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MOOREBANK PRECINCT WEST - STAGE 3

Noise & Vibration Impact Assessment

23 April 2020

Tactical Group

TJ741-09F02 (r5) Moorebank Precinct West - Stage 3 EIS NVIA.docx

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1 Introduction

Renzo Tonin & Associates was engaged by Tactical Group on behalf of the Sydney Intermodal Terminal Alliance (SIMTA) to undertake an environmental noise and vibration assessment of the proposed Moorebank Precinct West (MPW) Stage 3 (MPW Stage 3). The noise and vibration assessment will form part of the Environment Impact Statement (EIS) submission addressing the Secretary's Environmental Assessment Requirements (SEARs) (ref. SSD-10431, dated 20 March 2020).

MPW Stage 3 generally consists of works to support MPW Stage 2, and as such the following noise and vibration impacts have already been addressed in the MPW Concept and Stage 1 or MPW Stage 2 noise and vibration assessments and will not be addressed in this report:

- Operational noise impacts (rail or industrial noise)
- Construction activities required for MPW not identified in Section 2, including other ancillary facilities and works outside of standard construction hours
- Construction road traffic
- Construction vibration.

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

2 Proposal overview

The MPW Stage 3 proposal (the Proposal) involves the construction and operation of Stage 3 of the MPW Project, consistent with the approved concept plan (SSD-5066). The layout and works areas for Stage 3 are presented in Figure 1 and includes allowance for:

- Establishment of a works compound to facilitate site development works for the MPW site , which include hardstand, laydown and materials stockpile areas, access roads and utilities and services
- Progressive subdivision of the MPW site into nine allotments, for the purposes of creating separate lots for the intermodal terminal facility (IMT) and rail link corridor, for warehousing and distribution facilities, biodiversity conservation, as presented in Figure 1
- Ancillary works to facilitate the Stage 3, including access roads, earthworks, utilities, stormwater and drainage, signage and landscaping.

2.1 Assessment purpose and overview of noise and vibration aspects

This noise and vibration assessment has been prepared to provide an assessment of the potential noise and vibration impacts associated with the Proposal. The assessment has been undertaken considering the documentation prepared for the MPW Concept Plan, MPW Stage 2, and the Secretary's Environmental Assessment Requirements (SEARs) for the Proposal, and the applicable legislation and guidelines to assess the associated noise and vibration impacts from the Proposal.

The noise and vibration impacts have in general already been previously assessed as part of the broader MPW Concept Plan and MPW Stage 2 environmental impact assessments which have largely covered the Proposal works. The Proposal does not introduce any new or additional works not already anticipated and assessed as part of the MPW Concept and Stage 1 and MPW Stage 2. The extent of the MPW Stage 2 construction area assessed along with the key changes that are introduced as part of MPW Stage 3 are presented in Figure 2.

The main potential noise impacts as a result of the Proposal are:

- Updated location of the temporary construction support compound and associated activities, laydown and materials stockpile locations, and offices to support the residual MPW Early Works Stage 1 (site establishment works which will generally be completed by Stage 3), MPW Stages 2 and 3 site development works and future stages of the MPW development construction works.
- Continuation of crushing activities as approved under MPW Stage 2 in an updated location within the MPW Stage 3 footprint.
- Updated vehicle access to the Stage 3 temporary construction support compound, which was previously along Moorebank Avenue, and is now along the permanent access road and temporary loop road along the western MPW site boundary.

As such, this technical memorandum will make reference to these previous assessments for further background, and where there are no changes in proposed construction or operations associated with the Proposal, reference to the applicable assessments are made.

The relevant reference assessments are as follows:

- MPW Concept Plan and Stage 1 (SSD 5066 MOD 1) – *MPW Concept Plan Modification Noise and Vibration Impacts Assessment, Wilkinson Murray, Report reference: 15324-MO Report Ver. B, dated June 2015 (MPW Concept NV assessment).*
- MPW Stage 2 (SSD 7709) – *MPW Stage 2 Noise and Vibration Impacts Assessment, Wilkinson Murray, Report reference: 15324 Report Ver. D, dated October 2016 (MPW2 NV assessment).*

2.2 Construction Program

The Stage 3 temporary construction support compound will support the remaining Early Works Stage 1, and Stages 2 and 3 Project and will operate throughout the construction works of these stages.

The Proposal construction works are expected to commence shortly after the revised MPW Stage 2 CEMP/sub-plans and other required documentation in accordance with CoA have been approved, and be completed within 12 months from the date of commencement.

The indicative Stage 3 construction program is shown in Table 1. This will support the remaining Early Works Stage 1, and Stages 2 and 3 projects for this period.

Table 1 – Indicative construction program MPW Stage 3

Delivery Phase	Construction works period	2020				2021			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Support	Stage 3 temporary construction support compound								

Figure 1 – Proposed MPW Stage 3 development works area and layout

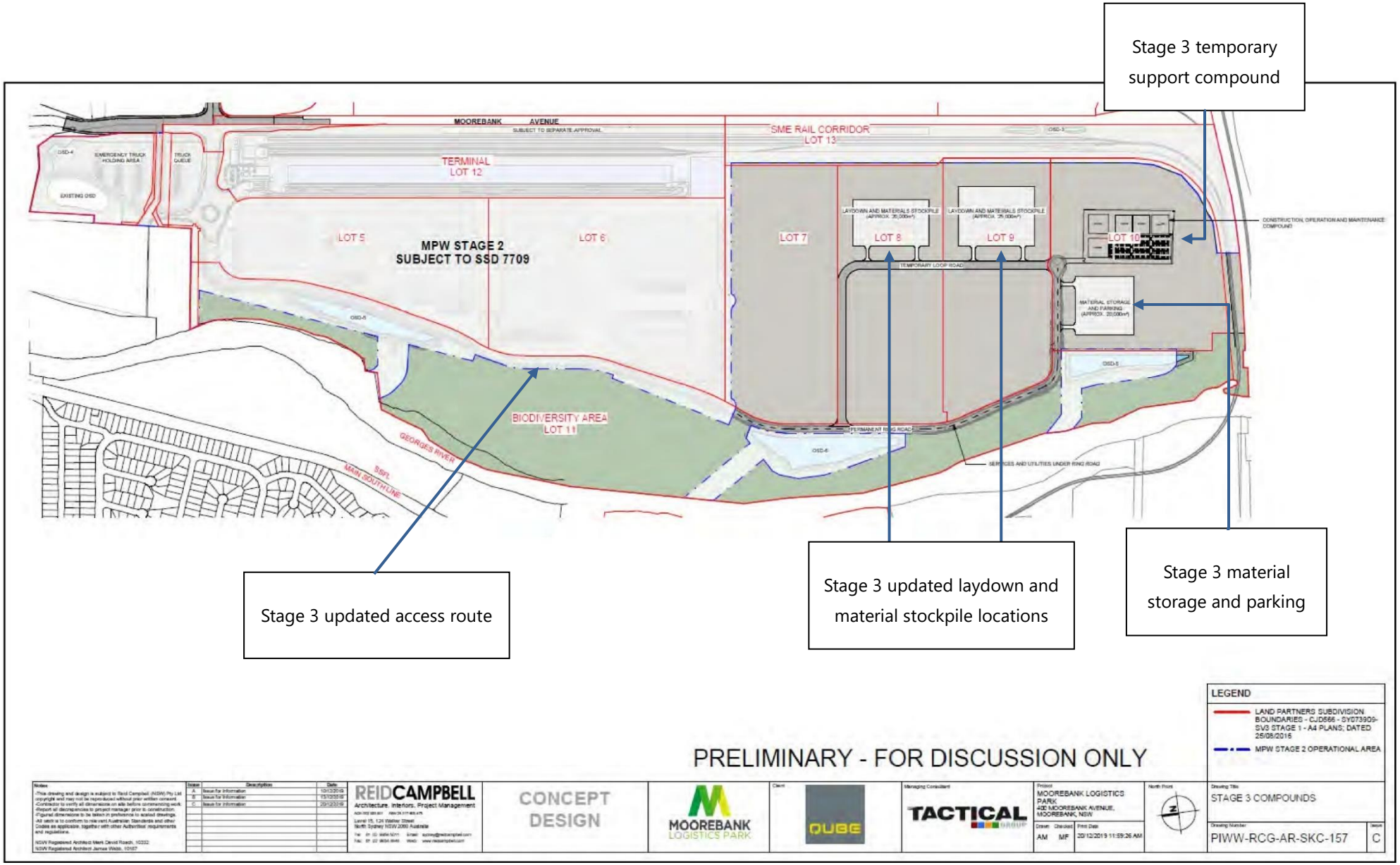
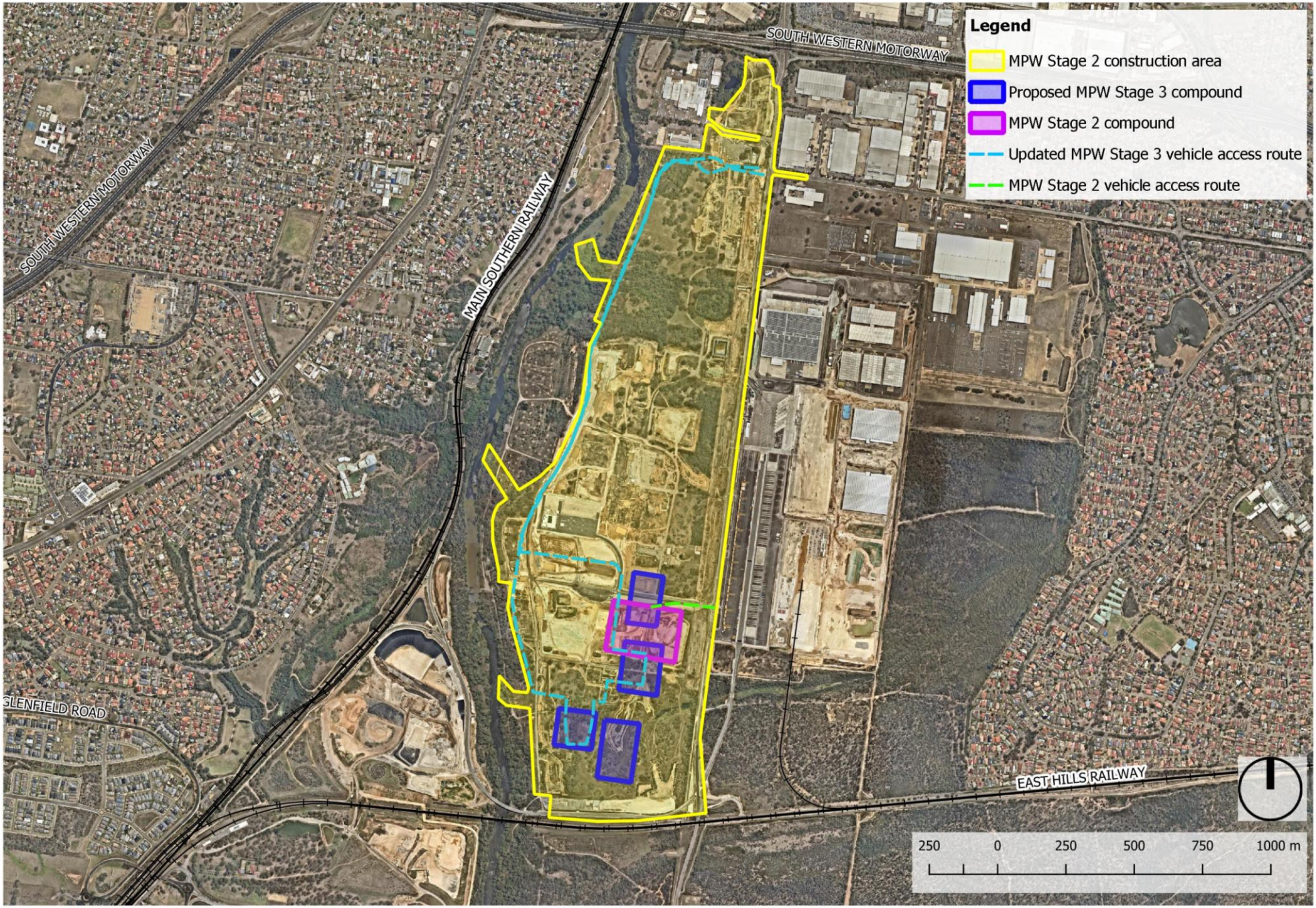


Figure 2 – MPW Stage 2 and MPW Stage 3 construction work areas



2.3 Construction Hours

The following standard construction hours for the Project are in accordance with the EPA's 'Interim Construction Noise Guideline' (ICNG, 2009), and are consistent with those defined by Condition B125 (SSD 7709) for MPW Stage 2 and Condition D5 (5066 MOD 1) for MPW Concept Plan.

- 7:00am to 6:00pm, Monday to Friday
- 8:00am to 1:00pm, Saturday
- No work on Sunday and Public holidays

Works that are not within standard construction hours would be undertaken through the out of hours work (OOHW) Protocol developed in accordance with Conditions B127 and B135 of SSD 7709.

The OOHW construction is divided into the periods detailed in Table 2, which are the typical OOHW periods required by the Project and no construction works are anticipated on Sundays or Public Holidays. Additional OOHW periods may be implemented during the construction process; however, any works will be subject to the OOHW Protocol.

Table 2 – OOHW construction periods

OOHW Period	Time	Days
OOH Period 1	6.00am – 7.00am	Monday to Friday
OOH Period 2	6.00pm – 10.00pm	Monday to Friday
OOH Period 3	7.00am – 8.00am	Saturday
OOH Period 4	1.00pm – 6.00pm	Saturday

2.4 Sensitive receivers

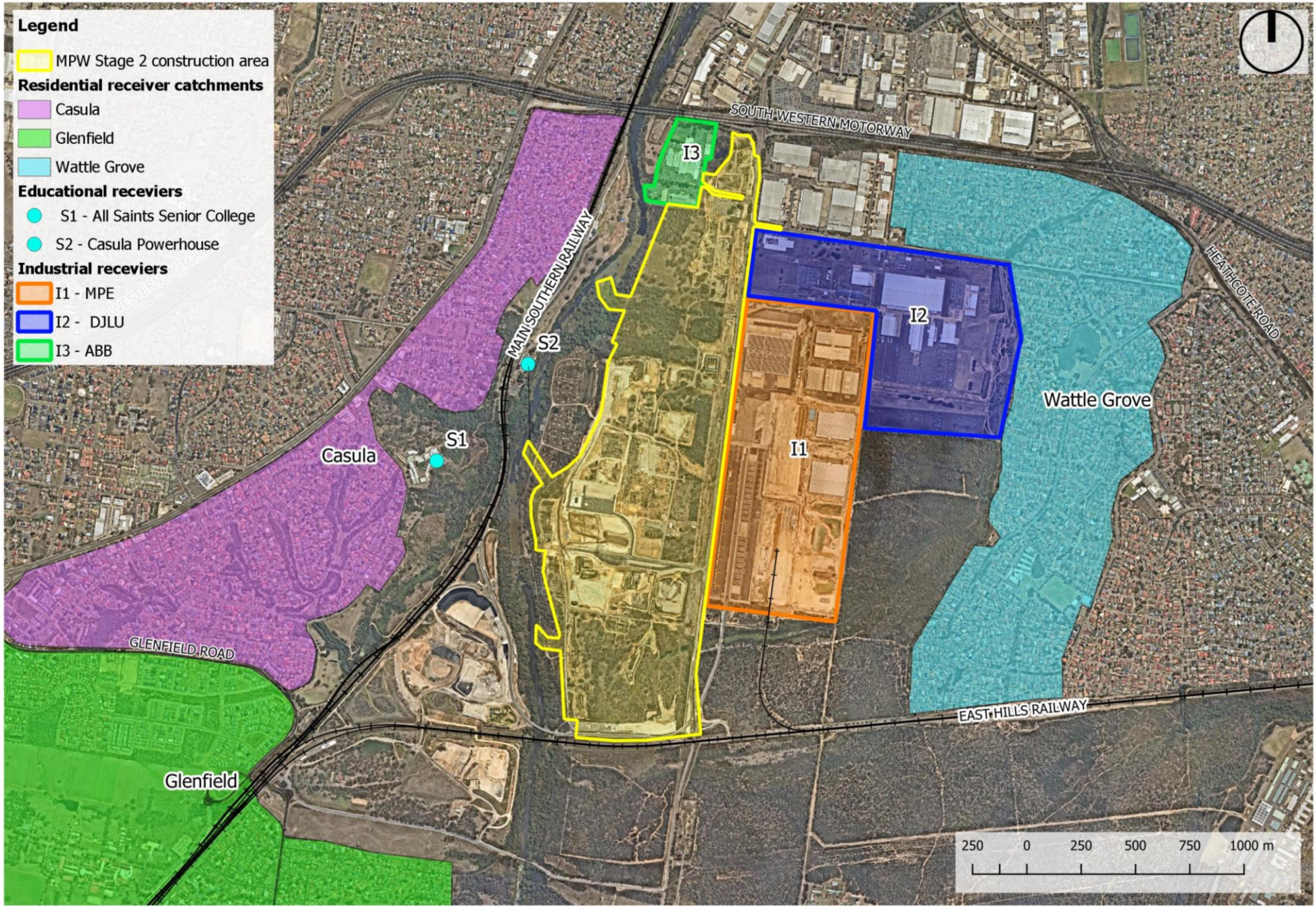
The potentially most affected residential receivers in the vicinity of the Proposal are located in the suburbs of Casula, Glenfield and Wattle Grove. In addition to residential receivers, a number of potentially affected non-residential receivers have been identified near the Proposal, including All Saints Senior College and the Casula Powerhouse, both of which are located to the west of the Proposal and across the Georges River. The MPW construction area is also bounded by industrial receivers, which consist of Moorebank Precinct East (MPE), ABB Australia and the Defence Joint Logistics Unit (DJLU).

Table 3 presents a summary of the potentially most affected receivers near the Proposal based on the approximate minimum distance from the MPW Stage 2 & 3 construction works area to the potentially most affected receiver. Distances are based upon both the Stage 2 and Stage 3 components as these are proposed to occur concurrently. These locations are presented in Figure 3.

Table 3 – Sensitive receivers

Receiver/Suburb	Category	Distance from Stage 2 & 3 construction areas
Casula	Residential	350 m
Glenfield		1,800 m
Wattle Grove		640 m
S1 - All Saints Senior College	Educational	630 m
S2 - Casula Powerhouse		360 m
I1 - MPE	Industrial	Share common boundary
I2 - DJLU		50 m
I3 - ABB Australia		Share common boundary

Figure 3 – Noise and vibration sensitive receivers



3 Project noise and vibration requirements

3.1 Secretary's environmental assessment requirements

This report has been prepared to address the SEARs (reference SSD 10431, dated 20 March 2020) issued for Stage 3.

The SEARs relating to the project, and where these requirements are addressed in this report, are outlined in Table 1.

Table 1 – SEARs – Noise and Vibration

SEARs	Where addressed
2. Compliance with the Approval Concept Proposal	
The EIS must demonstrate that the proposal is consistent with the Concept Proposal and Stage 1 approval SSD 5066, dated 3 June 2016 (as modified), including compliance with development outcomes approved under the Concept Proposal for stage1, 2 and 3 and meeting of all the requirements stipulated under Schedule 4 (Conditions to be met in future development applications).	Section 3.2
5. Noise and Vibration	
including but not limited to: An updated assessment of noise and vibration impacts. The assessment shall: a) assess construction noise and vibration impacts associated with construction of the proposal, including impacts from construction traffic and ancillary facilities. The assessment must identify sensitive receivers and assess construction noise/vibration generated by representative construction scenarios focusing on high noise generating works. Where work hours outside of standard construction hours are proposed, clear justification and detailed assessment of these work hours must be provided, including alternatives considered, mitigation measures proposed and details of construction practices, work methods, compound design, etc;	**Section 6** assesses the changes in construction noise and vibration impacts associated with the Proposal. Construction noise and vibration impacts from all other MPW Stage 2 construction works are addressed in the ***MPW2 NV assessment***
b) assess operational noise and vibration impacts and identify feasible and reasonable measures proposed to be implemented to minimise operational noise impacts from use of the facility;	Operational noise is addressed in the ***MPW2 NV assessment***
c) include a framework for on and off-site noise monitoring during operation and	Operational noise is addressed in the ***MPW2 NV assessment***
d) be prepared in accordance with: NSW Noise Policy for Industry (EPA 2017), Interim Construction Noise Guideline (EPA, 2009), Assessing Vibration: a technical guide (EPA 2006), and the NSW Road Noise Policy (EPA, 2011).	**Section 5** details the construction noise and vibration impact assessment requirements. Construction noise and vibration impacts from all other MPW Stage 2 construction works are addressed in the ***MPW2 NV assessment*** Operational noise is addressed in the ***MPW2 NV assessment***

3.2 SSD 5066 MOD 1 (Concept Proposal and Stage 1) and SSD 7709 (MPW Stage 2)

Only conditions directly relevant to the Proposal have been included in Table 2 below.

Table 2 – Relevant existing approval assessment requirements – Noise and Vibration

Condition of Consent	
SSD 5066	
E28. All future Development Applications must provide the timing for construction and operation on both the MPW and MPE sites and provide cumulative assessments for construction and operation on the MPW and MPE sites including, but not limited to: ... b) noise and vibration impacts;	Section 6.4.3

Stage 3 does not introduce any new or additional works not already anticipated and assessed as part of the MPW Concept and Stage 1 and MPW Stage 2, however it does relocate some noise generating items included in these earlier stages in order to create site efficiencies. As detailed in Section 6, this assessment evaluates the potential changes in construction noise impacts as a result of the Proposal in order to confirm that it does not compromise the MPW Stage 2 development works to be undertaken, in accordance with SSD 7709 Conditions of Consent relating to noise and vibration.

4 Existing noise environment and sensitive receivers

The existing noise environment for sensitive areas in the vicinity of the Project were presented in the *MPW2 NV assessment*, including the representative Rating Background Levels (RBLs) at the three potentially most affected residential receiver areas. The representative RBLS are presented in Table 3.

Table 3 – Measured rating background levels, dB(A)

NCA	Daytime (7:00am to 6:00pm)	Evening (6:00pm to 10:00pm)	Night-time (10:00pm to 7:00am)
Casula	39	39	33
Glenfield	35	37	33
Wattle Grove	35	36	32

5 Construction noise and vibration management levels

Construction noise and vibration management levels were derived for the *MPW Concept NV assessment* and *MPW2 NV assessment*, which have been reviewed by the relevant regulatory and approval authorities. The construction noise and vibration management levels for the Proposal have been adopted from these assessments so that the assessment of potential impacts are consistent with those undertaken for *MPW Concept NV assessment* and *MPW2 NV assessment*.

The exception to this is where the NSW 'Industrial Noise Policy' (INP, 2000) has been replaced by the NSW 'Noise Policy for Industry' (NPfI, 2017), which has minor differences on the applicable references for assessment of sleep disturbance and the derivation of NMLs applicable for shoulder periods.

5.1 Noise management levels

The policies and standards outlined in Table 4 have been used to establish construction Noise Management Levels (NMLs) that are applicable to the MPW Stage 3.

Table 4 – Applicable construction noise policies and standards

Environment impact	Relevant policy / standard used to establish noise and vibration management level
Airborne noise	• NSW Interim Construction Noise Guideline (ICNG) • Noise Policy for Industry (EPA, 2017)
Sleep disturbance and maximum noise events	• NSW Road Noise Policy (RNP)
Construction related road traffic noise	• Guidance taken from the NSW Interim Construction Noise Guideline (ICNG) and the NSW Road Noise Policy (RNP)

Construction noise management levels for residential receivers were derived in Section 6.5 of the *MPW2 NV assessment*, and have been adopted for this assessment. In addition to residential type receivers, the All Saints Senior College and the Casula Powerhouse have been identified as school and educational type receivers. Furthermore, the MPE, ABB Australia and DJLU receivers have been identified as industrial type receivers. It is noted that the receiver types for these other sensitive receivers were established in the *MPW2 NV assessment*.

Table 5 presents the summary of NMLs applicable for standard construction hours, which were established in the *MPW2 NV assessment* and based on the measured RBL values presented in Table 3. The construction works are expected to typically occur during standard construction hours.

Table 5 – Summary of NMLs for standard construction hours, $L_{Aeq,15min}$, dB(A)

Receiver type	Receiver	Standard construction hours NML
Residential	Casula	49
	Glenfield	45
	Wattle Grove	45
Educational	S1, S2	55
Industrial	I1, I2, I3	75

Should construction works occur outside of standard hours, then construction noise impacts should be assessed against the NMLs presented in Table 6 for each of the OOHW periods identified.

Additional long-term noise monitoring was undertaken as part of the MPE Stage 2 project to satisfy Conditions B26 and B63 of the SSD 16-7628 Development Consent. This data was presented in the document *MPE Stage 2 Noise Monitoring Report*, *Wilkinson Murray, Report reference: 12186-M2 Report Ver. D, dated February 2018* (MPE Noise Monitoring Report). The data presented in the report was

analysed in accordance with Section A3 *"Dealing with 'shoulder' periods"* of the NPfI for the 6:00am to 7:00am weekday morning shoulder period. The monitoring data determined the following RBL values for the nominated weekday morning shoulder period.

- Casula = **39 dB(A)**
- Glenfield = **48 dB(A)**
- Wattle Grove = **36 dB(A)**

Where the above morning shoulder period RBL values are typically equal to or higher than the adopted daytime RBL values presented in Table 3, the daytime values have been adopted for this period so they are no higher than those adopted for the daytime, consistent with the requirements of the NPfI.

Table 6 – Construction noise management levels by OOHW periods, $L_{Aeq,15min}$, dB(A)

Receiver	OOHW 1 6am – 7am (Monday – Friday)	OOHW 2 6pm – 10pm (Monday – Friday)	OOHW 3 7am – 8am (Saturday)	OOHW 4 1pm – 6pm (Saturday)
Casula	44[1]	44	44	44
Glenfield	40[1,]	40[1]	40	40
Wattle Grove	40[1,]	40[1]	40	40
S1, S2 (Note 2)	55	55	55	55
I1, I2, I3 (Note 2)	75	75	75	75

Notes:
1. As outlined in the NPfI, the evening and night crtieria or management levels are set no louder than the daytime levels, which includes shoulder periods.
2. Noise management levels are only applicable when the facility is in use.

5.2 Sleep disturbance

Maximum noise levels generated by construction activities have the potential to disturb sleep. For residential receptors, the ICNG recommends that where construction works are planned to extend over two or more consecutive nights, night is defined as 10:00pm to 7:00am in accordance with ICNG, the Proposal should consider maximum noise levels and the extent and frequency of maximum noise level events exceeding the RBL. The potential for both sleep disturbance and awakenings should be considered in the assessment for the OOHW 1 period / morning shoulder period.

Section 4.3 of the ICNG refers to the NSW 'Environmental Criteria for Road Traffic Noise' (ECRTN, 1999), which has been superseded by the NSW 'Road Noise Policy' (RNP, 2011). Although noise goals are not specifically provided in the RNP, the RNP includes a review of internal sleep arousal research which provides the basis for reviewing the potential for sleep disturbance impacts.

To assess the likelihood of sleep disturbance, an initial screening level of $L_{Amax} \leq L_{A90(15min)} + 15$ dB(A) is used. In situations where this results in an external screening level of less than 55 dB(A), a minimum screening level of 55 dB(A) is set.

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

- the likely number of events that might occur during the night assessment period, and
- whether events exceed an 'awakening reaction' level of $L_{A1(1min))}$ 65 dB(A).

Based on the above and the measured morning shoulder period RBLs for each residential receiver area, the applicable initial screening levels are presented in Table 7.

Table 7 – $L_{A1,1min}$ (or L_{Amax}) sleep disturbance screening levels for OOHW 1 period

Catchment	Initial screening level, dB(A)[1]	Adopted screening level, dB(A)
Casula	39 + 15 = **54**	55
Glenfield	48 + 15 = **63**	63
Wattle Grove	36 + 15= **51**	55

Notes
1. RBL value based upon the established weekday morning shoulder period values for the 6:00am to 7:00am period, as detailed in Section 5.1
2. In situations where this results in an external screening level of less than 55 dB(A), a minimum screening level of 55 dB(A) is set

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

- The likely number of events that might occur during the night assessment period
- Whether events exceed an 'awakening reaction' level of 55 dB(A) L_{Amax} (internal), which equates to an external L_{Amax} NML of **65 dB(A)**, assuming open windows.

5.3 Construction traffic noise criteria

No additional construction traffic travelling along public roads is proposed as part of the Proposal. The only change from the assessment presented in *MPW Concept NV assessment* and *MPW Stage 2 NV assessment* is that the construction traffic would leave Moorebank Ave at the intersection with Anzac Ave and enter the construction site, travelling along the western boundary and the temporary loop road instead of travelling along Moorebank Avenue prior to entering the southern area of MPW. As such, construction traffic noise along public roads was determined to not increase road traffic noise levels by more than 2dB(A) in the *MPW Concept NV assessment*, and as such would not require further noise mitigation to be considered in accordance with the RNP.

Therefore, noise from construction traffic within the site has been assessed as part of the overall construction noise impacts assessed in Section 6.4.

5.4 Vibration management

The policies and standards outlined in Table 8 are relevant for establishing vibration management levels for the Project.

Table 8 – Vibration standards

Environment impact	Relevant policy/ standard used to establish noise and vibration management level
Vibration impact on humans	• Assessing Vibration: A Technical Guideline (DECC, 2006) • British Standard BS 6472-1992 and 2008 'Guide to evaluation of human exposure to vibration in buildings (1-80Hz)'
Vibration (structural damage to buildings and buried services)	• British Standard BS 7385-1993 – Part 2 'Evaluation and measurement of vibration in buildings' • German Standard DIN 4150:2016 – Part 3 Structural vibration in buildings – Effects on structures • Construction Noise and Vibration Strategy (Transport Construction Authority, 2019)[1]

Notes 1. This document has been updated to Version 4.1 since the MPW Concept Plan EIS and MPW Stage 2 EIS were undertaken

Given that vibration intensive activities are not proposed as part of the Proposal and considering the distances from any construction works to nearby vibration sensitive receivers are greater than 100 meters, no vibration impacts from the works are expected. As such, no further assessment of potential vibration impacts on nearby receivers has been undertaken from herein.

6 Construction noise and vibration assessment

6.1 Construction activities

The construction activities associated with the Proposal are:

- Establishment of a works compound to facilitate site development works for the MPW development, as shown in Figure 1 and Figure 2.
- Updated vehicle access route to the temporary construction support compound, which was previously along Moorebank Avenue, and is now along the permanent access road and temporary loop road along the western MPW site boundary.
- Ancillary works including access roads, earthworks, utilities, stormwater and drainage, signage and landscaping. These ancillary works have already been assessed as part of the *MPW Concept NV assessment* and *MPW Stage 2 NV assessments* and are not proposed to change as a result of the Proposal.

6.1.1 Standard construction hours

A summary of the indicative construction works proposed to take place as part of the Proposal during standard construction hours is provided in Table 9.

These works will take place concurrently with the MPW Stage 2 construction activities and will mainly be associated with the "*Works period C – Bulk earthworks, drainage and utilities*" portion of the MPW Stage 2 construction works. Site establishment works associated with Early Works (Stage 1) will generally be completed by Stage 3 and so have not been directly assessed in this report.

As such, this assessment has only directly assessed this portion of the MPW construction works. The potential noise impacts from the ancillary works associated with the Proposal have been assessed in the *MPW Concept NV assessment* and *MPW Stage 2 NV assessment*.

Table 9 – Construction activities to be undertaken as part of MPW Stage 3 assessed works

Construction works period	MPW Stage 3 construction works component	Activity
Works period C – Bulk earthworks, drainage and utilities	Temporary compound (including stockpiling and material processing) + associated vehicles	• Offices, staff amenities, meeting and training rooms, staff kitchen and canteen facilities. • Car parking hardstand area in the eastern portion of the site. • Preparation of stockpile sites for materials, temporary spoil storage and mulch • Concrete and asphalt batch plants, crushing plants and material processing sites.

6.1.2 Out of hours work

As a result of the updated internal haul road location, there is potential for changes in construction noise impacts outside of standard construction hours due to construction traffic movement within the site.

Consistent with the *MPW Stage 2 NV assessment,* it is proposed to undertake the importation and placement of fill to the MPW site during the bulk earthworks period during the following hours:

- Material delivery is proposed during the 6:00am to 7:00am weekday morning shoulder period
- Material delivery & stockpiling is still proposed during:
  - 6:00pm to 10:00pm weekdays
  - 7:00am to 8:00am Saturdays
  - 1:00pm to 6:00pm Saturdays

Construction noise impacts from the direct placement of spoil were assessed as part of the *MPW Stage 2 NV assessment*.

6.2 Construction plant and equipment

A summary of the amount of likely plant and equipment that would be associated with the temporary works compound and associated construction activities and vehicles for Stage 3 is provided in Table 10. This equipment is only associated with the temporary works compound that forms part of the Proposal, while concurrently as part of MPW Stage 2 construction works there could also be the construction

plant and equipment operating as presented in the *MPW2 NV assessment*. The potential combined construction noise from these concurrent operations is address in the assessment of noise impacts in Section 6.4.

Table 10 – Indicative construction plant and equipment

Equipment	Indicative number of construction plant and equipment assumed operating concurrently	Assumed indicative working area
Material deliveries		
Truck and Dog (per hour)[1]	67	Access road via the western boundary and the temporary loop road to the compound and laydown areas
Works compound		
Water trucks	2	Operating within the temporary compound
Forklifts	2	
Generators	2	
Truck and Dog	2	
Crushing & materials processing[2]		
Crushing plant[2]	1	Operating within the laydown and material stockpile areas
Truck and Dog	2	
Stockpiling areas		
Loader	1	Operating within the laydown and material stockpile areas

Notes: 1. Based upon an even distribution of daily movements, as presented in the MPW Stage 2 traffic assessment. It was then assumed that these movements were evenly distributed over the hour and 15-minute periods.

2. Concrete and asphalt batch plants, crushing plants and material processing sites, which have already been approved under MPW Stage 2, could be required, and the crushing plant, being the loudest out of these has been modelled operating.

Sound Power Levels (SWLs) associated with typical construction plant to be used throughout the construction works are identified in Table 11. The SWLs are based on those presented in the *MPW2 NV assessment* for the same type of plant and equipment. Table 11 gives the SWL assumed for each piece of plant or equipment. It is noted that SWL is independent of measurement distance.

Table 11 – Typical construction plant sound power levels, dB(A)

Plant	Sound Power Level, dB(A) re. 1pW
Loaders[1]	112
Crushing plant[1]	118
Water trucks[1]	105
Forklifts[1]	106
Truck and Dog[2]	106
Generators[2]	94

Notes: 1. Data obtained from the *MPW2 NV assessment*
2. Source from past projects Renzo Tonin & Associates (RT&A) library files from noise measurements and references.

6.3 Construction assessment methodology

Consistent with the requirements of the ICNG, construction noise impacts are assessed based on a realistic worst-case assessment of plant and equipment, operating in locations likely to result in the highest impacts on nearby sensitive receivers.

For most construction activities, it is expected that the actual construction noise levels will be lower than predicted at the most exposed receiver, as the noise levels presented in this document are based on a worst-case assessment. Noise levels at other receiver locations within the receiver areas are expected to be even lower than the predicted levels.

Airborne noise impacts from activities associated with the construction works were assessed by modelling the noise sources, receiver locations, topographical features, and possible noise mitigation measures using the CadnaA environmental noise modelling software implementing the CONCAWE algorithms. This is consistent with the *MPW Stage 2 NV assessment*. The model calculates the contribution of each noise source to each identified noise-sensitive receiver building location surrounding the construction area and allows for the prediction of the total noise from the construction works.

The noise prediction model considers:

- Location of noise sources and sensitive receiver locations
- Height of sources and receivers referenced to digital ground contours for the site and surrounding area
- Sound Power Levels (SWL) of plant and equipment likely to be used during the various construction activities
- Separation distances between sources and receivers
- Ground type between sources and receivers
- Attenuation from barriers and topography (natural and purpose built)
- Noise propagation calculated on the implementation of the CONCAWE noise propagation algorithm, assuming neutral meteorological conditions, consistent with the ICNG.

6.4 Construction noise impacts

6.4.1 Standard construction hours

To assess construction noise impacts from the Proposal during standard construction hours, the potential construction noise impacts from the MPW Stage 2 and MPW Stage 3 (the Proposal) construction activities is required to be assessed as they take place concurrently.

The Proposals construction activities were assessed in the *MPW Stage 2 NV assessment;* but in different locations. Therefore, the aim of this assessment is to determine the change in construction noise impacts due to the relocation of these construction activities during the "*Works period C – Bulk earthworks, drainage and utilities*" portion of works.

To do this, the Proposals construction activities were modelled in the original Stage 2 locations as presented in the *MPW Stage 2 NV assessment*, assuming the stockpiling, temporary compound activities, and crushing occur within the earthworks compound (see Figure 3-1 of *MPW2 NV assessment)*, as presented in Figure 2. These activities were then modelled in the Proposal locations, based on the same realistic worst-case plant and equipment, as detailed in Section 6.2.

This predicted noise contribution from the Stage 2 location was then subtracted from the overall "*Works period C – Bulk earthworks, drainage and utilities*" Stage 2 predicted construction noise levels, presented in Table 10-3 of the *MPW Stage 2 NV assessment*, and the contribution from the Proposal locations added to this overall construction noise level, in order to see the potential change.

The overall worst case predicted $L_{Aeq,15minute}$ construction noise levels during the "*Works period C – Bulk earthworks, drainage and utilities*" works at the nominated sensitive receivers during standard hours is presented in Table 12. Predicted noise levels for Stage 2 construction activities as presented in the *MPW Stage 2 NV assessment* and the Proposal locations are presented as well as the difference in overall construction noise levels between the two stages are also presented in the table.

Table 12 – Predicted construction noise levels during standard hours

Receiver	NML	Bulk earthworks, drainage and utilities		*Difference between MPW Stage 2 (EIS[3]) & the Proposal (Stage 2 & 3)*
		MPW Stage 2 (EIS[3])	Proposal (MPW Stage 2 & 3)	
Casula	*49*	**50**	**51**	1
Glenfield	*45*	36	37	1
Wattle Grove	*45*	37	38	1
S1	*55*	49	49	0
S2	*55*	48	49	1
I1 – MPE	*75*	51	51	0
I2 – DJLU	*75*	44	49	5
I3 – ABB	*75*	53	57	4

Notes: 1. Assumes a maximum of 67 heavy vehicle deliveries per hour
2. Bold indicates exceedance of the NML.
3. EIS = Locations assessed based upon the *MPW Stage 2 NV assessment*

A review of the predicted construction noise levels presented in Table 12 concludes that:

- A minor change in construction noise level of 1 dB(A) as a result of the Proposal compared with Stage 2 construction levels predicted in the *MPW Stage 2 NV assessment*. Furthermore, construction noise levels are predicted to exceed the NML at Casula in both situations. However, exceedances of up to 2 dB(A) were predicted and are considered to be negligible in accordance with the NPfI.
- The change in construction noise levels is controlled by the updated access road location, and there is no increase in overall construction noise impacts as a result of moving the location of the temporary works compound and associated laydown areas.
- There are no new residential receiver areas identified to exceed the NMLs as a result of the relocated compound, that were not previously identified in the *MPW Stage 2 NV assessment*.
- The predicted noise levels and increases in construction noise between the Proposal and Stage 2 works as predicted in the *MPW Stage 2 NV assessment* are during the most intensive bulk earthworks activities, with maximum truck movements.

The assessment demonstrates that the Proposal is not expected to result in any substantial changes in construction noise impacts at nearby sensitive receivers during standard construction hours.

6.4.2 Outside standard construction hours

During OOH Period 1, which is the 6:00am to 7:00am weekday morning shoulder period, the only construction activity proposed is material delivery.

During OOH Period 2 (6:00pm to 10:00pm weekday evening period), OOH Period 3 (7:00am to 8:00am Saturdays) and OOH Period 4 (1:00pm to 6:00pm Saturday period), the only construction activities proposed are material delivery & stockpiling activities.

These activities have been assessed in the proposed locations as other MPW Stage 2 construction works are not proposed to occur concurrently.

The overall worst case predicted $L_{Aeq,15minute}$ construction noise levels at the sensitive receivers during the OOH periods are presented in Table 13.

Table 13 – Predicted construction noise levels during OOH Periods – MPW Stage 3 activities

Receiver	NML	Material deliveries[2]	Material deliveries[2] + stockpiling
		OOHW Period 1	OOHW Period 2, 3 & 4
Casula	*44*	44	44
Glenfield	*40*	31	32
Wattle Grove	*40*	32	34
S1	*55*	40	40
S2	*55*	44	44
I1 – MPE	*75*	48	50
I2 – DJLU	*75*	47	47
I3 – ABB	*75*	55	55

Notes: 1. OOHW 1= 6am – 7am Mon – Fri, OOHW 2= 6pm – 10pm Mon – Fri, OOHW 3= 7am – 8am Saturday, OOHW 4= 1pm – 6pm Saturday

2. Maximum potential heavy vehicle deliveries of 67 per hour have been assumed.

3. Bold indicates exceedance of the NML.

As the construction works proposed during OOH Period 1 would occur within the night period (10:00pm to 7:00am), a sleep disturbance assessment has been undertaken assessing the worst case predicted L_{Amax} construction noise levels. Source L_{Amax} levels have been based on noise from metal-on-metal bangs [ie. tailgate bangs or loose chains, with a SWL of 120 dB(A)] as the trucks move along the internal haul road. The sleep disturbance assessment results are presented in Table 14.

Table 14 – Predicted L_{Amax} construction noise levels during OOH Period 1 – MPW Stage 3 activities

Receiver	Screening level	Awakening reaction	Predicted Noise Level
Casula	*55*	*65*	**58**
Glenfield	*63*	*65*	43
Wattle Grove	*55*	*65*	43

Notes: 1. Bold indicates exceedance of the screening level

As review of the predicted construction noise levels presented in Table 13 and Table 14 concludes that:

1. During the worst-case scenario where truck material delivery movements are occurring during the proposed OOH periods, the predicted noise levels achieve the NML.

2. The sleep disturbance screening level is achieved at all residential receivers, except for potentially some in Casula. However, all predicted noise levels remain below the awakening reaction level at all nearby residential receivers.

The assessment demonstrates that the Proposal is not expected to exceed the NML at nearby sensitive receivers during OOH periods, however there is the potential for high noise events to exceed the sleep disturbance screening level. Management of these sources high noise events (ie. tailgate bangs or loose chains) from delivery vehicles will help to minimise the potential for sleep disturbance impacts on nearby receivers. As such, it is recommended that a feasible and reasonable approach towards noise management measures outside of standard construction hours be applied to manage the potential impacts from construction noise. Further details on construction noise management and mitigation measures are provided in Section 6.5.

6.4.3 Cumulative construction noise impacts

As required by Condition E28 (5066 MOD 1), potential cumulative construction noise impacts from concurrent works as part of the MPE project are to be reviewed.

As part of the MPE project, the miscellaneous structural construction and finishing works phases of the will be completed during the construction period of the Proposal. The programs for these concurrent projects is presented in Table 15.

Table 15 – Indicative construction program of concurrent projects

Project	Type of construction works	2020				2021			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Proposal works (MPW Stage 2 & 3)	Bulk earthworks, roadworks, drainage and utilities, building construction and finishing works with associated support activities								
MPE	Miscellaneous structural construction and finishing works								

Construction works associated with the MPE miscellaneous structural construction and finishing works, may occur concurrently with the Proposal. These works are predominately daytime works, and do not require significant periods of high noise construction activities (ie. bulk earthworks, rock-hammering, etc.). As such, the construction noise levels at nearby sensitive receivers would generally be dominated by the MPW Stage 2 works. Considering the predicted construction levels presented in the *MPW Stage 2 NV assessment* and this report, management of construction noise from the MPW Stage 2 should sufficiently manage construction noise impacts on nearby sensitive receivers with consideration of other concurrent construction projects taking place within the MPE project.

6.5 Noise and vibration management measures

The assessment has demonstrated that there is potential for exceedances of the established noise management levels due to the construction works associated with the Proposal; however, the impacts are not substantially different from those already assessed and presented in the *MPW2 NV assessment* and *MPW Concept NV assessment*.

The best practice mitigation and management measures to minimise construction noise and vibration impacts at sensitive receivers, as outlined in the previous assessments, should be implemented through the Construction Noise and Vibration Management Plan (CNVMP).

As part of the CNVMP, the following noise and vibration mitigation measures in addition to the general management measures detailed in Section 6.5 above would be considered to assist with mitigating and managing noise and vibration impacts from the updated Stage 3 temporary compound and associated construction works and heavy vehicle movements, where reasonable and feasible.

- Ensuring the heavy vehicles are not required to stop and use air brakes along the access road or when close to nearby residential receivers
- Loose items or items with the potential to generate high noise events (ie. tailgate bangs or loose chains) on delivery vehicles are substituted or prevented from moving (ie. straps or plastic covered chains)
- All plant to be well maintained and fitted with noise mufflers, engine hoods, etc
- Timetabling noisiest activities to occur at the least sensitive times
- Using spotters, closed circuit television monitors, "smart" reversing alarms, or "squawker" type reversing alarms in place of traditional reversing alarms
- Mitigation of specific noise sources using portable temporary screens or enclosures, where practicable and safe
- Turning off plant and equipment when not in use
- Carrying out loading and unloading away from sensitive receivers, where practicable
- Avoid dropping materials from a height
- Substituting noisy / vibration intensive equipment with less intrusive types
- Maximising the offset distance between noisy plant items and sensitive receivers
- Avoiding using noisy plant simultaneously and / or close together, adjacent to sensitive receivers, where practicable
- Orienting noise generating equipment with directional characteristics so that loud axis points away from sensitive receivers, where practicable

- Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including cranes, graders, excavators and trucks
- Selecting plant and equipment based on noise emission levels
- Temporary acoustic shielding.

The potential noise reduction that can be achieved by noise mitigation measures are shown in Table 16.

Table 16 – Noise mitigation measures and potential noise reductions

Management measure	Anticipated noise reduction, dB(A)
Administrative controls	
Operate during approved hours	-
Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers	-
Appropriate training of onsite staff	-
Undertake community consultation and respond to complaints in accordance with established project procedures	-
Turning off machinery when not in use	0-5
Implementing controls that heavy vehicles are not required to or exhaust air brakes along the access road or at locations close to nearby residential receivers	5-10
Engineering controls	
Using straps or plastic covered chains where reasonable and feasible on delivery vehicles to minimise high noise events from metal-on-metal bangs	10-15
Portable temporary screens (where feasible and reasonable and blocking line of site to receiver)	5-10
Screen or enclosure for stationary equipment	10-15
Maximising the offset distance between noisy plant items and sensitive receivers	3-6
Avoiding using noisy plant simultaneously and / or close together, adjacent to sensitive receivers	2-3
Orienting equipment with directional noise so that it points away from sensitive receivers	3-5
Carrying out loading and unloading away from sensitive receivers	3-5
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Using spotters, closed circuit television monitors, “smart” reversing alarms, or “squawker” type reversing alarms in place of traditional reversing alarms	2-5
Arranging non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers	5-10

7 Conclusion

Renzo Tonin & Associates was engaged by Tactical Group on behalf of the Sydney Intermodal Terminal Alliance (SIMTA) to undertake an environmental noise and vibration assessment of the proposed Moorebank Precinct West (MPW) Stage 3 (MPW Stage 3). The MPW Stage 3 proposal comprises:

- Establishment of a works compound to facilitate site development works for the remaining Early Works (Stage 1), MPW Stages 2 and 3 and future stages of the MPW development
- Progressive subdivision of the MPW site into nine (9) allotments
- Ancillary works, for which noise and vibration impacts have been assessed as part of the MPW Stage 2

The main potential noise and vibration impacts as a result of the Proposal are:

- Updated location of the temporary construction support compound and associated activities, laydown and materials stockpile locations, and offices to support residual MPW Early Works Stage 1, Stages 2 and 3 site development works and future stages of the MPW development construction works.
- Continuation of crushing activities as approved under MPW Stage 2 in an updated location within the MPW Stage 3 footprint.
- Updated vehicle access to the Stage 3 temporary construction support compound, which was previously along Moorebank Avenue, and is now along the permanent access road and temporary loop road along the western MPW site boundary.

As the majority of the construction noise impacts had already been assessed as part of the MPW Concept and Stage 1 and MPW Stage 2 noise and vibration impact assessments, the assessment aimed to determine the potential changes in construction noise during the MPW Stage 3 works and activities. The assessment predicted and reviewed the potential impacts on nearby sensitive receivers against the relevant noise criteria set by the ICNG generally established as part of the previous assessments.

The assessment found that the Proposal is not expected to result in any substantial changes in construction noise impacts at nearby sensitive receivers during standard construction hours from those already assessed and presented in the *MPW2 NV assessment* and *MPW Concept NV assessment*.

For construction works outside of standard construction hours material deliveries along with stockpiling are predicted to achieve the noise management levels. High noise events are predicted to exceed the sleep disturbance screening level; however, they are not expected to exceed awakening reaction levels at any nearby residential receivers.

It is recommended that a feasible and reasonable approach towards noise mitigation and management measures outside of standard construction hours be applied manage construction noise levels at nearby sensitive receivers. As the potential noise impacts are generally consistent with those already presented

in the *MPW2 NV assessment* and *MPW Concept NV assessments,* by implementing feasible and reasonable mitigation measures consistent with those required by the previous project approvals, the potential noise impacts from MPW Stage 3 should be sufficiently managed.

APPENDIX A Glossary of terminology

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

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment Point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 110dB Operating a chainsaw or jackhammer 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

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