APPENDIX E

NOISE AND VIBRATION IMPACT ASSESSMENT

Noise and Vibration Impact Assessment

IXOM Botany Chlorine Liquefaction Plant
16-20 Beauchamp Road
Banksmeadow, NSW

Prepared for: IXOM Operations Pty Ltd
C/- Element Environment Pty Ltd
July 2025
MAC232001-01RP1V2

Muller Acoustic Consulting

Document Information

Noise and Vibration Impact Assessment

IXOM Botany Chlorine Liquefaction Plant

16-20 Beauchamp Road

Banksmeadow, NSW

Prepared for: IXOM Operations Pty Ltd

C/- Element Environment Pty Ltd

PO Box 1563

Warriewood NSW 2102

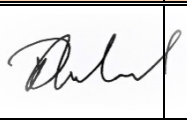
Prepared by: Muller Acoustic Consulting Pty Ltd

PO Box 678, Kotara NSW 2289

ABN: 36 602 225 132

P: +61 2 4920 1833

www.mulleracoustic.com

DOCUMENT ID	DATE	PREPARED	SIGNED	REVIEWED	SIGNED
MAC232001-01RP1V2 PC.20301993-PM-029	16 July 2025	Dale Redwood		Oliver Muller	

CONTENTS

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Element Environment Pty Ltd (Element), on behalf of IXOM Operations Pty Ltd (IXOM) to prepare a Noise and Vibration Impact Assessment (NVIA) to quantify emissions from the construction and operation of a chlorine liquefaction plant (the 'project') at IXOM's Botany – Chlor–alkali Plant (CAP) at 16–20 Beauchamp Road, Banksmeadow, NSW.

The NVIA has quantified potential noise emissions associated with the construction and operation of the project, including sleep disturbance impacts and road traffic noise levels. Where required, the NVIA recommends reasonable and feasible noise controls to manage potential noise impacts.

This assessment has been undertaken in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- NSW Department of Environment and Climate Change (DECC), NSW Interim Construction Noise Guideline (ICNG), 2009;
- NSW Department of Environment, Climate Change and Water (DECCW), NSW Road Noise Policy (RNP), 2011;
- NSW Environment Protection Authority (EPA's), Approved Methods for the measurement and analysis of environmental noise in NSW, 2022;
- NSW Department of Environment and Conservation (DEC) – NSW Environmental Noise Management – Assessing Vibration: a Technical Guideline (the NSW vibration guideline), February 2006;
- Standards Australia AS 1055:2018 (AS 1055) – Acoustics – Description and Measurement of Environmental Noise; and
- Standards Australia AS/NZS IEC 61672.1 - 2019 (AS 61672) – Electro Acoustics - Sound Level Meters Specifications.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

1.1 Assessment Requirements

The NVIA has been prepared in accordance with the NSW Department of Planning, Housing and Infrastructure (DPHI) Secretary's Environmental Assessment Requirements (SEARs) for the Project. The SEARs identify matters which must be addressed in the assessment and essentially form the Project's terms of reference. **Table 1** lists individual requirements relevant to this NVIA and where they are addressed in this report.

Table 1 Noise Related SEARs and Agency Requirements

SEAR	Section
Department of Planning, Housing and Infrastructure (DPHI)	
A quantitative noise and vibration impact assessment including background noise levels, identification of impacts from construction, operation and traffic associated with the modification and details of proposed mitigation measures to minimise impacts.	Section 3 Section 6
Randwick City Council	
Please provide an acoustic report that identifies the probable noise sources and associated activities related to the proposal. Additionally, include any necessary acoustic measures to ensure acceptable residential amenity in accordance with relevant guidelines. The modelling assessment should specifically address: • nighttime noise impacts • prevailing wind direction and temperature inversion effects on noise during winter months, particularly when south westerly winds amplify noise in nearby residential areas	Section 5.3 Section 6
Environment Protection Authority (EPA)	
Identify all noise sources or potential sources from the development (including both construction and operation phases). Detail all potentially noisy activities including ancillary activities such as transport of goods and raw materials.	Section 5 Appendix C
Specify the times of operation for all phases of the development and for all noise producing activities.	Section 2.4.2
For projects with a significant potential traffic noise impact provide details of road alignment (include gradients, road surface, topography, bridges, culverts etc), and land use along the proposed road and measurement locations – diagrams should be to a scale sufficient to delineate individual residential blocks.	N/A
Identify any noise sensitive locations likely to be affected by activities at the site, such as residential properties, schools, churches, and hospitals. Typically, the location of any noise sensitive locations in relation to the site should be included on a map of the locality.	Section 2.2.1
Identify the land use zoning of the site and the immediate vicinity and the potentially affected areas.	Section 2.2.1
Determine the existing background (LA90) and ambient (LAeq) noise levels, as relevant, in accordance with the NSW Noise Policy for Industry (EPA 2017).	Section 3 Section 4

Table 1 Noise Related SEARs and Agency Requirements	
SEAR	**Section**
Determine the existing road traffic noise levels in accordance with the NSW Road Noise Policy (EPA 2011), where road traffic noise impacts may occur.	N/A
The noise impact assessment report should provide details of all monitoring of existing ambient noise levels including: 1. details of equipment used for the measurements 2. a brief description of where the equipment was positioned 3. a statement justifying the choice of monitoring site(s), including the procedure used to choose the site(s), having regards to Fact Sheets A and B of the NSW Noise Policy for Industry. 4. details of the exact location of the monitoring site and a description of land uses in surrounding areas 5. a description of the dominant and background noise sources at the site 6. day, evening and night assessment background levels for each day of the monitoring period 7. the final Rating Background Level (RBL) value 8. graphs of the measured noise levels for each day should be provided 9. a record of periods of affected data (due to adverse weather and extraneous noise), methods used to exclude invalid data and a statement indicating the need for any re-monitoring.	N/A Criteria based on Existing EPL Noise Limits
Determine the project noise trigger levels for the site. For each identified potentially affected receiver, this should include: 1. determination of the project intrusive noise level for each identified potentially affected receiver 2. selection and justification of the appropriate amenity category for each identified potentially affected receiver 3. determination of the project amenity noise level for each receiver 4. determination of the appropriate maximum noise level event assessment (sleep disturbance) trigger level.	Criteria based on Existing EPL Noise Limits
Maximum noise levels during night-time period (10pm-7am) should be assessed to analyse possible affects on sleep. Determine expected noise level and noise character likely to be generated from noise sources during: 1. site establishment 2. construction 3. operational phases 4. transport including traffic noise generated by the proposal 5. other services. *Note: The noise impact assessment report should include noise source data for each source in 1/1 or 1/3 octave band frequencies including methods for references used to determine noise source levels. Noise source levels and characteristics can be sourced from direct measurement of similar activities or from literature (if full references are provided).*	Section 6 Appendix C

Table 1 Noise Related SEARs and Agency Requirements	
SEAR	**Section**
Determine the noise levels likely to be received at the reasonably most affected location(s) (these may vary for different activities at each phase of the development).	**Section 6**
The noise impact assessment report should include: 1. a plan showing the assumed location of each noise source for each prediction scenario 2. a list of the number and type of noise sources used in each prediction scenario to simulate all potential significant operating conditions on the site 3. any assumptions made in the predictions in terms of source heights, directivity effects, shielding from topography, buildings or barriers, etc 4. methods used to predict noise impacts including identification of any noise models used. 5. the weather conditions considered for the noise predictions 6. the predicted noise impacts from each noise source as well as the combined noise level for each prediction scenario 7. for developments where a significant level of noise impact is likely to occur, noise contours for the key prediction scenarios should be derived 8. an assessment of the need to include modification factors as detailed in Fact Sheet C of the NSW Noise Policy for Industry.	**Appendix B** **Section 5.1** **Section 5.2** **Section 5** **Section 5.3** **Section 6** **Appendix F and Appendix G** **Section 5.4 and Appendix E**
Discuss the findings from the predictive modelling and, where relevant noise criteria have not been met, recommend additional feasible and reasonable mitigation measures.	**Section 6**
The noise impact assessment report should include details of any mitigation proposed including the attenuation that will be achieved and the revised noise impact predictions following mitigation. a) Where relevant noise/vibration levels cannot be met after application of all feasible and reasonable mitigation measures the residual level of noise impact needs to be quantified	**N/A**
For the assessment of existing and future traffic noise, details of data for the road should be included such as assumed traffic volume; percentage heavy vehicles by time of day; and details of the calculation process. These details should be consistent with any traffic study carried out in the EIS.	**Section 5.8**
Determine the most appropriate noise mitigation measures and expected noise reduction including both noise controls and management of impacts for both construction and operational noise. This will include selecting quiet equipment and construction methods, noise barriers or acoustic screens, location of stockpiles, temporary offices, compounds and vehicle routes, scheduling of activities, etc.	**Section 2.4.1**

Table 1 Noise Related SEARs and Agency Requirements	
SEAR	**Section**
For traffic noise impacts, provide a description of the ameliorative measures considered (if required), reasons for inclusion or exclusion, and procedures for calculation of noise levels including ameliorative measures. Also include, where necessary, a discussion of any potential problems associated with the proposed ameliorative measures, such as overshadowing effects from barriers. Appropriate ameliorative measures may include: 1. use of alternative transportation modes, alternative routes, or other methods of avoiding the new road usage 2. control of traffic (eg: limiting times of access or speed limitations) 3. resurfacing of the road using a quiet surface 4. use of (additional) noise barriers or bunds 5. treatment of the façade to reduce internal noise levels buildings where the night-time criteria is a major concern 6. more stringent limits for noise emission from vehicles (i.e. using specially designed 'quite' trucks and/or trucks to use air bag suspension 7. driver education 8. appropriate truck routes 9. limit usage of exhaust brakes 10. use of premium muffles on trucks 11. reducing speed limits for trucks 12. ongoing community liaison and monitoring of complaints	N/A

This page has been intentionally left blank

2 Project Description

2.1 Introduction

IXOM is one of Australia's larger manufacturers of chlor-alkali projects including chlorine, caustic soda, sodium hypochlorite and hydrochloric acid. Due to IXOM's expansive storage and distribution infrastructure, safety and security systems, and regulatory compliance, IXOM is a leading supplier of chlor-alkali products within Australia. The supply of chlorine is critical to Australia, as it is the primary disinfection method for drinking water and the safe management of wastewater.

2.2 Site Location

The IXOM site is located at 16-20 Beauchamp Road, Banksmeadow, NSW, in the Botany Industrial Park (BIP), and covers an area of approximately 67,500 square metres (m^2) (refer to **Figure 1**). IXOM operates the following lots (the site) in the BIP at 16-20 Beauchamp Road, Banksmeadow NSW 2019:

- Lot 1101 DP 1227173
- Lot 1102 DP 1227173
- Lot 1103 DP 1227173
- Lot 1104 DP 1227173

The site is privately owned by Orica and leased by IXOM.

FIGURE 1
Site layout

Botany Chlorine Liquefaction Plant

2.2.1 Receiver Review

The IXOM site is located within the BIP and is bordered by a rail corridor to the west, Beauchamp Road to the south, Denison Street to the east and other users of the BIP to the north. Land surrounding the IXOM site is predominantly IN1 – General Industrial or E4 – General Industrial, with industrial premises located to the north, west and south of the IXOM site.

The closest residential receivers are located to the east of the IXOM site (~80m from the IXOM site boundary), on the eastern side of Denison Street, in the suburb of Hillsdale. Residential receivers fronting Denison Street are zoned R2 – Low Density Residential, while receivers set back from Denison Street are predominantly R3 – Medium Density Residential. Further residential receivers (R2 – Low Density Residential) are located about 360m southeast of the IXOM site in the suburb of Matraville. It is noted that the residence located at 105 Beauchamp Road, Matraville, approximately 100m to the south of the IXOM site, is defined under the NPI as an "isolated residence within an industrial land zone" and is assessed as an industrial receiver.

The closest non-residential receivers are identified as commercial and industrial receivers on Beauchamp Road to the south of the IXOM site, Nilson Avenue Reserve, approximately 200m east of the IXOM site, and the Matraville Public School located about 570m east of the IXOM site. Based on the location of the potentially sensitive receivers, where compliance is demonstrated at the nearest residential receivers in Hillsdale, it is considered that residential receivers in Matraville and non-residential receivers, will also comply. Hence, assessment is undertaken to the nearest residential receivers along Denison Street, Hillsdale only.

A summary of nearby sensitive receivers is presented in **Table 2** while **Figure 2** provides a locality plan showing the position of the nearest receivers in relation to the project. It is noted that the nearest identified commercial premises at 16 – 20 Beauchamp Road includes the Proponent's site office.

Table 2 Receiver Locations				
Receiver	Description	Receiver Type	Coordinates (GDA94/MGA56)	
			Easting	Northing
R1	30 Denison St	Residential	335885	6241136
R2	32 Denison St	Residential	335882	6241157
R3	34 Denison St	Residential	335881	6241176
R4	36 Denison St	Residential	335880	6241203
R5	38 Denison St	Residential	335879	6241223
R6	40 Denison St	Residential	335881	6241243
R7	44 Denison St	Residential	335877	6241264
R8	46 Denison St	Residential	335874	6241282
R9	48 Denison St	Residential	335875	6241298
R10	50 Denison St	Residential	335876	6241312
R11	52 Denison St	Residential	335875	6241328
R12	54 Denison St	Residential	335872	6241343
R13	56 Denison St	Residential	335871	6241360
R14	58 Denison St	Residential	335874	6241373
R15	60 Denison St	Residential	335871	6241390
R16	62 Denison St	Residential	335871	6241404
R17	64 Denison St	Residential	335874	6241420
R18	66 Denison St	Residential	335870	6241433
R19	68 Denison St	Residential	335868	6241450
R20	70 Denison St	Residential	335868	6241467
In1R	105 Beauchamp Rd	Isolated Residence in Industrial Zone	335804	6241012
ED1	Matraville Public School	Education Institution	336352	6241381
AR1	Nilson Avenue Reserve	Active Recreation	335990	6241292
C1	16-20 Beauchamp Rd	Commercial Premises	335775	6241098
In1	1 Beauchamp Rd	Industrial Premises	335542	6241142

FIGURE 2

Receiver Map

MAC232001-01

IXOM Botany

KEY

- Chlorine Liquefaction Plant
- IXOM Site
- Receiver Locations

0 40 80 120 160 m

N

MAC
Muller Acoustic Consulting

2.3 Project Background

Development consent (DA35/98) was granted by the former Minister of Urban Affairs and Planning in 1998 for the installation of a replacement CAP to produce 35,000 tonnes per annum (tpa) of gaseous chlorine. The new CAP was commissioned in 2001 and the development has been modified five times since original approval:

- 2006 – Construction of sodium hypochlorite manufacturing facilities.
- 2006 – Demolition of old CAP;
- 2009 – Relocation of sodium hypochlorite manufacturing facility;
- 2012 – Replacement of two 1.1 megalitre steel caustic tanks and demolition of two existing and disused steel caustic storage tanks; and
- 2018 – Construction of repackaging facility.

The CAP operates under Environment Protection Licence (EPL) 20547, which permits the scheduled activities of chemical production, chemical storage, waste processing (non-thermal treatment) and waste storage.

The CAP manufactures chlorine and caustic soda though the electrolysis of salt using a mercury-free membrane technology. Hydrogen is generated as a by-product during this process, which is combined with chlorine to manufacture hydrochloric acid. The chlorine is also used to manufacture sodium hypochlorite and ferric chloride.

The IXOM site does not have a chlorine liquefaction plant and liquefied chlorine is not stored in process tanks. All liquefied chlorine is transported to site from the IXOM owned chlorine liquefaction plant at Laverton, Victoria, in both 33kg and 70kg cylinders and 920kg drums for distribution to customers.

The existing site infrastructure comprises (refer to **Appendix B**):

- Administration building.
- Brine treatment and electrolyser.
- Caustic evaporation plant.
- Caustic loading bays.
- Caustic soda product tanks.
- Chlorine container storage (Block Q).
- Control room.

- Cooling tower.
- Ferric chloride product plant, including product tanks and tanker loading bay.
- HCL product plant, including product tanks and loading bay.
- Old chlorine container filling facilities (decommissioned 2001).
- Repackaging facility.
- Salt storage pile.
- Sodium hypochlorite loading bay (Block L).
- Sodium hypochlorite product plant including product tanks.
- Workshop.

The BIP is accessible via main gates (1-3) on Denison Street and Gate 4 provides access from Corish Circle, however, Gate 3 is the main access. Gate 5 is for emergency exit or entry.

The site operates 24 hours a day, seven days a week for 350 days a year, with an allowance for 15 days per year for planned and unplanned maintenance work, including scheduled plant shutdowns.

The site received and dispatches heavy vehicles during salt delivery campaigns and normal operations. There are two eight-day salt delivery campaigns during the year, each involving approximately 1,000 truck movements in total.

There are approximately 76 truck movements per day during normal operations for delivery of raw materials and product dispatch.

Employees, contractors and visitors generate approximately 100 light vehicle movements per day.

2.4 Proposed Modification

IXOM proposes to construct and operate a new chlorine liquefaction and packaging plant at the site, which will be integrated into existing site operations with all chlorine material being sourced from existing CAP processes. The chlorine liquefaction plant will provide redundancy in the event that the existing chlorine liquefaction plant at Laverton becomes non-operational or is no longer able to meet market demands. During this unlikely scenario, the proposed Botany chlorine liquefaction plant would produce 50 tpd of liquified chlorine products as required to compensate for any loss of production volume at the Laverton liquefaction plant. During normal operation, the chlorine liquefaction plant will operate at a reduced rate to supply bulk liquefied chlorine throughout NSW.

2.4.1 Plant Location and Details

The new chlorine liquefaction plant will be located at Block L, with the sodium hypochlorite bay to be relocated to the adjacent Block Q. A new driveway and hardstand will be constructed on Block Q prior to relocation of the sodium hypochlorite loading bay to the new hardstand.

Most of the chlorine liquefaction plant will be in a leak-tight containment building to minimise the risk associated with a fugitive chlorine gas emission. The building, which will be approximately 8m high, extending to approximately 16m at its highest point, approximately 60m long and 33m wide, will have a steel girt frame and steel portal frame roof. It will have a reinforced concrete floor, and the exterior wall and roof cladding will comprise Colorbond sheet steel. Access to the building will be via roller doors.

The containment building will be fitted with a scrubbing system to ensure any potential chlorine emissions are captured and treated. The stack of the scrubbing system will extend above the roofline.

The chlorine liquefaction plant will be designed from proven equivalent IXOM processes, and will comprise:

- Shell and tube heat exchanger to liquefy chlorine.
- Ammonia refrigeration system (mostly located outside of the containment building).
- Chlorine separator to separate liquefied chlorine from incondensable gases.
- Two chlorine stock tanks to store up to 50t of liquefied chlorine.
- Two chlorine storage pumps to distribute chlorine for tanker and container filling.
- Vacuum chlorine catch pot to ensure any liquefied chlorine from filling functions will pass the absorptions system as gas.
- Chlorine tanker loading station.
- Two chlorine drum filling stations and two chlorine cylinder filling stations.
- Eight chlorine drum degassing stations.
- 12 chlorine cylinder degassing stations.
- Degas reactor to absorb incondensable gases from the separator and intermittent liquefied chlorine and chlorine gas from chlorine container filling and degassing functions.
- Containment building scrubbing system to absorb any fugitive emissions of chlorine in the building and to provide tertiary absorption of any chlorine gas from storage and container degassing and filling functions.

2.4.2 Hours of Operation

Operation of the chlorine liquefaction plant will be consistent with the existing hours of operation at the IXOM site.

In the normal operating mode, operations will be required to produce liquefied chlorine from the control room. It is anticipated that this work will be absorbed by existing operations, with no requirement for additional personnel.

Additional vehicles associated with the dispatch of liquefied chlorine will consist of three 13t bulk tankers per week during normal operating mode. For the contingent case, in the unlikely event that the existing liquefaction plant at Laverton becomes non-operational, there would be up to a further three trucks per week (six movements).

2.5 Construction

The construction state of the project will comprise:

- Block Q:
  - Works to prepare Block Q for relocation of the sodium hypochlorite loading bay, comprising removal of surface material and paving the access driveway and hardstand.
  - Dismantling the sodium hypochlorite loading bay on Block L and relocating to / assembly on Block Q.
- Block L:
  - Earthworks on Block L to remove existing surface material, level the block, excavate building footings and install services.
  - Paving external hardstand areas and pouting the reinforced concrete floor.
  - Erection of the steel girt frame and portal frame roof.
  - Cladding of external walls and installation of roof sheeting.
  - Installation of internal componentry.
  - Commissioning and testing.

2.5.1 Construction Hours

Construction of the project will take approximately 12 months, with works undertaken during standard hours, that is:

- Monday to Friday: 7am to 6pm.
- Saturday: 8am to 1pm.
- Sunday and public holidays: no construction.

There will be up to 20 construction personnel on site at any one time.

3 Review of Environmental Performance

3.1 Noise Monitoring and Compliance Reporting

Attended noise monitoring is undertaken monthly to demonstrate compliance with the licence conditions in EPL #20547. A review of the IXOM Annual Reports for 2021, 2022 and 2023 identified that noise levels were observed to be below the night period criterion of 50dBA $LA_{eq(15min)}$ at all assessed receiver locations, during each of the noise surveys conducted between December 2020 and November 2023.

3.2 Complaints History

A review of the IXOM Botany Complaints Register indicated that there have been no noise-related complaints recorded since December 2020.

This page has been intentionally left blank

4 Noise Assessment Criteria

IXOM Botany currently operates under development approval DA 35/98 and EPL #20547, with Condition L4 addressing noise limits during operation, and Condition L5 addressing applicable construction hours.

4.1 Operational Noise Criteria

Condition L4.2 of EPL #20547 provides the operational noise limits for the IXOM site, reproduced in **Table 3**.

Table 3 Operational Noise Criteria from EPL #20547

Receiver Location	Day dB $L_{Aeq(15min)}$	Evening dB $L_{Aeq(15min)}$	Night dB $L_{Aeq(15min)}$
All privately owned residences	65	55	50

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

For non-residential receivers, the amenity noise levels as per Table 2.2 of the NPI, as summarised in **Table 4**, are the applicable project noise trigger levels.

Table 4 Operational Noise Criteria – Non-residential Receivers

Receiver Location	Period	Recommended ANL dB $L_{Aeq(period)}$ [1]	PANL dB $L_{Aeq(period)}$ [2]	PANL / PNTL dB $L_{Aeq(15min)}$ [3]
Isolated Residence in Industrial Zone	When in use	70	65	68
Education Institution	When in use	45[4]	40[4]	43[4]
Active Recreation	When in use	55	50	53
Commercial Premises	When in use	65	60	63
Industrial Premises	When in use	70	65	68

Note 1: Recommended Amenity Noise Levels as per Table 2.2 of the NPI.

Note 2: Includes a -5dB adjustment to the amenity level to account for existing industrial noise as per Section 2.4 of the NPI.

Note 3: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period as per Section 2.2 of the NPI.

Note 4: External level allowing for 10dB internal to external correction.

In accordance with Condition L4.8 of EPL #20547 the noise limits provided in **Table 3** apply under the following conditions:

- wind speeds up to 3m/s at 10m above ground level; or
- temperature inversion conditions of up to 3 degrees C/100m and wind speeds up to 2m/s at 10m above ground level.

4.1.1 Maximum Noise Assessment Trigger Levels

Short term attended noise monitoring was undertaken during the night period (2.14am on 19 July 2024) to establish background noise levels. The maximum noise level screening criteria shown in **Table 5** is based on the night-time RBLs and trigger values as per Section 2.5 of the NPI. The trigger levels will be applied to transient noise events that have the potential to cause sleep disturbance.

Table 5 Maximum Noise Assessment Trigger Levels

Residential Receivers			
$L_{Aeq(15min)}$		L_{Amax}	
40dB $L_{Aeq(15min)}$ or RBL + 5dB		52dB L_{Amax} or RBL + 15dB	
Trigger	40	Trigger	52
RBL 50+5dB	55	RBL 50+15dB	65
Highest	**55**	**Highest**	**65**

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays; Night 10pm to 8pm.

Note: As per Section 2.5 of the NPI, the highest of the two criteria are adopted as the trigger level.

4.2 Construction Noise Management Levels

Condition L5.1 of EPL #20547 states that all activities likely to generate perceivable noise outside the boundaries of the lots on which the plant is located shall be restricted to the hours of 7am to 6pm Monday to Friday and 8am to 1pm Saturday, unless otherwise agreed to in writing by the EPA.

Construction activities that are not audible at the nearest affected receivers are permitted at any time.

It is noted that the EPL does not prescribe specific construction noise management levels (NMLs), hence, the operational noise criteria (refer **Table 3**) has been adopted for the assessment of potential construction noise impacts on residential receivers.

Construction NMLs for non-residential receivers are established in accordance with the ICNG and are summarised in **Table 6**.

Table 6 Construction Noise Management Levels – Non-residential Receivers

Receiver Type	Management Level, dB $L_{Aeq(15min)}$
Education Institution	55[1]
Active Recreation	65
Commercial Premises	70
Industrial Premises	75

Note 1: External level allowing for 10dB internal to external correction.

4.3 Road Traffic Noise Criteria

In accordance with the Road Noise Policy (RNP) (EPA, 2011), this assessment has adopted the 'Freeway/arterial/sub-arterial road' category for the designated inbound and outbound transport routes. Table 7 reproduces the road traffic noise assessment criteria relevant for this road type.

Table 7 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of Project/development	Assessment Criteria - dB(A)	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial road	Existing residences affected by additional traffic on existing freeways/sub-arterial/roads generated by land use developments	60dB(A) $LA_{eq(15hr)}$	55dB(A) $LA_{eq(9hr)}$

Note: For road noise assessments, the day period is from 7am to 10pm (ie there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dBA, which is generally accepted as the threshold of perceptibility to a change in noise level.

This page has been intentionally left blank

5 Modelling Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers using DGMR (iNoise, Version 2024) noise modelling software. iNoise is an intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

The model calculation method used to predict noise levels was in accordance with ISO 9613:1 and ISO 9613:2 including corrections for meteorological conditions using CONCAWE[1]. The ISO 9613 standards are the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

5.1 Operational Noise Modelling Scenarios

Under the proposal, amendments to the site would include the operation of a new chlorine liquefaction and packaging plant, which would be integrated into existing site operations.

The new chlorine liquefaction plant will be located at Block L and will be mostly housed within a leak-tight containment building with dimensions of 8m high, extending to 16m at its highest point, 60m long and 33m wide. The building will have a reinforced concrete floor, and the exterior wall and roof cladding will comprise Colorbond sheet steel.

Additional traffic generated by the proposed changes to operations would comprise three 13t bulk liquid tanker arrivals and departures per week in normal mode, and up to 6 trucks (12 movements) per week under the Laverton shutdown mode.

No additional light vehicle movements anticipated, with the work to be absorbed by existing personnel.

[1] Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

5.2 Sound Power Levels

Attended noise monitoring was undertaken by MAC at the IXOM Botany site on Thursday 18 July 2024 to calculate sound power levels (SWLs) of significant existing noise generating processes on the site. It is noted that due to the nature of the site and its surrounds, noise measurements were likely to be influenced by extraneous noise sources. Hence, the calculated SWLs for each item of plant at the IXOM Botany site are considered to be conservatively high.

Noise emission data for the proposed chlorine liquefaction plant was sourced from noise measurements undertaken by LRM Global Pty Ltd (LRM Global) at the IXOM Laverton North facility on Monday 30 September 2024.

The noise mapping was undertaken at locations surrounding the IXOM Laverton North facility, and captured all operations, including the chlorine liquefaction plant. The measurement location closest to the chlorine liquefaction plant was used to calculate the plant SWLs.

It is noted that the measured levels were influenced by extraneous noise sources including other site processes and adjacent industries. Hence, the calculated SWLs for the chlorine liquefaction plant are considered to be highly conservative.

The locations of the modelled plant and equipment are provided in **Appendix B**. The noise emission levels for existing plant and equipment on the IXOM Botany Site, used in modelling, are summarised in **Table 8** while octave data is provided in **Appendix C** .

Table 8 Significant Existing Equipment Sound Power Levels, dB $L_{Aeq(15min)}$

Noise Source/Item	Sound Power Level (SWL), dBA	Source Height, m
Brine Treatment and Electrolysers	105	5m
Caustic Evaporation Plant	106	5m
HCL Product Plant	99	5m
Sodium Hypochlorite Product Plant	93	5m
Cooling Towers	99	3m
Heavy Vehicles (low speed manoeuvring on site)	103	1.5m
Excavator (20t or similar)	105	2m
Front-end Loader (CAT930K or similar)	104	2m
Chlorine Liquefaction Plant[2,3]	90	Emitting façade up to 8m
LAmax (Airbrake Release)	112	0.5m

Note 1: Sourced from TfNSW CMNET or manufacturer's specifications.

Note 2: Measured at IXOM Laverton North Facility.

Note 3: SWL at building façade.

5.3 Meteorological Analysis

Noise emissions can be influenced by prevailing weather conditions. Light stable winds (<3m/s) and temperature inversions have the potential to increase noise at a receiver.

Fact Sheet D of the NPI provides two options when considering meteorological effects:

- adopt the noise enhancing conditions for all assessment periods without an assessment of how often the conditions occur – a conservative approach that considers a source to receiver winds for all receivers and F class temperature inversions with wind speeds up to 2m/s at night; or
- determine the significance of noise enhancing conditions. This requires assessing the significance of temperature inversions (F and G Class stability categories) for the night time period and the significance of light winds up to 3m/s for all assessment periods during stability categories other than E, F or G.

Standard meteorological conditions and noise-enhancing meteorological conditions as defined in Table D1of the NPI are reproduced in **Table 9**.

Table 9 Standard and Noise-Enhancing Meteorological Conditions

Meteorological Conditions	Meteorological Parameters
Standard Meteorological Conditions	Day/evening/night: stability categories A–D with wind speed up to 0.5m/s at 10m AGL.
Noise Enhancing Meteorological Conditions	Daytime/evening: stability categories A–D with light winds (up to 3 m/s at 10m AGL). Night-time: stability categories A–D with light winds (up to 3m/s at 10m AGL) and/or stability category F with winds up to 2m/s at 10 m AGL.

5.3.1 Temperature Inversions

Temperature inversions form when a layer of warm air traps cooler air near to the ground surface. When this occurs, temperature inversions can increase noise levels by focusing sound waves. Temperature inversions are predominantly associated with winter months when clear, calm nights promote rapid ground cooling and reduced natural mixing of cold and warm air (ie radiative or nocturnal inversion). For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total time during winter, or about two nights per week.

In coastal regions, differential heating between the land and sea surfaces can result in interactions between air masses of different temperatures. These interactions can result in the generation of a wind field (eg sea breeze), or a marine layer, which can persist of an extended period of time. This differential heating is generally associated with warmer months when the difference between the land surface temperatures and sea surface temperatures are at their greatest, while the during the colder months, high relative sea surface temperatures have a modulating effect, reducing the likelihood of temperature inversions forming.

Although a detailed analysis of the prevalence of temperature inversions has not been undertaken as part of this study due to data availability, a study for the Port Authority of NSW by AECOM (2018; Ref: 60551910) demonstrated that frequency of occurrence of moderate to strong temperature inversions (F and G Class stability) within Sydney Harbour is about 11% during winter nights. Hence, the prevalence of winter temperature inversions is well less than the 30% threshold and are not considered to be a feature of the locality.

5.3.2 Prevailing Winds

To determine the prevailing conditions for the project, weather data for a five-year period from September 2019 to October 2024 was obtained from the Bureau of Meteorology's (BOM) Sydney Airport AMO weather station located approximately 5km west of the project site. The data was analysed using the EPA's Noise Enhancement Wind Analysis (NEWA) program to determine the frequency of occurrence of winds speeds up to 3m/s in each seasonal period.

Table 10 summarises the results of the wind analysis and includes the dominant wind direction and percentage occurrence during each season for each assessment period. The results of the detailed analysis of meteorological data are presented in Appendix D.

Table 10 Seasonal Frequency of Occurrence Wind Speed Intervals			
Season	Period[1]	Wind Direction ±(45°)	% Wind Speeds (m/s)
			0.5 to 3 m/s
Summer	Day	W, WNW, NW, NNW	4
	Evening	NNE, NE, ENE, ESE	4
	Night	N, NNW	13
Autumn	Day	W, WNW	9
	Evening	NNW	10
	Night	WNW	25
Winter	Day	W, WNW	10
	Evening	NNW	15
	Night	WNW	23
Spring	Day	W, WNW	5
	Evening	E	9
	Night	NNW	20

Based on the results of this analysis, prevailing winds are not applicable for the assessment and the relevant meteorological conditions adopted in this assessment are summarised in **Table 11**.

Table 11 Modelled Site-Specific Meteorological Parameters				
Assessment Condition	Temperature	Wind Speed / Direction	Relative Humidity	Stability Class[1]
Day	20°C	Calm	60%	D
Evening	18°C	Calm	65%	D
Night	15°C	Calm	70%	D

Note: Day 7am to 6pm; Evening 6pm to 10pm; Night 5am to 7am.

Note 2: Implemented using CONCAWE meteorological corrections.

5.4 Annoying Characteristics

Fact Sheet C of the NPI provides guidelines for applying 'modifying factors' adjustments to account for annoying noise characteristics such as low-frequency, tonality, intermittent noise, irregular or noise of short duration. An assessment of annoying characteristics has been undertaken for the Project, and is provided in **Appendix E**. It is noted that due to the nature of the operations, intermittent noise is unlikely to be a feature of the site and has not been considered further.

The analysis of low-frequency noise found that modelled noise levels from all sources did not exceed the screening test of C-A weighted noise levels greater or equal to 15dB. Hence, no correction for low-frequency noise is applied.

An assessment of tonality was undertaken to identify dominant tones associated with the operation. The tonal noise correction applies when the level of an octave band exceeds the level of the adjacent band on either side by at least 5dB. The results of the tonality assessment demonstrates that the operations do not result in dominant tones. Hence, no correction for tonality is applied.

5.5 Noise Validation

Validation of the noise model was undertaken via a combination of attended noise measurement and predictive noise modelling in accordance with Section 7 of the NPI.

Attended noise monitoring was undertaken at one location adjacent to residential receivers on Denison Street (ATTM1) during the night period (2:14am) of 19 July 2024. The noise survey was completed during clear conditions with a gentle (~1m/s) wind about the southwest. Observations during the time of the attended monitoring identified that the ambient noise environment was influenced by several industrial noise sources and road traffic noise. The site contribution at the time of the measurement was determined through operator observations with consideration of extraneous noise sources.

On-site noise validation measurements (18 July 2024) were also undertaken at three locations nearer to the plant, including:

- east of the brine treatment plant (OSM1);
- south of the caustic evaporation plant (OSM2); and
- northwest of the sodium hypochlorite plant (OSM3).

The monitoring locations are shown in **Figure 3**. Plant and equipment operating at the time of the validation measurements included:

- brine treatment and electrolysers;
- caustic evacuation plant;
- hydrochloric acid product plant;
- sodium hypochlorite product plant;
- cooling towers; and
- front-end loader at salt storage pile.

FIGURE 3

Validation Monitoring

MAC232001-01

IXOM Botany

KEY

- IXOM Site
- Validation Monitoring Points
- Front-end Loader

Fixed Plant

- Brine Treatment Plant
- Caustic Evacuation Plant
- HCL Production Plant
- Sodium Hypochlorite Plant

0 20 40 60 80 m

N

MAC Muller Acoustic Consulting

A noise modelling scenario was developed based on the SWLs of plant and equipment measured on site, their relative positions within the IXOM Botany site and the weather conditions noted at the time of the measurements. The results of the noise model validation (refer to **Table 12**) indicate that the modelled $LA_{eq(15min)}$ noise levels were within -0.2 to 0.5dB of the measured noise levels. Hence, as the difference between the modelled and measured noise levels is within the industry accepted model tolerance of +/- 2dBA, the noise model is considered representative of the real world within the limitations of the prediction algorithm, and no model calibration is required.

Table 12 Results of Model Validation

Monitoring Location	Measured Noise Level dB $LA_{eq(15min)}$	Modelled Noise Level dB $LA_{eq(15min)}$	Difference, dB
ATTM1	48	48.2	+0.2
OSM1	60	60.2	+0.2
OSM2	61	60.8	-0.2
OMS3	55	55.5	+0.5

5.6 Construction Noise Assessment Methodology

Noise emissions were modelled for the following scenarios, considered to be the main noise generating activities:

- Earthworks to clear the site;
- Concreting works for slabs and footings; and
- Installation of plant and construction of buildings.

Noise emission data and assumptions for each construction scenario modelled in this assessment are summarised in **Table 13**.

Table 13 Construction Noise Sources - Sound Power Levels dBA (re 10^{-12} Watts)		
Item and number modelled	Individual Sound Power Level, dB LAeq(15min)	Modelled Sound Power Level, dB LAeq(15min)
Earthworks		
Miscellaneous Vehicles[1] (4/hr)	102	102
Road Truck[1] (4/hr)	104	104
Excavator (x2)	110	113
Grader (x1)	113	113
Roller (x1)	109	109
Foundations / Concreting		
Miscellaneous Vehicles[1] (4/hr)	102	102
Concrete Agitator Truck[1] (8/hr)	105	108
Concrete Agitator Truck Idle (x2)	102	105
Concrete Boom Pump (x2)	102	105
Vibrating Pokers (x3)	103	108
Concrete Power Trowel (x2)	106	109
Plant Installation and Building		
Miscellaneous Vehicles[1] (4/hr)	102	102
Road Truck[1] (4/hr)	104	104
Mobile Crane (x2)	105	108
EWP (x2)	98	101
Welder (x2)	105	108
Power Tools (x4)	105	111
Generators (x2)	99	102

Note 1: Modelled as a moving point source with adjustments for length of travelled path, velocity and number of movements in a 15-minute period.

5.7 Construction Vibration Assessment

A qualitative assessment of potential vibration impacts has been completed. Due to the nature of the works proposed and distances to potential vibration sensitive receivers, vibration impacts from the project would be negligible.

The Construction Noise & Vibration Guideline Public (CNVG) (Transport for NSW, 2023) sets out safe working distances for vibration intensive plant to achieve the human response criteria for vibration. Significant vibration intensive plant such as large vibratory rollers and large hydraulic hammers typically have a safe working distance of up to 100m.

A review of aerial imagery identifies that the closest potentially sensitive receiver is located approximately 250m to the east of the proposed chlorine liquefaction plant. Hence, human exposure to vibration is anticipated to be negligible. Furthermore, where the human response criteria are satisfied, the structural or cosmetic criteria for sensitive receivers will be achieved. Therefore, vibration impacts are not considered to be a significant issue and have not been considered further in this assessment.

5.8 Road Traffic Noise Assessment

Under existing operations, the site typically generates approximately 76 heavy vehicle movements per day for delivery of raw materials and product dispatch. The proposal would result in an additional three 13t bulk liquid tankers per week (six movements) associated with the dispatch of liquefied chlorine, and up to six trucks per week (12 movements) under the Laverton shutdown scenario. Light vehicle numbers would remain consistent with existing conditions, with operation of the new chlorine liquefaction plant likely to be undertaken by existing employees.

Assuming the worst-case scenario where all 12 additional heavy vehicle movements occur within a single day of the week, the proposal would generate an increase in heavy vehicle movements of approximately 15% compared with existing site generated traffic volumes.

In considering the high existing traffic volumes on the local road network, the proposed increase in heavy vehicles associated with the chlorine liquefaction plant would have a negligible (<0.1dBA) impact on road traffic noise levels.

6 Noise Assessment Results

6.1 Operational Noise Assessment

Noise predictions from all sources have been quantified at surrounding residential receivers to the project site and are presented in **Table 14**, while the predicted operational noise contours are provided in **Appendix F**. It is noted that the noise predictions considered the Laverton shutdown scenario. Where this scenario complies with the noise goals, the normal operating mode is also deemed to comply.

Table 14 Noise Predictions – All Receivers

Location	Predicted Noise Level[1] dB LAeq(15min)			PNTL (D/E/N) dB LAeq(15min)	Compliant
	Day	Evening	Night		
R1	46	46	46	65/55/50	✓
R2	44	44	44	65/55/50	✓
R3	43	43	42	65/55/50	✓
R4	42	42	42	65/55/50	✓
R5	46	46	45	65/55/50	✓
R6	45	45	45	65/55/50	✓
R7	44	44	44	65/55/50	✓
R8	48	48	48	65/55/50	✓
R9	49	49	49	65/55/50	✓
R10	48	48	48	65/55/50	✓
R11	43	43	43	65/55/50	✓
R12	42	42	42	65/55/50	✓
R13	44	44	44	65/55/50	✓
R14	46	46	46	65/55/50	✓
R15	44	44	44	65/55/50	✓
R16	44	44	44	65/55/50	✓
R17	44	44	44	65/55/50	✓
R18	45	45	45	65/55/50	✓
R19	45	45	45	65/55/50	✓
R20	43	43	43	65/55/50	✓
In1R	43	43	43	68	✓
ED1	45	45	44	43[2]	✓
AR1	27	27	27	53	✓
C1	34	34	34	63	✓
In1	59	59	56	68	✓

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: External level allowing for 10dB internal to external correction.

6.1.1 Maximum Noise Level Assessment

In assessing maximum noise events, typical L_{Amax} noise levels from transient events were assessed at the nearest residential receivers. For the sleep disturbance assessment, a sound power level of 112dBA for airbrake release from heavy vehicles was adopted for maximum noise level (L_{Amax}) events during the night period.

Predicted noise levels from $L_{Aeq(15min)}$ and L_{Amax} events for assessed receivers are presented in **Table 15.** Results identify that the maximum noise trigger levels will be satisfied for all assessed receivers.

Table 15 Maximum Noise Level Assessment

Receiver	Predicted Noise Level		Maximum Trigger Levels		Compliant
	dB $L_{Aeq(15min)}$	dB L_{Amax}	dB $L_{Aeq(15min)}$	dB L_{Amax}	
Residential Receivers Denison Street	42 – 49	<30 – 48	55	65	✓

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays Night 10pm to 8am.

6.2 Construction Noise Assessment

Predicted $L_{Aeq(15min)}$ noise emissions for construction satisfy relevant construction NMLs for all assessed receivers. **Table 16** presents the results of the construction noise model assessment, while the predicted construction noise contours are provided in **Appendix G**.

Table 16 Construction Noise Assessment Results

Receiver	Assessment Period	Predicted dB $L_{Aeq(15min)}$			Noise Management Level dB $L_{Aeq(15min)}$
		Earthworks	Foundations	Building	
Residential Receivers Denison Street	Standard Hours	39 – 54	36 – 48	43 – 54	65

Note: See Section 2.5.1 of this report for Recommended Standard Hours for Construction.

7 Discussion and Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise and Vibration Impact Assessment to quantify emissions from the construction and operation of a chlorine liquefaction plant at IXOM's Botany Chlor–alkali Plant at 16-20 Beauchamp Road, Banksmeadow, NSW.

The assessment has quantified potential noise emissions associated with the construction and operation of the project, including sleep disturbance impacts and road traffic noise levels.

The results of the assessment demonstrate that noise emissions from the operation would satisfy the relevant NPI criteria and EPL noise limits at all assessed receivers for all assessment periods. Furthermore, sleep disturbance is not anticipated, as emissions from maximum noise events (ie airbrake release from heavy vehicles) are predicted to satisfy the NPIs maximum noise trigger levels.

An assessment of road traffic noise demonstrated that due to existing high volumes of traffic on the road network, the proposed increase of up to 12 truck movements per week would not result in a material change to road traffic noise levels.

Modelled noise emissions from construction activities demonstrate that predicted noise emissions would meet the ICNG management levels at all receiver locations. Notwithstanding, IXOM will implement good work practices to minimise construction noise emissions, where practicable.

In summary, the Noise and Vibration Impact Assessment adequately address the requirements outlined in the SEARs and supports the Development Application for the project without further management measures being required.

This page has been intentionally left blank

Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in **Table A1**.

Table A1 Glossary of Acoustical Terms

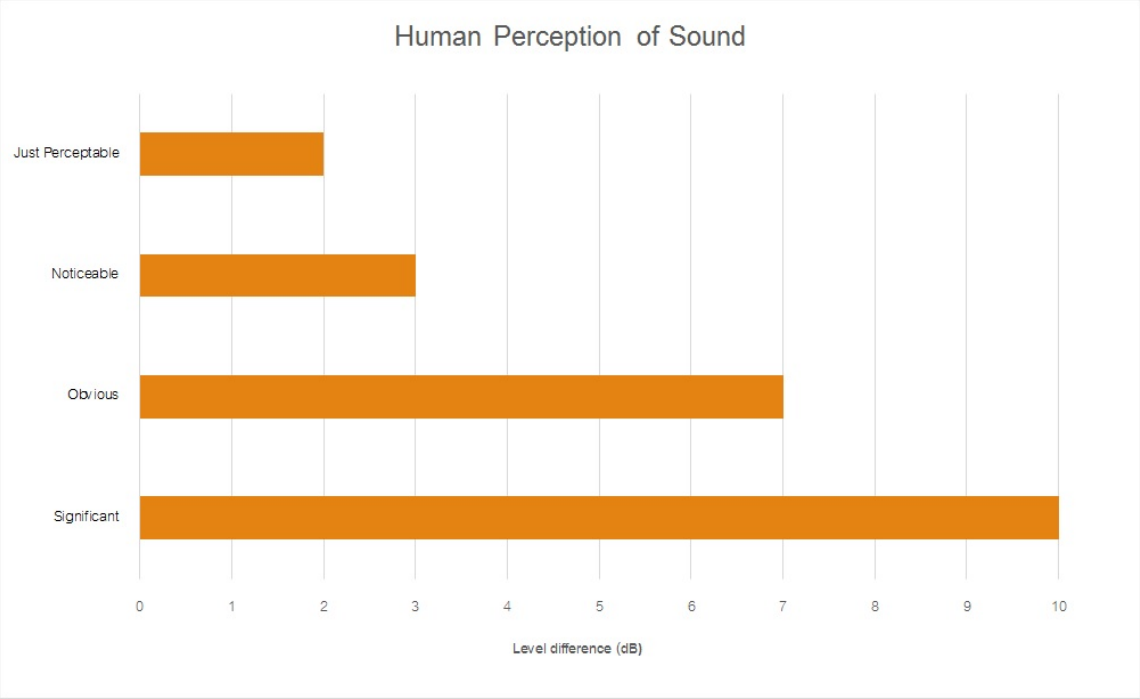
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The total noise associated with a given environment. Typically, a composite of sounds from all sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to sound.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is usually represented by the LA90 descriptor
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Z-weighted or decibels Linear (unweighted).
Extraneous Noise	Sound resulting from activities that are not typical of the area.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A sound level which is exceeded 10% of the time.
LA90	Commonly referred to as the background noise, this is the level exceeded 90% of the time.
LAeq	Represents the average noise energy or equivalent sound pressure level over a given period.
LAmax	The maximum sound pressure level received at the microphone during a measuring interval.
Masking	The phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.
RBL	The Rating Background Level (RBL) as defined in the NPI, is an overall single figure representing the background level for each assessment period over the whole monitoring period. The RBL, as defined is the median of ABL values over the whole monitoring period.
Sound power level (Lw or SWL)	This is a measure of the total power radiated by a source in the form of sound and is given by 10.log10 (W/Wo). Where W is the sound power in watts to the reference level of 10^{-12} watts.
Sound pressure level (Lp or SPL)	the level of sound pressure; as measured at a distance by a standard sound level meter. This differs from Lw in that it is the sound level at a receiver position as opposed to the sound 'intensity' of the source.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Pressure Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



This page has been intentionally left blank

Appendix B – Site Layout

Site layout

Botany Chlorine Liquefaction Plant
MODIFICATION TO STATE SIGNIFICANT DEVELOPMENT - SCOPING REPORT

Appendix C – Sound Power Data

The noise emission levels used in modelling are summarised in **Table C-17**. Where possible, plant and equipment noise emission data were measured on site under typical operating conditions. Where equipment was not operational at the time of site visit, noise emission data were obtained from the Transport for NSW Construction and Maintenance Noise Estimator Tool or manufacturer's specifications.

Table C-17 Single Octave Equipment Sound Power Levels, dB $L_{Aeq(15min)}$ *(re 10^{-12}W)*

Noise Source/Item	Octave Band Centre Frequency, Hz								Total, dBA
	63	125	250	500	1000	2000	4000	8000	
Brine Treatment and Electrolysers	81	90	93	100	101	98	94	84	105
Caustic Evaporation Plant	84	90	94	97	100	99	99	89	106
HCL Product Plant	83	86	89	92	94	92	89	81	99
Sodium Hypochlorite Product Plant	70	80	85	87	88	85	80	72	93
Cooling Towers	75	83	88	92	95	92	85	74	99
Heavy Vehicles (low speed manoeuvring on site)	76	82	90	96	99	95	90	82	103
Excavator (20t or similar)	81	94	94	97	99	98	97	92	105
Front-end Loader (CAT930K or similar)	86	91	93	100	98	96	90	81	104
Chlorine Liquefaction Plant	72	78	81	85	84	83	77	79	90
L_{Amax} (Airbrake Release)	74	78	82	93	99	104	108	108	112

Appendix D – NEWA Meteorological Data

Table D1 NEWA Analysed Daytime Meteorological Conditions, Sydney Airport AMO NSW					
Direction ± 45°	Season	Day Percentage Occurrence %	Direction	Season	Day Percentage Occurrence %
0	Summer	3	180	Summer	3
0	Autumn	4	180	Autumn	5
0	Winter	6	180	Winter	4
0	Spring	3	180	Spring	2
22.5	Summer	3	202.5	Summer	3
22.5	Autumn	3	202.5	Autumn	5
22.5	Winter	4	202.5	Winter	4
22.5	Spring	2	202.5	Spring	3
45	Summer	2	225	Summer	3
45	Autumn	3	225	Autumn	5
45	Winter	3	225	Winter	5
45	Spring	2	225	Spring	3
67.5	Summer	2	247.5	Summer	3
67.5	Autumn	3	247.5	Autumn	8
67.5	Winter	3	247.5	Winter	8
67.5	Spring	2	247.5	Spring	4
90	Summer	2	270	Summer	4
90	Autumn	3	270	Autumn	9
90	Winter	3	270	Winter	10
90	Spring	2	270	Spring	5
112.5	Summer	2	292.5	Summer	4
112.5	Autumn	4	292.5	Autumn	9
112.5	Winter	4	292.5	Winter	10
112.5	Spring	2	292.5	Spring	5
135	Summer	3	315	Summer	4
135	Autumn	4	315	Autumn	8
135	Winter	3	315	Winter	9
135	Spring	2	315	Spring	4
157.5	Summer	2	337.5	Summer	4
157.5	Autumn	3	337.5	Autumn	7
157.5	Winter	3	337.5	Winter	9
157.5	Spring	1	337.5	Spring	4

Table D2 NEWA Analysed Evening Meteorological Conditions, Sydney Airport AMO NSW					
Direction ± 45°	Season	Night Percentage Occurrence %	Direction	Season	Night Percentage Occurrence %
0	Summer	3	180	Summer	3
0	Autumn	9	180	Autumn	5
0	Winter	11	180	Winter	3
0	Spring	7	180	Spring	3
22.5	Summer	4	202.5	Summer	2
22.5	Autumn	9	202.5	Autumn	6
22.5	Winter	9	202.5	Winter	5
22.5	Spring	8	202.5	Spring	3
45	Summer	4	225	Summer	1
45	Autumn	9	225	Autumn	7
45	Winter	7	225	Winter	9
45	Spring	9	225	Spring	3
67.5	Summer	4	247.5	Summer	1
67.5	Autumn	8	247.5	Autumn	9
67.5	Winter	4	247.5	Winter	12
67.5	Spring	8	247.5	Spring	3
90	Summer	3	270	Summer	1
90	Autumn	5	270	Autumn	9
90	Winter	2	270	Winter	14
90	Spring	5	270	Spring	3
112.5	Summer	4	292.5	Summer	1
112.5	Autumn	5	292.5	Autumn	8
112.5	Winter	2	292.5	Winter	14
112.5	Spring	5	292.5	Spring	3
135	Summer	3	315	Summer	1
135	Autumn	4	315	Autumn	7
135	Winter	2	315	Winter	13
135	Spring	5	315	Spring	3
157.5	Summer	2	337.5	Summer	3
157.5	Autumn	3	337.5	Autumn	10
157.5	Winter	1	337.5	Winter	15
157.5	Spring	3	337.5	Spring	7

Table D3 NEWA Analysed Night-time Meteorological Conditions, Sydney Airport AMO NSW					
Direction ± 45°	Season	Night Percentage Occurrence %	Direction	Season	Night Percentage Occurrence %
0	Summer	13	180	Summer	5
0	Autumn	16	180	Autumn	3
0	Winter	17	180	Winter	1
0	Spring	17	180	Spring	3
22.5	Summer	12	202.5	Summer	6
22.5	Autumn	10	202.5	Autumn	4
22.5	Winter	10	202.5	Winter	2
22.5	Spring	13	202.5	Spring	5
45	Summer	10	225	Summer	6
45	Autumn	4	225	Autumn	7
45	Winter	2	225	Winter	6
45	Spring	7	225	Spring	7
67.5	Summer	7	247.5	Summer	7
67.5	Autumn	3	247.5	Autumn	12
67.5	Winter	1	247.5	Winter	11
67.5	Spring	5	247.5	Spring	10
90	Summer	4	270	Summer	9
90	Autumn	2	270	Autumn	20
90	Winter	1	270	Winter	17
90	Spring	3	270	Spring	15
112.5	Summer	4	292.5	Summer	11
112.5	Autumn	2	292.5	Autumn	25
112.5	Winter	0	292.5	Winter	23
112.5	Spring	3	292.5	Spring	19
135	Summer	4	315	Summer	11
135	Autumn	2	315	Autumn	24
135	Winter	0	315	Winter	22
135	Spring	2	315	Spring	19
157.5	Summer	3	337.5	Summer	13
157.5	Autumn	1	337.5	Autumn	23
157.5	Winter	0	337.5	Winter	22
157.5	Spring	2	337.5	Spring	20

Appendix E – Annoying Characteristics

Table APP-1 Tonality & Low Frequency Noise Assessment							
Frequency (Hz)	Values (dBZ)	A-wt Spectrum	C-wt Spectrum	1/3 Octave Tonality Test	1/1 Octave Tonality Test	LFN Present (Table C1 -NPI 2017)	NPI LFN Criteria (dBZ)
10		0	0			FALSE	92
12.5		0	0			FALSE	89
16		0	0			FALSE	86
20		0	0			FALSE	77
25	59	13.9	54.2			FALSE	69
31.5	53	13.9	50.3	FALSE	FALSE	FALSE	61
40	49	13.9	46.5	FALSE		FALSE	54
50	54	23.6	52.5	FALSE		FALSE	50
63	50	23.6	49	FALSE	FALSE	FALSE	50
80	46	23.6	45.6	FALSE		FALSE	48
100	46	27.2	46	FALSE		FALSE	48
125	43	27.2	43.1	FALSE	FALSE	FALSE	46
160	41	27.2	40.5	FALSE		FALSE	44
200	41	30.1	41	FALSE			
250	39	30.1	38.7	FALSE	FALSE		
315	37	30.1	36.7	FALSE			
400	41	37.2	41.4	FALSE			
500	40	37.2	40.4	FALSE	FALSE		
630	39	37.2	39.1	FALSE			
800	41	40.1	40.9	FALSE			
1000	40	40.1	40.1	FALSE	FALSE		
1250	40	40.1	39.5	FALSE			
1600	36	36.8	35.7	FALSE			
2000	36	36.8	35.4	FALSE	FALSE		
2500	36	36.8	35.2	FALSE			
3150	30	31	29.3	FALSE			
4000	30	31	29.2	FALSE	FALSE		
5000	31	31	29.2	FALSE			
6300	6	6.2	4.3	FALSE			
8000	7	6.2	4.3	FALSE	FALSE		
10000	9	6.2	4.3				
12500		0	0				
16000		0	0				
20000		0	0				

	Total dBA	Total dBC	C-A
Total SPL	48	59	11

Assessment	
Low Frequency Noise Present	No
Tonal Noise Present	No

Appendix F – Operational Noise Contour Plots


FIGURE F1
Operatonal Noise Contours
Day Period
MAC232001-01
IXOM Botany
KEY
Chlorine Liquefaction Plant
IXOM Site
LAeq(15min) Noise Contours
40 dB
45 dB
50 dB
55 dB
60 dB
65 dB
70 dB
75 dB
0
55
110
165
220 m
N
MAC
Muller Acoustic Consulting
GRACE CAMPBELL CRESCENT
NILSON AVENUE
RHODES STREET
FLACK AVENUE
DENISON STREET
NANT STREET
MCPHERSON STREET
BEAUCHAMP ROAD
PERRY STREET
RAYMOND AVENUE
HAROLD STREET
MCCAULEY STREET
AUSTRALIA AVENUE
BOTANY ROAD


FIGURE F2
Operatonal Noise Contours
Evening Period
MAC232001-01
IXOM Botany
KEY
Chlorine Liquefaction Plant
IXOM Site
LAeq(15min) Noise Contours
40 dB
45 dB
50 dB
55 dB
60 dB
65 dB
70 dB
75 dB
0
55
110
165
220 m
N
MAC
Muller Acoustic Consulting
NANT STREET
MCPHERSON STREET
BOTANY ROAD
DENISON STREET
NILSON AVENUE
GRACE CAMPBELL CRESCENT
RHODES STREET
FLACK AVENUE
BEAUCHAMP ROAD
PERRY STREET
RAYMOND AVENUE
HAROLD STREET
MCCAULEY STREET
AUSTRALIA AVENUE

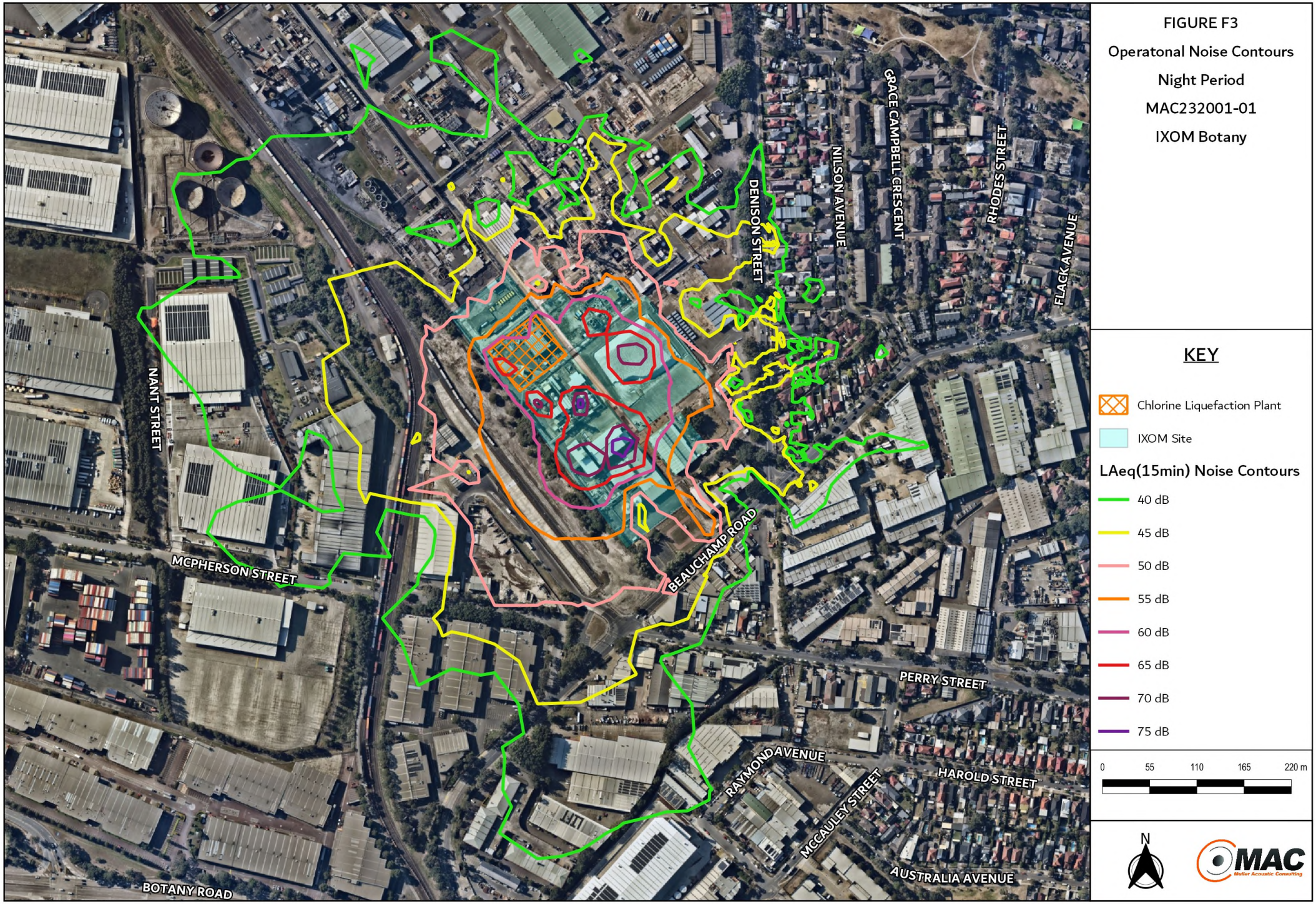


FIGURE F3
Operatonal Noise Contours
Night Period
MAC232001-01
IXOM Botany
KEY
Chlorine Liquefaction Plant
IXOM Site
LAeq(15min) Noise Contours
40 dB
45 dB
50 dB
55 dB
60 dB
65 dB
70 dB
75 dB
0
55
110
165
220 m
N
MAC
Muller Acoustic Consulting
NANT STREET
MCPHERSON STREET
BOTANY ROAD
DENISON STREET
NILSON AVENUE
GRACE CAMPBELL CRESCENT
RHODES STREET
FLACK AVENUE
BEAUCHAMP ROAD
PERRY STREET
RAYMOND AVENUE
HAROLD STREET
MCCAULEY STREET
AUSTRALIA AVENUE

Appendix G – Construction Noise Contour Plots

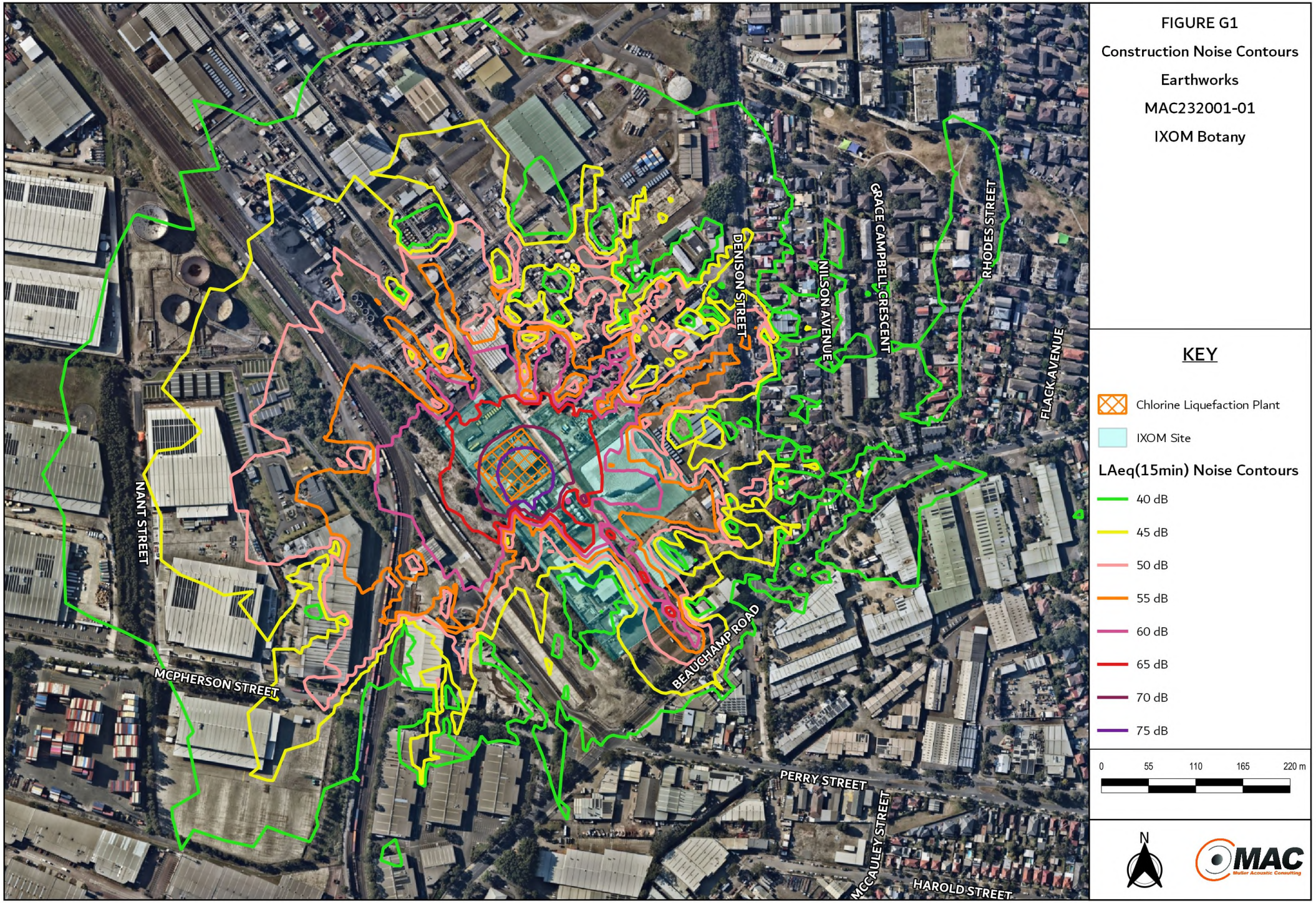


FIGURE G1

Construction Noise Contours

Earthworks

MAC232001-01

IXOM Botany

KEY

Chlorine Liquefaction Plant

IXOM Site

LAeq(15min) Noise Contours

- 40 dB
- 45 dB
- 50 dB
- 55 dB
- 60 dB
- 65 dB
- 70 dB
- 75 dB

0 55 110 165 220 m

N

MAC Muller Acoustic Consulting

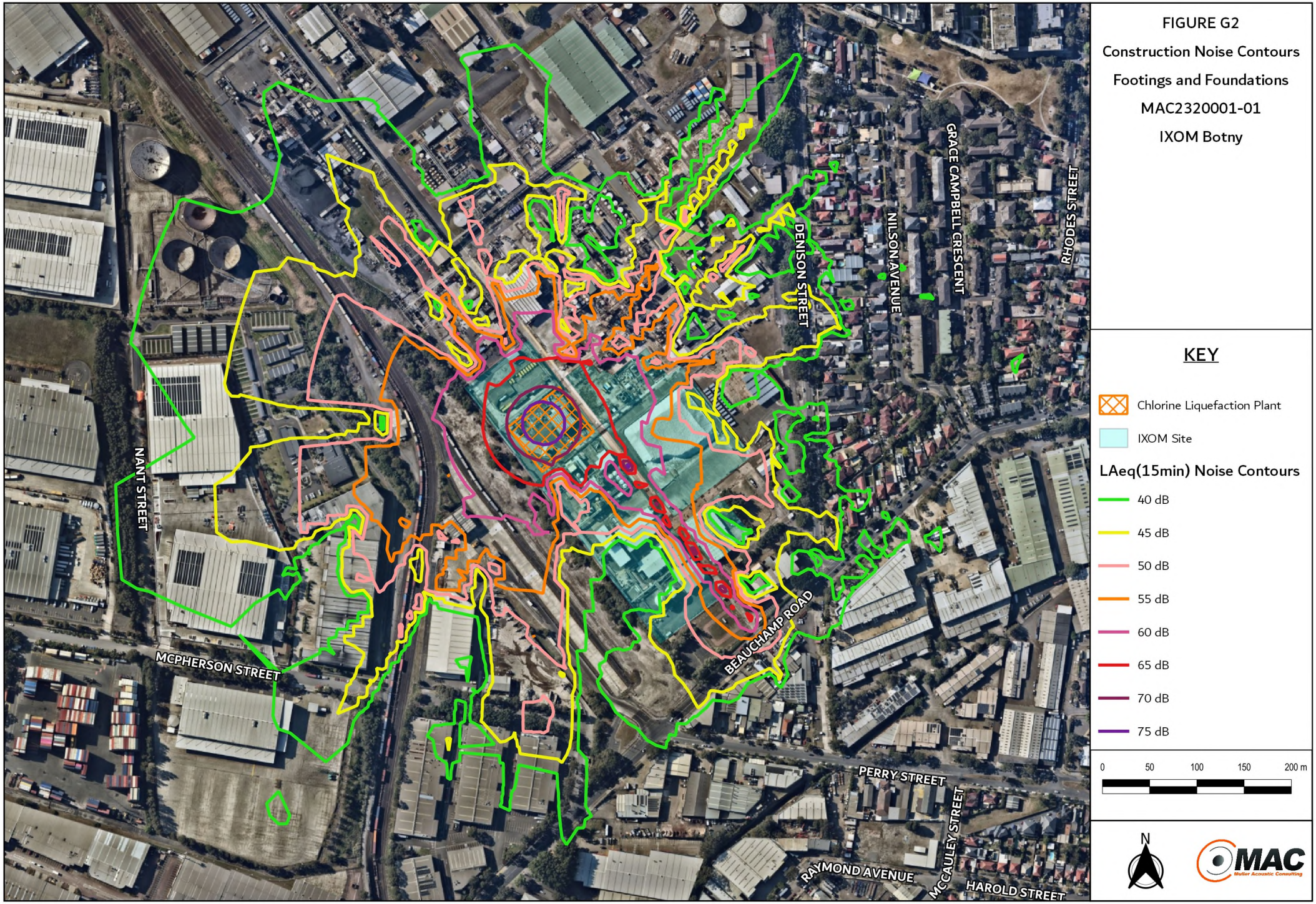


FIGURE G2

Construction Noise Contours

Footings and Foundations

MAC2320001-01

IXOM Botny

KEY

Chlorine Liquefaction Plant

IXOM Site

LAeq(15min) Noise Contours

- 40 dB
- 45 dB
- 50 dB
- 55 dB
- 60 dB
- 65 dB
- 70 dB
- 75 dB

0 50 100 150 200 m

N

MAC
Muller Acoustic Consulting

FIGURE G3

Construction Noise Contours

Building Works

MAC232001-01

IXOM Botany

KEY

Chlorine Liquefaction Plant

IXOM Site

LAeq(15min) Noise Contours

- 40 dB
- 45 dB
- 50 dB
- 55 dB
- 60 dB
- 65 dB
- 70 dB
- 75 dB

0 65 130 195 260 m

N

MAC Muller Acoustic Consulting

This page has been intentionally left blank

Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
Ph: +61 2 4920 1833
www.mulleracoustic.com

MAC
Muller Acoustic Consulting