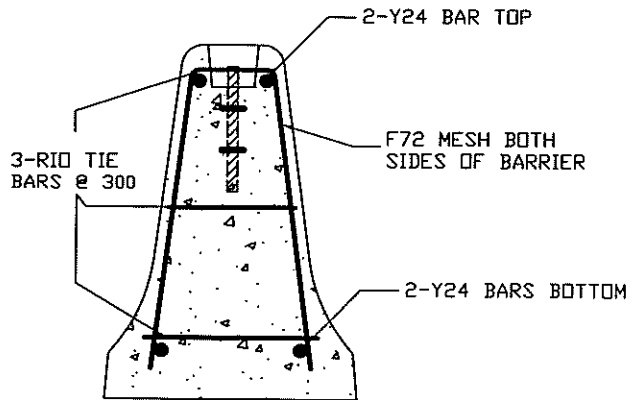


END ELEVATION

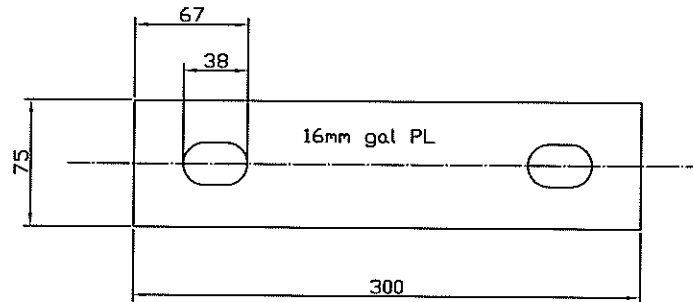


ELEVATION

2 - 75dia holes through the barrier for anti gawk screen



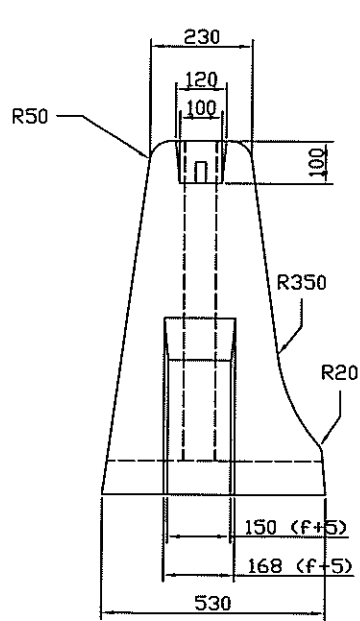
SECTION



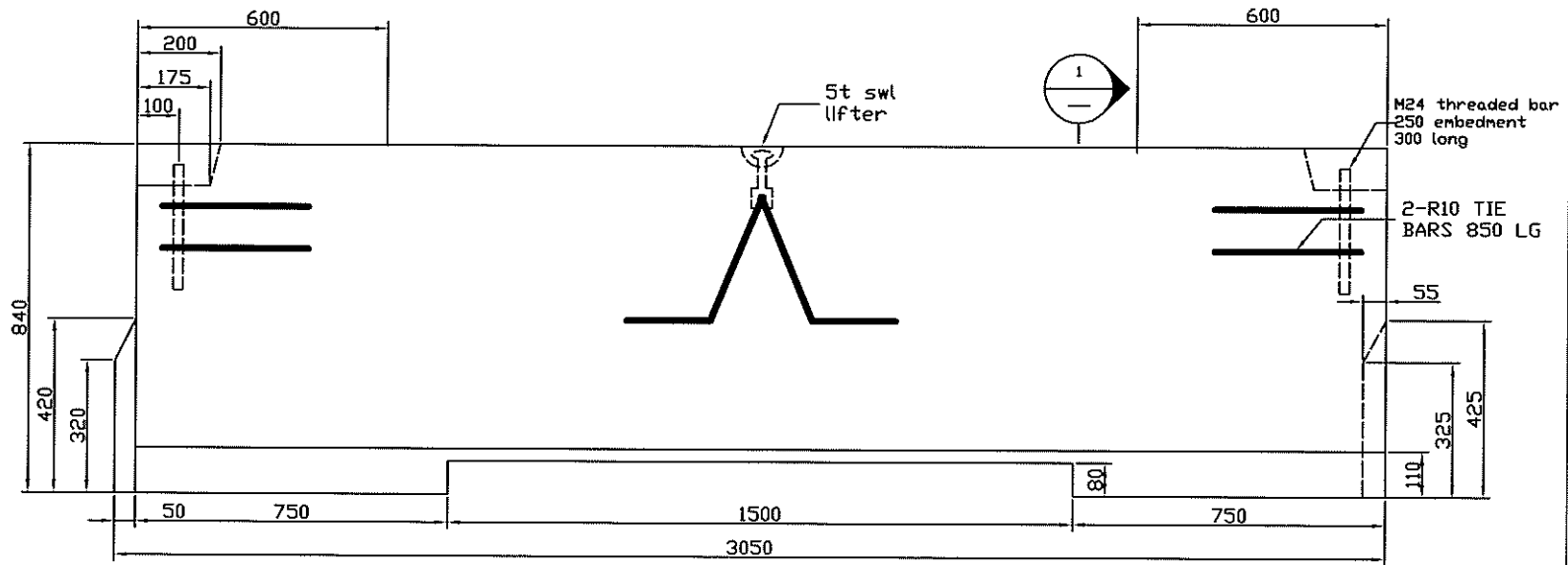
CONNECTION PLATE

NOTE:
MINIMUM CONCRETE
STRENGTH 32MPA

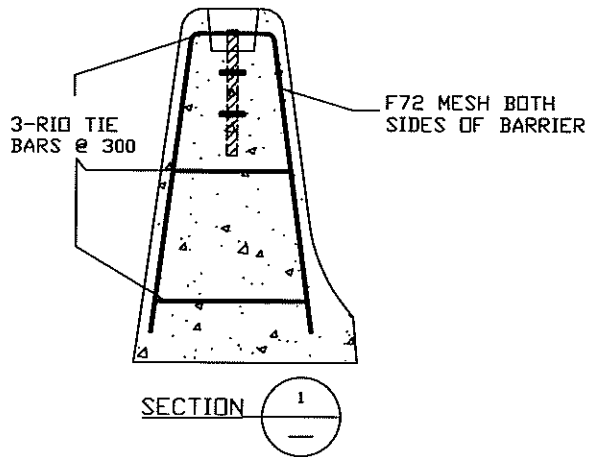
NOTE: F TYPE BARRIER IS TO THE RTA
STANDARD SECTION



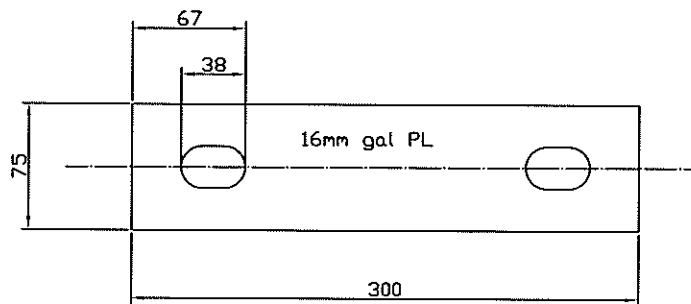
END ELEVATION



ELEVATION

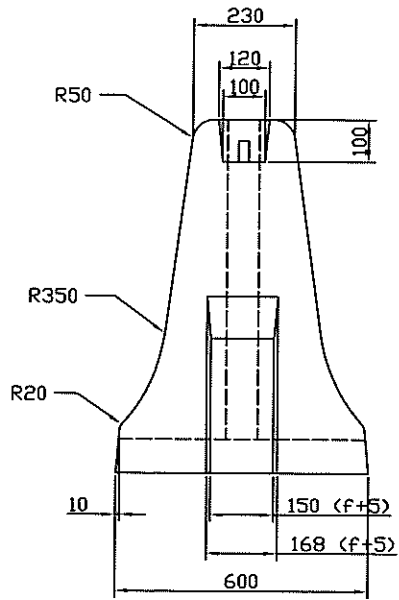


SECTION

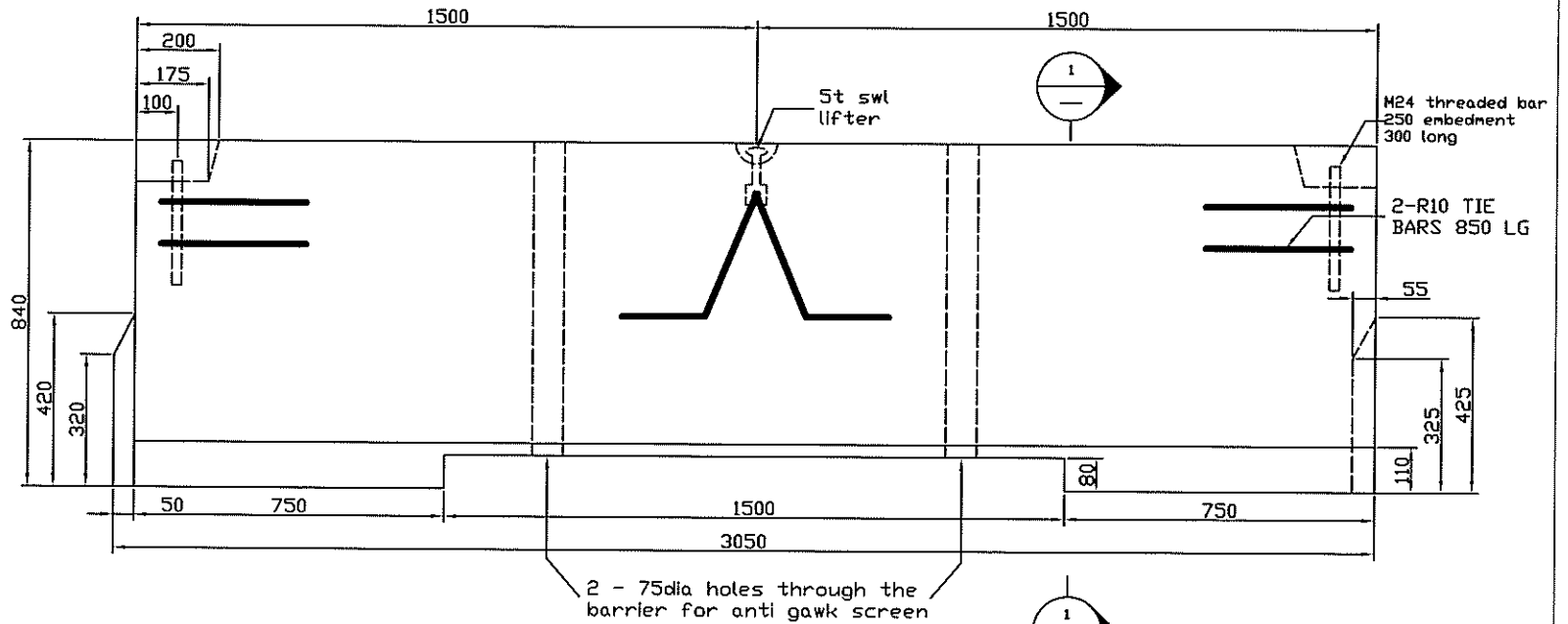


CONNECTION PLATE

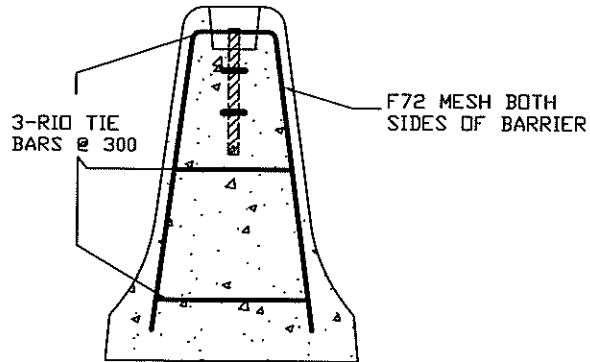
NOTE:
MINIMUM CONCRETE
STRENGTH 32MPA



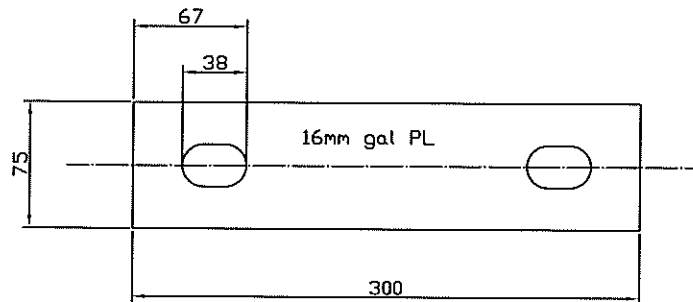
END ELEVATION



ELEVATION



SECTION



CONNECTION PLATE

NOTE:
MINIMUM CONCRETE
STRENGTH 32MPA

NOTE: F TYPE BARRIER IS TO THE RTA
STANDARD SECTION

Introduction

F type road barriers are manufactured with a linkage system using a top plate and a tongue and groove concrete joint at the base of the joint.

F Type barriers *must* be jointed when installed. Dynamic deflections *must* be allowed for in design, minimum offset 300mm.

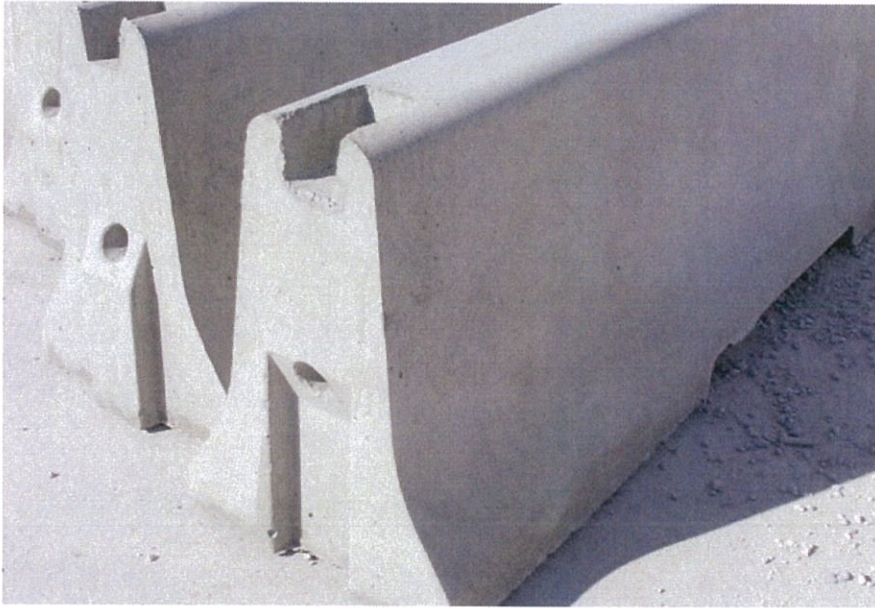
The F Type barriers manufactured are shown on the drawings FT-1, FT-RTA-1, FT-GS-1 and FT-SS-1, which can be found at the end of this document.

F Type products can be made with or without drainage slots on the base. As a standard drainage slots are provided.

F Type barriers are a semi rigid traffic barrier offering the impact strength of concrete barriers, the energy absorbing capability of metal barriers and crash performance better than other products.



F-TYPE BARRIER



Precast Concrete Road Barrier

 Email

From: [Redacted]
To: [Redacted]
CC: [Redacted]
Subject: RE: Barrier Mounted Hoarding

Sent: 10/05/2016 9:09:16 AM



Attachments may contain viruses that are harmful to your computer. Attachments may not display correctly.

 [image001.jpg \(6Kb\)](#)

[Redacted]

Contact details as follows:

[Redacted]

I should have details as discussed at yesterday's meeting to you this afternoon for your action and consideration.

Thanks

[Redacted]

From: [Redacted]

Sent: Monday, 9 May 2016 4:54 PM

To: [Redacted]

Cc: [Redacted]

Subject: Barrier Mounted Hoarding

Importance: High

[Redacted]

Once again thank you for taking the time to set up the meeting. I think it was definitely worthwhile and we can see the potential of making a positive contribution to the subject. Would you please be so kind and forward me the contact details of [Redacted] I would like to keep them in the loop of our communications.

Best regards

[Redacted]

Project Engineer

WestConnex New M5



[Redacted]

www.westconnex.com.au

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Appendix E: Consultation Materials

25 May 2016

Site establishment work – Kingsgrove

Work is underway on WestConnex which involves widening and extending the M4 and M5 and joining them to create a free-flowing motorway network.

As part of the project, the New M5 will duplicate the existing M5 East corridor, doubling vehicle capacity and easing congestion between St Peters and Beverly Hills. It will include twin tunnels, an upgrade of King Georges Road Interchange and a new interchange at St Peters. For more information, visit westconnex.com.au/NewM5.

In preparation for the start of construction for the New M5, over the next four months, three construction sites will be established in Kingsgrove:

- on the northern side of the M5 East motorway near Rosebank Avenue, Armitree Street and Glamis Street. The entry point to this site will be located via the M5 East motorway (east bound) and Garema Circuit
- on the southern side of the M5 East motorway near The Crescent. The entry point to this site will be located via the M5 East motorway (west bound)
- near Commercial Road. The entry point to this site will be located off Commercial Road.

A map showing the location of the sites is provided overleaf.

Site establishment works

Establishing the construction sites will involve:

- levelling ground and trimming and clearing vegetation
- installing temporary noise walls, hoarding, access gates and utility services including power, communications, water and sewerage
- constructing internal access roads, car parks, entry gates and temporary shared paths
- delivering and installing temporary buildings, such as site offices, workshops and storage facilities
- undertaking geotechnical and environmental drilling and surveying
- monitoring water quality and noise and vibration levels.

Equipment used throughout the works will include trucks, chainsaws, lighting towers, concrete cutters, generators, excavation and boring equipment, cranes, compressors, pumps and mulchers. Every effort will be made to minimise the impact of work on nearby residents and businesses.

Work hours

Site establishment works will generally be undertaken **between 7.00 am and 6.00 pm from Monday to Friday and 8.00 am and 1.00 pm on Saturday**. There will be no work on Sunday or public holidays, unless notified otherwise.

Reference: 070

ABOUT WESTCONNEX

WestConnex is part of a broader transport plan for Sydney which includes improved public transport, such as Sydney Metro and light rail, as well as better, more reliable motorway solutions. More than two-thirds of WestConnex will be built underground. Once complete, motorists will be able to avoid up to 52 sets of traffic lights and enjoy significant travel time savings.

For more information

✉ info@westconnex.com.au
☎ 1800 660 248
🌐 westconnex.com.au





Easing
congestion



Creating
jobs



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communities

Night works will be intermittently required for the safety of workers and motorists and will be undertaken **between 8.00 pm and 5.00 am from Sunday to Thursday**. Residents and businesses impacted by night works will be notified prior to works commencing.

Upcoming night works will be carried out during the standard M5 East operations maintenance shutdown and may include:

- installing concrete safety barriers on the motorway
- removing the slip lane on the motorway
- reducing lane widths along a one kilometre section on the M5 East motorway.

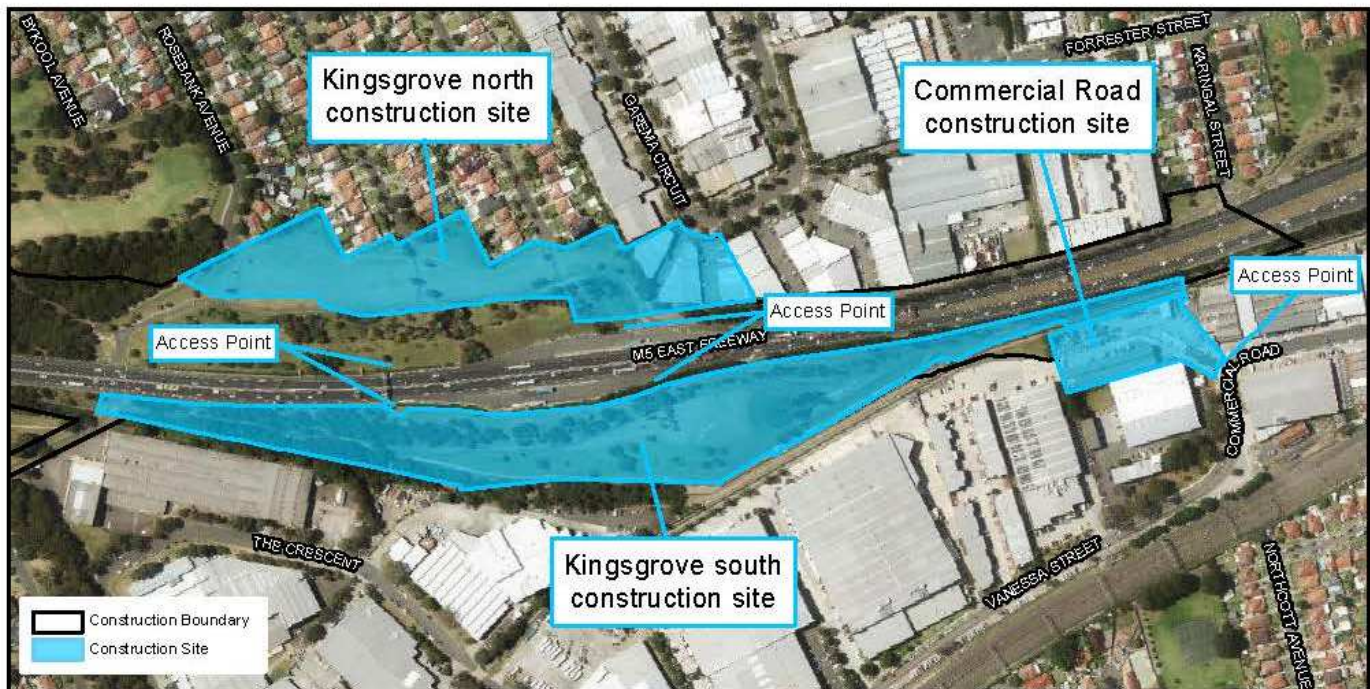
Temporary traffic changes

Temporary traffic changes will be required to safely complete the works. Traffic control and signage will be in place to guide motorists, pedestrians and cyclists through any changed traffic conditions.

For more information

If you have any questions about this work, please call toll free 1800 660 248 during office hours (8.30 am to 5.00 pm, Monday to Friday) and ask to speak to a member of the New M5 community engagement team. You can also subscribe to receive email updates at westconnex.com.au/subscribe.

Location of Kingsgrove construction sites



We speak your language

To learn more simply visit westconnex.com.au/yourlanguage.

Need an interpreter? Call the Translating and Interpreting Service on 131 450



Pale Eucalypt



Dune



Windspray



Artist's impression of the New M5 tunnels at Kingsgrove

A New M5 is proposed to more than double the capacity of the M5 East Motorway corridor by providing new twin tunnels from St Peters to Kingsgrove. The Environmental Impact Statement, released on 27 November 2015, includes information on permanent infrastructure and construction activities around Kingsgrove.

The New M5 will:

- reduce traffic on the M5 East, improving travel speeds for heavy vehicles travelling to and from Sydney Airport and Port Botany
- have tunnels that are taller, wider and not as steep as the existing M5 East, resulting in a smoother ride for motorists and reduced emissions
- have efficient and modern ventilation systems which meet stringent air quality standards in the tunnels and surrounding suburbs
- create around 14 kilometres of new and upgraded shared, pedestrian and cycle paths, realigning and improving the shared pedestrian and cyclist path from Beverly Grove Park, north of the M5 East Motorway.

Activities in Kingsgrove

Three construction sites for the New M5 will be located around the existing M5 East in Kingsgrove.

The sites were selected as they:

- are adjacent to the M5 East, which needs to be widened and realigned in this location
- are next to the proposed motorway tunnel entry and exit points

- avoid Wolli Creek bushland and Tallawalla Street Park and netball courts
- have space for a permanent motorway operations facility
- eliminate the need for residential property acquisition at these sites
- have good access to the M5 East and main roads for construction vehicles.

A permanent motorway operations complex will be located south of the M5 East (see map over leaf).

Once construction is complete, the land not required for the new motorway arrangement and operational facilities will be remediated and landscaped.

Changes to the M5 East

Some changes to the existing M5 East will be required between King Georges Road Interchange and Kingsgrove Road to integrate the New M5 motorway. This includes:

- four new lanes (two in each direction) to connect the M5 South West Motorway and the King Georges Road Interchange with the New M5 tunnels



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New M5 – Kingsgrove

Fact sheet

November 2015

- realignment of the M5 East Motorway between King Georges Road and Kingsgrove Road. The motorway will be resurfaced, separated from the New M5 and provided with new signage
- eastbound and westbound ramps to connect the King Georges Road Interchange and the M5 East
- a permanent noise barrier on the northern side of the M5 East motorway
- a permanent noise barrier on the southern side of the M5 East motorway
- extension of the Kindilan underpass to accommodate the wider motorway corridor
- tolling infrastructure on the M5 East Motorway.

See Chapter 5 of the Environmental Impact Statement (EIS) for more information.

Entry and exit points

The western entry and exit points for the New M5 tunnels will be within the existing motorway corridor located next to the Kingsgrove business area.

Kingsgrove motorway operations complex

The New M5 will be supported by permanent operational facilities at Kingsgrove, south of the existing M5 East Motorway.

The motorway operations complex will include:

- a ventilation facility
- deluge tanks and the tunnels' emergency response system
- a maintenance facility and workshop
- offices and storage
- on-site staff car parking.

See Chapter 5 of the EIS for more information.

Kingsgrove ventilation facility

The Kingsgrove ventilation facility has been designed to achieve some of the most stringent standards in the world and will be effective at maintaining local air quality.

The site for the Kingsgrove ventilation facility was selected as it

was close to the tunnel entry and exit points and will be located within an established commercial and industrial area, limiting the potential impacts on residential properties to the north of the motorway.

See Chapters 10 and 14 of the EIS for more information.

Active transport

Construction of the New M5 will result in some changes to existing pedestrian paths and cycleways.

Permanent changes

- The M5 East will be permanently closed to cyclists from the start of construction. Cyclists will be diverted onto the shared paths within Beverly Grove Park and/or surrounding local roads.
- The path through Beverly Grove Park, north of the M5 East, will be upgraded and reinstated.
- The shared path on the southern side of the M5 East will be replaced with an upgraded path south of the Kingsgrove motorway operations complex.

Temporary changes

- The shared path within Beverly Grove Park on the southern side of the M5 East will be closed during construction and pedestrians and cyclists will be diverted to the new temporary northern path.
- Pedestrian and cyclist access will be maintained at the Kindilan underpass and hoardings will be installed to ensure community safety. The Kindilan underpass will be closed for only a short period of time during the extension of the Kindilan underpass.
- During construction of the project, the Kindilan underpass will be used by construction vehicles moving between construction compounds on the north and south sides of the motorway.

See Chapter 9 of the EIS for more information.

Minimising community impact

The New M5 has been designed to reduce impact on local communities. To reduce noise and visual impacts to the Kingsgrove community during construction:

- noise barriers will be installed around the tunnelling site and hoarding will be installed along the northern boundaries of the Kingsgrove North compound

- an acoustic shed will be installed over the tunnel access point and its nearest stockpile
- a shed will be installed over the Commercial Road tunnel access point and related stockpile
- trucks will follow designated routes to and from site.

Minimising environmental impact

Some Cooks River Ironbark Forest vegetation will be removed to allow for the New M5 widening. This will be offset in accordance with the Framework for Biodiversity Assessment.

See Chapter 21 of the EIS for more information.

Construction of the New M5

Construction sites

Three construction sites will be established in Kingsgrove:

- Kingsgrove north: Located on the northern side of the M5 East, this site will support the changes to the M5 East and tunnelling work.
- Kingsgrove south: Located on the southern side of the M5 East, this site will support the changes to the M5 East and construction of the Kingsgrove motorway operations complex
- Commercial Road: Located between Tallawalla Street and Commercial Road, Kingsgrove, this site will support tunnelling activities.

Construction schedule

If approved, construction of the New M5 will commence in mid-2016 and be completed by late-2019. See Tables 1 and 2 below for indicative construction timeframes across the Kingsgrove New M5 sites.

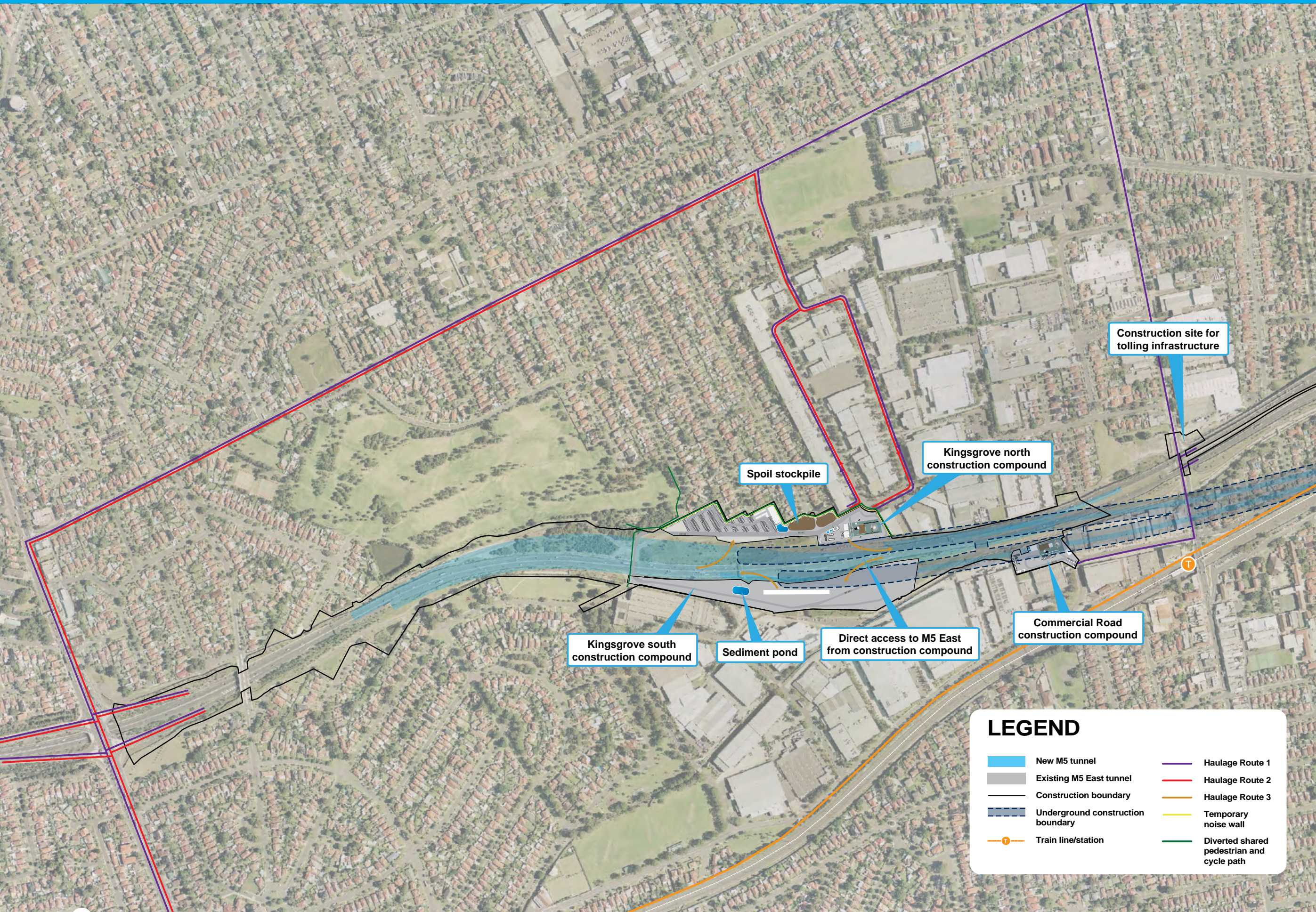
See Chapter 6 in the EIS for more information.

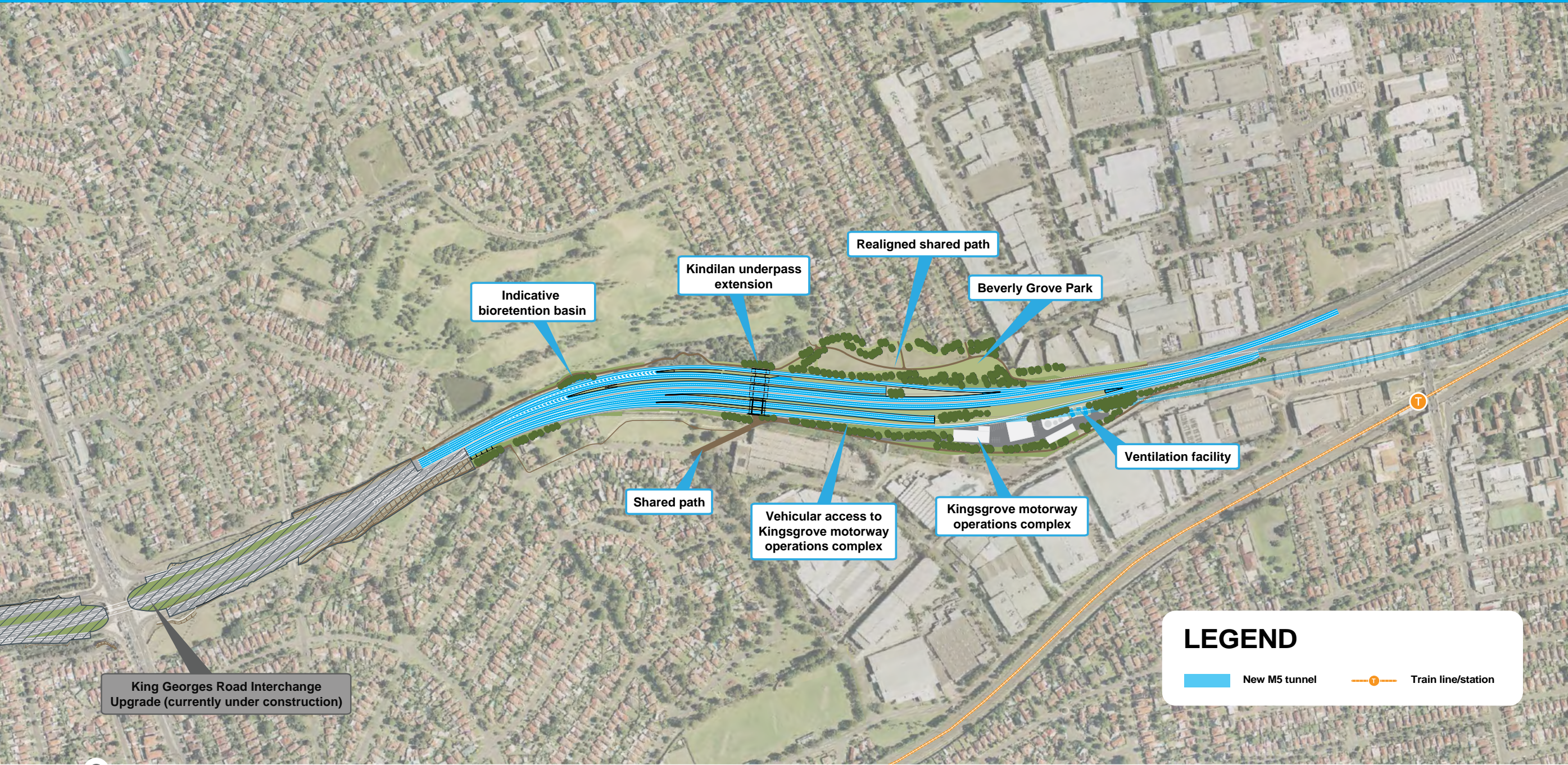
Table 1: Indicative program for the Kingsgrove north and south construction compounds

Construction activity	2016	2017	2018	2019
Site establishment				
Western surface works				
Cut and cover structure for the eastbound and westbound main alignment tunnel				
Tunnelling (including sinking of shaft and excavation)				
Construction of the Kingsgrove South motorway operations complex				
Construction of permanent operational facilities				
Demobilisation and rehabilitation				



Table 2: Indicative program for the Commercial Road construction compound

Construction activity	2016	2017	2018	2019
Site establishment				
Tunnelling (including sinking of shaft and excavation)				
Demobilisation and rehabilitation				





LEGEND

 New M5 tunnel	 Train line/station
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Easing
congestion



Creating
jobs



Connecting
communities

Construction movements

Table 3 below shows the proposed construction vehicle movements across the Kingsgrove sites. To minimise impacts to local traffic and the community, construction vehicles will use the existing motorway and main roads as much as possible.

See Chapter 9 of the Environmental Impact Statement for more information.

Hours of work

Aboveground construction

- 7:00am to 6:00pm Monday to Friday
- 8:00am to 1:00pm Saturday
- generally, there will be no work on Sundays or public holidays.

Table 3: Indicative construction vehicle movements for the Kingsgrove construction program

Construction traffic route	Construction route number	Access point	Vehicle type	Daily vehicles [^]	AM peak (vehicles per hour)	PM peak (vehicles per hour)
Kingsgrove North*	Route 1	Garema Circuit (left in, left out)	Light	452	14	12
			Heavy	672	21	19
	Route 2	Garema Circuit (left in, left out)	Light	452	14	12
			Heavy	672	21	19
	Route 3	M5 East Motorway (left in, left out)	Light	86	3	2
			Heavy	631	20	18
Total (Route 1, 2 and 3)	Garema Circuit and M5 East Motorway	Light	989	31	26	
		Heavy	1975	62	56	
Kingsgrove South	Route 3**	M5 East Motorway (left in, left out)	Light	24	1	1
			Heavy	72	3	3
Commercial Road	N/A	Commercial Road (left in, left out)	Light	133	7	7
			Heavy	192	8	8

*Construction traffic from the Kingsgrove North construction compound onto Garema Circuit (construction routes 1 and 2) comprises heavy and light vehicle movements from the Kingsgrove South construction compound which are not entering and exiting the construction compound directly via the M5 East Motorway (westbound).

**The Kingsgrove South construction compound construction routes 1 and 2 are included as part of the Kingsgrove North construction compound construction route 1 and 2. Construction traffic will travel to the Kingsgrove North construction compound via the Kindilan underpass.

[^]Daily vehicles account for traffic movements across a 24-hour period, including movements outside of standard construction hours.

For safety and operational reasons, some work on the M5 East Motorway and local roads will occur out of hours. This work will be conducted in accordance with conditions of approval and Environment Protection licences.

Tunnelling work

Tunnelling work and support activities, including transporting excavated material, will take place up to 24 hours a day, seven days a week.

More information on tunnelling can be found in the New M5 - Tunnelling fact sheet at westconnex.com.au.

Keeping the community informed

We are committed to keeping you informed and will provide regular information on the New M5 through direct mail and email notifications, community updates, advertising and other consultations.

You can also contact the WestConnex info line on **1300 660 248**, email info@westconnex.com.au or visit westconnex.com.au for more information.



Milestones for the New M5

Aug 2013	WestConnex Business Case approved
May 2014	Australian Government loan to fast track construction
Sept 2014	Request Expressions of Interest from construction contractors
Nov 2014	Lodge planning application
Nov 2014	Request detailed tenders
Sept 2015	Select preferred design
Nov 2015	Environmental Impact Statement exhibition and consultation WE ARE HERE
Early 2016	Respond to submissions and adapt design as needed
Early 2016	Detailed design underway
Early 2016	Planning approval decision
Mid 2016	Start major work (subject to approval)



We speak your language

English

Learn more by visiting www.westconnex.com.au/yourlanguage to watch project videos in your language and read more about WestConnex. If you need an interpreter, call the Translating and Interpreting Service on **131 450**.

Arabic

اعرف المزيد بزيارة الموقع www.westconnex.com.au/yourlanguage وذلك لمشاهدة الفيديوهات الخاصة بالمشروع باللغة العربية وقراءة المزيد عن وست كونكس. إذا كنت في حاجة إلى مترجم، اتصل بخدمة الترجمة الخطية والشفهية على الرقم **.131 450**

Chinese

了解詳情請上網 www.westconnex.com.au/yourlanguage 觀看(普通話) 視頻, 並查閱有關WestConnex的更多訊息。如需要傳譯員請 撥電話傳譯服務 **131 450**

Hindi

इस वेबसाइट पर अधिक जानकारी पाएँ: www.westconnex.com.au/yourlanguage व (हिन्दी) में इस परियोजना के बारे में वीडियो देखें और वेबसाइट के बारे में और अधिक सामग्री पढ़ें। यदि आपको दुभाषिया चाहिए तो अनुवाद व दुभाषिया सेवा को **131 450** पर फोन करें।

Greek

Μάθετε περισσότερα επισκεπτόμενοι το www.westconnex.com.au/yourlanguage για να δείτε τα βίντεο του έργου στα ελληνικά και να διαβάσετε περισσότερα για το WestConnex. Εάν χρειάζεστε διερμηνέα, καλέστε την Υπηρεσία Μετάφρασης και Διερμηνείας στο **131 450**.

Italian

Per saperne di più visiti il sito www.westconnex.com.au/yourlanguage, dove potrai guardare i video del progetto in lingua italiana e trovare maggiori informazioni su WestConnex. Se ha bisogno di un interprete, contatti il Servizio di Traduzione ed Interpretariato (Translating and Interpreting Service) al numero **131 450**.

Korean

www.westconnex.com.au/yourlanguage 를 방문하여 한국어로 된 프로젝트 비디오를 보고 WestConnex 에 관해 읽고 배우세요. 통역이 필요하시면 번역 및 통역 서비스 **131 450** (TIS) 으로 전화 하십시오.

Vietnamese

Hãy tìm hiểu thêm và viếng trang mạng www.westconnex.com.au/yourlanguage để xem phim ảnh bằng Việt ngữ về công trình này và đọc thêm về WestConnex. Nếu quý vị cần thông ngôn viên, xin vui lòng gọi Dịch Vụ Thông Ngôn Phiên Dịch số **131 450**.