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Westfield Kotara Loading Dock and Access

Noise Impact Assessment

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1 INTRODUCTION

Acoustic Logic Consultancy Pty Ltd has been engaged to conduct an acoustic assessment for the purpose of assessing the potential impacts on the acoustic amenity of the proposed loading dock and access ways proposed for the Westfield Kotara development as part of the Planning Application submission. The noise sources investigated are as follows:

- Noise emissions associated with traffic generated from the site.
- Noise emissions from the site including mechanical plant noise to surrounding receivers.
- Noise emissions associate with the propose operation of the loading dock area and entry ramps.

The report addresses noise generated from the development potentially impacting on surrounding properties including building services and the proposed loading dock and entry ramps. Detailed design of the mechanical plant will be provided as part of the CC submission for each stage of the project. This study will set the goal assessment criteria applicable to the project based on the Environmental Protection Authority (EPA) requirements, other council and relevant statutory/regulatory requirements.

1.1 SITE DESCRIPTION

Figure 1 below illustrates the location of the proposed alterations and additions to the Westfield Kota development site and the location of noise monitoring and measurements.

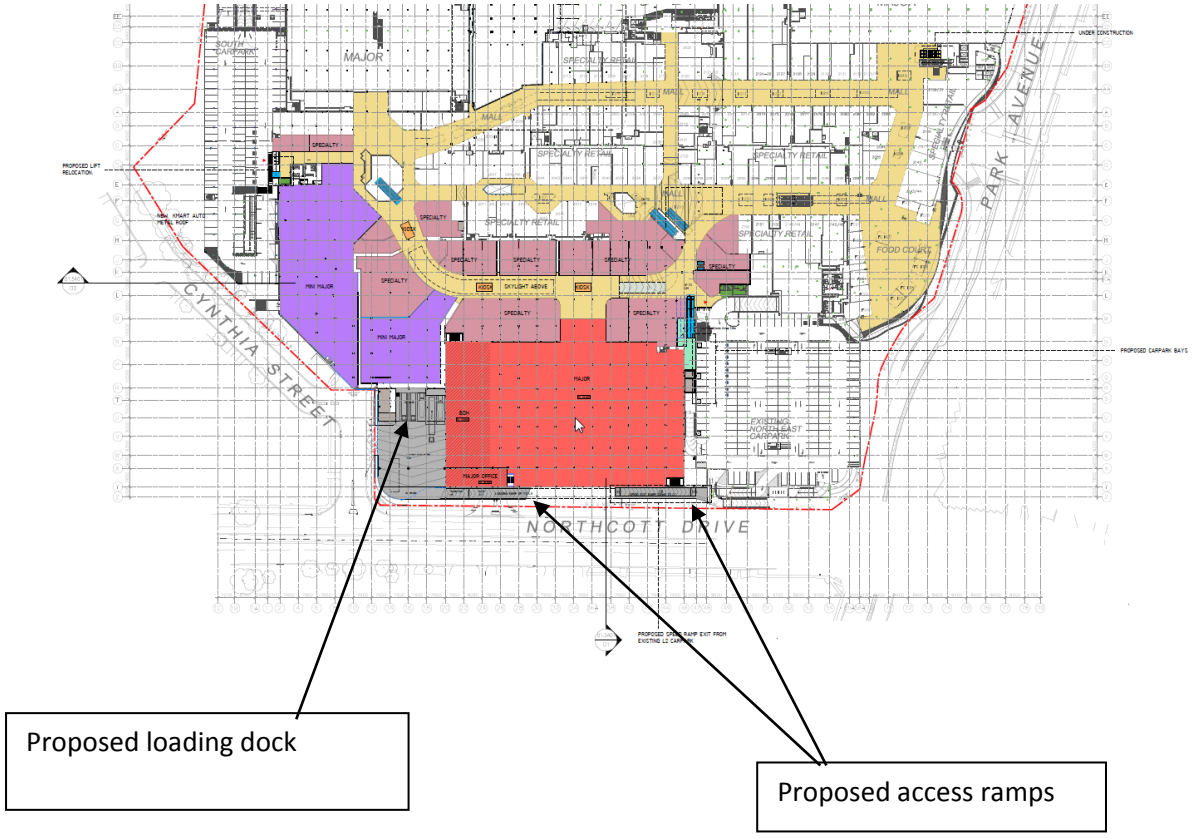


Figure 1 – Site Location, including proposed changes to the loading dock and entry ramps, Level 2

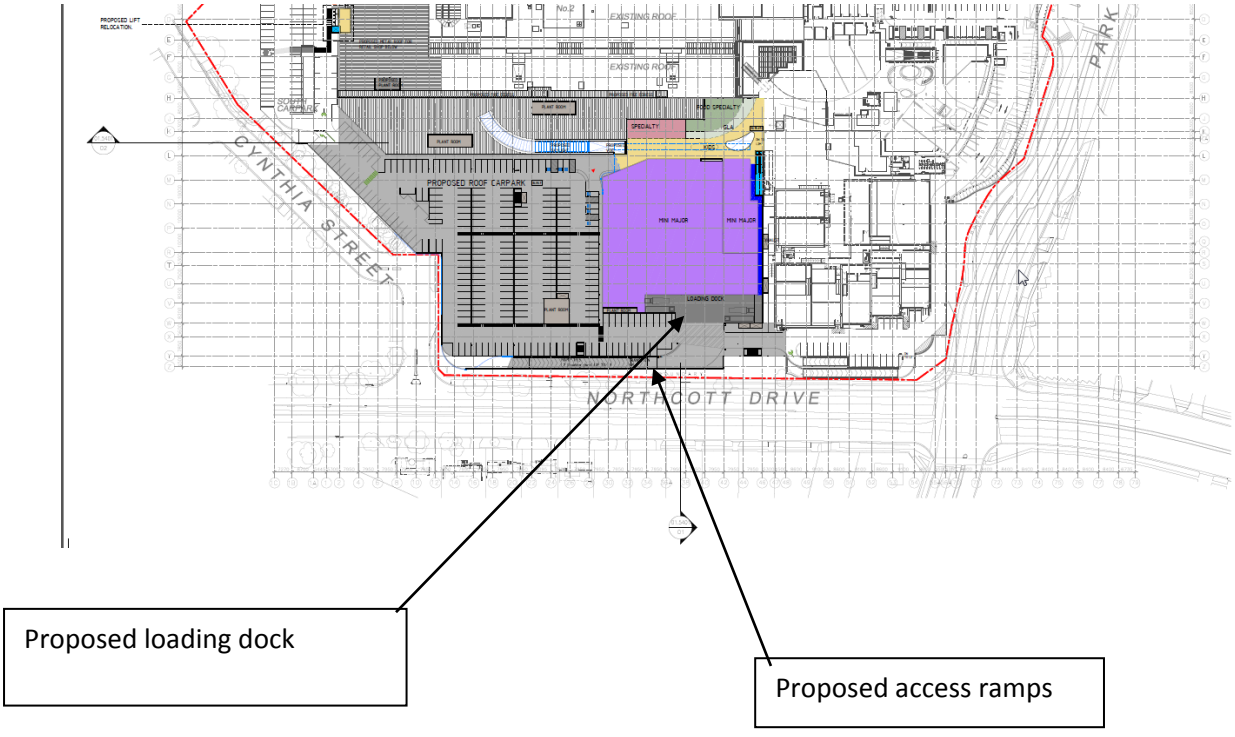


Figure 2 – Site Location, including proposed changes to the loading dock and entry ramps, Level 3

Figure 3 – Site Location and Measurement Positions

The existing environmental noise sources affecting the site are as follows:

- The development is affected by environmental noise predominantly from traffic noise from Northcott Drive to the east of the site which carries high volumes of traffic.

The environmental noise source outlined above has varying degrees of impact upon the proposed development which will be outlined in this report.

2 EXISTING ACOUSTIC ENVIRONMENT

Environmental noise impacting the site is a result of traffic noise from the surrounding perimeter roadways and other surrounding land existing land uses.

2.1 TOPOGRAPHY

The topography of the site and surrounding land of the proposed development is generally flat, the acoustic assessment has taken this topography into account.

3 ACOUSTIC SURVEY

As part of this assessment an acoustic survey of the proposed development site has been conducted.

The acoustic survey included attended and unattended noise logging which is detailed in this section of the report.

3.1 ENVIRONMENTAL NOISE LEVELS

Environmental noise constantly varies in level, due to fluctuations in local noise sources including road traffic. Accordingly, a 15 minute measurement interval is normally utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In the case of environmental noise three principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source depends on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of industrial noise.

3.2 ATTENDED NOISE MEASUREMENTS

Attended noise level measurements conducted as part of this assessment are detailed in this section of the report. All noise levels undertaken as part of this assessment were conducted in conjunction with the requirements of AS1055.

3.2.1 Measurement Equipment

Attended measurements were undertaken using a Norsonic 140 sound level analyser, set to A-weighted fast response. The sound level analyser was calibrated before and after the measurements, no significant drift was noted.

3.2.2 Measurement Period

Noise measurements was conducted at the locations detailed in Figure 3 in Section 2 above during the following period:

1. Peak afternoon conditions between 4.30pm and 6pm on the 14th of April, 2015.

2. Attended measurements were conducted on the evening of the 14th of April, 2015 during a period when the existing centre was not impacting on noise levels surrounding site between the hours of 10pm and 11pm.

3.3 UNATTENDED NOISE MONITORING

Unattended noise monitoring conducted as part of this assessment is detailed in this section of the report. The results of unattended noise logging are included in Appendix A.

3.3.1 Unattended Monitoring Period

Unattended noise monitoring was conducted at the site during the period of 12th to 18th April 2016 in order to measure the existing background and environmental noise levels at the site.

The noise level monitors were located at the following locations:

1. Location 1 – Within the boundary of the exiting Westfield Kotara site facing towards Northcott Drive. This location was selected as it is a suitable position to ascertain representative background noise levels for the residential receivers opposite the site to the east.

3.3.2 Monitoring Equipment

Unattended noise measurements were obtained using an Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The noise monitors were calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator. No significant drift was detected. All measurements were taken on A-weighted fast response mode. Periods of adverse weather conditions during the during the measurement period have not be used in this assessment.

3.4 RESULTS OF THE ACOUSTIC SURVEY

An acoustic survey was undertaken at the proposed works to be conducted as part of the Westfield Kotara site in order to determine the existing acoustic environment. The unattended monitor results will be used to determine the variation between day, evening and night time noise levels. Attended measurements will be compared with the unattended monitoring data during the same measurement period so that relative differences between the attended and unattended locations can be formed thereby providing a comprehensive study of existing noise levels around the proposed site.

3.4.1 Existing Background Noise Levels

Background noise levels during day time are dominated by general vehicular traffic movements. The NSW Environmental Protection Authority (EPA) Industrial Noise Policy (INP) details specific steps in determining the background noise level for assessment of the day, evening and night time periods. Table 1 summarises the background determined at the monitoring location, based on the guidelines set out in the INP and the results of unattended noise monitoring.

Table 1 – Measured Ambient Noise Levels

Location	Description	Day Noise Level 7am to 6pm (dB(A)L_{90})	Evening Noise Level 6pm to 10pm (dB(A)L_{90})	Night Noise Level 10pm to 7am (dB(A)L_{90})
Northcott Drive	Background $L_{90,15min}$	50	44	38

In addition to the background levels obtained at the unattended monitoring position presented above, attended noise monitoring was conducted on Northcott Drive as detailed in Figure 1 of Section 1 above. The results of the attended noise measurements are presented in Table 2 below.

Table 2 – Measured Attended Environmental Noise Levels

Location	Time Period	Measured Noise level dB(A) $L_{eq\ (15\ min)}$
Location 1 – Northcott Drive	Peak Afternoon Period	68
	Night Time	61

4 NOISE EMISSION LIMITS – NOISE GENERATED ON THE SITE

The NSW Environmental Protection Authority (EPA) Industrial Noise Policy (INP) provides guidelines for assessing noise impacts from development sites. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The EPA's Industrial Noise Policy has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion. In addition, the EPA in its Environmental Noise Control Manual states that noise controls should be applied with the general intent to protect residences from sleep arousal.

For land use developments with the potential to create additional traffic on local roads the development should comply with the requirements detailed in the Environmental Criteria for Road Traffic Noise (ECRTN).

4.1 EPA INTRUSIVENESS CRITERION

The EPA guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5 dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

4.2 EPA AMENITY CRITERION

The EPA guideline is intended to limit the absolute noise level from all industrial noise sources to a level that is consistent with the general environment.

The EPA's Industrial noise policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Table 5 of the INP provides the recommended ambient noise levels for the suburban residential receivers for the day, evening and night periods. For the purposes of this condition:

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays;
- Evening is defined as the period from 6pm to 10pm; and
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.

Table 3 – EPA Recommended Amenity Noise Levels

Type of Receiver	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Residential	Day	55
	Evening	45
	Night	40

4.3 SLEEP AROUSAL

To minimise the potential for sleep arousal the $L_{1\ (1\ minute)}$ noise level of any specific noise source does not exceed the background noise level (L_{90}) by more than 15 dB(A) outside a resident's bedroom window between the hours of 10pm and 7am. The L_1 noise level is the level exceeded for 1 per cent of the time and approximates the typical maximum noise level from a particular source. Where the typical repeatable existing L_1 levels exceed the above requirement then the existing L_1 levels form the basis for, sleep disturbance criteria.

4.4 SUMMARY OF ASSESSMENT CRITERIA FOR PROPOSED SITE

The EPA's INP intrusiveness, amenity and sleep arousal criteria for this project have been determined using these guidelines and the noise monitoring results. These are summarised below. We note that the formulation of the assessment criteria has been based on the lowest ambient levels determined from all monitoring data.

4.4.1 Day Time Period

The following table sets out the measured L_{eq} amenity and L_{90} background noise levels, and the assessment criteria based on the suburban criteria. The day period applies between 7am and 6pm Monday to Saturday; and 8am to 6pm Sundays and public holidays.

Table 4 – Measured L_{eq} & L_{90} Noise Levels and Criteria - Daytime

Location	Measured L_{eq} Noise Level dB(A)	Measured L_{90} Noise Level dB(A)	Amenity Criterion dB(A) L_{eq}	Intrusiveness Criterion dB(A) L_{eq}
Northcott Drive	68	50	55	55

4.4.2 Evening Period

The following table sets out the measured L_{Aeq} and L_{90} background noise levels, and the assessment criteria based on the suburban criteria. The evening period applies between 6pm and 10pm.

Table 5 –Measured L_{eq} & L_{90} Noise Levels and Criteria - Evening Period

Location	Measured L_{eq} Noise Level dB(A)	Measured L_{90} Noise Level dB(A)	Amenity Criterion dB(A) L_{eq}	Intrusiveness Criterion dB(A) L_{eq}
Northcott Drive	64	44	45	49

4.4.3 Night Time Period

The night period (that is, between 10pm and 7am) is the period where noise emissions can have the most significant effect on residential amenity. In addition to the quasi-steady state criteria the L_1 noise emission level should not exceed the background noise level by more than 15 dB(A) to prevent sleep arousal from intermittent events. The night time period applies between 10pm and 7am.

Table 6 –Measured L_{eq} & L_{90} Noise Levels and Criteria - Night Time Period

Location	Measured L_{eq} Noise Level dB(A)	Measured L_{90} Noise Level dB(A)	Amenity Criterion dB(A) L_{eq}	Intrusiveness Criterion dB(A) L_{eq}	Night time Sleep Disturbance dB(A) $L_{1\ (1\ Min)}$
Northcott Drive	61	38	40	43	53

4.5 RESULTING NOISE LEVEL CRITERIA

The criteria for the various monitoring locations have been considered and assessed for the surrounding receivers. Table 7 below details the noise level criterion for properties surrounding the proposed development. In all cases, if a discrepancy in attended and unattended noise levels were obtained at two nearby locations within a residential grouping the more conservative noise level criterion has been adopted.

Table 7 – Noise Objectives for Surrounding Receivers

Location	Day time Noise Objective dB(A) L_{eq}	Evening Noise Objective dB(A) L_{eq}	Night time Noise Objective dB(A) L_{eq}	Noise Objective for Intermittent Activities dB(A) $L_{1\ (1\ Min)}$ (Background + 15 dB(A))
Northcott Drive	55	45	40	53

*Note: Noise level criteria above includes noise levels impacting the future residential receivers proposed within the Westfield Kotara development as result of the operation of the proposed facilities within the development.

Noise level criteria are to be applied to commercial traffic levels generated from vehicle movements on the site only, as presented by the Industrial Noise Policy. Noise levels generated from the movement of vehicles entering and exiting the site on ramps are generally required to comply with levels presented in the presented tables for surrounding receivers.

In addition to the criteria detailed above noise levels from the operation of mechanical plant and equipment will be designed to comply with the previously detailed noise level criteria as detailed in The Acoustic Group "*Acoustic Report, Operational Noise for Proposed Additions and Alterations, Westfield Kotara"* dated 27th September 2004 and previously agreed previous approvals process. The relevant noise level criteria detailed in this report is detailed in the table below:

Table 8 – Previously Agreed Mechanical Plant Noise Criteria

Location	Day time Noise Objective dB(A) L_{eq}	Evening Noise Objective dB(A) L_{eq}	Night time Noise Objective dB(A) L_{eq}
5 Cynthia Street	53	49	40
105 Lexington Parade	54	49	44
113 Lexington Parade	53	49	44
121 Lexington Parade	56	50	45

4.6 ASSESSMENT CRITERIA – ADDITIONAL TRAFFIC GENERATION

For land use developments with the potential to create additional traffic on local roads the development should comply with the requirements detailed in the EPA ECRTN. Criteria applicable to the development are detailed below. If existing noise levels exceed those in Table 8 a 2 dB increase in noise is allowed.

The proposed development includes the use of a carpark located to the south west of the site and future roadways within the development site which will be assessed against the criteria detailed in the table below.

Table 9 - Criteria for Traffic Noise for New Developments

Time of day	Criteria for Acceptable Traffic Noise Level dB(A)
Day (7am to 10pm)	60 $L_{Aeq(1hr)}$ – Collector Road 55 $L_{Aeq(1hr)}$ – Local Road
Night (10pm to 7am)	55 $L_{Aeq(1hr)}$ – Collector Road 50 $L_{Aeq(1hr)}$ – Local Road

Attended and unattended traffic noise levels measurements were conducted at a number of locations surrounding the development including locations as detailed in the table below. The resulting noise levels have been used to generate the resulting noise level criterion for additional traffic movements which been used in this assessment.

Table 10 - Criteria for Traffic Generation

Location	Criteria for Acceptable Traffic Noise Level dB(A) $L_{eq\ (1hr)}$	
	Day (7am to 10pm)	Night (10pm to 7am)
Northcott Drive	70	63

Note: Noise levels calculated to potentially worst affected residential facades from results of onsite testing.

5 ADDITIONAL TRAFFIC NOISE GENERATION ASSESSMENT

The proposed parking for the centre will be increased from 2,906 spaces (existing) to some 3,119 spaces (proposed) on the completion of this application.

Potential noise impacts from traffic movements generated by the development on public roads have been assessed for residents surrounding the site and future tenancies within the development, including the potential for noise impact generated from the proposed additional roadways on the perimeter of the site. The assessment is based on the maximum traffic flow periods using FHWA and CORTN traffic noise prediction models and noise level measurements conducted at the site and presented in this report.

5.1 ADDITIONAL TRAFFIC NOISE ON LOCAL STREETS

Traffic noise generated by the proposed development was assessed using current and predicted traffic numbers based on the potentially worst case condition of half the carpark replenishing itself in any 1 hour day or evening period. Additionally 15 service vehicles which will be accessing the site from Northcott Drive on any given day. These additional movements have also been included in this assessment.

The predicted worst case noise increases on each of the streets surrounding the development are summarised in the following table.

The calculated potential noise from additional traffic movements from the site are displayed in the table below at the potentially worst affected residential receivers located on surrounding roadways.

Table 11 – Calculated Noise Associated with Traffic Generation

Roadway	Time Period	Current Traffic Noise Levels	Criteria for Acceptable Traffic Noise Level dB(A) $L_{eq\ (1hr)}$	Calculated Future Traffic Noise $L_{eq\ (1\ hr)}$	Compliance
Northcott Drive	Day (7am to 10pm)	**68**	70	No Noise Increase	Yes
	Night (10pm to 7am)	61	63	Approximately 61.3 dB(A)	Yes

Note: All calculations were conducted using FHWA and CORTN traffic modelling.

The investigation into noise associated with additional traffic movements revealed that any increased traffic flows will cause either no noise increase to existing roadways or compliance with INP criteria for increased traffic volumes on surrounding roadways and would not adversely impact on the acoustic amenity of surrounding residential receivers.

6 MECHANICAL PLANT TREATMENTS

A detailed mechanical noise assessment will be conducted once plant selections and services drawings have been finalised as part of the construction documentation to ensure noise levels comply with the criteria detailed in this report. Details will be provided as part of the CC submission of the project.

Based on experience with similar development acoustic treatments are both possible and practical using acoustic treatments such as lining of ductwork, acoustic silences, variable speed controllers, time switches, acoustic screens etc. General requirements for a number of potential plant items on the site are expanded on below.

Plant and equipment will be designed to comply with the previously detailed noise level criteria as detailed in The Acoustic Group "*Acoustic Report, Operational Noise for Proposed Additions and Alterations, Westfield Kotara"* dated 27th September 2004 and previously agreed previous approvals process. The relevant noise level criteria detailed in this report is detailed in the table below:

Table 12 – Previously Agreed Mechanical Plant Noise Criteria

Location	Day time Noise Objective dB(A) L_{eq}	Evening Noise Objective dB(A) L_{eq}	Night time Noise Objective dB(A) L_{eq}
5 Cynthia Street	53	49	40
105 Lexington Parade	54	49	44
113 Lexington Parade	53	49	44
121 Lexington Parade	56	50	45

Typical acoustic treatments to plant and equipment items are detailed in the following section. These types of treatments have previously been used successfully on other similar developments and details of specific treatments will be provided as part of the detailed design stage of the project and will form part of the CC approval documentation.

6.1 CHILLERS / AIR HANDLING UNITS

Units can be located on roof tops with an acoustic screen or in basement areas, with acoustic treatment to intake and exhaust as necessary.

These units would predominantly operate during the day, with the potential to operate with extended hours. Acoustic treatment to these units may be required to ameliorate noise impact to the surrounding residents and to comply with the criteria specified in this report and verified at CC stage.

6.2 SUPPLY / EXHAUST FANS

Supply and exhaust fans may be located within the underground plant rooms or in rooftop plant areas. These units typically emit high noise levels and require acoustic treatment such as silencers and internal lined ductwork. Silencer requirements would be determined once fan selections have been completed at CC stage.

6.3 CONDENSER UNITS

Condensing units typically emit relatively low noise levels and with careful selection, it is possible that no further acoustic treatment would be necessary.

6.4 MINOR PLANT

Other minor plant items, such as bathroom or kitchen exhaust fans, will be required. These items typically emit relatively low noise levels and may require minimal acoustic treatment of a standard nature, such as internally lining of ductwork.

7 ASSESSMENT OF LOADING DOCK ACTIVITIES

This section of the report presents the assessment of noise associated with the operation of the loading docks associated with the proposed alterations to the Westfield Kotara loading docks. The assessment was conducted in conjunction with the EPA criteria presented in this report.

Loading dock will be open to receive deliveries 24 hours and is located within the development as detailed in the figure below.

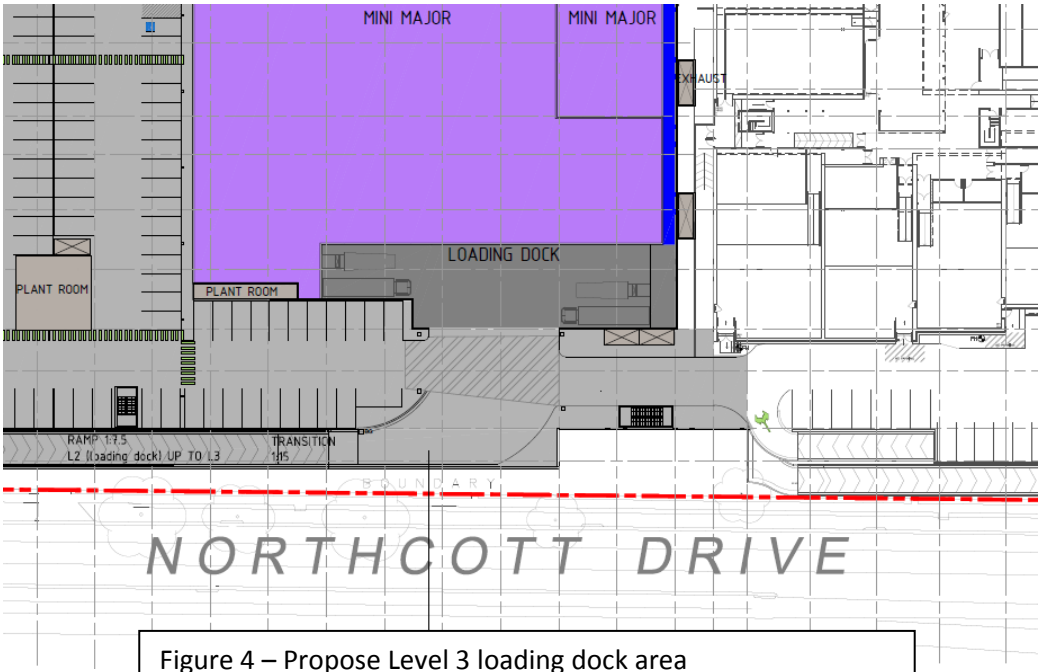


Figure 4 – Propose Level 3 loading dock area

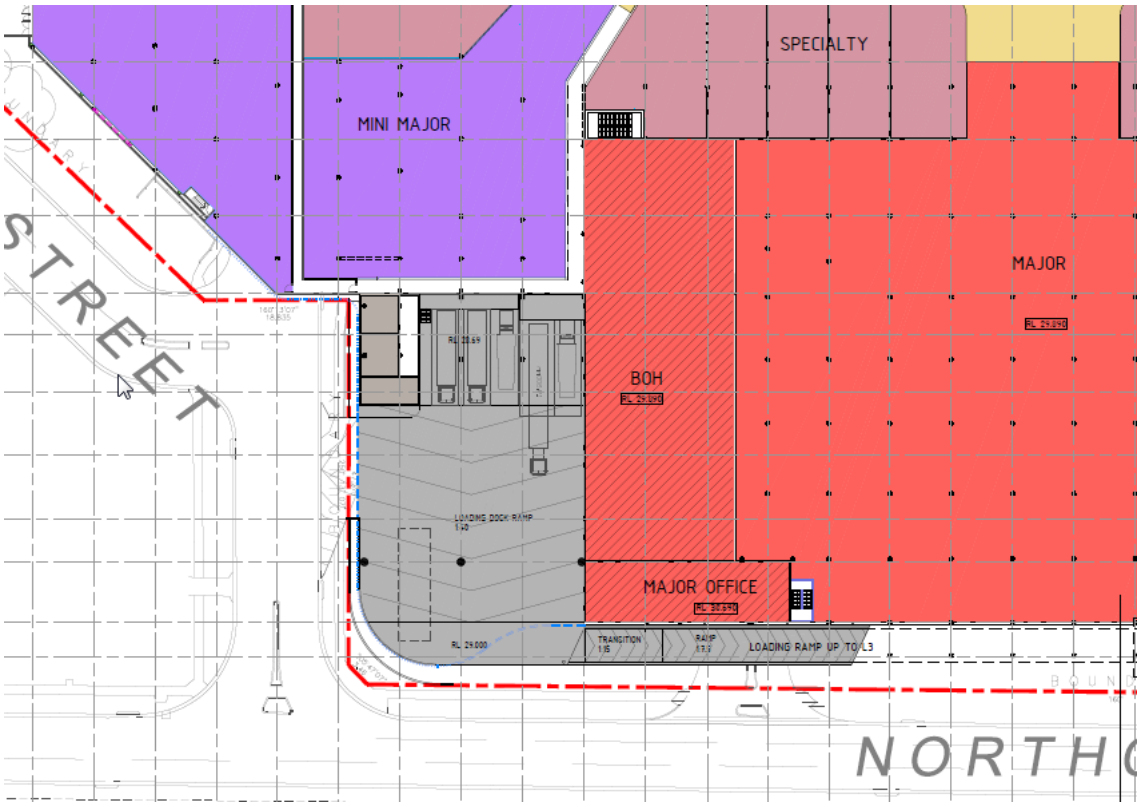


Figure 5 – Proposed Level 2 Loading Dock Area

7.1 POTENTIAL LOADING DOCK NOISE SOURCES

The potentially significant loading dock noise sources are listed in Table 13 below long with noise emission levels. The emission levels in Table 13 have been obtained from noise monitoring carried out at similar warehouse and retail loading dock facilities. Noise measurements were obtained using a Norsonics SA 110 sound level meter, set to fast response. The sound level meter was calibrated before and after the measurements using a Rion NC-73 calibrator. No significant drift was recorded.

Table 13 - Noise Source Emission Levels

Noise Source	Sound Emission Level dB(A) at 7m	Type of Noise Source
Small Truck Reversing alarm	75(1)	Quasi-Steady, tonal
Trucks Manoeuvring/Reversing	75	Quasi-Steady
Truck Air Brakes	89	Transient
Truck Door Closing	75	Transient
Truck Starting	72	Transient
Trucks using an inclined ramp	78	Quasi-Steady

(1) A 5 dB(A) penalty has been applied to this source to account for the tonal characteristic of noise produced.

7.2 PREDICTED NOISE LEVELS AT MOST AFFECTED RECEIVERS

Noise levels at the residences were predicted based on the noise emission levels in Table 13, which are typical for this type of development.

Table 14 summaries the predicted noise levels at the nearest residence on Northcott Drive of the proposed loading dock and within the proposed development. The noise levels below assume the acoustic treatments detailed in this report are adopted. Based on the location of the loading dock there are no residence which will have a direct line of sight to the area.

Table 14 – Assessment of Loading Dock Noise Emissions

Location/Activity	Receiver	Predicted Noise Level at Residence $L_{eq,15min}$	Allowable Noise Level at Residence $L_{eq,15min}$
Truck Loading/Unloading(1) Within the Loading Dock	Worst affected residence to the south opposite on Northcott Drive	< 40 dB(A) Day < 40 dB(A) Evening < 40 dB(A) Night	55 dB(A) Day 45 dB(A) Evening 40 dB(A) Night
Truck Loading/Unloading(1) Within the Loading Dock	Worst affected residence to the South on Cynthia Street	< 40 dB(A) Day < 40 dB(A) Evening < 40 dB(A) Night	55 dB(A) Day 45 dB(A) Evening 40 dB(A) Night

1 - These activities include activities such as the delivery truck being idle in the dock, movement of pallet trucks, operation of compactors, etc.

The assessment includes noise from the use of the loading docks simultaneously.

7.3 RECOMMENDED LOADING DOCK DEVELOPMENT CONTROLS

It is recommended that the following management and physical controls be implemented into the design and operation of the proposed loading dock associated with the Westfield Kotara project (note that all treatment and controls include those required to ensure noise levels comply at all surrounding residential receivers include on Northcott Dive and Cynthia Street):

1. Bail and/or garbage compactors are to be used only within the building fabric or during day time hours.

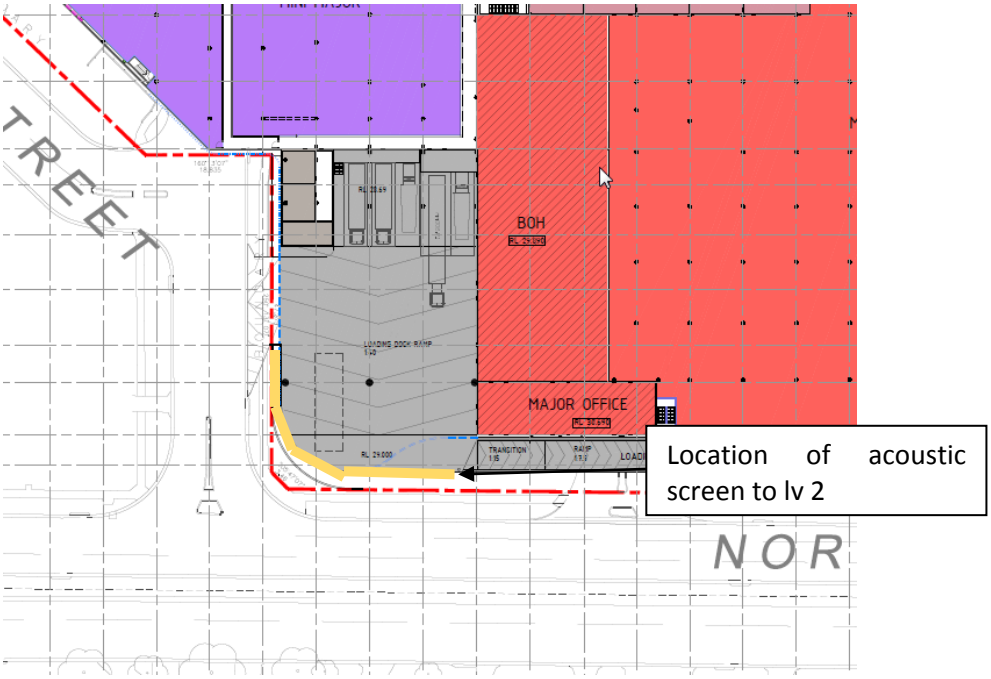
2. Neoprene rubber buffers should be installed on the vertical face of the loading dock where vehicles park to absorb impacts.

3. A detailed assessment of noise emissions from plant and equipment associated with the loading dock is required to be conducted prior to installation in conjunction with Local council requirements.

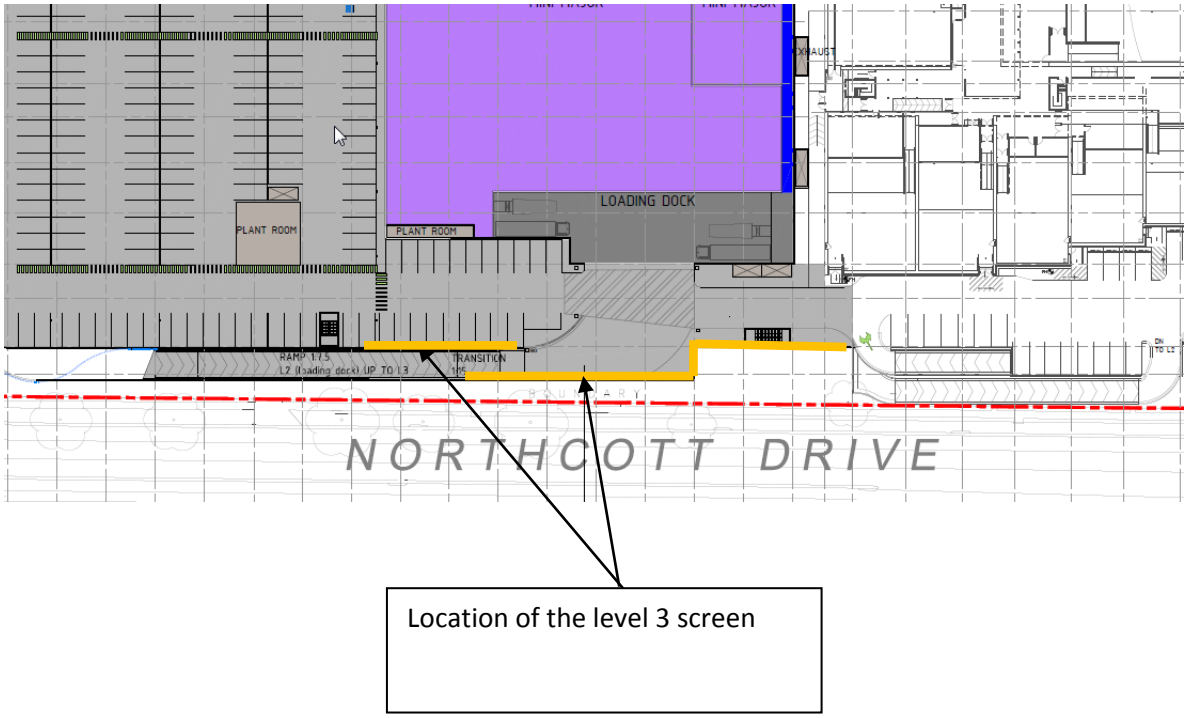
4. Vehicle engines should be switched off during loading and unloading within the dock.

5. Solid screen should be installed to the loading dock areas including the following, screens are lo be of a solid constriction such as FC sheet, sheet metal, masonry, concrete or the like;

    a. Level 2 loading dock area – Screen to the east of the loading dock to a minimum height of 2.5m as detailed below.



b. Level 3 loading dock area – Screen to the east of the loading dock to a minimum height of 1.5m as detailed below.



8 SLEEP DISTURBANCE NOISE LEVELS

Sleep disturbance assessment based on the requirements of the EPA's Industrial Noise Policy (INP) should be conducted in conjunction with the following as directed by the EPA's Application Notes:

Sleep disturbance

Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The INP does not specifically address sleep disturbance from high noise level events.

EPA reviewed research on sleep disturbance in the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research, EPA recognised that current sleep disturbance criterion of an LA1, (1 minute) not exceeding the LA90, (15 minute) by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, EPA will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or LA1, (1 minute), that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the appendices to the ECRTN. Other factors that may be important in assessing the extent of impacts on sleep include:

- *How often high noise events will occur*
- *Time of day (normally between 10pm and 7am)*
- *Whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*

The LA1, (1 minute) descriptor is meant to represent a maximum noise level measured under 'fast' time response. EPA will accept analysis based on either LA1, (1 minute) or LA, (Max).

8.1 CRITERIA

Sleep arousal is a function of both the noise level and the duration of the noise.

To assess potential sleep arousal impacts, a two stage test is carried out:

Step 1 - An "emergence" test is first carried out. That is, the L_1 noise level of any specific noise source should not exceed the background noise level (L_{90}) by more than 15 dB(A) outside a resident's bedroom window between the hours of 10pm and 7am. If the noise events are within this, then sleep arousal impacts are unlikely and no further analysis is needed. This is consistent with the Noise Guide for Local Government. The guideline level is set out below.

Table 15 – Sleep Arousal Emergence Criteria

PERIOD/TIME	BACKGROUND NOISE LEVEL dB(A)L_{90}	EMERGENCE LEVEL (dB(A) L_1)
Night (10pm-7am)	38	53

Step 2 - If there are noise events that could exceed the emergence level, then an assessment of sleep arousal impact is required to be carried out taking into account the level and frequency of noise events during the night, existing noise sources, etc. This test takes into account the noise level and number occurrences of each event with the potential to create a noise disturbance. As is recommended in the explanatory notes of the EPA Industrial Noise Policy, this more detailed sleep arousal test is conducted using the guidelines in appendix B of the EPA Environmental Criteria for Road Traffic Noise.

Appendix B of the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999) includes criteria for the assessment of sleep disturbance. The criteria details noise levels which are likely to be a source of a sleep disturbance, this is represented within as a graph within the standard which is detailed below.

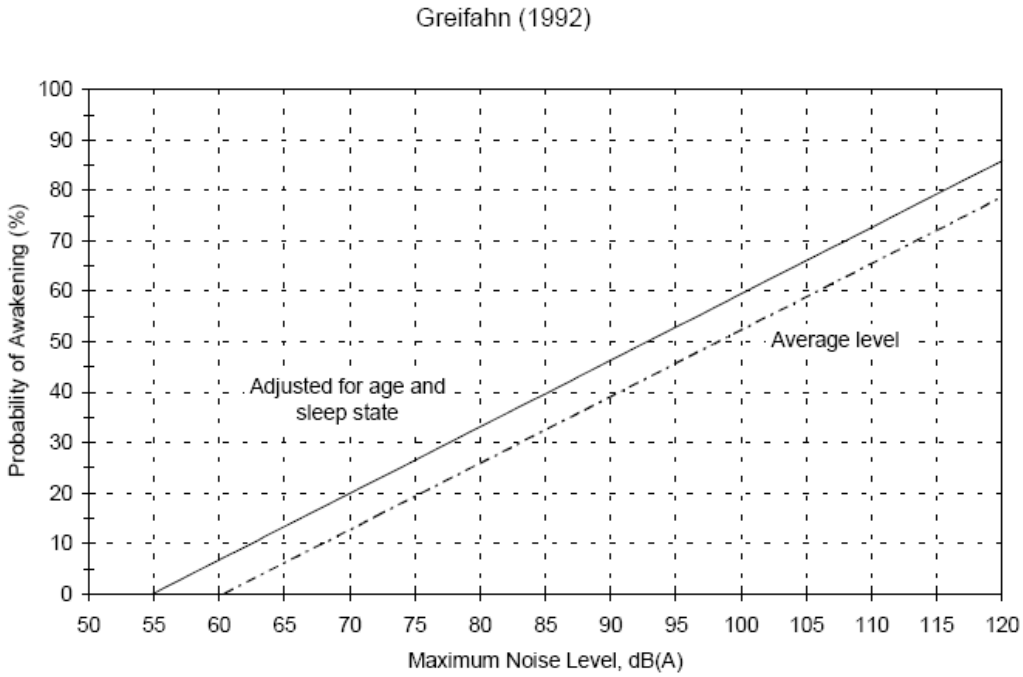


Figure B4 Probability of awakening related to age and sleep state (Griefahn 1992)

Based on the requirements of the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999) as represented on the table below an internal noise level of 55 dB(A) or less will result in a 0% probability of sleep arousal and is therefore considered to be acceptable.

8.2 POTENTIAL CARPARK NOISE SOURCES

The potentially significant carpark noise sources which have been used as the basis of this report are listed in Table 15 below. The emission levels in Table 15 have been obtained from noise measurements of typical car doors and engines. Noise measurements were obtained using a Norsonics SA 140 sound level meter, set to fast response. The sound level meter was calibrated before and after the measurements using a Rion NC-73 calibrator. No significant drift was recorded.

Table 16 – Carpark and Loading Dock Noise Source Emission Levels

Noise Source	Sound Emission Level dB(A)
Car Door Closing	69 dB(A) L_1 @ 5m
Car Starting	68 dB(A) L_1 @ 5m
Truck engines Starting	76 dB(A) L_1 @ 5m
Loading Dock Material Movement	78 dB(A) L_1 @ 5m

8.3 PREDICTED NOISE LEVELS AT MOST AFFECTED RECEIVERS

Noise levels at the worst affected receiver to the south of the carpark have been predicted based on the noise emission levels in Table 15, which are typical for the proposed carpark and loading dock areas. Noise levels have been predicted based on the potential worst case location of cars within the carpark (see figure 1 above) of 15m to the existing building façade (linearly) and the loading dock areas as detailed in Figures 1 and 2.

Step 1: Assessment requires that noise emissions from cars starting, car doors closing or activites within the loading dock areas (including engines, activities and materials movements etc) not exceed 53 dB(A)L_1 (15dB(A) above the background noise level).

Our analysis indicates that vehicles located within carpark will create L_1 noise levels of up to 55 dB(A) external which is marginally exceeding the 53 dB(A) when starting their engines and closing doors. Therefore more detailed assessment using EPA Road Traffic Noise sleep disturbance analysis is recommended (and is presented below).

For the loading dock areas noise from the starting of engines and activities which will be conducted in the loading dock areas (including material movement etc) will be up to 59 dB(A) L_1 externally and a detailed analysis of sleep disturbance is required.

Step 2: Applying the Road Traffic Noise Sleep Disturbance test, noise levels of less than 55dB(A) when measured *inside* a bedroom are considered to result in a 0% probability of sleep arousal (page 29 of the guidelines, extracted, appendix 15 as detailed in the graph above).

Assuming that the window of a bedroom overlooking the car park is left open, there will be a 10dB(A) noise reduction as noise travels from outside to inside the room.

Calculating the resulting noise levels from car doors closing and engine start ups and the distance correction for the location of cars at the potentially worst location within the carpark the following levels have been calculated:

- Calculated noise level from a car starting at the potentially worst affected parking spot to the nearest residential window will be 55 dB(A)L_1 when measured inside the bedroom on the first floor of the neighbouring residence externally resulting in an internal noise level of 45 dB(A). This nose level complies with the EPA Road Traffic Noise sleep disturbance criteria as there will be a 0% probability of sleep arousal.

- Calculated noise level from a car door closing at the potentially worst affected parking spot to the nearest residential window will be 56 dB(A)L_1 when measured inside the bedroom on the first floor of the neighbouring residence externally resulting in an internal noise level of 46 dB(A). This nose level complies with the EPA Road Traffic Noise sleep disturbance criteria as there will be a 0% probability of sleep arousal.

- Calculated noise level from a truck starting in the loading dock areas and from materials movement at the potentially worst affected residential window will be up to 59 dB(A)L_1 when measured inside the bedroom on the first floor of the neighbouring residence externally resulting in an internal noise level of 49 dB(A). This nose level complies with the EPA Road Traffic Noise sleep disturbance criteria as there will be a 0% probability of sleep arousal.

- Noise levels generated by cars starting in all but the closest parking spot will be less than the calculated levels above and also comply with required criteria.

Based on the results of the assessment the used of the proposed carpark as well as the loading dock areas will not result in a noise levels which would generate a sleep disturbance event and therefore is acoustically acceptable.

9 KMART AUTO CENTRE

This section of the report details the assessment of noise associated with the proposed Kmart Auto Centre which is to be located on the site as detailed in the figure below.

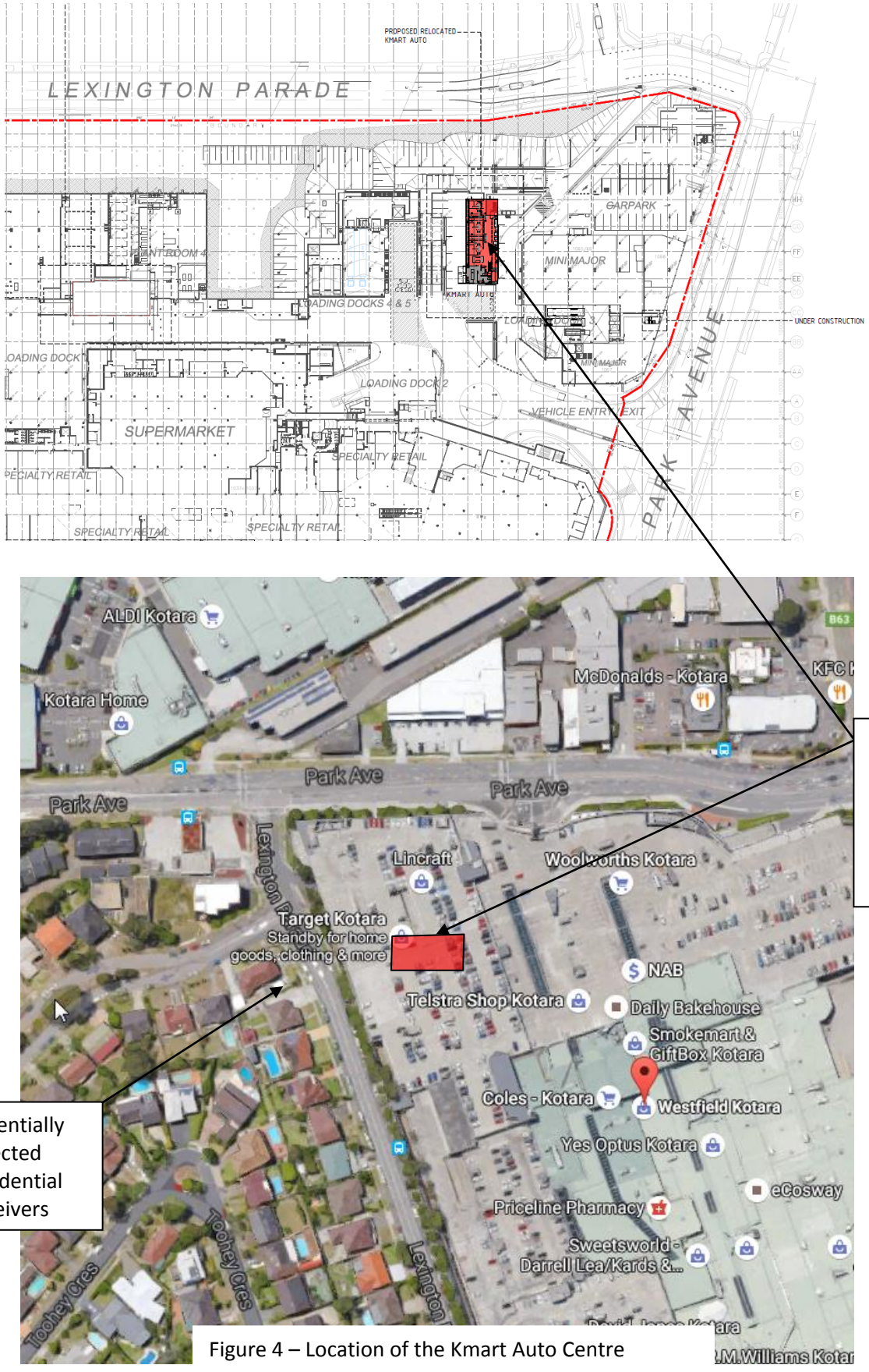


Figure 4 – Location of the Kmart Auto Centre

9.1 HOURS OF OPERATION

The proposed hours of operation of the Kmart Auto Centre include the following:

- 7am – 6pm Monday to Friday
- 7am – 1pm Saturday
- Closed on Sunday

9.2 ENVIRONMENTAL NOISE CRITERIA

The noise criteria applicable for the operation of the Kmart Auto Centre based on the noise levels recorded at the site and the previously agreed noise levels as detailed within The Acoustic Group "*Acoustic Report, Operational Noise for Proposed Additions and Alterations, Westfield Kotara"* dated 27th September 2004 are detailed in the table below.

Table 17 – Kmart Auto Centre Operations Environmental Noise Limits

Period	Noise Level Criteria L_{eq} (dB(A))
Day	53
Evening	49
Night – time	40

9.3 KMART AUTO CENTRE NOISE EMISSION ASSESSMENT

Potential noise emission from the operation of the proposed Kmart Tyre and Auto Services has been assessed using noise level obtained within a similar services centre and the distance from the noise receivers, construction of the building envelop. The resulting assessment has predicted the noise levels at the residential receiver locations within proximity to the proposed Kmart Service Centre.

9.3.1 Noise Level Measurements

Potential noise generated within the Kmart Auto was measured at a similar Kmart Tyre and Auto Services located at Greensborough. Noise levels were measured using an ARL Ngara noise monitor from the 31st March to 4th April, 2016. The noise monitor was setup to fast response mode, noise monitor was calibrated using a B&K Type 4231 calibrator before and after measurements, no significant drift was recorded.

The measured noise levels within Kmart Auto Greensborough is presented in table below.

Table 18 – Unattended Long-Term Noise Measurements – Workshop

Location	Period	Measured Noise Level $L_{eq(1hr)}$ dB(A)
Within Kmart Auto Greensborough	Day (7am – 10pm)	79

9.3.2 evaluation of noise impact

The primary noise source on site are the noise generated by the torque wrench and compressor within the workshop. This section of the report will assess the impact from the proposed Kmart Auto workshop to nearby sensitive receivers. The proposed workshop will operate within the hours 7am to 6pm Monday to Friday, 7am to 1pm Saturday and close on Sunday. As such, the noise from the operation of the Kmart Auto workshop will be assessed to the day time noise limit in accordance with the relevant daytime noise level criteria of 53 dB(A) as detailed in Section 9.2 above.

The predicted noise levels from the operation of activities within the Kmart Auto Centre are based on the following assumptions:

- The internal sound pressure level within the workshop is 79dB(A)L_{eq} based on the measured noise level within the existing Kmart Auto Greensborough.
- The proposed construction of the workshop will consist concrete walls and sheet metal roof.
- The roller doors will remain open during the operation hours and open to the South West, perpendicular to the receivers opposite on Cynthia Street.
- Distance between the proposed Kmart Auto Centre and the residence on Lexington Parade is 50m or greater.

Predicted noise level is presented in table below and are assessed against the day time noise limit as the workshop only operated during day period.

Table 19 – Predicted Kmart Auto Centre Noise Emission

Receiver	Time of Day	Predicted Level dB(A)L_{eq}	Project Objectives dB(A)L_{eq}	Compliance
Residential Dwellings to the South on Lexington Parade	Day (7am to 6pm)	46	53	Yes

Based on the predicted worst case scenario, the predicted noise level from the operation of the Kmart Auto Centre will comply with the relevant NSW EPA Industrial Noise Policy day time noise limit without any additional noise attenuation.

10 CONSTRUCTION NOISE AND VIBRATION

This document presents a specification for the processes, which will be followed to manage noise and vibration associated with the proposed construction activities which are required as part of the Project and the potential for noise and vibration impact to receivers within close proximity.

The principal objective of this study is to undertake an evaluation of works to be performed during the operation of the various activities during construction and develop a management plan to ensure noise and vibration is:

1. Minimised to all surrounding receivers.

2. Does not exceed OH&S standards at surrounding receivers.

3. Is monitored when potentially high noise and vibration generating activities are being used.

This assessment will formulate/present the relevant noise and vibration criteria which construction activities are required to comply with. Additionally effective mitigation measures will be recommended where possible to ensure criteria is achieved and impacts are.

The principal issues, which will be addressed in this report, are:

- Identification of the noise and vibration standards which will be applicable to this project.

- Formulation of a strategy for construction activities to comply with the standards identified in the above point.

10.1 PROJECT OBJECTIVES

The objective of this management plan is to set up a protocol to ensure noise and vibration emissions from the construction works associated with the project comply with applicable standards, recommend required management controls and treatments are adopted where required and detail the required monitoring to ensure standards are met.

10.2 PROJECT DESCRIPTION AND POTENTIALLY EFFECTED PROPERTIES

The proposed project includes the excavation of material including infill and soft sand stone and construction of the development. The expected activities can be expected to include:

1. Removal of infill material.
2. Excavation.
3. Building constructions.

10.3 CONSTRUCTION NOISE CRITERIA

It is proposed to utilise Australian Standard AS2436:1981 *"Guide to noise control on construction, maintenance and demolition sites"*, which is the standard commonly applied by Councils for the regulation of construction noise, the New South Wales Construction Noise Guideline developed by The NSW EPA and OH&S requirements are presented in this section of the report.

10.3.1 Australian Standard AS2436:1981 "Guide to noise control on construction, maintenance and demolition sites

The Australian Standard AS2436 states that where all reasonable and available measures have been taken to reduce construction noise, mitigation strategies may be put in place to reduce levels noise levels to within a reasonable and acceptable level.

For the control and regulation of noise from construction sites AS2436:1981 *"Guide to noise control on construction, maintenance and demolition sites"* nominates the following:

a. That reasonable suitable noise criterion is established,

b. That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes to locations of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours, and

c. The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the demolition, excavation and construction site.

10.3.2 EPA Construction Noise Guideline

The Department of Environment and Climate Change have developed a specific construction noise guideline in the aid of reducing the impact of construction associated noise.

The guideline reflects on feasible and reasonable mitigation strategies, management controls and public liaising in the effort to reach realistic comprises between construction sites and potential noise affected receivers.

10.3.3 EPA Construction Noise Guideline - Qualitative Assessment Method

The guideline refers to a qualitative assessment method in which construction noise is assessed on a case by case basis with regard to various activities to be conducted on site. This assessment method was developed to smaller scale projects.

Essentially this method of assessment requires that the proponent take into consideration and employ all reasonable and feasible measures to ensure that the impact on noise receivers is minimised. This is generally conducted in the following manner:

- The drafting of a noise management plan outlining all reasonable and feasible mitigation methods for the reduction of noise impact;
- The assessment of high impact equipment such as rock-hammers and piling equipment for lower noise producing methods of construction/excavation;
- The implementation of a complaints handling register and community consultation system;
- Employee (builders, contractors etc) education in effective noise reducing techniques and site etiquette; and
- The operation of plant in a quiet and efficient manner (i.e. turning off machinery when not in use).

This qualitative assessment method has been used for the basis of this report and has been used as the basis for the development of acoustic management and treatments of proposed construction activities.

In addition, the guideline specifies goals which can be used in the effort of minimising noise from construction related activities. These noise goals are presented within the table below.

Table 20 – EPA Recommended Construction Noise Goals

Governing Body	Receiver Type	External sound level Goal, $L_{eq\ 15\ min}$ dB(A)
EPA	Residential	Background + 10 dB(A)[1]
		75 dB(A)[2]

1: Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. (DECC CNG, 2008).

2: Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided. (DECC CNG, 2008).

These criteria for resultant noise from construction activities are aimed at maintaining comfort levels within the surrounding residential dwellings. Additionally, noise mitigation techniques as discussed in this report should be used if noise emissions exceed the above criteria. All work is to be carried out in accordance with AS 2436:1981 *"Guide to noise control on construction, maintenance and demolition sites"*.

10.3.4 OH&S guidelines

Regulation 49 of the Occupational Health and Safety Regulation specifies maximum levels of noise which a 'worker' may be exposed to. Acoustic treatment to the work environment or hearing protection is recommended for workers exposed to higher noise levels. These maximum OH&S noise levels are presented in the table below.

Table 21 – OH&S Maximum Noise Level Exposure

	Energy Averaged Over 8 Hour Day	**Maximum Noise Level During Day**
OH&S maximum noise level exposure	85 dB(A) L_{eq}	140 dB(C)$_{Peak}$

10.4 CONSTRUCTION VIBRATION CRITERIA

Construction vibration criteria associated with works on the project when measured at the potentially affected receivers should not exceed the following sets of vibration criteria to ensure no architectural or structural damage to surrounding buildings and human comfort is maintained. These standards have been selected as they are widely used in the assessment of vibration associated with construction activities within Australia, namely:

- German Standard DIN 4150-3 (1999-02): *"Structural Vibration – Effects of Vibration on Structures"*; and
- British Standard BS 6472:1992 *"Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*.

The criteria and the application of these Standards are discussed in separate sections below.

10.4.1 German Standard DIN 4150-3 (1999-02)

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

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

Table 22 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

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

10.4.2 British Standard BS 6472:1992

British Standard BS 6472:1992 develops criteria relating to levels of building vibration that may be expected to give rise to *"adverse comment"*, in the frequency range most applicable to impacts associated with construction, which is 1 to 80Hz. These threshold values are used as criteria for assessing the loss of amenity and are presented below in Table 3.

Table 23 – BS 6472:1992 Criteria to Avoid *"Adverse Comment"*

Type of Occupancy	Time of Day	Peak Particle Velocity (mms^{-1}) between 1Hz to 80Hz Likely to Cause *"Adverse Comment"*			
		Continuous Vibration		Intermittent Vibration and Impulsive Vibration Excitation with Several Occurrences per day	
		Vertical	Horizontal	Vertical	Horizontal
Residential	Day	0.3 to 0.6	0.8 to 0.6	8.4 to 12.6	24 to 36
	Night	0.2	0.6	2.8	8
Offices	Day	0.6	1.6	18	51
	Night	0.6	1.6	18	51
Workshops	Day	1.2	3.2	18	51
	Night	1.2	3.2	18	51

The limits indicate that people in buildings are significantly less susceptible to horizontal vibration than to vertical vibration. Furthermore, Section 4.1 of BS 6472 notes that situations can exist where vibration magnitudes above those generally corresponding to minimal *"adverse comment"* levels can be tolerated, particularly for temporary disturbances and infrequent and intermittent events such as those associated with construction projects.

10.5 CONSTRUCTION HOURS

Woking hours are subject to planning approval conditions. Typically the hours of work at sites will be:

- 7:00am to 5:00pm Monday to Friday
- 8:00am to 5:00pm on Saturdays
- No work on Sundays, Public Holidays or Saturdays adjacent to a Public Holiday.

Works which are proposed to be conducted outside of these hours will be subject to special approval.

10.6 CONTROL OF CONSTRUCTION NOISE AND VIBRATION

As a part of the noise management of noise and vibration on each site the following process should be conducted when investigating the impact and construction activities.

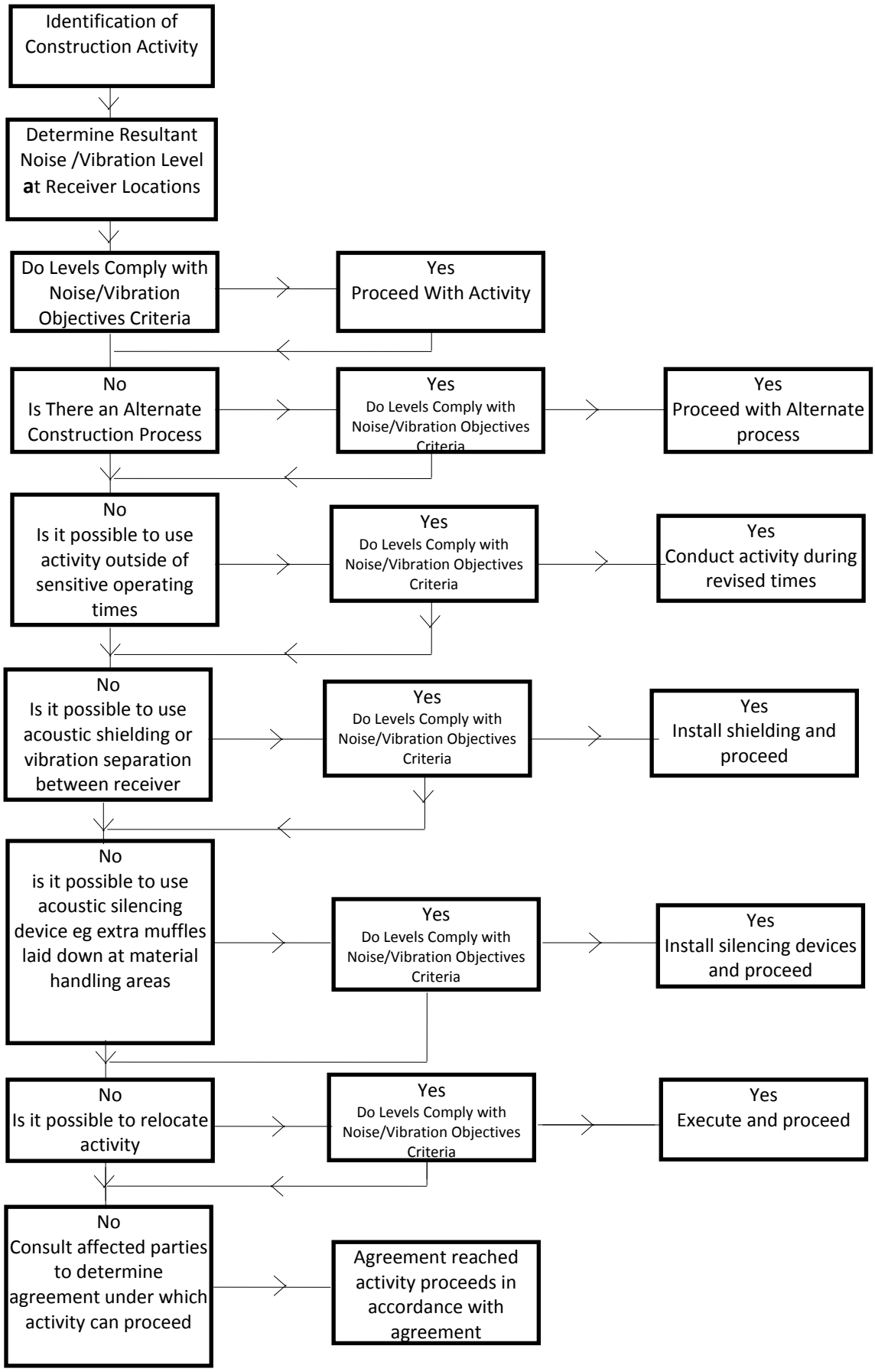


Figure 1 – Process Flowchart

10.7 NOISE AND VIBRATION CONTROL METHODS

The determination of appropriate noise control measures will be dependant on the particular activities and construction appliances. This section provides an outline of available methods.

10.7.1 Selection of alternate appliance or process

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying this activity by use of pneumatic hammers, bulldozers ripping and/or milling machines lower levels of noise will result.

10.7.2 Acoustic Barrier

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

The placement of barriers at the source is generally only effective for static plant (tower cranes). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependant on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance that is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10mm or 15mm thick plywood (radiata plywood) would be acceptable for the barriers.

10.7.3 Silencing devices

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

10.7.4 Material handling

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

10.7.5 Treatment of specific equipment

In certain cases it may be possible to specially treat a piece of equipment to dramatically reduce the sound levels emitted.

10.7.6 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. A noise plan will be developed for this project outlining work procedures and methods for minimising noise.

10.7.7 Regular noise checks of equipment

To determine the requirement for silencing devices on machinery it is proposed to undertake fortnightly noise check. Noise levels of all machines on site will be measured and if they are found to be higher than nominated for that equipment type, items such as mufflers and engine shrouds will be examined to ensure they are in good working order.

A record of these measurements will be kept on a form similar to that shown in Appendix 1. This measure is expected to maintain noise at constant levels, and prevent any increases.

10.7.8 TREATMENT of EXISTING EQUIPMENT

An effective method of mitigating vibration on existing equipment would be to vibration isolated mounts to existing equipment and installations. Vibration isolation would be required to be investigated on a case by case basis and consist of neoprene mounts as specified (such as waffle pads, supershear flex or the like).

Based on investigations conducted at the site the areas which may be suitable for treatment include tables with sensitive equipment such as microscopes and the like.

10.7.9 Noise and vibration Monitoring

Noise and vibration monitoring will be undertaken to determine the effectiveness of measures which are been implemented. The results of monitoring can be used to devise further control measures.

10.7.10 Combination of methods

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

10.7.11 Saw cutting

Introduction of a saw cut to manage vibration impacting on surrounding receivers from construction activities.

11 CONCLUSION

This report provides the results of Environmental Noise Study for the proposed alterations to the Westfield Kotara project including loading and carparking areas. Noise at the site has been measured and noise goals have been set in accordance with the requirements of the relevant statutory/regulatory authorities including Local Council and the Environmental Protection Authority.

Determination of noise assessment criteria based on the EPA's Industrial Noise Policy and ECRTN have been determined based on both unattended and attended noise monitoring conducted at the proposed development.

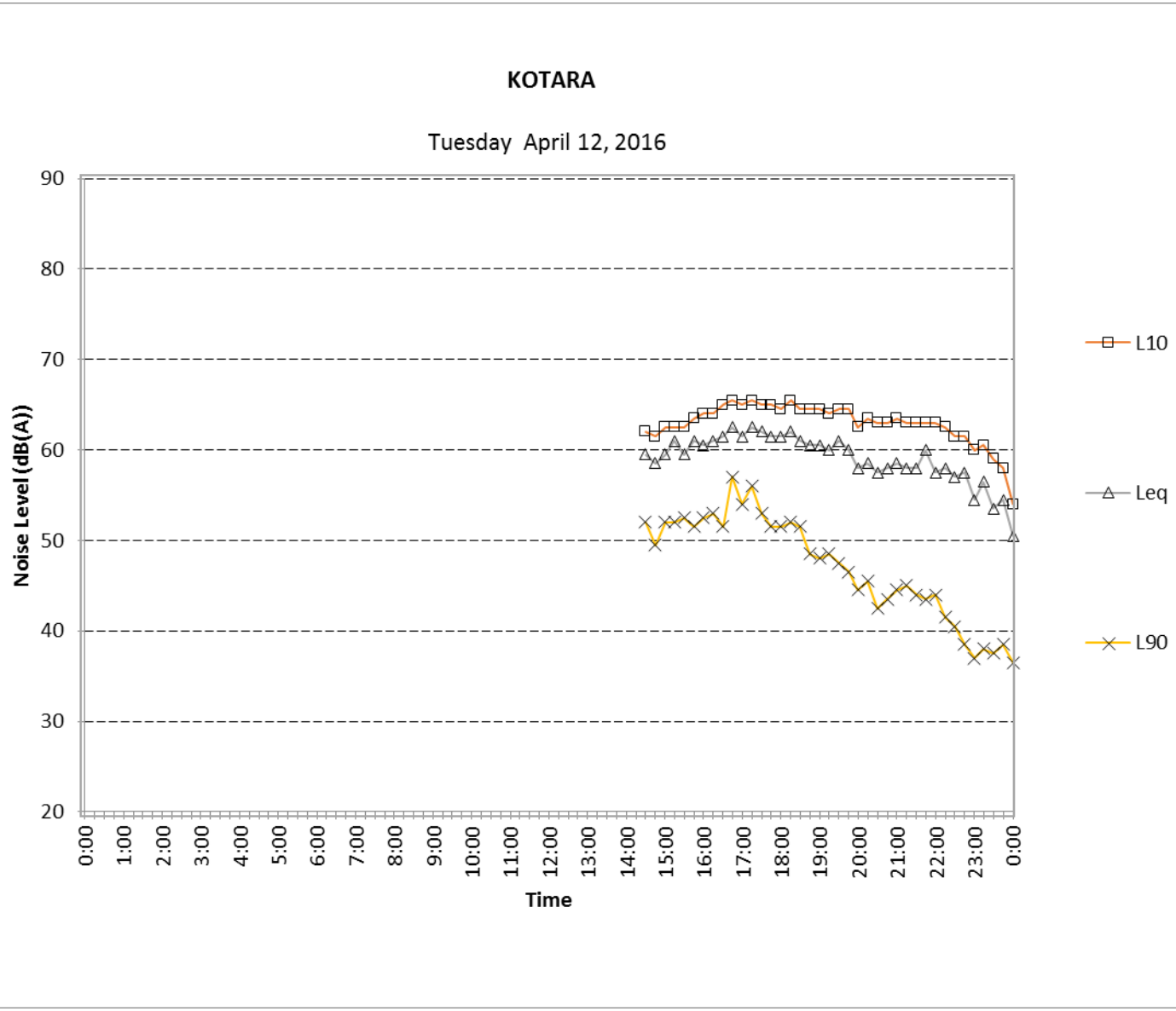
Based on the assessment detailed in this report the proposed development will comply with all relevant noise and vibration criteria.

We trust this information is satisfactory. Please contact us should you have any further queries.

Report prepared by,

ACOUSTIC LOGIC CONSULTANCY PTY LTD
Ben White

Appendix A – Noise Logging Results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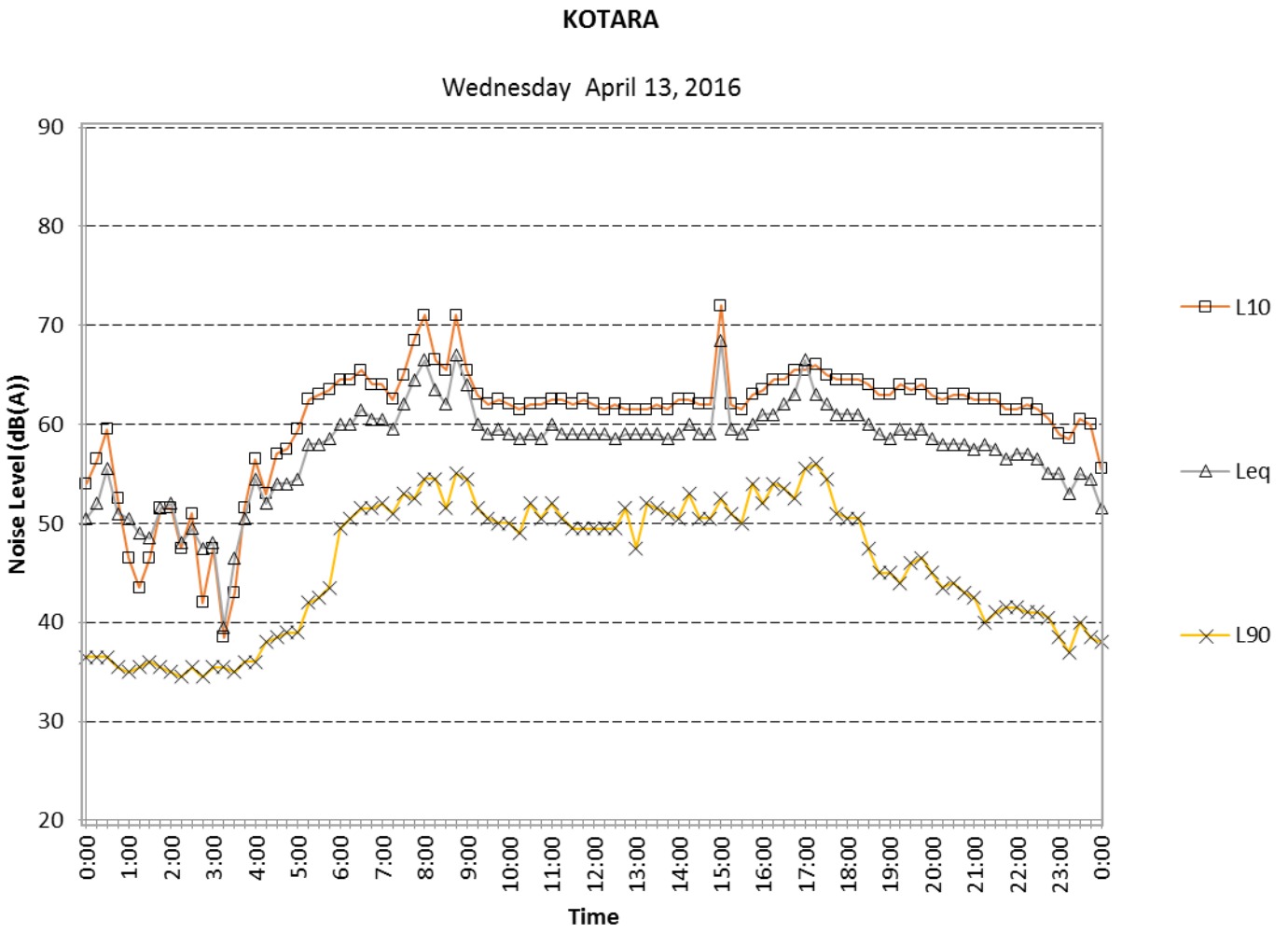
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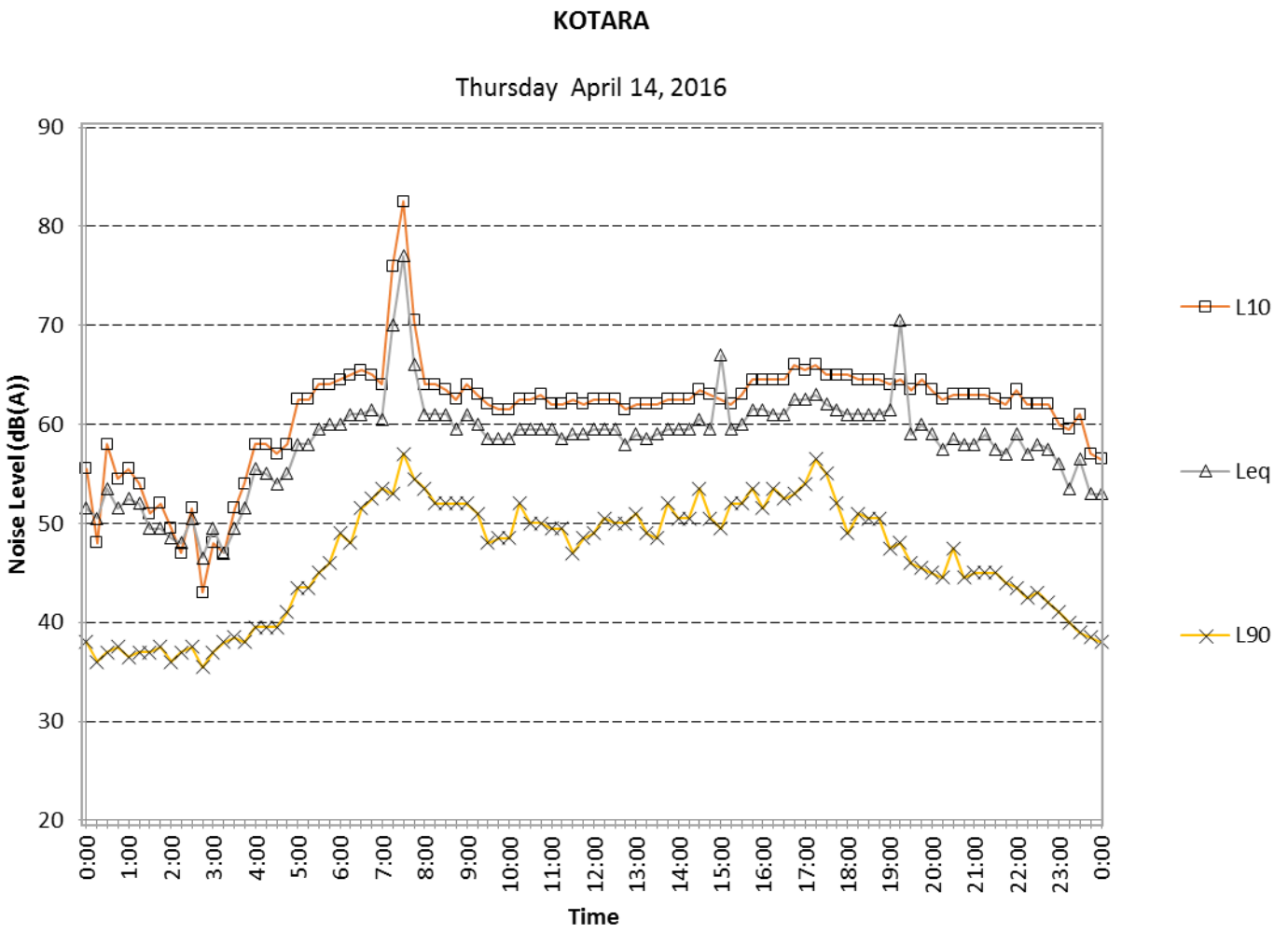
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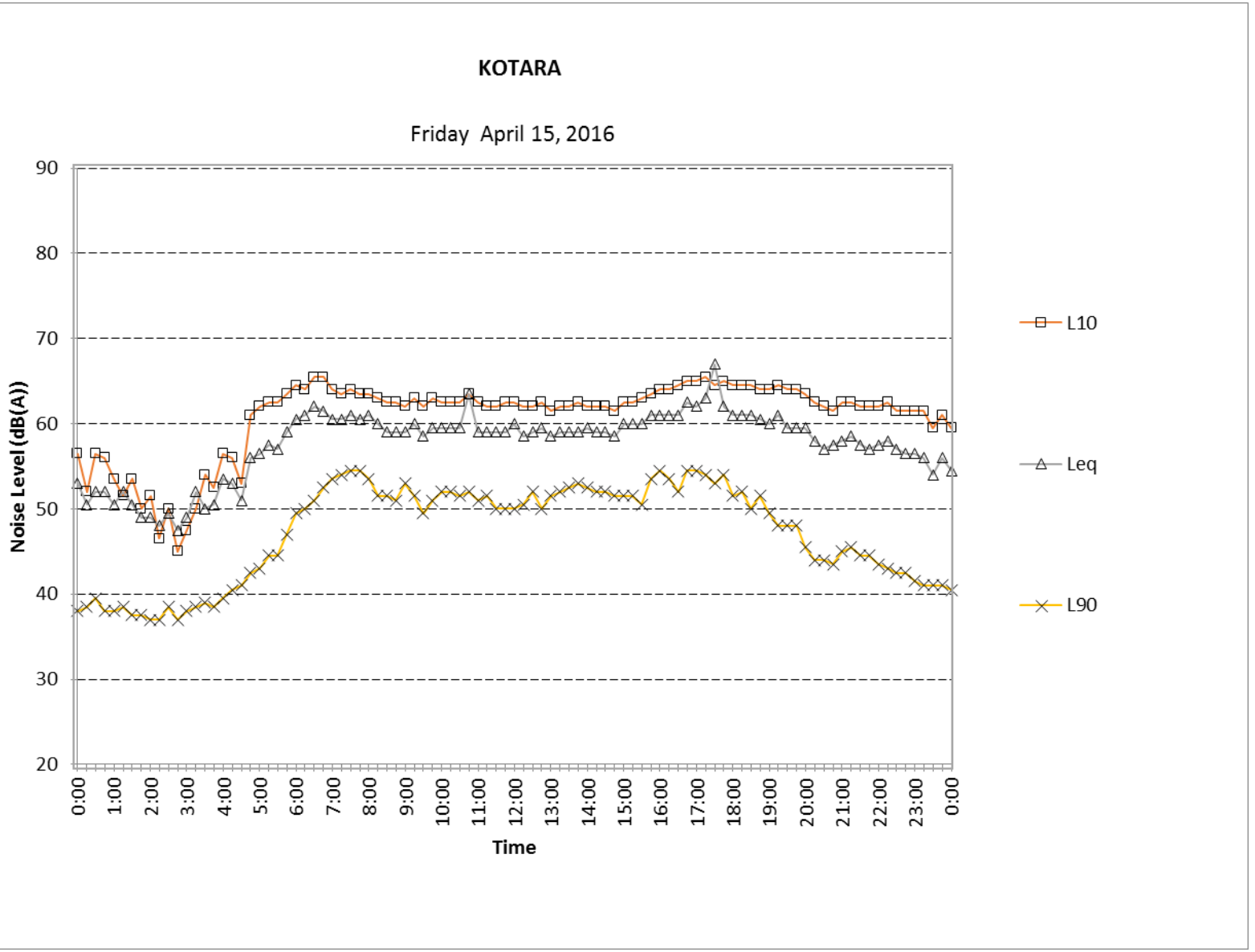
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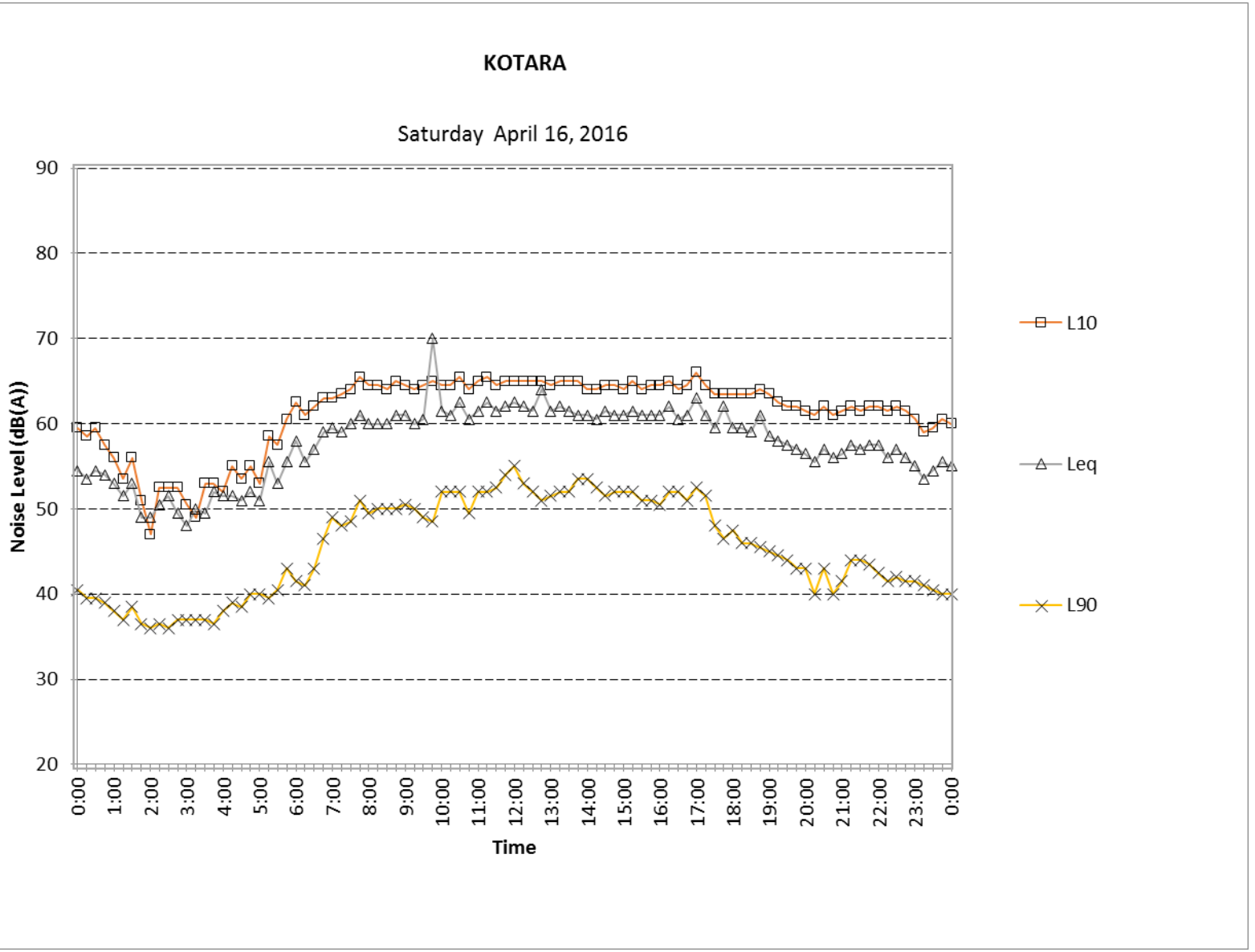
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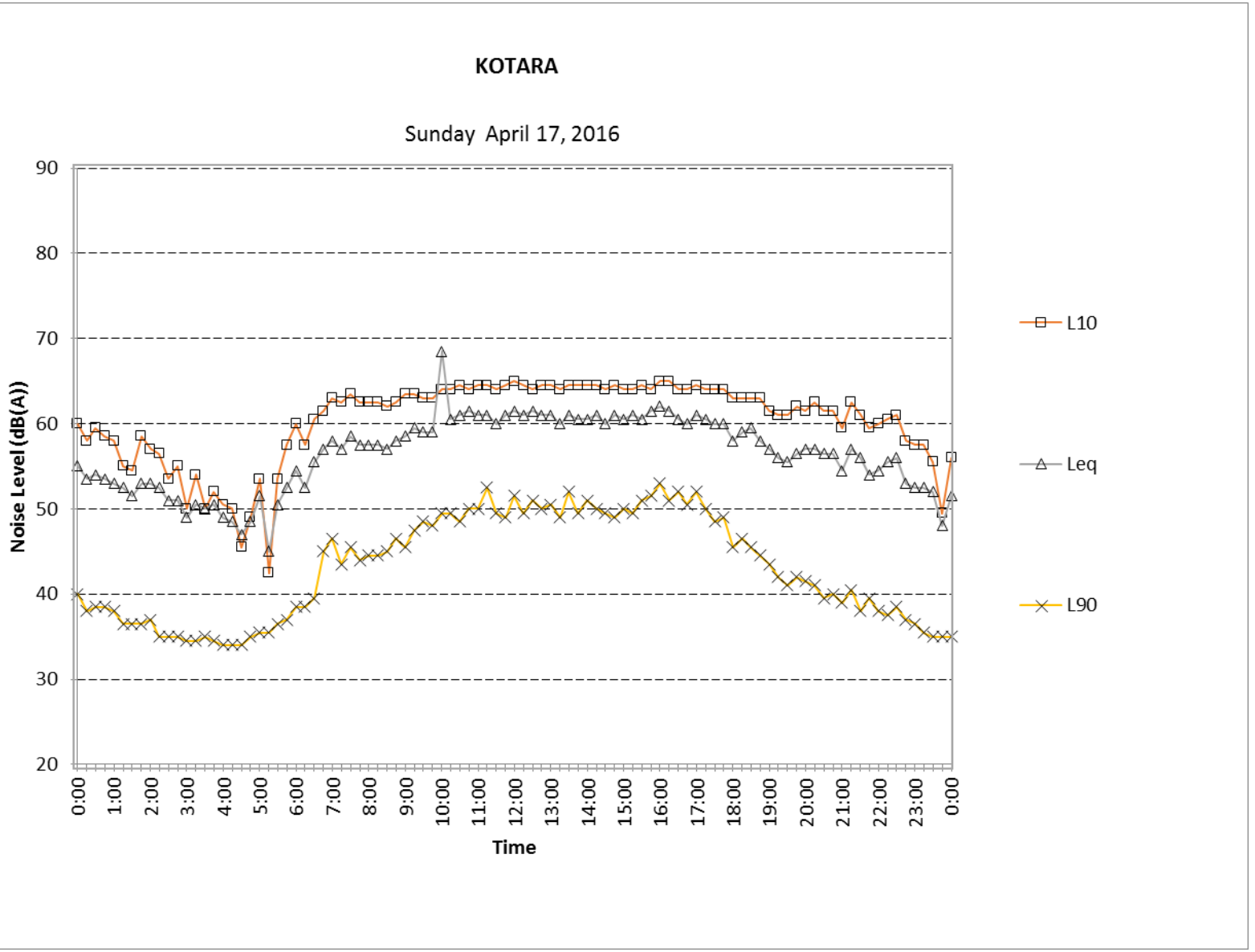
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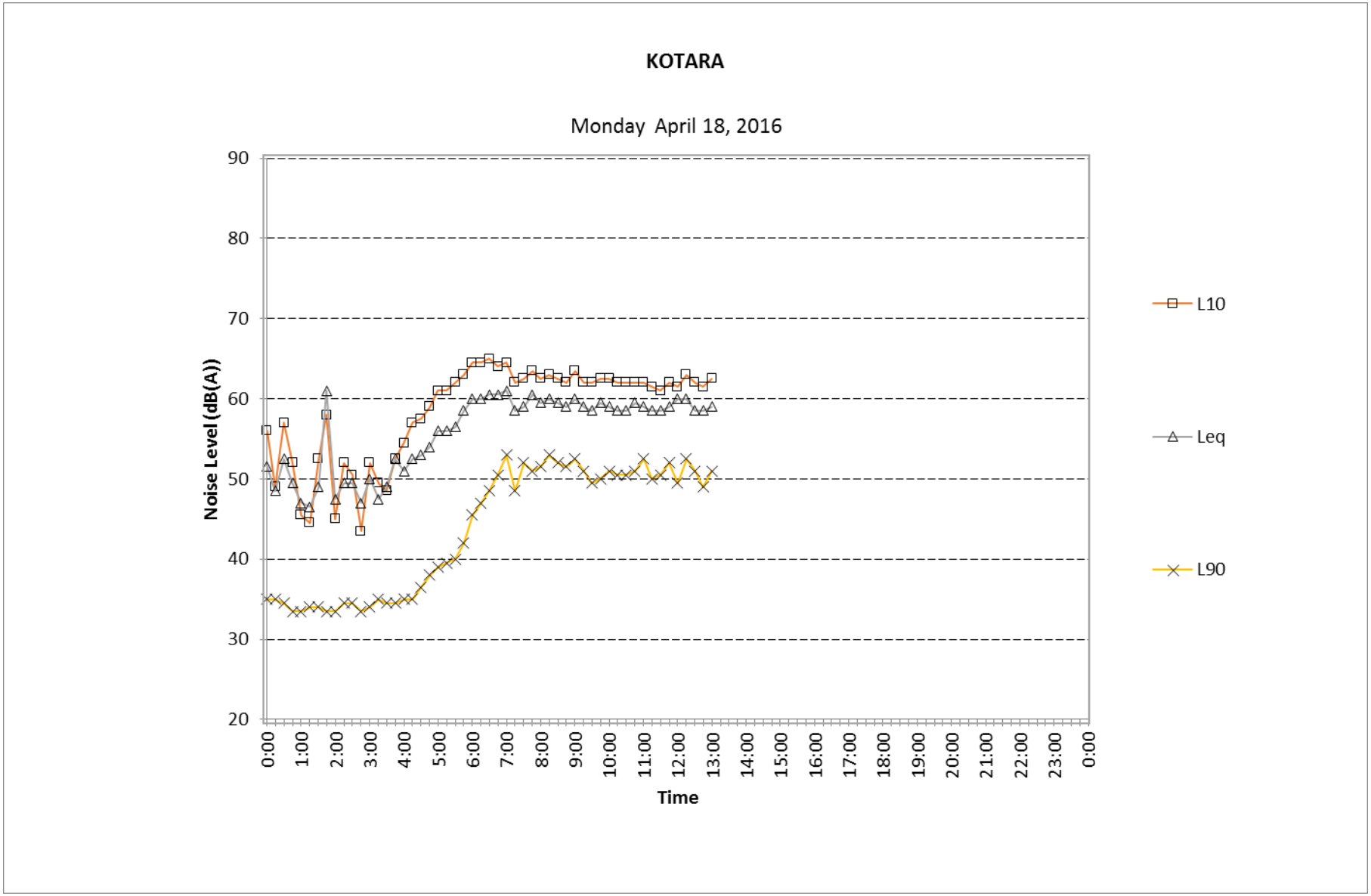
Leq
L90


KOTARA
Monday April 18, 2016
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90