APPENDIX C

NOISE AND VIBRATION IMPACT ASSESSMENT REPORT

Noise and Vibration Impact Assessment

Central Sydney Industrial Estate
Rosehill, NSW

Prepared for: Element Environment Pty Ltd
September 2020
MAC201090-01RP1V2

Muller Acoustic Consulting

Document Information

Noise and Vibration Impact Assessment

Central Sydney Industrial Estate

Rosehill, NSW

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Element Environment Pty Ltd (Element) to prepare a Noise and Vibration Impact Assessment (NVIA) for the development of the Central Sydney Industrial Estate (CSIE) (previously Western Area) incorporating Downer EDI Works Pty Ltd's (Downer) Sustainable Road Resource Centre at Rosehill, NSW (the 'project').

The NVIA quantifies potential noise impacts associated with operation, construction and road traffic at the relevant nearby receivers to the project. The NVIA has been prepared in accordance with the following policies and guidelines:

- NSW Environment Protection Authority's (EPA's), Noise Policy for Industry (NPI), 2017;
- NSW Department of Environment and Climate Change (DECC), Interim Construction Noise Guideline (ICNG), 2009;
- NSW Department of Environment, Climate Change and Water (DECCW), NSW Road Noise Policy (RNP), 2011; and
- NSW Department of Environment and Conservation (2006), Assessing Vibration: a technical guideline.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A.**

1.1 Project Background

MAC understands Downer currently owns and operates an asphalt plant, Reconomy facility, office and workshops at 1A Unwin Street, Rosehill, NSW (Rosehill site), and a reclaimed asphalt pavement (RAP) facility at 12 Grand Avenue, Rosehill, NSW (Camellia site).

To facilitate the Sydney Metro West, Downer was notified by the Sydney Metro West project that the Rosehill site would be compulsorily acquired. As a result, Downer proposes to relocate their Rosehill site and Camellia site operations to Lot 6 of the proposed subdivision of the Western Area of the former Clyde Refinery.

The relocation of Downer's operations to the CSIE will coincide with the subdivision and subsequent creation of the CSIE. Therefore, Downer and Viva Energy Pty Ltd (Viva) have agreed that both developments will be assessed under the single State significant development (SSD) application. Downer's operations will form the initial stage of development on the site.

The proposed activities, subject of the SSD application are summarised as follows:

- The staged subdivision of the western area of Lot 100 DP 1168951 into eight industrial lots.
- Prepare the lots via earthworks and civil works for future re-development (by future applications).
- Stage 1 (Sustainable Road Resource Centre) – occupy the newly created Lot 6 and construct and operate the following on the lot:
  - RAP processing operations.
  - Asphalt plant.
  - Reconomy facility.
  - A modern bitumen product manufacturing plant.

MAC understands that the subdivision will result in eight lots, with one to remain undeveloped, one to be developed by Downer as part of this SSD application and the remaining six to be developed by future owners, subject to separate development applications. Hence this assessment has considered construction earthworks and civil works for the subdivision works, and the construction and operational noise associated with the new Downer facility.

1.2 Project Location

The project site is located on the Camellia Peninsula of Rosehill, within the City of Parramatta Local Government Area (LGA), approximately 16km west of the Sydney Central Business District (CBD). The project site, known as the Central Sydney Industrial Estate (formerly Western Area), is a 40ha parcel of land formally identified as Lot 100 of DP 1168951, within the former Clyde Refinery site (refer to **Figure 1)**.

The project site is zoned IN3 Heavy Industry under the Paramatta Local Environment Plan (2011) (Parramatta LEP), and is bounded by industrial developments to the north, east and west, and by Duck River to the south. Other land uses within the locality include IN1 General Industrial, RE2 Private Recreation, B5 Business Development, and Low (R2), Medium (R3) and High (R4) Density Residential (refer to **Figure 2**).

1.3 Study Requirements

1.3.1 Secretary's Environmental Assessment Requirements

The key issues to be addressed, as identified in the Secretary's environmental assessment requirements (SEARS) are reproduced in **Table 1.**

Table 1 SEARS – Key Issues

Noise and Vibration Assessment Requirement	Report Reference
A quantitative assessment of construction, operation and transport noise and vibration impacts undertaken by a suitably qualified person in accordance with the Environment Protection Authority guidelines, including nearby sensitive receivers, landowners and businesses	Section 3.4, Section 6.3, Section 7.1 & Section 7.2
Cumulative impacts of other developments	Section 3.2.4 & Section 7.2
Details of proposed mitigation, management and monitoring measures.	Section 7.1 & Section 8

1.3.2 NSW Environment Protection Authority Requirements

The NSW EPA specific requirements for the NVIA are presented in **Appendix B** along with reference to where the requirements are addressed in the report.

Figure 1

Local context

Central Sydney Industrial Estate Incorporating Downer Sustainable Road Resource Centre

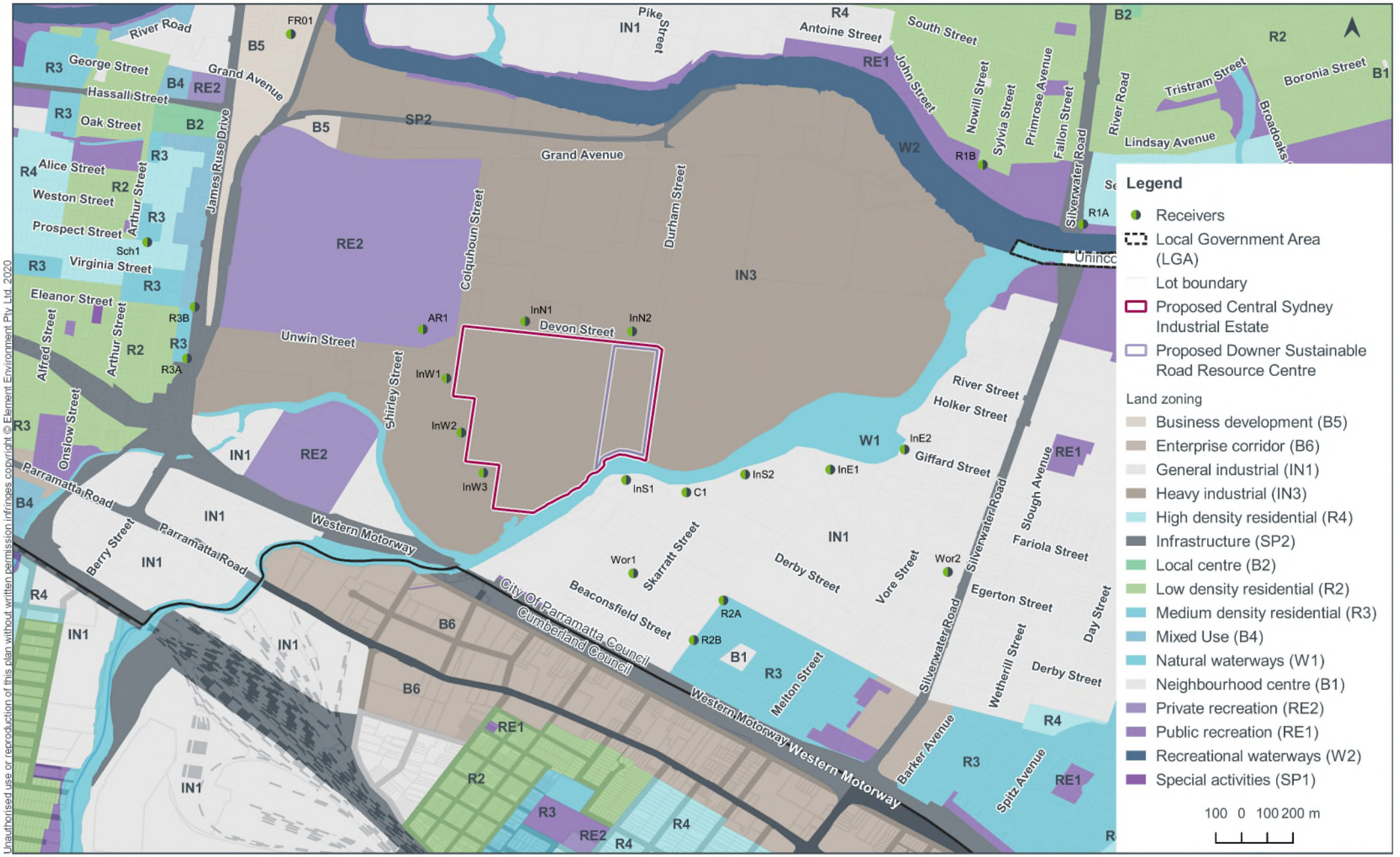
STATE SIGNIFICANT DEVELOPMENT - ENVIRONMENTAL IMPACT STATEMENT

Figure 2

Land zoning and receivers

Central Sydney Industrial Estate Incorporating Downer Sustainable Road Resource Centre

STATE SIGNIFICANT DEVELOPMENT - ENVIRONMENTAL IMPACT STATEMENT



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2 Project Overview

2.1 Existing activities

2.1.1 Viva Energy

State significant development 5147 was approved in 2015 comprising conversion of the former Oil Refinery at Clyde into a finished petroleum product import, storage and distribution terminal.

Works were approved to improve terminal efficiency and to consolidate the operational footprint including demolition and clearing of the old refinery. The Western Area lands were identified as future surplus industrial land for future reuse. The project will be on this land (the site).

State significant development 9302 was lodged in 2018 for the Western Area Remediation Project (WARP). This application has been determined and will result in the remediation and issuance of site audit certification of the site. The activities described in Section 2.2 will progressively occur on remediated areas once they are certified as appropriate for development.

2.1.2 Downer asphalt, reclaimed asphalt pavement and Reconomy operations

Reclaimed asphalt pavement is asphalt which is removed from road and other surfaces during maintenance and reconstruction of those surfaces and requires crushing and/or screening to size to allow recycling into new asphalt.

Downer operates a facility in Camellia that receives RAP from road construction and maintenance projects and processes these materials by crushing and screening to produce up to 235,000 tonnes per annum (tpa) of recycled road products. A large portion of this processed material is transported to Downer's Unwin Street site (the Rosehill site) for use in manufacturing asphalt.

Downer's lease at the Camellia site is coming to an end and Downer is seeking to more closely integrate RAP processing and asphalt production on a single site along with its other sustainable road product ventures.

The Rosehill site comprises:

- Asphalt plant, workshop and offices (subject to many consents since 1993 and most recently DA/115/2007/A).

- Reconomy facility (DA/1069/2016) – a recycling facility that receives material from the sweeping of Sydney's road network, cleaning of drainage systems and non-destructive excavation for washing and separating. This material is then repurposed for various activities including the manufacture of asphalt. Over 95% of the material is re-used and diverted from its traditional landfill disposal.

The Rosehill site is subject to compulsory acquisition by the NSW Government for use by the Sydney Metro West project. Loss of continuity of operations at the Rosehill site would have adverse consequences for the Government due to the significant compensation which would arise and delays in government road programs due to the loss of more than 25% of the road product manufacturing capacity in Sydney. Transport for New South Wales is working closely with Downer to avoid such disruption, but seeks possession of the site in early 2022.

2.2 Proposed activities

The application proposes:

- The staged subdivision of the western area of Lot 100 DP 1168951 into eight new industrial lots;
- Prepare the lots via earthworks and civil works for future re-development (by future applications);
- Stage 1 (Sustainable Road Resource Centre) – occupy the newly created Lot 6 and construct and operate the following on the lot:
  - RAP processing operations;
  - Asphalt plant;
  - Reconomy facility; and
  - A modern bitumen product manufacturing plant.

These project components are described below.

2.3 Subdivision and lot preparation

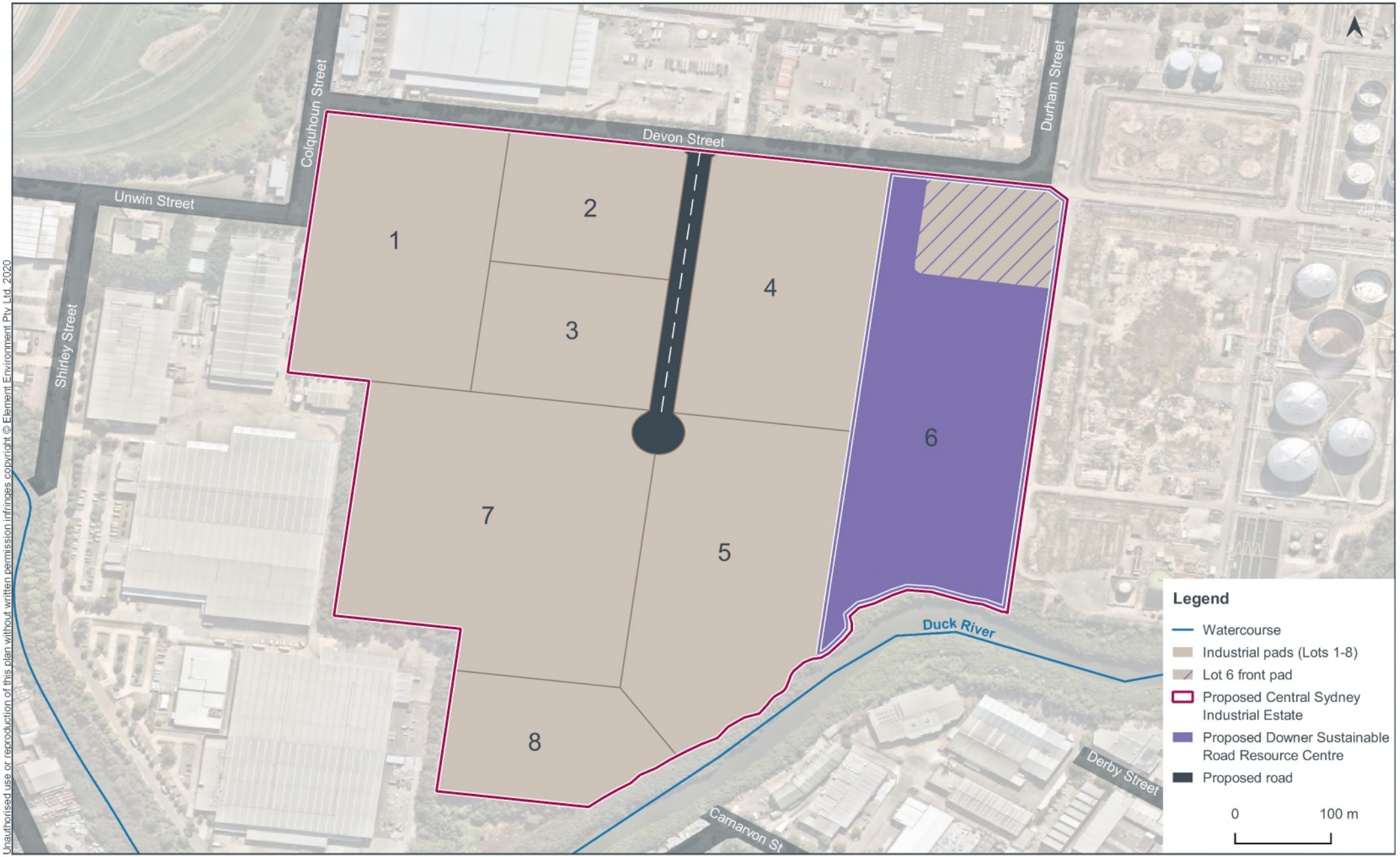
VE Property Pty Ltd (VEP) proposes the staged development of the CSIE on lands known as the Western Area of the former Oil Refinery at Clyde (refer to **Figure 3**). Stage 1 of the development will comprise the Sustainable Road Resource Centre, to be operated by Downer, described in the following section.

VE Property proposes the following on the site:

- The staged subdivision of the site into eight lots. Development of the lots for new industrial uses (in accordance with current zoning), which will be subject to future applications.
- Earthworks/filling to bench the lots to form a flat pad in the northern half of the site then gradually grading down to towards Duck River in the southern half of the site.
- Construction of a new public access road running south from an intersection with Devon Street, providing access to those lots that do not front onto Devon Street, in accordance with Parramatta Council specifications.
- Implementation of erosion and sediment controls to manage water quantity and quality over the lots until they are sold and developed, when permanent water management infrastructure will be installed.
- The extension of key municipal services to suit the needs of each of the lots comprising:
  - Potable water – potentially construction of a ring main linking the main under Colquhoun Street to the main under Durham Street (subject to separate approval by Sydney Water).
  - Wastewater (sewer) – extension of the rising main along Devon Street and minor sideline extension of the gravity sewer along Colquhoun Street (subject to separate approval by Sydney Water).
  - Electricity – supply may be required to each lot from the high voltage line along Devon Street (subject to separate approval by Endeavour Energy).
- A 30m riparian corridor along Duck River.
- Development of Lot 6 (Stage 1) for the land uses described below.

Figure 3
The project

Central Sydney Industrial Estate Incorporating Downer Sustainable Road Resource Centre
STATE SIGNIFICANT DEVELOPMENT - ENVIRONMENTAL IMPACT STATEMENT



2.4 Stage 1 – Sustainable Road Resources Centre

2.4.1 Overview

The conceptual Stage 1 layout is shown in **Figure 4**. Stage 1 will be aligned north-south as per the Lot 6 orientation and will comprise the separate facilities described in the following sections.

2.4.2 Site preparation and construction

Site preparation (civil works) will take approximately 30 weeks and will comprise:

- Site establishment – installation of site office, generator and toilet.
- Earthworks/filling - to bench the lot to form two flat pads, one in the northern third of the lot and the other in the southern two thirds of the lot.
- Drainage – stormwater management structures will be constructed.
- Services – water, sewer, electrical, gas and telecommunications services will be installed.
- Footings and slabs – after the ground surface is prepared, footings will be excavated/piled and filled with concrete in areas where structures will require stabilisation, and concrete building pads will be poured.
- Pavement areas of Lot 6 requiring extra stabilisation and strengthening (eg heavily trafficked areas) will be paved with concrete and remaining areas will be paved with asphalt.
- Barriers – aluminium, concrete and/or water filled plastic barriers will be installed in areas where traffic must be separated from pedestrian areas and/or to prevent vehicles crossing lanes/protect structures.
- Line marking and signage – lines will be marked on internal roads and speed limit and other signs will be erected.

The Stage 1 components will be constructed simultaneously and some activities will overlap with the civil works. Construction of the Stage 1 components will typically comprise:

- Construction of concrete foundations including piled foundations for certain plant.
- Construction of frames for sheds.
- Erection and installation of plant.
- Installation of tanks and silos.
- Wall and roof cladding.
- Stormwater connection.

2.4.3 Asphalt plant

A fixed Ammann Universal HRT Stationary asphalt plant will be constructed on Lot 6, which will produce up to 550,000tpa of asphalt and will comprise:

- Cold feed bins to receive aggregate, sand and RAP.
- Conveyors to transport aggregates to a dryer.
- Conveyors to transport RAP to a mixer.
- Hot aggregate storage bins.
- Hot RAP storage bins.
- A mixer for mixing materials in weighted proportions.
- A batch tower with a screen deck for sizing the hot aggregates.
- Weigh hoppers for aggregates, bitumen, lime baghouse fines and RAP weighing.
- Enclosed bucket elevator for elevating the heated aggregates to the top of the batch plant.
- Hot bitumen storage tanks with bitumen pumped from these to the batch plant.
- Lime filler silo to receive lime and pneumatic conveyors to convey lime to the batch plant.
- Fabric filter baghouse for cleaning exhaust gases from the dryer.
- Fan and stack for exhausting the gases from the baghouse.
- Recycled filler silo for storage of baghouse reclaimed fines and pneumatic conveyors to convey recycled filler to the batch plant.
- Control room containing plant switchboard and controls.
- Soap spray station for lining truck trays with an anti-stick film.

The asphalt plant is 41 m high at its tallest point.

The asphalt manufacturing process will comprise drying and mixing aggregates and combining them in specified quantities with heated bitumen and a filler and discharging the resulting ‘hot’ and ‘warm’ mix into trucks. Operation of the asphalt plant will comprise:

- Delivery of virgin aggregates and sand from offsite, tipped into an underground hopper and transferred via conveyor for temporary storage in one of 16 vertical silos. Virgin aggregates and sand are then transferred to the cold feeder bins via conveyor. Reclaimed aggregates, sand and glass produced by the on-site Reconomy facility and processed RAP is temporarily stored in above ground storage bays, then transferred to the asphalt plant cold feeder bins by front end loader.

- Imported filler material will be pneumatically pumped into silos from tankers and bitumen will be stored in heated/insulated tanks at approximately 160˚C.
- Aggregates in the cold feeder bins will be metered by belt feeders into the rotary dryer.
- Filler will be pneumatically conveyed and bitumen pumped into a weigh hopper then discharged into a pugmill mixer for mixing with aggregates. Exhaust emissions will be drawn off into a bag house for treatment with recovered fines reused in the asphalt process.
- Asphalt will be transferred to hot asphalt storage bins.
- The inside of the truck bodies are sprayed with bitumen release agent at the spray station (truck spray gantry), then trucks drive below the hot storage bins and are loaded. Pre-mix (cold mix asphalt) can be loaded into trucks as required.

2.4.4 Reclaimed asphalt pavement facility

As Downer's lease at the Camellia site is coming to an end, it is proposing to relocate the RAP operations to Lot 6.

Up to 250,000 tpa of RAP will be cold planed from pavements with specialist equipment and transported in tip trucks (truck and trailers or semi-trailers) to the site. It will then be stored on gravel hard stand areas.

The RAP plant will be inside an approximately 12 m high shed that will be enclosed on the north, west and south sides. The east side will be open so the front-end loader can feed the RAP plant and remove the finished products.

The RAP will be crushed and screened on an as required basis for use in the onsite production of asphalt (as a substitute for aggregates and bitumen) or for export for pavement materials. Up to 90,000 tpa of RAP will be stored on site at any one time on a 10,000 m^2 stockpile area. Stockpiles will be a maximum 10 m high.

2.4.5 Bitumen products plant

A next generation, co-located bitumen emulsion plant is proposed on Lot 6 to produce approximately 15,000 tpa of bitumen products for use in onsite asphalt production and export offsite. This investment would mark a first for Downer to have not only a combined blending facility but also situating the investment on the same site as its asphalt and Reconomy plant.

The bitumen products plant will comprise:

- Maximum 6 m high shed with roller door access on the southern side containing:
  - 150 t emulsifier and emulsion additives store containing up to 150 intermediate bulk containers.
  - 60 kilolitre (kl) kerosene store.
  - Office and toilet.
- An additional 8 m high shed for the overflow storage of emulsifier and emulsion additives.
- Maximum 6 m high toner additive storage shed with roller door access on the southern and western sides.
- Two 80 kl 12 m high (total 160 t) bitumen tanks.
- Four 80 kl 12m high warm emulsion and seven 60 kl 12 m high cold emulsion tanks (total 740 t).

2.4.6 Reconomy facility

Downer proposes to replicate the Reconomy facility from the Unwin Street site at Lot 6. The facility will process up to 40,000 tpa of road sweepings, gully waste and mud from non-destructive excavation, and will comprise:

- Receipt of incoming material into handling pits adjacent to the resource recovery plant. The handling pits will be impermeable and partially sunk into the ground.
- Material will be separated during the recovery process and temporarily stockpiled adjacent to the recovery plant at the separation points and removed as required. Recovered aggregates will be beneficially reused almost immediately in the adjacent asphalt plant and will require an external storage bay as a collection point prior to transport to the asphalt plant by front end loader.

The Reconomy facility will comprise:

- Conveyors.
- Hoppers.
- Trommel.
- Log washer.
- Clarifier.
- Water tanks.

- Water pumps.
- Centrifuge.
- Screen deck (with vibrator).
- Wash screens (with vibrator).
- Eddy current separator.
- Hydrocyclone and ferromagnetic separator.

The maximum height of fixed equipment will be 8 m and an in-ground pit will be 2 m below ground surface.

Downer intends to beneficially reuse the recovered aggregates and sand (approximately 20,000 tpa) in asphalt production and application to road surfaces. The proposed beneficial reuse of recovered aggregate and sand will reduce the use of virgin aggregate and sand from quarries in NSW. Recovered plastics, toner cartridges, glass and rubber are also likely to be incorporated into the production of asphalt, replacing filler and/or aggregate.

Downer does not propose to reuse the recovered organic material in the production of asphalt. The recovered organic material will be transported to an approved composting facility for beneficial reuse. Recovered metals will be transported to an appropriate metal recycling facility for beneficial reuse.

Any remaining recovered material which cannot be directly reused in the asphalt plant could be transported to recycling facilities near the site.

There will be a water recycling plant to treat water used during the process and a storage tank for future re-circulation of treated water or disposal as trade waste. The water loss factor for the resource recovery plant is low due to a portion of the incoming waste material being wet or semi-dry.

2.4.7 Ancillary infrastructure, hours of operation and employment

The Sustainable Road Resources Centre will also comprise the following ancillary infrastructure to facilitate the above land uses:

- 34 car parking bays.
- 25 truck parking bays.
- Site offices.
- Laboratory.
- Workshop building.
- Weighbridges.
- Stormwater management infrastructure.

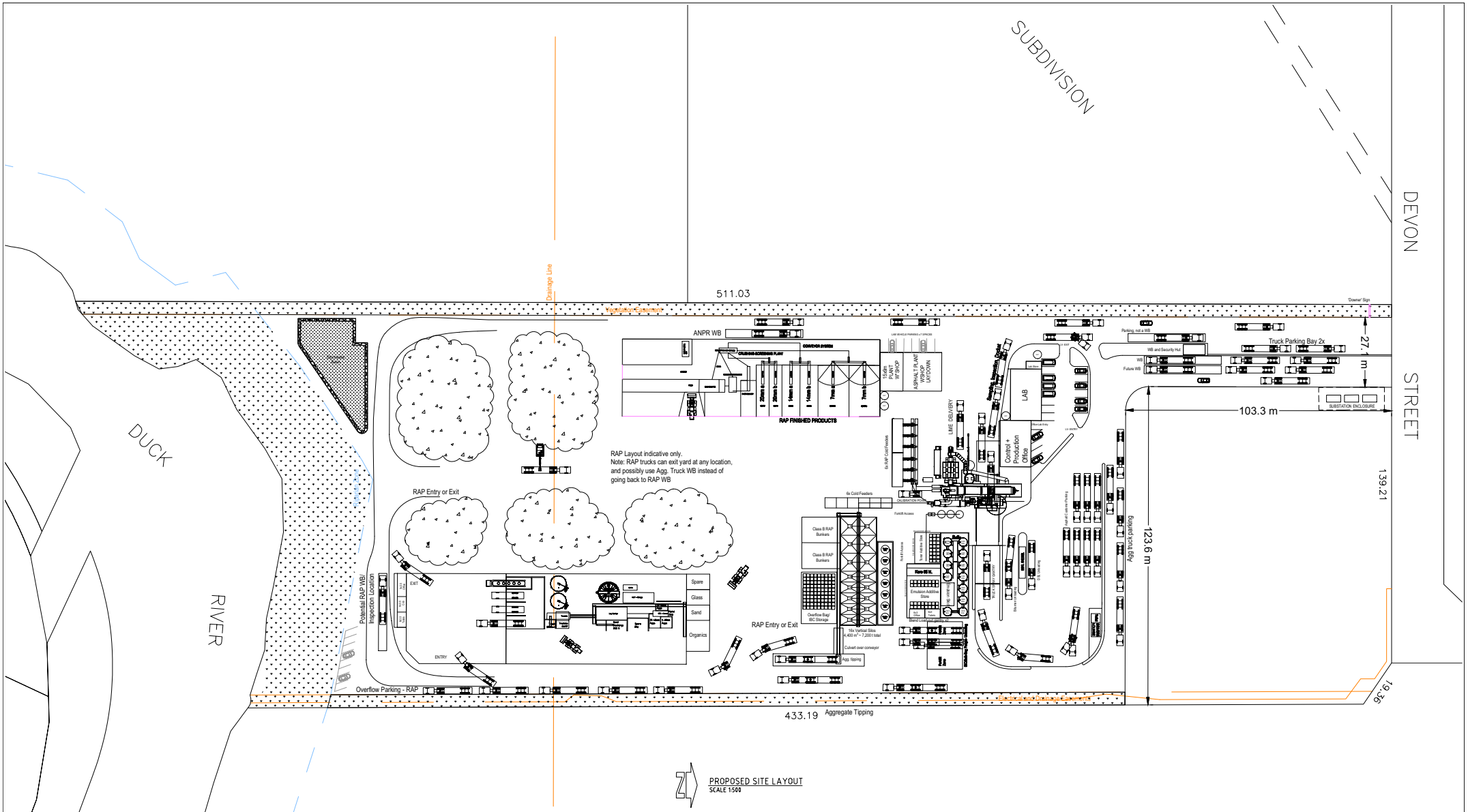
- Services and utilities including an electrical substation.
- Landscaping, fencing and signage.

The Sustainable Road Resources Centre is proposed to operate 24-hours a day, seven days a week, 365 days a year. This reflects the demand for asphalt to be provided at night due to government demands that road works minimize interference with traffic.

Construction and operation of the Sustainable Road Resources Centre will employ the personnel over the shifts summarised in **Table 2**.

Table 2 Construction and Operational Personnel

Component	Role	Shift	Personnel
Construction	Civil works	6am-6pm (with certain construction works to be conducted in the evening and night ie 6pm-6am)	35
	Asphalt plant		17
	RAP facility		14
	Reconomy facility		13
	Bitumen products plant		6
Asphalt plant	Laboratory and plant	6am-6pm	10
		6pm-6am	11
RAP facility	Operator	6am-6pm	3
		6pm-6am	2
Bitumen products plant	Operator	6am-6pm	4
Reconomy facility	Manager	7am-5pm	1
	Supervisor	5am-3pm	1
	Operator	7am-7pm	1
		6pm-6am	1
Weighbridge	Operator	6am-2pm	3
		2pm-10pm	3
		10pm-6am	3
Other	Asphalt and RAP Facility management staff	8am-5pm	5



PROPOSED SITE LAYOUT
SCALE 1:500

5m 0 10 20 30 40 50m
SCALE 1:500 AT A0 SIZE SHEET

FOR INFORMATION

ISSUED FOR INFORMATION	07.08.23	A
AMENDMENTS	DATE	ISSUE

ARCHITECT

CLIENT

PROJECT
SUSTAINABLE ROAD RESOURCE CENTRE (PHASE 1)
9 DEVON STREET, CLYDE NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
XC	HU	MAY 23		A0	AS SHOWN	C013919.01-AR100

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DRAWING TITLE
PROPOSED SITE LAYOUT

DRAWING No. C013919.01-AR100 ISSUE A

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3 Noise Policy and Guidelines

The following section summarises relevant policy and guidelines pertinent to undertaking a noise and vibration impact assessment for this type of project.

3.1 Interim Construction Noise Guideline

The assessment and management of noise from construction work is completed with reference to the ICNG. The ICNG is specifically aimed at managing noise from construction work regulated by the EPA and is used to assist in setting statutory conditions in licences or other regulatory instruments.

The ICNG sets out procedures to identify and address the impacts of construction noise on residences and other sensitive land uses.

3.1.1 Standard Hours for Construction

Table 3 summarises the ICNG recommended standard hours for construction activities where the noise from construction is audible at residential premises.

Table 3 Recommended Standard Hours for Construction

Period	Preferred Construction Hours
Day (Standard construction hours)	Monday to Friday - 7am to 6pm Saturdays - 8am to 1pm (only if required) Sundays or Public Holidays - No construction

The recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and / or to prevent environmental harm. Work conducted outside of standard hours are considered out of hours work (OOH). OOH periods are divided into two categories representing evening and night periods and cover the hours listed below:

> **Period 1** (evening / low risk period): Monday to Friday – 6pm to 10pm, Saturdays – 1pm to 6pm, Sundays – 8am to 6pm.
>
> **Period 2** (night / medium to high risk period): Monday to Friday – 10pm to 7am, Saturdays / Sundays – 6pm to 7am (8am on Sunday mornings).

Construction will typically occur between 6am and 6pm Monday to Friday and 7am and 1pm Saturday. Construction outside these hours will be required on both weekdays and weekends including Sundays. Construction on public holidays will be avoided.

3.1.2 Construction Noise Management Levels

Table 4 reproduces the ICNG construction noise management levels (NMLs) for residential receivers. The construction noise management levels are the sum of the management level and relevant rating background level (RBL) for each specific assessment period. The RBL is the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period and is calculated as the median of the assessment background levels (ABLs). The ABL is the single-figure background noise level for each assessment period for each 24-hour interval of the monitoring period.

Table 4 Noise Management Levels

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

3.2 Noise Policy for Industry

The EPA released the NPI in October 2017 which provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the NSW *Protection of the Environment Operations Act 1997*.

The objectives of the NPI are to:

- provide noise criteria that is used to assess the change in both short term and long-term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, considering the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the project noise trigger levels (PNTLs) (ie criteria) for a development. These are the levels (criteria), above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment; and maintaining the noise amenity of an area.
2. Predict or measure the noise levels produced by the development with regard to the presence of annoying noise characteristics and meteorological effects such as temperature inversions and wind.
3. Compare the predicted or measured noise level with the PNTL, assessing impacts and the need for noise mitigation and management measures.
4. Consider residual noise impacts - that is, where noise levels exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.

5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.

6. Monitor and report environmental noise levels from the development.

3.2.1 Project Noise Trigger Levels

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (ie, the more stringent) of the **project intrusiveness noise level** (PINL) and **project amenity noise level** (PANL) determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.2.2 Project Intrusiveness Noise Level

The PINL ($LA_{eq(15min)}$) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment. Hence, when assessing intrusiveness, background noise levels need to be measured.

3.2.3 Project Amenity Noise Level

The PANL is relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 of the NPI (reproduced in **Table 5**), where reasonable and feasible. The NPI defines two categories of amenity noise levels:

- **Amenity Noise Levels (ANL)** – are determined considering all current and future industrial noise within a receiver area; and
- **PANL** – is the noise goal for a receiver area, specifically focusing the project being assessed.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, Section 2.4 of the NPI states that '*a project amenity noise level applies for each new source of industrial noise as follows:'*

PANL for new industrial developments = recommended **ANL** minus 5dBA.

3.2.4 Cumulative Industrial Noise Impacts

As per Section 2.4 of the NPI, where the PANL is applicable and can be satisfied, the assessment of cumulative industrial noise is not required. However, in circumstances where this level cannot be feasibly and reasonably met, an assessment of existing industrial noise, and the combined resulting noise level from existing and proposed industries is required.

Table 5 Amenity Criteria			
Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level dB LAeq(period)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks.	See column 4	See column 4	5dB above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School Classroom	All	Noisiest 1-hour period when in use	35 (internal) 45 (external)
Hospital ward - internal	All	Noisiest 1-hour	35
- external	All	Noisiest 1-hour	50
Place of worship - internal	All	When in use	40
Passive Recreation	All	When in use	50
Active Recreation	All	When in use	55
Commercial premises	All	When in use	65
Industrial	All	When in use	70

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as rural residential; suburban residential; urban residential; industrial interface; commercial; industrial – see Table 2.3 and Section 2.7 of the NPI.

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

The following exceptions to the above method apply when deriving the PANL:

- areas with high traffic noise levels;
- proposed developments in major industrial clusters;
- existing industrial noise and cumulative industrial noise effects; and
- greenfield sites.

3.2.5 Maximum Noise Level Event Assessment

The potential for sleep disturbance from maximum noise level events from a project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages.

Where night-time noise levels from a development/premises at a residential location exceed the following trigger levels, a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq(15min)}$ 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- L_{Amax} 52dB or the prevailing RBL plus 15dBA, whichever is the greater.

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the impacts on sleep disturbance include:

- how often the events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

3.3 Road Noise Policy

The road traffic noise criteria are provided in the Department of Environment, Climate Change and Water NSW (DECCW), RNP, 2011. The policy sets out noise criteria that provide for a degree of amenity appropriate for the land use and road category.

3.4 Vibration

Indicative safe working distances from sensitive receivers for typical items of vibration intensive plant are provided by the Transport for NSW (TfNSW) Construction Noise and Vibration Strategy (2019) (CNVS). The safe working distances are quoted for both “cosmetic” damage in accordance with British Standard BS7385.2-1993 Evaluation of measurement for vibration in buildings Part 2, and human comfort in accordance with the Department of Environment and Conservation (2006) Assessing Vibration: a technical guideline. For detailed vibration criteria see **Appendix C**.

The item of plant with the highest vibration potential is identified as a vibratory roller. In accordance with the CNVS, the safe working distances to satisfy the cosmetic damage and human response criteria are 25m and 100m respectively for a >18t vibratory roller.

A review of aerial imagery indicates that the nearest residential receiver R2A is located approximately 680m to the south east of the project site. Hence, vibration impacts at the closest residential receivers are not anticipated to occur and no further assessment is required.

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4 Existing Environment

4.1 Noise Sensitive Receivers

From review of aerial imagery and associated project information, the following potentially sensitive receivers have been identified. Receivers immediately surrounding the project site are primarily industrial premises with residential receivers located further afield in the areas of Rydalmere/Ermington, Silverwater and Rosehill.

Table 6 presents a summary of receiver identification, description and MGA(56) coordinates. The location of the receivers are presented visually in **Figure 2.**

Table 6 Receiver Locations

Receivers	Receiver Type	Description	MGA56 Coordinates	
			Easting	Northing
R1A	Residential	72 River Road, Ermington	319702	6255731
R1B	Residential	530 John Street, Rydalmere	319373	6255955
R2A	Residential	86 Carnarvon Street, Silverwater	318567	6254254
R2B	Residential	101 Beaconsfield Street, Silverwater	318474	6254098
R3A	Residential	71 Penelope Lucas Lane, Rosehill	316815	6255157
R3B	Residential	88 James Ruse Drive, Rosehill	316835	6255357
FR01	Future Residential	181 James Ruse Drive, Camellia	317126	6256418
InN1	Industrial	5 Devon Street, Rosehill	317894	6255309
InN2	Industrial	10 Colquhoun Street, Rosehill	318251	6255289
InE1	Industrial	85 Egerton Street, Silverwater	318902	6254766
InE2	Industrial	42 Giffard Street, Silverwater	319141	6254849
InS1	Industrial	107 Carnarvon Street, Silverwater	318243	6254714
InS2	Industrial	15 Millennium Court, Silverwater	318627	6254743
InW1	Industrial	Shirley Street, Rosehill	317678	6255089
InW2	Industrial	Shirley Street, Rosehill	317716	6254885
InW3	Industrial	Shirley Street, Rosehill	317781	6254732
C1[1]	Commercial	Sydney Baha'I Centre	318439	6254669
Wor1	Place of Worship	Sydney Kali Temple	318273	6254353
Wor2	Place of Worship	C3 Church	319290	6254378
Sch1	School	Rosehill Public School	316677	6255604
AR1	Active Recreation	Rosehill Racecourse	317575	6255284

Note 1: Primarily used as a function centre, hence assessed under noise goals for 'commercial premises'.

4.2 Background Noise Environment

Background noise monitoring was previously undertaken by Wilkinson Murray for the project site as part of the Viva Energy Clyde Western Area Remediation Project (2018, Report No. 14248 Version B) (the 'historic assessment'). It is understood that the locality of the project site has not undergone significant change since completion of the historic assessment. Therefore, the historic assessment has been used as the basis for the quantification of the existing ambient noise environments at the surrounding residential areas.

The historic background noise monitoring was conducted between Tuesday 31 October 2017 and Tuesday 7 November 2017 to determine the RBL for the assessment during the day, evening and night periods in accordance with the NPI. It is noted that the ambient noise level (L_{Aeq}) is the all-encompassing noise associated within a given environment, while the background noise level (L_{A90}) is the underlying level of noise present in ambient noise.

Details of the monitoring locations selected to represent the residential receiver areas are provided as follows:

- Rydalmere – Location M1: Located at 530 John Street, Rydalmere to establish the ambient noise environment at residential receivers in Rydalmere to the north of the project site;
- Silverwater – Location M2: Located at 101 Asquith Street, Silverwater to establish ambient noise environment at residential receivers in Silverwater to the south of the project site; and
- Rosehill – Location M3: Located at 1-9 Eleanor Street, Rosehill to establish the ambient noise environment at residential receivers in Rosehill to the west of the project site.

The results of the unattended noise monitoring are presented in **Table 7.**

Table 7 Background and Ambient Noise Levels

Location	Rating Background Level, dB LA90(period)			Ambient Level, dB LAeq(period)		
	Day	Evening	Night	Day	Evening	Night
M1 Rydalmere	44	41	37	52	51	44
M2 Silverwater	42	41	38	55	51	48
M3 Rosehill	51	51	40	58	58	52

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

5 Assessment Criteria

5.1 Construction Noise Management Levels

Construction NMLs for each of the residential areas close to the project site are summarised in **Table 8**. It is noted that construction activities are planned for both standard construction hours and out of hours periods.

Table 8 Construction Noise Management Levels – Residential Receivers

Location	Assessment Period	RBL, dBA	NML dB $LA_{eq(15min)}$
Rydalmere R1	Day (Standard Hours)	44	54
	Evening (OOH Period 1)	41	46
	Night (OOH Period 2)	37	42
Silverwater R2	Day (Standard Hours)	42	52
	Evening (OOH Period 1)	41	46
	Night (OOH Period 2)	38	43
Rosehill R3	Day (Standard Hours)	51	61
	Evening (OOH Period 1)	51	56
	Night (OOH Period 2)	40	45

Construction NMLs for non-residential receivers are outlined in Section 4.1.3 of the ICNG and are reproduced in **Table 9**.

Table 9 Construction Noise Management Levels – Non-residential Receivers

Receiver	Land use	NML dB $LA_{eq(15min)}$
Sch1	Classrooms at schools and other educational institutions	45 (Internal noise level)
Wor1-2	Places of worship	45 (Internal noise level)
AR1	Active recreation areas	65
C1	Commercial Premises	70
InN1-2, InE1-2, InS1-2, InW1-3	Industrial Premises	75

5.2 Operational Noise Criteria

5.2.1 Project Intrusiveness Noise Levels

The PINLs for the project are presented in **Table 10** and have been determined based on the RBL + 5dBA.

Table 10 Intrusiveness Noise Levels

Receiver Type	Period[1]	Adopted RBL dB LA_{90}	PINL dB $LA_{eq(15min)}$
Rydalmere R1	Day	44	49
	Evening	41	46
	Night	37	42
Silverwater R2	Day	42	47
	Evening	41	46
	Night	38	43
Rosehill R3, FR01	Day	51	56
	Evening	51	56
	Night	40	45

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

5.2.2 Project Amenity Noise Levels

Residential receivers situated in the surrounding area have been classified under the EPA's urban amenity category.

The PANL is used in conjunction with the intrusiveness criteria to determine the PNTL, which represents the limiting criteria. The PANLs for residential receivers and other receiver types (ie non-residential) potentially affected by the project are presented in **Table 11** for the recommended ANL method.

Table 11 Project Amenity Noise Levels (Recommended ANL)

Receiver Type	Noise Amenity Area	Assessment Period[1]	Recommended ANL dB $LA_{eq(period)}$[2]	PANL dB $LA_{eq(period)}$	PANL dB $LA_{eq(15min)}$[3]
Residential	Urban	Day	60	55	58
		Evening	50	45	48
		Night	45	40	43
Classroom - internal	All	When in use	35	30	33
Place of worship - internal	All	When in use	40	35	38
Active Recreation	All	When in use	55	50	53
Commercial premises	All	When in use	65	60	63
Industrial	All	When in use	70	65	68

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Recommended amenity noise levels as per Table 2.2 of the NPI.

Note 3: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period as per Section 2.2 of the NPI.

5.2.3 Project Noise Trigger Levels

The PNTLs are the lower of either the PINL or the PANL. **Table 12** presents the derivation of the PNTL in accordance with the methodologies outlined in the NPI.

Table 12 Project Noise Trigger Levels, dB $LA_{eq(15min)}$

Receiver	Period	RBL	PINL dB $LA_{eq(15min)}$	PANL dB $LA_{eq(15min)}$[2]	PNTL dB $LA_{eq(15min)}$
Residential Receivers					
Rydalmere R1(A&B)	Day	44	49	58	49
	Evening	41	46	48	46
	Night	37	42	43	42
Silverwater R2(A&B)	Day	42	47	58	47
	Evening	41	46	48	46
	Night	38	43	43	43
Rosehill R3(A&B), FR01	Day	51	56	58	56
	Evening	51	56	48	48
	Night	40	45	43	43
Non-residential Receivers					
Sch1	When in use	n/a	n/a	33	33
Wor1-2	When in use	n/a	n/a	38	38
AR1	When in use	n/a	n/a	53	53
C1	When in use	n/a	n/a	63	63
InN1-2, InE1-2, InS1-2, InW1-3	When in use	n/a	n/a	68	68

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: ANL + 5dB to account for industrial interface.

5.2.4 Maximum Noise Level Assessment Trigger Levels

The maximum noise trigger levels shown in **Table 13** are based on night time RBLs and trigger levels as per Section 2.5 of the NPI. The trigger levels will be applied to transient noise events that have the potential to cause sleep disturbance.

Table 13 Maximum Noise Assessment Trigger Levels

Receiver	RBL	$L_{Aeq(15min)}$	L_{Amax}
		40dB $L_{Aeq(15min)}$ or RBL + 5dB	52dB L_{Amax} or RBL + 15dB
Rydalmere R1	37	42	52
Silverwater R2	38	43	53
Rosehill R3, FR01	40	45	55

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays; Night 10pm to 8pm.

Note: As per Section 2.5 of the NPI, the highest of the two criteria are adopted as the trigger level.

5.3 Road Traffic Noise Criteria

In accordance with the RNP, this assessment has adopted the 'Freeway/arterial/sub-arterial road' category for the designated inbound and outbound transport routes, consistent with the classification of the haulage route as a 'principal haulage route'. **Table 14** reproduces the road traffic noise assessment criteria for residential land uses relevant for this road type.

Table 14 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of Project/development	Assessment Criteria - dB(A)	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial road	Existing residences affected by additional traffic on existing freeways/sub-arterial/roads generated by land use developments	60dB(A) $L_{Aeq(15hr)}$	55dB(A) $L_{Aeq(9hr)}$

Note: For road noise assessments, the day period is from 7am to 10pm (ie there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

5.3.1 Relative Increase Criteria

In addition to meeting the assessment criteria, any significant increase in traffic noise at receivers must be considered. Receivers experiencing increases in traffic noise levels above those presented in **Table 15** due to the addition of vehicles along the haulage route should be considered for mitigation.

Table 15 Increase Criteria for Residential Land Uses

Road Category	Type of Project/Development	Total Traffic Noise Level Increase, dB(A)	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $LA_{eq(15hr)}$ +12dB (external)	Existing traffic $LA_{eq(9hr)}$ +12dB (external)

6 Noise Assessment Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers for typical construction activities and operations. DGMR (iNoise, Version 2020.0) noise modelling software was used to quantify noise emissions from typical construction activities and operations. iNoise is a new intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

6.1 Construction Noise Modelling Parameters

The construction of the project would involve two broad components; the subdivision and lot preparation of the project site, and the development of Stage 1 on Lot 6 of the subdivision.

As described in **Section 2.4** above, the subdivision and lot preparation would primarily involve bulk earthworks to provide level pads, installation of erosion and sediment controls, and the extension of key municipal services. Additionally, a proposed road would be constructed from Devon Street, between Lots 2 and 3, and Lot 4. The development of Stage 1 would involve sealing the site, installation of surface water management infrastructure, and the construction of the asphalt, RAP, Reconomy, and emulsion and bitumen products plant.

Construction activities are typically considered to be progressive, however, it is noted that the development of Stage 1 may be undertaken simultaneously with the subdivision and lot preparation works.

Civil works including bulk earthworks would be undertaken during standard and out of hours work periods, and would extend for approximately 30 weeks. It is anticipated that the development of Lot 6 would typically be undertaken during standard construction hours, however, works would need to be completed during OOH periods. The duration of the construction period will be up to approximately 11 months, commencing in 2021.

To quantify noise emissions from the worst-case construction activities, the following construction scenarios have been considered:

- Scenario 1 – Bulk earthworks to bench site and provide level pads to whole of subdivision;
- Scenario 2 – Construction of new road from Devon Street;
- Scenario 3 – Sealing/Capping of Lot 6; and
- Scenario 4 – Construction/Installation of plant on Lot 6.

Additionally, sleep disturbance impacts have been assessed assuming a L_{Amax} noise level of 117dB associated with an excavator loading soil/rock into a truck. The L_{Amax} noise source was modelled at the most exposed locations to each of the noise catchment areas for residential receivers.

The construction noise emission levels used in the modelling are summarised in Table 16. The construction modelling assessment adopted methodologies consistent with the operational assessment. It is noted that the construction phase noise model assumed all plant operating at peak capacity for 100 per cent of the assessment period. It is therefore considered that the predicted noise levels represent worst-case operating conditions.

Table 16 Acoustically Significant Sources - Sound Power Levels (dBA re 10^{-12} Watts).													
Scenario	Description	Octave Band Centre Frequency, Hz									Qty	Util %	Total, dBA
		63	125	250	500	1000	2000	4000	8000	Total, dBA			
1 Earthworks	Front End Loader	79	89	95	100	100	100	92	84	106	1	80%	105
	40t Excavator	81	101	102	101	102	98	93	84	108	1	80%	107
	CATD8 Dozer	88	97	101	109	105	103	102	92	112	1	80%	111
	Grader	80	99	102	102	104	103	98	89	110	1	80%	109
	Compactor	72	90	101	105	106	103	99	93	111	1	80%	110
	40t Articulated Dump Truck	76	96	102	102	103	100	93	84	108	3	80%	112
	Skid Steer	87	93	95	98	97	94	90	81	103	1	80%	102
	Jack Hammer	104	107	107	104	99	104	101	91	113	1	50%	110
	Tipper Truck	87	90	94	95	97	97	92	82	103	1	80%	102
	Truck and Dog	84	90	94	97	99	97	94	86	104	10	50%	109
	Generator	61	82	92	94	93	90	64	73	99	1	100%	99
	Light Vehicles	64	70	73	67	64	62	58	44	76	25	50%	86
	Water Cart	81	82	89	91	95	97	89	81	101	1	80%	100
	Total Fleet Lw												**119**
2 Road Construction	Paving Machine	91	98	103	107	109	107	105	94	114	1	80%	113
	Asphalt Truck & Sprayer	90	93	97	98	100	100	95	85	106	1	80%	105
	Roller	73	86	99	102	101	98	91	81	107	1	80%	106
	Concrete Truck	85	93	97	103	104	102	100	93	109	1	80%	108
	Total Fleet Lw												**115**

Table 16 Acoustically Significant Sources - Sound Power Levels (dBA re 10^{-12} Watts).													
Scenario	Description	Octave Band Centre Frequency, Hz									Qty	Util %	Total, dBA
		63	125	250	500	1000	2000	4000	8000	Total, dBA			
3 Lot 6 Pavement Capping	Small Excavator	85	98	99	99	96	96	89	81	105	1	80%	104
	Paving Machine	91	98	103	107	109	107	105	94	114	1	80%	113
	Asphalt Truck & Sprayer	90	93	97	98	100	100	95	85	106	1	80%	105
	Concrete Pump	84	94	91	96	97	97	91	81	103	1	80%	102
	Concrete Truck	85	93	97	103	104	102	100	93	109	1	80%	108
	Roller	73	86	99	102	101	98	91	81	107	1	80%	106
	Tipper Truck	87	90	94	95	97	97	92	82	103	1	80%	102
	Light Vehicles	64	70	73	67	64	62	58	44	76	25	50%	86
	Total Fleet Lw												**116**
4 Plant Installation	Crane (Mobile)	72	85	91	100	101	98	93	89	105	1	80%	104
	Crane (Tower)	85	94	96	102	105	106	97	85	110	1	80%	109
	Concrete Truck	85	93	97	103	104	102	100	93	109	2	80%	108
	Concrete Pump	84	94	91	96	97	97	91	81	103	1	80%	102
	Light Vehicles	73	79	82	76	73	71	67	53	85	8	50%	82
	Generator	61	82	92	94	93	90	64	73	99	1	80%	98
	Elevated Work Platform	65	78	84	93	94	91	86	82	98	1	80%	97
	Road Truck	87	90	94	95	97	97	92	82	103	10	50%	110
	Excavator with Breaker	100	103	107	108	110	110	105	95	116	1	50%	113
	Fork Lift / Telehandler	75	84	85	91	92	90	88	80	97	1	80%	96
	Total Fleet Lw												**117**

6.2 Operational Noise Modelling Parameters

The model incorporated three-dimensional digitised ground contours for the fixed plant and surrounding area, as derived from proposed project plans superimposed onto the surrounding land base topography. Where relevant, modifying factors in general accordance with Fact Sheet C of the NPI have been applied to calculations.

6.2.1 Meteorological Analysis

Noise emissions from industry can be significantly affected by prevailing weather conditions. Wind has the potential to increase noise at a receiver when it is at low velocities and travels from the direction of the noise source. As the strength of the wind increases, the noise produced by the wind will mask the audibility of most industrial sources.

Meteorological conditions that enhance received noise levels include source to receiver winds and the presence of temperature inversions. To account for potential enhancements, the NPI specifies that the source to the receiver wind component speeds up to 3m/s for 30% or more of the time in any seasonal period (i.e. day, evening or night), is considered to be a feature wind and predictions must incorporate these conditions. It is understood that temperature inversion conditions are not a feature of the site and have not been included in the modelled parameters.

To determine the prevailing conditions for the project, weather data during the period June 2018 to June 2020 was obtained from the Bureau of Meteorology's (BOM) Sydney Olympic Park (Archery Centre) weather station located approximately 3km east of the site. The data was analysed using the EPA's Noise Enhancement Wind Analysis (NEWA) program in order to determine the frequency of occurrence of winds speeds up to 3m/s in each seasonal period.

Table 17 summarises the results of the wind analysis and includes the dominant wind direction and percentage occurrence during each season for each assessment period. The results of the detailed analysis of meteorological data is presented in Appendix D.

Table 17 Seasonal Frequency of Occurrence Wind Speed Intervals			
Season	Period[1]	Wind Direction ±(45°)	% Wind Speeds (m/s)
			0.5 to 3 m/s
Summer	Day	ENE	18
	Evening	E, ESE	31
	Night	SE	19
Autumn	Day	WNW	21
	Evening	ESE, SE	14
	Night	WNW	20
Winter	Day	W, WNW	28
	Evening	W, WNW	21
	Night	W, WNW, NW	37
Spring	Day	ESE	16
	Evening	ENE, ESE	21
	Night	W, WNW	17

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Based on the results of this analysis, it is demonstrated that prevailing winds occur from the E and ESE during summer evenings and from the W, WNW and NW during winter nights periods. In accordance with Fact Sheet D of the NPI, standard meteorological conditions have been adopted for the day period, while noise-enhancing meteorological conditions including 3m/s winds about the E to ESE, and W to NW have been adopted for evenings and night periods respectively. Standard D class stability has been included for each assessment period. The relevant meteorological conditions adopted are summarised in **Table 18**.

Table 18 Modelled Site-Specific Meteorological Parameters				
Assessment Condition[1]	Temperature	Wind Speed / Direction	Relative Humidity	Stability Class
Daytime - Calm	25°C	0.5m/s	60%	D
Evening – Prevailing Winds	20°C	3m/s E-ESE	60%	D
Night – Prevailing Winds	15°C	3m/s W-NW	90%	D

Note 1: Daytime 7am to 6pm; Evening 6pm to 10pm; Night 10pm to 7am.

6.2.2 Operational Noise Modelling Scenarios

Stage 1 of the development will involve the operation of the Downer Sustainable Road Resource Centre on Lot 6 of the CSIE. The Sustainable Road Resource Centre is described in Section 2.4. The Sustainable Road Resource Centre will operate 24 hours, seven days a week.

One modelling scenario was adopted to assess the combined operation of each of the processes on the site. The scenario is summarised as:

- Reconomy facility (40,000 tpa):
  - incoming road sweepings will be deposited into handling pits;
  - material will be separated during the recovery process via trommels, screens and separators;
  - recovered material will be temporarily stockpiled at the separation points and removed as required;
  - aggregates will be beneficially reused in the asphalt plant; and
  - the remaining materials would be transported offsite.
- RAP facility (250,000 tpa):
  - material delivered from offsite to the unprocessed RAP stockpile, which is maintained by an excavator and/or front-end loader;
  - unprocessed material loaded by front-end loader to crush and screen plant comprising feed hopper, scalp screens, horizontal impact crusher, and triple deck screens, housed within a Colorbond steel shed (open on eastern façade); and
  - material crushed, screened and sized before deposited to the above ground concrete RAP finished product bins via conveyor.
- Asphalt Plant (550,000 tpa):
  - delivery of aggregates, sand, lime and bitumen by truck, and some internal deliveries of material from the Reconomy and RAP facilities by front-end loader;
  - feeding of sand and aggregates into a dryer for heating then elevated to the top of the batch tower, which comprise a screen deck, storage bins, weigh hopper, mixer and truck driveway under the mixer;
  - passing of heated aggregates and sand over the screen for sizing into the bins where they are weighted then mixed with portioned bitumen, lime and RAP; and
  - finished asphalt dropped into trucks for transport offsite.

- Bitumen products plant (15,000 tpa):
  - Fully enclosed process of storage tanks and mixers.
- Ancillary infrastructure;
  - 34 car parking bays and 25 truck parking bays;
  - site offices and Laboratory;
  - workshop building; and
  - weighbridges.

Mobile and fixed plant noise emission data used in modelling for this assessment were obtained from the following sources:

- Reconomy facility – Element Environment for Downer EDI Works (2016) Rosehill Repurposing Facility Environmental Impact Assessment (Ref: PR35).
- RAP facility – provided by Downer/Element Environment curtesy of ASTEC Crushing and Screening.
- Asphalt plant – Air Noise Environment for Downer EDI Works (2019) Air and Noise Assessment: Proposed Asphalt Facility, Brendale (Ref: 5838Report03.1).
- Bitumen products plant – JTA for Downer EDI Rail (2014) Occupational Noise Assessment Downer EDI Rail, Largs Bay, SA (Ref: N3192).
- Mobile plant – MAC noise database.

The noise emission levels used in modelling are summarised in Table 19.

Table 19 Acoustically Significant Sources - Sound Power Levels (dBA re 10^{-12} Watts).													
		Octave Band Centre Frequency, Hz											
Scenario	Description	63	125	250	500	1000	2000	4000	8000	Total, dBA	Height (m)	Util %	Total, dBA
1 Reconomy facility	Front end loader	84	94	90	98	97	96	95	85	104	2	80%	103
	Truck (Idle)	75	83	86	87	90	91	89	84	97	1	50%	94
	Trommel	92	83	85	94	93	94	92	86	101	2	100%	101
	Logwash	82	82	93	95	98	98	95	80	103	2	100%	103
	Hydrocyclone	58	72	83	93	96	92	89	83	99	2	100%	99
	Centrifuge	71	78	87	99	97	97	97	87	104	2	100%	104
	WBT sludge / ECS screen	63	65	75	79	80	79	83	72	87	2	100%	87
	Conveyor	56	60	67	64	67	67	72	70	77	2	100%	77
	Total fleet Lw												**110**
2 RAP facility	Front end loader	84	94	90	98	97	96	95	85	104	2	80%	103
	Excavator	86	89	100	100	97	97	90	82	105	2	80%	105
	Truck (idle)	75	83	86	87	90	91	89	84	97	1	50%	94
	Receiving hopper/feeder	90	93	93	101	98	95	90	81	104	4	100%	104
	Twin deck scalping screen												
	Horizontal impact crusher												
	Triple deck screen												
	Conveyor	56	60	67	64	67	67	72	70	77	2	100%	77
	Total fleet Lw												**109**
3 Bitumen plant	Forklift	65	74	75	81	82	80	78	70	87	1.5	80%	86
	Truck (idle)	75	83	86	87	90	91	89	84	97	1	50%	94
	Bitumen plant					82					2	100%	82
	Total fleet Lw												**95**

Table 19 Acoustically Significant Sources - Sound Power Levels (dBA re 10^{-12} Watts).													
		Octave Band Centre Frequency, Hz											
Scenario	Description	63	125	250	500	1000	2000	4000	8000	Total, dBA	Height (m)	Util %	Total, dBA
4 Asphalt plant	Dryer counterflow with drive	75	86	88	90	91	90	99	87	97	3	100%	97
	Burner device												
	Ventilator fan with drive												
	Load container compressor												
	Cold feed system with drive	66	75	83	86	85	85	81	75	92	1	100%	92
	Prop machine with drive	62	76	81	86	85	85	85	75	92	2.5	100%	92
	Hot elevate with drive	75	87	89	93	93	91	91	87	99	37	100%	99
	Mixing tower												
	Parallel drum												
	Burner device												
	Filler elevate with drive	67	78	84	88	88	90	88	78	95	37	100%	95
	Elevator with drive												
	Transfer chute drum												
	Stack outlet	71	77	79	87	86	86	83	74	92	41	100%	92
	Truck (idle)	75	83	86	87	90	91	89	84	97	1	50%	94
	Total fleet Lw												**104**
	LA_{max} (metal contact)					117							**117**

Note 1: SWL allows for duration adjustments for equipment usage.

6.2.3 Noise Attenuation Assumptions

Standard noise mitigation options as provided by the asphalt plant supplier Ammann shall be implemented. The measures and expected noise reductions are summarised in **Table 20**.

Table 20 Noise Mitigation for Asphalt Plant

Noise Source	Noise Reduction as Indicated by Supplier	Description
Cold Feed System with Drive	3dB	Rubber liners in feeders
Burner Devices	6dB	Frequency drive
Ventilation Fan with Drive	26dB	Sound protection walls plus frequency drive
Stack Outlet	20dB	Silencer
Hot Elevator with Drive	10dB	Insulated head station
Proportioning Machine with Drive	3dB	Rubber liners in feeders
Transfer Chute Drum	3dB	Insulated chute

In addition to the above, the noise modelling has considered a Colorbond shed around the RAP processing facility, enclosed on the northern, southern, and western façades, and a 5m high stockpile of material within the unprocessed RAP stockpile area. The modelled stockpile height represents 50% of the maximum stockpile height.

6.3 Road Noise Assessment

The daily number of vehicle movements are provided in **Table 21**. The total number of one-way vehicle trips is 189 heavy vehicles and 42 light vehicles, representative of staffing numbers. Therefore, the total number of project related vehicle movements along the local road network is 378 heavy vehicles and 84 light vehicles.

It is noted that under the existing Camellia RAP facility and Rosehill asphalt and Reconomy facility, the current one-way heavy vehicle trips is 188 trips per day. It is therefore considered that there would be no tangible net change between the number of daily truck movements associated with Downer's existing Camellia and Rosehill facilities and the number of daily truck movements associated with the project. Nevertheless, assessment of project-related road traffic noise to receivers adjacent to James Ruse Drive and Parramatta Road is provided below.

Table 21 Daily Number of Truck Movements			
Process	Daily Number of Trucks (per 24 hours)		
	Incoming Raw Materials	Dispatch Product	Total
Reconomy Facility	27 loads	7 loads	34 trucks
RAP Plant	34 loads	10 loads	44 trucks
Asphalt Plant	39 loads	58 loads[1]	97 trucks
Bitumen Products Plant	8 loads (7am to 6pm)	6 loads (7am to 6pm)	14 trucks

Note: 50% of incoming RAP trucks will be used to transport finished asphalt products.

The incoming and outgoing travel routes are provided as follows:

- Incoming:
  - James Ruse Drive, Grand Avenue, Colquhoun Street, Devon Street;
  - James Ruse Drive, Grand Avenue, Durham Street, Devon Street; and
  - Parramatta Road, Wentworth Street, Kay Street, Unwin Street, Colquhoun Street, Devon Street.
- Outgoing:
  - Devon Street, Colquhoun Street, Grand Avenue, James Ruse Drive;
  - Devon Street, Durham Street, Grand Avenue, James Ruse Drive; and
  - Devon Street, Colquhoun Street, Unwin Street, Kay Street, Wentworth Street, Parramatta Road.

A review of the aerial imagery shows that along the designated travel route, residential receivers are located adjacent to James Ruse Drive and Parramatta Road only, with the remaining roads located within the heavy industrial precinct. Based on annual average daily traffic volumes (AADT) from the TfNSW Traffic Volume Viewer, James Ruse Drive carries approximately 79,000 vehicles per day (AADT 2018) and Parramatta Road carries approximately 45,500 vehicles per day (AADT 2016).

The additional traffic generated by the project is therefore considered to be negligible (ie <0.1dB change) compared to the existing noise contribution from traffic volumes along James Ruse Drive and Parramatta Road and will have no additional impact on the $LA_{eq(15\ hour)}$ or $LA_{eq(9\ hour)}$ road traffic noise levels.

7 Noise Modelling Results and Discussion

7.1 Construction Phase Noise Results

Predicted noise levels for the construction scenarios described in **Section 6.1** are provided in **Table 22**. The results of the analysis show that noise emissions from construction activities are predicted to satisfy the relevant noise management levels at all receiver locations during the day, evening and night.

Furthermore, the combined noise levels for all construction activities occurring simultaneously, assuming a conservative 5dB reduction for the implementation of standard noise management measures as provided below, are unlikely to exceed the relevant day, evening and night noise management levels.

Table 22 Combined Noise Predictions – Construction Scenario

Receiver	Predicted Noise Level dB $LA_{eq(15min)}$					NML dB $LA_{eq(15min)}$	Compliant
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Cumulative[2]	Day/Evening/Night	
R1A	34	<30	31	34	33	54/46/42	✓
R1B	35	<30	32	35	34		✓
R2A	41	33	37	40	40	52/46/43	✓
R2B	40	31	39	41	40		✓
R3A	38	31	32	35	36	61/56/45	✓
R3B	40	33	33	35	37		✓
InN1	60	53	45	44	56	75	✓
InN2	58	51	60	59	59	75	✓
InE1	44	37	42	45	44	75	✓
InE2	41	34	40	42	41	75	✓
InS1	58	47	58	58	58	75	✓
InS2	46	41	49	50	49	75	✓
InW1	64	51	47	50	59	75	✓
InW2	61	40	43	44	56	75	✓
InW3	61	46	46	46	56	75	✓
C1	52	44	53	55	53	70	✓
Wor1[1]	32	<30	<30	30	30	45	✓
Wor2[1]	<30	<30	<30	<30	<30	45	✓
Sch1[1]	<30	<30	<30	<30	<30	45	✓
AR1	51	42	40	43	47	65	✓

Note 1: 10dB reduction applied for external to internal noise attenuation as per the ICNG.

Note 2: Cumulative construction totals include a conservative 5dB reduction for implementation of standard noise management measures.

Although it is demonstrated that there would be negligible impacts from project construction on surrounding potentially sensitive receivers during standard construction hours, it is recommended that during out of hours periods standard noise management strategies as per the ICNG should be implemented to minimise noise emissions from the works to the surrounding area.

Standard strategies may include the following:

- Universal work practices:
  - regularly train workers and contractors (such as tool box talks) to use equipment in ways to minimise noise;
  - avoid shouting and minimise talking loudly and slamming vehicle doors;
  - keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours and other relevant practices; and
  - avoid the use of equipment which generates impulsive noise and minimise metal to metal contact and dropping materials from height.
- Consultation and notification:
  - consider notifying immediate adjoining neighbours of the start, duration and nature of the construction activities;
  - keep a register for any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact details, person referred to, description of the complaint, work area and response;
- Plant and equipment:
  - use quieter methods and equipment where feasible and reasonable;
  - operate plant in a quiet and efficient manner;
  - regularly maintain equipment to ensure that it is in good working order;
  - place as much distance as possible between the equipment and sensitive land uses;
  - avoid the use of reverse beepers by designing the site to avoid reversing or install broadband reverse beepers where possible;
  - schedule noisy activities to occur during less sensitive periods; and
  - avoid undertaking multiple highly noise intensive activities concurrently.

7.1.1 Sleep Disturbance Impacts (Construction)

The most significant transient noise events associated with the construction of the project is from the loading of soil/rock/concrete to trucks using excavators. The predicted L_{Amax} noise levels at the nearby residential receivers are presented in **Table 23**. The results of the assessment demonstrate that sleep disturbance impacts as a result of high intensity, transient events associated with the construction activities would not exceed the sleep disturbance trigger level at any of the assessed residential receivers.

Table 23 Sleep Disturbance Impacts (Construction)

Receiver	Predicted Noise Level dB L_{Amax}	Sleep Disturbance Trigger Level	Compliant
R1A	32	52	✓
R1B	36		✓
R2A	45	53	✓
R2B	45		✓
R3A	43	55	✓
R3B	45		✓

7.2 Operational Noise Results

The prediction of operational noise levels considered the combined operation of the Reconomy facility, RAP facility, asphalt plant, bitumen products plant and onsite vehicle movements during calm (day period) and prevailing winds (evening and night periods). The predicted noise levels at each receiver are provided in **Table 24**. The noise contour maps for the facility are provided in **Appendix E**.

The results of the predictive modelling show that following the implementation of the attenuation measures described in **Section 6.2.3** noise emissions from the project satisfy the PNTLs during the day, evening and night periods at all sensitive receiver locations. It is noted that in satisfying the PNTLs, it is anticipated that there would be no cumulative industrial noise impacts at the nearby residential receivers. Hence, an assessment of the combined resulting noise level from existing and the proposed industrial noise is not required.

Table 24 Predicted Operational Noise Levels					
Receiver	Predicted Noise Level dB $LA_{eq(15min)}$			PNTL[1] dB $LA_{eq(15min)}$ Day/Evening/Night	Compliant
	Day	Evening	Night		
R1A	30	30	33	49/46/42	✓
R1B	31	31	34		✓
R2A	34	34	37	47/46/43	✓
R2B	36	35	38		✓
R3A	<30	30	<30	56/48/43	✓
R3B	30	32	30		✓
FR01	<30	<30	<30	56/48/43	✓
InN1	39	40	38	69	✓
InN2	55	56	54		✓
InE1	39	39	42		✓
InE2	39	39	42		✓
InS1	52	52	53		✓
InS2	46	46	48		✓
InW1	42	45	42		✓
InW2	37	40	37		✓
InW3	38	41	38		✓
C1	51	51	53	63	✓
Wor1[1]	<30	<30	<30	38	✓
Wor2[1]	<30	<30	<30		✓
Sch1[1]	<30	<30	<30	33	✓
AR1	37	39	37	53	✓

Note 1: Predicted noise levels reduced by 10dB to account for external to internal noise attenuation as per Section 2.6 of the NPI.

It is considered that noise emissions from the project are not anticipated to be impulsive, intermittent, or irregular. Nevertheless, it is recommended that the vehicle paths are designed to minimise the requirement for reversing on site, and where possible, broadband reverse alarms should be installed on mobile plant including front-end loaders and forklifts.

7.2.1 Maximum Noise Level Event Assessment (Operation)

In assessing the potential for sleep disturbance from maximum noise level events, a typical L_{Amax} noise source of 117dB was used to represent transient events such as metal contact from an excavator bucket under prevailing winds (ie worst case).

The predicted $L_{Aeq(15min)}$ and L_{Amax} noise levels at the nearby residential receivers (including future residential receivers) are presented in **Table 25**. The results of the assessment demonstrate that sleep disturbance impacts as a result of transient events associated with operational activities would not exceed the maximum noise trigger level at any of the assessed residential receivers. Hence, a detailed maximum noise level event assessment is not required.

Table 25 Sleep Disturbance Impacts (Operation)

Receiver	Predicted Noise Level		Maximum Noise Level Criteria		Compliant
	dB $L_{Aeq(15min)}$	dB L_{Amax}	dB $L_{Aeq(15min)}$	dB L_{Amax}	
R1A	33	37	42	52	✓
R1B	34	38			✓
R2A	37	41	43	53	✓
R2B	38	42			✓
R3A	<30	38	45	55	✓
R3B	30	38			✓
FR01	<30	32	45	55	✓

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8 Noise Monitoring and Management

8.1 Noise Management Measures

Although it is demonstrated that noise levels are predicted to meet the relevant noise goals under typical construction and operational scenarios, and no further mitigation measures are required, to proactively address any residual noise impacts, construction and operational noise management measures should be included in a construction environmental management plan (CEMP) and operational environmental management plan (OEMP) respectively. The noise management measures in the CEMP and OEMP will guide, manage, quantify and control noise emissions from the project through the implementation of feasible and reasonable best management practices. These may include:

- Using the quietest plant that can do the job.
- Scheduling the use of noisy equipment at the least-sensitive time of day.
- Reducing highly noise generating activities at night.
- Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area.
- Keeping equipment well maintained and operating it in a proper and efficient manner.
- Employing 'quiet' practices when operating equipment, for example, positioning idling trucks in appropriate areas.
- Running staff-education programs and regular tool box talks on the effects of noise and the use of quiet work practices.

The CEMP and OEMP may also address the use of best available technology including alternatives to tonal reversing alarms and efficient muffler design.

8.2 Noise Monitoring

It is recommended that the CEMP and OEMP includes a provision for attended noise monitoring within the community in response to received complaints, if any. The operator attended noise measurements and recordings would be conducted to quantify noise emissions from the Project as well as the overall level of ambient noise.

When required, the operator shall quantify and characterise the energy equivalent (L_{Aeq}) intrusive noise level from the project over a 15-minute measurement period. In addition, the operator shall quantify and characterise the overall levels of ambient noise over the 15-minute measurement interval. It is

recommended that instrumentation used during the monitoring is to be equivalent to a Type 1 meter with 1/3 octave band analysis and have audio recording functionality for post processing source identification. It is noted that 1/3 octave band analysis is required to establish whether modification factors in accordance with the NPI are to be applied.

All acoustic instrumentation used as part of the attended monitoring program must been designed to comply with the requirements of AS IEC 61672.1-2019, Electroacoustics - Sound level meters - Specifications and shall have current calibration certificates. All instrumentation shall be programmed to record statistical noise level indices in 15-minute intervals including L_{Amax}, L_{Amin} and L_{Aeq}.

Instrument calibration shall be checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA. The measurement position(s) should be selected considering:

- weather conditions such as rain and wind, insect noise;
- the location and direction of any noise source/s;
- the most sensitive position at the affected receiver; and
- the need to avoid reflecting surfaces (where possible).

9 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has conducted a Noise and Vibration Impact Assessment of potential impacts associated with the proposed construction of the Central Sydney Industrial Estate, and the operation of the Downer Sustainable Road Resource Centre on Lot 6 of the CSIE subdivision at Rosehill, NSW. The assessment has quantified potential construction and operational noise emissions pertaining to fixed and mobile plant within the facility, loading and dispatch and light and heavy vehicle movements. Nosie impacts have been assessed to residential and non-residential receivers within the catchments of Rydalmere, Silverwater and Rosehill.

Construction Noise and Vibration

Construction noise has been assessed in accordance with the ICNG with levels demonstrated to remain below the noise goals for all assessment periods at each assessed receiver location. Construction vibration levels at the nearest residential receivers are anticipated to be negligible.

Although demonstrated that there would be negligible impact from project construction on nearby receivers, it is recommended that standard noise management strategies as per the ICNG should be implemented, where feasible and reasonable to minimise noise emissions from the works to the surrounding area.

Operational Noise

The results of the NVIA demonstrate that operational noise levels will achieve the relevant NPI criteria at each assessed receiver location during calm (day period) and noise-enhancing meteorological conditions (evening and night periods). Furthermore, in satisfying the relevant criteria, it is anticipated that there would be no cumulative industrial noise impacts at the nearby residential receivers.

The operational noise assessment assumed attenuation measures including the construction of a Colorbond shed around the RAP facility (open on eastern façade), implementation of standard controls for the asphalt plant, and shielding effects from RAP stockpiles.

No additional mitigation measures or regular compliance monitoring is considered necessary, however, it is recommended that a CEMP and OEMP including construction and operational noise management measures respectively, are prepared to manage any residual impacts, if any. This would include a provision for attended noise monitoring in the event of receipt of a complaint from the community.

Road Traffic Noise

It is anticipated that there will be no tangible net change in vehicle movements associated with the existing Downer Camellia and Rosehill facilities and the project. Hence, it is considered that there will be no change in road traffic noise levels as a result of the project. Furthermore, the NVIA demonstrates that the project related road traffic noise levels will meet the objectives of the RNP for the nearest receivers on James Ruse Drive and Parramatta Road.

Based on the NVIA results, there are no noise or vibration related issues which would prevent the approval of the project. The results of the assessment show compliance with the relevant operational and road noise criteria. Additionally, the results of the assessment demonstrate compliance with the relative EPA and DECCW policies, without additional ameliorative measures being required.

Appendix A – Glossary of Terms

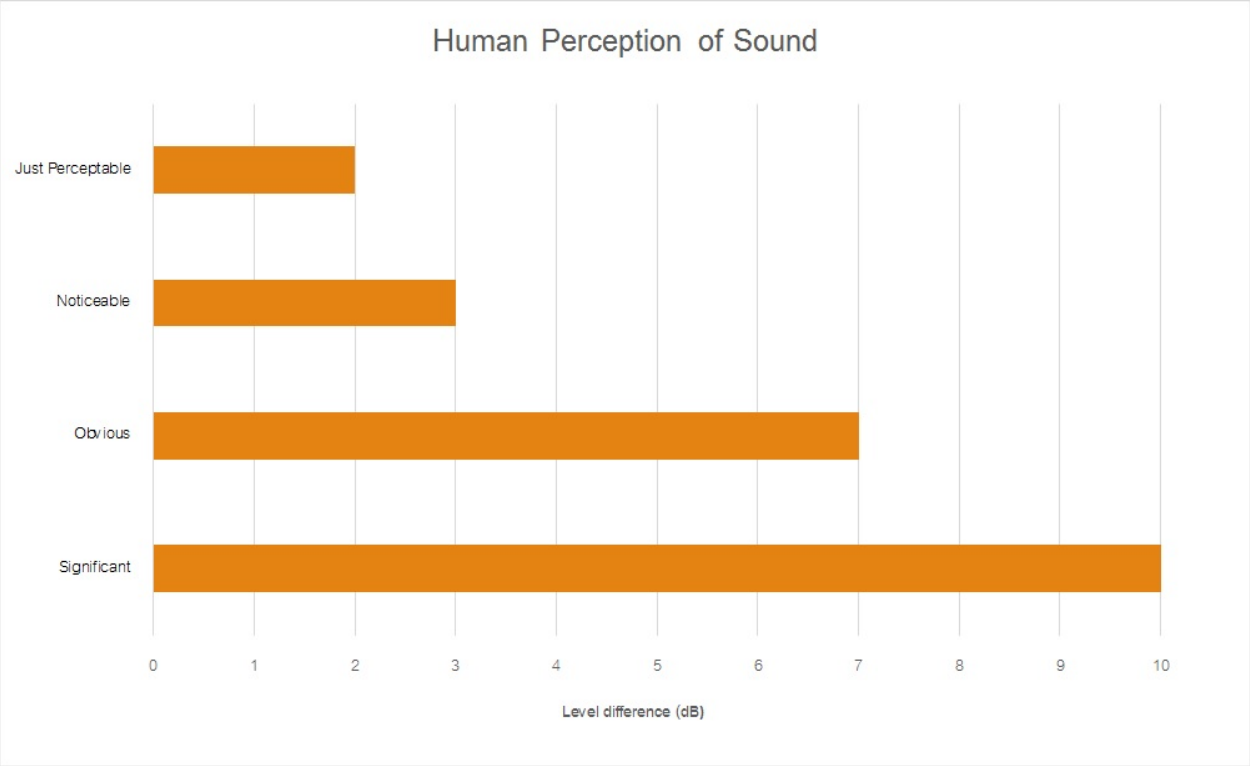
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA_{90} statistical noise levels.
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 noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dB(A)	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear. In some cases the overall change in noise level is described in dB rather than dB(A), or dB(Z) which relates to the weighted scale.
dB(Z)	Linear Z-weighted decibels.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA_{10}	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA_{90}	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LA_{eq}	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LA_{max}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dB(A)	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Appendix B – EPA Requirements

The key issues to be addressed, as identified in the NSW EPA requirements are reproduced in **Table B1.**

Table B1 NSW EPA agency comments

Noise and Vibration Assessment Requirement	Report Reference
The proponent must assess noise impacts and demonstrate effective controls to manage noise impacts, including from increased traffic, at all receptors	**Section 6** **Section 7**
Identify all noise sources or potential sources from the development (including both construction and operation phases). Detail all potentially noisey activities including ancillary activities such as transport of goods and raw material.	**Section 6**
Specify the times of operation for all phases of the development and for all noise producing activities.	**Section 2**
For projects with a significant potential traffic noise impact provide details of road alignment (including gradients, road surface, topography, bridges, culverts, etc), and land use along the proposed road and measurement locations – diagrams should be to a scale sufficient to delineate individual residential blocks.	**Section 6**
Identify any noise sensitive locations likely to be affected by activities at the site, such as residential properties, schools, churches, and hospitals. Typically the location of any noise sensitive locations in relation to the site should be included on a map of the locality.	**Section 4**
Identify the land use zoning of the site and the immediate vicinity and the potentially affected areas.	**Section 1**
Describe baseline conditions:	
– Determine the existing background (LA90) and ambient (LAeq) noise levels, as relevant, in accordance with the *NSW Noise Policy for Industry.*	**Section 4**
– Determine the existing road traffic noise levels in accordance with the *NSW Road Noise Policy,* where road traffic noise impacts may occur.	**Section** 6
– The Noise impact assessment report should provide details of all monitoring of existing ambient noise levels including: – details of equipment used for the measurements – a brief description of where the equipment was positioned – a statement justifying the choice of monitoring site(s), including the procedure used to choose the site(s), having regards to Fact Sheets A and B of the *NSW Noise Policy for Industry* – details of the exact location of the monitoring site and a description of land uses in surrounding areas – a description of the dominant and background noise sources at the site – day, evening and night assessment background levels for each day of the monitoring period – the final Rating Background Level (RBL) value – graphs of the measured noise levels for each day should be provided	**Section 4**

Table B1 NSW EPA agency comments	
– a record or periods of affected data (due to adverse weather and extraneous noise), methods used to exclude invalid data and a statement indicating the need for any re-monitoring.	
Assess impacts:	
– Determine the project noise trigger levels for the site. For each identified potentially affected receiver, this should include: – A determination of the project intrusive noise level for each identified potentially affected receiver – Selection and justification of the appropriate amenity category for each identified potentially affected receiver – Determination of the project amenity noise level for each receiver – Determination of the appropriate maximum noise level event assessment (sleep disturbance) trigger level.	**Section 5**
– Maximum noise levels during night-time period (10pm-7am) should be assessed to analyse possible affects on sleep. Determine expected noise level and noise character likely to be generated from noise sources during: – Site establishment – Construction – Operational phases – Transport including traffic noise generated by the proposal – Other services. *Note: The noise impact assessment re[ort should include noise source data for each source in 1/1 or 1/3 octave band frequencies including methods for references used to determine noise source levels. Noise source levels and characteristics can be sourced from direct measurement of similar activities or from literature (if full references are provided)*	**Section 7**
– Determine the noise levels likely to be received at the reasonably most affected location(s) (these may vary for different activities at each phase of the development).	**Section 7**
– The noise impact assessment report should include: – A plan showing the assumed location of each noise source for each prediction scenario – A list of the number and type of noise sources used in each prediction scenario to simulate all potential significant operating conditions on the site – Any assumptions made in the predictions in terms of source heights, directivity effects, shielding from topography, buildings or barriers, etc – Methods used to predict noise impacts including identification of any noise models used – The weather conditions considered for the noise predictions – The predicted noise impacts from each noise source as well as the combined noise levels for each prediction scenario	**Section 6**

Table B1 NSW EPA agency comments	
– For developments where a significant level of noise impact is likely to occur, noise contours for the key prediction scenarios should be derived – An assessment of the need to include modification factors as detailed in Fact Sheet C of the *NSW Noise Policy for Industry.*	
– Discuss the findings from the predictive modelling and, where relevant noise criteria have not been met, recommend additional feasible and reasonable mitigation measures.	Section 7
– The noise impact assessment report should include details of any mitigation proposed including the attenuation that will be achieved and the revised noise impact predictions following mitigation. – Where relevant noise/vibration levels cannot be met after application of all feasible and reasonable mitigation measures the residual level of noise impact needs to be quantified.	Section 6 Section 7 Section 8
– For the assessment of existing and future noise, details of data for the road should be included such as assumed traffic volume; percentage heavy vehicles by time of day; and details of the calculation process. These details should be consistent with any traffic study carried out in the EIS.	Section 6
– Where blasting is intended an assessment in accordance with the *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZECC, 1990) should be undertaken.	n/a
Describe management and mitigation measures: – Determine the most appropriate noise mitigation measures and expected noise reduction including both noise controls and management of impacts for both construction and operational noise. This will include selecting quiet equipment and construction methods, noise barriers or acoustic screens, location of stockpiles, temporary offices, compounds and vehicle routes, scheduling of activities, etc. – For traffic noise impacts, provide a description of the ameliorative measures considered (if required), reasons for including or exclusion, and procedures for calculation of noise levels including ameliorative measures. Also include, where necessary, a discussion of any potential problems associated with the proposed ameliorative measures, such as overshadowing effects from barriers. Appropriate ameliorative measures may include: – Use of alternative transportation modes, alternative routes, or other methods of avoiding the new road usage – Control of traffic (eg limiting times of access or speed limitation) – Resurfacing of the road using a quiet surface – Use of (additional) noise barriers or bunds – Treatment of the façade to reduce internal noise levels buildings where the night-time criteria is a major concern – More stringent limits for noise emissions from vehicles (ie using specially designed 'quiet' trucks and/or trucks to use air bag suspension	Section 7 Section 8

Appendix C – Vibration Criteria

C Construction Vibration

C1. Cosmetic Damage Criteria

British Standard BS 7385:Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2”, gives guidance on the levels of vibration which building structures could be damaged. BS7385 also takes into consideration the frequency of the vibration which is critical when assessing the likelihood of building damage.

Guide values are set for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are considered to result in a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

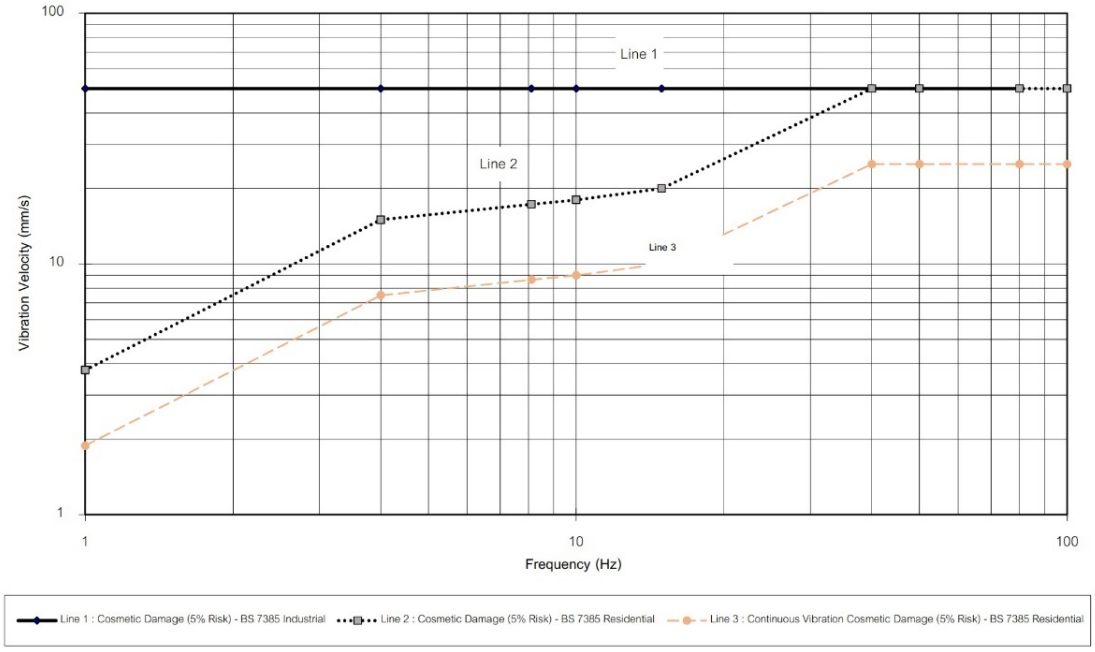
The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and heavy commercial/industrial buildings are presented in **Table C1**, with a visual representation presented in **Figure C1**.

Where sources of continuous vibration may give rise to dynamic magnification due to resonance, the values provided in **Table C1** should be reduced by 50%. This is especially the case with respect to Peak Particle Velocity (PPV) at lower frequencies.

Table C1 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Figure C1– **Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage**



Sources of vibration, which are considered in the standard, include blasting (carried out during mineral extractions or construction excavation), demolition, piling, ground treatments (compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

To assess the likelihood of cosmetic damage due to vibration, BS 7385 specifies that vibration levels should be obtained from a monitoring position situated at the base of the building and the maximum level of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in **Figure C1**.

C2. Human Comfort – Assessing Vibration a Technical Guideline

Humans are far more sensitive to vibration than is commonly realised and may detect vibration levels which are well below levels that may cause damage to buildings or structures. Assessing vibration: a technical guideline was published in February of 2006 by the DECC and is based on guidelines contained in BS 6472 – 1992, Evaluation of human exposure to vibration in buildings (1-80 Hz) and provides guidance on assessing vibration against human comfort.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to

building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in **Table C2**.

Table C2 Examples of types of vibration (from Table 2.1 of the guideline)

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990)	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

C2.1 Continuous Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to continuous vibration (1-80Hz), the criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. **Table C3** reproduces the preferred and maximum criteria relating to measured peak velocity.

Table C3 Criteria for Exposure to Continuous Vibration

Place	Time	Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night	0.14	0.28
Residences	Day	0.28	0.56
	Night	0.20	0.40
Offices	Day or Night	0.56	1.1
Workshops	Day or Night	1.1	2.2

Note: rms velocity (mm/s) and vibration velocity value (dB re 10^{-9} mm/s) values given for most critical frequency >8Hz assuming sinusoidal motion.

C2.2 Intermittent Vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of activities such as impact hammering, rolling or general excavation work (such as an excavator tracking).

Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz. To calculate VDV the following formula (refer section 2.4.1 of the guideline) was used:

$$VDV = \left[\int_0^T a^4(t)dt\right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, a (t) is the frequency-weighted rms of acceleration in m/s2 and T is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for Intermittent Vibration is reproduced in **Table C4**.

Table C4 Acceptable Vibration Dose Values (VDV) for Intermittent Vibration

Location	Daytime		Night-time	
	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$
Critical Areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am

Note: These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

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Appendix D – NEWA Analysed Meteorology

Table D1 NEWA Analysed Daytime Meteorological Conditions, Sydney Olympic Park AWS					
Direction ± 45°	Season	Day Percentage Occurrence %	Direction	Season	Day Percentage Occurrence %
0	Summer	8	180	Summer	6
0	Autumn	11	180	Autumn	8
0	Winter	8	180	Winter	8
0	Spring	8	180	Spring	7
22.5	Summer	9	202.5	Summer	6
22.5	Autumn	12	202.5	Autumn	7
22.5	Winter	6	202.5	Winter	10
22.5	Spring	9	202.5	Spring	7
45	Summer	17	225	Summer	5
45	Autumn	15	225	Autumn	9
45	Winter	6	225	Winter	13
45	Spring	15	225	Spring	7
67.5	Summer	18	247.5	Summer	4
67.5	Autumn	15	247.5	Autumn	12
67.5	Winter	7	247.5	Winter	17
67.5	Spring	14	247.5	Spring	8
90	Summer	17	270	Summer	6
90	Autumn	15	270	Autumn	19
90	Winter	7	270	Winter	28
90	Spring	14	270	Spring	10
112.5	Summer	18	292.5	Summer	7
112.5	Autumn	15	292.5	Autumn	21
112.5	Winter	8	292.5	Winter	28
112.5	Spring	16	292.5	Spring	11
135	Summer	17	315	Summer	7
135	Autumn	14	315	Autumn	20
135	Winter	9	315	Winter	26
135	Spring	13	315	Spring	11
157.5	Summer	7	337.5	Summer	8
157.5	Autumn	8	337.5	Autumn	18
157.5	Winter	6	337.5	Winter	20
157.5	Spring	6	337.5	Spring	10

Table D2 NEWA Analysed Evening time Meteorological Conditions, Sydney Olympic Park AWS					
Direction ± 45°	Season	Evening Percentage Occurrence %	Direction	Season	Evening Percentage Occurrence %
0	Summer	8	180	Summer	14
0	Autumn	9	180	Autumn	10
0	Winter	11	180	Winter	5
0	Spring	9	180	Spring	13
22.5	Summer	16	202.5	Summer	9
22.5	Autumn	11	202.5	Autumn	10
22.5	Winter	8	202.5	Winter	7
22.5	Spring	12	202.5	Spring	10
45	Summer	26	225	Summer	5
45	Autumn	13	225	Autumn	8
45	Winter	6	225	Winter	12
45	Spring	19	225	Spring	6
67.5	Summer	29	247.5	Summer	4
67.5	Autumn	13	247.5	Autumn	10
67.5	Winter	4	247.5	Winter	16
67.5	Spring	21	247.5	Spring	6
90	Summer	31	270	Summer	4
90	Autumn	13	270	Autumn	12
90	Winter	3	270	Winter	21
90	Spring	20	270	Spring	6
112.5	Summer	30	292.5	Summer	4
112.5	Autumn	14	292.5	Autumn	12
112.5	Winter	3	292.5	Winter	21
112.5	Spring	21	292.5	Spring	6
135	Summer	23	315	Summer	4
135	Autumn	14	315	Autumn	12
135	Winter	4	315	Winter	20
135	Spring	20	315	Spring	6
157.5	Summer	15	337.5	Summer	5
157.5	Autumn	10	337.5	Autumn	11
157.5	Winter	2	337.5	Winter	18
157.5	Spring	13	337.5	Spring	6

Table D3 NEWA Analysed Night-time Meteorological Conditions, Sydney Olympic Park AWS					
Direction ± 45°	Season	Night Percentage Occurrence %	Direction	Season	Night Percentage Occurrence %
0	Summer	5	180	Summer	15
0	Autumn	6	180	Autumn	5
0	Winter	10	180	Winter	1
0	Spring	6	180	Spring	7
22.5	Summer	5	202.5	Summer	12
22.5	Autumn	3	202.5	Autumn	6
22.5	Winter	4	202.5	Winter	3
22.5	Spring	5	202.5	Spring	8
45	Summer	8	225	Summer	9
45	Autumn	1	225	Autumn	7
45	Winter	2	225	Winter	8
45	Spring	4	225	Spring	10
67.5	Summer	11	247.5	Summer	7
67.5	Autumn	1	247.5	Autumn	10
67.5	Winter	1	247.5	Winter	15
67.5	Spring	4	247.5	Spring	13
90	Summer	14	270	Summer	7
90	Autumn	2	270	Autumn	18
90	Winter	1	270	Winter	33
90	Spring	5	270	Spring	17
112.5	Summer	18	292.5	Summer	7
112.5	Autumn	3	292.5	Autumn	20
112.5	Winter	1	292.5	Winter	37
112.5	Spring	6	292.5	Spring	17
135	Summer	19	315	Summer	7
135	Autumn	3	315	Autumn	19
135	Winter	1	315	Winter	34
135	Spring	7	315	Spring	16
157.5	Summer	14	337.5	Summer	7
157.5	Autumn	3	337.5	Autumn	15
157.5	Winter	1	337.5	Winter	27
157.5	Spring	6	337.5	Spring	12

Appendix E – Noise Model Contours

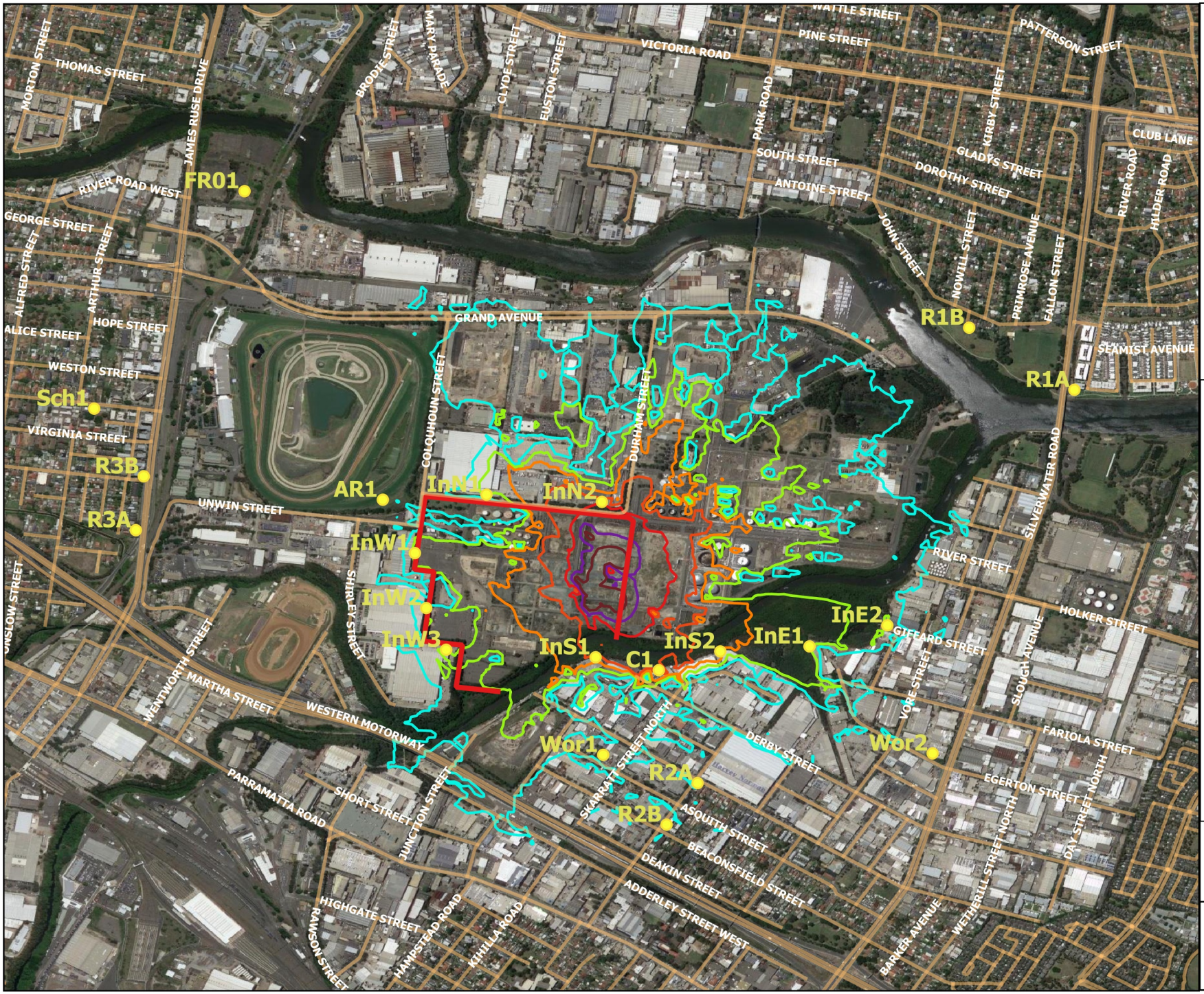

FIGURE E1

LAeq(15min) Noise Contours

Day Period (Calm)

MAC201090-01

WESTERN AREA SUBDIVISION

KEY

Project Site

Receivers

Noise Contours

35

40

45

50

55

60

65

0 150 300 450 600 m

N

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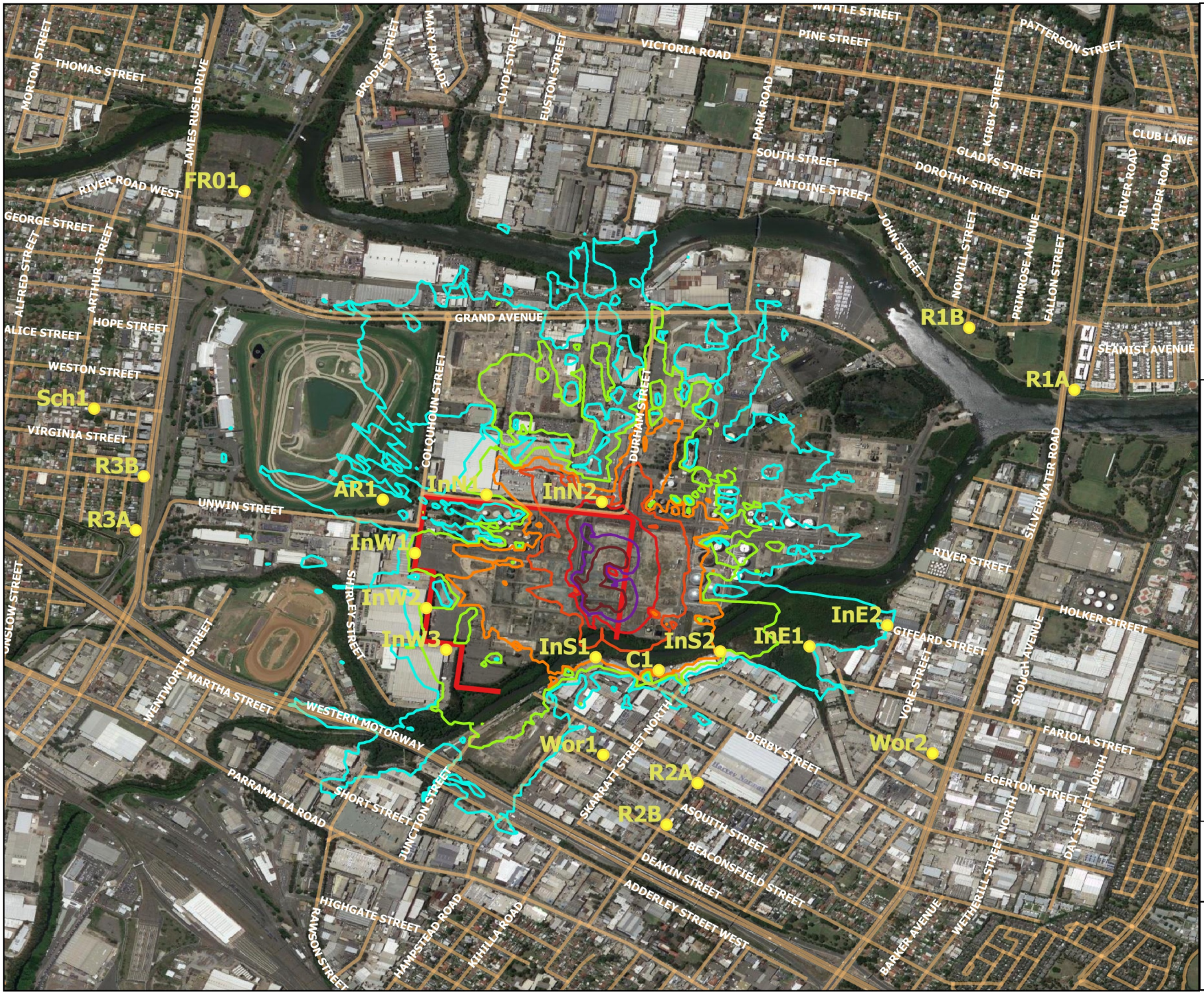

FIGURE E2

LAeq(15min) Noise Contours

Evening Period (Enhancing)

MAC201090-01

WESTERN AREA SUBDIVISION

KEY

Project Site

Receivers

Noise Contours

35

40

45

50

55

60

65

0 150 300 450 600 m

N

MAC
Muller Acoustic Consulting

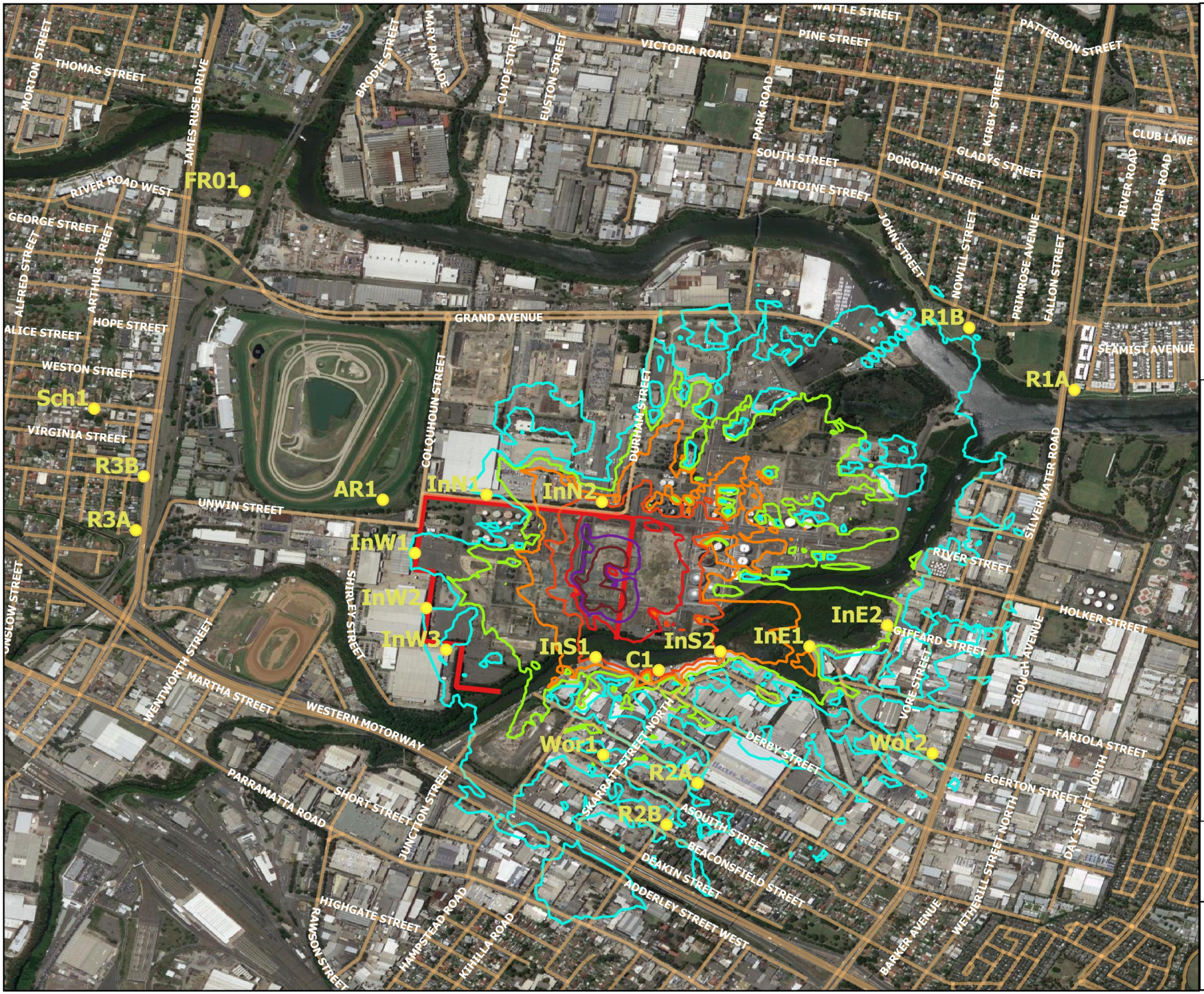

FIGURE E3

LAeq(15min) Noise Contours

Night Period (Enhancing)

MAC201090-01

WESTERN AREA SUBDIVISION

KEY

Project Site

Receivers

Noise Contours

35

40

45

50

55

60

65

0 150 300 450 600 m

N

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