The Picton Sewerage Scheme Boundary Modifications - Noise and Vibration Assessment

20 April 2011

Sydney Water

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19 April 2011

Cathy O'Rouke
Environmental Planning and Management
Sydney Water Corporation
1 Smith Street
Parramatta NSW 2150

Dear Cathy

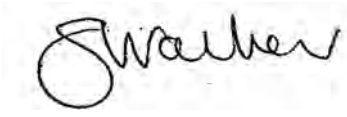
Picton Sewerage Scheme Boundary Modifications - Noise and Vibration Assessment

This Noise and Vibration Impact Assessment has been prepared by Parsons Brinckerhoff Australia Pty Ltd (PB) on behalf of Sydney Water, for the assessment of potential impacts from the proposed construction and operation of the Picton Sewerage Scheme Boundary Modifications.

The assessment has been undertaken in accordance with the agreed scope of works, 201026191 LT_3386/KM/ac, 2 December 2010, as part of PB-MWH (Joint Venture) project number 24203-132.

Please contact Steven Walker (email: swalker@pb.com.au, Tel: (02) 9272 5233) to discuss this report and its findings as necessary,

Yours sincerely



Steven Walker
Senior Environmental Scientist
Parsons Brinckerhoff Australia Pty Limited

Contents

List of tables

List of figures

Appendices

Glossary

A-weighted sound pressure

The human ear is not equally sensitive to sound at different frequencies. People are more sensitive to sound in the range of 1 to 4 kHz (1000 – 4000 vibrations per second) and less sensitive to lower and higher frequency sound. During noise measurement an electronic '*A-weighting*' frequency filter is applied to the measured sound level *dB(A)* to account for these sensitivities. Other frequency weightings (B, C and D) are less commonly used. Sound measured without a filter is denoted as linear weighted dB(linear).

Ambient noise

The total noise in a given situation, inclusive of all noise source contributions in the near and far field.

Community annoyance

Includes noise annoyance due to:

- character of the noise (e.g. sound pressure level, tonality, impulsiveness, low-frequency content)
- character of the environment (e.g. very quiet suburban, suburban, urban, near industry)
- miscellaneous circumstances (e.g. noise avoidance possibilities, cognitive noise, unpleasant associations)
- human activity being interrupted (e.g. sleep, communicating, reading, working, listening to radio/TV, recreation).

Compliance

The process of checking that source noise levels meet with the noise limits in a statutory context.

Cumulative noise level

The total level of noise from all sources.

EPA Licence

Environment Protection Authority Licence.

Extraneous noise

Noise resulting from activities that are not typical to the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.

Feasible and reasonable measures

Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors:

- noise mitigation benefits (amount of noise reduction provided, number of people protected)
- cost of mitigation (cost of mitigation versus benefit provided)
- community views (aesthetic impacts and community wishes)
- noise levels for affected land uses (existing and future levels, and changes in noise levels).

Impulsiveness

Impulsive noise is noise with a high peak of short duration or a sequence of these peaks. Impulsive noise is also considered annoying.

Low frequency

Noise containing major components in the low-frequency range (20 to 250 Hz) of the frequency spectrum.

Noise criteria

The general set of non-mandatory noise levels for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (e.g. noise levels for various land use).

Noise Level (goal)

A noise level that should be adopted for planning purposes as the highest acceptable noise level for the specific area, land use and time of day.

Noise Limits

Enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.

Non-compliance

A development is deemed to be in non-compliance with its noise consent / licence conditions if the monitored noise levels exceed its statutory noise limit by more than 2 dB.

NSW DECCW

New South Wales Department of Environment, Climate Change and Water.

Performance-based goals

Goals specified in terms of the outcomes/ performance to be achieved, but not in terms of the means of achieving them.

Rating background level

The rating background level is the overall single figure background level representing each day, evening and night time period. The rating background level is the median L_{A90} noise level measured over all day, evening and night time monitoring periods.

Receiver

The noise-sensitive land use at which noise from a development can be heard.

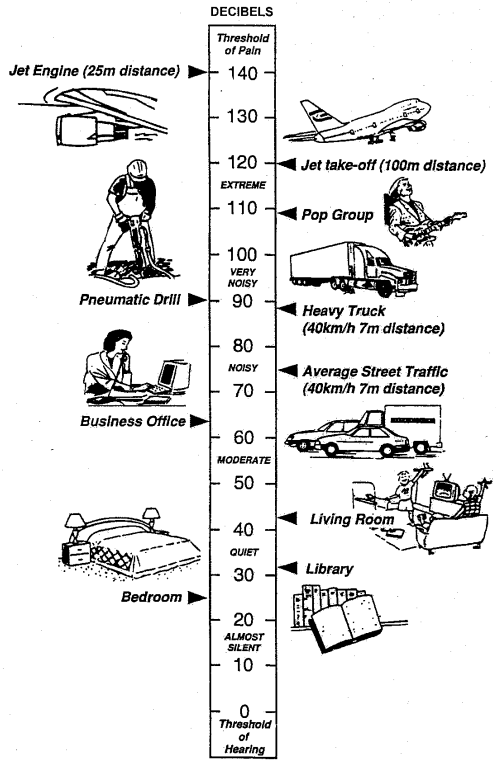
Sleep disturbance

Awakenings and disturbance of sleep stages.

Sound & decibels (dB)

Sound (or noise) is caused by minute changes in atmospheric pressure that are detected by the human ear. The ratio between the quietest noise audible and that which would cause permanent hearing damage is a million times the change in sound pressure. To simplify this range the sound pressures are logarithmically converted to decibels from a reference level of 2×10^{-5} Pa.

The picture below indicates typical noise levels from common noise sources



dB is the abbreviation for decibel — a unit of sound measurement. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

Sound power level (SWL)

The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in *dB(A)*.

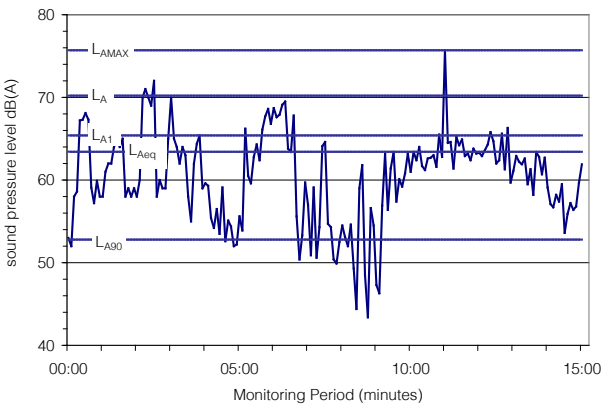
Sound pressure level (SPL)

The level of noise, usually expressed as SPL in *dB(A)*, as measured by a standard sound level meter with a pressure microphone. The sound pressure level in *dB(A)* gives a close indication of the subjective loudness of the noise.

Statistical noise levels

Noise levels varying over time (e.g. community noise, traffic noise, construction noise) are described in terms of the statistical exceedance level.

A hypothetical example of A weighted noise levels over a 15 minute measurement period is indicated in the following figure:



Key descriptors:

L_{AMax} Maximum recorded noise level.

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} Noise level present for 10% of the 15 minute interval. Commonly referred to the average maximum noise level.

L_{Aeq} Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.

L_{A90} Noise level present for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).

Steady state noise level

The steady state noise level is the operator observed baseline noise level where sources influencing the statistical results are determined.

Threshold

The lowest sound pressure level that produces a detectable response (in an instrument/person).

Tonality

Tonal noise contains one or more prominent tones (and characterised by a distinct frequency components) and is considered more annoying. A 5 dB(A) penalty is typically applied to noise sources with tonal characteristics.

Executive summary

Parsons Brinckerhoff Australia Pty Ltd (PB) was commissioned by Sydney Water to undertake an assessment of potential noise and vibration impacts from the proposed Picton Sewerage Scheme Boundary Modification. The Project involves the upgrade of existing and installation of new sewage pumping stations and associated rising mains and wastewater pipeline in the rural residential communities of Picton, Tahmoor and Thirlmere.

The assessment has been prepared in accordance with the NSW Department of Environment, Climate Change and Water *Interim Construction Noise Guideline* (ICNG, 2009) and the Environmental Protection Agency NSW *Industrial Noise Policy* (NSW INP, 2000).

PB carried out attended and unattended background noise surveys at adjacent residential communities in January 2011, to characterise the existing noise environment and determine the baseline noise levels.

All construction work is to be undertaken during standard construction hours of Monday to Friday 7 am to 6 pm and Saturday 8 am to 1 pm only. To assess potential construction noise impacts, measured background noise levels and ICNG guidance were adopted to establish receiver specific construction noise management levels.

Predictive assessment of potential construction noise impacts determined the adopted noise management levels would generally be exceeded at residential receivers within 300 to 400 metres of construction works during worse case noise generating activities such as rock breaking, saw cutting, concreting and excavation works.

A low probability of human disturbance from ground vibration during construction works is expected based on typical ground vibration levels. Worse case vibration levels may be perceptible at nearest residences to the wastewater pipeline exit site. Structural damage to off-site property and buildings is not expected.

Construction road traffic noise impacts would be compliant with an adopted 55 dB(A) $L_{Aeq,1hr}$ road traffic noise management level.

Recommendations have been provided for the investigation and design of noise and vibration management and mitigation measures to reduce and control noise impacts. Measures include a construction noise and vibration management plan, application of on-site noise screens, maximising separation distance between plant and receivers, scheduling rock breaking and saw cutting works to less sensitive day time periods (post 9 am) and community consultation prior to construction.

The measured background noise levels were used to establish a conservative NSW INP noise design objective of 35 dB(A) $L_{Aeq,15min}$ at the nearest residences for assessing potential operational noise impacts.

Site specific noise assessment models were prepared utilising the SoundPLAN noise propagation software and measured 1/3 octave band source noise levels to assess the dominant noise generating pumping operations at each pumping station location.

The proposed new and upgraded SPS sites and sewage pump operations are expected to achieve NSW INP compliance and maintain acoustic amenity at all future receivers developed within the identified Future Growth Areas.

It is recommended the Sydney Water confirm the predicted noise impacts during the detailed design phase by verifying the sewage pump source noise level of 56 dB(A) L_{Aeq} at 1 metre, free of annoying characteristics, adopted in this assessment.

1. Introduction

Parsons Brinckerhoff Australia Pty Ltd (PB) has been engaged by Sydney Water to assess potential airborne noise and ground vibration impacts from the proposed construction and operation of the Picton Sewerage Modification Scheme (hereafter referred as the Project).

The assessment has been undertaken in accordance with the Department of Environment, Climate Change and Water (DECCW) *Interim Construction Noise Guideline* (ICNG, 2009), Environmental Protection Authority (EPA) NSW *Industrial Noise Policy* (NSW INP, 2000) and the EPA *Environmental Criteria for Road Traffic Noise* (ECRTN, 1999).

1.1 Objectives

The objectives of this noise and vibration assessment were to:

- Establish criteria for the assessment and management of potential impacts to minimise potential disturbance at nearest receivers.
- Provide a detailed assessment of potential airborne noise and ground vibration impacts from the construction and operational stages of the Project.
- Develop noise and vibration management and mitigation measures to, where feasible and reasonable, achieve compliance with established criteria.

1.2 Scope of works

The scope of works included tasks to characterise the noise environment of the study area and predict potential noise and vibration levels at nearest receivers and communities:

- Identification of existing and potential future residential and sensitive receivers to the proposed SPS and work locations.
- A baseline noise study incorporating attended and unattended noise monitoring within the study area to characterise the existing noise environments.
- Establishing project specific noise design goals in accordance with relevant statutory and regulatory guidelines for construction and operational phases of the project.
- Prediction of construction and operational noise levels at nearest potentially affected receivers and the assessment noise levels to Project specific noise goals to determine potential impacts.
- Recommendation of noise mitigation measures and/or noise abatement strategies where adopted noise design objectives are likely to be exceeded.

This study is subject to the limitations provided in Section 10.

2. Project description and study area

2.1 Picton Sewerage Scheme Modifications

The existing Ministerial Approval for Stage 1 of the Picton Sewerage Scheme restricts Sydney Water's service area to the villages of Picton, Tahmoor and Thirlmere. Any properties outside this boundary cannot legally be serviced by the Picton Sewerage Scheme.

The Department of Planning's 2007-08 Metropolitan Development Plan forecasts that 1,100 residential lots located in six precincts on the outskirts of Picton, Tahmoor and Thirlmere will be developed by 2017.

To service the precinct development the Picton Sewerage Scheme boundary needs to be extended including the provision of new and upgraded infrastructure to the sewerage network.

Sydney Water propose to construct and operate three new sewage pumping stations (SPS) and three associated rising mains and a new wastewater pipeline at West Picton. The expanded scheme will also require upgrades to two existing SPSs at Tahmoor. The proposed works are summarised in Table 2-1.

Table 2-1 Proposed Picton Sewerage Scheme Modification

Infrastructure	Proposed works	Location
SPS 920 Upgrade	Increase SPS capacity from 134 litres/ second to 200 L/sec	River Road, Tahmoor
SPS 1045 Upgrade	Increase SPS 20 L/sec to 35 L/sec	Castlereagh Street, Tahmoor
SPS A1 and A2	A new SPS with 24 L/sec capacity will be installed either at A1 or A2	Cross Street, Tahmoor
SPS B	A new SPS with 60 L/sec capacity will be installed	Progress Street, Tahmoor
SPS C	A new SPS with 25 L/sec capacity will be installed	Marion Street, Thirlmere
Rising Main A	150 mm diameter pipeline, 590 metres in length	Cross Street & Myrtle Creek Avenue, Tahmoor
Rising Main B	225 mm diameter pipeline, 440 metres in length	Progress Street, Tahmoor
Rising Main C	150 mm diameter pipeline, 260 metres in length	Marion Street and Rita Street, Thirlmere
West Picton wastewater pipeline	150 mm diameter, 210 metres in length. Constructed by horizontal directional drilling or similar	Between Connellan Crescent and Remembrance Driveway, Picton

Note: Referenced from Sydney Water Consultancy brief – Noise and Vibration Assessment, November 2010

2.2 Surrounding environment to the Project sites

The Project sites are located in rural suburban communities surrounded by dense bushland. The nearest residential and noise sensitive properties are located at 10 to 400 metres away from the SPS sites and 30 metres away from the rising main and wastewater pipeline corridors.

Proposed development sites for new residential communities in Thirlmere, Tahmoor and West Picton are to be located within 20 metres of the proposed SPS sites and rising main and wastewater pipeline corridors.

The local noise environments are influenced by road traffic on residential and local roads and local fauna. No industrial operations are located within the Project study areas and the day time, evening and night time noise environments are considered sensitive due to low background noise levels. A baseline noise survey has been undertaken and is detailed in Section 3.

Figure 2-1, Figure 2-2 and Figure 2-3 detail the location of proposed project works, nearest communities and the Future Growth Areas.

Figure 2-1 Picton Sewerage Boundary Modification project sites SPS 920 and SPS 1045

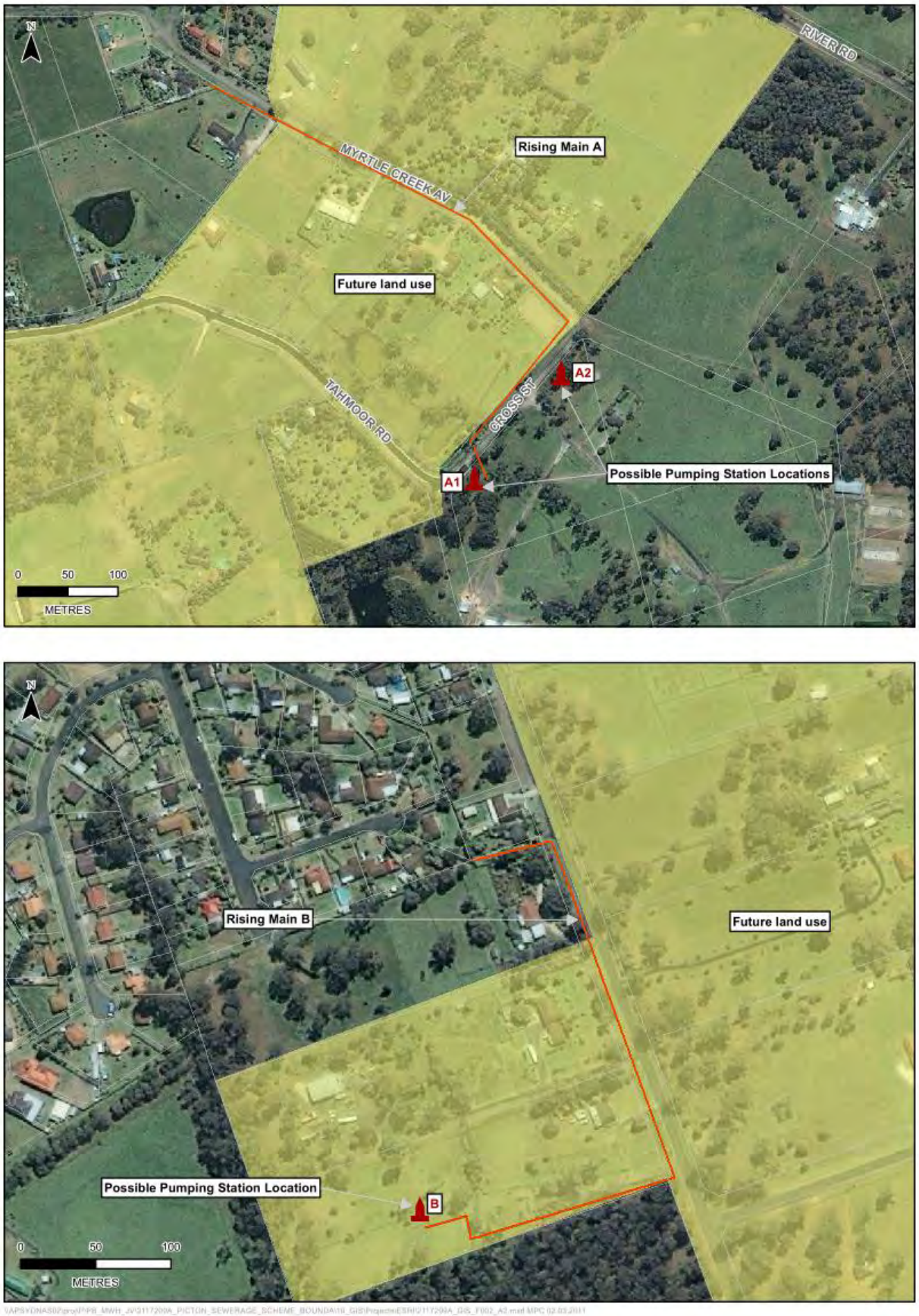


Figure 2-2 Picton Sewerage Boundary Modification project sites SPS A and SPS B

Figure 2-3 Picton Sewerage Boundary Modification project sites SPS C and Wastewater pipeline

2.2.1 Construction phase

The construction phase will require works at fixed and mobile locations during the day time period, Monday to Friday 7 am to 6 pm and Saturdays 8 am to 1 pm. No works are to be scheduled for Sundays, Public Holidays or outside the day time hours unless otherwise approved.

An overview of key works for the construction of the new infrastructure and SPS upgrades was supplied by Sydney Water. Construction road trucks and light vehicles will be required intermittently throughout all daily construction works.

New sewage pumping stations

Construction of the new SPSs will involve site establishment works for levelling the site, excavation of the SPS wet well and disposal of the excess spoil. Construction works will be undertaken above and below ground level for the installation of the SPS wet well, emergency storage well and control and chemical dosing buildings. If required chemical dosing equipment and a vent shaft will be installed.

Once construction and installation works are completed the SPSs will be connected to the network and landscaping and restoration of the site undertaken.

Construction of the new SPSs would be undertaken over a period of at least six months.

Upgrades to existing sewage pumping stations

The existing pumps will be removed and new pumps installed at SPS 920 and SPS 1045. Modification of the existing wet wells may be required. Once works are completed the site shall be restored and landscaped.

The upgrade of the existing SPSs would take approximately three to six months to complete.

Construction of rising mains

The rising mains will be constructed by open trenching with excavators and short term cutting works and removal of pavement at local roads may be required to prepare for the excavation phase.

The rising main pipeline will be installed in sections, maintenance holes constructed and the trench backfilled and compacted with the excavated spoil. Restoration works will reinstate the road surfaces and excavated soft ground.

Construction of the rising mains and SPSs would take approximately six to twelve months to complete with works progressing along the rising main route. Construction works are expected to be required adjacent to receivers for a typical duration of 1week.

Construction of wastewater pipeline

The wastewater pipeline at West Picton will be constructed from Connellan Crescent to Remembrance Driveway under the existing railway line. Construction of the pipeline will be carried out using either mirco-tunnelling or Horizontal Directional Drilling (HDD) boring techniques.

For micro-tunnelling, a launch shaft would be excavated at Connellan Crescent, and drilling undertaken to a receiving shaft excavated at Remembrance Driveway. Drilling requires the use of a Bentonite drilling medium, construction of sediment and erosion control and the management of wastewater at the launch shaft.

Extracted slurry and cuttings would be treated at the surface of the launch shaft, typically in a settlement pond or tank. The wastewater pipeline would be installed in section within the drilled void.

HDD does not require a launch shaft, the HDD rig would be operated from the surface at Connellan Crescent and the drill head directed to the receiver site at Remembrance Driveway. The drill would be extracted to the launch surface with no receiver shaft required. No drilling medium or erosion and sediment management is required.

All work sites will be restored to their original condition at the completion of works. Construction of the wastewater pipeline would take up to 4 weeks to complete.

2.2.2 Operational phase

Noise emissions associated with SPS operations are the sewage pumps located approximately 10 metres below ground level within the concrete shaft. The pumps are continuously operational for approximately 2 – 5 minute periods at a frequency of one operational event every 15 minutes during the 24 hour period. A total of two pumps in series are to be installed at each upgrade SPS and new SPS site.

The shafts are sealed with steel plates which reduce potential operational noise breakout during sewage pump operation.

No operational noise events are expected within the rising mains and wastewater pipeline, no assessment of operational noise and ground vibration has been considered necessary for the rising mains A, B and C and the West Picton wastewater pipeline.

The only road traffic requirement during the operation of the SPS sites would be occasional light vehicles for staff arrival on site for any maintenance or inspection works. No road traffic noise impacts are expected from the operation of the new and upgraded SPS sites.

3. Existing noise environment

A baseline noise survey was undertaken to develop existing background noise profiles and establish project-specific noise design objectives for residential and noise sensitive receivers.

3.1 Noise monitoring locations

Long term (unattended) and short term (operator attended) monitoring of ambient noise levels was carried out at existing accessible residential receivers adjacent to the Project sites.

Long term noise monitoring locations were selected for the determination of conservative (low) background noise levels representative of all nearest residential and noise sensitive receivers to the proposed construction work locations and infrastructure and SPS sites.

Noise monitoring Location A at Suffolk Place was established at the boundary of SPS 920 to to characterise existing SPS operations.

Location B Rita Street was selected to be representative of residential noise environments adjacent to Project sites where there is currently no existing Sydney Water infrastructure and minimal influence to ambient noise levels.

Location C Castlereagh Street was chosen to characterise the noise environment at existing residences adjacent to SPS infrastructure.

Table 3-1 details the noise monitoring locations and the nearest infrastructure locations. The noise monitoring locations are presented in Figure 3-1 and Figure 3-2.

Table 3-1 Noise monitoring locations

Monitoring location	Measurement undertaken	Nearest infrastructure and land use
Location A Suffolk Place Tahmoor	Unattended noise monitoring with noise logger (serial number 16-306-008) Attended day time noise monitoring	Existing residential receivers to SPS 920 Proposed East Tahmoor development Lots
Location B Rita Street Thirlmere	Unattended noise monitoring with noise logger (serial number 878031) Attended day time noise monitoring	Existing receivers to proposed rising main and new SPS C Proposed East Thirlmere development Lots
Location C Castlereagh Street Tahmoor	Unattended noise monitoring with noise logger (serial number 878043) Attended day time noise monitoring	Residential receivers adjacent to existing SPS 1045

Figure 3-1 Baseline noise monitoring locations

Figure 3-2 Baseline noise monitoring locations

3.2 Instrumentation

Operator attended noise measurements were carried out using a RION NA27 Precision Sound Level Meter (serial number 10552408) and long-term unattended noise monitoring carried out using Acoustic Research Laboratories statistical environmental noise loggers type EL-316 (serial numbers 16-306-008, 878031).

Instrument sets were calibrated by a NATA accredited laboratory within two years of the measurement period and comply with Australian Standard AS-1259: Sound Level Meters. Copies of the instrument set calibration certificates have been included in Appendix E.

Microphones were positioned 1.2 m above ground level and were fitted with windsocks. Each instrument was calibrated before and after the measurement period to ensure the reliability and accuracy of results. No significant variances were observed.

3.3 Noise monitoring methodology

The instrumentation was set on A-weighted, fast response with statistical noise levels, logged over 15 minute intervals. Observations of ambient noise influences were recorded during the measurement interval.

Unattended noise loggers were established at Location A Suffolk Place, Tahmoor and Location B Rita Street, Thirlmere and Location C Castlereagh Street, Tahmoor. Continuous 15 minute statistical measurements at all locations were obtained for the period Wednesday 2 February to 10 February 2011.

Attended monitoring was undertaken during the day time period on 2 February and 10 February 2011 at the noise logger locations to assist in the determination of existing ambient noise influences.

3.4 Analysis of meteorological data

Hourly meteorological data was obtained from the nearest Bureau of Meteorology operated all-weather station to the study area, Camden Airport, station number 68192.

A review of the meteorological data indicated that unsatisfactory conditions were present for less than 11% of the monitoring period as a result of precipitation and wind speeds in excess of 5 m/s. Baseline noise levels were not adversely influenced by meteorological conditions and are considered representative of the existing noise environment.

Periods of inclement meteorological conditions have been shown as shaded on the compiled daily noise logger graphs (Appendix A).

3.5 Baseline noise survey

3.5.1 Attended day time noise survey

The results of the short term attended baseline noise survey are detailed in Table 3-1 and include observed influences to the measured noise levels from all events including operational noise from SPS 920 and SPS 1045.

Table 3-2 Attended measured residential noise levels

Location	Time & Date	$L_{Aeq,15min}$	$L_{A90, 15min}$	Observed noise influence
Location A Suffolk Place	10:45 2/2/2011	56.5	46.5	Local fauna 48-61 Residential activity 59-60 Aircraft pass over 45-53 SPS 920 49-51, peak 59 S.S. 43-44
Location B Rita Street	13:25 2/2/2011	50	37	Rita Street road traffic, 65-70 Local fauna 40-41 Residential activity 44-45 S.S. 38-39
Location C Castlereagh Street	12:30 10/2/2011	51	41	Local fauna 40-44 Aircraft pass over 43-46 SPS 1045 operation 39-40 S.S. 39-40 SPS 1045 influenced

Notes: Values expressed as A-weighted dB and rounded to nearest 0.5 dB(A)
L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level
L_{A90} = A-weighted sound pressure level exceeded for 90% of the time (background)
S.S. Steady state measurement made in the presence of minimal influences to noise levels

Existing daytime noise levels of 50 – 56.5 dB(A) $L_{Aeq,15min}$ within the study area are influenced by local road traffic, local fauna (birds), residential activity such as gardening and aircraft passing over.

At Location A Suffolk Place existing SPS 920 operations were audible at 49 – 51 dB(A) L_{Aeq} when measured approximately 10 metres from the sewage pumps. SPS 1045 operations were audible at 39-40 dB(A) L_{Aeq} when measured at the site boundary, approximately 15 metres from the sewage pumps

3.5.2 Long term unattended noise survey

Unattended ambient noise monitoring at Location A Suffolk Place, Location B Rita Street and Location C Castlereagh Street was undertaken during the period of 2 February to 10 February 2011. Measured noise levels are detailed in Table 3-3.

The Rating Background Level (RBL) is the median L_{A90} noise level and has been adopted to establish representative construction noise objectives for nearest residential and noise sensitive receivers.

The measured noise environs followed typical diurnal trends where the background noise level was reduced during the night-time period. Informed by observation during the attended noise survey, ambient noise levels are primarily influenced by local road traffic and fauna.

Peak noise levels measured at Location B Rita Street on 7 February 2011 between 9.45 am to 10 am, 10.30 am to 11 am and at 12.00 am exceeded 90 dB(A) L_{Amax} and are considered erroneous for the ambient noise environment. It is likely noise levels were influenced by interference with the monitoring equipment, the noise levels have been filtered from the noise levels in Table 3-3.

The day time RBL noise levels of 31 – 38.5 dB(A) L_{A90} measured in the rural residential environments are low and typical of the sensitive noise environments adjacent to proposed construction work location and the future infrastructure.

Table 3-3 Unattended noise monitoring results (median period noise levels)

Date	Day (7 am-6 pm)		Evening (6 pm-10 pm)		Night (10 pm-7 am)	
	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}
Location A Suffolk Place, Tahmoor						
Noise range	55.5 – 58	37 – 42	50 – 54.5	35 – 40	44 – 49.5	30.5 – 39
RBL (L_{A90})	38.5		37.5		32	
Location B Rita Street, Thirlmere						
Noise range	50.5 – 58	31.5 – 37.5	49.5 – 53.5	32.5 – 38.5	42 – 47.5	24.5 – 30.5
RBL (L_{A90})	35.5		35.5		29	
Location C Castlereagh Street, Tahmoor						
Noise range	45 – 51.5	29.5 – 33	42 – 57	28 – 33	34.5 – 59	24 – 28
RBL (L_{A90})	31		31		27	

Notes: Values expressed as A-weighted dB and rounded to nearest 0.5 dB(A);
L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level
L_{A90} = A-weighted sound pressure level exceeded for 90% of the time (background)

4. Adopted noise and vibration criteria

4.1 Overview

The *Protection of the Environment Operations Act 1997* (POEO Act) regulates noise generation and prohibits the generation of 'offensive noise' as defined under the POEO Act. In addition to the POEO Act, the NSW EPA and DECCW provide guidelines regarding acoustic goals and noise controls.

4.2 Construction noise management levels

Noise criteria for construction works are established in accordance the NSW *Interim Construction Noise Guideline* (ICNG, 2009) which provides guidance for the assessment and management of construction (airborne) noise.

Noise management levels for standard day time construction period and out of standard hours working are detailed in Table 4-1 and have been established adopting the most conservative (lowest) measured background noise levels (L_{A90}) from Location C Castlereagh Street, Tahmoor.

Table 4-1 Recommended residential construction noise criteria

Construction period	RBL L_{A90} dB(A)	Management level $L_{Aeq, 15min}$	Application
Standard day time construction hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	31	**41**	Where measured or predicted noise level > management level: ▪ Proponent is to apply all feasible and reasonable work practises to meet the management level. ▪ Potentially affected residents are to be informed of the works and expected noise levels duration.
Outside of standard day time construction hours	31 evening 30 night time	**36** **evening** **35** **night time**	▪ Strong justification for works is required. ▪ Proponent to apply all feasible and reasonable work practices to meet the management level. ▪ Where all feasible and reasonable practices have been applied and noise is >5 dB(A) the management level the Proponent is to negotiate with the community.
Highly noise affected	-	**75**	Where noise is above this level respite periods for dominant noise generating activity may be required, the Proponent is to consider: ▪ Times identified by the community where they are less sensitive. ▪ If the community is prepared to accept a longer period of construction exchange for restrictions on construction hours.

Note: RBL rating background level, the measured L_{A90} noise level
Adopted noise goal = RBL + 10 dB(A)

4.2.1 Standard day time construction hours

Construction works are proposed to be undertaken during the standard day time construction hours of Monday to Friday 7 am to 6 pm and 8 am to 1 pm Saturdays.

A noise management level for standard day time construction hours of **41 dB(A) $L_{Aeq,15min}$** has been adopted for the assessment and management of potential construction noise impacts at residential receivers.

A **75 dB(A) $L_{Aeq,15min}$** highly noise affected construction noise management level at residential receivers will be applied as a trigger for the application of additional construction noise controls such as respite periods or restriction of construction hours.

In accordance with the ICNG a noise management level of **45 dB(A) $L_{Aeq,15min}$** has been adopted for the child centre and church receivers on Progress Street within 500 metres of SPS B. The noise management level is an internal noise level trigger to preserve acoustic amenity within occupied rooms.

The Wollondilly Abattoir (south-east SPS 920) and a commercial area at Remembrance Driveway (Wastewater pipeline) are located 200 metres from the proposed construction works. The ICNG recommends a construction noise management level of **70 dB(A) $L_{Aeq,15min}$** is adopted to preserve acoustic amenity and minimise disturbance to commercial activity.

The recommended noise management levels are planning goals only. Factors such as the social benefits of the activity, economic constraints, and the nature and duration of the proposed construction program need to be considered when assessing potential noise impacts from construction works.

Where predicted or measured airborne noise levels at the receivers are determined to exceed the noise management levels Sydney Water would investigate feasible and reasonable management and mitigation measures to control and, as required reduce, noise impacts at nearest noise affected receivers.

4.2.2 Out of standard day time construction hours

Where construction works are required out of standard day time construction hours the measured evening (6 pm – 10 pm) and night time (10 pm – 7 am) RBL's have been adopted to establish residential noise management levels.

The ICNG recommends a minimum RBL of 30 dB(A) L_{A90} is adopted when establishing noise management levels where the RBLs is measured below 30 dB(A) L_{A90}. A night time RBL of 30 dB(A) L_{A90} at Location C Castlereagh Street has been adopted for a measured RBL of 27 dB(A) L_{A90}.

Residential noise management levels of **36 dB(A) $L_{Aeq,15min}$** evening and **35 dB(A) $L_{Aeq,15min}$** night time have been adopted for the assessment and management of potential noise impacts.

It has been assessed that the nearest noise sensitive (child care and church) and commercial receivers will not be occupied out of standard construction hours.

4.3 Construction ground vibration management levels

Vibration during construction works is considered an intermittent source associated with two main types of impact; disturbance at receivers and potential architectural/structural damage to buildings. Generally, if disturbance issues are controlled, there is limited potential for structural damage to buildings.

4.3.1 Human exposure to ground vibration

The DECCW's *Assessing Vibration: A Technical Guideline* (2006) provides guidance for assessing human exposure to ground vibration. In consideration to British Standard BS6472:1992, the DECCW guideline recommends Vibration Dose Value (VDV) levels, to achieve a low probability of annoyance or disturbance at affected residential and sensitive land use during construction.

Table 4-2 details adopted VDV vibration goals for residential and sensitive receivers adjacent to proposed construction work locations.

Table 4-2 Adopted construction ground vibration goals

Location	Vibration Dose Value goals, $m/s^{-1.75}$			
	Day time		Night time	
	Preferred	Maximum	Preferred	Maximum
Residences and child care centres	0.20	0.40	0.13	0.26
Offices, schools, places of worship	0.40	0.80	0.40	0.80
Commercial premises	0.80	1.60	0.80	1.60

Note: Day time 7 am – 10 pm, Night time 10 pm – 7 am

4.3.2 Structural ground vibration

To evaluate the effects of vibration on structures and buildings, the DECCW guidance references German Standard DIN 4150: Part 3-1999. Dependent upon the dominant frequency of vibration, assessed in Hertz (Hz), structural vibration limits are established at the foundation of nearest buildings.

Adopted DIN 4150 structural Peak Particle Velocity (PPV) vibration goals in Table 4-3 are considered conservative for all construction events. Dominant frequency of vibration for construction is typically < 100 Hz.

Table 4-3 Adopted structural ground vibration goals

Structure	Structural vibration goal, PPV mm/s		
	1 – 10 Hz	10 – 50 Hz	50 Hz – 100 Hz
Dwellings and residences or similar occupancy	5	5 to 15	15 to 20
Commercial and industrial premises and buildings of similar design	20	20 to 40	40 to 50
Sensitive structures not classified by either definition above and of great intrinsic value	3	3 to 8	8 to 10

Note Referenced from German Standard DIN 4150

In consultation with the consultant engaged by Sydney Water for the Aboriginal Heritage Assessment, (*Archaeological Heritage Management Solutions*) no vibration sensitive heritage sites have been identified in the study area.

4.4 Construction road traffic noise objectives

The proposed construction phase would require vehicle movements on the local collector roads to facilitate the removal of cleared material and the delivery of pumping station and pipeline components, construction equipment and staffthroughout the construction programme.

A 55 dB(A) $L_{Aeq, 1hr}$ day time road traffic construction noise goal, consistent with the *Environmental Criteria for Road Traffic Noise* (NSW EPA, ECTRN, 1999), has been adopted as a guide to minimise potential noise impacts at nearest residential receivers on local residential roads.

The ECRTN recommends that where existing road traffic noise is above the adopted road traffic noise goal, road traffic noise should be managed to limit any increase in existing noise levels by not greater than 2 dB(A).

Referencing the measured existing day time noise levels of between 50 dB(A) L_{Aeq} and 56 dB(A) L_{Aeq} the ECRTN noise goal is considered appropriate to minimise the potential increase to ambient noise levels from intermittent construction traffic.

4.5 Operational noise objectives

Noise emissions from the operation of the upgraded and new SPS infrastructure would require adherence to the NSW *Industrial Noise Policy* (EPA NSW INP, 2000).

The policy sets out two goals that are used to assess potential off-site noise impacts. The first criterion aims at controlling intrusive short-term noise impacts for residences (intrusive criterion). The second criterion aims at maintaining the long-term amenity of particular land uses (amenity criterion).

The more conservative of the two limits are established as project-specific operational noise goals for the assessment of potential noise impacts.

The intrusive goal can be summarised as L_{Aeq} (15 min) ≤ rating background level plus 5 dB(A).

The amenity goal is determined based on guidelines presented in the NSW INP for a rural area as detailed in Table 4-4.

Table 4-4 NSW INP amenity goals – rural environment

Type of receiver	Period of day/day of week	Acceptable noise level (L_{Aeq})
Residential - daytime	7 am – 6 pm, Monday to Saturday 8 am – 6 pm, Sundays and Public Holidays	50 dB(A)
Residential - evening	6 pm – 10 pm	45 dB(A)
Residential - night time	Remaining periods	40 dB(A)

Note Source: Table 2.1 NSW INP (EPA 2000)
L_{Aeq} = Equivalent noise level (average)

4.5.1 Adopted operational noise objectives

Table 4-5 presents the adopted noise design goals established for the project referencing the relevant amenity and intrusive goals, and are designed to minimise the potential degradation of the local ambient noise environment.

The adopted operational noise goals have been established from the conservative (lowest) baseline noise levels measured at Location C Castlereagh Street. No existing industrial noise was audible in the study areas; in accordance with the NSW INP no correction factors for existing industrial noise are required in establishing noise goals.

The NSW INP recommends a minimum RBL of 30 dB(A) L_{A90} is adopted when establishing noise criteria where the RBLs is measured below 30 dB(A) L_{A90}. A night time RBL of 30 dB(A) L_{A90} has been adopted for a measured night time period RBL of 27 dB(A) L_{A90} at Location C Castlereagh Street.

Table 4-5 Adopted residential operational noise criteria

Period	Measured L_{A90}	Noise design goal $L_{Aeq, 15min}$		
		Intrusive limit	Amenity limit	Adopted criteria
Measured RBLs from Location C Castlereagh Street				
Day time (7 am – 6 pm)	31	36	50	**36**
Evening (6 pm – 10 pm)	31	36	45	**36**
Night (10 pm – 7 am)	30	35	40	**35**

Note: Values expressed as dB(A)
L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level
L_{A90} = A-weighted sound pressure level exceeded for 90 percent of the time (background)

The SPS are expected to operate on a 24 hour per day schedule, as such the night time period (10 pm – 7 am), when background noise levels are low, presents the worst case assessment period.

An operational noise goal of **35 dB(A) $L_{Aeq,15min}$** has been adopted at all residential receivers. Where operational compliance is achieved with the night time noise goal, day time and evening operational noise impacts would also achieve noise goal compliance.

The NSW INP recommends a **40 dB(A) $L_{Aeq,15min}$** internal noise goal for nearest noise sensitive child care and church receivers.

In accordance with the NSW INP a **65 dB(A) $L_{Aeq,15min}$** noise goal has been adopted for the assessment of day time noise impacts at the Wollondilly Abattoir, the nearest commercial receiver to SPS 920. No other commercial receivers are located within 500 metres of all other SPS sites.

4.5.2 Sleep disturbance noise criteria

The emission of peak noise levels for an instant or very short time period may cause sleep disturbance to residents during the night time (10 pm – 7 am) period. In accordance with the NSW INP guidance, a sleep disturbance goal of an L_{A1} (1 minute) noise level not exceeding the night time background $L_{A90, 15min}$ noise level by 15 dB(A) has been adopted.

Applying the 30 dB(A) L_{A90} background noise level a sleep disturbance goal of **45 dB(A) L_{A1}** has been adopted for nearest residential receivers.

Sleep disturbance is a subjective response and not all individuals are affected by noise to the same degree; the noise goal for sleep disturbance is designed to protect potentially affected residents from sleep arousal.

5. Construction noise and vibration assessment

Potential noise and vibration impacts during construction of the proposed new and upgrade infrastructure have been assessed.

As the full construction program had not been finalised, experience and knowledge of construction practises and standard construction techniques have been applied to the modelled scenarios where deemed necessary.

5.1 Assessed construction scenarios

Table 5-1 details the assessed construction work stages and the plant and machinery required. All plant and machinery listed in Table 5-1 have been directly applied in the predictive assessment of noise impacts. Source sound power levels for the construction plant are detailed in Appendix C

Table 5-1 Construction work stages and required plant

Construction stage	Plant required	
Site preparation	20 T excavator	Construction truck
Excavation works	20 T excavator	Excavator with rock breaker
	Construction truck	Backhoe
Removal of existing pumps	Construction truck	20T Crane
Installation of upgrade pumps	20 T crane	Powered hand-tools
	Compressor	-
Concreting works for shaft	Concrete truck	Agitator
Road surface cutting	Saw cutter	Electric generator
Trench excavation	20 T excavator	Construction truck
Micro-tunnelling Launch/ Exit shaft	20 T excavator	
Micro-tunnelling and treatment works	Micro-tunnelling rig	Bentonite pump
HDD tunnelling	HDD rig	
Restoration	20 T excavator	Wacker Packer

5.2 Predicted construction noise impact

Given the separation distances between the construction site and nearest receivers, the noise impact assessment can be undertaken through the application of Equation 5-1.

$$SPL_{received} = SWL_{source} - 20\log(r) - 8 \quad \text{Equation 5-1}$$

, where:

- SPL received is the received sound pressure level.
- SWL is the source sound power level.
- 8 dB is a constant, applied for the loss of acoustic energy resultant from hemi-spherical radiation of noise from a point source.

- -3 is a correction applied for the loss of acoustic energy from soft vegetated ground coverage.

For the prediction of potential worse case noise impacts there has been no allowance for noise reduction from intervening property and structures (fencing) in the calculation.

A 10 dB(A) reduction to noise levels from powered hand tools has been applied where construction plant is used within the shaft for SPS installation works.

All construction plant and equipment have been treated as point noise sources and noise impacts have been assessed for the worse case 15 minute period assuming the dominant noise generating plant are operating simultaneously.

The nearest residential receivers are located 20-100 metres from the proposed SPS and rising main construction sites. At the West Picton wastewater pipeline nearest receivers are located 10 metres from the pipeline exit.

The predicted construction noise levels within a 400 metre radius of work locations are detailed in Table 5-2. Noise levels predicted to exceed the adopted residential receiver noise management level of 41 dB(A) $L_{Aeq,15min}$ are shown as shaded.

Predicted exceedance of the noise management level triggers the requirement for Sydney Water to investigate feasible and reasonable noise management and mitigation measures recommended in Section 8.

Table 5-2 Predicted received construction noise levels

Construction phase	$L_{Aeq, 15min}$ dB(A) noise impact within 400m of works						
	10	30	50	100	200	300	400
Upgrade to existing SPS 920 and SPS 1045							
Removal of existing pumps	-	56	52	46	40	36	34
Installation of upgrade pumps	-	55	50	44	38	35	32
Restoration	-	59	55	49	43	39	37
Construction of new SPS A1, A2, B and C							
Site preparation	-	59	55	49	43	39	37
Excavation works with rock breaker	-	73	69	63	57	53	51
Excavation works no rock breaking	-	59	55	49	43	39	37
Concreting works for shaft	-	64	60	54	48	44	42
Installation of new pumps and wet well	-	55	50	45	38	35	32
Restoration	-	59	55	49	43	39	37
Rising main construction A, B and C							
Road surface cutting	75	66	62	56	50	46	44
Excavation works with rock breaker	82	73	69	63	57	53	51
Excavation works no rock breaking	68	59	55	49	43	39	37
Pipeline installation	70	61	58	52	46	41	40
Restoration	68	59	55	49	43	39	37
Wastewater pipeline Micro-tunnelling technique							
Launch/ Exit shaft construction	65	59	55	49	43	40	37
Micro-tunnelling and treatment works	63	57	52	46	40	36	34
Restoration	65	59	55	49	43	39	37
Wastewater pipeline HDD technique							
HDD tunnelling	-	60	55	49	43	40	37
Excavation works for connection	65	59	55	49	43	40	37
Restoration	65	59	55	49	43	39	37

Note: all noise levels to nearest 1 dB(A)

L_{Aeq} Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.

The predicted noise impacts are representative of the worse case 15-minute period of construction works where all required dominant noise generating plant are in simultaneous operation.

Based on the worse case predicted noise impacts compliance with the noise management level is predicted at residences located greater than 400 metres away from rock breaking and saw cutting works and greater than 200 – 300 metres away from all other construction works.

The simultaneous operation of construction plant and the worse case predicted noise impacts are not expected to occur throughout daily construction works. A 5 dB(A) reduction in worse case noise impacts is predicted at all receivers where dominant noise generating plant are not in simultaneous operation.

Where rock breaking and saw cutting works are not undertaken, a 5 dB(A) reduction is predicted to achieve compliance with the noise management level at receivers greater than 100 - 200 metre separation distance away for the majority of works.

The construction works for the rising mains are transitory, the worse case noise impacts at individual receivers are expected for less than one week as works progress on the rising main routes.

5.2.1 Upgrade of SPS 920 and SPS 1045

- Construction noise impacts of up to 59 dB(A) $L_{Aeq,15min}$ have been predicted at nearest residential receivers. Noise impacts potentially trigger the day time 41 dB(A) $L_{Aeq,15min}$ residential noise management level by up to 18 dB(A) $L_{Aeq,15min}$.
- A potential 10 dB(A) reduction to noise impacts may be achieved at receivers greater than 100 metres from SPS 920 and 200 metres from SPS 1045 where intervening residential property provides screening to construction noise.
- Potential noise impacts of up to 43 dB(A) $L_{Aeq,15min}$ at the Wollondilly Abattoir from construction works at SPS 920 would be compliant with the 70 dB(A) $L_{Aeq,15min}$ commercial receiver noise management level.

5.2.2 Construction of SPS A1 or SPS A2

- Construction noise impacts of up to 48 dB(A) $L_{Aeq,15min}$ have been predicted at the nearest residences 200 metres away from SPS A1 and SPS A2.
- Where rock breaking works are required as part of excavation works for the new pump systems, predicted noise impacts of up to 57 dB(A) $L_{Aeq,15min}$ would trigger the noise management level at nearest residential receivers.
- Noise impacts potentially trigger the residential construction noise management level by 7 – 16 dB(A).

5.2.3 Construction of SPS B

- At the nearest residences 100 metres away from SPS B, noise impacts of up to 54 dB(A) $L_{Aeq,15min}$ have been predicted. Noise impacts potentially trigger the residential noise management level by 13 dB(A).

- Predicted noise impacts of less than 42 dB(A) $L_{Aeq,15min}$ at the child care centre and church at Progress Street, 500 metres away from SPS B, would be compliant with the internal 45 dB(A) $L_{Aeq,15min}$ noise management level for sensitive receivers.

- During rock breaking works predicted worse case noise impacts of 63 dB(A) $L_{Aeq,15min}$ potentially trigger the noise management level by 22 dB(A) $L_{Aeq,15min}$.

  Potential external noise impacts of less than 51 dB(A) $L_{Aeq,15min}$ during rock breaking at 500 metres away from the works would be compliant with the internal noise management level for sensitive receivers. Predicted compliance assumes a minimum 10 dB(A) reduction to external noise levels achieved where windows are open for ventilation.

5.2.4 SPS C

- Noise impacts of up to 64 dB(A) $L_{Aeq,15min}$ have been predicted at nearest residences 30 metres away from SPS C. Noise impacts potentially exceed the residential noise management level by 23 dB(A).

- Whilst worse case noise impacts of 73 dB(A) $L_{Aeq,15min}$ during rock breaking are within the ICNG 75 dB(A) $L_{Aeq,15min}$ highly noise affected noise management level, disturbance or annoyance may be experienced at the nearest occupied residences.

5.2.5 Rising main A

- Noise impacts of up to 61 dB(A) $L_{Aeq,15min}$ have been predicted at nearest receivers 30 meters away from to rising main A. Noise impacts potentially trigger the noise management level by 20 dB(A).

- During worse case saw cutting and rock breaking works, predicted construction noise impacts of 66 – 73 dB(A) $L_{Aeq,15min}$ potentially trigger the noise management level by up to 32 dB(A).

5.2.6 Rising main B

- Predicted noise impacts of up to 61 dB(A) $L_{Aeq,15min}$ at nearest receivers 30 metres away from rising main B potentially trigger the noise management level by 20 dB(A).

- During worse case saw cutting and rock breaking works, predicted noise impacts of residences of 66 – 73 dB(A) $L_{Aeq,15min}$ at nearest potentially trigger the noise management level by up to 32 dB(A)

- Worse case noise impacts of 73 dB(A) $L_{Aeq,15min}$ during rock breaking are within the ICNG 75 dB(A) $L_{Aeq,15min}$ highly noise affected noise management level, but are may cause disturbance or annoyance at the nearest occupied residences.

- Potential construction noise impacts during all construction works would be compliant with the adopted 45 dB(A) $L_{Aeq,15min}$ internal sensitive receiver noise management level at the child care centre and church 500 metres from the rising main works

5.2.7 Rising main C

- Noise impacts of up to 70 dB(A) $L_{Aeq,15min}$ predicted at nearest residences 10 metres away from rising main C potentially trigger the noise management level by up to 29 dB(A).
- Worse case noise impacts of 75 – 82 dB(A) $L_{Aeq,15min}$ predicted at nearest residences during saw cutting and rock breaking works potentially trigger the noise management level by up to 32 dB(A).
- Worse case noise impacts of 82 dB(A) $L_{Aeq,15min}$ during rock breaking trigger the ICNG 75 dB(A) $L_{Aeq,15min}$ highly noise affected noise management level, and may cause disturbance or annoyance at the nearest occupied residences.
- Where saw cutting and rock breaking works are not undertaken noise management level compliance is predicted where works are undertaken at least 300 metres away from nearest residences.

5.2.8 Wastewater pipeline

Micro-tunnelling works

- Construction noise impacts of up to 65 dB(A) $L_{Aeq,15min}$ have been predicted at nearest receivers located 10 metres away from the launch and receiver shafts
- Worse case construction noise impacts potentially trigger the residential noise management level by up to 24 dB(A)
- Noise impacts are compliant with the 65 dB(A) $L_{Aeq,15min}$ commercial receiver noise management level at all nearest businesses and commercial premises.

HDD drilling works

- Noise impacts of 39 – 60 dB(A) $L_{Aeq,\ 15min}$ have been predicted at the nearest receivers to the launch pit during the HDD drilling construction works. Potential construction noise impacts trigger the residential noise management level by up to 19 dB(A).
- Noise impacts of up to 65 dB(A) $L_{Aeq,15min}$ have been predicted at nearest receivers located 10 metres away from the receiver shafts during excavation works to connect the wastewater pipeline to the existing network and during site restoration
- Predicted noise impacts at the nearest residence 10 metres away from the receiver shaft and site restoration potentially trigger the residential noise management level by up to 24 dB(A).
- Noise impacts at all nearest businesses and commercial premises are predicted to be compliant with the 65 dB(A) $L_{Aeq,15min}$ commercial receiver noise management level throughout the construction program.

5.3 Cumulative construction noise

Where construction works for the SPS and rising main infrastructure are undertaken simultaneously potential received noise impacts at the nearest residential receivers may be increased by up to 3 dB(A) L_{Aeq}.

The potential cumulative construction noise impacts may trigger the 41 dB(A) $L_{Aeq,15min}$ residential noise management level at additional residential receivers. Consistent with the recommendations provided in Section 7, it will be important for Sydney Water to implement all feasible and reasonable noise management and mitigation measures during the planning of works and throughout the construction program.

5.4 Construction road traffic noise impacts

Daily construction traffic movements are expected to include light vehicles for staffing and construction trucks for excavated material and plant handling and concrete delivery.

Construction road traffic movements were not confirmed at the time of assessment. Based on the proposed construction works typical hourly construction traffic movements of five light vehicles and four construction trucks during peak periods of construction activity have been assumed.

Construction heavy vehicles (truck) pass by events of less than 1 minute may be audible during the day time period at the nearest receivers but would not exceed the adopted 55 dB(A) $L_{Aeq,1hr}$ construction traffic noise management level.

Potential construction road traffic volumes are not expected to increase hourly road traffic noise levels on local residential roads or local collector roads in the study areas.

5.5 Construction ground vibration impacts

The assessment of potential construction vibration impacts has adopted typical vibration levels informed from previous PB monitoring and assessment of construction vibration levels from excavation, trenching and HDD.

Table 5-3 details adopted PPV (human response) and eVDV (structural damage) vibration levels for the assessment of potential impacts.

The construction vibration levels are for assessment purposes where site specific received vibration levels would be dependent upon the vibration source, the separation distance to receivers and the localised ground strata and surface material.

Table 5-3 Predicted construction vibration levels at 10 metres from plant

Plant	PPV vibration level (mm/s)	eVDV m/s $^{1.75}$
Road cutter[2]	0.2	< 0.4
Excavator[1]	1	0.8
Roller[1]	1.8	0.45
Compactor[2]	2.4	> 0.4
HDD rig[1]	0.2	< 0.4

Note: Source: 1 PB database

2 NSW RTA Hunter Expressway Alliance Construction Noise and Vibration Management Sub-Plan (HEA-PL-GL-NVP-001-001-00-03, Jul 2010)

- Based on typical vibration levels at 10 metres away from construction plant potential ground vibration levels are expected to be within adopted 0.2 – 0.4 m/s$^{1.75}$ VDV goals for human annoyance at nearest residences 30 metres away from construction works.

  There is a low probability that annoyance or disturbance issues would occur at nearest occupied residences.

- At the wastewater pipeline connection to the existing network, nearest residential receivers 10 metres away from the construction works may experience ground vibration levels exceeding 0.4 m/ s$^{1.75}$. Potential received ground vibration may cause annoyance or disturbance during excavation and roller plant operations.

- Potential received ground vibration levels of up to 2.4 mm/s PPV at nearest receivers within 10 – 20 m of plant and machinery would be within adopted structural vibration objectives of 5 mm/s – 20 mm/s.

  Where construction plant and machinery is operated responsibly structural damage to off-site property and structures is unlikely to occur.

- Recommended vibration management measures detailed in Section 7 should be implemented to reduce potential ground vibration and limit potential for disturbance.

6. Sewage pumping station operational noise assessment

This section identifies predicted noise impacts at the nearest residential receivers for the proposed SPS operations.

Potential SPS noise impacts have been assessed utilising a site-specific noise propagation model and representative source sound pressure levels (SPL) for above ground sewage pump noise emissions.

6.1 SPS operational source noise levels

PB measured existing operational noise levels at the SPS 920 and SPS 1045 sites to determine SPL's for sewage pump external noise emissions. Attended noise measurements were made at a separation distance of 1 metre from the ground level steel plates which cover the 20 metre deep concrete vertical shafts which house the pumps.

All measurements were undertaken during the day time period of 2 February 2011 and it was confirmed by Sydney Water that measured noise levels would be representative of typical daily operation of two pumps with the concrete shaft.

Table 6-1 details the measured SPL's for SPS 920 and SPS 1045. All noise levels were measured during 2 minute periods of continuous pump operation and were undertaken during periods of low background noise to minimise the influence to noise levels from non sewage pump ambient noise events on measured noise levels.

The measured source noise levels are representative of typical continuous sewage pump operations of 2 to 5 minutes in duration. Two pumps operate simultaneously at SPS 920 and SPS 1045 as proposed for the Project sites.

Table 6-1 Sewage pump surface source noise levels (two pumps in operation)

Pump operation event	Measured SPL, dB(A) at 1 metre	
	$L_{Aeq, 2min}$	$L_{A1, 2min}$
SPS 920 (134 L/ sec)		
1	52.5	60.5
2	54.5	65.5
SPS 1045 (20 L/sec)		
1	47	57
2	50.5	62

Note: Values expressed as dB(A)

L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

Comparison of measured SPL's for the SPS 920 and SPS 1045 pumps has determined an approximate seven fold increase in flow rate has increased noise levels at the surface of the shaft by up to 5 dB(A).

The proposed new and upgraded SPS pumps are to operate at 24 to 200 L/sec (Table 2-1), representing a 1.5 flow rate increase from the 134 L/sec pumps. Adopting a linear relationship between flow rate and source noise levels, source SPL's of 56 dB(A) $L_{Aeq,2min}$ at 1 metre and 66 dB(A) L_{A1} at 1 metre have been derived for the assessment of operational noise from the proposed 200 L/sec pumps.

The source SPL's have been adopted for a worse case assessment of potential noise impacts from the pump system with the highest flow rate.

The adopted SPL is representative of the simultaneous operation of two sewage pumps within the 20 metre deep concrete shaft housing the water pumps where the shaft opening at is covered with steel plates.

In accordance with the NSW INP, an analysis of measured 1/3 octave band SPL's determined that no modifying correction factor additions to the SWL for annoying source noise characteristics (tonality, low frequency) were required. Measured 1/3 octave band noise levels are detailed in Appendix B.

6.2 SPS operational noise models

A noise propagation model has been established for the assessment of potential operational noise impacts from the Project at the nearest residential and noise sensitive receivers. Noise modelling was undertaken through the use of SoundPLAN noise propagation modelling software (Version 7.0) incorporating the following datasets:

- digital land topography 2 metre contours for the immediate Project area
- ground coverage assumed to be non reflective with vegetation areas modelled with a 1.0 absorption co-efficient
- SPS sites as detailed in Figure 2-1, Figure 2-2 and Figure 2-3
- Source SPL at 1 metre for external noise breakout of the submerged sewage pumps of 56 dB(A) L_{Aeq} and 66 dB(A) L_{A1} adopted for a worse case continuous 5 minute operational events
- operational sewage pump noise sources modelled as point sources 0.5 metres above ground level
- receivers modelled at ground floor (1.5 m above the ground level) and first floor (4.2 metres above ground level)
- CONCAWE industrial standard model parameters were applied for neutral meteorological conditions. A separation distance of < 50 metres to the nearest receivers limits the potential for noise enhancing influence from wind gradient or temperature inversion events.

To provide a conservative assessment of potential noise impacts, fencing at residential property boundaries has not been included in the noise model.

6.3 Assessed receiver locations

The nearest residential receivers are shown in Figure 6-1, Figure 6-2 and Figure 6-3. These locations have been applied for the assessment of worse case off-site noise impacts from the proposed new and upgraded infrastructure.

Figure 6-1 Assessed receiver locations SPS 920 and SPS 1045

Figure 6-2 Assessed receiver locations SPS A and SPS B

Figure 6-3 Assessed receiver locations SPS C

6.4 Predicted operational noise impacts

The NSW INP requires operational noise impacts to be assessed over a 15-minute operational period. During a 15 minute period the sewer pumps will be in continuous operation for a single event of up to 5 minutes in duration.

Predicted noise impacts have been subject to a -5 dB(A) correction adjustment to account for the influence of short term sewage pump operation on the 15 minute noise impact.

Predicted noise impacts at nearest residential receivers to the new and upgrade SPS locations have been summarised in Table 6-2. All predicted noise impacts at the assessed receivers are detailed in Appendix D.

The predicted noise impacts are considered a worse case assessment of potential noise impacts from the Project for the highest pump system flow rate of 200 L/sec.

A reduction in predicted noise impacts may occur at nearest receivers to SPS 1045, SPS A1 and A2, SPS B and SPS C (25 L/sec) where pump systems with lower flow rates are proposed.

SPS operation would typically be inaudible where received noise impacts are at least 10 dB(A) below the existing background noise levels. Based on a measured conservative background night time noise level of 27 dB(A) L_{A90} (Table 3-3), noise impacts of 17 dB(A) $L_{Aeq,15min}$ or less are expected to be inaudible at nearest receivers.

Table 6-2 Predicted construction noise impacts at nearest residential receivers

Operational site	Receivers	Predicted received noise impacts, $L_{Aeq,15min}$ dB(A)
$L_{Aeq,\ 15min}$ noise management levels; 35 dB(A) residential		
SPS 920 (upgrade)	R1 to R7	<10
SPS 1045 (upgrade)	R8 to R13	<10 – 15
SPS A1	R14 to R16	<10
SPS A2	R14 to R16	<10
SPS B	R17 to R19	<10
SPS C	R20 to R28	<10 – 20

Notes: Values expressed as A-weighted dB and rounded to nearest 1 dB(A);
L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

SPS 920 upgrade

All predicted operational noise impacts at nearest receivers on Suffolk Place are compliant with the NSW INP during the proposed 24 hour operations for the proposed upgrade.

No operational impacts have been predicted at the Wollondilly Abattoir located to the south-east of SPS 920.

SPS 1045 upgrade

Predicted operational noise impacts of up to 15 dB(A) $L_{Aeq,15min}$ at all nearest residences on Castlereagh Street and Amblecote Place are compliant with the NSW INP during the proposed 24-hour operations and likely to be inaudible at nearest residences.

SPS A1

All predicted noise impacts at the nearest receivers on Cross Street, Myrtle Creek Avenue and Tahmoor Road would be less than 10 dB(A) $L_{Aeq,15min}$ and NSW INP compliant. No audible impacts are expected at the nearest receivers.

SPS A2

All predicted noise impacts at the nearest receivers on Cross Street, Myrtle Creek Avenue and Tarmoor Road are less than 10 dB(A) $L_{Aeq,15min}$ and NSW INP compliant. No audible impacts are expected at the nearest receivers.

SPS B

All predicted noise impacts at the nearest receivers on Progress Street and adjacent to the site are less than 10 dB(A) $L_{Aeq,15min}$ and compliant with the NSW INP. No audible impacts are expected at the nearest receivers.

Compliance with the adopted 40 dB(A) $L_{Aeq,15min}$ internal noise goal at the child care centre and church on Progress Street is predicted to be achieved.

SPS C

Predicted operational noise impacts of 20 dB(A) $L_{Aeq,15min}$ at the nearest receivers at Rita Street would be compliant with the NSW INP noise goal of 35 dB(A) $L_{Aeq,15min}$.

During periods of low background noise (< 30 dB(A) L_{A90}) sewage pump operations may be audible at nearest receivers

6.5 Potential noise impacts at future residential Lots

Based on the predicted NSW INP compliance at the nearest existing residential receivers to the new and upgraded SPS sites; NSW INP compliance would be achieved at future receivers developed within the proposed Future Growth Areas where the sewage pumps are located at least 10 metres away from nearest residential and noise sensitive receivers.

The planning for the Future Development Areas should consider potential noise from adjacent operational Sydney Water SPS sites and, as required, include appropriate noise management and controls to preserve the acoustic amenity at future land uses.

Notwithstanding, the proposed SPS sites and sewage pump operations are expected to maintain acoustic amenity within the rural residential environments and limit potential for noise impacts at future receivers.

6.6 Sleep disturbance assessment

Adopting the sewage pump source noise level of 66 L_{A1} at 1 metre, operational noise impacts of up to 33 dB(A) $L_{A1, 1min}$ have been predicted at the nearest residences to the SPS sites.

Compliance to the adopted 45 dB(A) L_{A1} sleep disturbance noise goal would be achieved at all nearest residential receivers for all upgrade and new SPS sites. No sleep disturbance impacts or disturbance issues are expected with the Project.

6.7 Operational ground vibration assessment

No ground vibration was perceptible from SPS operations at 1 metre and 10 metres from the sewage pumps or at the nearest residential receivers during the baseline noise surveys and source noise measurements.

Where new sewage pumps are installed within the concrete shafts, no off-site ground vibration impacts are expected. Any perceptible ground vibration at the nearest residential receivers would be fully compliant with the adopted disturbance and structural objectives outlined in Section 4.3 for intermittent vibration events.

No further assessment of potential ground vibration impacts is required.

7. Recommended noise and vibration management measures

This section provides recommendation of feasible and reasonable noise and vibration management and mitigation measures for managing and controlling potential impacts from the construction and operational phases of the Project.

7.1 Construction noise and vibration management

The predictive assessment of construction noise impacts has identified that potential received noise levels are likely to exceed the adopted residential noise management levels by up to 32 dB(A) during peak noise generating rock breaking and saw cutting works and by up 23 dB(A) during works to upgrade and install new SPS and rising mains.

The ICNG guidance advises potential noise impacts may result in disturbance at nearest residential receivers where predicted noise levels trigger the adopted noise management levels. Exceedance of the noise management levels is a trigger for the investigation and implementation of management and mitigation measures.

A series of noise and vibration management and mitigation measures designed to control and reduce noise levels are detailed below. The recommended measures are considerate of the predicted noise impacts, nearest receivers and proposed construction timeframes.

The management measures have been informed by the ICNG which promotes the principles of best management practice and community notification of likely noise impacts.

It is unlikely that the recommended noise management measures will fully ameliorate noise impacts during worse case noise generating works to achieve noise management level compliance at all receivers. Sydney Water needs to undertake all reasonable and feasible measures to reduce noise impacts and minimise impact potential through scheduling and planning of its works and liaising with affected landowners and local communities throughout the construction program.

All Contractors commissioned by Sydney Water to undertaken construction works associated with the Project should be contractually required to adhere to all recommended noise and vibration management and mitigation measures.

Potential ground vibration levels from construction are expected to be compliant with adopted annoyance and structural damage management levels. A recommendation has been provided to assist in minimising potential off-site vibration impacts.

7.1.1 Construction planning and design

The predicted noise levels should be considered in establishing work site locations, construction techniques and on site practises.

During the planning and scheduling of construction works the following principles and proactive noise management measures should be considered for implementation:

- A Construction Noise and Vibration Management Plan (CNVMP) for the Project should be formulated to provide a framework for addressing noise levels associated with construction works. Noise control options including site mitigation and the investigation of low noise plant should be detailed and direction provided for the delivery of best practice noise management on site.

  Low noise plant include electrically powered plant or equipment with appropriate acoustic enclosures and exhausts

- Construction works should adopt Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) practices as identified in the ICNG. BMP includes factors discussed within this report and encouragement of a project objective to reduce noise emissions. BATEA practices involve incorporating the most advanced and affordable technology to minimise noise emissions.

- Standard construction working hours should be restricted to 7 am and 6 pm (Monday to Friday) and Saturdays 8 am and 1 pm, with no works on Sundays or public holidays, unless site specific engineering, health and safety or existing Sydney Water operational conditions expressly require works outside these times.

- Exceedance of the noise management level by up to 32 dB(A) has been predicted at nearest residential receivers during construction works.

  Temporary acoustic screens/solid fencing should be installed at all construction work sites located less than 300 metres away from nearest receivers to, where practicable, reduce potential received noise impacts from the dominant noise generating plant:

  - 20T excavator
  - Excavator with rock breaker
  - Saw cutter
  - Wacker packer
  - Crane.

  Potential noise impact reduction of up to 6 dB(A) is achievable where acoustic screens/ fencing are located within 5 metres of the construction plant. Screens should be at least 2 metres in height and provide a solid façade with no gaps or openings.

  - It is recommended that the barrier be constructed of plywood hoarding or similar material of of typical 10 kg/m^2 superficial weight and minimum thickness 9 mm.
  - Wavebar or similar absorptive lining can be installed on existing fencing at SPS 920 and SPS 1045. Fencing with acoustic absorptive lining should be installed at SPS sites A, B and C at the earliest feasible stage of construction for the screening of noise emissions.

- Where rock breaking or saw cutting works are undertaken within 50 metres of nearest receivers, to provide respite to nearest residences and minimise potential for annoyance and disturbance:
  - respite periods of 1 hour are recommended for every continuous 3 hour period of work, or
  - works should be scheduled between 9 am – 12 pm and 2 pm – 5 pm.
- Fixed and mobile construction plant and equipment should be located to maximise the separation distance from the nearest noise and vibration sensitive and residential receivers. Plant should be orientated away from the nearest receivers and where feasible be located to take advantage of on-site buildings and structure with the potential to impede noise propagation.
- Where practical, the simultaneous operation of dominant noise generating plant should be managed to reduce noise impacts. This could involve the plant operating at different times or increasing the distance between the plant.

  The predicted noise impacts infer a potential 2 to 5 dB(A) noise reduction may be achieved where the following plant is operated separately:
  - Excavator mounted rock breaker
  - Saw cutter
  - 20T excavator
  - Construction or concreting trucks
  - Wacker Packer
- Where rock breaking is required, alternative construction techniques to impact rock breaking such as pressurised rock splitting techniques, for example gas expansion (use of compressed gas), should be investigated to minimise the potential for high noise generating construction activity.
- Where possible and provided that occupational safety and health standards are not impacted, the requirement for tonal reversing beepers on all construction vehicles and mobile plant should be limited.

  Alternatives to tonal reversing beepers include the use of spotters, variable sound level alarms, visual alarms or broadband alarms. Designing the site to reduce the need for reversing may also assist in minimising the use of tonal reversing beepers.
- At least 2 weeks prior to the commencement of works, Sydney Water shall undertake detailed consultation with potentially noise affected residents to inform them of the proposed works, anticipated impacts and to investigate their preferred times for construction works.

7.1.2 Noise management and mitigation during construction

In addition to the noise and vibration management measures in Section 7.1.1 developed for the planning and design, the following measures should be implemented during all construction works.

- A one page summary of required construction noise and vibration management practices should be provided to all staff and contractors and be included during site inductions and tool-box talks. The summary should include, as a minimum, the permitted hours of construction work, work site locations, site ingress/egress and the required noise management measures for each construction phase.
- Engines and construction plant should not be started and onsite activities should not be undertaken outside of the specified construction hours. Works which do not generate off-site noise impacts can be undertaken at staging areas where not adjacent to residential and commercial receivers.
- Construction plant and machinery should be switched off when unattended for extended periods and not be left idling.
- Construction works outside of standard day time construction hours will be subject to a separate assessment of noise impacts and be undertaken where works have received required approvals.
- Monitoring of construction noise and vibration is recommended at the following times:
  - At the commencement of rock breaking works, trenching excavation and micro-tunnelling/HDD works. Monitoring should occur during standard construction hours to verify predicted construction noise levels and confirm the requirements for noise management and mitigation measures.
  - At the commencement of any construction works required outside of standard day time construction hours to verify construction noise levels and confirm the requirements for noise management and mitigation measures.
  - Noise monitoring should, where practicable, be undertaken during the most sensitive period where background noise levels are low.
  - In response to any noise or vibration complaints.

All noise and vibration monitoring should be undertaken by suitably qualified practitioners with consideration to the ICNG and relevant regulatory and statutory guidelines.

7.2 Sewage Pump operations

NSW INP compliance has been predicted at all residential, noise sensitive and commercial receivers for the proposed new and upgraded SPS operations. No noise management or mitigation measures are required to reduce received noise impacts or control potentially disturbing noise characteristics

Compliance with the NSW INP and the noise management and mitigation recommendation has been determined by applying a derived source noise level of 56 dB(A) $L_{Aeq,2min}$ at 1 metre, free of annoying characteristics, for the proposed 200 L/sec sewage pumps.

- Sydney Water should verify predicted noise impacts by confirming sewage pump source noise levels at the shaft surface, with steel plates covering the shaft opening, are consistent with the 56 dB(A) L_{Aeq} at 1 metre adopted in this assessment.

- For future land use development and planning, compliance with NSW INP residential noise goals would be expected where nearest residential receivers are located greater than 10 metres from nearest SPS sites.

- The analysis of predicted received noise impacts at nearest residences for proposed SPS A1 and A2 operations, has determined location A1 to be the acoustically preferred location. Potential received noise impacts are approximately 8 dB(A) less than the noise impacts predicted for the SPS A2 location.

  NSW INP compliance is predicted with either SPS A1 or SPS A2 proposed site location. Final site selection by Sydney Water is not expected to result in adverse noise impacts at nearest residences.

8. Conclusion

An assessment of potential construction noise and vibration impacts has been undertaken for the proposed Picton Sewerage Scheme Boundary Modification.

In accordance with the NSW ICNG, day time standard construction hour noise management levels of 41 dB(A) $L_{Aeq,15\ min}$ for residential receivers, 40 dB(A) $L_{Aeq,15min}$ (internal) for noise sensitive receivers and 65 dB(A) $L_{Aeq,15min}$ for commercial receivers have been adopted for the assessment of potential construction noise impacts.

Based on the predicted noise impacts an exceedance of adopted noise management levels is expected at nearest residential receivers. It is recommended Sydney Water investigate feasible and reasonable noise mitigation measures where construction works are required within 400 metres of the nearest residential receivers during rock breaking and saw cutting works and within 300 metres of nearest residential receivers during all other construction works.

The recommended noise management measures include the development of a construction noise and vibration management plan, scheduling rock breaking and saw cutting works outside the most sensitive day time period (7 am to 9 am), erecting solid acoustic screening/ fencing around SPS sites and micro-tunnelling/HDD construction work locations, mobile screening for rising main works and community consultation prior to and during the construction program.

No ground vibration or construction road traffic issues are expected with the proposed construction works.

A 35 dB(A) $L_{Aeq,15min}$ residential noise design objective has been adopted for new and upgrade SPS operations in accordance with the NSW INP guideline.

Predictive assessment of SPS operational noise impacts has determined that compliance with the NSW INP is expected at all nearest residential receivers at the new and upgraded SPS sites.

The proposed new and upgraded SPS sites and sewage pump operations are expected to achieve NSW INP compliance and maintain acoustic amenity at all future receivers developed within the identified Future Growth Areas.

It is recommended the Sydney Water confirm the predicted noise impacts during the detailed design phase by verifying the sewage pump source noise level of 56 dB(A) L_{Aeq} at 1 metre, free of annoying characteristics, adopted in this assessment.

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9. References

NSW DEC *Environmental Noise Management Assessing Vibration: a technical guideline* (2006).

NSW DECCW *Interim Construction Noise Guideline* (2009).

NSW EPA *Industrial Noise Policy* (2000).

NSW EPA *Environmental Criteria for Road Traffic Noise* (1999).

NSW RTA Hunter Expressway Alliance Construction Noise and Vibration Management Sub Plan (2010).

10. Limitations

10.1 Scope of services and reliance of data

This noise and vibration impact study ('the study') has been prepared in accordance with the scope of work/services set out in the contract, or as otherwise agreed, between Parsons Brinckerhoff (PB) and the Client. In preparing this noise impact study, PB has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the noise and vibration impact study ('the data'). Except as otherwise stated in the noise impact study, PB has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this noise and vibration impact study ('conclusions') are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. PB will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to PB.

10.2 Study for benefit of client

This noise and vibration impact study has been prepared for the exclusive benefit of the Client and no other party. PB assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with in this noise and vibration impact study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this noise impact study (including without limitation matters arising from any negligent act or omission of PB or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this noise impact study). Other parties should not rely upon the noise impact study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

10.3 Other limitations

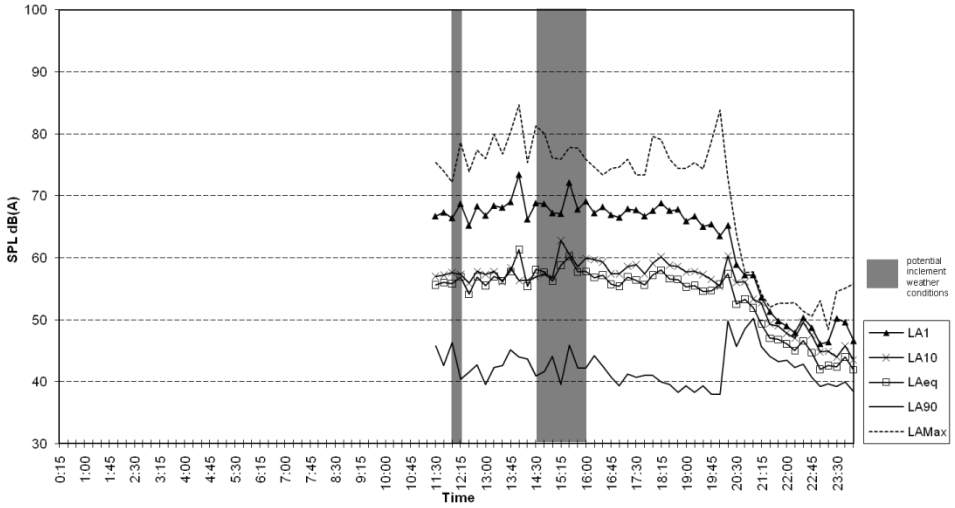
To the best of PB's knowledge, the proposal presented and the facts and matters described in this noise and vibration impact study reasonably represent the Client's intentions at the time of printing of the noise impact study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the Proposal and of its possible noise and vibration impact.

PB will not be liable to update or revise the noise impact study to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the noise impact study.

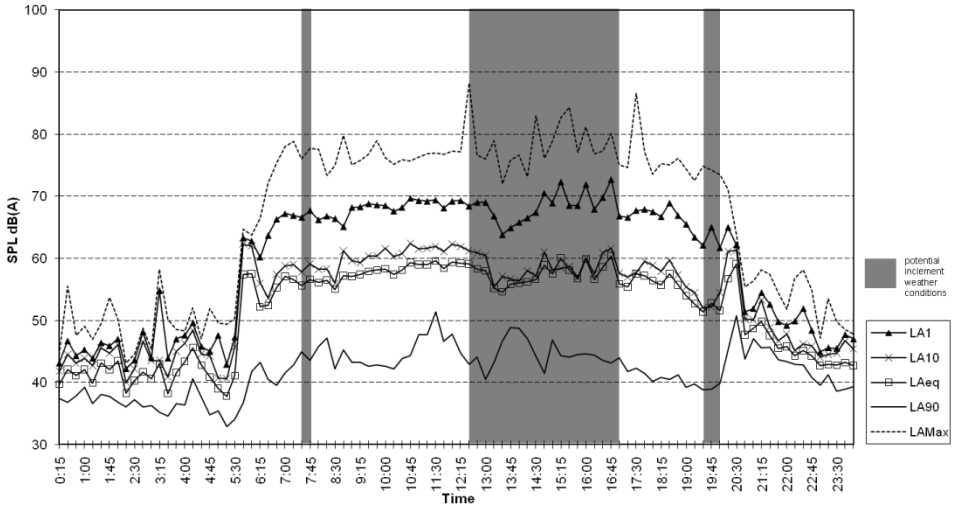
Appendix A

Baseline noise survey

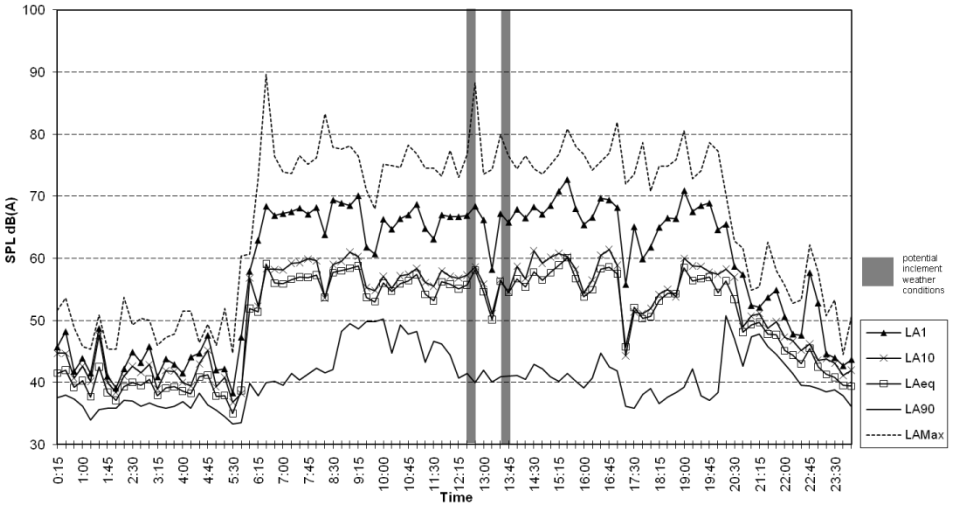
Location A - 2 Suffolk Place, Tahmoor
Measured Noise Levels - Wednesday 2nd February, 2011



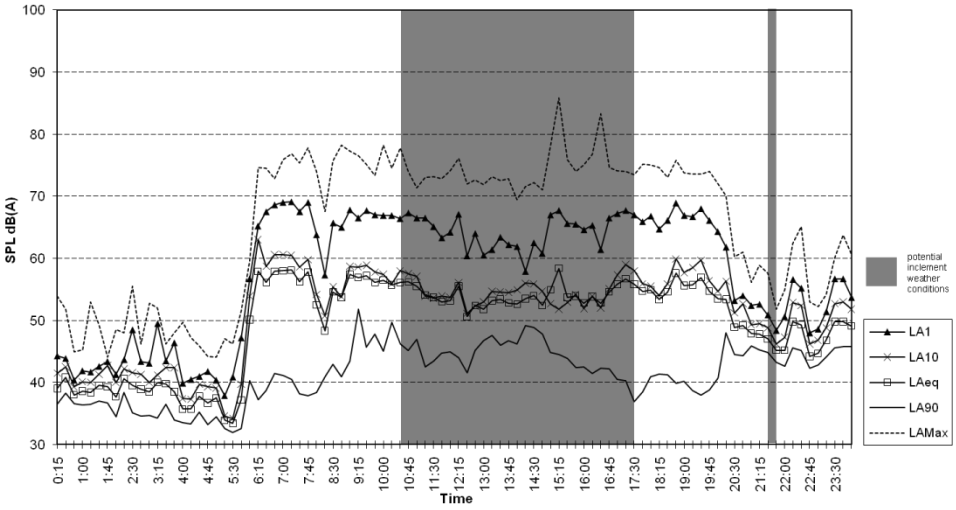
Location A - 2 Suffolk Place, Tahmoor
Measured Noise Levels - Thursday 3rd February, 2011



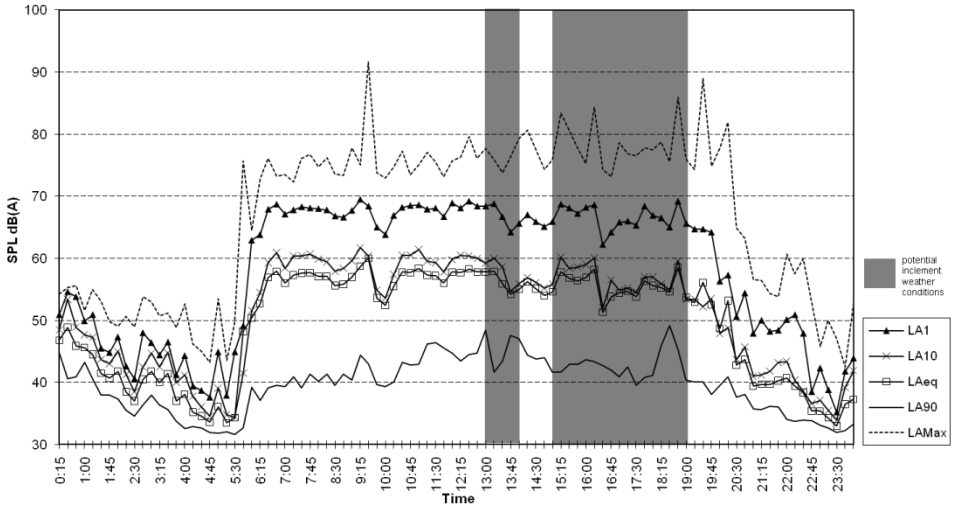
Location A - 2 Suffolk Place, Tahmoor
Measured Noise Levels - Friday 4th February, 2011



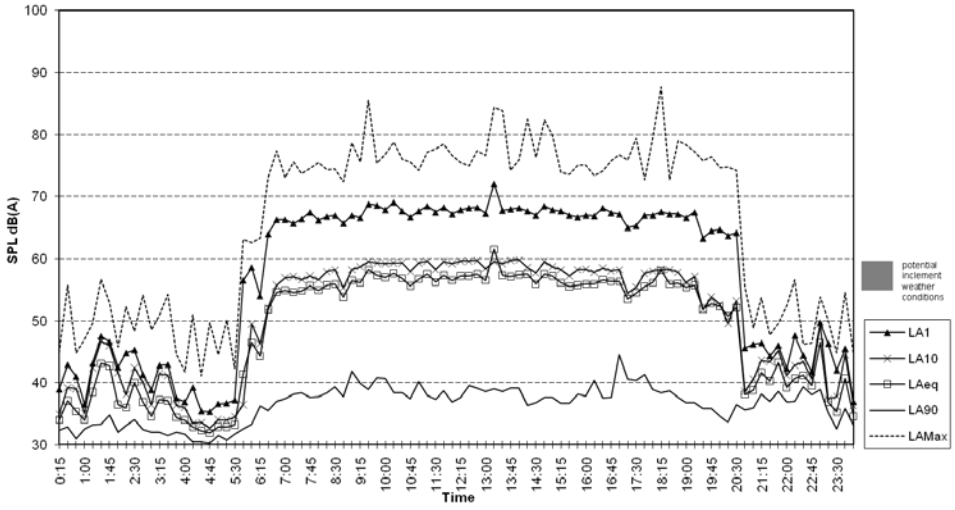
Location A - 2 Suffolk Place, Tahmoor
Measured Noise Levels - Saturday 5th February, 2011



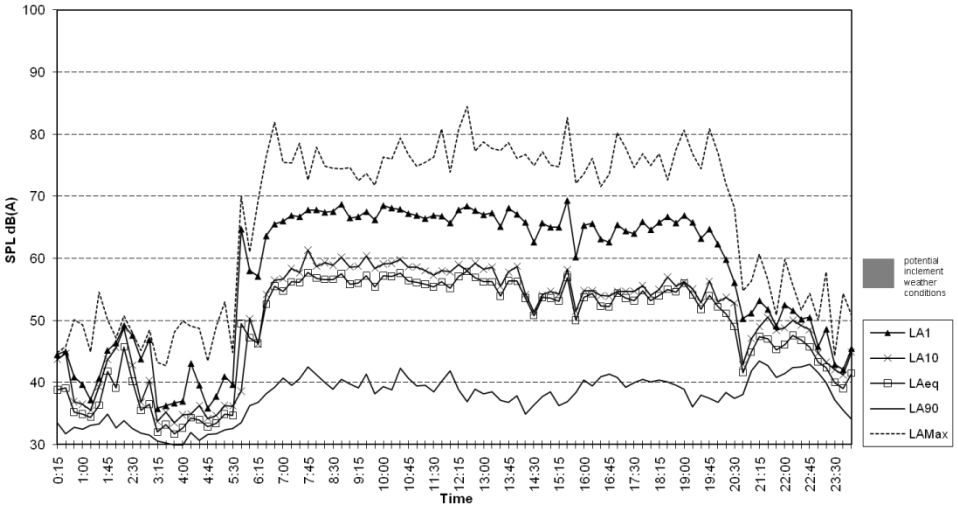
Location A - 2 Suffolk Place, Tahmoor
Measured Noise Levels - Sunday 6th February, 2011



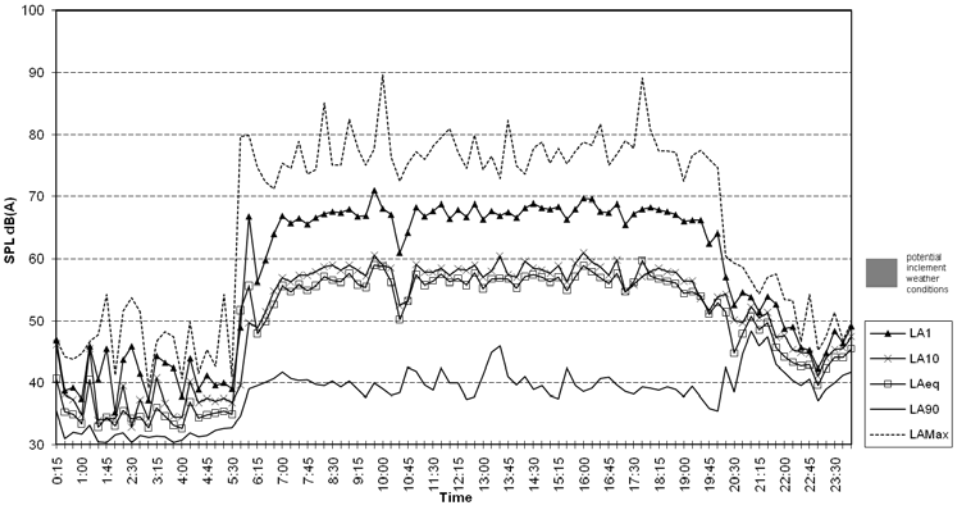
Location A - 2 Suffolk Place, Tahmoor
Measured Noise Levels - Monday 7th February, 2011



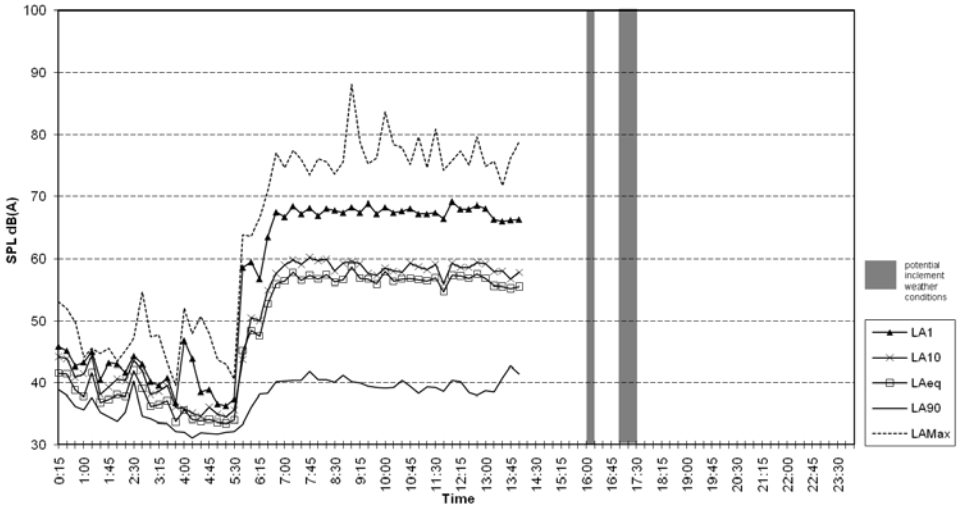
Location A - 2 Suffolk Place, Tahmoor
Measured Noise Levels - Tuesday 8th February, 2011



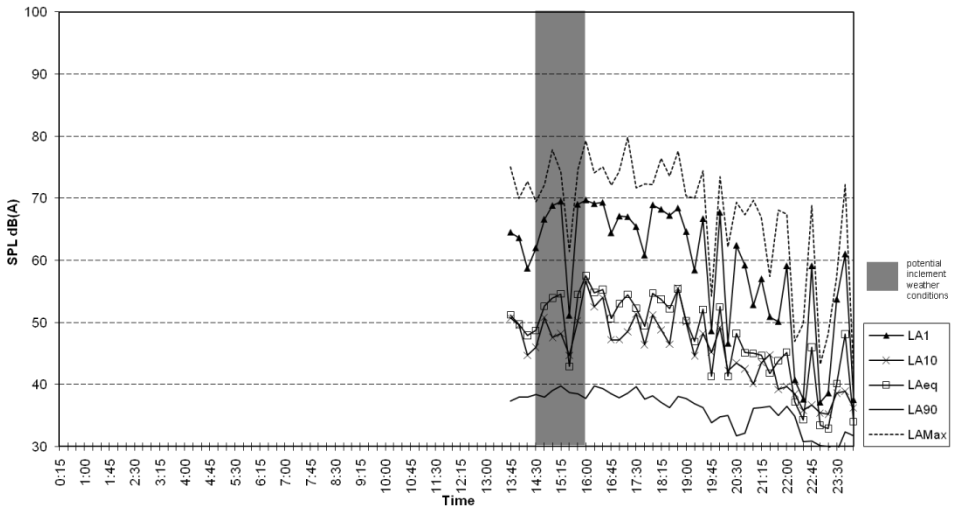
Location A - 2 Suffolk Place, Tahmoor
Measured Noise Levels - Wednesday 9th February, 2011



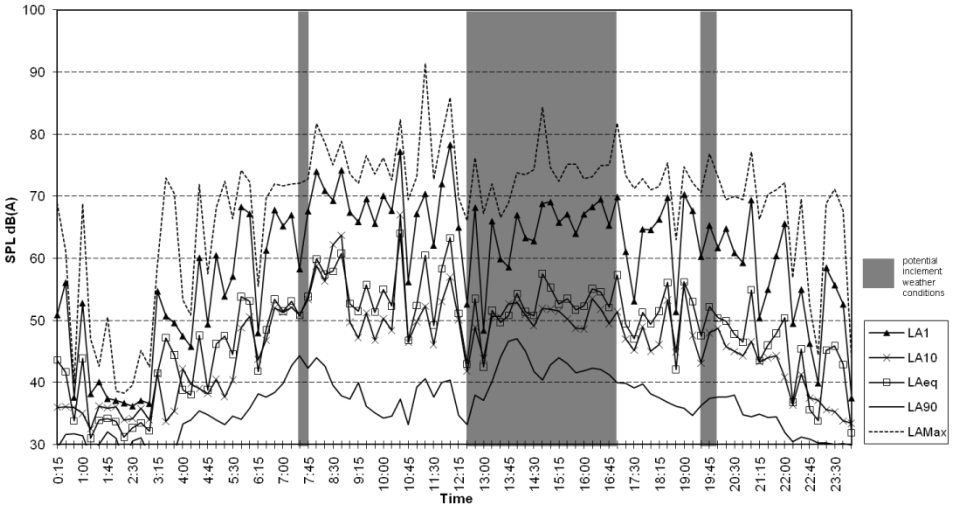
Location A - 2 Suffolk Place, Tahmoor
Measured Noise Levels - Thursday 10th February, 2011



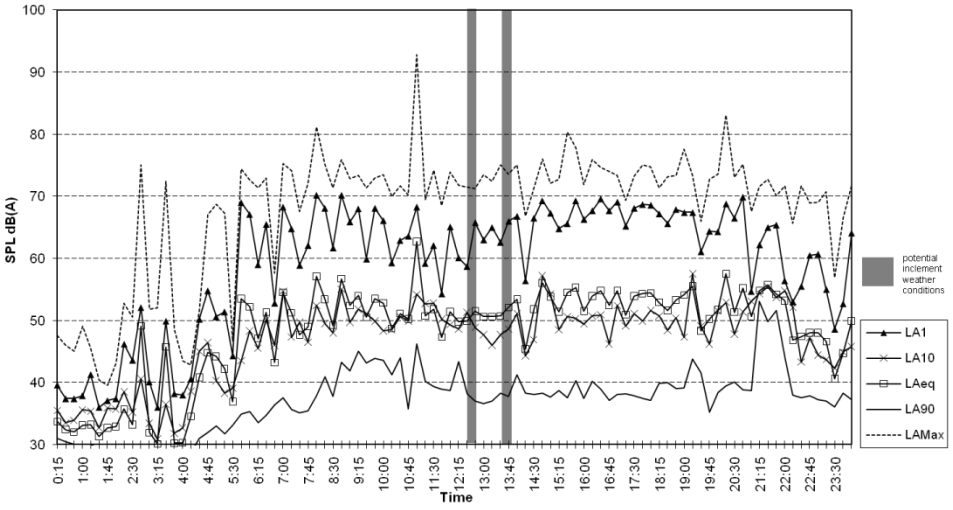
Location B - 34 Rita Street, Thirlmere
Measured Noise Levels - Wednesday 2nd February, 2011



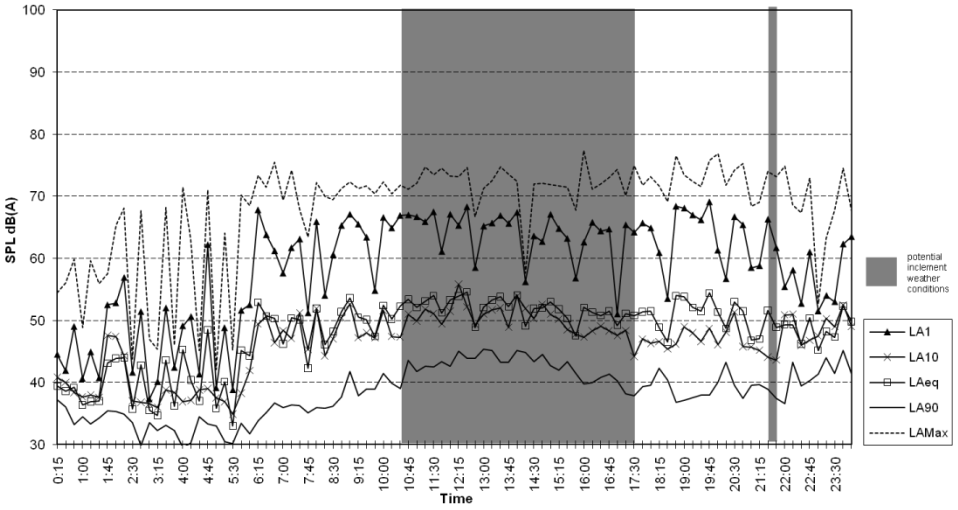
Location B - 34 Rita Street, Thirlmere
Measured Noise Levels - Thursday 3rd February, 2011



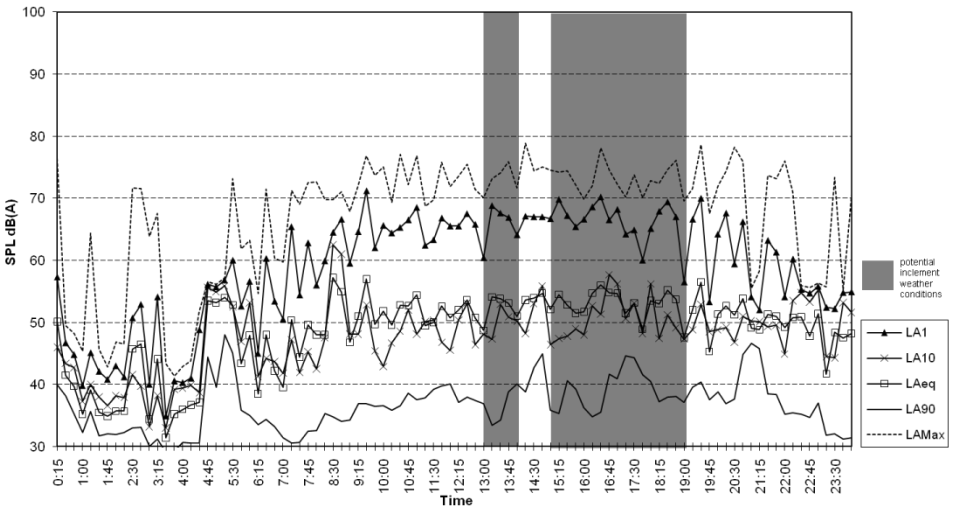
Location B - 34 Rita Street, Thirlmere
Measured Noise Levels - Friday 4th February, 2011



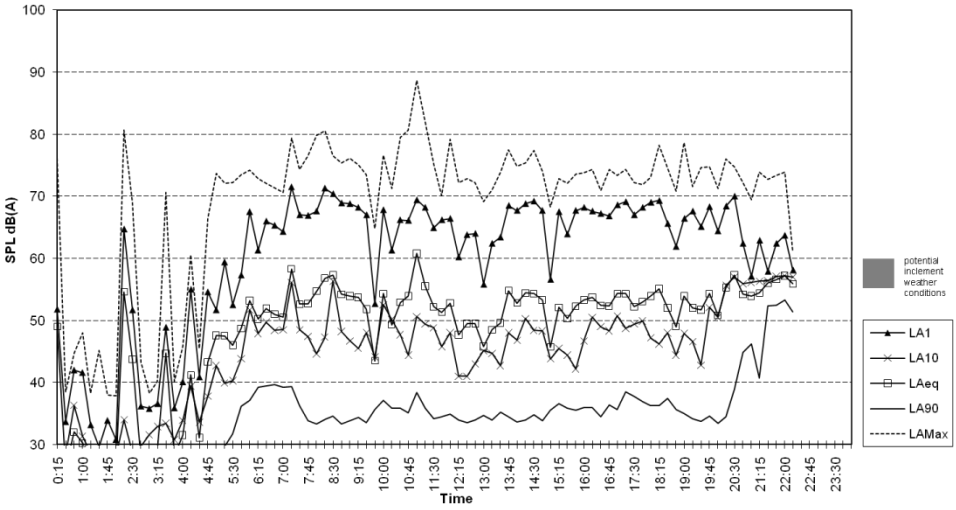
Location B - 34 Rita Street, Thirlmere
Measured Noise Levels - Saturday 5th February, 2011



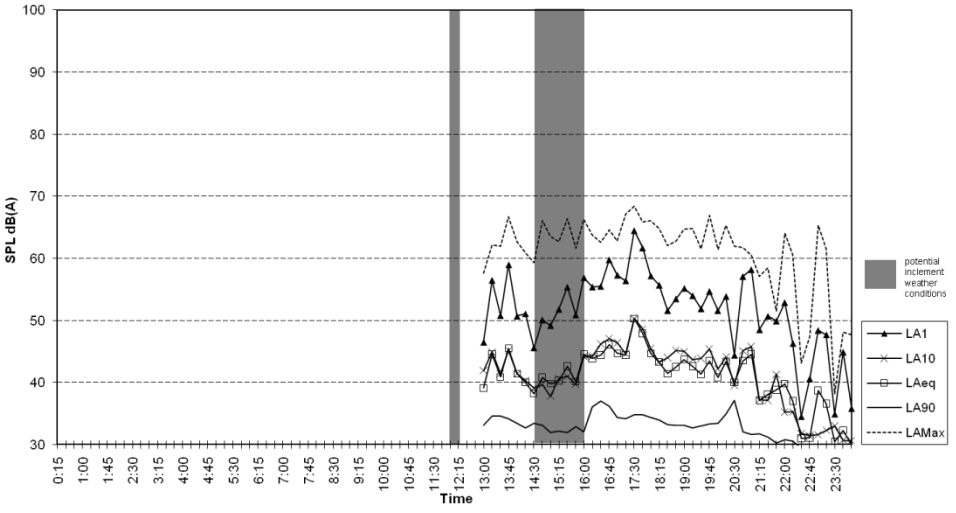
Location B - 34 Rita Street, Thirlmere
Measured Noise Levels - Sunday 6th February, 2011



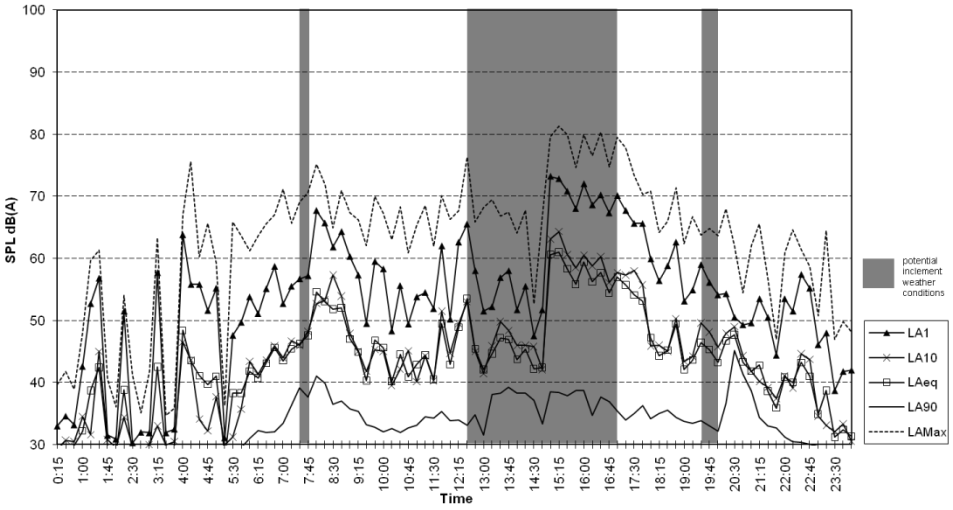
Location B - 34 Rita Street, Thirlmere
Measured Noise Levels - Tuesday 8th February, 2011



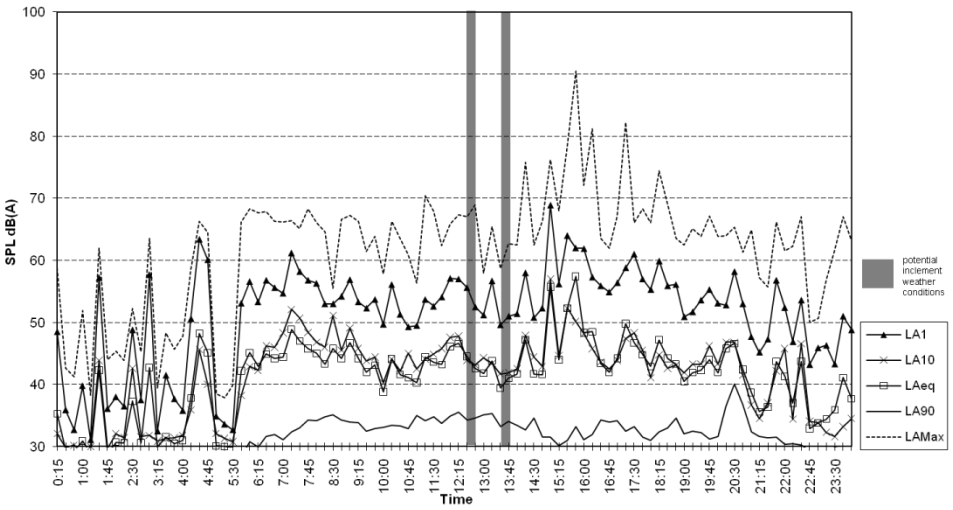
Location C - Castlereagh Street, Tahmoor
Measured Noise Levels - Wednesday 2nd February, 2011



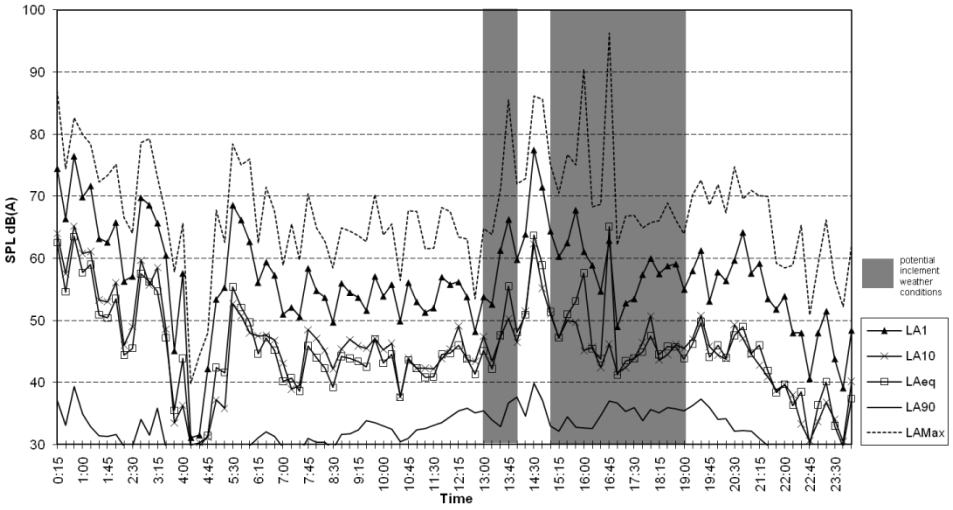
Location C - Castlereagh Street, Tahmoor
Measured Noise Levels - Thursday 3rd February, 2011



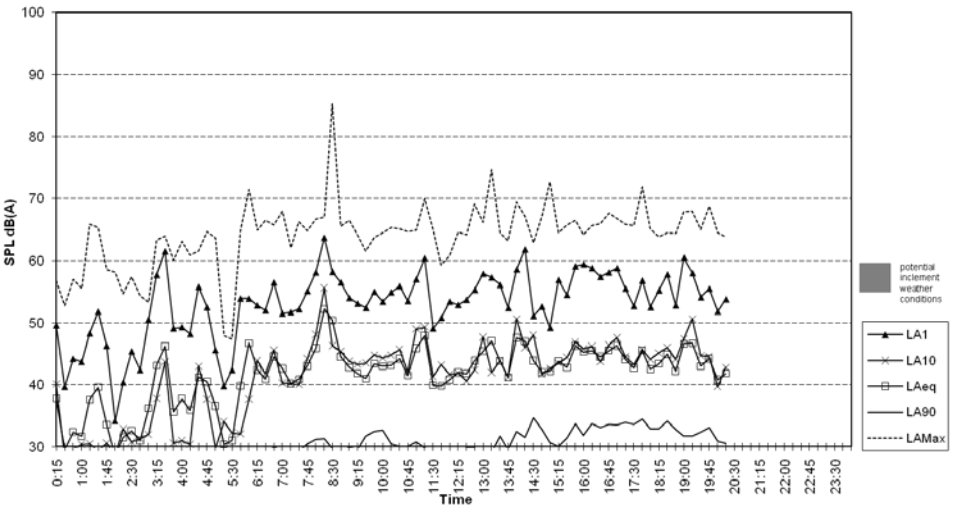
Location C - Castlereagh Street, Tahmoor
Measured Noise Levels - Friday 4th February, 2011



Location C - Castlereagh Street, Tahmoor
Measured Noise Levels - Sunday 6th February, 2011



Location C - Castlereagh Street, Tahmoor
Measured Noise Levels - Monday 7th February, 2011



Appendix B

Sewerage pump source noise levels

Table B-1 details the measured sound pressure level at 1metre for 134 L/sec sewage pump operations applied in the predictive assessment of potential operational noise impacts. Measurements were undertaken at the existing SPS 920 Sydney Water sewage pumping station.

Table B-1 Adopted1/3 octave band source noise profile for sewage pumps

Octave band centre frequency, Hz										
12.5	25	50	100	200	400	800	1600	3150	6300	
16	31.5	63	125	350	500	1000	2000	4000	8000	
20	40	80	160	315	630	1250	2500	5000	10000	
Measured A-weighted sound pressure level										**Lw dB(A)**
7	8.9	24.2	34	32.5	33.3	40	36.3	50	34.7	
6.6	9.3	23.1	24.8	30.9	36.1	48.4	38.7	40.5	32.9	**54.5**
7.7	13.1	26.1	28.3	31.4	34.8	38.5	46.2	39.8	29.1	

Appendix C

Construction plant source noise levels

Table C-1 details the source sound power levels (SWL) adopted in the construction noise model.

Jack hammering works are associated with potentially annoying tonal or impulsive noise characteristics, with consideration to the ICNG, the excavator with jack hammer SWL has been subject to a 5 dB(A) correction factor addition for potential annoyance noise emissions.

Table C-1 Construction plant sound power levels

Generic plant			
Source	**SWL (L_{Aeq})**	**Source**	**SWL (L_{Aeq})**
20T Excavator	105	Powered Hand-tools	92
Crane	98	Electric generator	90
Backhoe	88	Saw cutter	105
Construction truck	102	Concrete truck	107
Excavator with rock breaker	120	Saw cutter	108
Water cart	100	Compressor	98
Wacker Packer	100	Micro-tunnelling rig	97
Agitator	102	Bentonite pump	89
HDD rig	100	-	-

Notes: Values expressed as dB(A), to nearest 1 dB(A)

Appendix D

Predicted operational noise impacts

Table D-1 Predicted operational noise impacts

Receiver	Predicted $L_{Aeq,15min}$ noise impact, dB(A)					
	SPS 920	SPS 1045	SPS A1	SPS A2	SPS B	SPS C
R1	4	-	-	-	-	-
R2	10	-	-	-	-	-
R3	7	-	-	-	-	-
R4	No impact	-	-	-	-	-
R5	No impact	-	-	-	-	-
R6	No impact	-	-	-	-	-
R7	No impact	-	-	-	-	-
R8	-	15	-	-	-	-
R9	-	No impact	-	-	-	-
R10	-	No impact	-	-	-	-
R11	-	3	-	-	-	-
R12	-	6	-	-	-	-
R13	-	6	-	-	-	-
R14	-	-	No impact	3	-	-
R15	-	-	No impact	No impact	-	-
R16	-	-	No impact	No impact	-	-
R17	-	-	-	-	No impact	-
R18	-	-	-	-	No impact	-
R19	-	-	-	-	3	-
R20	-	-	-	-	-	3
R21	-	-	-	-	-	2
R22	-	-	-	-	-	No impact
R23	-	-	-	-	-	5
R24	-	-	-	-	-	6
R25	-	-	-	-	-	6
R26	-	-	-	-	-	8
R27	-	-	-	-	-	8
R28	-	-	-	-	-	20

Appendix E

Calibration certification

Acoustic Research Laboratories
Proprietary Limited A.B.N. 47 050 100 804
Noise and Vibration Monitoring Instrumentation for Industry and the Environment

Sound Level Meter Test Report

Report Number : 10275

Date of Test : 03/06/2010

Report Issue Date : 04/06/2010

Equipment Tested/ Model Number: **EL-316 Environmental Noise Logger**

Instrument Serial Number: 16-306-008

Microphone Serial Number: 313046

Preamplifier Serial Number: 27585

Client Name : Parsons Brinckerhoff

Level 27, Ernst & Young Centre,
680 George Street

Sydney NSW 2000

Contact Name : Aaron McKenzie

Tested by : Michelle Youssef

Approved Signatory :

Date : 4 June 2010

NATA
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Telephone +61 2 9484 0800 ♦ Facsimile +61 2 9484 0884
www.acousticresearch.com.au

Acoustic Research Laboratories
Proprietary Limited A.B.N. 47 050 100 804
Noise and Vibration Monitoring Instrumentation for Industry and the Environment

Sound Level Meter Test Report

Report Number : 09228

Date of Test : 27/05/2009

Report Issue Date : 29/05/2009

Equipment Tested: **Real Time Sound Acquisition System**

Model Number: Ngara S-Pack

Serial Number: 878031

Client Name : Parsons Brinckerhoff

Level 27 Ernst and Young Centre 680 George St

Sydney NSW 2000

Contact Name : Steven Walker

Tested by : Paul Chi

Approved Signatory :

Ken Williams

Date : **29/05/2009**

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Acoustic Research Laboratories
Proprietary Limited A.B.N. 47 050 100 804
Noise and Vibration Monitoring Instrumentation for Industry and the Environment

Sound Level Meter Test Report

Report Number : 09227

Date of Test : 27/05/2009

Report Issue Date : 29/05/2009

Equipment Tested: **Real Time Sound Acquisition System**

Model Number: Ngara S-Pack

Serial Number: 878043

Client Name : Parsons Brinckerhoff

Level 27 Ernst and Young Centre 680 George St

Sydney NSW 2000

Contact Name : Steven Walker

Tested by : Paul Chi

Approved Signatory :

Ken Williams

Date : **29/05/2009**

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Acoustic Research Laboratories
Proprietary Limited A.B.N. 47 050 100 804
Noise and Vibration Monitoring Instrumentation for Industry and the Environment

Sound Level Meter Test Report

Report Number : 09357

Date of Test : 06/08/2009

Report Issue Date : 06/08/2009

Equipment Tested: **Rion Sound Level Meter**

Model Number: NA-27

Serial Number: 10552408

Client Name : Parsons Brinckerhoff

Level 27, Ernst & Young Centre, 680 George Street

Sydney NSW 2000

Contact Name : Vesna Cokleska

Tested by : Morgan Rae

Approved Signatory :

Ken Williams

Date : **6 August 2009**

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