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# THE NORTHERN BEACHES HOSPITAL

## Stage 1 Modification - Noise & Vibration Assessment

1 December 2014

Healthscope

TG661-01F06 (r2) Stage 1 Mod CNVA

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# 1 Introduction

Renzo Tonin & Associates was engaged to prepare an assessment of noise and vibration emission from the preparation works associated with the Northern Beaches Hospital (NBH) development. In particular, this report assesses the potential noise and vibration impact from preparatory earthworks (levelling of site), provision of haul roads and preliminary infrastructure.

This work is proposed under modification of the Northern Beaches Stage 1 approval (SSI_5982, dated 22 June 2014). Within the Stage 1 application, approval was granted for early site works, including vegetation clearing and services / infrastructure diversion and reinstatement. A noise and vibration management plan supporting Stage 1 was prepared by Acoustic Logic on 2 July 2014. Details of the noise and vibration management plan are provided in the document 20140697.1/0207A/R3/JS. The proposed modification works are consistent with and represent an extension of the approved Stage 1 works.

This report however presents an assessment of noise and vibration generated by the proposed modification works and presents management measures to reduce potential impacts on surrounding noise and vibration sensitive development.

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

# 2 Nearest receivers and existing noise environment

## 2.1 Nearest receivers

The nearest potentially affected receivers to the site preparation works are presented in Table 1 and graphically in Figure 1.

**Table 1: Nearest receivers**

| Receiver type | Receiver ID | Receiver location | Distance from boundary of site (Approx. m) |
|---|---|---|---|
| Residential | R1 | Residences to the north across Frenchs Forest Rd West | 22 |
| | R2 | Residences to the south across Warringah Rd | 37 |
| Commercial | C1 | Commercial premises to the south across Warringah Rd | 27 |
| Other sensitive receiver | E1 | The Forest High School | 15 |

Notes: Distance from boundary of site to receiver calculated to nearest façade of receiver

## 2.2 Existing noise environment

Criteria for the assessment of operational and construction noise are usually derived from the existing noise environment of an area, excluding noise from the subject development. Appendix B of the NSW EPA *Industrial Noise Policy* (INP) outlines two methods for determining the background noise level of an area, being 'B1 – Long-term background noise method' and 'B2 – Short-term background noise method'. This assessment has used a combination of long-term and short-term noise monitoring.

Long-term noise measurements have previously been undertaken by Acoustic Logic for the Stage 1 EIS. Details of the long-term noise monitoring undertaken by Acoustic Logic are presented below. Supplementary short-term attended measurements were undertaken by Renzo Tonin & Associates to provide additional detail of the surrounding noise environment.

## 2.3 Noise measurement locations

The long-term and short-term measurement locations are outlined in Table 2and shown in Figure 1.

**Table 2: Noise monitoring locations**

| ID | Address | Description |
|---|---|---|
| **Long-term noise monitoring** | | |
| La | Northern Beaches Hospital | Monitoring carried out by Acoustic Logic<br>The monitor was installed next to the school building nearest the hospital site. Noise levels at this logger will be indicative of ambient noise levels at the Frenchs Forest School and at the residential development on Frenchs Forest Road to the north of the site |

| ID | Address | Description |
|---|---|---|
| Lb | Northern Beaches Hospital | Monitoring carried out by Acoustic Logic<br>The monitor was installed on the school property boundary, towards the southern end of the site. Noise levels at this logger will be indicative of ambient noise levels on Warringah Road. |
| **Short-term noise monitoring** | | |
| S1 | 112A Frenchs Forest Road West | The sound level meter was positioned approximately 3m from road kerb and 5m from residential boundary, 1.5m above the ground level in the free field. |
| S2 | Wakehurst Parkway | The sound level meter was positioned approximately 3m from road kerb and 1.5m above the ground level in the free field. |
| S3 | Corner of Hilmer Street and Warringah Rd | The sound level meter was positioned approximately 1m from Warringah Road kerb and 1.5m above the ground level in the free field. |

**Figure 1: Nearest receivers and noise monitoring locations**


## 2.4 Long-term noise measurement results

The long-term noise monitoring undertaken by Acoustic Logic was conducted between 2 July and Tuesday, 9 July 2013. While the tabulated background noise levels presented in the Stage 1 acoustic report are for day-time hours only, noise levels graphs are presented for the complete monitoring period. Estimated Rating Background Levels (RBL) and representative ambient $L_{eq}$ noise levels have been established for the evening and night time periods. Table 3 presents the overall single RBL and ambient $L_{eq}$ noise levels for each assessment period, determined in accordance with the INP.

**Table 3: Long-term noise monitoring results, dB(A)**

| Monitoring location | $L_{A90}$ Rating Background Level (RBL) | | | $L_{Aeq}$ Ambient noise levels | | |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night |
| La - north (Frenchs Forest Rd West) | 44 | 43 | 39 | 52 | 46 | 43 |
| Lb - south (Warringah Rd) | 52 | 49 | 42 | 56 | 53 | 48 |

Notes: Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays
Evening: 18:00-22:00 Monday to Sunday & Public Holidays
Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays

## 2.5 Short-term noise measurement results

Short-term noise measurements were undertaken on Wednesday, 12 March 2014 between 2:30pm and 11:00pm, in order to provide greater detail of the surrounding noise environment, particularly during evening and night time hours. The short-term measurement results are summarised in Table 4.

**Table 4: Short-term noise monitoring results**

| Time | Measured Noise Level, dB(A) | | Comments on measured noise levels |
|---|---|---|---|
| | $L_{Aeq}$ | $L_{A90}$ | |
| **S1 – 112A Frenchs Forest** | | | |
| 14:31-14:51 | 65 | 51 | The background $L_{A90}$ was determined by distant road traffic. The ambient $L_{Aeq}$ noise level was determined by local road traffic along Frenchs Forest Road West. |
| 14:52-15:08 | 65 | 54 | |
| 21:49-22:04 | 58 | 45 | |
| 22:04-22:19 | 57 | 45 | |
| **S2 – Wakehurst Parkway** | | | |
| 15:12-15:27 | 68 | 55 | The background $L_{A90}$ was determined by distant road traffic. The ambient $L_{Aeq}$ noise level was determined by local road traffic along Wakehurst Parkway. |
| **S3 – Corner of Hilmer Street and Warringah Rd** | | | |
| 15:50-16:05 | 74 | 63 | The background $L_{A90}$ was determined by local and distant road traffic. The ambient $L_{Aeq}$ noise level was determined by local road traffic along Waringah Road. |
| 16:06-16:21 | 75 | 63 | |
| 22:30-22:45 | 69 | 54 | |
| 22:46-23:01 | 69 | 55 | |

Notes: The equipment used for noise measurements was an NTi Audio Type XL2 precision sound level analyser which is a class 1 instrument having accuracy suitable for field and laboratory use. The instrument was calibrated prior and subsequent to measurements using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed. All instrumentation complies with AS IEC 61672.1 2004 "*Electroacoustics - Sound Level Meters*" and carries current NATA certification (or if less than 2 years old, manufacturers certification).

## 2.6 Project assessment noise levels

The short-term noise measurements indicate that the prevailing noise levels at the nearest residential receivers, that front Warringah Road and Frenchs Forest Road West are exposed to noise levels higher than that recorded by the long-term unattended noise monitoring carried out for Stage 1 EIS. This result is expected given that the long-term noise monitoring locations are set back from the road frontages.

Table 5 outlines the background and ambient noise levels used for determining preliminary noise criteria for the assessment.

**Table 5: Residential equivalent long-term noise levels, dB(A)**

| Assessment location | $L_{A90}$ rating background level (RBL) | | | $L_{Aeq}$ ambient noise levels | | |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night |
| R1 - Residences to the north across Frenchs Forest Rd West | 51 | 45 | 41 | 65 | 57 | 54 |
| R2 - Residences to the south across Warringah Rd | 63 | 54 | 47 | 74 | 69 | 64 |

Notes: Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays
Evening: 18:00-22:00 Monday to Sunday & Public Holidays
Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays
As required by the INP, the external ambient noise levels presented are free-field noise levels. [ie. no façade reflection]

# 3 Noise and vibration objectives

The following sections present the standards and guidelines relevant to the noise and vibration assessment for the site preparation works.

## 3.1 Noise objectives

Construction noise management levels can be been determined using the NSW *Interim Construction Noise Guideline* (ICNG), consistent with the Stage 1 assessment. Based on the measured background noise levels presented in Table 5, Table 6 outlines the noise goals during site preparation works.

**Table 6: Project noise goals within standard hours**

| Receiver ID | Address | Noise affected target $L_{Aeq\ 15minute}$ dB(A) |
|---|---|---|
| **Residential receivers** | | |
| R1 | Residences to the north across Frenchs Forest Rd West | 61 external |
| R2 | Residences to the south across Warringah Rd | 73 external |
| **Commercial receivers** | | |
| C1 | Commercial premises to the south across Warringah Rd | 73 external* |
| **Other sensitive receivers** | | |
| E1 | The Forest High School | 45 internal |

Notes: * Not set lower than residential target

## 3.2 Vibration objectives

### 3.2.1 Disturbance to buildings occupants

Assessment of potential disturbance from vibration on human occupants of buildings is made in accordance with the DECCs '*Assessing Vibration; a technical guideline*'. The guideline provides criteria which are based on the British Standard BS 6472-1992. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent'. Table 7 provides definitions and examples of each type of vibration.

**Table 7: Types of vibration**

| Type of vibration | Definition | Examples |
|---|---|---|
| Continuous vibration | Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time) | Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery). |
| Impulsive vibration | A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds | Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. |

| Type of vibration | Definition | Examples |
|---|---|---|
| Intermittent vibration | Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude | Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers.<br>Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria. |

Source: Assessing Vibration; a technical guideline (Department of Environment and Conservation (NSW), 2006)

The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced in Table 8.

**Table 8: Preferred and maximum levels for human comfort**

| Location | Assessment period [1] | Preferred values | | Maximum values | |
|---|---|---|---|---|---|
| | | z-axis | x- and y-axis | z-axis | x- and y-axis |
| **Continuous vibration[3] (Weighted RMS acceleration, $m/s^2$, 1-80Hz)** | | | | | |
| Critical areas [2] | Day or night time | 0.005 | 0.0036 | 0.010 | 0.0072 |
| Residences | Daytime | 0.010 | 0.0071 | 0.020 | 0.014 |
| | Night time | 0.007 | 0.005 | 0.014 | 0.010 |
| Offices, schools, educational institutions and places of worship | Day- or night time | 0.020 | 0.014 | 0.040 | 0.028 |
| Workshops | Day- or nighttime | 0.04 | 0.029 | 0.080 | 0.058 |
| **Impulsive vibration [3] (Weighted RMS acceleration, $m/s^2$, 1-80Hz)** | | | | | |
| Critical areas [2] | Day or night-time | 0.005 | 0.0036 | 0.010 | 0.0072 |
| Residences | Daytime | 0.30 | 0.21 | 0.60 | 0.42 |
| | Night-time | 0.10 | 0.071 | 0.20 | 0.14 |
| Offices, schools, educational institutions and places of worship | Day- or night-time | 0.64 | 0.46 | 1.28 | 0.92 |
| Workshops | Day or night-time | 0.64 | 0.46 | 1.28 | 0.92 |
| **Intermittent vibration [4] (Vibration Dose Values, VDV, $m/s^{1.75}$, 1-80Hz)** | | | | | |
| Critical areas[2] | Day or night-time | 0.10 | | 0.20 | |
| Residences | Daytime | 0.20 | | 0.40 | |
| | Night-time | 0.13 | | 0.26 | |
| Offices, schools, educational institutions and places of worship | Day- or night-time | 0.40 | | 1.60 | |
| Workshops | Day or night-time | 0.80 | | 1.60 | |

Notes:
1. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above. Stipulation of such criteria is outside the scope of their policy and other guidance documents (e.g. relevant standards) should be referred to.

### 3.2.2 Structural damage to buildings

Currently there is no Australian Standard for assessment of vibration induced structural damage. Reference is made to a German Standard DIN 4150 - Part 3, consistent with the Stage 1 Management Plan.

DIN 4150 - Part 3 provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are generally recognised to be conservative. DIN 4150-3 presents the recommended maximum limits over a range of frequencies (Hz), measured in any direction, and at the foundation or in the plane of the uppermost floor of a building or structure. The vibration limits increase as the frequency content of the vibration increases. The criteria are presented in Table 9

**Table 9: DIN 4150-3 structural damage criteria**

| Group | Type of structure | Vibration velocity, mm/s | | | |
|---|---|---|---|---|---|
| | | At foundation at frequency of | | | Plane of floor uppermost storey |
| | | 1Hz to 10Hz | 10Hz to 50Hz | 50Hz to 100Hz | All frequencies |
| 1 | Buildings used for 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 Group 1 or 2 and have intrinsic value (eg buildings under a preservation order) | 3 | 3 to 8 | 8 to 10 | 8 |

Given the distance to surrounding sensitive development, works are not expected to impose any risk of cosmetic damage to surrounding buildings. Notwithstanding, minimum working distances for vibration generating equipment are presented in Section 5.2.

# 4 Noise and vibration assessment

## 4.1 Proposal

### 4.1.1 Proposed works

The proposed modification to the approved Stage 1 is to undertake levelling of the site to prepare a base for the Stage 2 construction of the NBH. Table 10 sets out the indicative construction program.

**Table 10: Indicative construction program**

| | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 | WK10 | WK11 | WK12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Remove top soil | | | | | | | | | | | | |
| Level site | | | | | | | | | | | | |
| Excavate north and south tanks | | | | | | | | | | | | |
| Construct tanks | | | | | | | | | | | | |
| Construct retaining walls | | | | | | | | | | | | |
| Back fill retaining walls | | | | | | | | | | | | |
| Construct haul roads | | | | | | | | | | | | |

**Figure 2: Earthworks cut and fill**

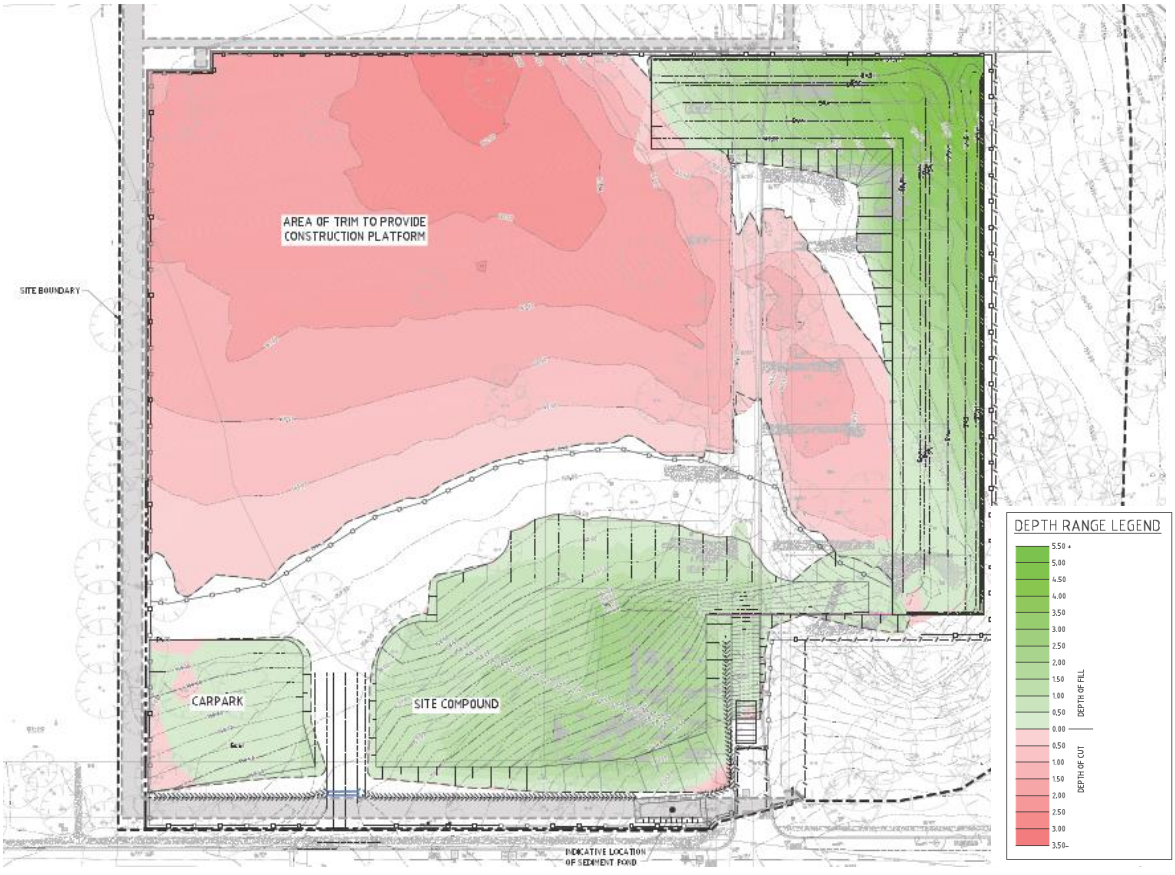
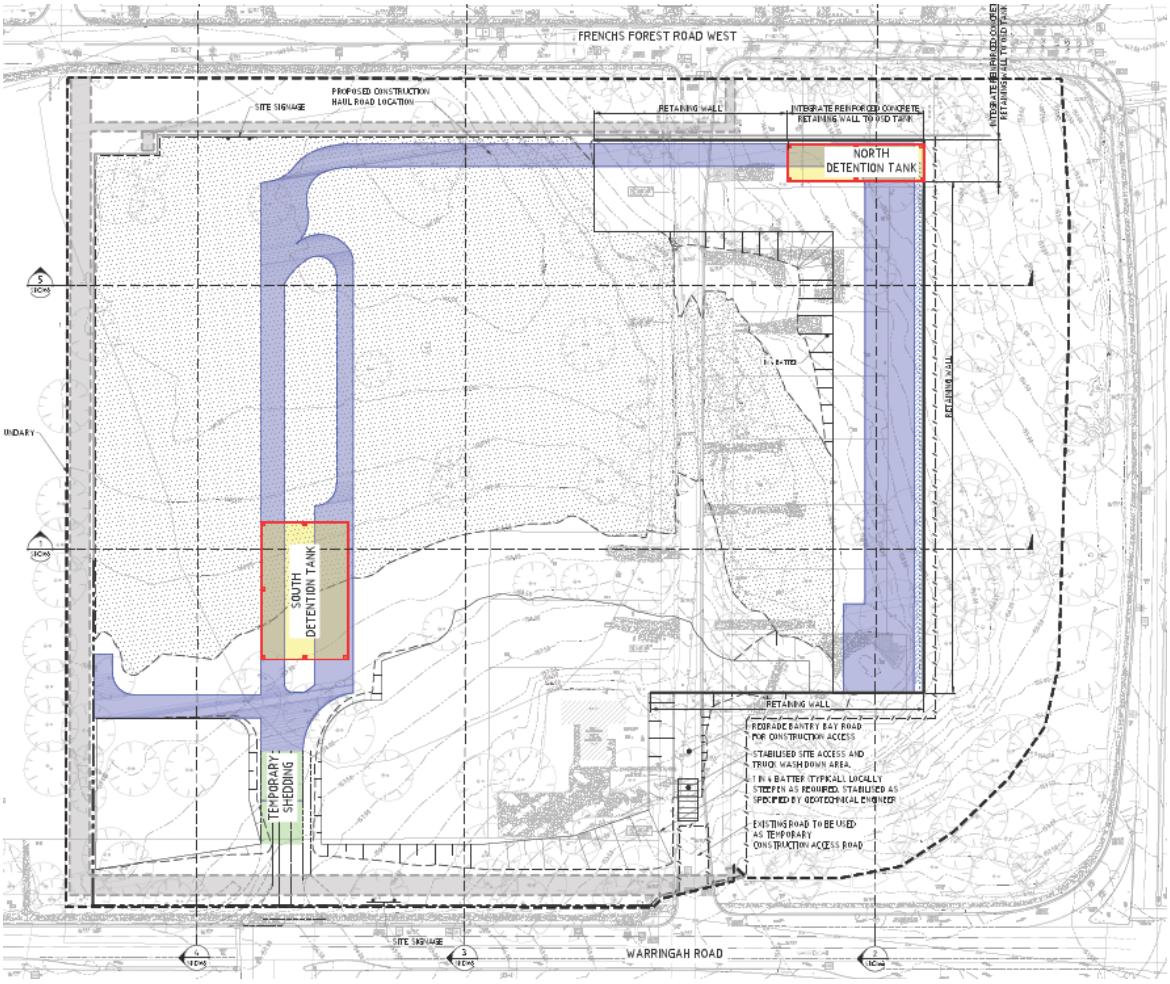


**Figure 3: Haul roads**




### 4.1.2 Construction hours

Hours of work are to be in accordance with Condition C1:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm
- Sunday/ Public holiday: No work

### 4.1.3 Preparatory works plant and equipment

Noise generated from the site will vary depending on the level and specific type of activity carried out, as well the number of items of plant equipment operating at any one time. An indication of plant and equipment to be used during the works is provided in Table 11.

**Table 11: Plant and equipment sound power levels, dB(A)**

| Equipment type | Indicative size | $L_w$ Sound power level |
|---|---|---|
| **Earth works** | | |
| Bulldozer | 50t | 103 |
| 2 x Excavator | 20t | 99 |
| Excavator | 7t | 102 |
| Articulated Dump Truck (Haulage) | 40t | 116 |
| 2 x Crane - Mobile (retaining walls) | 35t | 98 |
| Water Cart (dust suppression) | - | 111 |
| **TOTAL earth works** | - | **118** |
| **Road works** | | |
| Concrete Pump | 6t | 103 |
| Pad Foot and Smooth Drum Rollers | 7t | 116 |
| Water Cart | - | 111 |
| Bitumen spray | - | 105 |
| **TOTAL road works** | - | **117** |

## 4.2 Noise assessment

Preparatory works are to take place at various locations across the development site. While equipment is likely to be distributed across various locations of the site, phases of work have been conservatively assessed by assuming all associated equipment is located in a specific zone, similar to those adopted for the Stage 1 assessment (see Figure 4). The site has been divided into nine work zones and noise emission from works within each of the zones has been assessed at the nearest receiver locations.

**Figure 4: Work zones and nearest receiver locations**


Noise prediction calculations have been carried out to determine worst case scenario noise levels of preparatory works at the subject site. Noise predictions have been assessed on the basis of the following.

- All plant and equipment for each stage operating concurrently for conservative assessment,
- Plant and equipment distributed across each work zone,
- The Forest High School assessment assumes that the nearest building is a classroom, and a 20dB(A) reduction from outside to inside with closed windows. This assessment would be subject to review should the building accommodate less sensitive uses, and
- 4m high construction hoarding along the western and northern boundaries.

Table 12 presents the predicted $L_{Aeq}$ noise levels for peak activities during earth works and road works.

**Table 12: Predicted noise levels at nearest affected receivers**

| Receiver location | Work zones | Predicted LAeq noise level, dB(A) | | 'Noise affected' targets | Highly noise affected' targets |
|---|---|---|---|---|---|
| | | Earth works | Road works | | |
| R1 - Residences to the north - Frenchs Forest Rd West | 1, 4 and 7 | **67** | **66** | 61 | 75 |
| | 2, 5 and 8 | 60 | 59 | 61 | 75 |
| | 3, 6 and 9 | 57 | 56 | 61 | 75 |

| Receiver location | Work zones | Predicted LAeq noise level, dB(A) | | 'Noise affected' targets | Highly noise affected' targets |
|---|---|---|---|---|---|
| | | Earth works | Road works | | |
| R2 - Residences to the south - Warringah Rd | 3^ | 71 | 70 | 73 | 75 |
| C1 - Commercial premises - Warringah Rd | 3 and 6^ | 71 | 70 | 73 | 75 |
| E1 - The Forest High School (inside nearest ground floor building) | 1, 2 and 3^ | 44 | 42 | 45 | 55 |
| E1 - The Forest High School (inside nearest first floor building) | 1, 2 and 3^ | 49 | 47 | 45 | 55 |

Notes: ^ Presented nearest/most critical work zones only

Based on the assessment, noise emission from construction activities is expected to comply with relevant noise targets at locations along Warringah Road and ground floor of Forest High School. At the upper level classrooms of Forest High School, minor exceedance is predicted of the noise affected target; however such exceedance is limited to works in the closest zones. Noise levels are however predicted to be below the highly noise affected targets.

At residences to the north of the site, on Frenches Forest Road West, noise levels are predicted to be below the highly affected target, but will exceed the noise affected target during works in zones 1, 4 and 7. Compliance is predicted for work in all other zones.

The predicted noise levels do not represent the continuous noise to be generated by the site, and periods of lower activity would be expected during the course of a given day.

With regard to consideration of reasonable and feasible noise mitigation measures it is noted that a solid 4m hoarding is to be constructed, and has been included in the assessment. The extent of the predicted exceedances is reduced from that presented in the original Stage 1 assessment and on this basis, restrictive respite periods are not deemed to be warranted. Notwithstanding, discussion regarding other potential measures is presented in Section 5.

# 5 Recommendations

## 5.1 Noise control measures

The following at-source control and management measures should be considered for the management of noise from construction works to reduce potential noise impacts. As physical noise mitigation measures are already proposed, the management measures are focused on minimising unnecessary noise generation from the site and the extent and duration of peak noise levels.

**Table 13: Construction noise control measures**

| Measure | Detail |
|---|---|
| **Source controls** | |
| Noise barriers | Where possible, stage development so that structures provide acoustic shielding to sensitive receiver locations.<br>Construct the proposed solid site hoarding as soon as practical. Where possible, stationary equipment should be located to make most use of the solid hoarding.<br>Barriers or enclosures around stationary plant should also be considered where it is required to be located in close proximity to sensitive receivers. |
| Location equipment | Loading/unloading zones and stationary plant where practicable be located away from the most sensitive receivers, in this case the nearest buildings of the adjacent school. |
| Equipment selection | Use the quietest and least vibration emitting construction methods where feasible and reasonable. |
| Limit equipment in use | Only the equipment necessary for the works to be used at any time. Avoid any unnecessary noise when carrying out manual operations and when operating plant<br>Simultaneous operation of noisy plant and equipment within discernible range of a sensitive receiver should be avoided/ limited where possible. |
| Limit activity duration | Any equipment not in use for extended periods shall be switched off. For example, heavy vehicles should switch engines off whilst being unloaded. |
| Reversing alarms | Alternative reverse alarm, such as 'quackers' should be installed where feasible and reasonable. |
| **Management measures** | |
| Implement community consultation measures | Inform community of construction activity and potential impacts.<br>To include specific consultation with Forest High School. |
| Develop good relations | Good relations with building occupants should be established at the beginning of the works and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with residents and the school should be adequately trained and experienced in such matters. |
| Dilapidation surveys | Dilapidation surveys are to be undertaken of sensitive structure prior to undertaking of vibration generating works. |
| Work staging | Where practical, stage works so that that intrusive works are carried out at least noise sensitive periods, eg. extended work hours on Saturdays for most intrusive works in proximity to the school buildings.<br>Also consider timetable for school exam periods and, where practical, adjust construction activities accordingly |

| Measure | Detail |
|---|---|
| Site inductions | All employees, contractors and subcontractors are to receive a Project induction. The environmental component may be covered in toolboxes and must include:<br>• all relevant project specific and standard noise and vibration mitigation measures<br>• relevant licence and approval conditions<br>• permissible hours of work<br>• any limitations on high noise generating activities<br>• location of nearest sensitive receivers<br>• construction employee parking areas<br>• designated loading/unloading areas and procedures<br>• site opening/closing times (including deliveries), and<br>• environmental incident procedures |
| Complaints management procedure | A management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits. |

## 5.2 Vibration control measures

Based on available data from a database containing vibration measurements from past projects and from library information, Table 14 presents the recommended minimum working distances for vibration generating plant.

**Table 14: Vibration minimum working distances**

| Plant item | Rating / description | Minimum working distance, m | |
|---|---|---|---|
| | | Cosmetic damage[2] | Human response[3] |
| Bobcat | Travelling | 1 (nominal) | Avoid contact with structure |
| Compactor[1] | 852G | 10 | 20 |
| Excavator | <=30 Tonne (travelling/ digging) | 5 | 15 |
| Grader[1] | <= 20 tonne | 2 (nominal) | 10 |
| Truck Movements[1] | Travelling loaded | 5 | 10 |
| Vibratory Rollers | 20t | 25 | 100 |

Notes: Renzo Tonin & Associates project files, databases & library
Based on DIN4150.3 Group 1 Buildings
For residential receivers

Site specific buffer distances shall be determined where vibration significant plant items, in particular vibratory rollers, operate within Cosmetic Damage minimum working distances detailed in Table 14. Where this occurs, minimum buffer distances to affected receivers shall be determined by site measurements prior to the commencement of the regular use of the vibration significant plant on site. The site specific minimum working distance shall be maintained in order to comply with relevant vibration limits.

# 6 Conclusion

Renzo Tonin & Associates has completed a noise and vibration assessment of the Stage 1 Modification Application seeking to extend site preparation works of The Northern Beaches Hospital development. The assessment has been carried out in accordance with the noise and vibration criteria outlined in the Stage 1 approval.

The assessment found exceedance of the ICNG noise affected targets only at upper levels of the Forest High School, and residences on Frenches Forest Road west. At both locations, the construction of a solid hoarding along the northern and western boundaries of the site, contributes to reducing potential noise impact from the NBH site. Furthermore, background noise monitoring results have established higher noise targets for residential premises along Frenches Forest Road West. The extent of the predicted exceedances is reduced from that presented in the original Stage 1 assessment and on this basis, restrictive respite periods are not deemed to be warranted. Notwithstanding, general guidelines and management measures have also been outlined.

With regard to vibration, the proposed equipment and activities are not expected to result in adverse impacts. Nonetheless, general management measures are outlined.