acoustic studio

Sue Folliot
TSA Management

18 January 2019

Dear Sue

TWEED VALLEY HOSPITAL

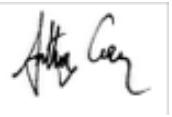
Response to EIS Submissions – Acoustic

This letter provides Acoustic Studio's response to EIS Submissions related to acoustics which have been reviewed and include:

- Environment Protection Agency – Letter reference EF13/9457 SF/67251 DOC18/840492-2 SSD9575
- Tweed Shire Council – Letter reference DA18/0685 LN40120
- NSW Department of Planning and Environment – Letter Reference SSD 9575

Should you have any queries or require any further information please do not hesitate to contact us.

Yours sincerely



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1. PLANNING APPLICATION ACOUSTIC ASSESSMENT

Acoustic Studio has completed a noise impact assessment for the proposed Tweed Valley Hospital, including establishing relevant criteria plus a general review and comment with relation to the Stage 1 Concept Proposal and Early Enabling Works

The assessment has been prepared in support of the planning application of the project and addresses the requirements outlined in the Secretary's Environmental Assessment Requirements issued for the project. The assessment is detailed in the following document.

- [1] Tweed Valley Hospital, Noise and Vibration Impact Assessment for State Significant Development (SSD), *(ref:20181002 SVM.0002.rep).*

2. EIS SUBMISSIONS

2.1 Environment Protection Agency (EPA)

The following outlines the EPA's EIS comments and recommendations plus Acoustic Studio's responses.

"Noise and vibration

The EPA anticipates significant demolition/construction noise and vibration impacts and operational phase noise impacts on the above mentioned sensitive receiver locations. The proponent should ensure that background noise monitoring and subsequent assessment of demolition/construction and operational noise impacts is undertaken in accordance with the guidance material provided in the EPA's Noise Policy for Industry (NPI), published in October 2017.

The EPA emphasises that as background noise monitoring is fundamental to proper noise impact assessment, the proponent should ensure that any such monitoring is consistent with guidance provided in NPI Fact Sheets A and B.

Tweed Valley Hospital EIS V6 Final, Appendix P Noise and Vibration Assessment and CNVMP includes the 'The Tweed Valley Hospital Noise and Vibration Impact Assessment for State Significant Development' by acoustic studio (dated 17 October 2018). This assessment states that construction works noise impacts from various plant and equipment operating individually are generally predicted to be above the Noise Management Level's (NML's) and the Highly Noise Affected levels at the two most sensitive/noise impacted receivers by up to 24dB(A) during recommended standard hours and up to 28dB(A) when used outside recommended standard hours on a Saturday.

Implementation of all reasonable and feasible mitigation measures for all works should occur to ensure that any adverse noise and vibration generating activities are minimised when NML's and vibration levels cannot be met due to safety or space constraints".

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Acoustic Studio Response

Noted.

Noise monitoring has been carried out in accordance with guidance provided in NPI Fact Sheets A and B.

The SSD (ref:20181017 SVM.0001.Rep) includes a quantitative assessment of the potential noise impacts from the proposal and includes mitigation measures in accordance with the NPI.

HI is committed to implementing all reasonable and practicable mitigation measures for all works to ensure any adverse noise and vibration generating activities are minimised when NML's and

"Recommendation

The EPA emphasises that demolition, site preparation, bulk earthworks, construction and construction related activities should be undertaken during the recommended standard construction hours, being —

(a) 7am to 6pm Monday to Friday;
(b) 8am to 1pm Saturday, and
(c) No work on Sundays or gazetted public holidays"

Acoustic Studio Response

Noted. In response to submissions, proposed construction hours on Saturdays from 8am to 4pm have been revised to 8am to 1pm. This is in line with standard construction hours and the EPA recommendation.

"Recommendation

The proponent be required to ensure construction vehicles (including concrete agitator trucks) involved in demolition, site preparation, bulk earthworks, construction and construction-related activities do not arrive at the project site or in surrounding residential precincts outside approved construction hours."

Acoustic Studio Response

Noted. Management of construction related traffic noise will be carried out in accordance with Section 2.2 of the Preliminary CNVMP. A comprehensive CNVMP will be developed by the engaged contractor to ensure that traffic noise impacts on noise neighbouring receivers is minimised.

"Recommendation

A comprehensive Construction Noise Vibration Management Plan (CNVMP) should be prepared prior to the commencement of any works."

Acoustic Studio Response

Noted -The SSD (ref:20181017 SVM.0001.Rep) includes a preliminary CNVMP in Appendix D. A comprehensive plan will be prepared by the engaged contractor prior to the commencement of works and will address the relevant applicable criteria.

2.2 Tweed Shire Council

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The following outlines the Tweed Shire Councils EIS recommendations plus Acoustic Studio's responses.

"12. General Engineering Matters – Continued

Internal Works

Recommendations"

"…BBB. The geotechnical report by Morrison Geotechnic dated September 2018 indicates that the site may require blasting. Concerns are raised regarding noise and vibration on neighbouring properties and should be addressed. …"

Acoustic Studio Response

We understand from Bonacci that Blasting is not required at this stage and therefore is not proposed. In the event that Blasting is confirmed as required, a detailed blast noise and vibration assessment and management plan will be prepared prior to commencement of works by the engaged contractor.

"…CCC. The Civil structural report by Bonacci Group (NSW) Pty Ltd specifies that the excavated rock is proposed to be crushed on site. Concerns are raised regarding noise for neighbouring properties and should be addressed. …"

Acoustic Studio Response

Noted - The SSD (ref:20181017 SVM.0001.Rep) includes a quantitative assessment of the potential noise impact predicted from on-site rock crushing.

The noise mitigation measures that are considered reasonable and practicable for these works include:

- Applying standard construction hours
- Including respite periods where activities are found to exceed the 75 dB(A) highly affected noise levels at receivers, such as 3 hours on and 1 off.
- Hoarding around the site, and local noise curtains (such as EchoBarrier or SilentUp) where these would break the line of site between noise source and receiver.

"14. Other Miscellaneous – continued

Noise

"…Recommendation

RRR. The Noise and Vibration Impact Assessment shall be amended to consider the impact of localised blasting and heavy ripping that may be required as outlined in the Preliminary Geotechnical Investigation (Morrison Geotechnic, September 2018)…."

Acoustic Studio Response

We understand from Bonacci that Blasting is not considered necessary at this stage, and therefore is not proposed for this project. In the event that Blasting is confirmed as required, a modification to the consent conditions would be sought and a detailed blast noise and vibration assessment and management plan would be prepared prior to commencement of approved works by the engaged contractor.

With regard to Ripping, equipment associated with this work is expected to generate a similar range of noise emissions predicted for Excavators (with rock breaker / saw / bucket) and Backhoes / Front Loaders. Ripping is not expected to take place within the safe working distances for vibration to any surrounding buildings or sensitive structures and therefore vibration impacts to buildings and structures are considered unlikely.

Noise and vibration monitoring (attended and unattended) would be used to ensure site laws are established and any exceedance confirmed / identified and all practicable noise and control measures are applied as required.

"… SSS. The construction noise particularly hammering, wood chipping, and rock crushing associated with this proposal is substantial and noise above background levels are likely to create amenity impacts to sensitive receivers particularly along Cudgen Rd and Kingscliff TAFE. Highly noise affected levels or where noise is outside recommended standard hours as per Interim Construction Noise Guideline (DECC, 2009) may cause a strong community reaction to noise and negotiation with affected premises is recommended…."

Acoustic Studio Response

Noted. Section 1.4 of the CONVMP requires that *"The main contractor shall be responsible for developing a comprehensive Construction Noise and Vibration Management Plan prior to commencement of works and to ensure that noise and vibration from activities carried out on site is minimised as far as practical."* Which will include *"Consulting with the occupants of neighbouring premises and buildings to inform them of the nature of the demolition work, to determine any specific noise and vibration sensitivity they may have and to negotiate respite times during noisier works."*

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"…TTT. An extension to construction noise is proposed to meet the delivery timeframe. It is noted the Interim Construction Noise Guideline (DECC, 2009) recommends Saturday 8am to 1pm. Given the potential disturbance of noise sensitive receivers it is recommended that Saturday hours are kept consistent with the Guideline and limited to 8am to 1pm on Saturdays…."

Acoustic Studio Response

Noted. Saturday hours of work will be revised accordingly (i.e. 8.00 am to 1.00 pm)

"…UUU. Provision of dilapidation Reports may be required…."

Acoustic Studio Response

Noted. It is unlikely that dilapidation reports would be required. If for any reason they are, they will be procured as part of the due diligence process by the main works Contractor.

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2.3 Department of Planning and Environment

"5. Noise Assessment

Stage 1 Works

Table 25 in Section 7.3.4.1 of the Noise Impact Assessment identifies a high level of exceedance in Residential Catchment B, Educational B (the TAFE) and some exceedances at Educational A (the High School) for standard construction hours in Stage 1 works (20-24dB)

Section 7.3.5 notes that the individual and cumulative noise levels from operations of various plant and equipment are predicted to be up to 19dB lower when location of activities within the site boundary are further away from a particular receiver. The noise assessment report should include detailed justification of how this reduction in the noise emissions can be achieved during the Stage 2 construction works…"

Acoustic Studio Response

To clarify, Section 7.3.5 notes that noise levels are predicted to be up to 19dB lower for plant and equipment when located on the proposed site at the centre of the construction site, where the maximum level is calculated at the closest boundary to the respective receiver. This is not proposed as a noise reduction measure. The ICNG requires, and it is usual practice, to predict the reasonable worst-case noise level. For construction-type activities this will typically be when plant is operating close to an assessment location. However, on larger construction sites (such as this one) where plant moves around, noise will not be at the reasonable worst-case noise level throughout the entire duration of the activity: it will be lower when the plant is further away. This information has been provided in the assessment because potentially affected receivers can be potentially misled, and unduly alarmed, if only the worst-case levels are presented without clarifying that that levels will be lower at times throughout the construction activity. It should also be noted that no blasting is required or proposed as part of the project.

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"…Several mitigation measures have been recommended to reduce noise emissions due to construction works in Stage 1. However, the mitigation measures are considered to be generic and applicable to all construction sites. The proposed mitigation measures should be detailed to include:

- *Approximate estimate of noise reduction at each affected noise sensitive reliever with the implementation of these measures;*
- *Heights of hoardings and locations of screenings;*
- *The triggers that would require the employment of additional mitigation measures;*
- *Noise monitoring methods during construction works; and*
- *A brief stakeholder engagement process for determining appropriate activity planning or respite times or when no mitigation can be proposed…"*

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Acoustic Studio Response

Section 7.3.5 recommends several mitigation measures. They are generic and applicable to all construction sites.

Approximate estimates of noise reduction at each affected noise sensitive receiver with the implementation of these measures are:

- Scheduling noisy activities to occur outside of the most sensitive times of the day for each nominated receiver - up to 85dBA. For example, avoiding works during "outside standard hours" at nearby residential receivers - this would eliminate 85dB predicted at residential catchment B for Excavator with Hammer / Saw.
- Implementing equipment-specific temporary screening for noisy equipment, or other noise control measures recommended in Appendix E of AS2436 - up to 5 to 10dBA.
- Solid screening or hoarding as part of the worksite perimeters - up to 5dBA.
- Locate specific activities such as carpentry areas (use of circular saws, or wood chipping areas etc) to internal spaces or where shielding is provided by existing structures or temporary screening - up to 5 to 10dBA.
- Limit the number of trucks and heavy vehicles on site at any given time (through scheduling deliveries at different times) - up to 5dBA.
- Unnecessary idling of vehicles and equipment - up to 5dBA
- Traffic routes are to be prepared to minimise the noise impact on the community - up to 5dBA
- When loading and unloading trucks, adopt best practice noise management strategies to avoid materials being dropped from a height - up to 5 to 10dBA.
- Adopt quieter methodologies. For example, where possible, use concrete sawing and removal of sections as opposed to jackhammering - up to 20dBA.
- Ensure that any miscellaneous equipment (extraction fans, hand tools, etc), not specifically identified in this assessment, incorporates silencing / shielding equipment as required to meet the noise criteria - up to 20dBA.

Heights of hoardings and locations of screenings. Acoustic Studio expects that hoardings would be around 2.4m height. Screenings would most likely be limited to hoarding around the site perimeter, as noted in the assessment.

Acoustic Studio recommends that alternative temporary noise curtains are investigated for the site, noting that SilentUp noise curtains are marketed in NSW with a maximum height of 6m. It is understood that the use of noise curtains of this type require wind loading and other engineering considerations, and may not always be practicable for this project. However it is an example of one potential option which would be investigated as the construction methodology and site conditions are progressed.

All practicable and reasonable additional mitigation measures would be implemented at the project triggers of the Noise Management Levels and the "Highly Noise Affected" level of 75dBA.

Section 7.6.1 of the SSD recommends monitoring is considered at the East Boundary (Catchment A) and the Southern Boundary (Catchment B) at the commencement of works for a minimum of 1.5 days per week (at least) for the first four weeks of construction. Further monitoring would reviewed after this time or sooner should it be deemed necessary by the acoustic consultant and project manager.
Attended monitoring would also be carried out at the commencement of works to establish relevant site laws for project and confirm actual noise levels against criteria / predictions.

A stakeholder engagement process for determining appropriate activity planning or respite times or when no mitigation can be proposed would include consultation with the TAFE, school and other noise sensitive receivers to establish, for example, times of exams for activity planning; class times for respite; and vacation times when no mitigation is necessary. In addition, Section 7.7 outlines recommendations for the Contractor to establish a communication register for recording incoming complaints and procedures for addressing complaints.

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3. Additional Stage 1 Works

The site accesses (identified as 'A' and 'D' on the plans) and associated Turnock Street improvements were identified in the SSDA and EIS submission, with the east and west Site access points forming part of the Concept Proposal. These components were originally proposed to be constructed as separate preliminary works, however they are now sought to be included in the Stage 1 Early and Enabling Works scope.

Acoustic Studio has prepared an Addendum SSD Report to include the Additional Stage 1 Works and is attached in Appendix A.

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APPENDIX A:

Noise and Vibration Impact Assessment for State Significant Development (SSD)
Additional Stage 1 Works – Site Access and Associated Improvements

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TWEED VALLEY HOSPITAL

Noise and Vibration Impact Assessment for State Significant Development (SSD)

Additional Stage 1 Works – Site Access and Associated Road Works

Issued

18 January 2019

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Proj & Code	Tweed Valley Hospital		SVM - 3270
Doc Title	Noise and Vibration Impact Assessment for SSD Additional Stage 1 Works – Site Access and Associated Improvements		
Ref	20190118 SVM3207.0008.rep.docx		
Date	18 January 2019		Revision: Issue 1
Author(s)	Anthony Cano, Sav Shimada		
Circulation	**Organisation**	**Location**	**Delivered Via**
Sue Folliott	TSA Management	Tweed	Aconex
Simon Waterworth	Geolink	Tweed	Aconex
Appendices	As listed in the Table of Contents		

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This document takes into account the particular instructions and requirements of our Client.
It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Glossary & Abbreviations

Term	Definition
dB	Decibel is the unit used for expressing sound pressure level (SPL) or power level (SWL).
dB(A)	Decibel expressed as an 'A – weighted' sound pressure level, based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is noted that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.
EIS	Environmental Impact Statement
Frequency	The rate of repetition of a sound wave. Frequency is measured Hertz (Hz), or cycles per second. Human hearing ranges approximately from 20 Hz to 20 kHz (2000 Hz).
Ground-borne noise	The transmission of noise energy as vibration of the ground. The energy may then be re-radiated as airborne noise.
ICNG	Interim Construction Noise Guideline
$L_{1(period)}$	The sound pressure level that is exceeded for 1% of a measurement period. This is commonly accepted as the maximum noise level.
$L_{10(period)}$	The sound pressure level that is exceeded for 10% of a measurement period. This is commonly accepted as the maximum noise levels.
$L_{90(period)}$	The sound pressure level that is exceeded for 90% of a measurement period. This is commonly accepted as the background noise level.
$L_{Aeq(period)}$	The equivalent continuous sound pressure level. The level of noise equivalent to the energy average of noise levels occurring over a measurement period.
L_{Amax}	The highest sound pressure level recorded over a measurement period.
Octave Band Centre Frequency	The most commonly used frequency bands are octave bands, in which the centre frequency of each band is twice that of the band below it.
Rating Background Level (RBL)	Rating background level is the overall single-figure background level representing each assessment period (day/evening/night) over a measurement period.
Sound Power Level (SWL)	Expressed in dB, it is the total acoustic energy radiated by a plant or equipment to the environment
Sound Pressure Level (SPL)	Expressed in dB, it is the level of noise measured by a standard sound level meter and requires a description of where the noise was measured relative to the source
SSD	State Significant Development
Vibration	Vibration may be expressed in terms of displacement, velocity and acceleration. Velocity and acceleration are most commonly used when assessing structure-borne noise or human comfort issues respectively.

Executive Summary

NSW Health Infrastructure proposes the construction of new Tweed Valley Hospital. This Noise and Vibration Assessment has been prepared as an Addendum to the SSD application to include Additional Stage 1 Works.

This assessment is based on the existing noise environment information has been measured based on long-term and short-term monitoring surveys and appropriate criteria established for both noise and vibration in the SSD[1] that was prepared for The Project.

A summary of the outcomes and recommendations of this noise and vibration assessment are as follows:

- Proposed construction hours for the Additional Stage 1 Works are as follows:
  - Monday to Friday - 7:00am to 6:00pm.
  - Saturday - 8:00am to 1:00pm.
  - Sunday and Public Holidays – No works.
- Based on the results of the assessment of construction activities, we make the following comments:
  - Location 1 will have the greatest impact on Residential receivers at Catchment B, exceeding Highly Affected Noise levels for most activities. The next most impacted receiver being nearby Agricultural land uses.
  - Location 2 will impact multiple receivers, exceeding the relevant noise management levels at residential receivers in Catchment A, the nearest commercial and TAFE.
  - Tweed Coast Road, Cudgen Road Upgrade works have also been considered as information only, as they are similar works, however this it is noted that these works are not part of the Stage 1 assessment and will be included in Stage 2. It will have the highest noise level impact at residential receivers in Catchment C due to the close proximity of works, exceeding the Highly Noise Affected levels for all activities.
  - Excavator works with hammering are predicted to have the highest noise impacts, affecting multiple receivers from all Additional Stage 1 Works locations.
  - Mitigation measures to be considered and incorporated where reasonable and feasible would include:

[1] "Tweed Valley Hospital, Noise and Vibration Impact Assessment for State Significant Development (SSD) 20181017 SVM.0001.Rep

        - Maintaining standard work hours
        - Limiting more intensive works, such as excavator hammering to the least sensitive times of the day (i.e. avoid early morning, early evening where practical).
        - Including Respite Periods where activities are found to exceed the 75 dB(A) Highly Affected Noise Level at receivers, such as 3 hours on 1 hour off.
        - Consideration of localised screening or barriers for high noise level / isolated works.
        - Apply best practice noise and vibration controls as per Section 7.5 to 7.8 of the SSD.
    - For all other receivers, the noise generated from the construction works noise from individual equipment operating is below the Highly Noise Affected Levels and generally able to meet the NMLs achieve the relevant criteria when further away from the perimeter boundary.
    - It is recommended that a CNVMP is prepared further to this assessment at the detailed design stage. The Contractor would be required to prepare a final CNVMP based on their proposed plant, equipment and construction methodology.
- Based on the results of the construction vibration assessment, this Preliminary CNVMP concludes that:
    - Human perception vibration impacts may occur – particularly from the use of excavators with hammers and vibratory rollers at the nearest sensitive receivers. The details of the vibration management controls required for the works would be determined when the Contractor prepares works plans and methodologies.
    - Vibration controls would consider modifying the construction equipment and / or method, and rescheduling activities to less sensitive times.
    - Vibration surveys are recommended prior to the commencement of each key vibration-generating-activity / equipment.
    - Vibration surveys are recommended at the commencement of operations for each vibration generating activity to determine whether the existence of significant vibration levels justifies a more detailed investigation.
    - If the assessment indicates that vibration levels might exceed the relevant criteria then vibration mitigation measures will need to be put in place, including monitoring vibration levels.

1 Introduction

1.1 Scope of Additional Stage 1 Works

This SSD Addendum has been prepared to include a noise and vibration assessment for Additional Stage 1 Works associated with the Tweed Valley Hospital. This assessment is based on assumed works methods and equipment, and outlines likely requirements for managing construction noise and vibration impacts from this Project to nearby sensitive receivers.

This report provides the following:

- A quantitative construction noise and vibration assessment, which includes:
    - Identifying noise and vibration sensitive receivers potentially affected by the proposed works.
    - Identifying noise and vibration sources associated with the proposed works.
    - Providing an assessment of noise and vibration generated by the proposed works against the relevant criteria.
    - Determining the likely need for noise and vibration mitigation and management measures.

The following has specifically been omitted from this report and can be referenced in the SSD[2] that was prepared for The Project:

- Reporting noise surveys which determine the existing ambient and background noise and vibration levels at the nearest sensitive receivers that surround the proposed development site.
- Quantifying the existing ambient and background noise levels at noise sensitive receivers on and surrounding the site.
- Establishing the appropriate construction noise and vibration criteria based on the measurement results from the surveys.

[2] "Tweed Valley Hospital, Noise and Vibration Impact Assessment for State Significant Development (SSD) 20181017 SVM.0001.Rep

1.2 Additional Stage 1 Works Overview

The scope of Additional Stage 1 Works includes:

- Construction of two entry site points and associated road works.
  - Creation of a new slip lane entry point to the site along Cudgen Road.
  - Turnock Street upgrade works, including creation of a new entry point to the site of the existing Turnock Street roundabout.

An additional intersection / road upgrade is proposed at Tweed Coast Road and Cudgen Road, however will be carried out in Stage 2. An assessment of these works has also been included for information purposes however is not proposed to be part of Stage 1 works.

The following outlines location of work with respect to the receivers surrounding the site.

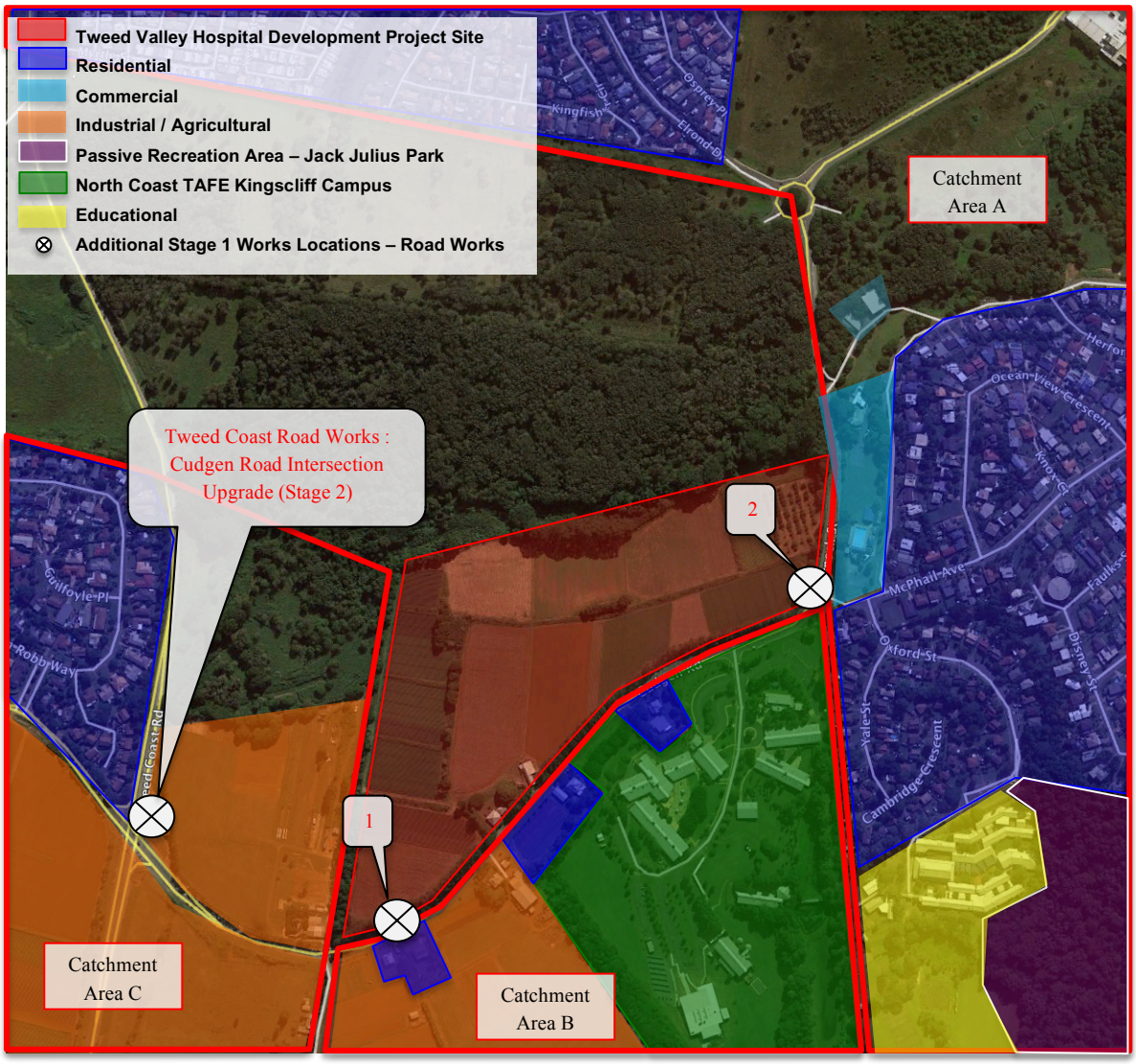

Figure 1: The Project Site in relation to noise-sensitive receivers including Additional Stage 1 Works Locations 1, 2 and 3.

2 Construction Noise and Vibration Assessment – Additional Stage 1 Works

2.1 Relevant Criteria

The relevant noise and vibration criteria for the project is as per Section 5.2 of the SSD[3].

2.2 Proposed Hours

Proposed construction hours for the Additional Stage 1Works of the Hospital are proposed to be as follows:

- Monday to Friday - 7:00am to 6:00pm.
- Saturday - 8:00am to 1:00pm.
- Sunday and Public Holidays – No works.

2.3 Proposed Works Overview

The Project Manager has developed an indicative construction works program that outlines the key activities in each particular location. Based on this, it is anticipated that the key activities to occur for each area / stage are as follows:

Additional Stage 1 Works include:

- Construction of two entry site points and associated road works.
    - Additional Stage 1 Works Location 1 - Creation of a new slip lane entry point to the site along Cudgen Road.
    - Additional Stage 1 Works Location 2 - Turnock Street upgrade works, including creation of a new entry point to the site of the existing Turnock Street roundabout.

An additional intersection / road upgrade is proposed at Tweed Coast Road and Cudgen Road, however will be carried out in Stage 2. An assessment of these works has also been included for information purposes however is not proposed to be part of the Stage 1 works.

[3] "Tweed Valley Hospital, Noise and Vibration Impact Assessment for State Significant Development (SSD) 20181017 SVM.0001.Rep

Figure 2: Additional Stage 1 Works - Location 1

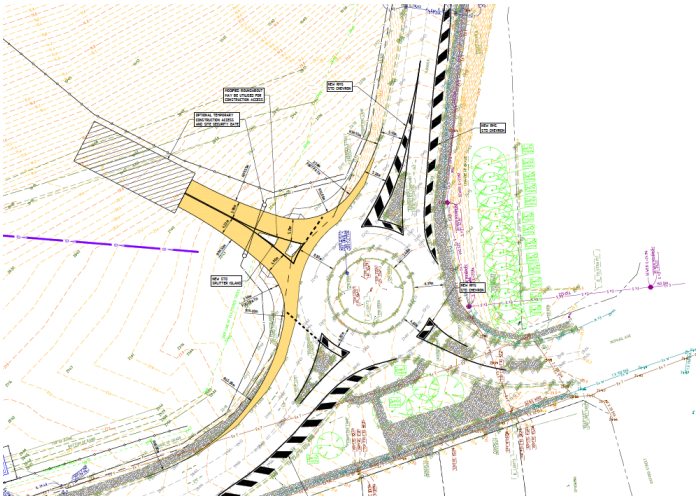

Figure 3: Additional Stage 1 Works - Location 2

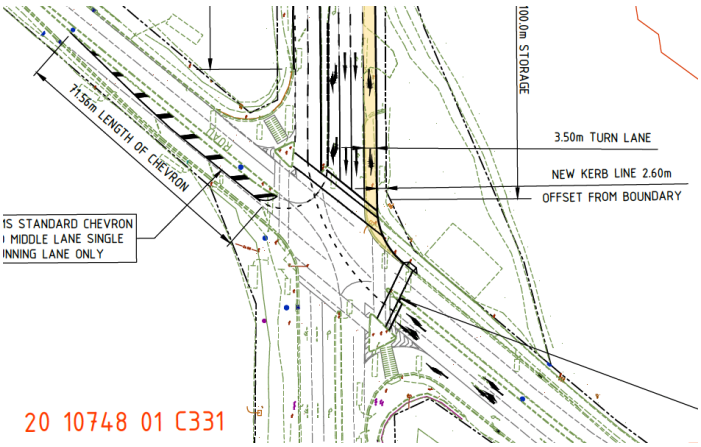

Figure 4: Tweed Coast Road – Cudgen Road Upgrade

Activities Associated with Proposed Works

- Removal of existing ground and formed pavements, preparation and rolling of Subgrades, placement of Gravel road bases, and rolling.
- Placement of new storm water drainage concrete pipework and pits, and formation of swale drains.
- Placement of concrete kerb and gutters, pedestrian islands and concrete aprons or crossings.
- Placement of Asphalt with trucks and profile machine and rollers. Scarifying or vacuum blasting old road line marking off and new line marking.

2.4 Construction Noise

The following sections outline the preliminary assessment carried out for construction noise emissions.

2.4.1 Noise Sources

The key noise sources for the activities occurring during construction works and the associated equipment noise levels are listed in Table 1. These values are based on Acoustic Studio's database and the relevant Australian and International Standards including AS2436:2010 and BS5228-1:2009.

Equipment Type	Item	Typical Noise Level $L_{Aeq,15min}$ SWL[4]
Heavy Vehicles	Tipper / Skip Truck	111
	Asphalt Paver	108
	Line Marking Truck	108
	Concrete Mixer trucks	109
Site Machinery	Bobcat	110
	Excavator (with hammers)	119
	Excavator (w/bucket) / Backhoe / Front Loader	113
	Compactor	110
	Grader	107
	Vibratory Roller	107
	Concrete Vibrator	101
	Concrete pump	110
	Scarifier	110
	Rock Crusher	119
Hand Held Tools	Jackhammer	110
	Road Saw	117

Table 1: Anticipated airborne noise levels for equipment / plant during construction works

Potential sources of vibration during the Project works include:

- Excavator hammering
- Vibratory Roller

[4] Noise levels provided in terms of Sound Power Level (SWL).

2.4.2 Sensitive receivers

Nearest sensitive receivers to the Project Site that will be potentially affected by noise and vibration are surrounding residential, commercial and educational premises as presented in Figure 1.

Table 2 outlines the most critical receivers surrounding the site for each type of impact.

Receiver	Impact	Location	Approximate Distance from Works		
			Location 1	Location 2	Tweed Coast Road Cudgen Road Upgrade
Residential	Airborne	Catchment A	600	40	870
	Airborne	Catchment B	20	220	370
	Airborne	Catchment C	350	880	10
Industrial / Agricultural / Commercial	Airborne	Catchment A	700	20	930
	Airborne	Catchment B	20	490	410
Educational	Airborne	Catchment A (Kingscliff High School)	570	320	905
		Catchment B (TAFE)	300	130	590
Passive Recreational Area	Airborne	Catchment A	740	400	1050

Table 2: Noise sensitive receivers and approximate distance to Additional Stage 1 Works Locations

2.4.3 Construction Noise Assessment Methodology

A preliminary assessment of the likely noise impacts of the proposed works on the most-affected receivers surrounding the site has been carried out.

The assessment has considered the following:

- Typical activities considered in the noise impact assessment are as detailed in Section 2.3.
- Project specific Noise Management Levels at each sensitive receiver location as outlined established in Section 5.2 of the SSD.
- Noise level predictions are calculated using the noise data provided in Table 1.
- Noise level predictions consider:
    - Distance attenuation
    - Ground and building reflections
    - Meteorological conditions
- The noise level predictions are based on assumptions that represent the worst-case scenario.
- L_{Aeq} noise levels are predicted for the operations of the nearest works area on the site to each of the nearest sensitive receiver location.
- The predictions consider individual tasks and associated equipment
- The predictions assume continuous operation of equipment / plant over the 15-minute assessment period to provide a worst-case assessment, unless otherwise stated.
- The assessment predicts noise levels with equipment located at each Additional Stage 1 Works location to the nearest noise sensitive receiver to provide a worst-case assessment.

2.4.4 Assessment Results

2.4.4.1 Construction Noise

Table 3 to Table 5 presents the results for the construction noise assessment at surrounding receivers based on typical plant and equipment outlined in Section 2.4.1 operating within the boundary of the construction works site.

Additional Stage 1 Works - Location 1

Location and Construction Activity	Predicted equipment noise levels at surrounding community receivers, in $dBL_{Aeq,15min}$							
	Residential			Commercial	Agricultural	Passive Recreation Area	Educational	
							TAFE	KHS
	Catchment							
	A	B	C	A	B	A	B	A
	Noise Management Level, dB(A)							
	55[5]	57[7]		70	75	60	55	55
Tipper/Skip Truck	48	77	52	46	77	46	53	48
Asphalt Paver	45	74	49	43	74	43	50	45
Line Marking Truck	45	74	49	43	74	43	50	45
Concrete Mixer Trucks	46	75	50	44	75	44	51	46
Bobcat	47	76	51	45	76	45	52	47
Excavator (with Hammer)	56	85	60	54	85	54	61	56
Excavator / Backhoe / Front Loader	50	79	54	48	79	48	55	50
Compactor	47	76	51	45	76	45	52	47
Grader	44	73	48	42	73	42	49	44
Vibratory Roller	44	73	48	42	73	42	49	44
Concrete Vibrator	38	67	42	36	67	36	43	38

[5] Standard Recommended Hours

Location and Construction Activity	Predicted equipment noise levels at surrounding community receivers, in $dBL_{Aeq,15min}$							
	Residential			Commercial	Agricultural	Passive Recreation Area	Educational	
							TAFE	KHS
	Catchment							
	A	B	C	A	B	A	B	A
	Noise Management Level, dB(A)							
	55[5]	57[7]		70	75	60	55	55
Concrete Pump	47	**76**	51	45	**76**	45	52	47
Scarifier	47	**76**	51	45	**76**	46	52	47
Jackhammer	47	**76**	51	45	**76**	46	52	47
Road Saw	54	**83**	**58**	52	83	52	59	54

Table 3: Location 1 - Predicted equipment/plant noise levels at the nearest surrounding community receiver locations – Levels predicted to exceed the "Recommended Standard Hours"/ commercial, industrial, educational criteria are in **red**.

Additional Stage 1 Works - Location 2

Location and Construction Activity	Predicted equipment noise levels at surrounding community receivers, in $dBL_{Aeq,15min}$							
	Residential			Commercial	Agricultural	Passive Recreation Area	Educational	
							TAFE	KHS
	Catchment							
	A	B	C	A	B	A	B	A
	Noise Management Level, dB(A)							
	55[6]	57[7]		70	75	60	55	55
Tipper/Skip Truck	**71**	56	44	**77**	49	51	**61**	53
Asphalt Paver	**68**	53	41	**74**	46	48	**58**	50
Line Marking Truck	**68**	53	41	**74**	46	48	**58**	50
Concrete Mixer Trucks	**69**	54	42	**75**	47	49	**59**	51

[6] Standard Recommended Hours

Location and Construction Activity	Predicted equipment noise levels at surrounding community receivers, in $dBL_{Aeq,15min}$							
	Residential			Commercial	Agricultural	Passive Recreation Area	Educational	
							TAFE	KHS
	Catchment							
	A	B	C	A	B	A	B	A
	Noise Management Level, dB(A)							
	55[6]	57[7]		70	75	60	55	55
Bobcat	**70**	55	43	**76**	48	50	**60**	52
Excavator (with Hammer)	**79**	**64**	52	**85**	57	59	**69**	**61**
Excavator / Backhoe / Front Loader	**73**	**58**	46	**79**	51	53	**63**	54
Compactor	**70**	55	43	**76**	48	50	**60**	52
Grader	**67**	52	40	**73**	45	47	**57**	49
Vibratory Roller	**67**	52	40	**73**	45	47	**57**	49
Concrete Vibrator	**61**	46	34	67	39	41	**51**	43
Concrete Pump	**70**	55	43	**76**	48	50	**60**	52
Scarifier	**70**	55	43	**76**	48	50	**60**	52
Jackhammer	**70**	55	43	**76**	48	50	**60**	52
Road Saw	**77**	**62**	50	**83**	55	57	**67**	**59**

Table 4: Location 2 - Predicted equipment/plant noise levels at the nearest surrounding community receiver locations – Levels predicted to exceed the "Recommended Standard Hours"/ commercial, industrial, educational criteria are in **red**.

Location and Construction Activity	Predicted equipment noise levels at surrounding community receivers, in $dBL_{Aeq,15min}$							
	Residential			Commercial	Agricultural	Passive Recreation Area	Educational	
							TAFE	KHS
	Catchment							
	A	B	C	A	B	A	B	A
	Noise Management Level, dB(A)							
	55[7]	57[7]		70	75	60	55	55
Tipper/Skip Truck	44	52	83	44	51	43	48	44
Asphalt Paver	41	49	80	41	48	40	45	41
Line Marking Truck	41	49	80	41	48	40	45	41
Concrete Mixer Trucks	42	51	81	42	49	41	46	42
Bobcat	43	51	82	43	50	42	47	43
Excavator (with Hammer)	52	60	91	52	59	51	56	52
Excavator / Backhoe / Front Loader	46	54	85	46	53	45	50	46
Compactor	43	51	82	43	50	42	47	43
Grader	40	48	79	40	50	39	44	40
Vibratory Roller	40	48	79	40	50	39	44	40
Concrete Vibrator	34	42	73	34	41	33	38	34
Concrete Pump	43	51	82	43	50	42	47	43
Scarifier	43	51	82	43	50	42	49	43
Jackhammer	43	51	82	43	50	42	49	43
Road Saw	50	58	89	50	57	50	56	50

[7] Standard Recommended Hours

Table 5: Location 1 - Predicted equipment/plant noise levels at the nearest surrounding community receiver locations – Levels predicted to exceed the "Recommended Standard Hours"/ commercial, industrial, educational criteria are in **red**.

2.4.5 Summary of Noise Assessment Findings and Discussion of Noise Controls During Construction

Based on the results from the high-level assessment based on the indicative works, we make the following comments:

- Construction works noise impacts from each works location is as follows:
    - Location 1 will have the greatest impact on Residential receivers at Catchment B, exceeding Highly Affected Noise levels for most activities. The next most impacted receiver being nearby Agricultural land uses.
    - Location 2 will impact multiple receivers, exceeding the relevant noise management levels at residential receivers in Catchment A, the nearest commercial and TAFE.
    - The Tweed Coast Road, Cudgen Road Upgrade works have also been considered as information only, as they are similar works, however this it is noted that these works are not part of the Stage 1 wrksassessment and will be included in Stage 2. It will have the highest noise level impact at residential receivers in Catchment C due to the close proximity of works, exceeding the Highly Noise Affected levels for all activities.
    - Excavator works with hammering are predicted to have the highest noise impacts, affecting multiple receivers from all Additional Stage 1 Works locations.
- Mitigation measures to be considered and incorporated where reasonable and feasible would include:
    - Maintaining standard work hours
    - Limiting more intensive works, such as excavator hammering to the least sensitive times of the day (i.e. avoid early morning, early evening where practical).
    - Including Respite Periods where activities are found to exceed the 75 dB(A) Highly Affected Noise Level at receivers, such as 3 hours on 1 hour off.
    - Consideration of localised screening or barriers for high noise level / isolated works.
    - Apply best practice noise and vibration controls as per Section 7.5 to 7.8 of the SSD.
- For all other receivers, the noise generated from the construction works noise from individual equipment operating is below the Highly Noise Affected Levels and

generally able to meet the NMLs achieve the relevant criteria when further away from the perimeter boundary.

- The predictions above for noise levels above NMLs is not unusual given the plant and equipment that must be used, such as excavators and road saws plus the proximity of sensitive receivers.

It is important to recognise that the actual noise levels generated during the construction works are likely to vary considerably depending on many factors including:

- Number of items of plant and equipment operating simultaneously.
- Location of equipment on the site – relative to the noise-sensitive receivers.
- Natural shielding of noise provided by changing elevation along and around the site.
- Reflections provided by existing structures on and around the site.
- Meteorological conditions.

When construction works are likely to exceed stated criteria at nearest sensitive receivers, particularly when works occur in the areas closer to the nominated receiver, all feasible and reasonable noise control measures are to be considered.

If, during construction works, an item of equipment exceeds either the noise criteria at any location or the equipment noise level limits, the following noise control measures, together with construction best practices presented in Section 5.5 to 7.8 in the SSD[8] shall be considered to minimise the noise impacts on the neighbourhood:

- Schedule noisy activities to occur outside of the most sensitive times of the day for each nominated receiver.
- Consider implementing equipment-specific temporary screening for noisy equipment, or other noise control measures recommended in Appendix E of AS2436. This is most likely to apply to noisier items such as jackhammers.
- For large work areas, solid screening or hoarding as part of the worksite perimeters would be beneficial.
- Unnecessary idling of vehicles and equipment is to be avoided.
- Adopt quieter methodologies. For example, where possible, use concrete sawing and removal of sections as opposed to jackhammering.

[8] "Tweed Valley Hospital, Noise and Vibration Impact Assessment for State Significant Development (SSD) 20181017 SVM.0001.Rep

- Ensure that any miscellaneous equipment (extraction fans, hand tools, etc), not specifically identified in this assessment, incorporates silencing/shielding equipment as required to meet the noise criteria.

Implementation of all reasonable and feasible mitigation measures for all works will ensure that any adverse noise impacts to surrounding residential, commercial and recreational receivers are minimised when Noise Management Levels cannot be met due to safety or space constraints.

It is recommended that a comprehensive CNVMP is prepared further to this assessment. The engaged Contractor would be required to prepare a comprehensive CNVMP based on their proposed plant, equipment and construction methodology, prior to the commencement of any works.

2.5 Construction Vibration

When considering the vibration impact associated with construction works, the following is to be taken into account.

- The type of vibration generating equipment.
- Geotechnical characteristics of the site.
- The layout of the site, including the location of static sources of vibration.
- Techniques used in construction to minimise generated vibration levels.
- Hours of work with regard to the nature of operations in the affected buildings and the duration of the works.

2.5.1 Summary of Vibration Assessment and Discussion of Vibration Controls During Construction

A detailed vibration assessment has not been carried out at this stage, as actual vibration levels experienced will be dependent upon

- Site and strata characteristics.
- Specific construction equipment used.
- Vibration requirements of sensitive equipment.

Based on the scope of works and typical equipment required, some human perception vibration impacts may occur – particularly from the use of excavators with hammers and vibratory rollers at the nearest receivers to the works.

It is recommended that, prior to the commencement of the Additional Stage 1 Works, vibration surveys be carried out of each key vibration-generating-activity / equipment.

The Contractor shall carry out a vibration assessment at the commencement of operations for each vibration generating activity to determine whether the existence of significant vibration levels justifies a more detailed investigation.

If the assessment indicates that vibration levels might exceed the relevant criteria, then vibration mitigation measures will need to be put in place to ensure vibration impacts are minimised using all reasonable and feasible measures.

A more detailed investigation would involve methods of constraining activities that generate high vibration levels. A method of monitoring vibration levels must then be put in place. Additionally, vibration monitors must also be put in place to manage sensitive areas. Vibration mitigation measures and vibration criteria will then need to be reviewed.

All practical means are to be used to minimise impacts on the affected buildings and occupants from activities generating significant levels of vibration on site.

The following considerations shall be taken into account:

- Modifications to construction equipment used.
- Modifications to methods of construction.
- Rescheduling of activities to less sensitive times.

If the measures given above cannot be implemented or have no effect on vibration levels or impact generated, a review of the vibration criteria is to be undertaken and the vibration management strategy amended.

Catchment A and B residences present the most stringent vibration criteria, particularly given their proximity to the Project site. Controlling vibration at these receivers will also ensure that vibration criteria at all other receivers will also be satisfied.

It is recommended that a CNVMP is prepared further to this assessment at the detailed design stage when a Contractor is engaged. The Contractor would be required to prepare a final CNVMP based on their proposed plant, equipment and construction methodology.