Western Sydney Stadium

Demolition, Excavation & Construction Noise & Vibration Management Plan

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1 EXECUTIVE SUMMARY

The Management Plan outlines the development of controls and safeguards that would be applied to all activity on the Western Sydney Stadium site during the demolition, excavation and construction phases. The objective of these controls is to ensure that all work is carried out in a highly controlled and predictable manner that will minimise emissions and protect the amenity of the sensitive receivers surrounding the site including residential, commercial, educational and places of worship.

This review has been conducted in accordance with Condition of Consent C2 of Application SSD 7534. Further reviews will be undertaken through the demolition, excavation and construction period, as required, in response to revised methods and equipment, as well as in response to the monitoring and evaluation of actual impacts. This management plan outlines the procedures that would be adopted by the contractor during the detailed demolition, excavation and construction planning and execution phases.

2 INTRODUCTION

This document presents the demolition and construction noise and vibration plan that will be used to manage noise and vibration from the demolition of the existing structures, excavation of footings and construction of new structures.

3 PROJECT DESCRIPTION

3.1 GENERAL

The proposal is to construct a new 30,000 seat rectangular stadium on the site of the existing Pirtek Stadium at Parramatta. It is proposed that the existing Pirtek Stadium is completely demolished and the new Western Sydney Stadium be constructed in its place.

3.2 THE SITE AND POTENTIALLY MOST IMPACTED RECEIVERS

The site is bounded to the north by the Parramatta Leagues Club with Residential Aged Care Facilities and residential properties located on O'Connell Street. To the west of the site, across Parramatta River, are residential properties located on Queens Road and Park Avenue. To the south of the site, are residential properties located Lichen Place and Parkside Lane. To the southeast of the site is the Parramatta CBD. St Patricks Cathedral, Our Lady of Mercy College, and small residential properties are located to the east of the site.

These receivers represent the nearest potentially affected locations for demolition, excavation and construction noise emissions from the Western Sydney Stadium site.

The area the proposed works is presented in Figure 1.

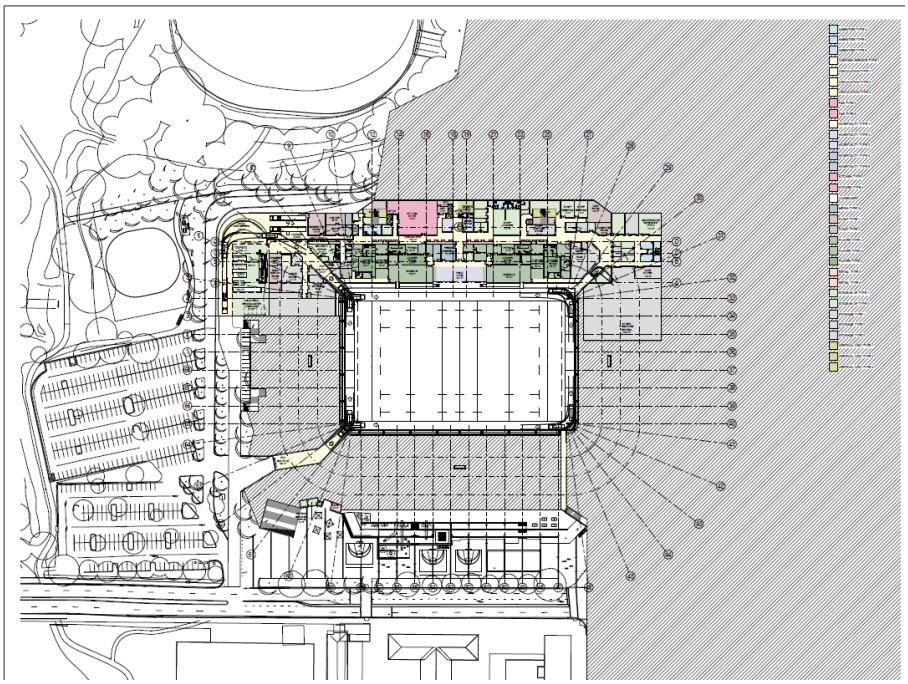


Figure 1 – Western Sydney Stadium Site

3.3 ACTIVITIES AND METHODOLOGY

Following is a description of the activities and methodology proposed to be employed to complete the various project phases.

3.3.1 EAST AND WEST STAND (DEMOLITION)

- Internal soft strip with bob cat and labour;
- Seats and external non-structural elements stripped with excavator;
- Bottom concrete bowl, is removed by an excavator with concrete crusher attachment;
- The roof is removed by an excavator with steel cutting attachment cutting the roof tension columns from behind to induce the roof lowering onto the upper bowl.
- The upper bowl is demolished with an excavator with concrete crusher attachment; and
- South East corner of the stand closest to the pool will have a scaffold screen installed to protect debris from falling into the operational swimming pool.

3.3.2 NORTH AND SOUTH STAND (DEMOLITION)

- Seats and non-structural elements are stripped with an excavator;
- Lower bowl slab on ground is demolished with an excavator with concrete crushing attachment; and
- The lower bowl slab, sitting directly above known areas of GSWA contamination, is demolished last, once the area is ready for establishment of asbestos controls, due to the risk of pulling up GSWA with asbestos from the ground below.

3.3.3 SWIMMING POOL

- The pool is drained and surrounding buildings soft stripped and demolished with an excavator; and
- An excavator will then batter back behind the swimming pool walls, before breaking up the concrete slabs and walls with the excavator with concrete crushing attachments.

3.3.4 BULK EXCAVATION / REMEDIATION STRATEGY

Lendlease has developed a design solution that allows the site to be remediated, whilst eliminating the need to remove GSWA from site. The known areas of contamination exist within the areas labelled below 'Training Pitch, Service Level, Northern Carpark, Northern Mound and the Southern Area of the Existing Pitch. These areas will be redirected as required and capped within the areas marked 'main concourse' as highlighted in orange on the diagram following. The proposed design allows the remediation of the site to take place, with final bulk levels being set prior to major structural works commencing on the project.

This is a time risk mitigation approach, allowing following trades to work in a clean environment, avoiding any industrial concerns during the build phase of the project.

3.3.5 PILING

The fundamental approach to the Piling activity is driven by the remediation strategy, being that the site is handed over to the following trades (the first being piling) 'clean' and do not require any means of asbestos related controls during the process of carrying out the following activity. The management or the avoidance of spoil created through the piling activity has driven Lendlease's methodology. Lendlease's approach to the foundations under the western stand service level could be a combination of Bored, Precast and CFA Piles in this area. Based on the bore log information,

there is no concern with bringing spoil to the surface in this area. The remainder of the 'new' build will be used to contain and cap GSWA from other areas of the site. Creation of spoil in this zone is not preferable considering clean fill has been specifically brought into this area to provide a clean zone for service trades to undertake concourse in-ground service trenching. It is for this reason, precast piles will be adopted in this zone.

3.3.6 WESTERN STADIUM STRUCTURE

The western stand will be constructed traditionally with formwork strutting heights ranging from 4.5m to 6m in height. The western stand is 4 levels in height hence from a materials handling perspective, the structure will effectively be built, then temporary supports (formwork) stripped, prior to services trades commencing. Given the crane demand will be limited solely to structure during this phase, 1 Tower Crane with approximately 70m in jib length will be established on the western stand to facilitate this activity. Supplementary mobile cranes may be adopted across the first two floors, purely to load in formwork materials.

The construction sequence will run across two fronts as the structure commences the 2nd suspended deck. Edge protection will be in the form of a perimeter scaffold, based off the concourse level, and the formed and poured levels as the tiers set-back level by level.

3.3.7 NORTH / SOUTH / EAST STADIUM TIER 2 CONSTRUCTION

The North, South and East Elevations of the Tier 2 Stadium will be constructed on three workfronts. The 'straight runs' will be constructed from the pitch construction zone utilising independent teams of steel, precast and crane crews. The four corners will be split into two workfronts with dedicated rigging crews and crane being allocated to the Southern and Northern Corners. These will be constructed from the outside of the bowl.

3.3.8 ROOF STRUCTURE

The lifting of Pre-Assembled Roof Sections in thirds minimises the size of crane requirements to a maximum capacity of 350t Crawler Crane. This size of crane maintains the ability to operate in the pitch area without increased safety risk. Each section of roof will be approximately 25 tonnes and has been designed with bolted splice connections only (no welding required). The construction methodology has also driven the design to eliminate the need for temporary supports during the installation process. Once two bays have been successfully installed, the infill steel sections (area in yellow) will be fixed into place. Preassembly durations have been built up through multi activity planning at 5 days, with installation being 3 days (1 day per roof section). This allows 2 days of crane redundancy to complete the section highlighted in yellow.

3.3.9 INFRASTRUCTURE WORKS – ELECTRICAL / WATER / COMMUNICATIONS / GAS

The future sites electrical infrastructure requires upgrading, hence High Voltage Mains will need to be run from the site (in the approximate location of O'Connell Street / Victoria Road intersection) to the North Parramatta Zone Substation in the order of 1km in distance.

It is possible conduits exist already, but in the worst case, trenching will need to be carried out to install the upgrade. Based on the final outcome, road closures and footpath closures will be sought and obtained through the City of Parramatta Council. These works will not be critical from a programming perspective based on the indicative date for chamber substation energisation located in the service level (L00) of the Western Stand. The Low Voltage feed across the Parrramatta River will also be cut over post chamber substation energisation. Relevant stakeholder engagement will support this process. Supply of water to the new precinct will come off the existing main located on

the eastern side of O'Connell Street. This work will require approximately 600mm trenching across O'Connell Street, and again will be coordinated through the City of Parramatta Council for relevant permits and approvals. The existing site has located in the NE Corner a series of communications pits and these will utilised as a means of feeding the new precinct and upgrading communications infrastructure.

The connection point for gas infrastructure is located on the western side of O'Connell Street. This work will require footpath and potentially single lane closures of O'Connell Street. Again, this will be coordinated with City of Parramatta Council. The sewer connection point is located in the SE Corner of the site. The connection will be in the order of 6m in depth from the existing levels in the area. The location for connection is within the landscaped area, hence there will be minimal disruption to the new build programme during the course of these works.

3.3.10 CONCOURSE FINISHES

The concourse food, beverage and amenities blocks will be constructed following the installation of the Southern, Eastern and Northern Tier 2 Structural Steel and Precast Elements. This activity of works will naturally follow the general build sequence, starting with the southern concourse working east and towards the north. These works will be coordinated with the roof truss and fabric installation above to ensure adequate separation and exclusion zones are maintained. This component of work will largely feature blockwork requiring working scaffolding around the perimeter, and within for dividing blockwork walls.

3.3.11 INTERNAL FINISHES

Post completion and strip out of the concrete structure to the Western Stand, services rough-in and internal finished works will commence. These works will be facilitated through materials movement by a hoist and as required through cranes via loading platforms to the western elevation of the western stand. Fit-out works will be prioritised based on lead time of joinery and kitchens, with the overarching concept of working from the Northern and Southern ends of each level back towards the location of materials entry points to the floors (Hoist location and Goods Lift location).

3.4 NOISE SOURCE LEVELS

The A-weighted sound power levels for typical equipment/processes anticipated to be used during these works are outlined in Table 1 below.

Table 1 - Sound Power Levels

EQUIPMENT /PROCESS	SOUND POWER LEVEL dB(A)**
Excavator/ Bulldozer	114
Concrete crusher	114
Bobcat	105
Hydraulic Hammer on 20-60t Excavator	125*
Hydraulic Hammer on 5t Excavator	120*
Rock/Masonry Saw on Excavator	110
Piling Rig	115
Rock Anchor Drill Rig	110
Pneumatic Hammer	115*
Electric Hammer	105*
Concrete Pump	110
Concrete Truck	110
Truck	108
Forklifts	100
Angle grinders	113*
Electric Saw	111*
Drilling	94
Hammering	120*
Site Crane	105
Impact drill	105
Remediation Plant	115
Air compressor	86
Concrete Float/Vibrators	105

* - includes 5 dB(A) addition for characteristics of noise source.

** - The noise levels presented in the above table are derived from on-site measurements, Table A1 of Australian Standard 2436-2010 and data held by this office from other similar studies.

3.5 CONSTRUCTION TRAFFIC

Arrival and departure routes have been outlined in a Construction Traffic Management Plan (CTMP) dated 9 January 2017.

Heavy vehicle traffic will include large rigid and articulated trucks. It is anticipated that the largest vehicle to be used will be a large semi-trailer as described in the RMS Guidelines (16.9m by 2.5m).

Following on from the initial stage of demolition, Stage 2 will see the pool complex closed and handed over to the contractor. The main entry/exit point remains at Gate A, and the expected peak load of truck traffic remains as 40 per day. An alternative entry/exit point at Gates C and D will be

used spontaneously when works staging restricts use of Gate A. Construction vehicles will be restricted to left-in – left-out movements at the southern carpark access from O'Connell Street when using Gates C and D. Given the existing number of vehicle and heavy vehicle movements on the existing local road network, and because off-site disposal of excavated material is to be minimised by reusing on the site, no adverse impacts are expected from the expected number of vehicle movements on local streets.

3.6 HOURS OF WORK

The proposed hours of work are:

- Monday to Friday 7am to 6pm in accordance with Condition of Consent C2
- Saturdays 8am to 5pm (proposed extension of hours in the afternoon from 1pm to 5pm).
- No work on Sundays or public holidays.

It is proposed that the standard hours of construction for Saturday construction be 8am to 5pm. The proposed construction hours are based on precedence set on other projects in the vicinity of the site including 330 Church Street, Parramatta; 10 Valentine Avenue, Parramatta; The Parkroyal Hotel Parramatta and The Promenade (Morton Street, Parramatta).

The reasons for the proposed construction hours are:

- Parramatta City Council guidelines are less stringent than standard EPA time restrictions and permit longer construction hours on Saturdays (8am to 5pm)

- Adopting the proposed hours will allow for efficient construction on Saturdays and the entire construction timetable will be expedited which will benefit the surrounding community.

- Noise restrictions are proposed to limit noise impacts outside the standard hours.

It is proposed that the following noise limits will be applied outside the standard hours:

- Between the hours of 1pm and 5pm on Saturday, only operations complying with "background +10dB(A)" limit at residential receivers will be permitted. It is noted that the "background + 10dB(A)" will be a noise emission limit rather than a management level.

4 CONSTRUCTION NOISE AND VIBRATION GOALS

4.1 NOISE

The applicable guidelines and standards are:

- EPA Interim Construction Noise Guideline. This guideline nominates a methodology for assessing and managing construction noise (and vibration) impacts.

  A quantitative assessment is undertaken involving the prediction of likely noise levels from activities at sensitive receivers, and these noise levels are compared to noise "goals". This process identifies the processes causing emissions that may exceed the goals, so that feasible and reasonable management of those processes can be assessed and implemented to these processes.

- Australian Standard 2436-2010 "Guide to Noise Control on Construction Maintenance and Demolition Sites".

  AS 2436 states that care shall be taken in applying criteria that normally would be used to regulate noise emitted from industrial, commercial and residential premises to construction, particularly for those activities which are transitory and of short duration. The principles of AS2436 are as follows:

  - A reasonable suitable noise criterion is established;
  - All practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes on parts of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours.
  - The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the building site.

AS 2436 and the EPA largely adopt the same broad objectives, except that the EPA Guideline is more detailed in its recommendations. Based on these the following procedure will be used to assess noise emissions:

- Develop noise management levels for sensitive receivers around the site to broadly achieve EPA guidelines and objectives.

- Assess noise levels produced by construction activities at the sensitive receivers.

- If noise levels exceed EPA "Noise Affected" Management Level (NAML) (rating background noise level + 10 dB(A) for residential receivers) investigate and implement all reasonable and feasible techniques to limit noise emissions.

- If noise levels exceed EPA "Highly Noise Affected" Management Level (HNAML) (75dB(A) for residential receivers) after applying all practical engineering controls to limit noise emissions investigate time management and other techniques to further mitigate noise emissions.

As per the EPA Interim Construction Noise Guideline, the external noise management level for commercial / retail outlets should be 70 dB(A) L_{eq} externally. The noise management level for the Our Lady of Mercy College should be 55dB(A) externally (assuming windows open). It is noted that the most recent building on the Our Lady of Mercy Site is the Ailsa Mackinnon Centre which has a fixed façade and shields the majority of the existing school from the Western Sydney Stadium site.

The external noise goal for the Alisa Mackinnon Centre is 65dB(A) (which assumes a 20dB(A) reduction from a modern façade to achieve 45dB(A) internally within classrooms as per the EPA ICNG)

The noise management level for the Parramatta should be 65dB(A) L_{eq} as it would be deemed an "active recreational area".

4.2 VIBRATION

It is proposed to adopt the following vibration guidelines, namely:

- German Standard DIN 4150-3 (1999-02): *"Structural Vibration – Effects of Vibration on Structures"* – which will be used to assess and limit building damage risk.

- EPA Interim Construction Noise Guideline – which contains guidelines to assess and limit impacts on building occupant's amenity based on the "Assessing Vibration: A Technical Guide".

This is in general accordance with Condition of Consent C3 which requires that BS6472 be adopted to evaluate human exposure to vibration in buildings, as the EPA "Assessing Vibration: A Technical Guide" adopts the BS6472.

The criteria and the application of this standard are discussed in separate sections below.

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 2.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 2 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		< 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

4.2.1 Assessing Amenity - EPA NSW "Assessing Vibration: A Technical Guideline"

EPA NSW "Assessing Vibration: A Technical Guideline" (Feb 2006) is based on the guidelines contained in BS 6472:1992. This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings.

The recommendations of this guideline should be adopted to assess and manage vibration from the site. Where vibration exceeds, or is likely to exceed, the recommended levels then an assessment of reasonable and feasible methods for the management of vibration should be undertaken.

Table 3 – EPA Recommended Vibration Criteria

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	Time	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Offices, Schools, Places of Worship		0.02	0.04	0.4	0.8	0.56	1.1
Workshops		0.04	0.08	0.8	1.6	1.1	2.2
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0
Offices, Schools, Places of Worship		0.64	1.28	13.0	26.0	18.0	36.0
Workshops		0.64	1.28	13.0	26.0	18.0	36.0

5 ASSESSMENT OF POTENTIAL NOISE EMISSIONS

5.1 INTRODUCTION AND INTENT

The purpose of the assessment of noise emissions is to highlight those activities that have the potential to exceed the NAML, so that management of those activities can be assessed in accordance with the ICNG. **The noise levels presented in the assessment are worst case noise levels without any management that may be possible (eg physical controls, time scheduling, selection of alternative process, etc that are proposed as part of this management plan).**

There will be some addition of noise levels as a result of concurrently operating equipment, however because the predicted noise levels are “worst case”, the cumulative effect will not be represented by the addition of the presented noise levels.

It is noted that this is a preliminary construction noise and vibration management plan and a full analysis will be conducted once construction processes become more defined.

5.2 POTENTIALLY AFFECTED RECEIVERS

A survey of nearest potentially affected sensitive commercial and residential receivers has been conducted and the following locations have been identified:

- O’Connell Street Residential Properties,
- Parramatta Leagues Club,
- Queens Road and Park Avenue Residential Properties,
- Lichen Place and Parkside Lane Residential Properties,
- Parramatta CBD Commercial Properties,
- St Patricks Cathedral,
- Our Lady of Mercy College, and
- Parramatta Park

As these are the nearest affected properties, any construction management controls applied for these locations will be applicable for properties located further from the site.

5.3 EXTERNAL NOISE GOALS

Noise generated by construction plant and equipment throughout the duration of the project will be managed in accordance with the management levels, and for the afternoon periods on Saturdays in accordance with the noise criteria at residences.

In order to establish noise goals specific to receivers, background noise levels were measured at all locations representing the most sensitive receiver groups.

Daytime background noise levels have been established during the stage one DA phase and have been presented in the AECOM report with reference 60504744. The daytime background noise level at these locations are summarised in the following table.

Table 4 - Measured Daytime Background Noise Levels and Corresponding Noise Goals/Management Levels

Location	Background Noise Level dB(A) L_{90}		"Noise Affected" Management Level dB(A) L_{eq}	
	7am – 6pm	Sat 1pm – 5pm	7am – 6pm	Sat 1pm – 5pm
O'Connell Street Residential Properties	54	55	64	65*
Queens Road and Park Avenue Residential Properties	40	40	50	50*
Lichen Place and Parkside Lane Residential Properties	43	44	53	54*
Parramatta Leagues Club	N/A (commercial)		70	
Parramatta Park	N/A (active recreational area)		65	
St Patricks Cathedral	N/A (place of worship)		55	
Our Lady of Mercy College	N/A (school)		55	
OLMC (Ailsa Mackinnon Centre)	N/A (school)		65	

*noise limit rather than NAML.

5.4 PREDICTED NOISE LEVELS

Noise levels have been predicted at various locations representing the range of potentially affected receivers around the site. The worst care noise level has been predicted based on the minimum working distances between the source and receiver that is likely to occur.

The predicted noise levels assume that the activity will be occurring continuously and that there is no screening between the source and the receiver. As plant items will generally be spread around the site, and the plant will not operate continuously for the entire day, the upper limit noise levels indicated in the tables would generally only be reached for limited periods and represent the absolute worst case.

The predictions take into account the nominated sound power levels, corrected for distance losses, screening losses (if applicable), air absorption, and time of continuous use.

5.4.1 O'Connell Street Residential Properties

The following tables present a summary of noise levels which will occur at the residential receivers located to the north on O'Connell Street as a result site construction.

Table 5 – Predicted Noise Levels

EQUIPMENT /PROCESS	PREDICTED NOISE LEVEL dB(A) L_{eq}	RECEIVER NOISE MANAGEMENT LEVEL dB(A) L_{eq}
Excavator/ Bulldozer	59	**NAML 64** **Sat 1pm to 5pm Noise Limit – 65** **HNAML 75**
Concrete crusher	59	
Bobcat	50	
Hydraulic Hammer on 20-60t Excavator	**70**	
Hydraulic Hammer on 5t Excavator	**65**	
Rock/Masonry Saw on Excavator	55	
Piling Rig	60	
Rock Anchor Drill Rig	55	
Pneumatic Hammer	60	
Electric Hammer	50	
Concrete Pump	55	
Concrete Truck	55	
Truck	53	
Forklifts	45	
Angle grinders	58	
Electric Saw	56	
Drilling	39	
Hammering	**65**	
Site Crane	50	
Impact drill	50	
Remediation Plant	60	
Air compressor	31	
Concrete Float/Vibrators	50	

Predictions indicate that in worst case situations hammering with the hydraulic hammer on a 20-60t excavator works will exceed the NAML. Noise emissions from these activities should be minimised by adopting the process indicated in CNVMP to ensure that noise emissions are managed. Noise emissions from excavator-mounted hammering will exceed the Saturday 1pm to 5pm noise limit, and therefore these operations should not occur during this period. Noise emissions from other plant items (excluding hammering) are generally within the NAML at all times.

See Section 5.5 for recommendations.

5.4.2 Queens Road and Park Avenue Residential Properties

The following tables present a summary of noise levels which will occur at the residential receivers located at Queens Road and Park Avenue.

Table 6 - Predicted Noise Levels

EQUIPMENT /PROCESS	PREDICTED NOISE LEVEL dB(A) L_{eq}	RECEIVER NOISE MANAGEMENT LEVEL dB(A) L_{eq}
Excavator/ Bulldozer	49	**NAML 50** **Sat 1pm to 5pm Noise Limit - 50** **HNAML 75**
Concrete crusher	49	
Bobcat	40	
Hydraulic Hammer on 20-60t Excavator	60	
Hydraulic Hammer on 5t Excavator	55	
Rock/Masonry Saw on Excavator	45	
Piling Rig	50	
Rock Anchor Drill Rig	45	
Pneumatic Hammer	50	
Electric Hammer	40	
Concrete Pump	45	
Concrete Truck	45	
Truck	43	
Forklifts	35	
Angle grinders	48	
Electric Saw	46	
Drilling	29	
Hammering	55	
Site Crane	40	
Impact drill	40	
Remediation Plant	50	
Air compressor	21	
Concrete Float/Vibrators	40	

Predictions indicate that in worst case situations hammering with the hydraulic hammer on a 20-60t excavator works will exceed the NAML. Noise emissions from these activities should be minimised by adopting the process indicated in CNVMP to ensure that noise emissions are managed. Noise emissions from excavator-mounted hammering will exceed the Saturday 1pm to 5pm noise limit, and therefore these operations should not occur during this period. Noise emissions from other plant items (excluding hammering) are generally within the NAML at all times.

See Section 5.5 for recommendations.

5.4.3 Lichen Place and Parkside Lane

The following tables present a summary of noise levels which will occur at the residential receivers located at Lichen Place and Parkside Lane.

Table 7 - Predicted Noise Levels

EQUIPMENT /PROCESS	PREDICTED NOISE LEVEL dB(A) L_{eq}	RECEIVER NOISE MANAGEMENT LEVEL dB(A) L_{eq}
Excavator/ Bulldozer	43	**NAML 53** **Sat 1pm to 5pm Noise Limit - 54** **HNAML 75**
Concrete crusher	43	
Bobcat	34	
Hydraulic Hammer on 20-60t Excavator	54	
Hydraulic Hammer on 5t Excavator	49	
Rock/Masonry Saw on Excavator	39	
Piling Rig	44	
Rock Anchor Drill Rig	39	
Pneumatic Hammer	44	
Electric Hammer	34	
Concrete Pump	39	
Concrete Truck	39	
Truck	37	
Forklifts	29	
Angle grinders	42	
Electric Saw	40	
Drilling	23	
Hammering	49	
Site Crane	34	
Impact drill	34	
Remediation Plant	44	
Air compressor	15	
Concrete Float/Vibrators	34	

Predictions indicate that there will be a marginal exceedance (1dB) of the noise management level when demolition is occurring using the excavator mounted hydraulic hammer on the southernmost boundary. Noise emissions from this activity should be minimised by adopting the process indicated in NVMP to ensure that noise emissions are managed. See Section 5.5 for recommendations.

5.4.4 Parramatta Leagues Club

The following tables present a summary of noise levels which will occur at the Parramatta Leagues Club.

Table 8 – Predicted Noise Levels

EQUIPMENT /PROCESS	PREDICTED NOISE LEVEL dB(A) L_{eq}	RECEIVER NOISE MANAGEMENT LEVEL dB(A) L_{eq}
Excavator/ Bulldozer	69	**NAML 70** **HNAML 75**
Concrete crusher	69	
Bobcat	60	
Hydraulic Hammer on 20-60t Excavator	80	
Hydraulic Hammer on 5t Excavator	**75**	
Rock/Masonry Saw on Excavator	65	
Piling Rig	70	
Rock Anchor Drill Rig	65	
Pneumatic Hammer	70	
Electric Hammer	60	
Concrete Pump	65	
Concrete Truck	65	
Truck	63	
Forklifts	55	
Angle grinders	68	
Electric Saw	66	
Drilling	49	
Hammering	**75**	
Site Crane	60	
Impact drill	60	
Remediation Plant	70	
Air compressor	41	
Concrete Float/Vibrators	60	

Predictions indicate that in worst case situations hammering with the hydraulic hammer on a 20-60t excavator works will exceed the NAML. Noise emissions from these activities should be minimised by adopting the process indicated in CNVMP to ensure that noise emissions are managed. Noise emissions from excavator-mounted hammering will exceed the Saturday 1pm to 5pm noise limit, and therefore these operations should not occur during this period. Noise emissions from other plant items (excluding hammering) are generally within the NAML at all times.

5.4.5 Parramatta Park

The following tables present a summary of noise levels which will occur at the Parramatta Park as a result of construction activity.

Table 9 - Predicted Noise Levels

EQUIPMENT /PROCESS	PREDICTED NOISE LEVEL dB(A) L_{eq}	RECEIVER NOISE MANAGEMENT LEVEL dB(A) L_{eq}
Excavator/ Bulldozer	57	NAML 65 HNAML 75
Concrete crusher	57	
Bobcat	48	
Hydraulic Hammer on 20-60t Excavator	**68**	
Hydraulic Hammer on 5t Excavator	63	
Rock/Masonry Saw on Excavator	53	
Piling Rig	58	
Rock Anchor Drill Rig	53	
Pneumatic Hammer	58	
Electric Hammer	48	
Concrete Pump	53	
Concrete Truck	53	
Truck	51	
Forklifts	43	
Angle grinders	56	
Electric Saw	54	
Drilling	37	
Hammering	63	
Site Crane	48	
Impact drill	48	
Remediation Plant	58	
Air compressor	29	
Concrete Float/Vibrators	48	

Predictions indicate that there will be a marginal exceedance (1dB) of the noise management level when demolition is occurring using the excavator mounted hydraulic hammer on the southernmost boundary. Noise emissions from this activity should be minimised by adopting the process indicated in NVMP to ensure that noise emissions are managed. See Section 5.5 for recommendations.

5.4.6 St Patrick's Cathedral

The following tables present a summary of noise levels which will occur at façade of St Patricks Cathedral

Table 10 - Predicted Noise Levels

EQUIPMENT /PROCESS	PREDICTED NOISE LEVEL dB(A) L_{eq}	RECEIVER NOISE MANAGEMENT LEVEL dB(A) L_{eq}
Excavator/ Bulldozer	**61**	**NAML 55** **HNAML 75**
Concrete crusher	**61**	
Bobcat	52	
Hydraulic Hammer on 20-60t Excavator	**72**	
Hydraulic Hammer on 5t Excavator	**67**	
Rock/Masonry Saw on Excavator	**57**	
Piling Rig	**62**	
Rock Anchor Drill Rig	**57**	
Pneumatic Hammer	**62**	
Electric Hammer	52	
Concrete Pump	**57**	
Concrete Truck	**57**	
Truck	55	
Forklifts	47	
Angle grinders	**60**	
Electric Saw	**58**	
Drilling	41	
Hammering	**67**	
Site Crane	52	
Impact drill	52	
Remediation Plant	**62**	
Air compressor	33	
Concrete Float/Vibrators	52	

Predictions indicate that there will be exceedances of the NAML. See Section 5.5 for recommendations. All noise emissions are predicted to be in compliance with the HANML at all times.

5.4.7 Ailsa Mackinnon Centre (Our Lady of Mercy College)

The following tables present a summary of noise levels which will occur at the Alisa Mackinnon Centre as a result of construction activity.

Table 11 - Predicted Noise Levels

EQUIPMENT /PROCESS	PREDICTED NOISE LEVEL dB(A) L_{eq}	RECEIVER NOISE MANAGEMENT LEVEL dB(A) L_{eq}
Excavator/ Bulldozer	**68**	**NAML 65** **HNAML 75**
Concrete crusher	**68**	
Bobcat	59	
Hydraulic Hammer on 20-60t Excavator	**79**	
Hydraulic Hammer on 5t Excavator	**74**	
Rock/Masonry Saw on Excavator	64	
Piling Rig	**69**	
Rock Anchor Drill Rig	64	
Pneumatic Hammer	**69**	
Electric Hammer	59	
Concrete Pump	64	
Concrete Truck	64	
Truck	62	
Forklifts	54	
Angle grinders	**67**	
Electric Saw	65	
Drilling	48	
Hammering	**74**	
Site Crane	59	
Impact drill	59	
Remediation Plant	69	
Air compressor	40	
Concrete Float/Vibrators	59	

Predictions indicate that there will be exceedances of the NAML. See Section 5.5 for recommendations. Noise emissions from excavator-mounted hammering will exceed the Saturday 1pm to 5pm noise limit, and therefore these operations should not occur during this period. Noise emissions from other plant items (excluding hammering) are generally within the NAML at all times.

5.5 DISCUSSION

Predicted worst case noise levels at various potentially affected receivers are presented above. Residential premises surrounding the site will receive noise levels exceeding the noise management level when these items are close to the site boundaries. These are primarily as a result of excavator mounted hydraulic hammers. Other operations would generally comply with the noise affected management levels at the residential receivers surrounding the site.

Specific treatments to items of plant will be developed in conjunction with Lendlease in an ongoing acoustic review of construction methodology. These reviews will be undertaken regularly and when more detailed planning regarding including possible actual plant locations, actual plant being used, etc are known.

The following potential site specific treatments are being proposed at this stage, however these will be updated as details about construction planning are available:

- During the undertaking of remediation soil treatment works on site, the treatment processes will typically be undertaken within enclosures (where practicable) which will aid in noise reduction.

- The utilisation of 2.4m high solid Class-A perimeter hoardings intermittently around the site will act as appropriate noise screens and barriers for lower level receivers and Parramatta Park.

- As the excavation reaches depths, the surrounding retention systems will act as barriers to noise generation equipment within the excavation.

- Where practicable, positioning major mobile temporary plant such as concrete crushers, concrete pumps, concrete trucks and the like as far as possible from sensitive receivers. The strategic positioning of these items can result in construction noise levels not exceeding the NAML around the site.

- Where possible the maintaining of buffer/separation zones at various stages of the works between the key noise generating activities and receptors such as the Alisa Mackinnon Centre should be adopted.

- Onsite crushing and screening of concrete for reuse on site thereby potentially reducing material transported offsite to landfill and reducing traffic on public roads and associated noise.

The noise and vibration assessment indicates that exceedances of the noise and vibration management goals would primarily be caused by excavator-mounted hydraulic hammer operations. Hence these activities should be managed as follows:

- Hammering should only be undertaken where non-percussive extraction method is not feasible or reasonable.

- Where hammering is undertaken it should be performed according to the following:

    - Using the smallest equipment as is practical provides benefits in terms of the noise/time to complete balance. (In other words a smaller hammer may be quieter but may result in significantly extended period of operation, leading to no overall benefit.)

    - Using hammers with low-noise heads or wrapping the head to minimise radiated noise.

    - Where practical and effective erect, temporary barriers consisting of heavy carpet lined 1.8m mesh barricades placed close to the work face to screen most affected receivers.

      In this regard, site hoardings and sheds where possible should form imperforate barriers and be placed to screen the most affected receivers being the Alisa Mackinnon Centre and the O'Connell Street residences on the north eastern boundary. It is noted that these barriers would be effective only for low level receivers.

    - Where noise emissions exceed the "highly noise affected management level" the location of this equipment around the site should be varied throughout the day such that noise is shared between the receivers.

    - The local community should be informed via a liaison committee (or other method as appropriate) as to the nature, period and times of hammering. Community response may be used to formulate impact minimisation strategies. For example, hammering close to the Alisa Mackinnon Centre may be avoided during the exam periods, or other sensitive periods.

5.6 RECOMMENDATIONS

Demolition and excavation activities are typically the loudest construction activities on site. Given the close proximity to existing developments, strict compliance with noise affected management levels (as set out in section 4) will not be possible at all times.

We note the following:

- While the demolition and excavation period will potentially generate higher noise levels than those recommended in Section 4, the period of the proposed works are relatively modest.

- The equipment to be used (excavator and bored piles) means the noise generated will be quieter than that often generated in excavation/typical piling.

- Substantial restrictions on times of use are likely to be of little benefit:

    - It would prolong the overall construction/excavation/demolition period.

    - Respite periods are likely to be of relatively minimum benefit as this will provide little benefit to residential receivers during the day.

5.6.1.1 Saturday Works

The following items of equipment should not be used on site between 1pm to 5pm on Saturdays:

- Hydraulic hammering; and
- Rock-breaking equipment;

It is noted that noise emissions from the piling rigs, pneumatic hammers, angle grinders and electric saws marginally exceed the Saturday 1pm to 5pm noise limit. However, these processes will be managed so that operations only occur on the southern and western boundary of site so that continued, compliant operation will occur during these periods.

6 ASSESSMENT OF VIBRATION

As the proposed piling method is bored piling, the only activity that has the potential to produce significant ground vibration would be the excavation of rock using hydraulic hammers. Due to the significant distance separation between the activities and most sensitive structures or occupancies and the nature of the works being undertaken, predictions indicate that the recommended vibration levels will not be exceeded and additional mitigation methods will not be required.

7 GENERAL MITIGATION METHODS THAT WOULD BE APPLIED TO MANAGE NOISE/VIBRATION EMISSIONS

The procedures that will be applied to regulate noise and vibration impacts are summarised in the following flow chart.

7.1 NOISE CONTROL METHODS

The determination of appropriate noise/vibration control measures will be dependent on the particular activities and demolition appliances. This section provides an outline of available methods.

7.1.1 Selection of Alternate Appliance or Process

Where a particular activity or demolition appliance is found to generate noise levels that exceed the criteria, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying out this activity by use of pneumatic hammers or pulverising techniques lower levels of noise will result.

It is proposed to use “low noise” hydraulic hammers either proprietary hammers, retro-fitted encased hammers or pulverising techniques.

7.1.2 Acoustic Barriers

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant (tower cranes). Placing barriers at the source cannot effectively attenuate equipment which is on the move or working in rough or undulating terrain.

Barriers can also be placed between the source and the receiver. The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8dB(A) may be achieved. Where the barrier does not obstruct line of sight, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 12mm plywood would be acceptable for the barriers.

It is proposed to utilise portable carpet faced plywood barriers to screen the affected receivers from hammering point wherever practicable.

7.1.3 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

7.1.4 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

7.1.5 Treatment of Specific Equipment

In certain cases it may be possible to specially treat a piece of equipment to reduce the sound levels emitted. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

7.1.6 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

Construction vehicles accessing the site should not queue in residential streets and should only use the designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

7.1.7 Introduction of Construction Joints

Construction joints will prevent the direct transmission of vibration from work spaces to sensitive spaces. It is noted that transmission of vibration may still occur via other connections and less direct structural paths.

7.1.8 Strategic Positioning of Processes On-Site

Where practicable, particular processes of activities can be located in particular positions on site to minimise noise to surrounding sensitive receivers.

For example, stationary plant may be positioned where direct line of sight shielding can be achieved using natural barriers, or may maximise the distance to the nearest sensitive receiver. This may also be applicable to the demolition of building structures where the façade closest to residential receivers is left until last to provide barrier screening for the demolition of the other parts of the building.

7.1.9 Combination of Methods

In some cases it may be necessary that two or more control measures be implemented to minimise noise emissions.

7.1.10 Establishment of Direct Communication with Affected Parties

In order for any construction noise management programme to work effectively, continual communication is required between all parties that may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process that allows for the adjustment of control methods and criteria for the benefit of all parties.

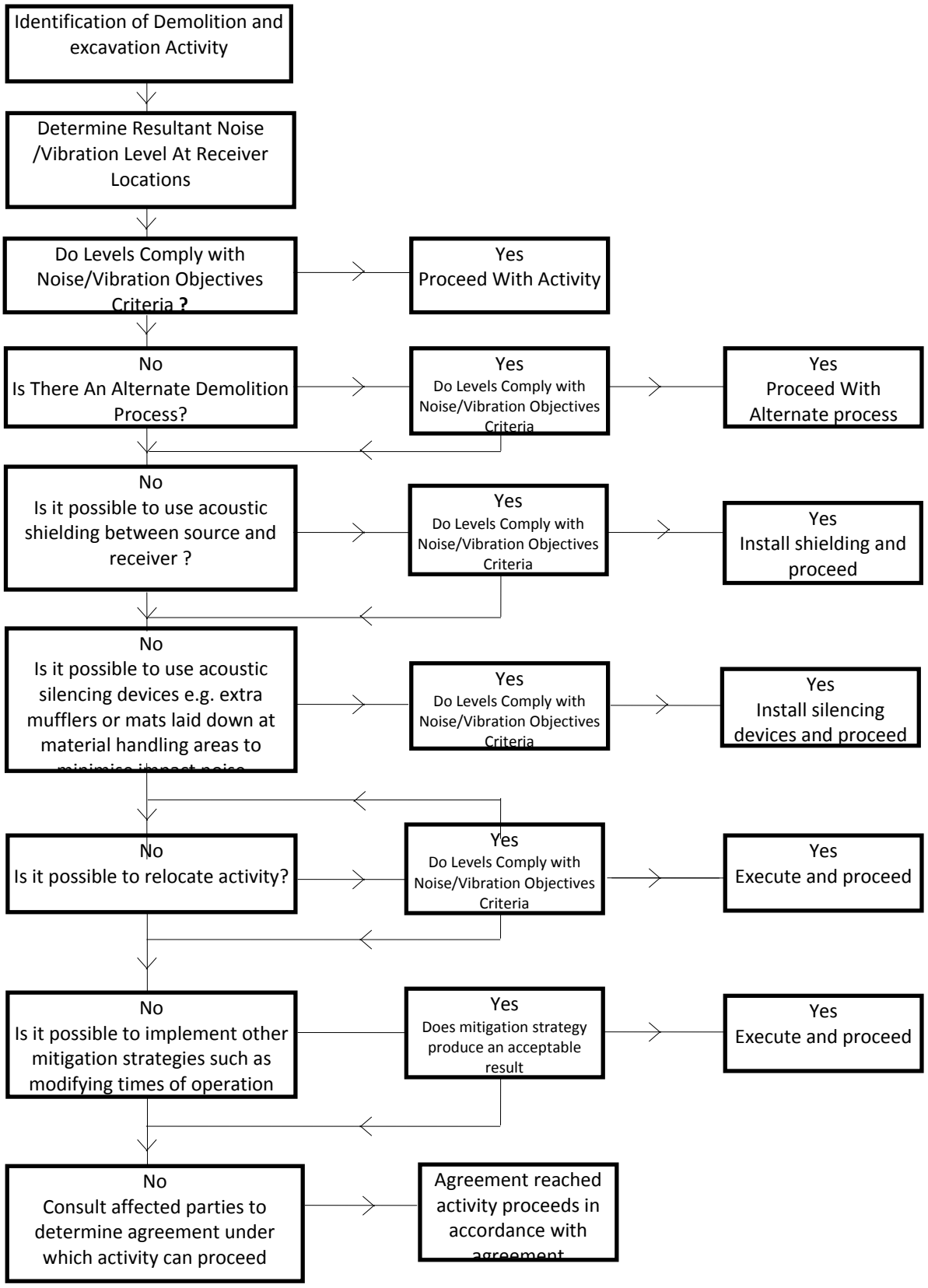
The objectives of the consultation process are to:

- Inform and educate the groups about the project and the noise controls being implemented.
- Increase understanding of all acoustic issues related to the project and the options available.
- Identify group concerns generated by the project, so that they can be addressed.

7.1.11 Management Training

All site managers should be made aware of noise and vibration limits, applicable control measures and methods. They should ensure that all agreed noise and vibration measures are carried out by employees and sub-contractors.

CONTROL OF NOISE FLOW CHART



8 MONITORING

It is proposed to undertake a programme of noise and vibration monitoring to comply to monitor noise and vibration levels within at critical locations around the site.

The monitoring would consist of attended monitoring (to confirm noise/vibration predictions, to identify safe working distances or methods and in response to complaints) and unattended monitoring in order to provide a historical record of emissions, to provide vibration alarms and to identify exceedences where complaints are made.

Vibration loggers, positioned in locations representative of sensitive receivers, would be used to provide a record of vibration levels and to provide alarms if vibration limits are exceeded. Installation of noise loggers would be undertaken for recording purposes in case of complaints and to monitor progress of the works.

8.1 RESPONSE TO VIBRATION ALARMS

The following general procedure should be adopted in zones where only unattended logging is required in response to alarm events. During the course of demolition and construction where a monitor alarm is activated the following action shall be undertaken:

- Monitoring alarms shall be managed using in built paging systems as part of the unattended vibration monitoring equipment. An SMS notification shall be sent upon an exceedence of the vibration trigger level to relevant site personnel.

- Where the exceedence of the amenity vibration targets is minor and does not occur for a greater than 5 minute interval per hour then the activities should continue but care should be taken to minimise vibration.

- If minor exceedences occur for greater than 5 minutes, or if single events occur that exceed 10mm/s then the following should occur:
    - Investigate if there may be sources of extraneous vibration.
    - If not, all vibration producing works in the vicinity of the alarm shall immediately be stopped.
    - The cause of the exceedence shall be investigated and if the cause is seen as a single event that is unlikely to be repeated continue with works.
    - If the cause of the event is likely to occur again, or if another alarm is triggered, then the acoustic consultant should be advised and further action taken before works recommence.

One of two courses of action can then follow. 1. If attended monitoring is established the activity can continue with the attended monitoring confirming that even if the alarm level is exceeded the works can proceed provided the vibration limit is not exceeded. 2. Work practices are modified and attended monitoring used to confirm.

9 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

9.1 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continuous communication is required between all parties which may be potentially impacted upon, Lendlease and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation processes is to:

- Inform and educate the groups about the project and the noise controls being implemented;
- Increase understanding of all acoustic issues related to the project and options available;
- Identify group concerns generated by the project, so that they can be addressed; and
- Ensure that concerned individuals or groups are aware of and have access to the Complaints Register which will be used to address any construction noise related problems should they arise.

An additional step in this process is to produce a newsletter informing nearby residents of upcoming activities that are likely to generate higher noise/vibration levels.

9.2 DEALING WITH COMPLAINTS

Should ongoing complaints of excessive noise or vibration criteria occur immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration limits all work potentially producing vibration shall cease until the exceedance is investigated.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided);
- The time and date the complaint was received;
- The nature of the complaint and the time and date the noise was heard;
- The name of the employee who received the complaint;
- Actions taken to investigate the complaint, and a summary of the results of the investigation;
- Required remedial action, if required;
- Validation of the remedial action; and
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable;

- noise measurements at the affected receiver;
- an investigation of the activities occurring at the time of the incident;
- inspection of the activity to determine whether any undue noise is being emitted by equipment; and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

10 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process
2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implement additional acoustic treatment in the form of localised barriers, silencers etc. where practical.
4. Selecting alternative equipment/processes where practical
5. If necessary, setup noise/vibration and dust monitoring devices at locations representing the nearest noise/vibration and dust affected receivers and provide data for each complain time period. Analysis is required to determine suitable mitigation measures.

Complaints associated with noise /vibration and dust generated by site activities shall be recorded on a Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager to the general public and their contact telephone number.

11 CONCLUSION

A demolition, excavation and construction noise and vibration management plan has been developed that will be used by the contractor to manage impacts from the Western Sydney Stadium construction activities.

The assessment of noise and vibration emissions indicates that:

- For at least part of the site demolition and excavation period, some processes are likely to generate noise levels that will require additional management according to the procedures outlined in the Management Plan. Adoption of the elements of the Noise and Vibration Management Plan will ensure that noise and vibration impacts will be minimised.

- Recommendations are made to safeguard existing structures immediately adjacent to the site.

The management plan outlines the development of controls and safeguards that would be applied to all activity on the site. The objective of these controls is to ensure that all work is carried out in a highly controlled and predictable manner that will minimise emissions and protect the amenity of the sensitive receivers surrounding the site.

The controls and safeguards implemented as a result of the analysis recommended in the Plan would be reviewed at a number of stages as required to respond to local conditions, revised methods and equipment, as well as in response to the monitoring and evaluation of actual impacts. This management plan outlines the procedures that would be adopted during the planning and execution phases by the contractor.

Further reviews would be undertaken through the demolition and construction period, as required, in response to revised methods and equipment, as well as in response to the monitoring and evaluation of actual impacts.

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