APPENDIX E

Noise and Vibration Impact Assessment Addendum

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WALLARAH 2 COAL PROJECT
NOISE AND VIBRATION IMPACT ASSESSMENT
ADDENDUM

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1.0 BACKGROUND

The Wyong Areas Coal Joint Venture (WACJV) is seeking development consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Wallarah 2 Coal Project (the Project). The key features of the Project include:

- A deep underground longwall mine extracting up to 5 million tonnes per annum (Mtpa) of export quality thermal coal;
- The Tooheys Road Site between the M1 Motorway and the Motorway Link Road, which includes a portal, coal handling facilities and stockpiles, water and gas management facilities, small office buildings, workshop, rail spur, train load out bin and connections to the municipal water and sewerage systems;
- The Buttonderry Site near the intersection of Hue Hue Road and Sparks Road, which includes administration offices, bathhouse, personnel access to the mine, ventilation shafts and water management structures;
- The Western Shaft Site in the Wyong State Forest, which includes a downcast ventilation shaft and water management structures;
- An inclined tunnel (or "drift") from the surface at the Tooheys Road Site to the coal seam beneath the Buttonderry Site;
- Transportation of product coal to the Port of Newcastle by rail; and
- An operational workforce of approximately 300 full time employees.

The Project has been subject to the assessment process under Division 4.1 of Part 4 of the EP&A Act, including a review by the Planning Assessment Commission (PAC). In June 2014, the PAC concluded that *'if the recommendations concerning improved strategies to avoid, mitigate or manage the predicted impacts of the project are adopted, then there is merit in allowing the project to proceed*'.

Following the review by the PAC, the Tooheys Road Site was re-designed to avoid land use conflicts with third parties. The changes to the Project include:

- Removal of the previously proposed rail loop;
- Re-location of the previously proposed rail spur to the eastern side of the Main Northern Rail Line;

- Re-location of the train load out facility to the eastern side of the Main Northern Rail Line;
- A conveyor system to deliver product coal from the stockpile to the new train load out facility; and
- Realignment of the sewer connection.

These proposed changes are referred to as the 'Amendment'. All other aspects of the Project remain identical to the original proposal.

To give effect to the proposed changes to the Project, WACJV is seeking an amendment to the Development Application (DA) under clause 55 of the *Environmental Planning and Assessment Regulation 2000.* This report forms part of the "*Amendment to Development Application SSD-4974"* (Amendment Document) being prepared by Hansen Bailey to support the application to amend the DA.

This report assesses the environmental impacts of the Amendment and where necessary, recommends additional management and mitigation measures to ameliorate these impacts. Aspects of the Project that are unchanged have not been reconsidered. The impacts associated with these aspects of the Project will remain as assessed in the *Wallarah 2 Coal Project Environmental Impact Statement* (Hansen Bailey, 2013).

2.0 OVERVIEW

To give effect to the proposed changes to the Project, WACJV is seeking an amendment to the Development Application (DA) under clause 55 of the *Environmental Planning and Assessment Regulation 2000.* This report forms part of the *Amendment Document* being prepared by Hansen Bailey to support the application to amend the DA.

The report assesses environmental noise and vibration impacts of the proposed changes to the Tooheys Road Site and where necessary, recommends additional management and mitigation measures to ameliorate these impacts. Aspects of the Project that are unchanged have not been reconsidered in detail in this report. The impacts associated with these aspects of the Project will remain as assessed in the *Wallarah 2 Coal Project Environmental Impact Statement* (Hansen Bailey, 2013).

The noise and vibration impact assessment has been prepared in accordance with the Director-General's Environmental Assessment Requirements (DGRs) for the Project, which were issued on 12 January 2012 in accordance with the requirements in Part 2 of Schedule 2 to the *Environmental Planning & Assessment Regulation 2000* (EP&A Regs).

This report presents the results, findings and recommendations of additional ambient background noise monitoring, field investigations, noise modelling, an assessment of noise and vibration due to the Amendment, together with conceptual mitigation design and management options.

The main aims of the assessment are to:

- Identify acoustic benefits from the relocation of the train load out facility and rail infrastructure,
- Identify residential areas/properties and other sensitive areas potentially exposed to noise/vibration impacts from the Amended Project;
- Measure, assess and comment on additional ambient background noise levels;

- Establish Project Specific Noise Criteria (PSNC) and vibration assessment goals in accordance with NSW Office of Environment and Heritage (OEH) Industrial Noise Policy (INP), OEH NSW Road Noise Policy (2011) (RNP), the Interim Construction Noise Guideline (ICNG), and Assessing Vibration: a technical guideline (AVTG*)*.
- Model noise and vibration emissions from the Amended Project; and
- assess the predicted noise and vibration levels for sensitive receivers.

The information presented in the report has been prepared for the investigation described herein, and should not be used in any other context or for any other purpose without agreement and written approval from Atkins Acoustics and WACJV.

3.0 SITE DESCRIPTION AND PROPOSAL

The proposed Amendment includes conveyors, transfer stations, train load out facility and a rail spur adjacent to the existing MNRL.

3.1 Conceptual Conveyor System

The conveyor design capacity will be up to approximately 4500 tonne per hour. The conveyor will be a belt type, open trough conveyor that will predominately follow the existing ground terrain. The conveyor will be located on WACJV land, Crown Land (under a lease to Boral), the RMS corridor for the Motorway Link Road and a Crown Road (Nikko Road). The conveyor will pass over the Main Northern Rail Line (MNRL) beside the Motorway Link Road bridge.

The overland conveyor will have a drive and transfer to a bin feed conveyor. The coal transfer point will be a “hood and spoon” configuration housed in a transfer building.

The bin loading conveyor will be predominately ground mounted, running parallel to the rail spur. It will potentially feed the train load out facility about 5m off the centre of the MNRL. There will be a vehicular track for access and maintenance along the side of the conveyor.

The configuration of the rail load out facility will be defined in the detailed design phase of the Project. It will need to be configured in consideration of the coal stockpile capacity, conveyor rates and train loading schedule requirements. The bin is nominally 12 m in diameter, 29 m in height and has a maximum nominal capacity of approximately 1,000 t. The bin could be enclosed in an acoustic cladding, if required by noise modelling. There would be automated controls with track weigh scales inserted before and after the bin along with other standard controls.

3.2 Rail information

The connection of the rail spur to the mainline is just south of the Gosford Road Rail Bridge and the entire spur is north of the Motorway Link Road. The total length of the

spur is approximately 2,300m.

The northern end of the spur will be within the existing rail corridor prior to the rail spur angling east into the Crown Road. The rail spur continues south on the Crown Road. All train loading infrastructure is located on the Crown Road.

Rail loading will be undertaken at a nominal rate of approximately 2,500 tph to 5,000 tph. Train speed at loading will be at approximately 0.9 kilometres per hour. Potential noise and vibration impacts associated with the Project include construction, conveyors, train loading and road traffic during construction.

It is envisaged that construction would be undertaken over a period of approximately twenty four (24) months. The site infrastructure *(Figure 1)* includes:

- rail spur;
- conveyors;
- transfer stations; and
- train loading facilities.

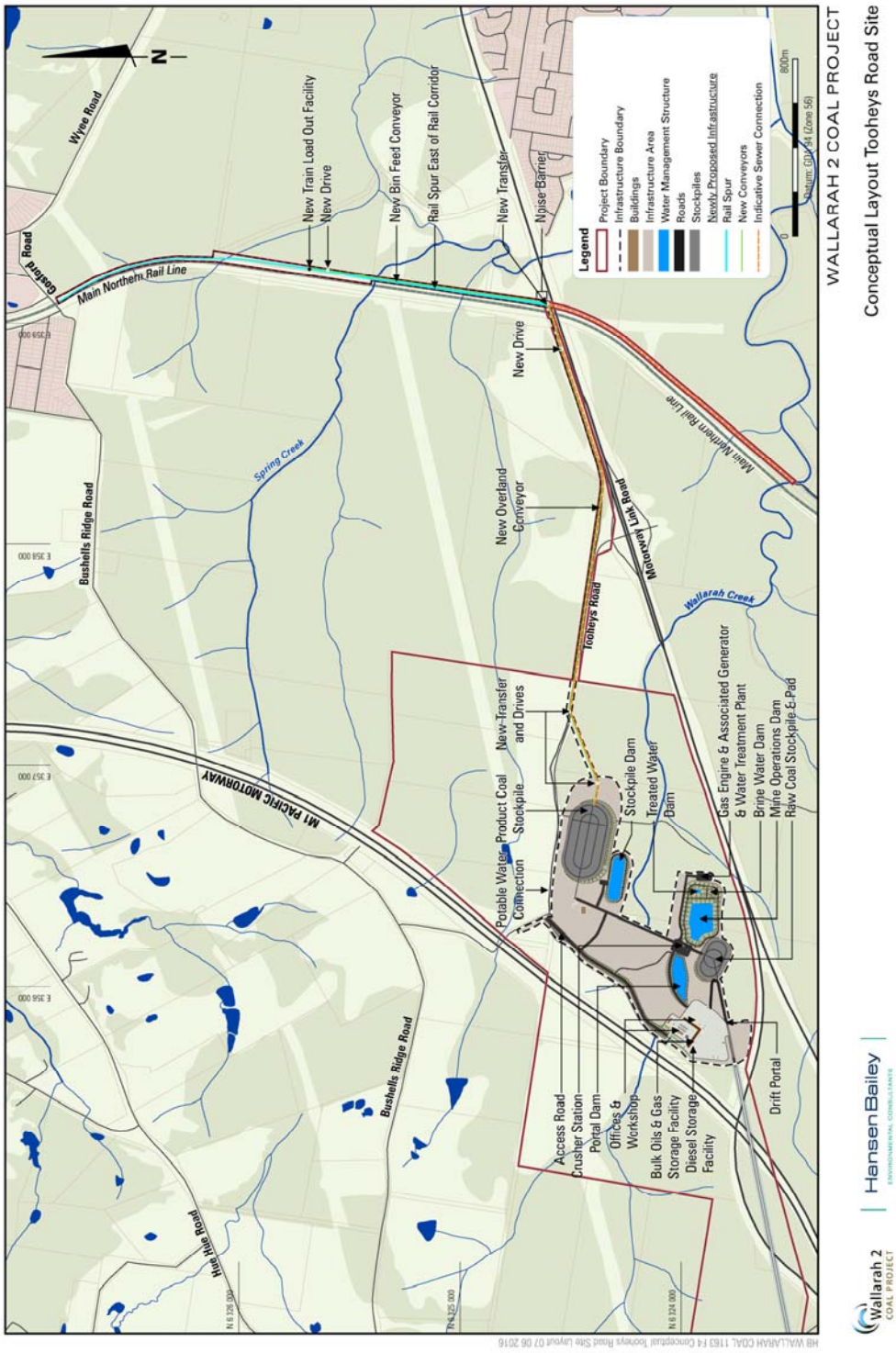
3.3 Noise Sources

The main operational noise sources include conveyors and train loading. To ameliorate noise the following strategies have been adopted for noise modelling:

- low noise rated conveyors and motor drives;
- conveyor structures with side and roof screens to provide effective directional noise amelioration;
- acoustic treated train load out bin;
- acoustic treatment to Transfer Building C;
- a 50 metre long 4.5 m high (above top of rail) cutting/ noise barrier at the southern end of the rail spur. Final details to be dependent on finished site RL's;
- to control impact noise, the coal out load bin will incorporate level sensors to maintain a coal base for falling coal;
- acoustically insulated conveyor head/transfer plates;

- conveyor motor drives and gearboxes on conveyors specified to achieve a noise level of less than 85dBA measured at one (1) metre;
- discussions with Sydney Trains have confirmed that there is no compliance requirement to sound the horn for routine train movements entering or departing the rail spur.
- WACJV will address the controlled use of train horns in the relevant management plan as well as in contractual arrangements with the relevant rail service provider;
- the rail spur will be used for low speed train loading. Various design and operating initiatives will be implemented to control shunting noise, especially at night and associated with low speed impacts between wagons during loading.
- the gradient design along the rail spur to maximise the length and duration of train movements while wagons are in tension;
- the use of rigid dual wagon units, effectively halving the number of points where any wagon impacts could occur;
- switching off the southern locomotive engines when on the rail spur;
- the installation of advanced locomotive operating systems such as asynchronous drive locomotives which control and share the propulsion among the locomotives between the front and rear of the train for maintaining optimum tension;
- telemetry loading system controlling the continuous slow movement of the train throughout the automated loading operation, avoiding stop-start movements;
- absence of tight radius curves along the rail spur will avoid wheel squeal.

Figure 1: Conceptual Tooheys Road Site Layout



3.4 Operating Hours

The mine and infrastructure would operate 24 hours, 7 days per week.

3.5 Road Traffic Generation

The likely public road routes taken by maintenance, construction, delivery and service vehicles during operation and construction would be via the Motorway Link Road, Thompson Vale Road and Spring Creek Road.

3.6 Rail Traffic Generation

Coal produced from the Tooheys Road Site would be transported to the Port of Newcastle via the MNRL.

Noise and vibration from the MNRL corridor is addressed in the previous noise and vibration assessment.

Coal haulage is anticipated to be undertaken in campaigns with four (4) trains per day. The basis of the design is to provide for four (4) locomotives and up to sixty (60) one hundred (100) tonne wagons. The anticipated train speed during loading is 0.9 kph.

3.7 Construction Hours

Surface construction activities would be undertaken between 7.00am and 6.00pm Monday to Friday, and 7.00am to 1.00pm Saturday. Some works outside standard hours (WOSH) are proposed where track possessions would be required. It is understood that WOSH rail infrastructure works would be the subject to a separate approval. Other WOSH would only be undertaken where it could be demonstrated that noise would not impact on residential receivers.

4.0 EXISTING AMBIENT NOISE ENVIRONMENT

For the purpose of assessing the existing ambient noise, attended and unattended audits were undertaken during February 2016. The referenced measurement locations *Table 1* are shown in *Figure 2.* The measurement results have been evaluated in accordance with the INP assessment procedures to confirm existing Rating Background Levels (RBLs) and ambient noise levels and develop Project Specific Noise Criteria (PSNC).

Site attended audits confirmed that the local acoustic environments are influenced by road and the MNRL rail traffic, natural sources and localised domestic activities. Traffic noise exposure is dependent on the location and proximity to the Motorway (Doyalson) Link Road and Bushells Ridge Road. Distant road traffic noise was audible at Bushells Ridge Road during calm and source (road) to receiver wind conditions. Industrial activities in the vicinity of the rail facility include the Boral quarry and tile manufacturing plant. Audits during the site attended measurements confirmed that no industrial noise was audible at the monitoring locations and road and rail traffic influenced the ambient noise.

4.1 Instrumentation

The instrumentation selected for the ambient noise measurements comprised RTA Technology Pty Ltd (RTA) Environmental Noise Loggers. Each instrument was set to A-weighting, fast response and 15 minute sampling periods. The reference level of each instrument was checked in the field prior to and after the measurements with a National Association of Testing Authorities (NATA) calibrated Bruel & Kjaer Sound Level Calibrator Type 4230, Serial No. 623590, with no significant drift recorded.

The ambient noise levels were measured and assessed as percentile A-weighted sound levels. The parameters regarded as being the most important amongst these for environment noise assessment purposes, are the "L_{A90}", the level exceeded for 90% of the sample period and referenced as the "background or average minimum noise level"; and "L_{Aeq}", which is the A-weighted energy equivalent continuous (constant) sound level.

Figure 2: Reference Measurement and Assessment Locations

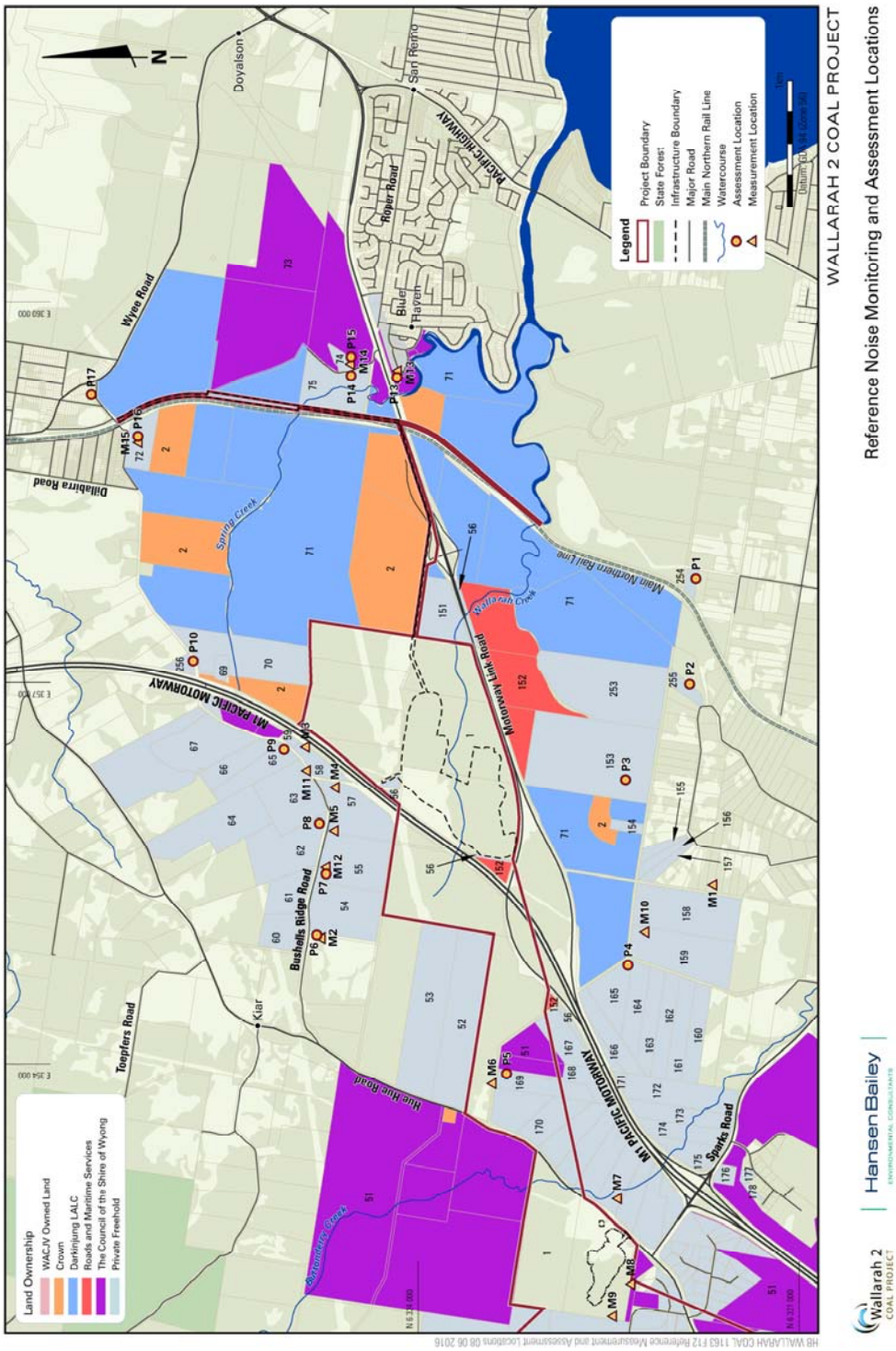


Table 1. Reference Noise Measurement Locations

2016 Reference Location	Noise Catchment Area	Reference Property	Measurement Location	Description of Ambient Noise Sources
M13	Blue Haven	19 Popran Way, Blue Haven	Rear of House	Motorway Link Road traffic, rail traffic; localised domestic activities
M14	Isolated Residences	Thompson Vale Road	North of Residence	Motorway Link Road traffic, rail traffic; localised domestic activities
M15	Wyee South	555 Bushell Ridge Road	East of Residence	Distant road traffic, rail traffic, localised domestic activities

4.2 Results

From the noise measurement results and INP assessment procedures, the Rating Background Level (RBL) and ambient $L_{Aeq, (Period)}$ levels were established. The RBL is the median of the tenth percentile background levels for each assessment period. The $L_{Aeq, (Period)}$ level represents the measured energy averaged noise level for each assessment period. *Table 2* presents a summary of the RBLs and ambient $L_{Aeq, (Period)}$ levels for the daytime, evening and night-time assessment periods.

Table 2 Assessment RBLs and LAeq Noise Levels

Date	Assessment Background Level RBL			Equivalent Continuous Level $L_{Aeq, (Period)}$		
	Day	Evening	Night	Day	Evening	Night
Location M13: Popran Way Blue Haven						
RBL	49	45	39			
Ambient L_{Aeq}				57	55	54
Location M14: Thompson Vale Road						
RBL	37	39	37			
Ambient L_{Aeq}				53	49	49
Location M15: Bushells Ridge Road						
RBL	33	39	34			
Ambient L_{Aeq}				45	48	43

1. Daytime: 7.00am to 6.00pm, Monday to Saturday and 8.00am to 6.00pm Sundays and Public Holidays.
2. Evening: 6.00pm to 10.00pm, Monday to Sunday and Public Holidays
3. Night: 10.00pm to 7.00am Monday to Saturday and 10.00pm to 8.00am Sundays and Public Holidays.

4.3 Meteorological Conditions

Meteorological conditions during the noise monitoring were characterised by generally low wind speeds (<3m/s), air temperatures between 22°C and 34°C, and no rain. The meteorological conditions during the measurement periods were considered to be acceptable for outdoor noise measurement.

5.0 PROJECT SPECIFIC NOISE CRITERIA

Noise was identified by the Director General (DG) of the Department of Planning and Infrastructure as a key issue with respect to the Project. Accordingly, the DGRs required a quantitative assessment of potential construction, operational and off-site transport noise impacts. In relation to noise, the DGRs refer to specific issues from the NSW OEH and assessment guidelines that should be addressed.

Guidelines and policies identified by the NSW OEH as being relevant for assessing environmental noise and vibration from industrial activities and transport infrastructure include Industrial Noise Policy (EPA 2000) (INP), Interim Construction Noise Guideline (DECC. 2009) (ICNG); Road Noise Policy (OEH 2011) (RNP) and Assessing Vibration: a technical guideline (OEH, 2006) (AVTG).

5.1 Operational Noise

Procedures for establishing operational noise criteria from industrial sources including coal mines are documented in the INP. The assessment procedures have two (2) components and were developed for the purpose of:

(1) controlling intrusive noise; and

(2) maintaining noise level amenity for particular land uses for residences and other uses.

The intrusiveness of a noise is considered to be acceptable if the $L_{Aeq,\ 15\ minute}$ level from the source does not exceed the RBL by more than 5dBA. In order to assess noise amenity, the source $L_{Aeq,\ Period}$ levels should not normally exceed recommended acceptable noise levels *(Table 3).*

When assessing noise impacts of industrial sources for residential receivers, both the intrusive and amenity limits are taken into account. In most situations the lowest level becomes the limiting criterion and used to determine the PSNC. The OEH recognises (INP Section 1.4.1) that in setting noise criteria the levels established in accordance with the INP assessment procedures are best regarded as planning tools and not mandatory.

The OEH recognises that an application for a noise producing development is not determined purely on the basis of compliance or otherwise of noise criteria.

For preservation of acoustic amenity, the INP requires industrial noise for residential areas to be within acceptable levels for the locality and land-use. The existing land uses in the vicinity of the proposal would be defined as *Industrial, Rural, Suburban* or *Urban* by the INP. *Table 3* presents a summary of the INP amenity noise criteria for industrial noise sources at residences in rural, suburban and urban settings.

Table 3 INP Noise Policy Amenity Criteria

Receiver Description	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq.\ Period}$ Noise Level	
Residence	Rural (1)	Day Evening Night	50 45 40	55 50 45
	Suburban (2)	Day Evening Night	55 45 40	60 50 45
	Urban (3)	Day Evening Night	60 50 45	65 55 50
Residence within LEP Industrial Zone (4)	All	When in use	70	75

NOTES: Daytime: (7.00am to 6.00pm); Evening: (6.00pm to 10.00pm); Night-time: (10.00pm to 7.00am)

(1) Rural
- an agricultural area, except those used for intensive agricultural activities
- a rural recreational area such as resort areas
- a wilderness area or national park
- an area generally characterised by low background noise levels (except in the immediate vicinity of industrial noise sources

This area may be located in either a rural, rural-residential, environment protection zone or scenic protection zone as defined on a council LEP or other planning instrument

(2) Suburban
- an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce
- or industry. This area often has the following characteristics:
- decreasing noise levels in the evening period (1800-2200); and/or
- evening ambient noise levels defined by the natural environment and infrequent human activity.

This area may be located in either a rural, rural-residential or residential zone, as defined on an LEP or other planning instrument.

(3) Urban
- an area with an acoustical environment that:
- is dominated by 'urban hum' or industrial source noise
- has through traffic with characteristically heavy and continuous traffic flows during peak periods
- is near commercial districts or industrial districts
- has any combination of the above
- where 'urban hum' means the aggregate sound of many unidentifiable, mostly traffic related sound sources.

This area may be located in either a rural, rural-residential or residential zone, as defined on an LEP or other planning instrument, and also includes mixed land-use zones such as mixed commercial and residential uses.

(4) For isolated residences within and industrial zone on an LEP the industrial amenity criteria would usually apply

Considering the measured ambient noise levels *(Table 2*) and the INP procedures, *Table 4* presents a summary of the assessment RBLs, the ambient $L_{Aeq,\ Period}$ levels and PSNC.

When determining noise criteria, the INP recommends that the intrusive night time noise criteria should be set no higher than the intrusive noise criteria for day or evening, and the evening no higher than the intrusive daytime criteria.

In accordance with INP guidelines, operational noise is assessed at the most affected point on or within the residential property boundary, or if this is more than 30m from the residence, at the most affected point within 30m of the residence (INP Section 2.2.1).

Table 4 Noise Criteria for Measurement Locations
dBA re: 20 x 10^{-6} Pa

Period	Recommended Noise Criteria $L_{Aeq, Period}$	Existing RBL	Existing $L_{Aeq, Period}$	Operational PSNC	
				Intrusive $L_{Aeq, 15 min}$	Amenity $L_{Aeq, Period}$
Location M13: Popran Way **					
Day(1)	60-65	49	57	54	60
Evening(2)	50-55	45	55	50	45(6)
Night(3)	45-50	39	54	44	44(6)
Location M14: Thompson Vale Road*_**					
Day(1)	60-65	37	53	42	60
Evening(2)	50-55	39	49	42(7)	50
Night(3)	45-50	37	49	42(7)	45
Location M16: Bushells Ridge Road					
Day(1)	70(8)	33	45	38	70
Evening(2)	70(8)	39	48	38(7)	70
Night(3)	70(8)	34	43	38(7)	70

1. OEH. INP Land Zoning (*) Rural
   (**) Suburban
   (***) Urban
2. Daytime: 7.00am to 6.00pm, Monday to Saturday and 8.00am to 6.00pm Sundays and Public Holidays.
3. Evening: 6.00pm to 10.00pm, Monday to Sunday and Public Holidays
4. Night: 10.00pm to 7.00am, Monday to Saturday and 10.00pm to 8.00am Sundays and Public Holidays.
5. Adjusted to account for localised noise sources.
6. Adjusted to account for existing traffic noise as per INP (Section 2.2.3)
7. Adjusted in accordance with OEH Application Notes
8. LEP Zoning 'Industrial

5.2 Sleep Disturbance

Noise from transient mobile plant and fixed plant operating at night have the potential to emerge above the background ambient and disturb sleep patterns of exposed

residents. Procedures for assessing sleep disturbance from short-term noise events are referenced in the EPA Environmental Noise Control Manual (ENCM) *(Section 19.3)*. The ENCM states that the $L_{A1,\ 1min}$ level measured over a one (1) minute period outside a residential bedroom window should not exceed the repeated L_{A90} background level by more than 15dBA. The assessment of sleep disturbance is complex and not fully understood. The EPA believe that there is insufficient information to recommend an alternative criterion. EPA Road Noise Policy research confirms that maximum internal noise levels below 50-55dBA are unlikely to cause awakening reactions, and one or two noise events per night with maximum internal noise levels of 65-70dBA, are not likely to affect health and wellbeing significantly. The recommended internal levels of 50-55dBA equate to external levels (assuming windows open) of 60-65dBA. Based on the above, the EPA suggest that the $L_{A1,\ 1min}$ level of RBL plus 15dBA is a suitable screening criterion for evaluating sleep disturbance during night hours. Based on the night-time (10.00pm to 7.00am) RBLs, *Table **5*** presents the sleep disturbance assessment criteria.

Table 5 Sleep Disturbance Criteria

Assessment Period	Existing RBL	Sleep Disturbance Assessment Criteria $L_{A1,\ min}$
Location M13: Popran Way		
Night	39	54
Location M14/15: Thompson Vale Road		
Night	37	52
Location M16: Bushells Ridge Road		
Night	33	48

5.3 Project Specific Noise Criteria

For assessment purposes, residential receptor locations with similar acoustic environments have been grouped together. *Table 6* presents a summary of the referenced measurement locations and grouped assessment locations with similar noise environments.

Table 6. Summary of Measurement and Assessment Locations

Reference Measurement Locations	Reference Assessment Locations	INP Indicative Noise Amenity	Assessment Area
M13	P13	Urban	Blue Haven
M14	P14	Urban	Individual
	P15	Urban	Individual
M16	P16	LEP Industrial	South Wyee
	P17	Suburban	South Wyee

5.3.1 Operational Project Specific Noise Criteria

Considering the above intrusive and amenity noise criteria *(Table 4* and *Table 5)* and the referenced residential locations selected for assessing noise from the proposal, *Table 7* provides a summary of the PSNC. Where the amenity criterion is less than the intrusive criterion, the amenity criteria were adopted and assessed as an $L_{Aeq\ 15min}$ level.

Table 7. Operational Project Specific Noise Criteria

Period	Recommended Noise Criteria	Existing RBL	Existing	Project Specific Noise Criteria	
				Operational Noise Criteria	Sleep Disturbance
	$L_{Aeq, Period}$		$L_{Aeq, Period}$	$L_{Aeq, 15 min}$	$L_{A1, 1 min}$
Assessment Location P13 Popran Way					
Day	60-65	49	57	54	-
Evening	50-55	45	55	50	-
Night	45-50	39	54	44	54
Assessment Location P14 Thompson Vale Road					
Day	60-65	37	53	42	-
Evening	50-55	39	48	42	-
Night	45-50	37	49	42	52
Assessment Location P15 Thompson Vale Road					
Day	60-65	37	53	42	-
Evening	50-55	39	49	42	-
Night	45-50	37	49	42	52
Assessment Location P16 Bushells Ridge Road					
Day	70	33	45	38	-
Evening	70	39	48	38	-
Night	70	34	43	38	48
Assessment Location P17 Wyee South (east)					
Day	55-60	33	45	38	-
Evening	45-50	39	48	38	-
Night	40-45	34	43	38	48

5.4 Discussion

The OEH recognises that it does not always follow that all people exposed to noise levels that exceed the PSNC would find the noise unacceptable. Subjectively, an increase in noise of less than 1dBA would not be noticeable and generally classified as negligible; increases of 1 to 2dBA would not be noticeable by most people and classified as marginal; increases of 3 to 5dBA would be moderate and noticeable by some people; while increases greater than 5dBA would be classified as noticeable. For situations where the PSNC are not achieved, the following criteria have been considered.

5.4.1 Undesirable Noise Impacts

For residences where the predicted noise levels exceed the PSNC, the affectation could be described as undesirable. For these situations and where all feasible and reasonable mitigation has been applied to the Project, it is recommended that consideration is given to acoustic treatments to exposed private receivers or discussions with identified property owners with respect to negotiated agreements. For properties identified in the *noise management zone*, agreements would be attempted to be entered into with each of the private property owners. The NSW government's *Voluntary Land Acquisition And Mitigation Policy for State Significant Mining, Petroleum and Extraction Industry Development (VLAMP)* presents consultation, mitigation and acquisition procedures where PSNCs are not satisfied at one or more residential receptors. *Table 8* presents a summary of mitigation and/or acquisition offers to landowners for different degrees of noise impact exposure.

Table 8 VLAMP Noise Categories and Recommended Actions

Noise Category	Project Noise Level	Recommended Action
Negligible	0-2dBA above PSNC	Not a discernible noise impact – no action required
Marginal	3-5dBA above PSNC and Project contributes less than 1dBA at residence	Mechanical ventilation and air conditioning
Moderate	3-5dBA above PSNC and Project contributes more than 1dBA at residence	Mechanical ventilation, air conditioning and faced upgrade
Significant	More than 5dBA above PSNC at residence	Mechanical ventilation, air conditioning and faced upgrade, property acquisition
Significant	More than 5dBA above amenity limit over 25% of land area	Properly acquisition

5.5 Road Traffic Noise

Procedures for assessing road traffic noise from new land use developments are documented in the OEH Road Noise Policy (RNP). *Table 9* presents a summary of the traffic noise assessment criteria recommended for new land use developments.

Table 9. Road Traffic Noise Criteria

Land Use Development	Traffic Noise Criteria		Where Criteria is already Exceeded
	Daytime (7.00am to 10.00pm)	Night-time (10.00pm to 7.00am)	
Land use developments with potential to create additional traffic on local roads	$L_{Aeq,\ 1\ hour}$ 55	$L_{Aeq,\ 1\ hour}$ 50	In all cases, the redevelopment should not increase existing noise levels by more than 2dBA. Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies.
Land use developments with potential to create additional traffic on collector roads	$L_{Aeq,\ 1\ hour}$ 60	$L_{Aeq,\ 1\ hour}$ 55	

6.0 METEOROLOGICAL EFFECTS

Research in the Hunter Valley identified that areas are subject to temperature inversions and seasonal winds. The effects of meteorological conditions can enhance or reduce noise propagation and noise perceived at distant receptors. In the near field, wind has minimal influence on measured downwind sound levels. Wind effects become more important as distances increase. Downwind effects depending on wind speed and distance can increase noise by 1-5dB. Depending on wind speed and distance from a noise source, upwind noise levels can drop by 5-10dB. Temperature gradients create similar enhancement effects to wind, except that the effects are generally uniform in all directions.

Meteorological information for the Project was supplied by *PAE Holmes.* The data includes annual and seasonal wind speed, wind direction and night stability classes.

The meteorological data shows that the percentage occurrence of winds with speeds of less than 3m/s during daytime and evening hours are predominantly from the south to north-east during spring and summer, and south to west during winter and autumn. During night-time hours the predominant winds are from the south-west to north-west. The meteorological data identifies that E and F Stability Class conditions during night hours occur for more than 30% of the time.

Considering the above and the INP assessment procedures, the conditions adopted for noise modelling are summarised in *Table 10*

Table 10. Meteorological Conditions for Noise Modelling

Assessment Period	Meteorological Conditions
Day	North East wind 3m/sec, 20°C, 60%RH
	South East wind 3m/sec, 20°C, 60%RH
	South wind 3m/sec, 20°C, 60%RH
	East wind 3m/sec, 20°C, 60%RH
Night	Calm, 20°C, 60%RH,
	TI 3°/100m, 20°C, 60%RH,
	South wind 3m/sec, 20°C, 60%RH
	South West wind 3m/sec, 20°C, 60%RH
	West wind 3m/sec, 20°C, 60%RH

TI = Temperature Inversion
RH = Relative Humidity

7.0 SCHEDULE OF SITE PLANT AND NOISE SOURCES

7.1 Operational Noise Sources

Noise modelling for the proposal changes considered fixed plant, mobile plant and train loading. A summary of the sound power levels adopted for noise modelling is presented in *Table 11*. The data was developed from reference data and site audits and represents the L_{Aeq} levels and octave band sound power levels (SWL).

Table 11. Equipment Sound Power Levels
dB re: 10^{-12} Watts

Plant Description	Sound Power Level dB re: 10^{-12} Watts									
	dBA	32	63	125	250	500	1k	2k	4k	8k
Conveyor A/50m	87	84	91	93	89	85	82	76	67	54
Conveyor Drive A/Wall	92	88	87	86	88	87	90	83	73	62
Transfer Building A/Wall	94	91	92	91	93	96	83	73	59	50
Conveyor B /50m	87	84	91	93	89	85	82	76	67	54
Conveyor Drive B/Wall	92	88	87	86	88	87	90	83	73	62
Transfer Building B/Wall	94	91	92	91	93	96	83	73	59	50
Conveyor C/50m	87	84	91	93	89	85	82	76	67	54
Conveyor Drive C/Wall	92	88	87	86	88	87	90	83	73	62
Transfer Building C/Wall	86	83	84	83	85	88	73	63	59	50
Conveyor D/50m	87	84	91	93	89	85	82	76	67	54
Conveyor Drive D/Wall	92	88	87	86	88	87	90	83	73	62
Rail Out Load Bin	100	99	100	99	105	106	89	79	75	66
Coal to Wagon	96	102	100	97	93	93	90	89	87	81
Coal Wagons Moving/40m	89	90	93	91	86	86	83	81	79	72
Train Moving/ 40m	96	93	98	93	88	89	94	83	81	76
Loco x 2 (Idle)	104	91	99	104	104	100	100	92	90	85

7.1.1 Intermittent Noise Sources

From our experience in the coal industry, engineered controls have been developed and introduced as part of site developments and site specific PRPs for controlling impact noise. A number of these have been recommended for the Amendment and include,

- laminated transfer chutes at conveyor transfer points,
- acoustically treated train out load bin;
- product level controller installed in the out load bin;
- the gradient design along the rail spur to maximise the length and duration of train movements while wagons are in tension;

- the use of rigid dual wagon units, effectively halving the number of points where any wagon impacts could occur;
- the installation of advanced locomotive operating systems such as asynchronous drive locomotives which control and share the propulsion among the locomotives between the front and rear of the train for maintaining optimum tension;
- telemetry loading system controlling the continuous slow movement of the train throughout the automated loading operation, avoiding stop-starting movements;
- WACJV has been advised by Sydney Trains that there is no compliance requirement to sound the train horn for routine train movements entering or departing the rail spur;

WACJV will also explore the potential for additional noise controls from operational management approaches such as the feasibility to temporarily switch off a locomotive engine at certain idling times or locations.

For modelling and assessment purposes *Table 12* presents a summary of sound power levels adopted for predicting impact noise from coal falling into an empty wagon.

Table 12. Impact L_{A1} Sound Power Levels
dB re: 10^{-12} Watts

Plant Description	Sound Power Level dB re: 10^{-12} Watts									
	dBA	32	63	125	250	500	1k	2k	4k	8k
Coal to Wagon	110	109	108	100	99	103	104	104	104	95

7.2 Off Site Road Traffic Noise

The projected daily traffic generation during construction is summarised in *Table 13.* RMS traffic counts (2004) for the Motorway Link Road confirmed a daily volume of 16,130 vehicles. An annual traffic growth rate of 5.77% was measured during traffic counts from 1995-2004. Assuming an annual traffic growth rate of 5.77%, the estimated 2016 volume is 31,621 vehicles per day.

Construction workers will drive to the Tooheys Road Site and transported to the proposed site of the rail spur by bus. As a result of this arrangement, there would be minimal additional traffic generated on the Motorway Link Road, Crown Road and Thompson Vale Road.

Table 13. Projected Construction Traffic Volumes

Vehicle Type	Vehicle Numbers per day	Vehicle Trips per day
Rigid /Articulated Trucks	10	20
	Total	20

8.0 NOISE MODELLING PROCEDURE AND ASSESSMENT

Noise modelling was undertaken with the OEH approved Environmental Noise Model (ENM) computer model. The ENM is based on digital topographical data for the study area and calculates attenuation factors including distance, shielding from structures, ground vegetation, atmospheric absorption, topographical features and weather effects.

The INP *(Section 5.3.1)* recommends that wind effects be assessed when wind speeds of 3m/s or below occur for at least 30 percent of the time in any assessment period or season. Considering the meteorological and seasonal wind data *(Section 6.0*) noise modelling was undertaken for a number of wind scenarios and temperature inversions.

8.1 Tooheys Road Site (without Rail Loop and original Train Load Out)

Noise modelling was undertaken to assess the acoustic benefits with the relocation of the rail loading facility. *Table 14.Predicted Noise Reduction Levels (Tooheys Road)* presents a summary of changes to the predicted noise levels for the Tooheys Road Site without the previously proposed rail loop, rail out load bin and associated conveyors. The modelling results show that during calm meteorological conditions the predicted levels reduce by up to 0.8dBA compared to the predicted levels for the previous Tooheys Road Site layout. During adverse conditions reductions of up to 1.1dBA were predicted. Subjectively, a change in noise levels of less than 1dBA would not be noticeable and generally classified as negligible; reductions of 1 to 2dBA would not be noticeable by most people and classified as marginal.

Table 14. Predicted Noise Reduction Levels (Tooheys Road)

L_{Aeq} dBA re: 20 x 10^{-6} Pa

Assessment Location	Predicted Noise Reductions dBA							
	Meteorological Conditions							
	Calm	NE 3m/s	E 3m/s	SE 3m/s	S 3m/s	SW 3m/s	W 3m/s	TI 3°C/100m
Assessment Location P1	0.5	0.4	0.6	0.6	0.5	0.4	0.2	0.3
Assessment Location P2	0.1	0.3	0.3	0.2	0.2	0.2	0.1	0.3
Assessment Location P3	0.1	0.3	0.3	0.2	0.2	0.2	0.1	0.2
Assessment Location P4	0.3	0.2	0.2	0.2	0.3	0.3	0.3	0.2
Assessment Location P5	0.3	0.2	0.1	0.2	0.2	0.1	0.1	0.2
Assessment Location P6	0.1	0.7	0.6	0.5	0.3	0.2	0.3	0.3
Assessment Location P7	0.2	0.7	0.7	0.6	0.3	0.1	0.2	0.4
Assessment Location P8	0.4	0.6	0.6	0.5	0.3	0.3	0.4	0.3
Assessment Location P9	0.8	1.0	1.0	0.6	0.5	0.5	0.6	0.6
Assessment Location P10	0.6	1.1	0.9	0.7	0.8	0.8	0.6	0.6

8.2 Tooheys Road Site (New Conveyors and Rail Spur)

Operational noise modelling for the new infrastructure included in the Amendment assumed the conveyor systems and train loading were operating simultaneously. *Table 15* and *Table 16* present the PSNC and predicted operational noise levels for the reference assessment locations and noise catchment areas.

Table 15 Predicted Operational Noise Levels (Day/Evening)

L_{Aeq} dBA re: 20 x 10^{-6} Pa

Assessment Location	Predicted Sound Pressure Levels dBA							
	Meteorological Conditions							
	PSNC	Calm	NE 3m/sec	E 3m/sec	SE 3m/sec	S 3m/sec	SW 3m/sec	W 3m/sec
Assessment Location P13	54/50	37	39	34	34	35	39	42
Assessment Location P14	42/42	43	44	41	41	43	46	46
Assessment Location P15	42/42	42	42	39	39	42	44	46
Assessment Location P16	38/38	35	33	38	42	42	39	35
Assessment Location P17	38/38	33	30	33	38	40	38	34

Table 16. Predicted Operational Noise Levels (Night)

L_{Aeq} dBA re: 20 x 10^{-6} Pa

Assessment Location	Predicted Sound Pressure Levels dBA					
	Meteorological Conditions					
	PSNC	Calm	TI °C/100m	S 3m/sec	SW 3m/sec	W 3m/sec
Assessment Location P13	44	37	40	35	39	42
Assessment Location P14	42	43	45	43	46	46
Assessment Location P15	42	42	44	42	44	46
Assessment Location P16	38	35	39	42	39	35
Assessment Location P17	38	33	38	40	38	34

The results in *Table 15* and *Table 16* show that the PSNC *(Table 7)* are satisfied at P13 and the Blue Haven noise catchment area. For the residences on Thompson Vale Road (P14 and P15) the predicted levels exceed the PSNC by up to 4dBA and satisfy the INP recommended amenity level for industrial/transition zoned land. The predicted levels for P14 and P15 represent a 'Moderate' degree of affectation (*Table 8*), and trigger the requirement for mitigation. At the Bushells Ridge Road residence (P16) the predicted levels exceed the PSNC by up to 4dBA and satisfy the INP recommended amenity level for industrial zoned land. The predicted levels for P16 represent a 'Moderate' degree of affectation (*Table 8*), and trigger the requirement for mitigation. For the Wyee South noise catchment area the predicted level the predicted levels for a south wind exceed the PSNC by up to 2dBA and satisfy the INP recommended amenity level for residential land in a 'suburban' area. The predicted levels for Wyee South (P17) referenced to *VLAMP* represent a 'Negligible' degree of affectation (*Table 8*), and does not trigger a requirement for mitigation. For descriptive purposes, noise contours plots are presented in *Attachments 5 to 12.* The noise plots are presented for visual purposes only, compliance with the recommended PSNC should be confirmed against the predicted levels *in Table 15* and *Table 16.* The noise contour plots *(Attachments 2)* show for privately owned land predicted noise levels do not exceed the *INP (Table 2.1)* recommended maximum levels for more than 25% of the land. Reviewing the Darkinjung land ownership and the 50dB night-time noise contour the estimated land area affected by the 50dB contour (night) is approximately 14ha, less than 1% of the total land.

8.2.1 Impact Noise Assessment

Table 17 presents a summary of the PSNC and predicted impact noise levels for the reference locations and noise catchment areas

Table 17. Predicted LA1 Noise Levels

$L_{A1,}$ dBA re: 20 x 10^{-6} Pa

Assessment Location	Predicted Sound Pressure Levels dBA					
	Meteorological Conditions					
	PSNC	Calm	TI °C/100m	S 3m/sec	SW 3m/sec	W 3m/sec
Assessment Location P13	54	30	36	25	26	34
Assessment Location P14	52	39	41	34	36	40
Assessment Location P15	52	38	40	34	36	40
Assessment Location P16	48	32	36	39	36	29
Assessment Location P17	48	30	33	37	35	31

The results in *Table 17* show that the predicted maximum noise levels satisfy the PSNC. With the effective incorporation of noise controls it is not envisaged that site related activities would give rise to maximum noise events that may cause exceedances of the sleep disturbance criteria *(Table 7).*

8.2.2 Rail Traffic Noise

Noise impacts associated with rail traffic on the MNRL are addressed in the *Wallarah 2 Coal Project Environmental Impact Statement* (Hansen Bailey, 2013) and Hansen Bailey (2013b), Wallarah 2 Coal Project Response to Submissions, Section 3.8.5 Rail Noise. The original proposal provided for three (3) locomotives at front of train either 38 x 120t or 40 x 100 t wagons and six (6) train trips (12 movements) per day.

The Amended Project provides for four (4) locomotives - 2 at front and 2 at rear, 60 x 100t wagons and only four (4) train trips (8 movements) per day. Depending on which available train paths are used, there will either be five (5) day, three (3) night or four (4) day, four (4) night additional train movement on the MNRL per day. As such, the rail noise modelling was rerun with this configuration.

Modelling for the Amended Project shows that day/night predicted noise level contributions from the revised train movements reduce by up to $L_{Aeq\ 15\ hour}$ 0.4dBA (day) and $L_{Aeq\ 9\ hour}$ 0.7dBA (night). These modelled values predict that the Amended Project will continue to meet the relevant criteria in the 'Rail Infrastructure Noise Guideline' (RING) (EPA 2013), i.e. The Amended Project will not increase the existing LAeq noise levels by more than 2dBA.

9.0 CONSTRUCTION

For the purpose of noise modelling, an indicative construction plan and works method is outlined in the report for civil and construction works.

Detailed construction staging plans and works methods will be prepared should Development Consent be granted. The actual construction method and staging may vary from the description presented in the report; however methods employed will ensure noise levels do not exceed the predictions in this assessment.

Construction of the rail spur will be carried out in three (3) phases. The preparatory phase work will isolate the construction zone from the MNRL and relocate or protect existing services and utilities. The second phase comprising major civil works will include earthworks and the construction of culverts and bridges. The third phase will include track construction and installation of signalling and communications facilities.

The plant and equipment likely to be used during the works include excavators, dozers, tippers, trucks, graders, vibratory rollers, compactors, concrete trucks and pumps, cranes, track laying machine, tamper, ballast regulator, rail grinding machines and water carts.

9.1 Construction Activities and Schedule

The construction works are expected to be completed over a nominal duration of 24 months from the commencement. An indicative schedule showing the duration of each construction stage is provided in *Table 18.* The scheduling is subject to change as a result of construction and ARTC requirements.

Table 18 Construction Stages and Scheduling

Major Staging	Timing	Description
Site Establishment	Q3 $_{2018}$ - Q4 $_{2018}$	Clearing, mulching, fencing, access roads, compounds
Conveyor Systems		
Conveyor Construction (CH 00 to CH 2280)	Q1 $_{2019}$ - Q3 $_{2019}$	Footing preparation, concrete pours, steel and structure erection
Conveyor Construction (over MNRL)	Q1 $_{2019}$ – Q3 $_{2019}$	Footing preparation, concrete pours, steel and structure erection
Rail Spur		
Bridge at CH 112080	Q3 $_{2019}$ – Q4 $_{2019}$	Earthworks, footing preparation, steel preparation, concrete pours
Bridge at CH 112480	Q3 $_{2019}$ – Q4 $_{2019}$	Earthworks, footing preparation, steel preparation, concrete pours
Bulk Earth Works	Q4 $_{2019}$ – Q1 $_{2020}$	Cut and fill, drainage
Construction of Train Load Out CH112780	Q4 $_{2019}$ - Q1$_{2020}$	Footing preparation, concrete pours, steel and structure erection
Conveyor Construction along MNRL	Q4 $_{2019}$ – Q2 $_{2020}$	Footing preparation, concrete pours, steel and structure erection
Track Construction	Q2 $_{2019}$ – Q2 $_{2020}$	Ballast, sleeper and rail installation
Decommissioning	Q4 $_{2019}$ – Q2 $_{2020}$	Removal redundant equipment, compounds and work areas

10.0 CONSTRUCTION NOISE AND VIBRATION CRITERIA

For major construction projects undertaken in NSW, the OEH recommend procedures for assessing noise and vibration impacts. Publications released and referred to by the OEH with reference to the assessment of construction noise and vibration impacts include the *Interim Construction Noise Guideline (2009)* and *Assessing Vibration: a technical guideline* (ICNG*).* The ICNG recommends that construction noise associated with mining be assessed under the *Industrial Noise Policy* (INP).

Albeit not directly related to construction noise from mining proposals, the ICNG was developed in response to concerns raised with respect to construction noise impacts. The primary objective of the ICNG is aimed at managing noise from construction works regulated by the OEH. The guideline deals with procedures to:

- promote a clear understanding of ways to identify and minimise noise from construction works;
- focus on applying all 'feasible and reasonable' work practices to minimise construction noise impacts;
- encourage construction to be undertaken during recommended hours;
- streamline the assessment and approval stages;
- reduce time spent dealing with complaints at the Project implementation stage; and
- provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

The OEH recognises that feasible work practices are practical to implement, while reasonable work practices take into account the balance of costs and benefits and community views. Work practices recommended by the OEH can include notifying the community of expected noise impacts and when they are expected to occur.

It is recognised that the procedures and recommendations published in the ICNG for assessing noise from construction activities are best regarded as planning tools. They are not mandatory, and their application for assessing construction noise is not determined purely on the basis of compliance or otherwise with numerical noise levels.

For the purpose of assessing and managing construction noise impacts, the ICNG refers to the proposed construction hours and the duration of the works. For construction works extending more than three (3) weeks a 'quantitative assessment method' is recommended. For construction works that are unlikely to affect an individual or sensitive land use for more than three (3) weeks in total, the ICNG refers to a 'qualitative assessment method'.

Therefore the proposed construction, which will last approximately two years, was assessed using a 'qualitative assessment method'.

10.1 Standard Construction Hours

The OEH recommended standard hours for construction are summarised in *Table 19*. Albeit the OEH recognise that the recommended hours are not mandatory and that there would be situations where construction works may be undertaken outside of these hours (if inaudible at any private receiver).

Table 19. Recommended Standard Construction Hours

Work Type	Recommended Standard Hours of Work*
Normal Construction	Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1.00pm No works on Sundays or public holidays

* The relevant authority (consent, determination or regulatory) may impose more or less stringent construction hours

10.2 Quantitative Noise Assessment Method

The ICNG refers to quantitative assessment methods involving predicted noise levels and comparing them with levels developed from Chapter 4 of the ICNG. For assessment purposes, the RBL is used when determining the Noise Management Level (NML). *Table 20* sets out NMLs for private receivers and how they are applied. Restrictions to construction hours may apply to activities that generate noise at residences above the 'highly noise affected ' NML *(Table 20)*. For construction during standard daytime hours,

a NML of RBL +10dBA applies for residential receivers. For construction work outside standard hours (WOSH), a NML of RBL +5dBA applies for residential receivers.
With respect to the INP assessment procedures, a NML of RBL +5dBA applies for residential receivers. Where the predicted noise levels exceed the NMLs, the ICNG recommends that all feasible and reasonable measures should be investigated to minimise impacts.

If the predicted construction noise levels exceed 75dBA, respite periods may need to be introduced. This may require restrictions on construction hours, where the community is prepared to accept a longer construction program.

Table 20. Noise at Residences (ICNG Quantitative Assessment)

Time of Day	Management Level LAeq, 15 min	How to Apply
Recommended Standard Hours: Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1.00pm No works on Sundays or public holidays	Noise affected RBL+10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ 15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences). 2. If the community is prepared to accept longer period of construction in exchange for restrictions on construction times
Work Outside Standard Hours (WOSH)	Noise affected RBL+5dB	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where feasible and reasonable practices have been applied and noise is more than 5dB above the noise affected level, the proponent should negotiate with the community

* Noise levels apply at the residential property boundary that is most exposed to construction noise. If the property boundary is more than 30m from the residence the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence.

10.3 Sleep Disturbance at Residences

Where construction works are planned to extend over more than two consecutive nights

and a quantitative assessment method is used, the ICNG recommends that the analysis include the assessment of maximum noise levels and the extent and number of times that the maximum noise level are likely to exceed the RBL.

10.4 Construction Noise Management Levels

Considering the recommendations of the ICNG, the INP and the measured RBLs, the Construction Noise Management Levels (CNML) recommended for evaluating construction noise are summarised in *Table 21*. For assessment purposes, construction noise is assessed at a residential property boundary or 30 metres from a residential dwelling, if the boundary is more than 30 metres from the dwelling.

Table 21. Construction Noise Management Levels
dBA 20×10^{-6} Pa

Period	Existing RBL	Existing LAeq	Construction Noise Management Levels LAeq
Assessment Location P13			
Day	49	57	59
Assessment Location P14			
Day	37	53	47
Assessment Location P15			
Day	37	53	47
Assessment Location P16			
Day	33	45	43
Assessment Location P17			
Day	33	45	43

Notes: Monday to Friday 7.00am to 6.00pm; Saturday 8.00am to 1.00pm
No works on Sundays or public holidays without prior approval

10.5 Ground Vibration

As part of the site preparation, rock may be encountered and accordingly rock hammers may be required. The effect of vibration on humans and structures is assessed and evaluated in terms of annoyance and structural damage.

10.5.1 Annoyance

The OEH, *Assessing Vibration: a technical guideline* recommends criteria for assessing human response and potential disturbance to the occupants of private residences. *Table 22* presents a summary of vibration levels (mm/s) referenced to specific frequency

bands weighted for residential receivers referenced to human response *(BS 6472-1992)*.

Table 22. Vibration Levels for Assessment of Human Comfort

Frequency (Hz)	Vibration Level (mm/s)			
	Continuous Vibration		Intermittent Vibration	
	Day (2)	Night (1.4)	Day (60)	Night (20)
1	3.2	2.2	95	31
1.25	2.3	1.6	68	22
1.6	1.6	1.1	47	15
2	1.1	0.8	33	11
2.5	0.8	0.6	24	8.0
3.15	0.6	0.4	17	5.8
4	0.4	0.3	19	4.0
5	0.3	0.2	9.5	3.2
6.3	0.3	0.2	7.6	2.5
8	0.2	0.1	6.0	2.0
10	0.2	0.1	6.0	2.0
12.5	0.2	0.1	6.0	2.0
16	0.2	0.1	6.0	2.0
20	0.2	0.1	6.0	2.0
25	0.2	0.1	6.0	2.0
31.5	0.2	0.1	5.4	1.8
40	0.2	0.1	6.0	2.0
50	0.2	0.1	6.0	2.0
63	0.2	0.1	6.0	2.0
80	0.2	0.1	6.0	2.0

( ) Multiplying factors with respect to human response

10.5.2 Structural Damage

German Standard DIN4150 Part 3 (1986) provides guidelines for evaluating the effects of v*ibration on structures. The values recommended in the Standard are summarised in Table 23.* The values are the maximum levels measured in any direction at the building foundation.

Table 23. Safety Limits for Structural Damage

Type of Structure	Vibration Level (mm/s)		
	< 10Hz	10Hz to 50Hz	50Hz to 100Hz
Commercial/industrial buildings or buildings with similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20
Structures of great intrinsic value (eg. buildings under preservation)	3	3 to 8	8 to 10

Ref: German Standard DIN4150

10.6 Construction Plant and Equipment

The construction plant schedule assumed for noise modelling and sound power levels are summarised in *Table 24.*

Table 24. Construction Plant Sound Power Levels

dBA re: 10^{-12} Watts

Plant/Equipment	Sound Power Level dBA
Water Cart	101
Front End Loaders	107
Truck and Dog/Semi Trailer	106
Scrapers	113
Track Excavators	110
Graders	107
Excavator (20 tonne)	105
Excavator (30 tonne)	110
Rollers	106
Backhoe	104
Concrete Truck	109
Concrete Pump	105
Truck Mounted Crane	102
Truck mounted auger drill	111
Flatbed Truck	100
Rail Saw	112
Rail Grinder	114

Table 24. Construction Plant Sound Power Levels. Cont'd.
dBA re: 10^{-12} Watts

Plant/Equipment	Sound Power Level dBA
Tamper	111
Ballast Regulator	114
Mulcher/Chipper	103
Vibratory Roller	114
Site Vehicles	84
Crane (100 tonne)	110
Crane (40 tonne)	98
Dump Truck (5 tonne)	95
Dump Truck (15 Tonne)	108
Dozer	113
Small Power Tools	102

10.6.1 Construction Traffic Generation

Construction workers will drive to the Tooheys Road Site and transported to the proposed rail spur construction area by bus. The estimated twenty (20) daily construction traffic trips *(Table 13)* is significantly less than the Motorway Link Road (2004) daily volume of 16,130 vehicles and the estimated 2016 volume of 31,621 vehicles per day. As a result of the additional construction traffic on the Motorway Link Road there would be minimal additional traffic noise generated by the proposal.

10.6.2 Construction Equipment Vibration Emission Levels

During excavation and construction activities associated with access roads and trenches, it may be necessary to use plant and equipment that generates ground vibration. To evaluate the likely effects of these activities, the following *(Table 25)* vibration levels have been considered.

Table 25. Typical Plant Vibration Levels

mm/sec

Plant Description	Vibration Levels mm/sec		
	@ 5m	@ 20m	@ 40m
Dynamic impact roller	9-20	2-4	<1.5
Vibrating roller compactor	20	1.5	<1.0
Rock-breaker (large)	5	0.5	0.3
Rock breaker (light)	1	0.3	0.1
Dozer	2	0.2	0.02
Truck	1	0.05	0.02

10.7 Modelling and Assessment of Construction Noise

Noise predictions for construction considered distance attenuation, shielding and local topographical features.

10.7.1 Construction Scenarios

In order to assess potential noise and vibration impacts during construction, plant and equipment that would be used in each scenario is summarised in. *Table 25.*

Table 25. Construction Scenarios

Major Staging	Plant/Equipment
Site Establishment east MNRL	Hand Tools 1 x Truck and Dog 1 x Excavator 1x Mulcher/Chipper
Conveyor Construction (CH 00 to CH 2280)	1 x Concrete Truck 1 x Crane Hand tools 1 x Dump Truck
Conveyor Construction (over MNRL)	1 x Concrete Truck 2 x Cranes Hand tools 1 x Semi Trailer
Bridge at CH 112080	2 x Concrete Truck 1 x Concrete Pump 1 x Excavator 1 x Crane Hand tools 1 x Dump Truck

Table 26. Construction Scenarios. Cont'd.

Major Staging	Plant/Equipment
Bridge at CH 112480	2 x Concrete Truck 1 x Concrete Pump 1 x Excavator 1 x Crane Hand tools 1 x Dump Truck
Bulk Earth Works	2 x Excavators 1x Dozer 2 x Dump Trucks 1 x Grader 2 x Vibratory Roller 1 x Water Truck
Construction Train Load Out CH112780	1 x Concrete Truck 2 x Cranes Hand tools 1 x Semi Trailer
Conveyor Construction along MNRL	1 x Concrete Truck 1 x Crane Hand tools 1 x Semi Trailer
Track Construction	1 x Track Laying 1 x Tamper 1 x Ballast Regulator 1 x Rail Grinder
Decommissioning	1 x Front End Loader Hand tools 2 x Truck and Dogs

10.7.2 Predicted Construction Noise Levels

Based on the above construction scenarios *(Table 27.)* and sound power levels *(Table 24),* predicted construction noise levels are presented in *Table 27. Table 27.*presents the predicted exceedances of the daytime CNMLs to assist with the identification and management of noise sensitive activities. To minimise potential noise impacts during construction, preference will be given to contractors able to use low noise emission equipment and all site personnel will be inducted and educated with best practice work methods to minimise noise. A Construction Noise and Vibration Management Plan and Monitoring Programme will be implemented. Considering the transient nature of the construction works and exposure to road and rail traffic noise from the Motorway Link Road, the predicted short-term exceedances of the CNMLs are capable of being managed to acceptable levels.

Table 27. Predicted Construction Noise Levels.

Work Stage	Scenario	Reference Receiver	RBL Day/Evening/Night	Construction Noise Management Level; LAeq 15 min		Predicted Noise Level LAeq 15 min	Predicted Exceedance of Noise Management Level dB	
				Standard Day	WOSH		Standard Hours Day	WOSH Day/Evening/Night
1	Site Establishment east MNRL	P13	49/45/39	59	54/50/44	13-38	-	-
		P14	37/39/37	47	42/44/42	14-42	-	-
		P15	37/39/37	47	42/44/42	13-40	-	-
		P16	33/39/33	43	38/44/38	12-16	-	-
2	Conveyor Construction (CH 00 to CH 2280)	P13	49/45/39	59	54/50/44	14-39	-	1/-/1
		P14	37/39/37	47	42/44/42	15-43	-	-
		P15	37/39/37	47	42/44/42	14-41	-	-
		P16	33/39/33	43	38/44/38	13-17	-	-/-/1
3	Conveyor Construction over MNRL	P13	49/45/39	59	54/50/44	45	-	1/-/1
		P14	37/39/37	47	42/44/42	43	-	-/-/1
		P15	37/39/37	47	42/44/42	42	-	-
		P16	33/39/33	43	38/44/38	17	-	-
4	Bridge at CH 112080	P13	49/45/39	59	54/50/44	48	-	-/-/4
		P14	37/39/37	47	42/44/42	58	11	16/14/16
		P15	37/39/37	47	42/44/42	56	9	14/12/14
		P16	33/39/33	43	38/44/38	28	-	-

Table 27. Predicted Construction Noise Levels.

Work Stage	Scenario	Reference Receiver	RBL Day/Evening/Night	Construction Noise Management Level; LAeq 15 min		Predicted Noise Level LAeq 15 min	Predicted Exceedance of Noise Management Level dB	
				Standard Day	WOSH		Standard Hours Day	WOSH Day/Evening/Night
5	Bridge at CH 112480	P13	49/45/39	59	54/50/44	44	-	
		P14	37/39/37	47	42/44/42	53	6	11/9/11
		P15	37/39/37	47	42/44/42	52	5	10/8/10
		P16	33/39/33	43	38/44/38	35	-	
6	Bulk Earth Works	P13	49/45/39	59	54/50/44	28-54	-	-/4/10
		P14	37/39/37	47	42/44/42	57-62	10-15	20/18/20
		P15	37/39/37	47	42/44/42	56-59	9-12	17/15/17
		P16	33/39/33	43	38/44/38	25-49	6	11/5/11
7	Construction Train Load Out CH112780	P13	49/45/39	59	54/50/44	24	-	
		P14	37/39/37	47	42/44/42	47	-	5/3/5
		P15	37/39/37	47	42/44/42	47	-	5/3/5
		P16	33/39/33	43	38/44/38	39	-	1/-/1
8	Conveyor Construction along MNRL	P13	49/45/39	59	54/50/44	23-41	-	
		P14	37/39/37	47	42/44/42	41-54	7	12/10/12
		P15	37/39/37	47	42/44/42	41-51	4	9/7/9
		P16	33/39/33	43	38/44/38	17-28	-	

Table 27. Predicted Construction Noise Levels. Cont'd.

Work Stage	Scenario	Reference Receiver	RBL Day/Evening/Night	Construction Noise Management Level; LAeq 15 min		Predicted Noise Level LAeq 15 min	Predicted Exceedance of Noise Management Level dB	
				Standard Day	WOSH		Standard Hours Day	WOSH Day/Evening/Night
9	Track Construction	P13	49/45/39	59	54/50/44	27-48	-	-/-/4
		P14	37/39/37	47	42/44/42	44-61	14	19/17/19
		P15	37/39/37	47	42/44/42	44-58	11	16/14/16
		P16	33/39/33	43	38/44/38	24-48	5	10/4/10
10	Decommissioning	P13	49/45/39	59	54/50/44	21-42	-	
		P14	37/39/37	47	42/44/42	38-53	8	13/11/13
		P15	37/39/37	47	42/44/42	38-52	5	10/8/10
		P16	33/39/33	43	38/44/38	18-42	-	4/-/4

10.8 Construction Road Traffic

Construction workers will drive to the Tooheys Road Site and transported to the proposed rail spur construction area by bus. The estimated twenty (20) daily construction traffic trips *(Table 13)* is significantly less than the Motorway Link Road (2004) daily volume of 16,130 vehicles and the estimated 2016 volume of 31,621 vehicles per day. As a result of the additional construction traffic on the Motorway Link Road there would be minimal additional traffic noise generated by the proposal.

10.9 Vibration Levels from Construction Activities

The main source of ground vibration that has been identified and assessed is associated with dynamic impact rollers. Ground vibration levels predicted from impact rollers typically range between 2-4mm/sec at 20 metres, and below 1.5mm/sec at 40 metres. Vibration levels are predicted to satisfy the structural damage assessment criteria *(Table 23)* at distances greater than 20 metres and be acceptable from a human disturbance point of view at the closet private receiver (Thompson Vale Road).

11.0 RECOMMENDATIONS

The following operational management strategies should be adopted to assist in controlling noise emissions from the Project:

- Implementation of a proactive strategy to engage predicted noise impacted residences identified in *Section 8.1* to achieve a management outcome agreed to by all parties;
- Development of a Noise Management Plan outlining a noise monitoring program. The program will include attended and noise monitoring at strategic locations to enable evaluation of compliance with relevant criteria;
- Selection of quiet plant for use in construction activities. When using contractors for construction, preference will be given to contractors able to use low noise emission equipment. All construction personnel will be educated in best practice work methods to minimise noise; and
- Implementation of reasonable and feasible noise mitigation measures such as double glazing, insulation and/or air conditioning will be made available to affected landowners, upon request.
- To manage noise level creep from the trains along the MNRL where feasible and reasonable, it is recommended that locomotives approved to operate on the New South Wales rail network are selected in accordance with the noise limits L6.1 to L6.4 in RailCorp and ARTC Environmental Licences.

12.0 CONCLUSION

WACJV is seeking an amendment to the Development Application (DA) under clause 55 of the *Environmental Planning and Assessment Regulation 2000.* This report forms part of the *Amendment Document* being prepared by Hansen Bailey to support the application to amend the DA.

The Amendment includes the construction of conveyor systems, transfer stations, train load out bin and a rail spur adjacent to the existing MNRL.

The report assesses environmental noise and vibration impacts of the Amendment and where necessary, recommends additional management and mitigation measures to ameliorate these impacts. Aspects of the Project that are unchanged (such as the Buttonderry Site) have not been reconsidered in detail in this report. The impacts associated with these aspects of the Project will remain as assessed in the *Wallarah 2 Coal Project Environmental Impact Statement* (Hansen Bailey, 2013).

Site attended background monitoring confirmed that the local acoustic environments at residential properties in the vicinity of the Project are controlled by road and rail noise, natural elements and local domestic activities. Traffic noise exposure for individual properties is dependent on location and exposure to the Motorway Link Road and Bushells Ridge Road.

Noise modelling has been undertaken to assess the acoustic benefits from the relocation of the rail loading facility. *Table 15* presents a summary of predicted noise levels for the Tooheys Road Site without the previously proposed rail loop, rail out load bin and associated conveyors. The results of the noise modelling show for calm meteorological conditions the predicted noise levels reduce by up to 0.8dBA; during adverse conditions reductions of up to 1.1dBA were predicted.

12.1 Operational Noise

The main operational noise sources for the proposal are associated with infrastructure and include conveyors, train loading and locomotives on the rail spur line.

From the measured existing ambient noise levels *(Table 2)* and INP procedures, *Table 7* presents a summary of the assessment RBLs, the L_{Aeq} noise levels and PSNC.

Noise modelling for the Project assumed that the conveyors were operating simultaneously during train loading. *Table 15* and *Table 16* present a summary of the predicted operational noise levels at the reference assessment locations.

The noise modelling for the existing private residential dwellings at Blue Haven show that the PSNC are satisfied.

For the residences on Thompson Vale Road (P14 and P15) the predicted noise levels exceed the PSNC by up to 4dBA and satisfy the INP recommended amenity level for industrial/transition zoned land. The predicted levels for P14 and P15 represent a 'Moderate' degree of affectation (*Table 8*), and referenced to *VLAMP* trigger the requirement for mitigation.

At the Bushells Ridge Road residence (P16) the predicted levels exceed the PSNC by up to 4dBA and satisfy the INP recommended amenity level for industrial zoned land. The predicted levels for P16 represent a 'Moderate' degree of affectation (*Table 8*), and referenced to *VLAMP* trigger the requirement for mitigation.

For the Wyee South noise catchment area the predicted level the predicted levels for a south wind exceed the PSNC by up to 2dBA and satisfy the INP recommended amenity level for residential land in a 'suburban' area. The predicted levels for Wyee South (P17) represent a 'Negligible' degree of affectation (*Table 8*), and referenced to VLAMP does not trigger a requirement for mitigation. . For descriptive purposes, noise contours plots are presented in *Attachments 5 to 12.*

For these situations where all feasible and reasonable mitigation has been applied to elements of the Project, it is recommended that consideration is given to acoustic treatments to exposed private receivers or discussions with identified property owners

with respect to negotiated agreements. For properties identified in the *noise management zone*, WACJV will negotiate with each of the private property owners.

The noise contour plots *(Attachments 2)* show for privately owned land predicted noise levels do not exceed the *INP (Table 2.1)* recommended maximum levels for more than 25% of the land.

12.2 Rail Traffic Noise

Noise impacts associated with rail traffic on the MNRL are addressed in the *Wallarah 2 Coal Project Environmental Impact Statement* (Hansen Bailey, 2013) and Hansen Bailey (2013b), Wallarah 2 Coal Project Response to Submissions, Section 3.8.5 Rail Noise. The original proposal provided for six (6) train trips (12 movements) per day whereas the Amended Project will involve four (4) train trips (8 movements) per day.

Modelling for proposed amendment to the proposal for day/night predicted noise contributions from the revised trains movements reduce by up to $L_{Aeq\ 15\ hour}$ 0.4dBA (day) and $L_{Aeq\ 9\ hour}$ 0.7dBA (night). These modelled values predict that the Amended Project will continue to meet the relevant criteria in the 'Rail Infrastructure Noise Guideline' (RING) (EPA 2013), i.e. The Amended Project will not increase the existing LAeq noise levels by more than 2dBA.

12.3 Road Traffic Noise

Construction workers will drive to the Tooheys Road Site and transported to the proposed rail spur construction area by bus. As a result of the additional construction traffic on the Motorway Link Road there would be minimal additional traffic noise generated by the proposal.

12.4 Construction Noise and Vibration

An indicative construction plan and method is outlined in this report for the civil and construction works. *Table 27.* presents the predicted exceedances of the daytime CNMLs to assist with the identification and management of noise sensitive activities. To minimise

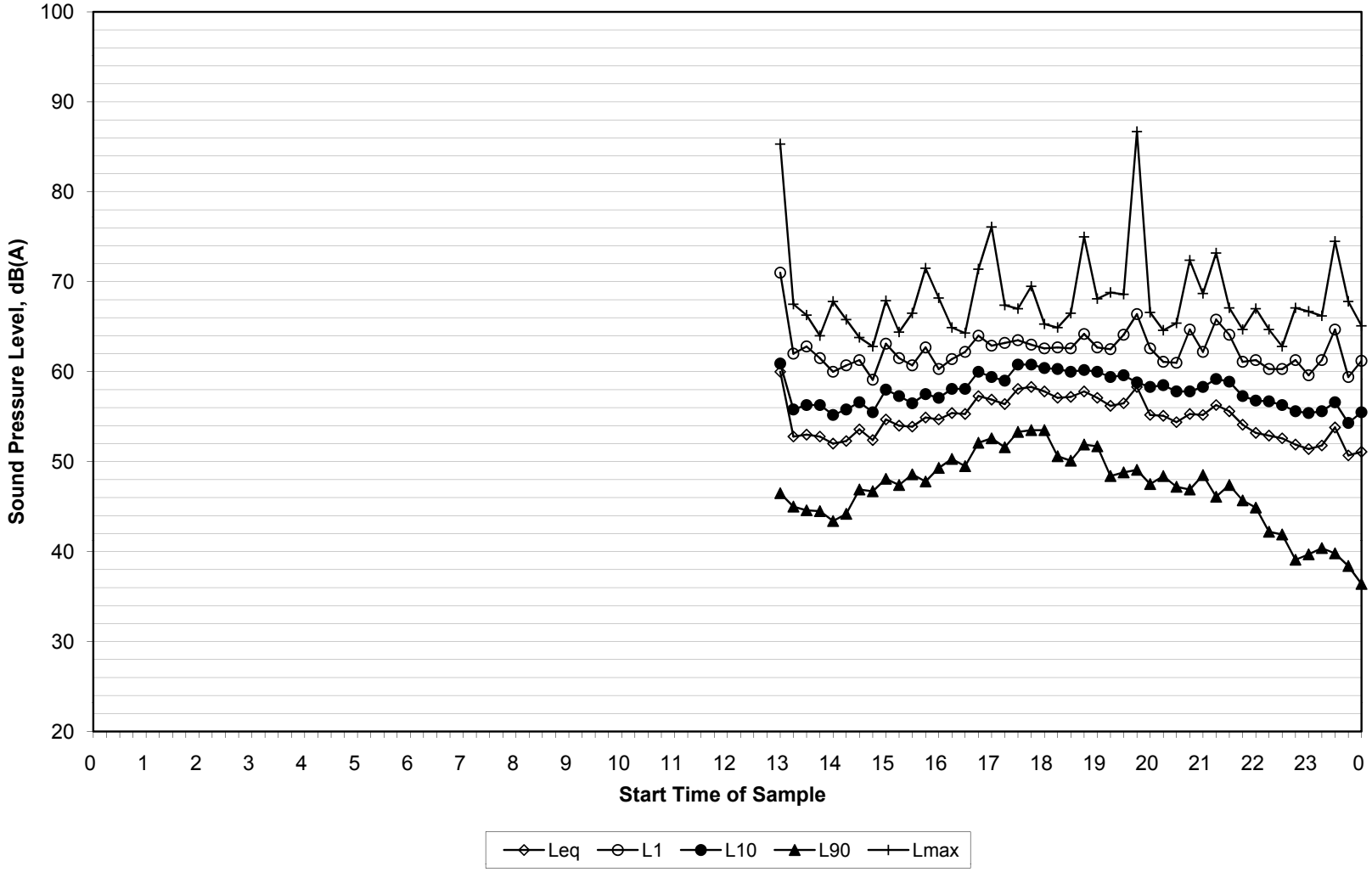
potential noise impacts during construction, preference will be given to contractors able to use low noise emission equipment and all site personnel will be inducted and educated with best practice work methods to minimise noise. A Construction Noise and Vibration Management Plan and Monitoring Programme will be implemented. Considering the transient nature of the construction works and exposure to road and rail traffic noise from the Motorway Link Road, the predicted short-term noise exceedances are capable of being managed to acceptable levels.

The main source of ground vibration that has been identified and assessed is associated with dynamic impact rollers. Ground vibration levels predicted from dynamic impact rollers typically range between 2-4mm/sec at 20 metres, and below 1.5mm/sec at 40 metres. Vibration levels are predicted to satisfy the structural damage assessment criteria *(Table 23)* at distances greater than 20 metres and are acceptable from a human disturbance perspective. The closest private receiver is at Thompson Vale Road and approximately 300 metres from the proposed construction activities.

ATTACHMENT 1: MEASURED AMBIENT NOISE LEVELS

Ambient Sound Pressure Levels

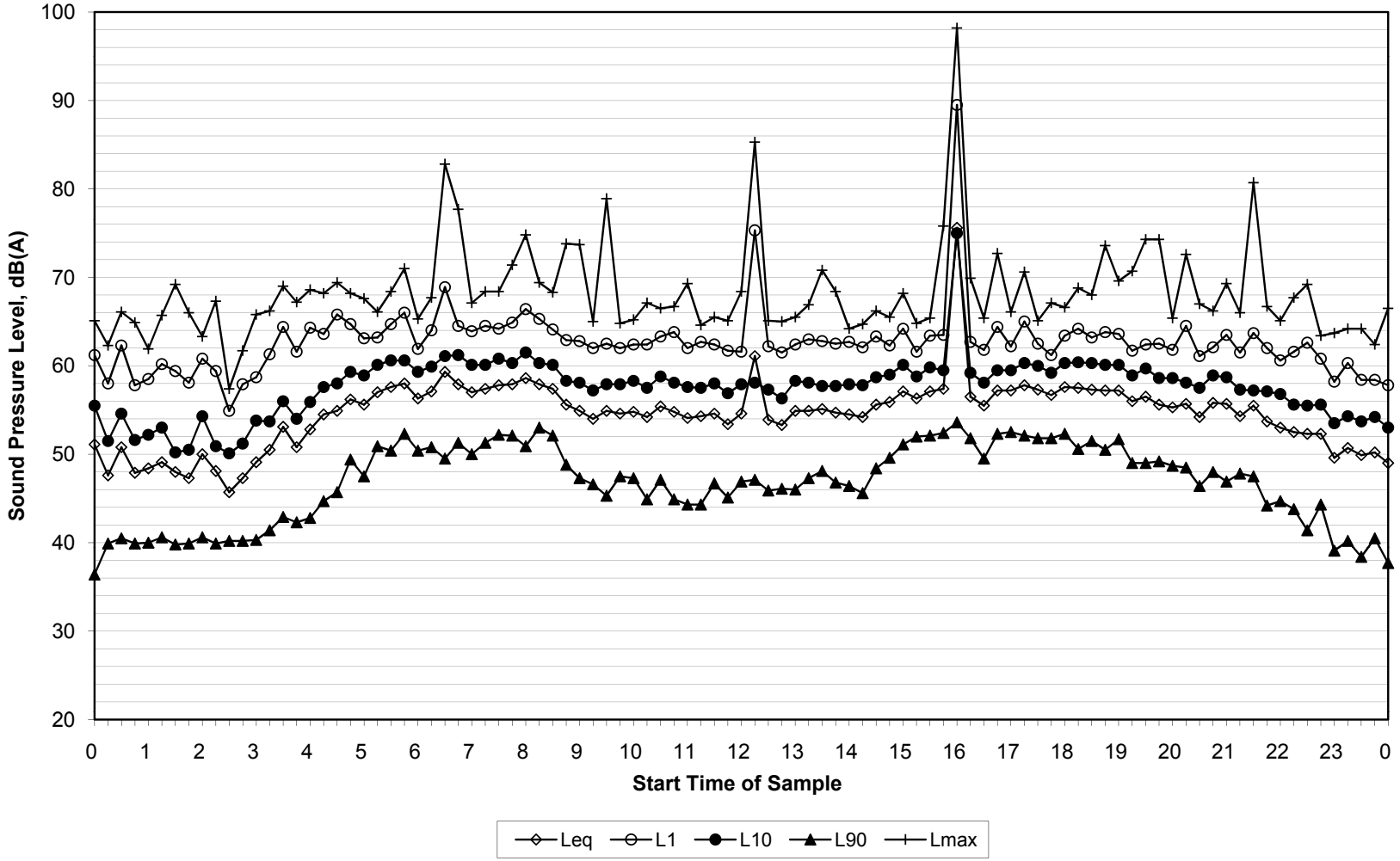
Thursday, 18 February 2016



Measurement Location M13
19 Popran Way Blue Haven

Ambient Sound Pressure Levels

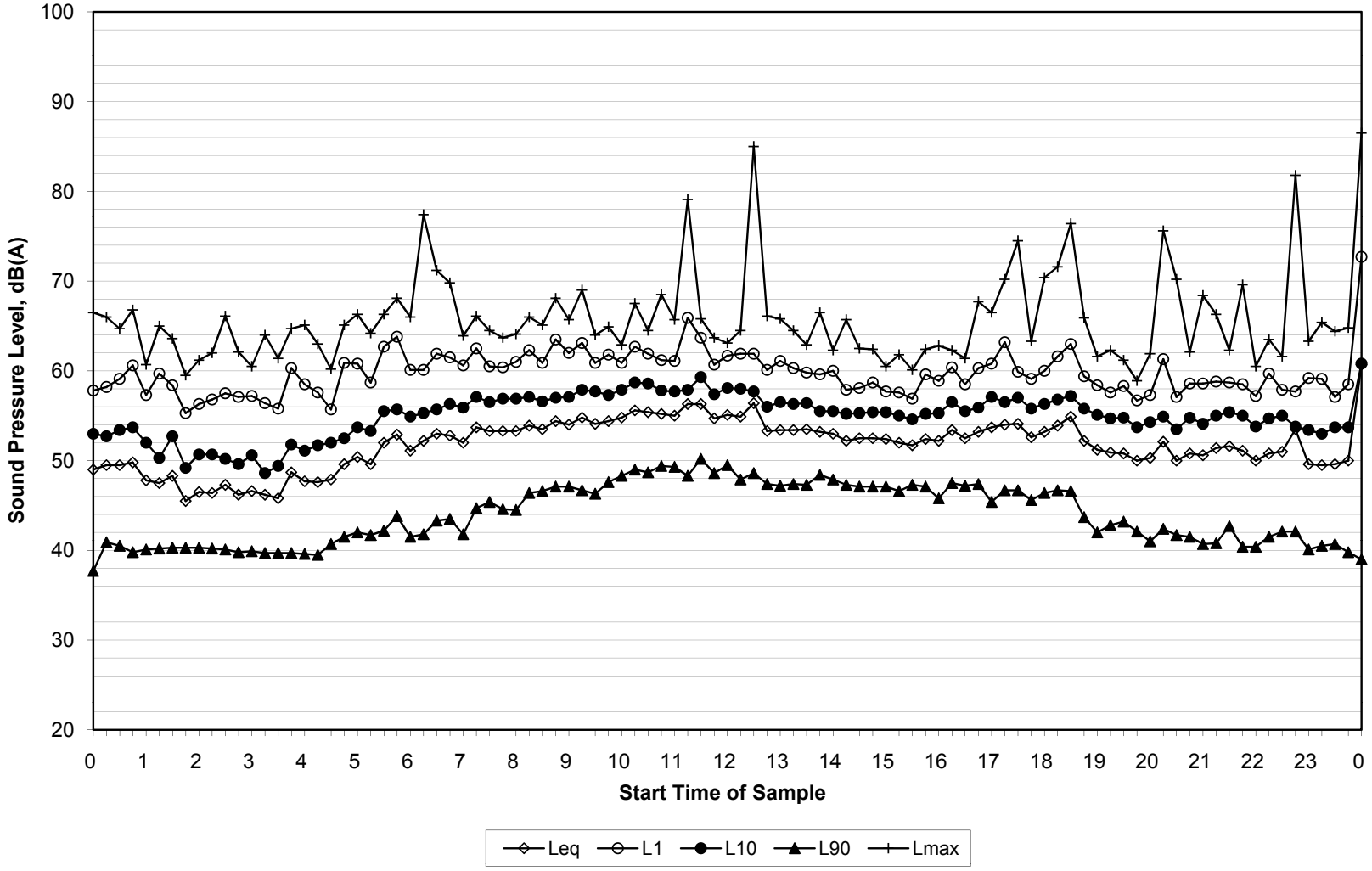
Friday, 19 February 2016



Measurement Location M13
19 Popran Way Blue Haven

Ambient Sound Pressure Levels

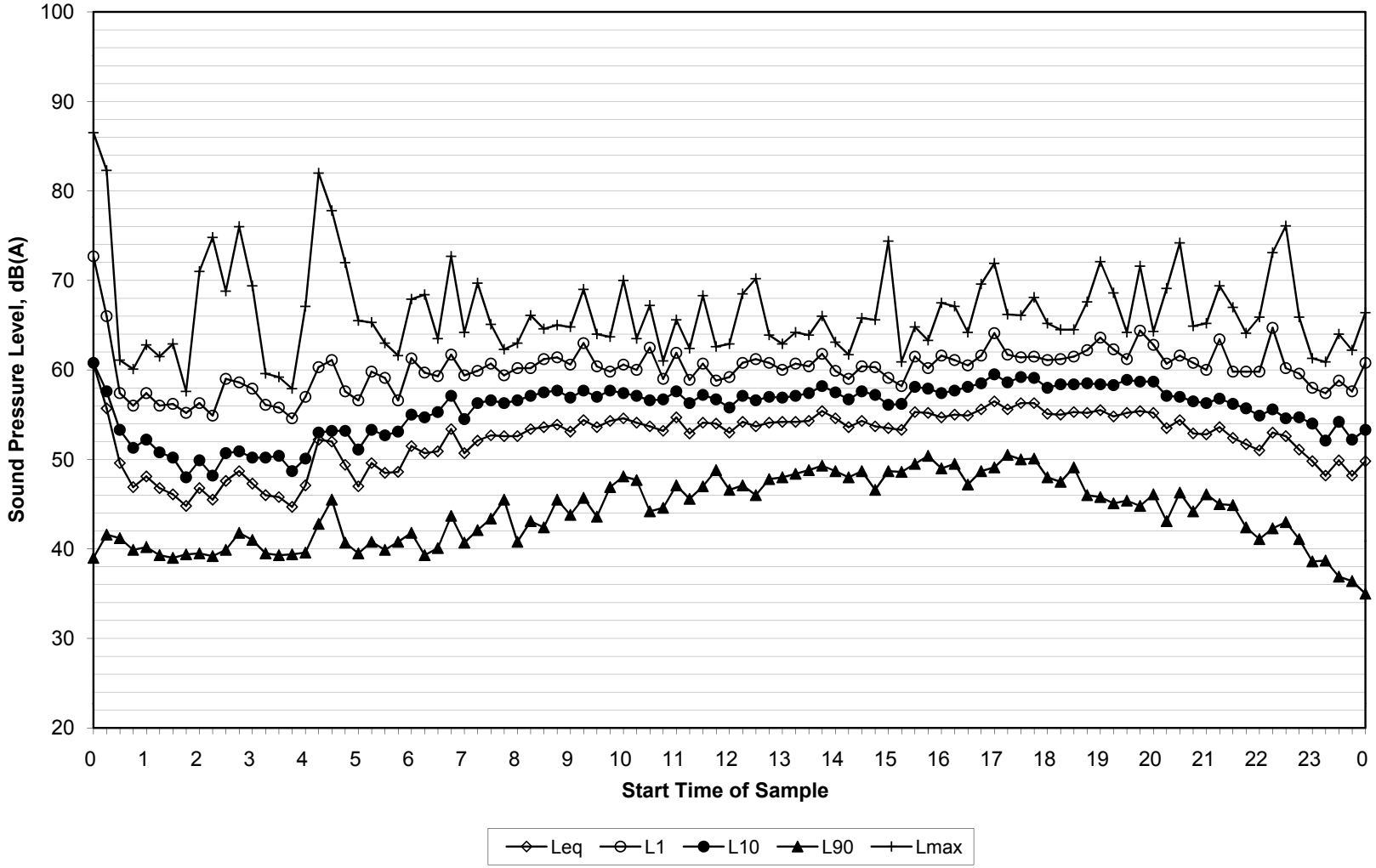
Saturday, 20 February 2016



Measurement Location M13
19 Popran Way Blue Haven

Ambient Sound Pressure Levels

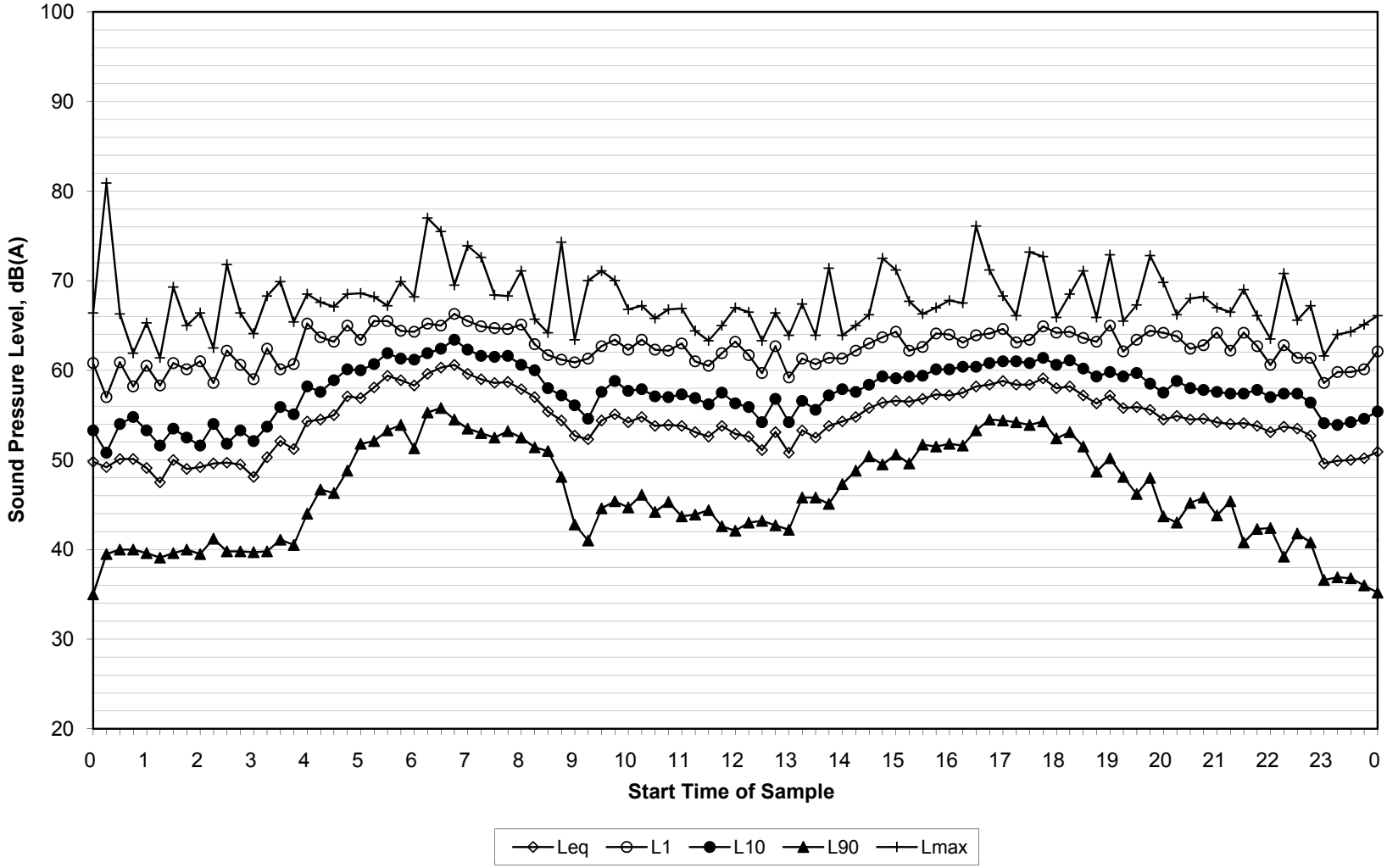
Sunday, 21 February 2016



Measurement Location M13
19 Popran Way Blue Haven

Ambient Sound Pressure Levels

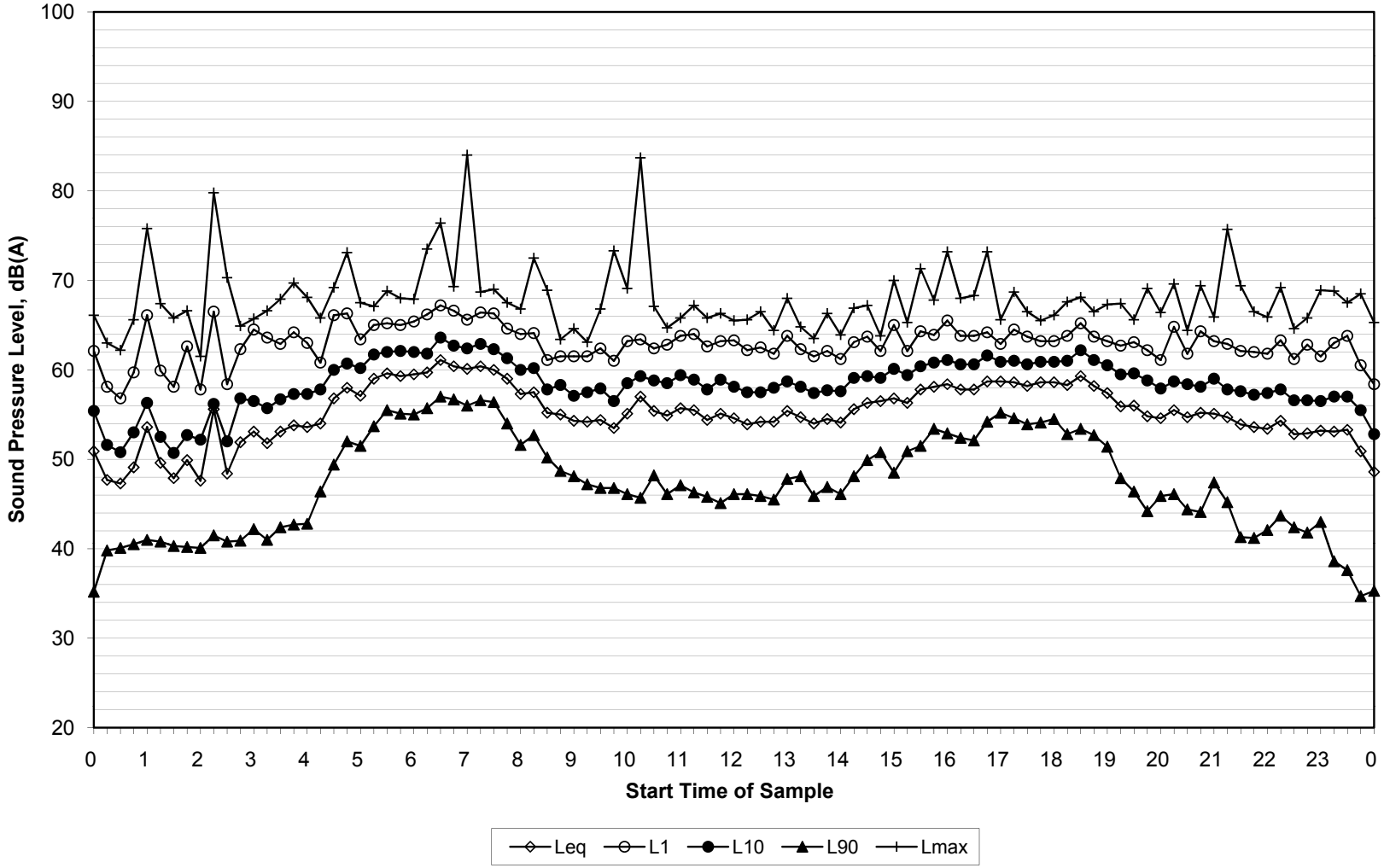
Monday, 22 February 2016



Measurement Location M13
19 Popran Way Blue Haven

Ambient Sound Pressure Levels

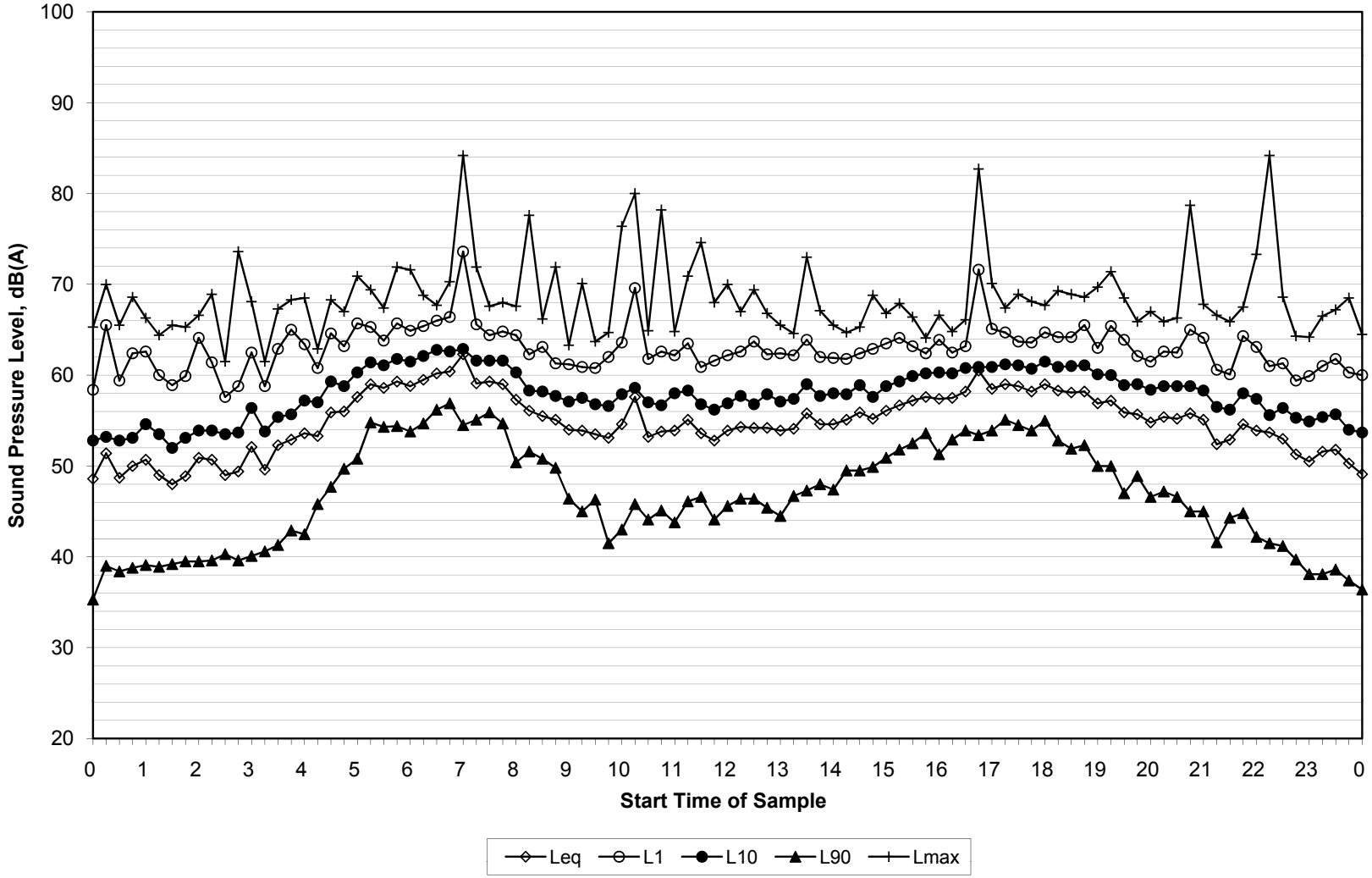
Tuesday, 23 February 2016



Measurement Location M13
19 Popran Way Blue Haven

Ambient Sound Pressure Levels

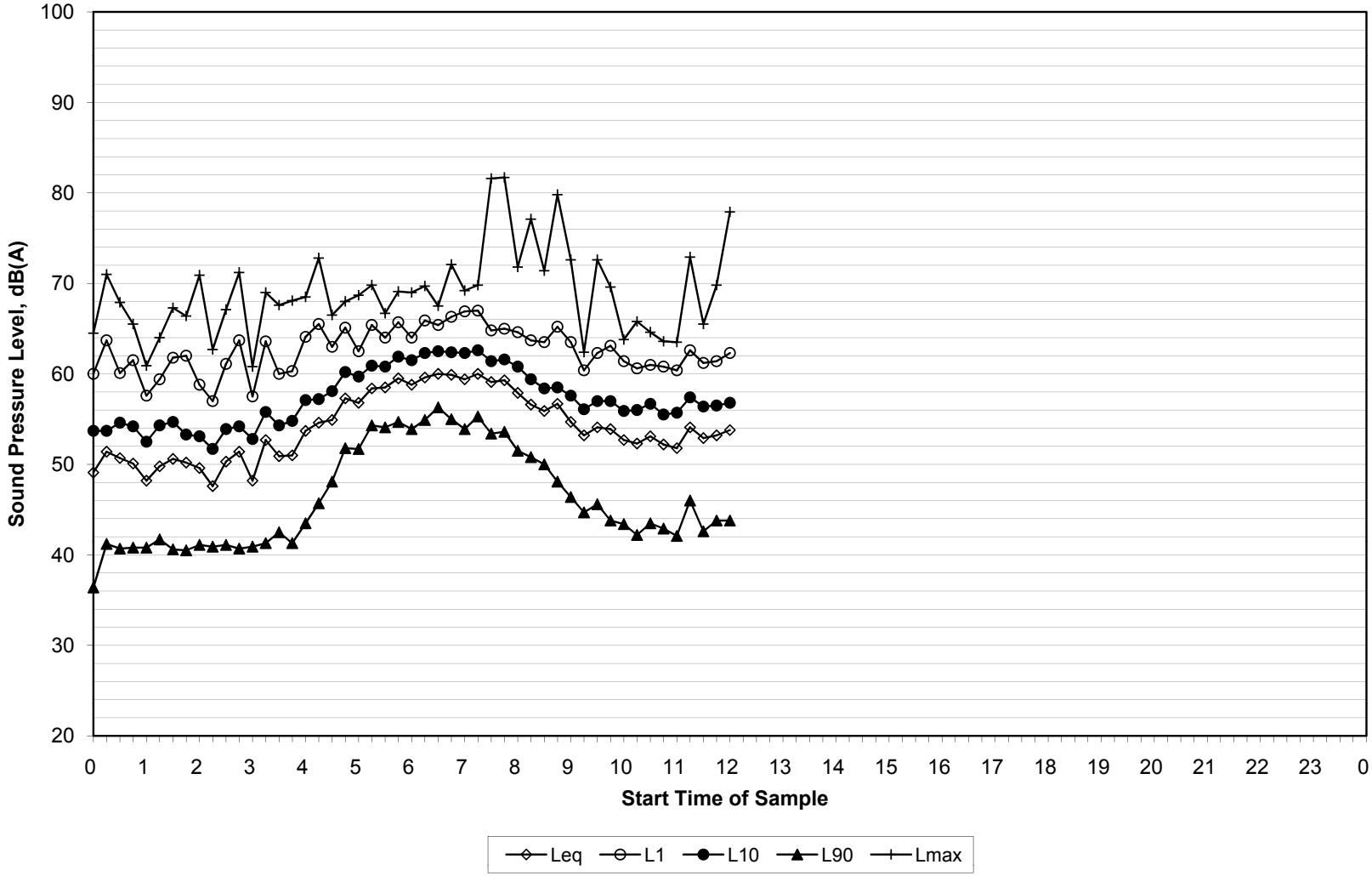
Wednesday, 24 February 2016



Measurement Location M13
19 Popran Way Blue Haven

Ambient Sound Pressure Levels

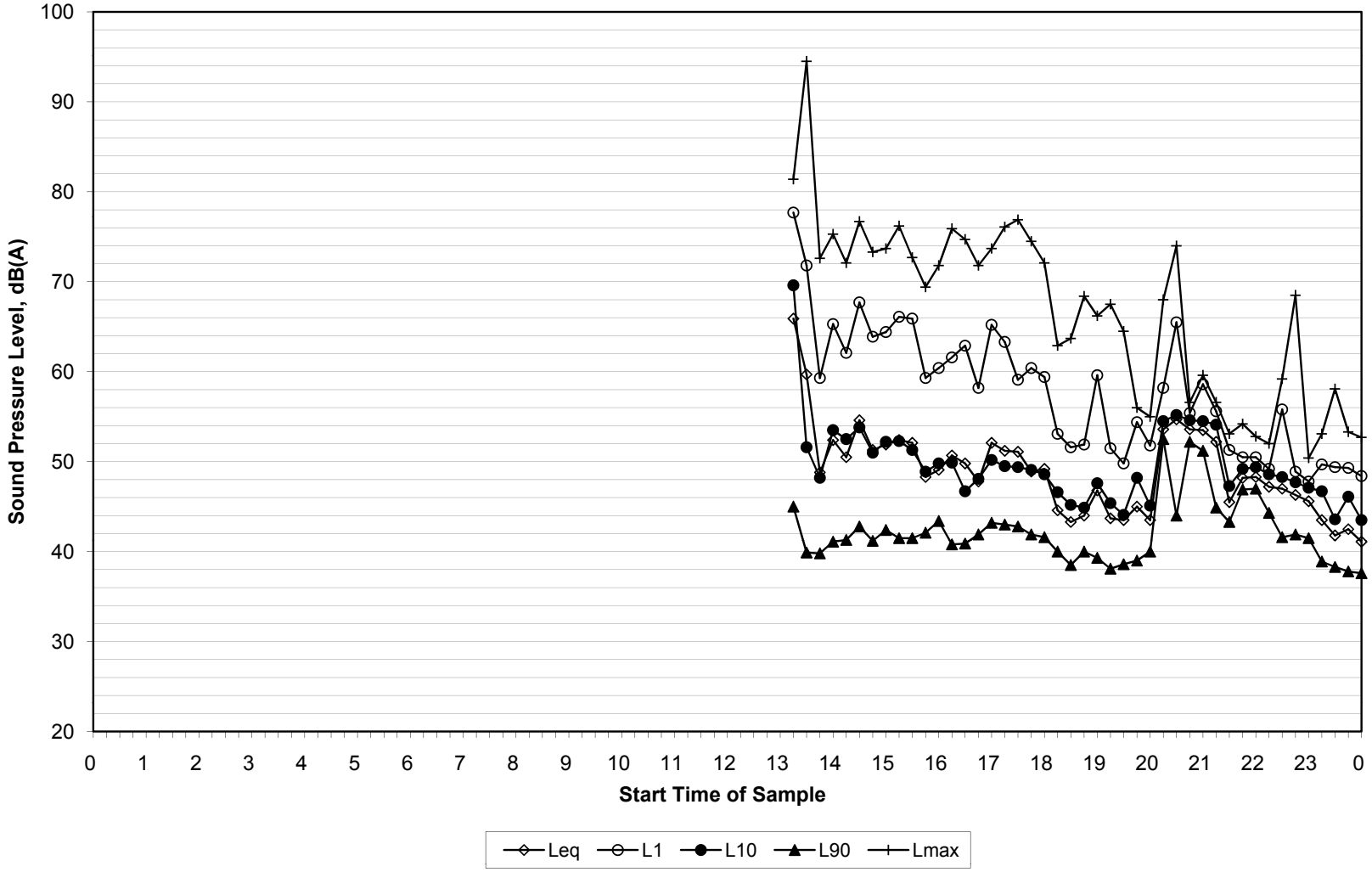
Thursday, 25 February 2016



Measurement Location M13
19 Popran Way Blue Haven

Ambient Sound Pressure Levels

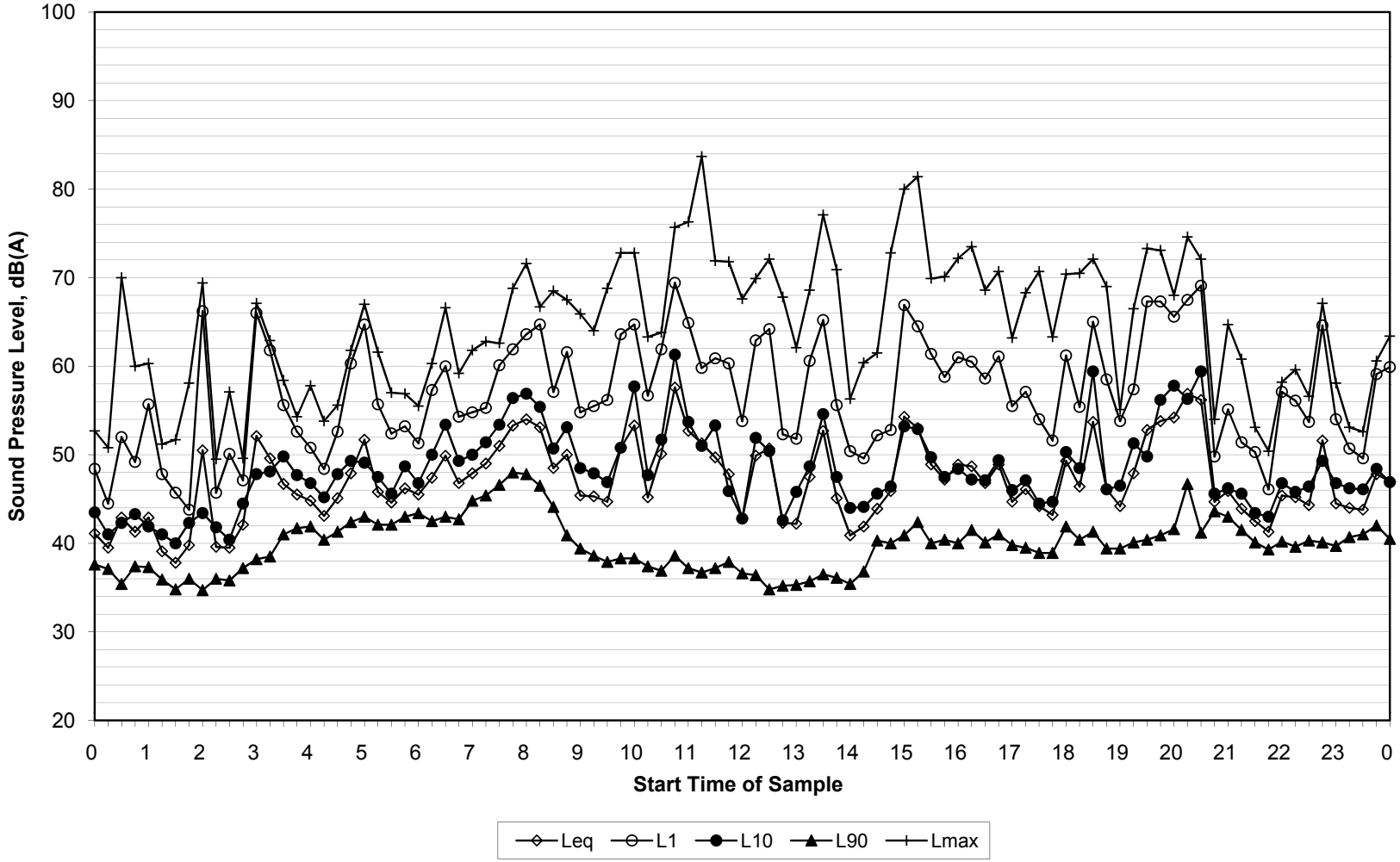
Thursday, 18 February 2016



Measurement Location M14
Thompson Vale Road

Ambient Sound Pressure Levels

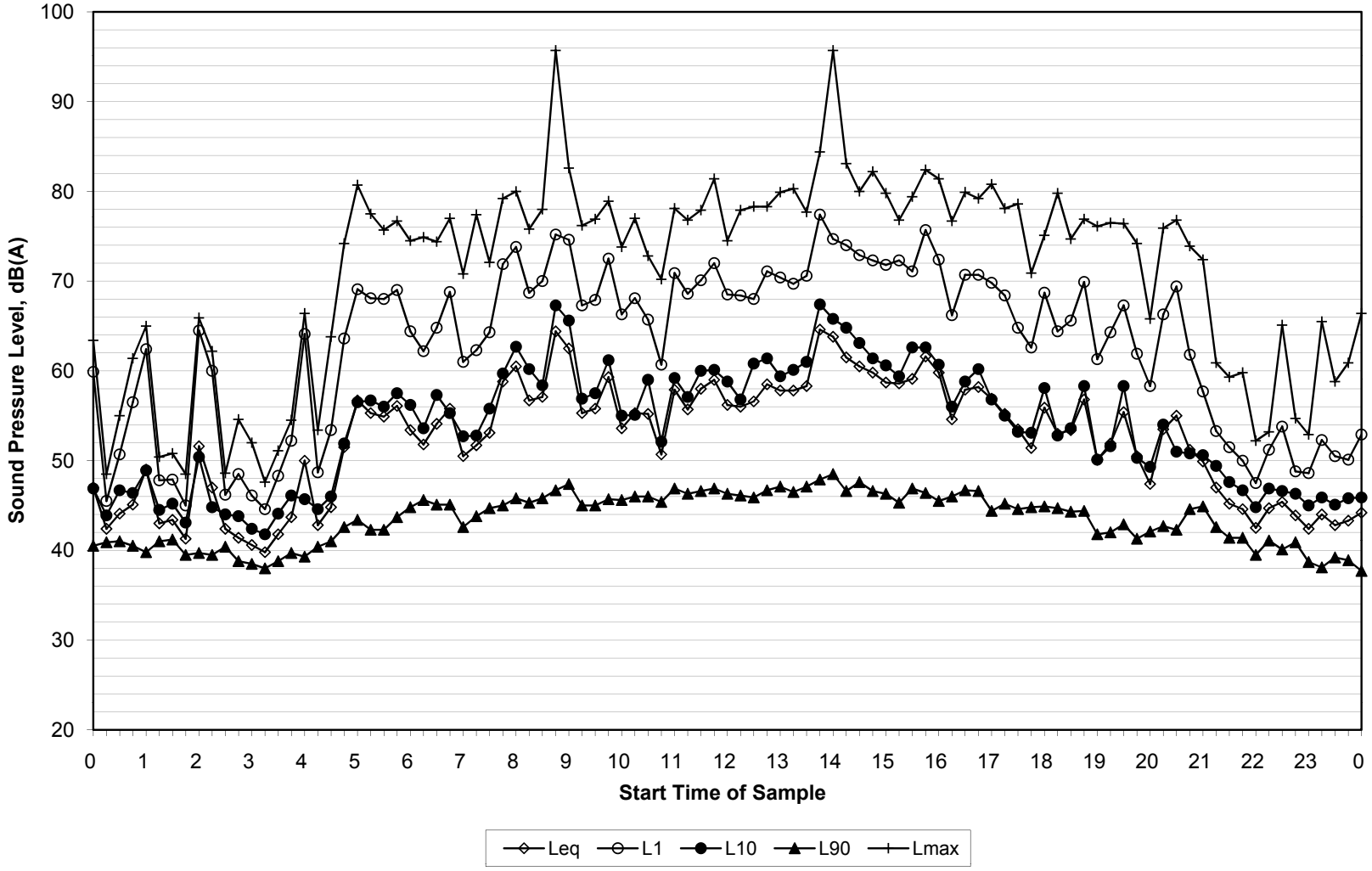
Friday, 19 February 2016



Measurement Location M14
Thompson Vale Road

Ambient Sound Pressure Levels

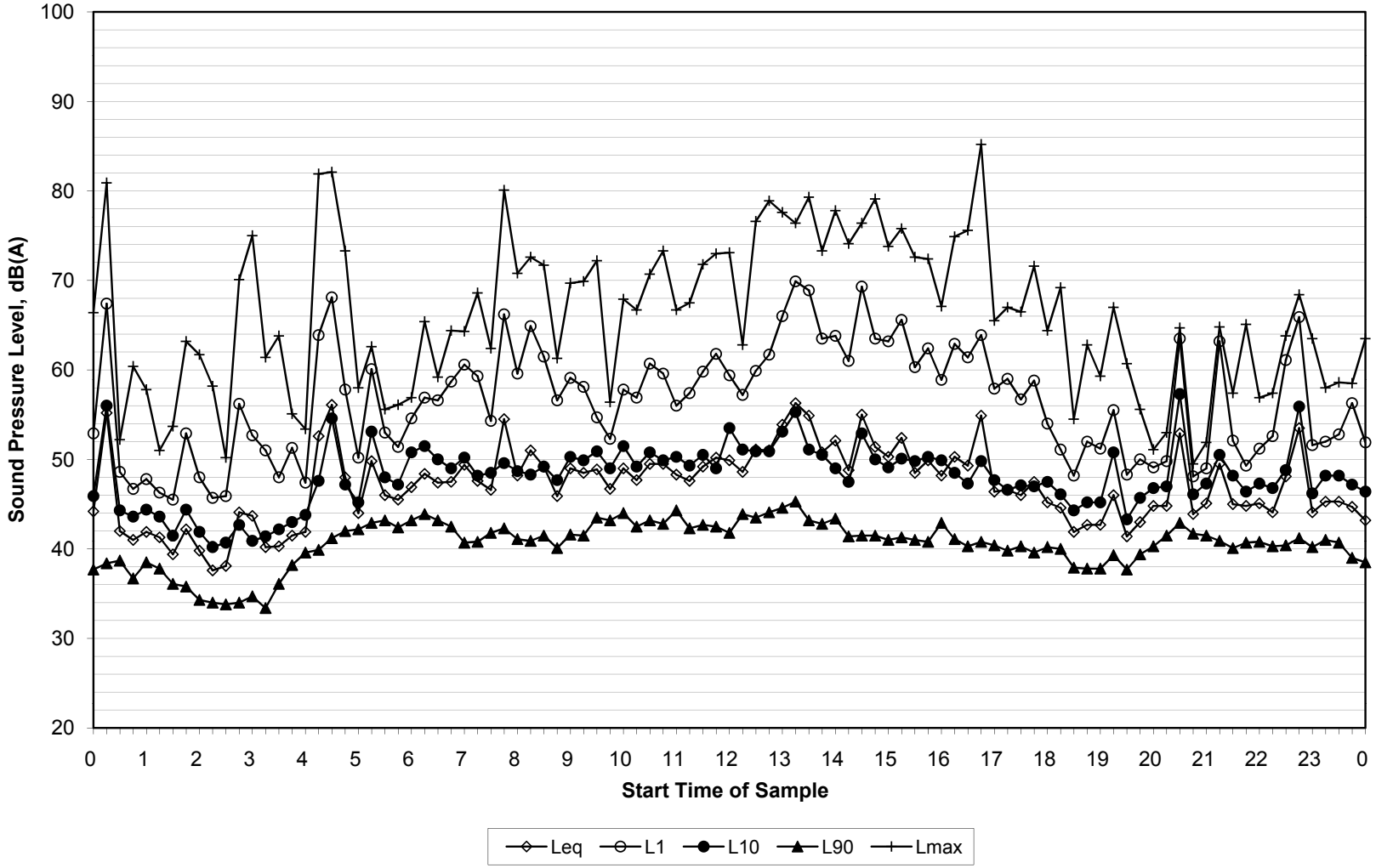
Saturday, 20 February 2016



Measurement Location M14
Thompson Vale Road

Ambient Sound Pressure Levels

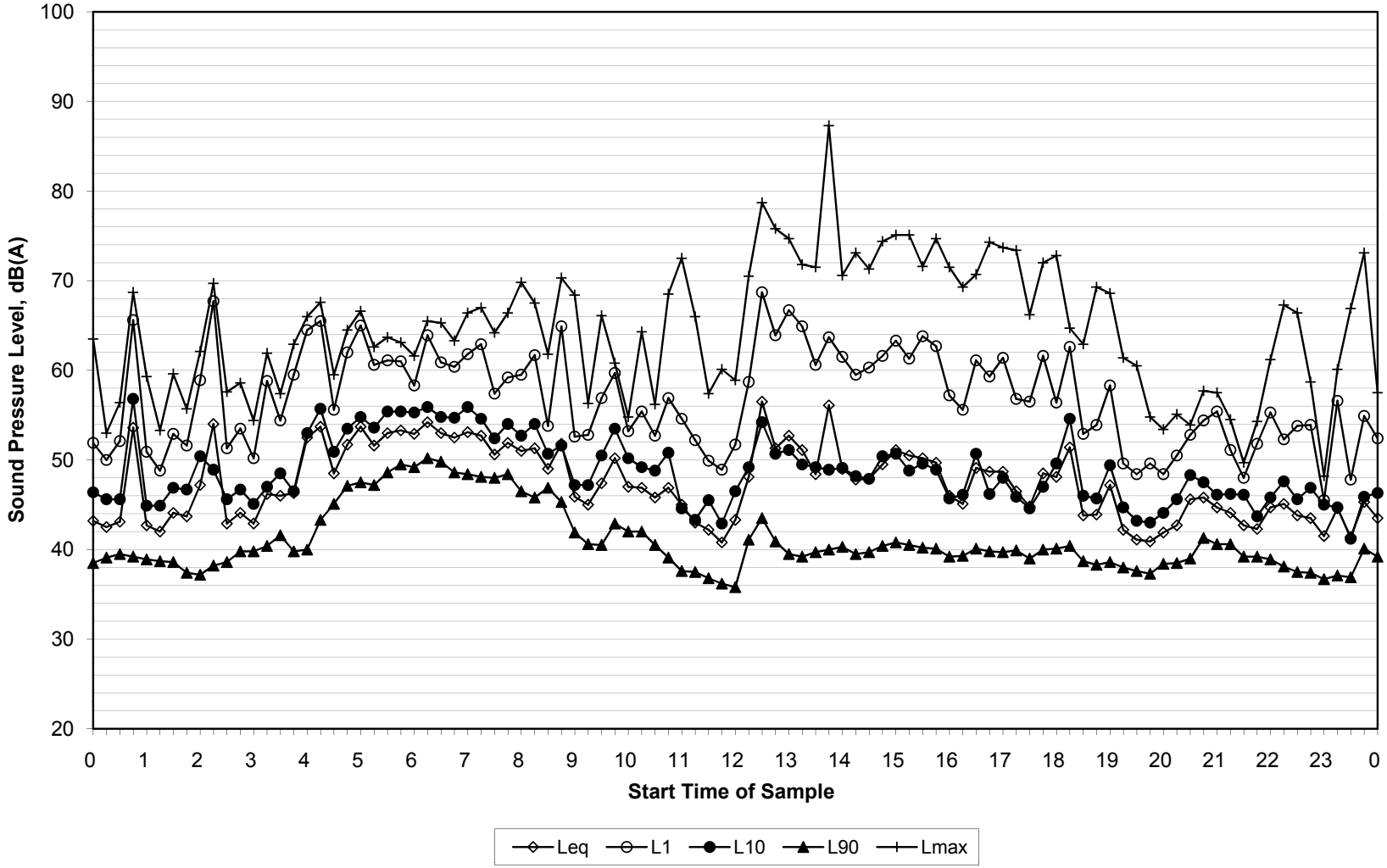
Sunday, 21 February 2016



Measurement Location M14
Thompson Vale Road

Ambient Sound Pressure Levels

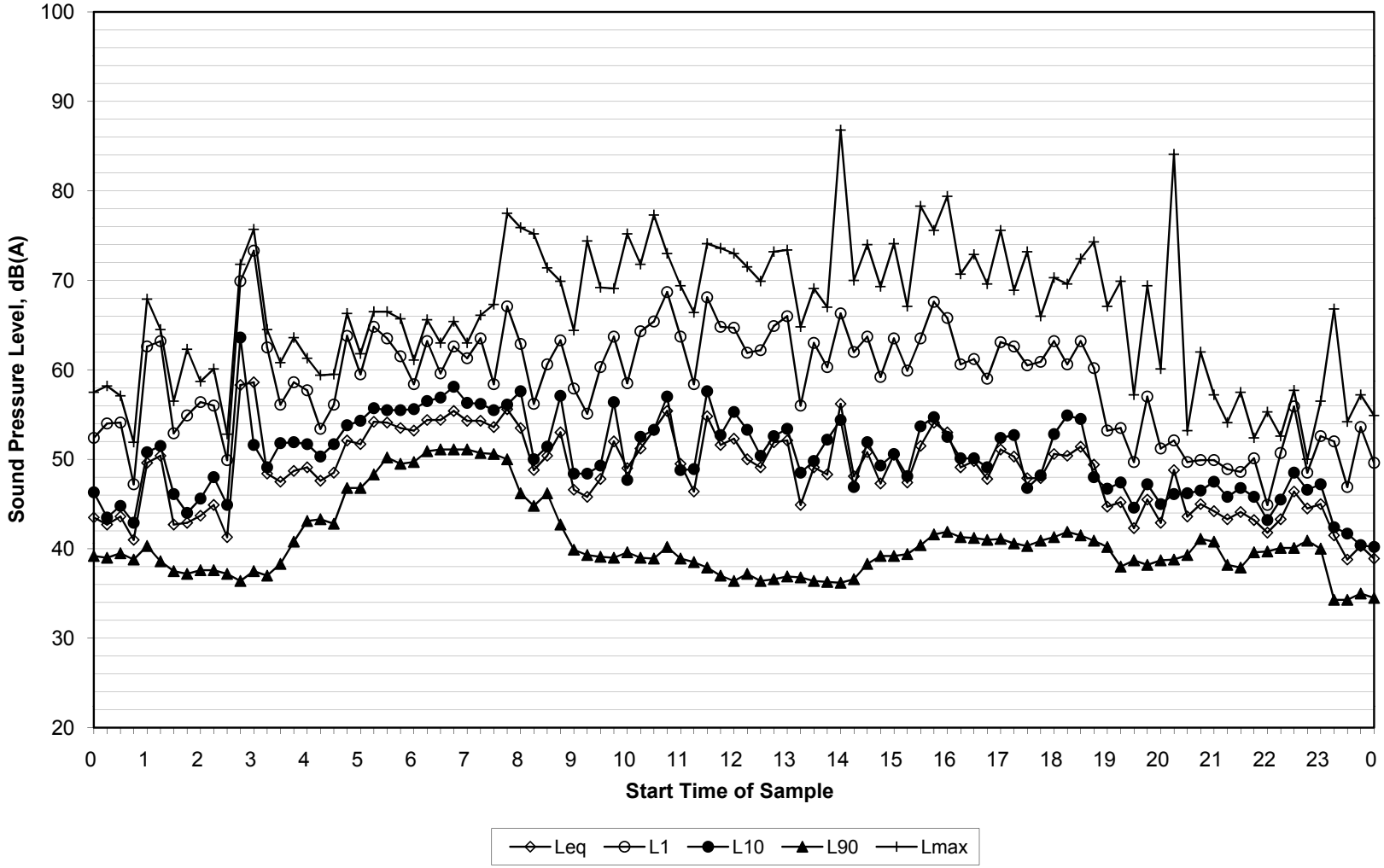
Monday, 22 February 2016



Measurement Location M14
Thompson Vale Road

Ambient Sound Pressure Levels

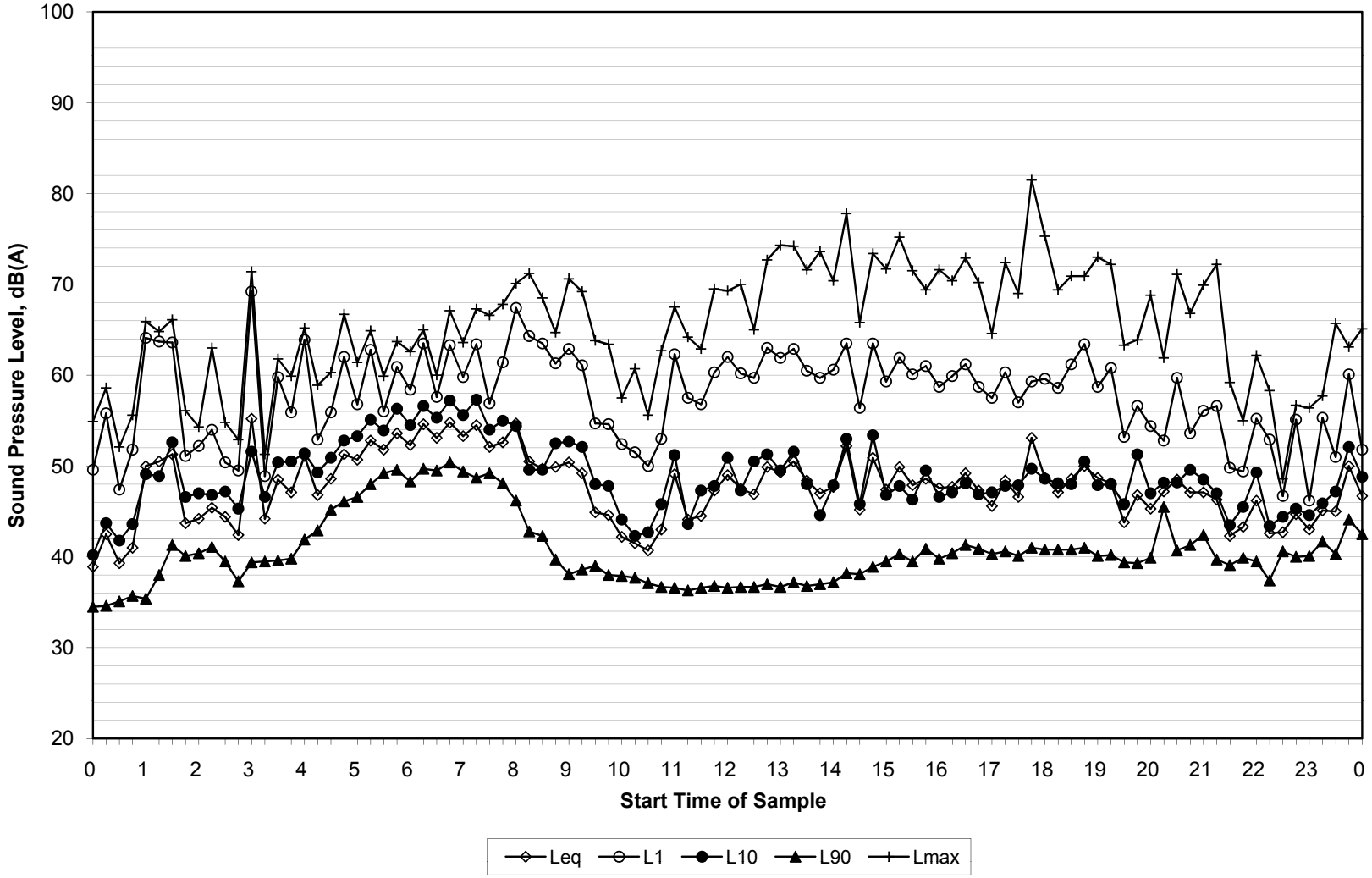
Tuesday, 23 February 2016



Measurement Location M14
Thompson Vale Road

Ambient Sound Pressure Levels

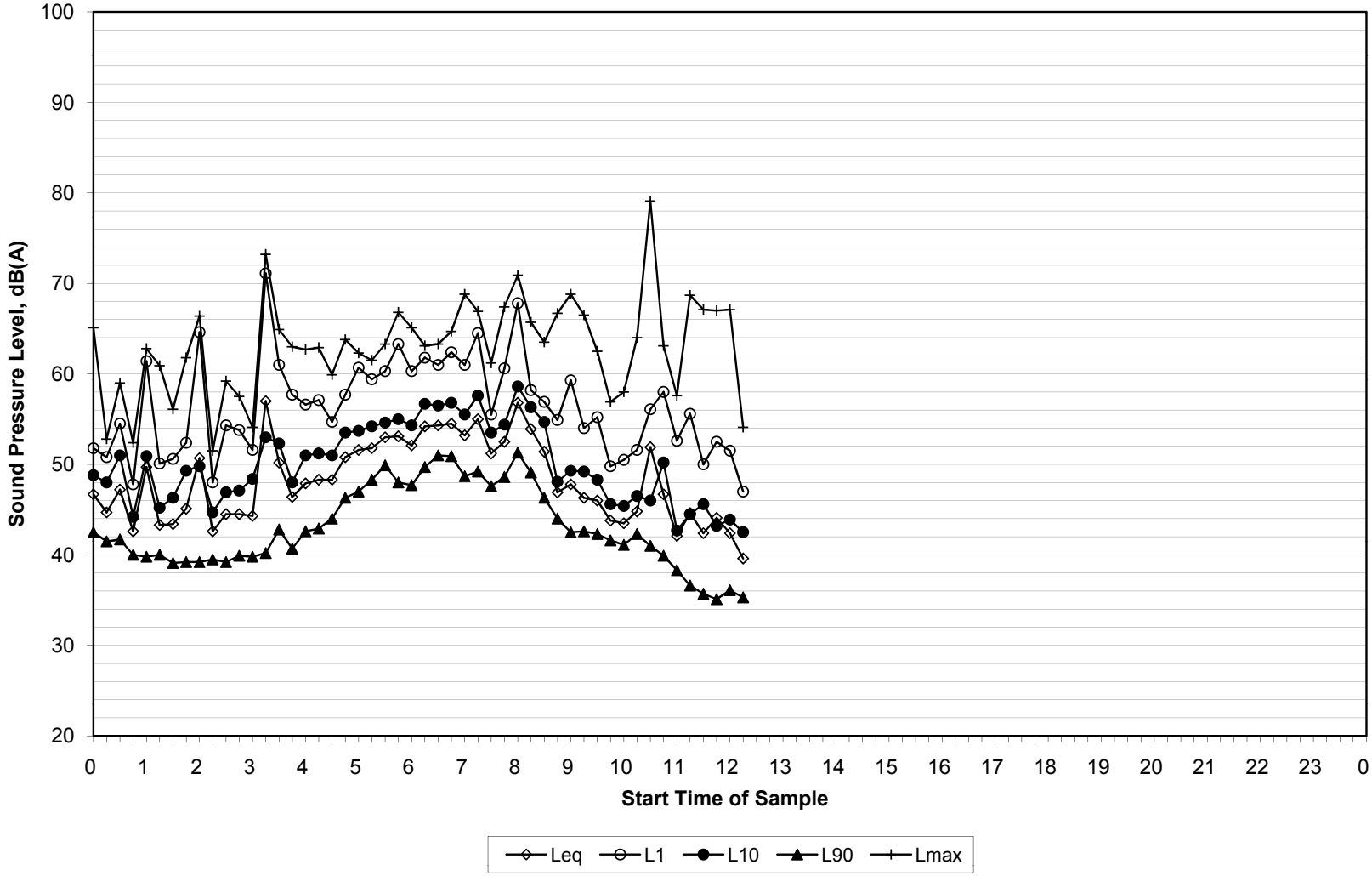
Wednesday, 24 February 2016



Measurement Location M14
Thompson Vale Road

Ambient Sound Pressure Levels

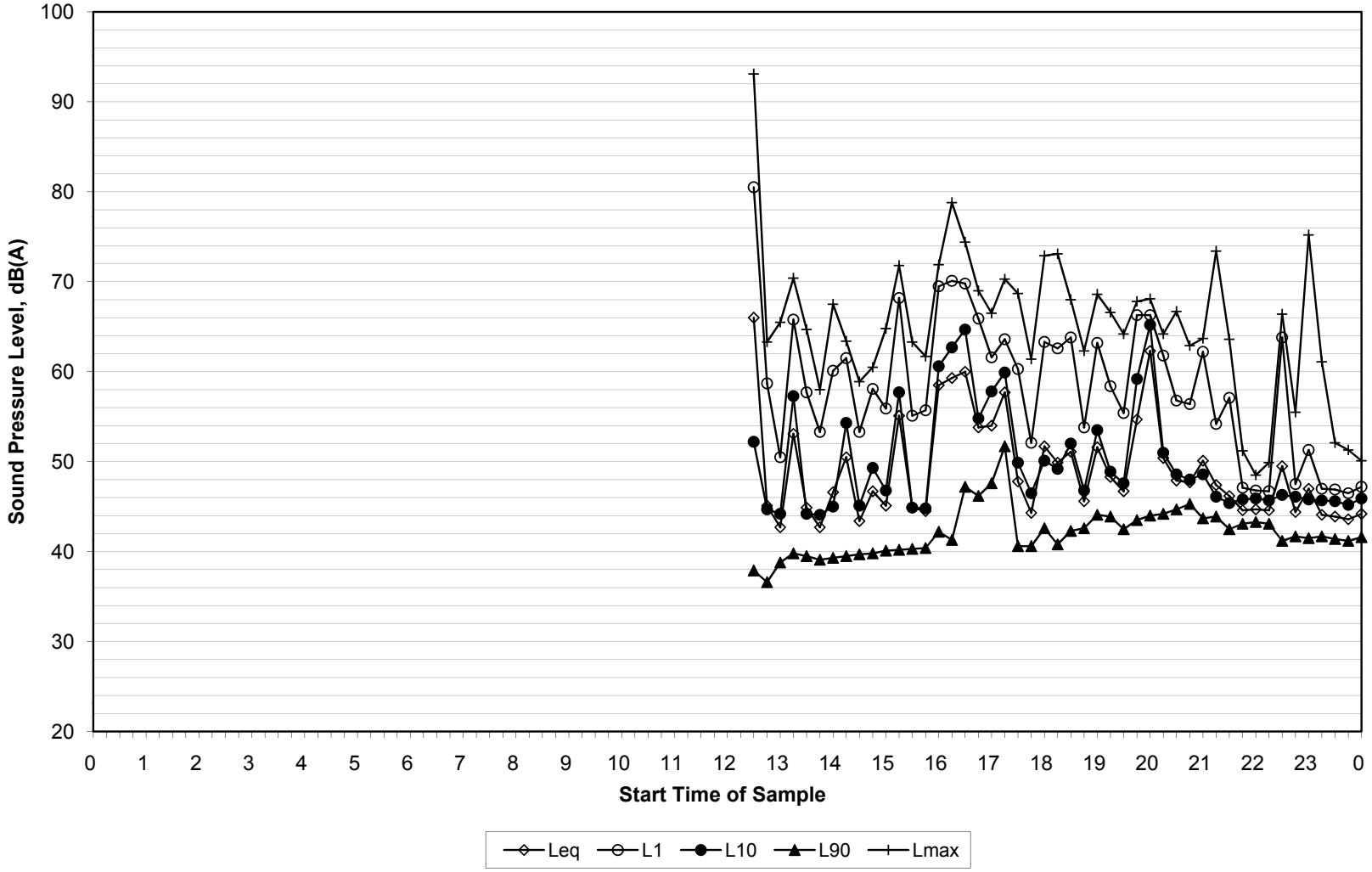
Thursday, 25 February 2016



Measurement Location M14
Thompson Vale Road

Ambient Sound Pressure Levels

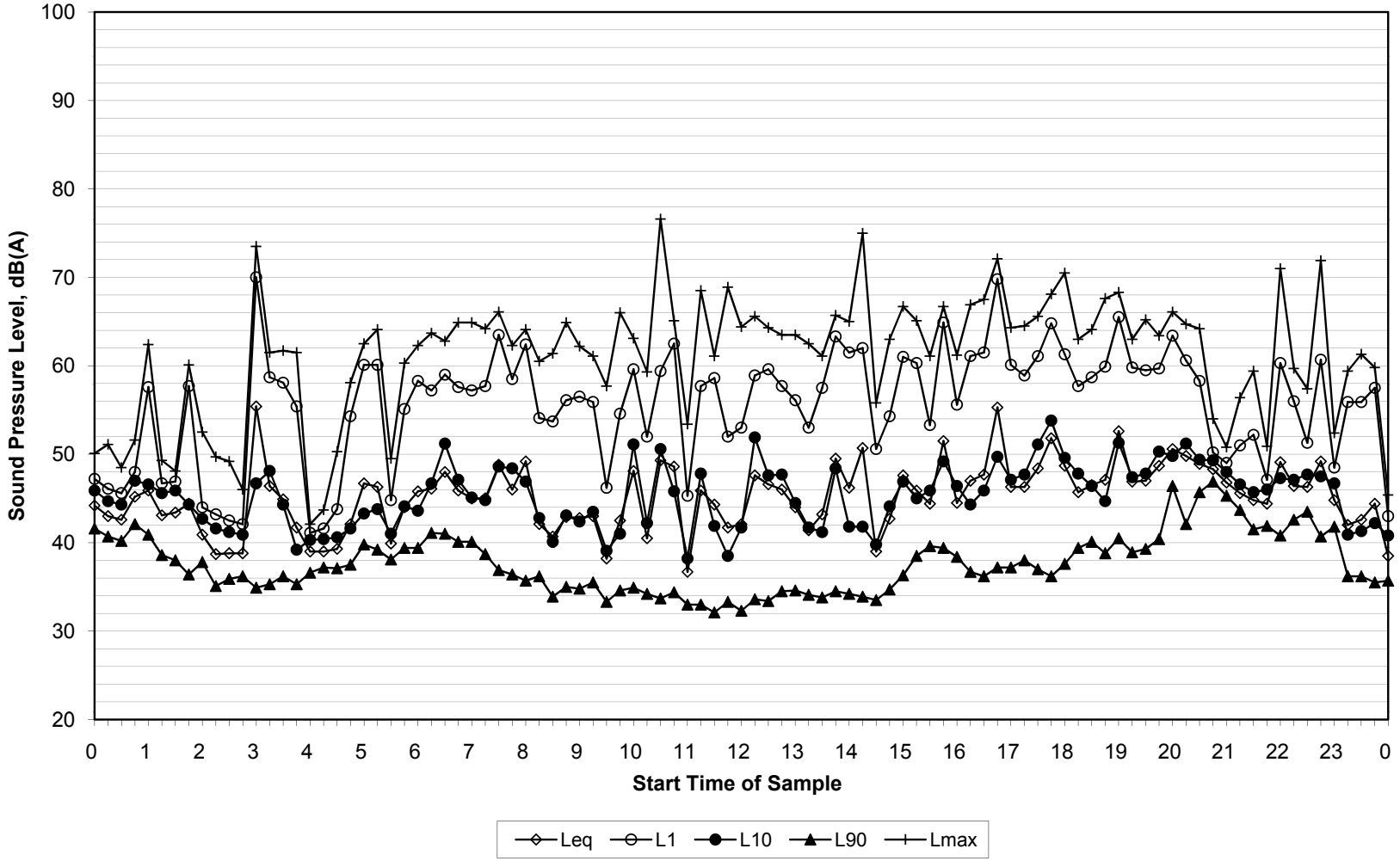
Thursday, 18 February 2016



Measurement Location M15
555 Bushells Ridge Road

Ambient Sound Pressure Levels

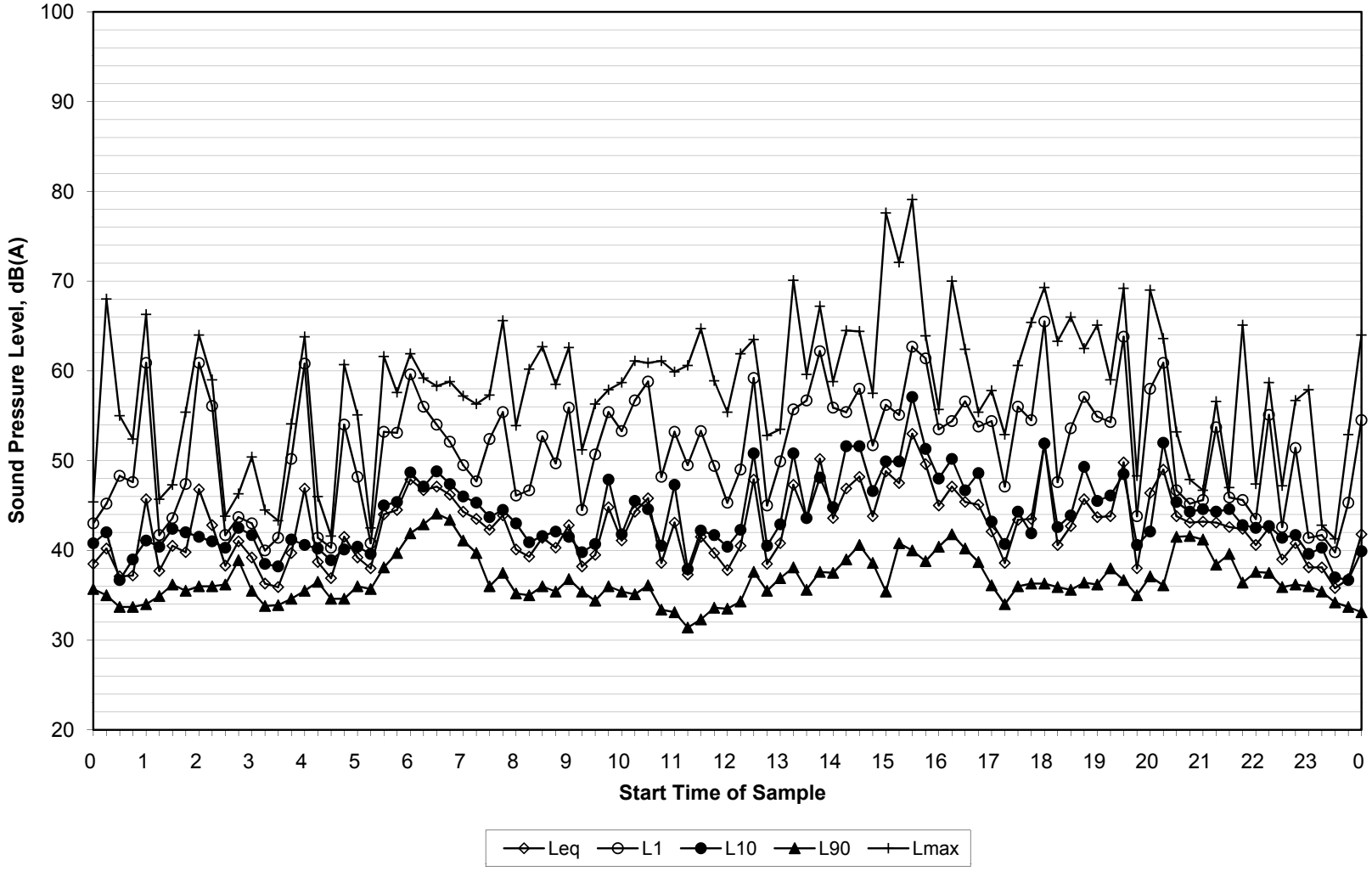
Friday, 19 February 2016



Measurement Location M15
555 Bushells Ridge Road

Ambient Sound Pressure Levels

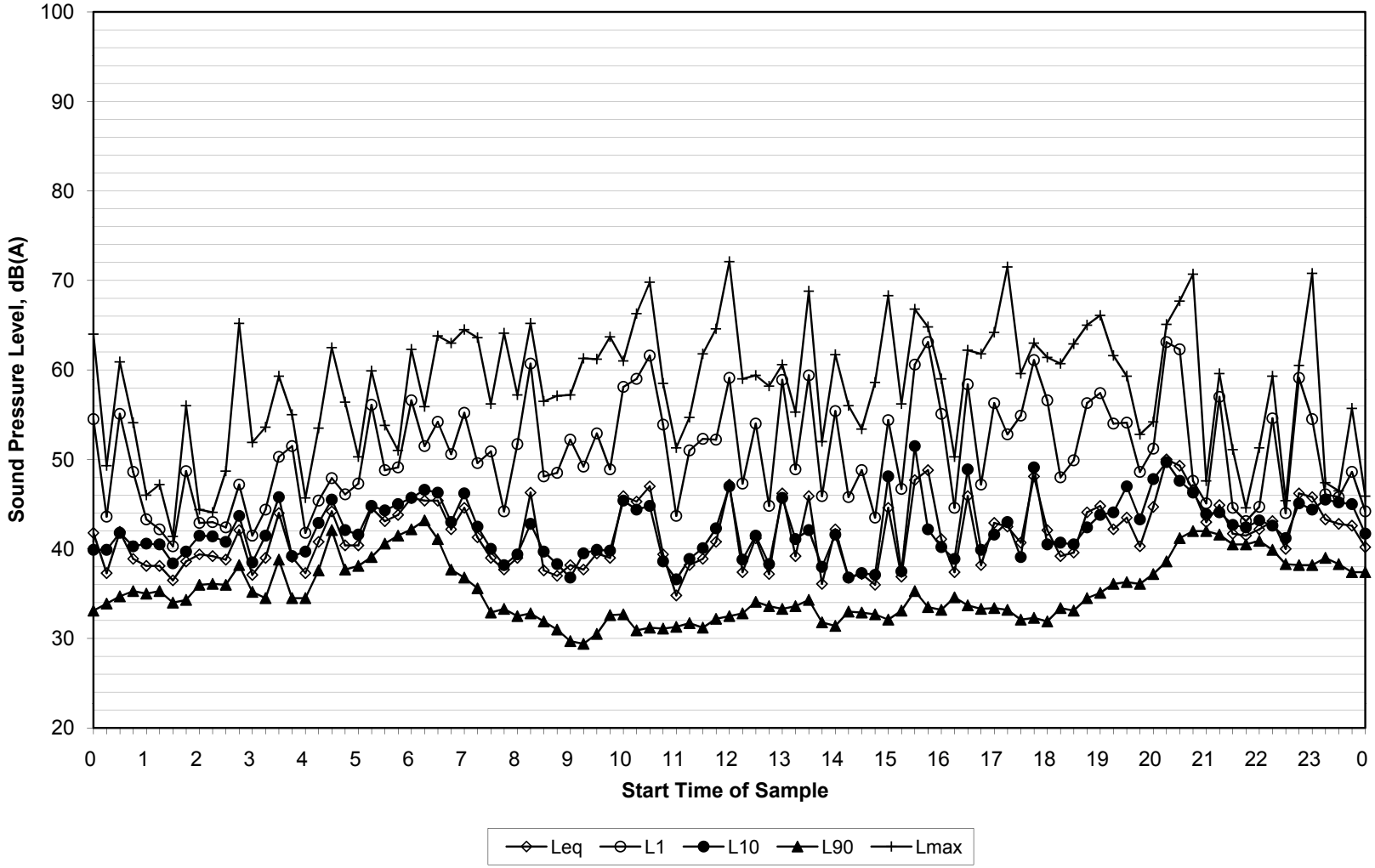
Saturday, 20 February 2016



Measurement Location M15
555 Bushells Ridge Road

Ambient Sound Pressure Levels

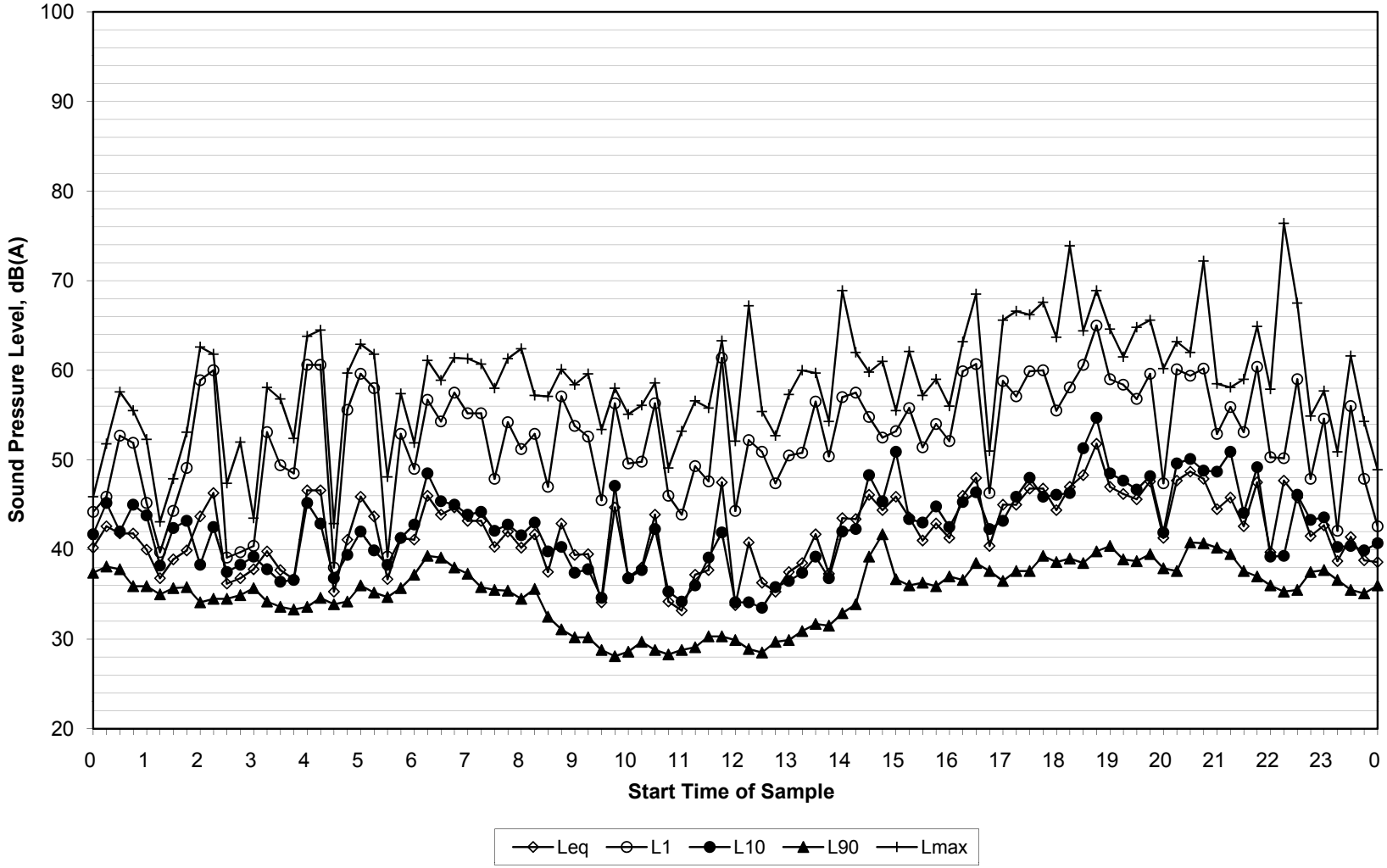
Sunday, 21 February 2016



Measurement Location M15
555 Bushells Ridge Road

Ambient Sound Pressure Levels

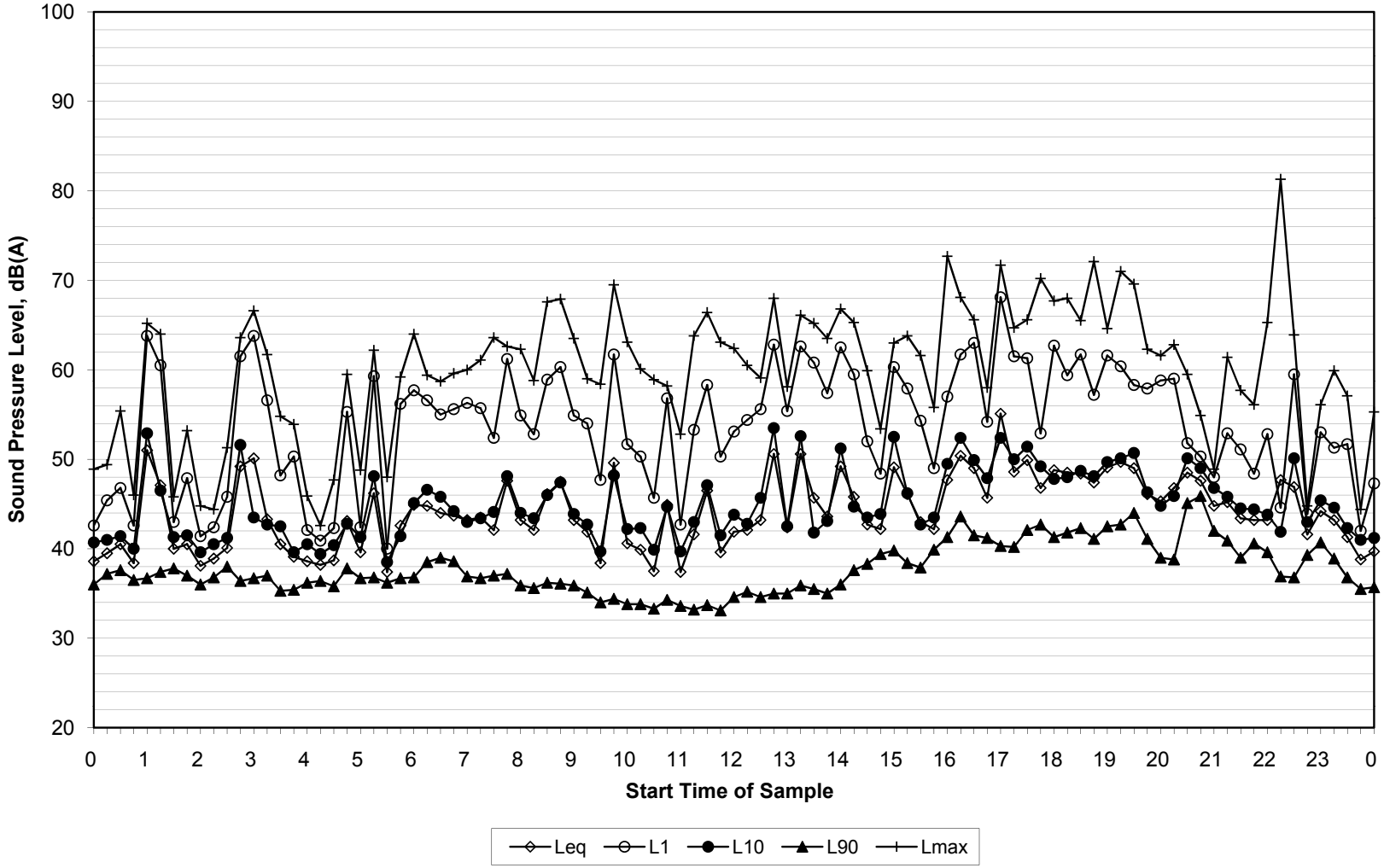
Monday, 22 February 2016



Measurement Location M15
555 Bushells Ridge Road

Ambient Sound Pressure Levels

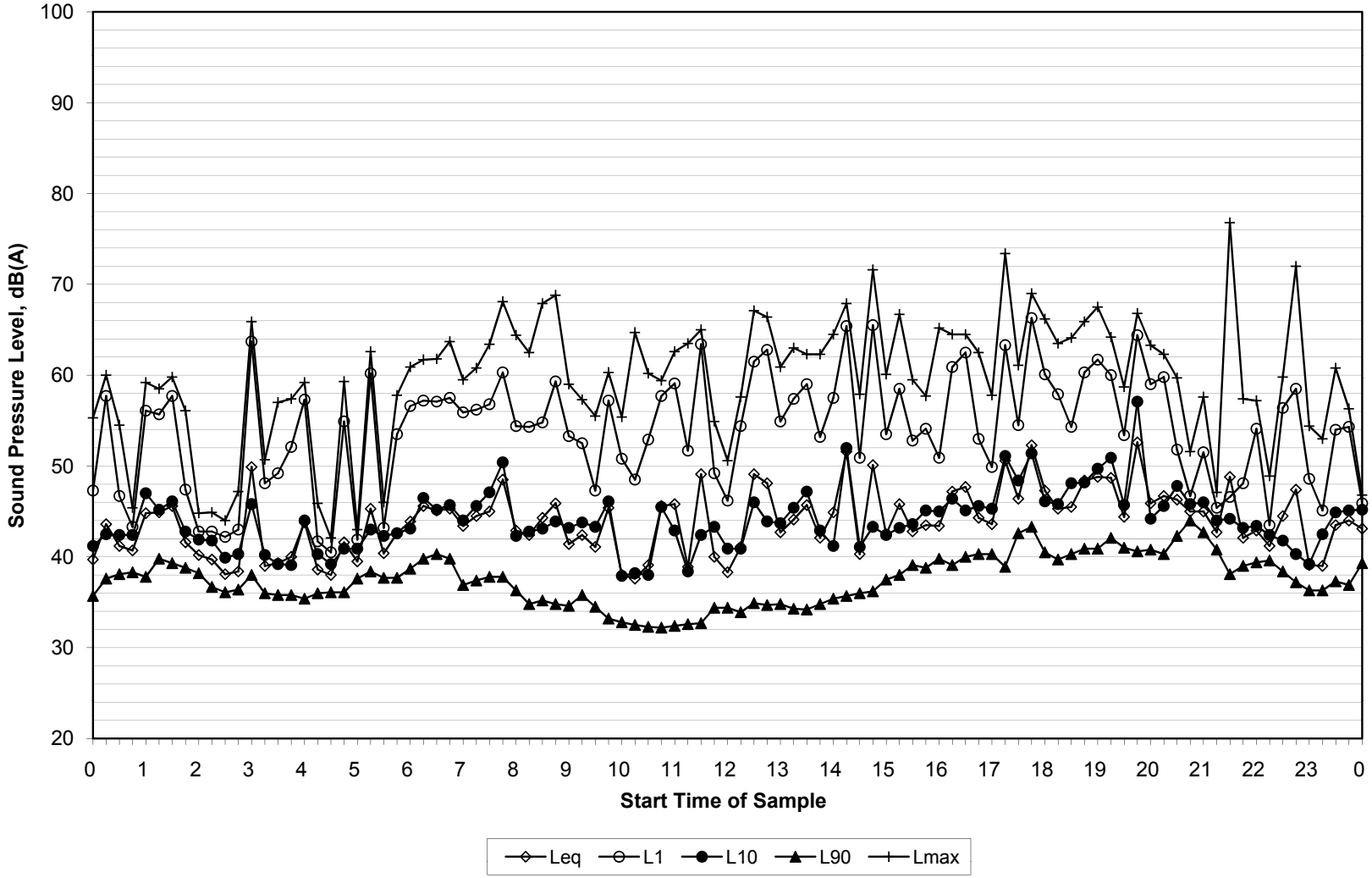
Tuesday, 23 February 2016



Measurement Location M15
555 Bushells Ridge Road

Ambient Sound Pressure Levels

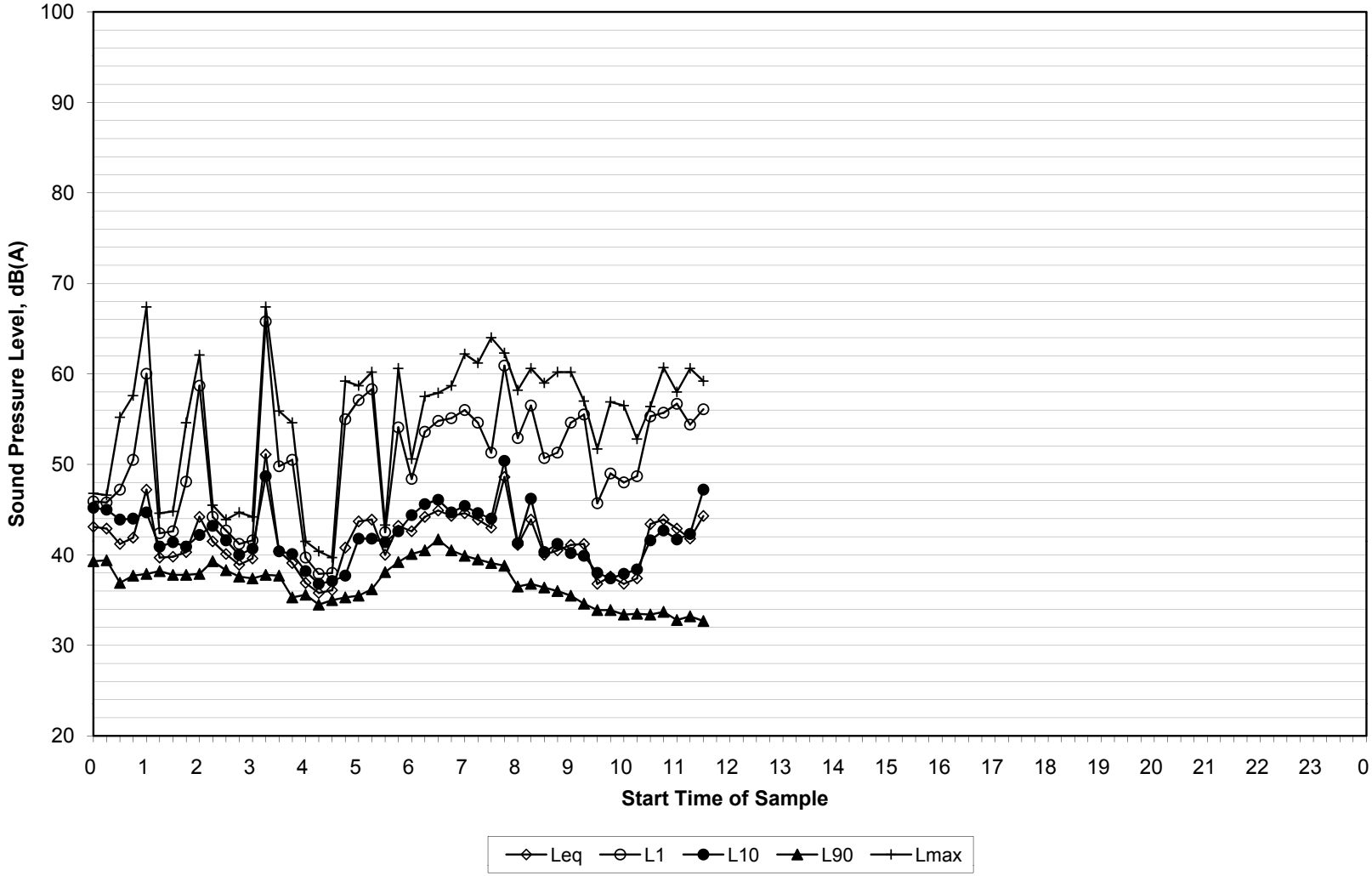
Wednesday, 24 February 2016



Measurement Location M15
555 Bushells Ridge Road

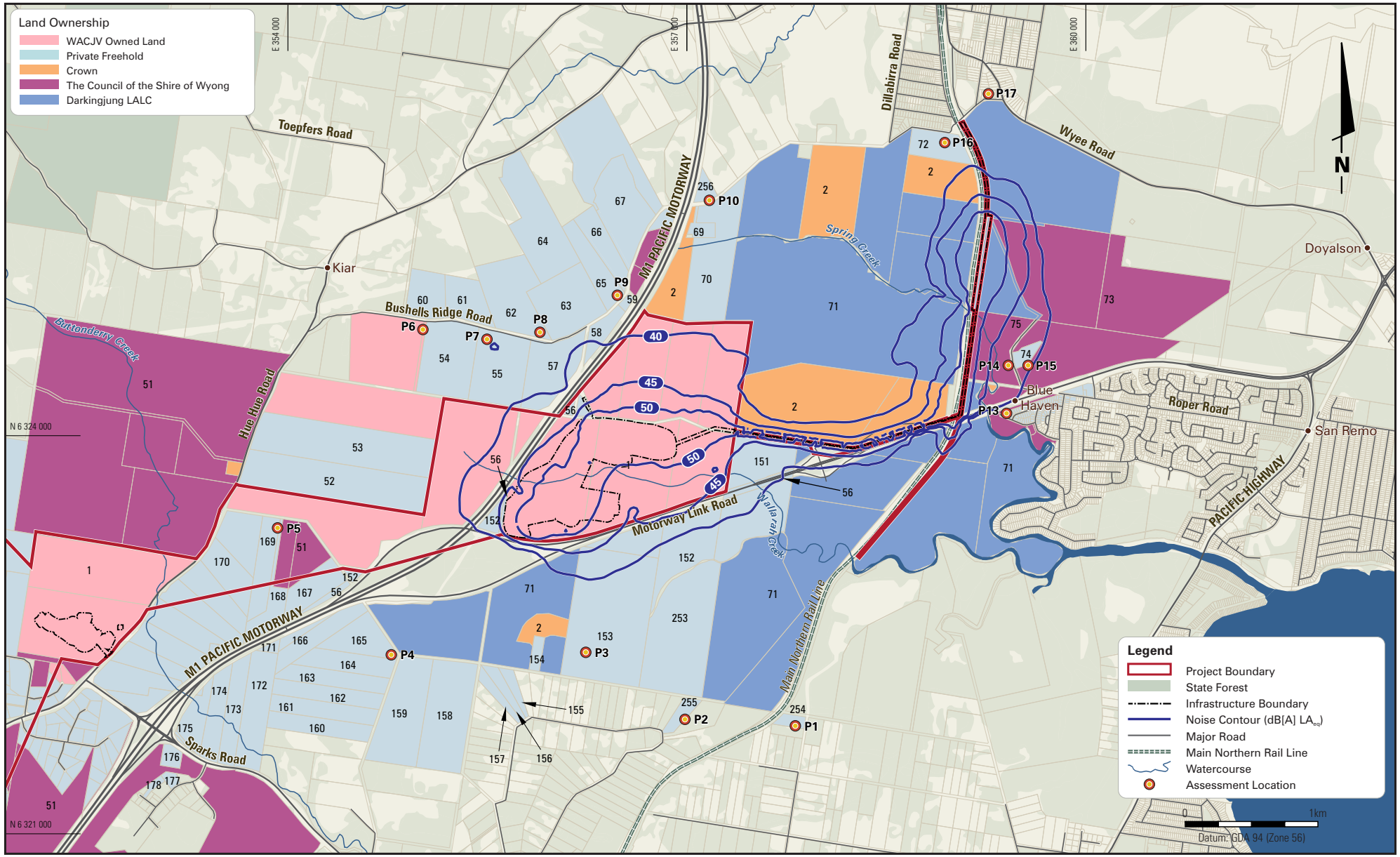
Ambient Sound Pressure Levels

Thursday, 25 February 2016



Measurement Location M15
555 Bushells Ridge Road

ATTACHMENT 2: OPERATIONAL NOISE PLOTS



HB WALLARAH COAL 1163 F2-1 Noise Contours - Calm Weather Condition 11 05 2016

WALLARAH 2 COAL PROJECT

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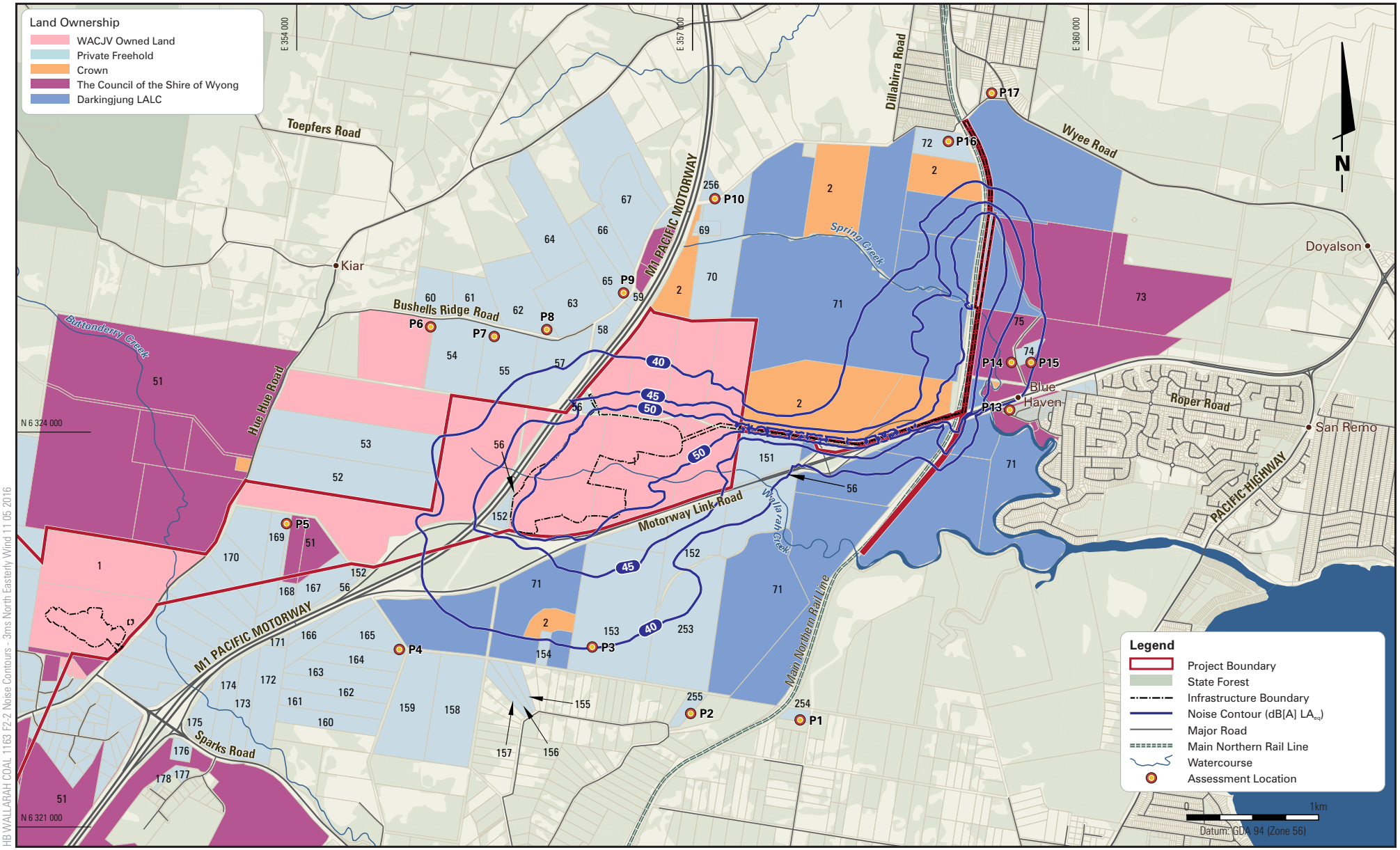
Noise Contours - Calm Weather Conditions

ATTACHMENT 2-1



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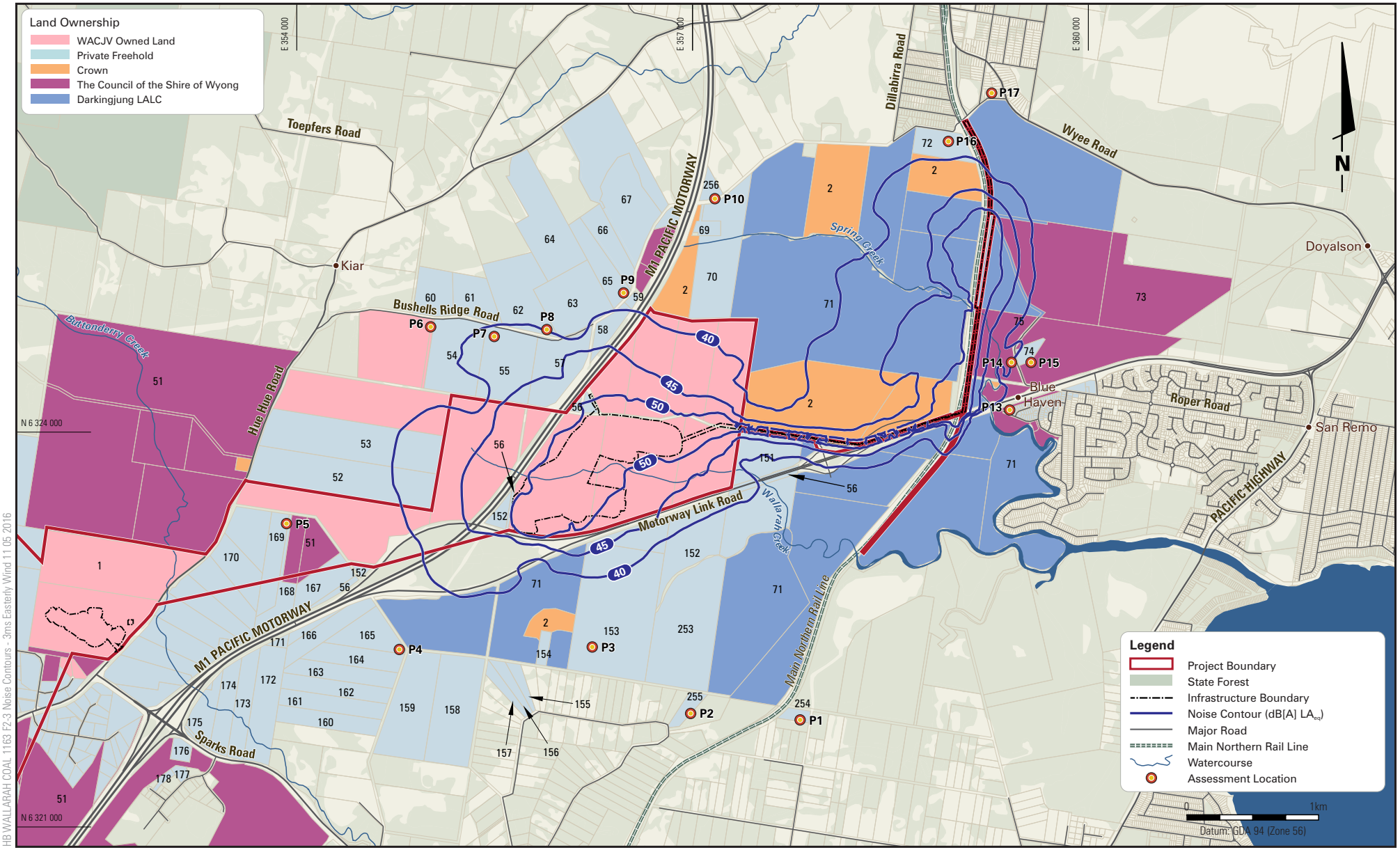
Noise Contours - 3m/s North-Easterly Wind

ATTACHMENT 2-2



HB WALLARAH COAL 1163 F2-3 Noise Contours - 3ms Easterly Wind 11 05 2016

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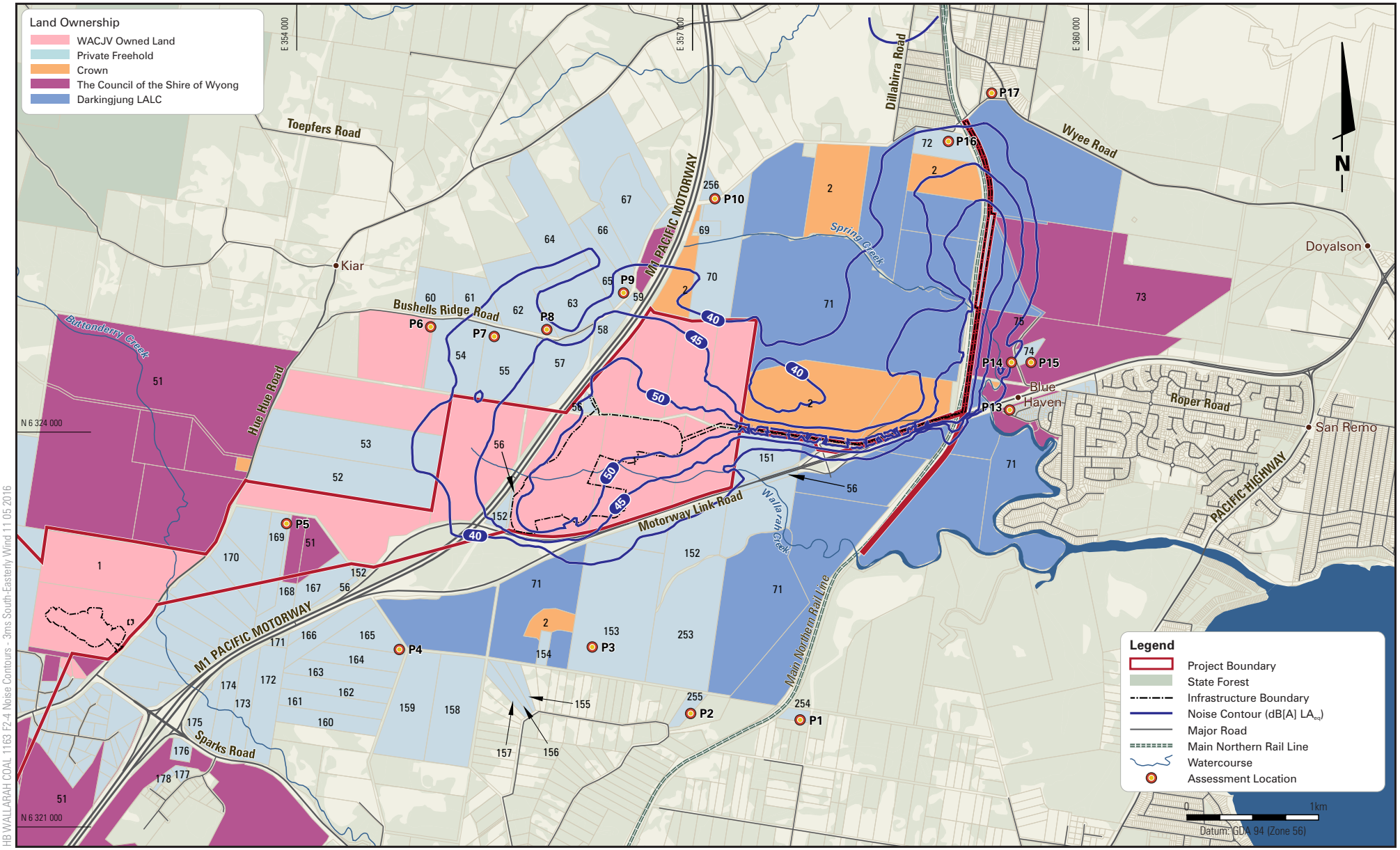
Noise Contours - 3m/s Easterly Wind

ATTACHMENT 2-3



HB WALLARAH COAL 1163 F2-4 Noise Contours - 3ms South-Easterly Wind 11 05 2016

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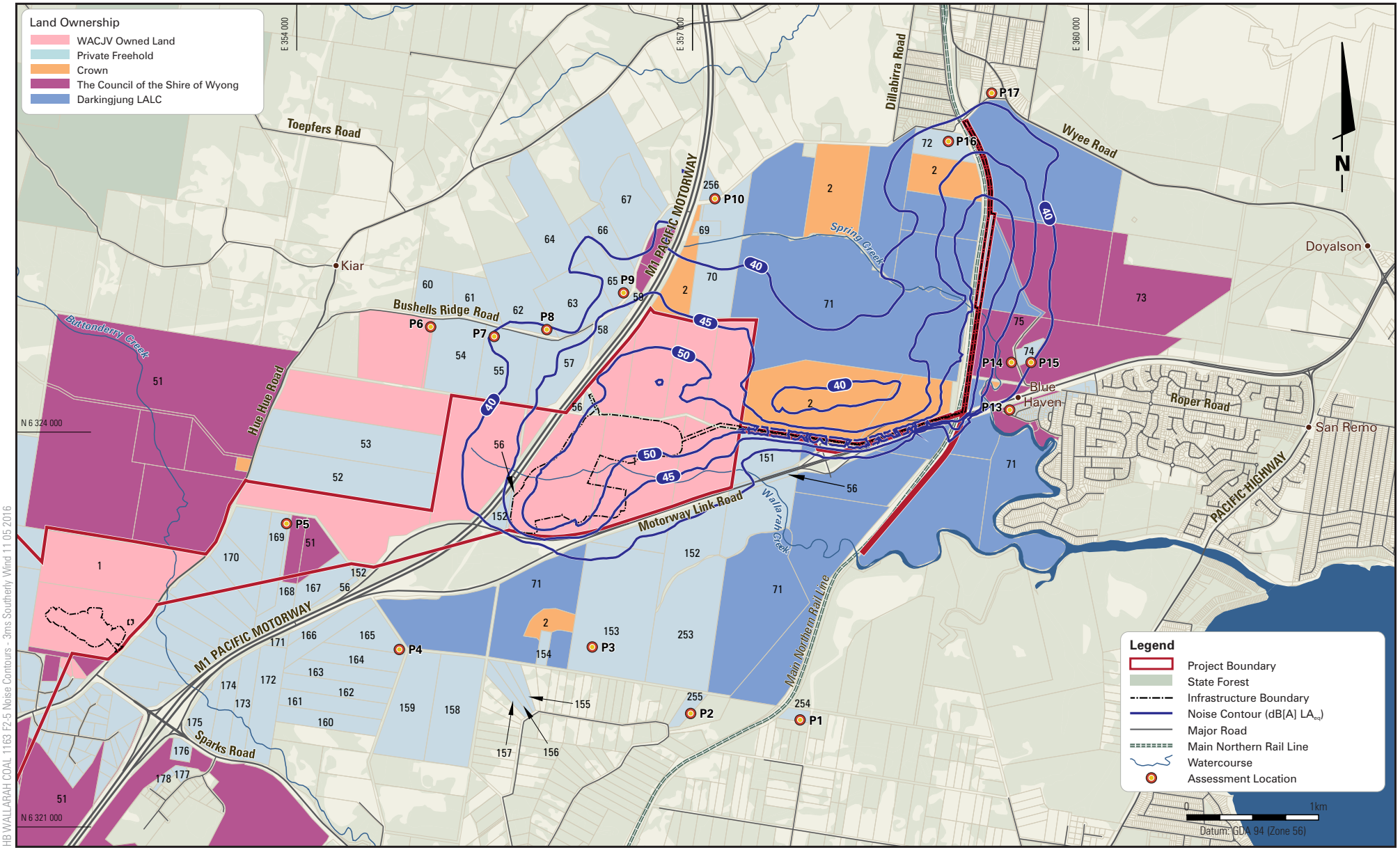
Noise Contours - 3m/s South-Easterly Wind

ATTACHMENT 2-4



HB WALLARAH COAL 1163 F2-5 Noise Contours - 3ms Southerly Wind 11 05 2016

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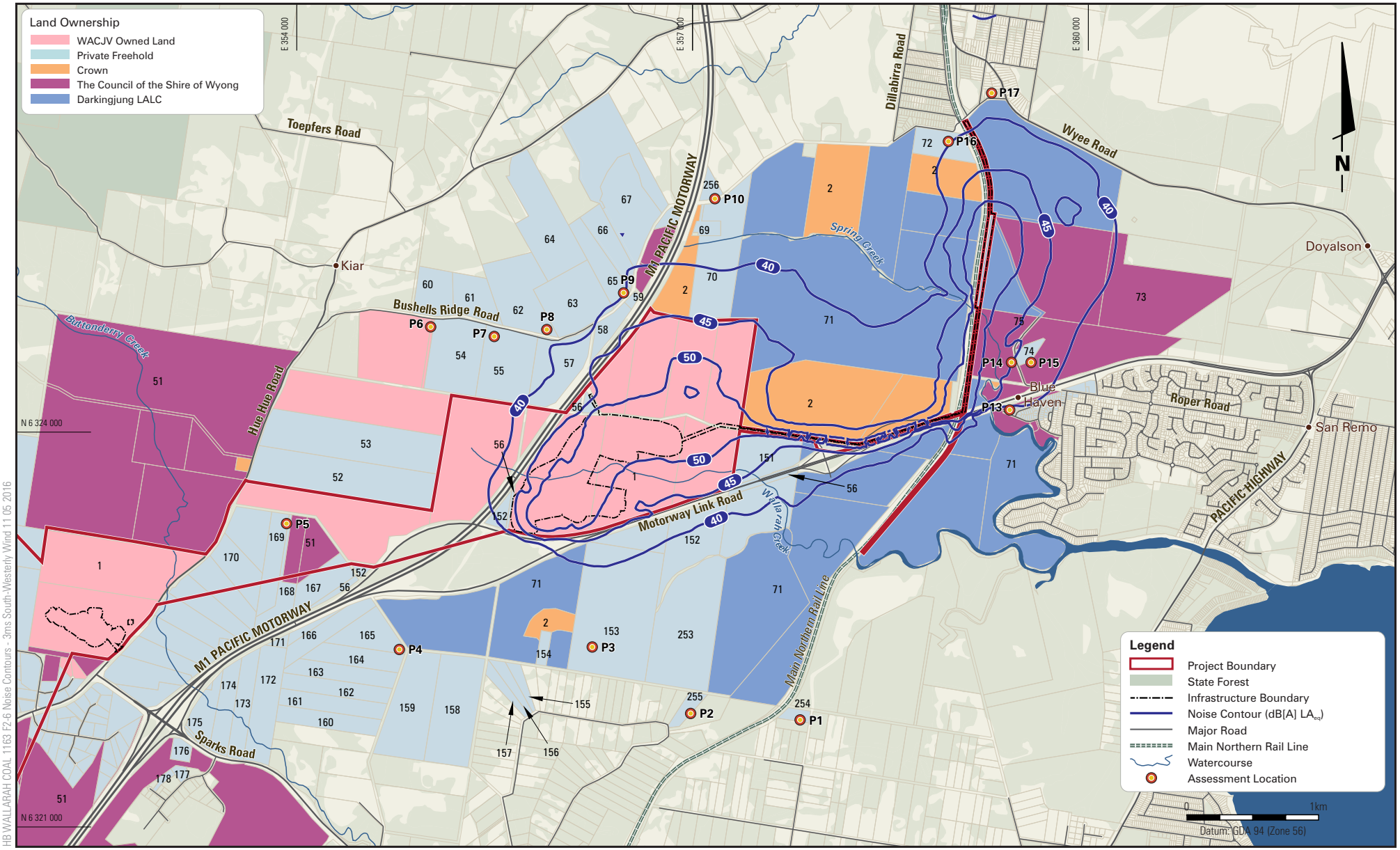
Noise Contours - 3m/s Southerly Wind

ATTACHMENT 2-5



HB WALLARAH COAL 1163 F2-6 Noise Contours - 3ms South-Westerly Wind 11 05 2016

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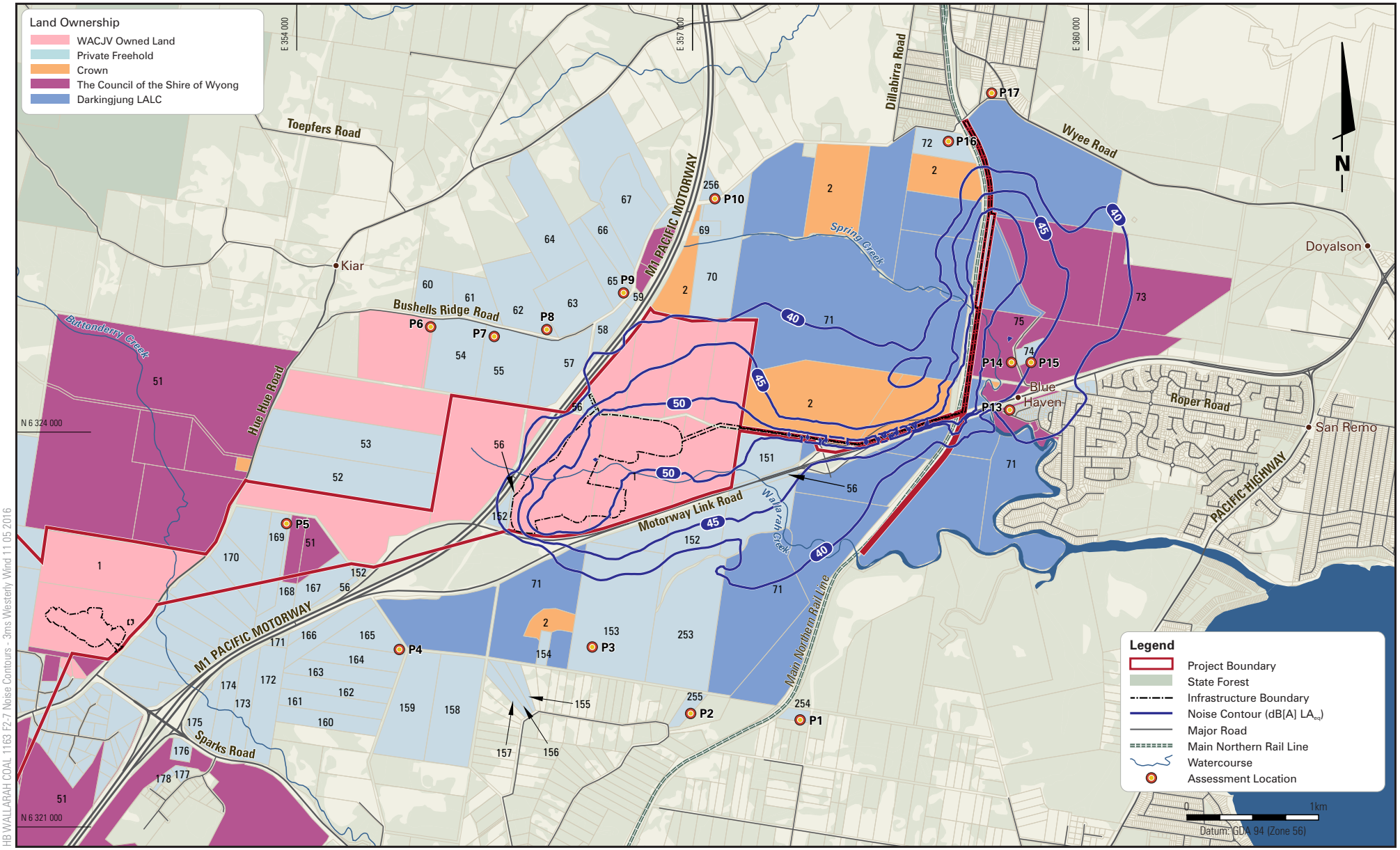
Noise Contours - 3m/s South-Westerly Wind

ATTACHMENT 2-6



HB WALLARAH COAL 1163 F2-7 Noise Contours - 3ms Westerly Wind 11 05 2016

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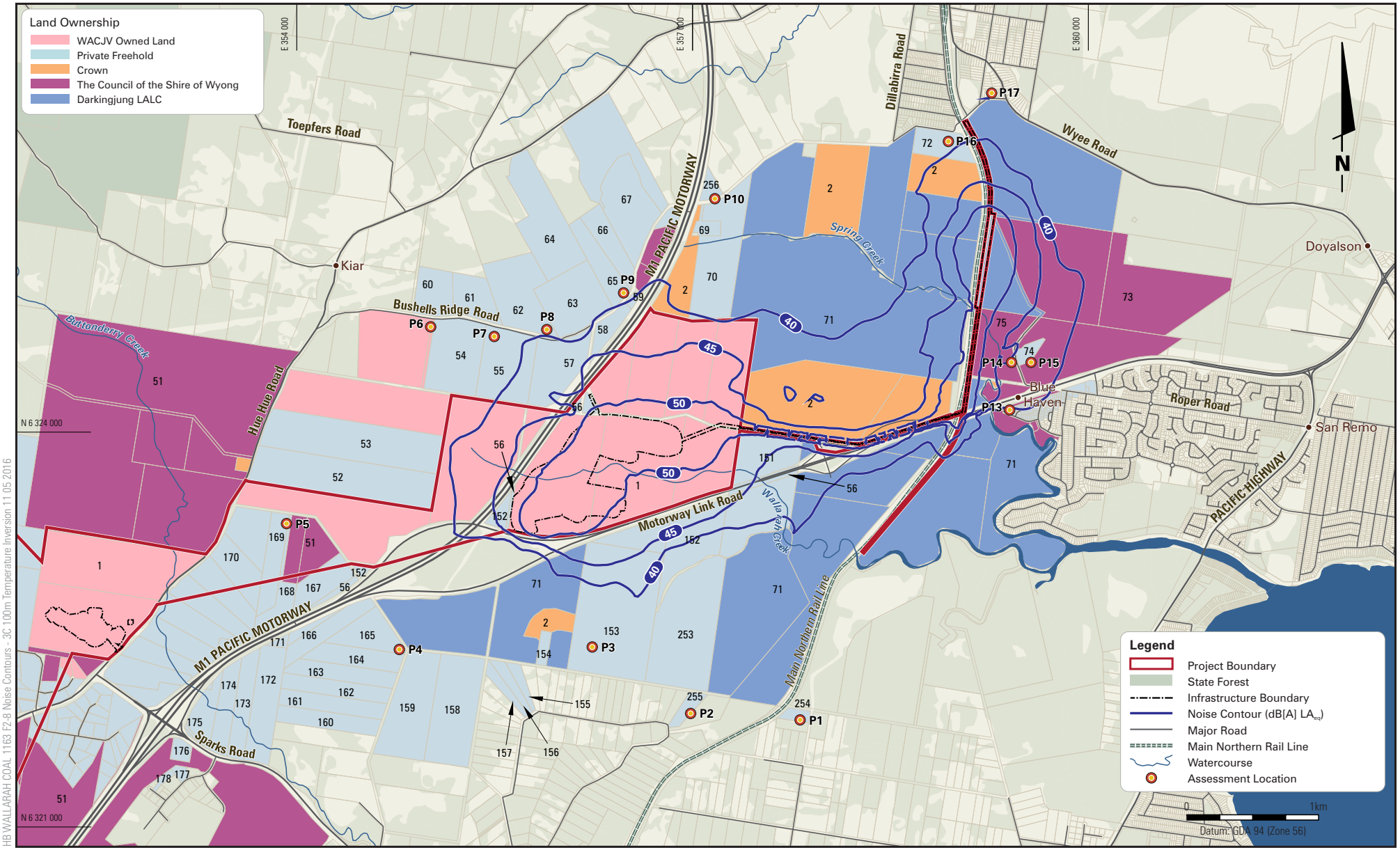
Wallarah 2 COAL PROJECT | HansenBailey ENVIRONMENTAL CONSULTANTS

Noise Contours - 3m/s Westerly Wind

ATTACHMENT 2-7



HB WALLARAH COAL 1163 F2-8 Noise Contours - 3C 100m Temperature Inversion 11 05 2016

WALLARAH 2 COAL PROJECT

Wallarah 2 COAL PROJECT | Hansen Bailey ENVIRONMENTAL CONSULTANTS

Noise Contours - 3C/100m Temperature Inversion

ATTACHMENT 2-8

ATTACHMENT 3: REFERENCES

- Environmental Protection Authority *(EPA)*, Industrial Noise Policy *(INP) (January 2000).*
- Environmental Protection Authority *(EPA)*, Environmental Noise Control Manual *(ENCM) (April 1993).*
- Environmental Protection Authority *(EPA)*, *Environment Criteria for Road Traffic Noise (ECRTN) (May 1999)* replaced with the Environment Climate Change & Water *(ECCW)* Road Noise Policy *(RNP). (March 2011)*
- Office of Environment & Heritage *(OEH),* Rail Infrastructure Noise Guideline (Draft) *(RING) (February 2012).*
- Department of Environment & Climate Change *(DECCC),* Interim Construction Noise Guideline *(ICNG) (July 2009).*
- Department of Environment and Conservation (*DEC)* Assessing vibration: a technical guideline *(AVTG) (February 2006).*
- PAE Holmes. Air Quality Assessment *(2012).*
- The NSW government's Voluntary Land Acquisition And Mitigation Policy for State Significant Mining, Petroleum and Extraction Industry Development (VLAMP)
- Wallarah 2 Coal Project Traffic and Transport Impact Assessment Parsons Brinckerhoff Australia Pty Limited. *(July 2012).*
- Rail Study for the Wallarah 2 Coal Project (W2CP). Rail Management Consultants. *(June 2012).*
- *Wheel Squeal Measurement, Management and Mitigation on the New South Wales Rail Network (Proceeding of ACOUSTICS 2004) (Dave Anderson (RailCorp)) (November 2004).*
- *German Standard DIN 4150 Part 3, 'Structural Vibration in Buildings, Effects on Structures' (May 1986).*
- *Australian Standard 2436 1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites.*

ATTACHMENT 4: TERMS AND DEFINITIONS

A-Weighted: See dB(A)

Adverse weather: Weather effects that enhance noise (that is, wind and temperature inversion) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more that 30% of the nights in winter).

Ambient noise: The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.

Assessment background level (ABL): The single figure background level representing each assessment period-day, evening and night (that is, three assessment background levels are determined for each 24-h period of the monitoring period). Its determination is by the tenth percentile method.

Assessment period: The period in a day over which assessments are made: day (0700-0800h), evening (1800 to 2200h) or night (2200 to 0700h).

Background Noise: The underlying level of noise present in the ambient noise, excluding the noise source under extraneous noise is removed. This is described using the L_{A90} descriptor.

Cumulative noise level: Refers to the total level of noise from all sources.

Day: The period between 0700 and 1800hrs (Monday-Saturday) and 0800-1800 (Sunday and Public Holidays).

dB: Abbreviation for decibel-a unit of sound measurement. Given sound pressure to a reference pressure.

dB(A): Unit used to measure “A-weighted” sound pressure levels. A-weighting is an adjustment made to sound level measurement to approximate the response of the human ear.

A change of 1dB(A) or dB(A) in the level of a sound is difficult to detect, whilst a 3dB(A) to 5dB(A) change corresponds to a small but noticeable change in loudness. A 10dB(A) change corresponds to an approximate doubling or halving in loudness.

The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Very noisy
100 90	Loud car hone at 3m Construction site with pneumatic hammering	Noisy
80 70	Kerbside of busy street Loud radio or TV	Loud
60 50	Department store General Office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quite
20	Unoccupied recording studio	Almost silent

Default parameters: In assessing meteorological enhancement of noise, refers to set values for weather parameters, such as wind speeds and temperature gradients, to be used in predicting source noise levels.

Equivalent Continuous Noise Levels: The level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Evening: Refers to the period between 1800-2200hrs.

Extraneous Noise: Noise resulting from activities that are not typical of 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 benefits provided)
- community views (aesthetic impacts and community wishes)
- noise levels for affected land uses (existing and future levels, and changes in noise levels).

Fluctuating Noise: Noise that varies continuously and to an appreciable extent over the period of observation.

Greenfield site: Undeveloped land.

Impulsive Noise: Noise having a high peak of short duration, or a sequence of such peaks. A sequence of such peaks. A sequence of such impulses in rapid succession is termed ‘repetitive impulsive noise’.

Intrusive Noise: refers to noise that intrudes above the background level by more than 5 decibels.

L_{A90}: The A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured.
This is considered to represent the background noise.

L_{Aeq}: The equivalent continuous noise level – the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Long-term annoyance: Prolonged annoyance over months and years.

Median: The middle value in a number of values sorted in ascending or descending order. Hence, for an odd number of values, the value of the median is simply the middle value. If there is an even number of values the median is the arithmetic average of the two middle values.

Meteorological conditions: wind and temperature inversion conditions.

Most-affected locations(s): Locations that experience (or will experience) offensive noise from the noise source under consideration. In determining these locations, one needs to consider existing background levels, exact noise source locations(s), distance from source (or proposed source) to receiver, and any shielding between source and receiver.

Negotiated agreement: An agreement involving the negotiation of an achievable noise limit in cases where the project specific noise levels cannot be met. The agreement is negotiated between the proponent and the EPA or the proponent and the community. Such an agreement is reached through balancing the merits of a development, the feasibility and reasonableness of available mitigation measures and the noise impacts produced.

Night: The period between 2200 and 0700 (Monday-Saturday) and 2200-0800 (Sunday and Public Holidays)

Noise criteria: The general set of non-mandatory noise level targets for protecting against intrusive noise (for example, background noise plus 5dB) and loss of amenity (for example, noise levels for various land uses).

Non-mandatory: With reference to the proposed policy, means not required by legislation. The proposed policy specifies criteria to be strived for, but the legislation does not make these criteria compulsory. However, the policy will be used as a guide to setting statutory (legally enforceable) limits for licences and consents.

Performed-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 (RBL): the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-h period used for the assessment background level). This is the level used for assessment purposed. It is defined as the median value of:

- all the day assessment background levels over the monitoring period for the day
- all the evening assessment background levels over the monitoring period for the evening; or
- all the night assessment background levels over the monitoring period for the night.

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

Stationary noise sources: Sources that do not generally move from place to place, eg. industrial or commercial sources. In general, these include:

Individual stationary sources such as:

- heating, ventilating and air conditioning (HVAC) equipment,
- rotating machinery,
- impacting mechanical sources,
- other mechanical equipment and machinery such as conveyors.

Mobile sources confined to particular location such as draglines and haul trucks.

Facilities, usually comprising many sources of sound, including:

- industrial premises,
- extractive industries,
- commercial premises,
- warehousing facilities,
- maintenance and repair facilities.

(In this case, the stationary source is understood to encompass all the activities taking place within the property boundary of the facility).

Temperature inversion: An atmospheric condition where temperature increases with height above the ground.