



# APPENDIX L

## NOISE IMPACT ASSESSMENT



# CSR ADVANCED MANUFACTURING HUB

## NOISE IMPACT ASSESSMENT - MOD 3

**REPORT NO. 17199-M3**  
**VERSION B**

MARCH 2019

**PREPARED FOR**

ELEMENT ENVIRONMENT  
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## DOCUMENT CONTROL

| Version | Status           | Date             | Prepared By | Reviewed By     |
|---------|------------------|------------------|-------------|-----------------|
| A       | Draft for Review | 4 December 2018  | Nic Hall    | John Wassermann |
| A       | Final Draft      | 15 January 2019  | Nic Hall    | John Wassermann |
| A       | Final            | 25 February 2019 | Nic Hall    | John Wassermann |
| B       | Final            | 20 March 2019    | Nic Hall    | John Wassermann |

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**APPENDIX A – Noise Measurement Results**

**APPENDIX B – Noise Modelling Source Locations**

**APPENDIX C – Operational Noise Contour Plots**

## GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

**Maximum Noise Level ( $L_{Amax}$ )** – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

**$L_{A1}$**  – The  $L_{A1}$  level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the  $L_{A1}$  level for 99% of the time.

**$L_{A10}$**  – The  $L_{A10}$  level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the  $L_{A10}$  level for 90% of the time. The  $L_{A10}$  is a common noise descriptor for environmental noise and road traffic noise.

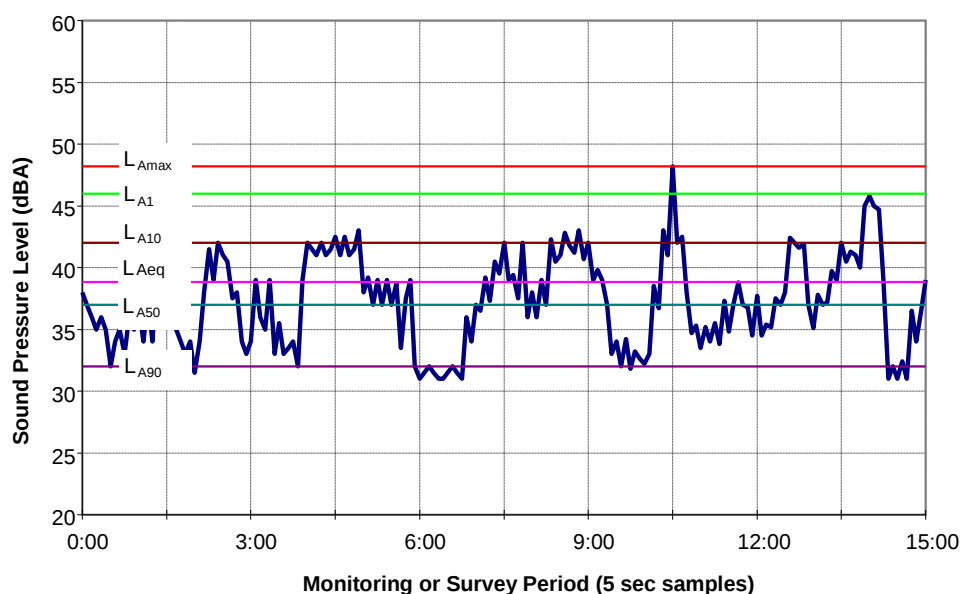
**$L_{A90}$**  – The  $L_{A90}$  level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the  $L_{A90}$  level for 10% of the time. This measure is commonly referred to as the background noise level.

**$L_{Aeq}$**  – The equivalent continuous sound level ( $L_{Aeq}$ ) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

**ABL** – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10<sup>th</sup> percentile (lowest 10<sup>th</sup> percent) background level ( $L_{A90}$ ) for each period.

**RBL** – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



## 1 INTRODUCTION

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### 1.1 Background

In October 2016, CSR Building Products Limited (CSR) acquired Boral Bricks Pty Limited (Boral) brick business along the eastern seaboard of Australia and with it, the Badgerys Creek Brick Making Facility site ('the site'), which is strategically placed in the Western Sydney Priority Growth Area and borders on the proposed Western Sydney Airport precinct.

To realise the full potential of the Badgerys Creek site and to allow the site to meet the strategic needs of their brick, roof products and other building product manufacturing businesses, CSR requires modifications to the existing Project Approval (PA10\_0014). CSR are proposing three separate modifications to their Project Approval as outlined in the following sections.

### 1.2 Modification 2

The existing Project Approval did not allow for the exportation of material extracted on-site. Due to recent and forecasted closure of many quarries in the region, reducing the availability of raw materials, CSR needed to be able to export raw material (clay) from the site. This was important for the sustainability of CSR's brick manufacturing business and to ensure an immediate and ongoing supply of raw material to other CSR brick factories.

Although the existing Project Approval allowed for the storage of finished brick products in the hard stand storage yard, to the east of the brick factory, this storage area would not be used for the storage of bricks manufactured at the site, until planning approval had been granted for the upgrade of the existing brick factory and the upgrade had been completed (Modification 3). In the interim CSR, urgently required additional finished product storage capacity in the greater Sydney region and therefore wished to make use of this valuable space for the temporary storage of finished building products from other CSR manufacturing facilities e.g. autoclaved aerated concrete panels or roof products.

As the ability to export clay from the Badgerys Creek site and temporarily store finished building products was required as a matter of urgency, CSR has lodged a separate modification application under Section 75W of the *Environmental Planning & Assessment Act 1979* (EP&A Act) for these two activities.

CSR recently obtained planning approval for Modification 2 from the Department of Planning and Environment (DP&E) on 5 May 2018.

### 1.3 Modification 3

CSR is now seeking to modify the Project Approval (10\_0014) to permit or allow the following additional development or changes to the approved project:

#### 1.3.1 Advanced Manufacturing - Brick Production

- Removal of most of the existing brick manufacturing equipment and replacement with new brick manufacturing equipment in the existing brick making facility;
- Increase in the building footprint of the existing brick making facility;
- Increase in the building footprint of the existing administration building;

- A NATA (National Association of Testing Authorities) Accredited Advanced Testing Laboratory;
- Extension to the existing visitor's carpark;
- An innovation centre;
- A weighbridge;
- Factory staff parking;
- A new access road to the factory staff parking area and for bulk material deliveries and dispatch;
- New rainwater tanks.

#### 1.3.2 Advanced Manufacturing - Roof Products Production

- Construction and operation of a roof products manufacturing facility on CSR owned land, outside the approved project boundary, immediately east of Pit 4;
- Modification to the approved project boundary to include the proposed roof products manufacturing facility, located on the adjacent property; and
- The processing of sandstone (overburden material not used in brick production) for use in the manufacture of roof products on-site.

#### 1.3.3 General

- Re-commence operations at the site as approved in the Project Approval (PA10\_0014), and expel the current mothballed status of the site;
- Amendment to the extent of Pit 5 to include a 200m buffer zone to neighbouring residential properties required under the *Mining Act 1992*;
- An increase in the importation of raw materials from off-site for use in both the brick making and roof products manufacturing facilities; and
- Modifications to the approved noise bunds.

#### 1.3.4 Martin Road-Elizabeth Drive Intersection Upgrade

The traffic impact assessment for the proposed modification assessed impacts on the operation and safety of the existing Martin Road-Elizabeth Drive intersection with the heavy and light vehicle traffic associated with the CSR operations. The traffic impact assessment concluded that the level of delay in Martin Road would result in unsafe traffic conditions at the intersection with large heavy vehicles forcing their way into Elizabeth Drive due to the level of vehicle delay. To address these unsafe traffic conditions, traffic signal control of the intersection would be required.

### 1.4 Modification 4

CSR has also concurrently lodged a further separate modification application (Modification 4) to permit the following additional changes to the approved project:

- The dewatering of Pit 1;
- Continued extraction of clay material in Pit 1 to a depth of 35 m;
- The importation of Virgin Excavated Natural Material (VENM) to backfill Pit 1 and potentially other pits, to rehabilitate the site and facilitate future development; and

- The establishment of a grid connected solar farm. This will allow energy security through a more diverse energy mix, initiate a clean renewable energy source on-site, reduce the greenhouse gas emissions that contribute to global warming and improve the land utilisation on the eastern flank, outside of the approved project boundary.
- A separate, detailed noise assessment has been prepared for Modification 4.

### 1.5 The Applicant

CSR Building Products Limited is the Applicant for the proposed modification. As CSR owns the land on which the modification to the existing Project Approval is proposed, landowner consent is not required.

CSR is an international building and construction materials group, headquartered in North Ryde, Australia. CSR's competitive position is underpinned by being a market leader in production and supply of building products for residential and commercial construction markets in Australia and New Zealand. Notable products produced by CSR include Gyprock plasterboard, Hebel, insulation, bricks and pavers, roof tiles and glass.

### 1.6 Site Description

As described in the *Environmental Assessment – Continuation of Operations – Quarry and Brick Making Facility, Badgerys Creek* (AECOM, 2010), the site is located at 235 Martin Road in the suburb of Badgerys Creek within Liverpool Local Government Area (LGA). Badgerys Creek is approximately 41 km south west of Sydney and 17 km west of Liverpool. Badgerys Creek is currently a small community comprising rural residences, agricultural activities, quarrying and industry. The locality supports many small rural residential holdings and a limited number of larger agricultural properties, agricultural enterprises (chicken farms, nurseries), composting and resource recovery facilities and market gardens. The region falls within the Western Sydney Priority Growth Area under the new Sydney Metropolitan Strategy *A Plan for Growing Sydney* (December 2014). The proposed Western Sydney Airport precinct lies to the west of the site. The regional context of the site is shown in Figure 1-1.

The site and surrounds are zoned RU1 - Primary Production zone under the Liverpool Local Environmental Plan (LEP) 2008.

The approximately 200-hectare (ha) site is bound by Badgerys Creek to the west, Ingham's Chicken to the south, South Creek to the east and Australian Native Landscapes and rural residential properties to the north (refer to the local context of the site in Figure 1-2). Sensitive residential receivers are also presented in Figure 1-2 and excludes residences that have/will be demolished in preparation for the new Western Sydney Airport. The Blue Mountains National Park is approximately 16 km to the west of the site.

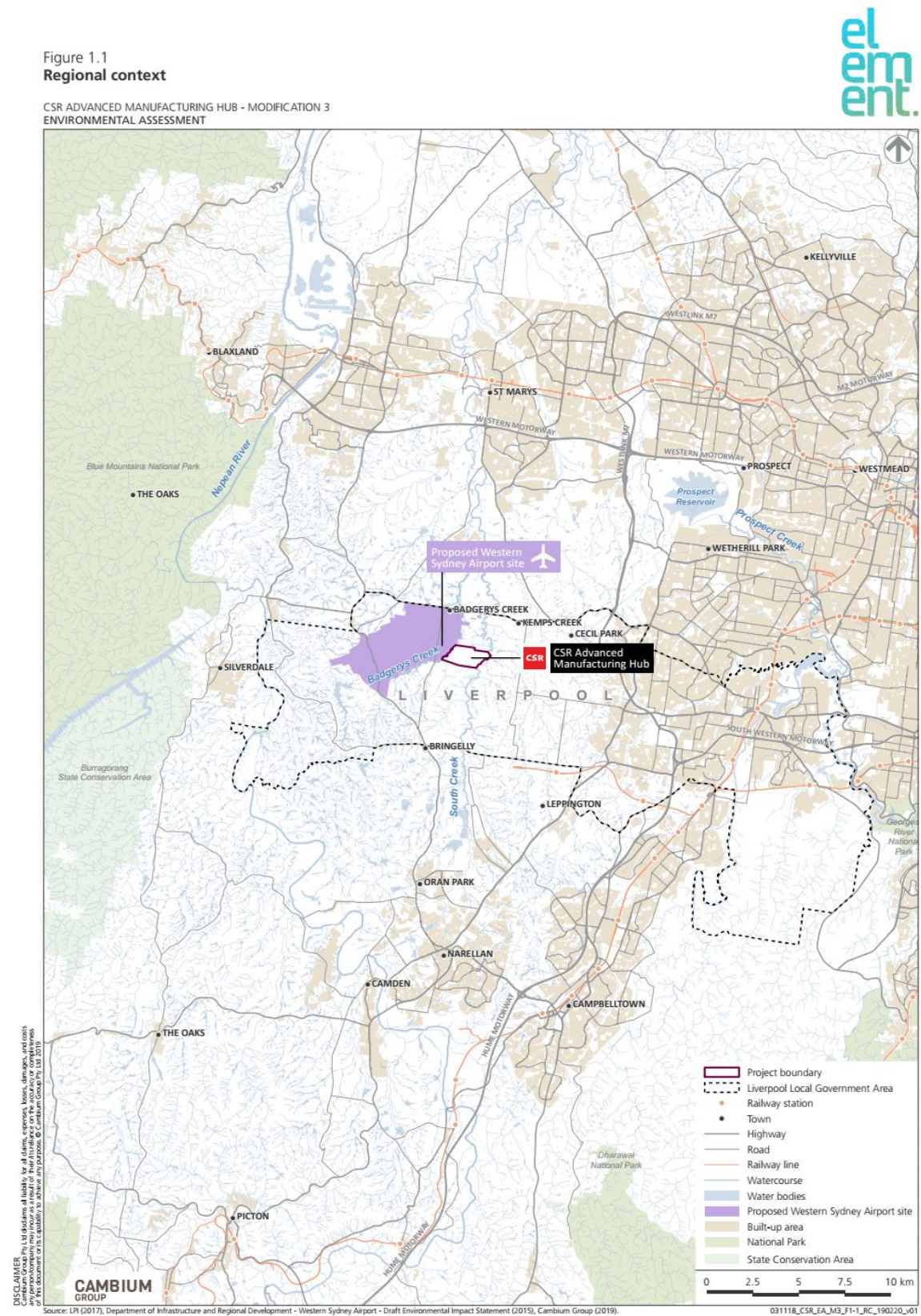
The underlying topography of the site is relatively flat, however historical quarrying activities on the site have substantially altered the natural landform with various voids and elevated stockpiles present in the western part of the site. The most prominent of these landforms is a rehabilitated stockpile in the far west of the site, known as the 'Western Stockpile'. This stockpile of unusable material is approximately 200 m x 125 m, with an average height of 10m and has been revegetated with native grasses and trees. Other significant landforms on the site include the raw material stockpile in the centre of the site, as well as unusable materials stockpiles in the south and centre of the site.

Existing voids on the site comprise Pits 1, 2 and 3. The largest of these, Pit 1, is in the west of the site and is used as the main water storage for the site. Pit 2, adjacent to Pit 1 is complete and was previously partially backfilled and rehabilitated. Pit 3 is an active pit where quarry campaigns were focused, prior to the site being mothballed. Three large sediment basins are in the north and east of the site, along with two smaller dams near these basins.

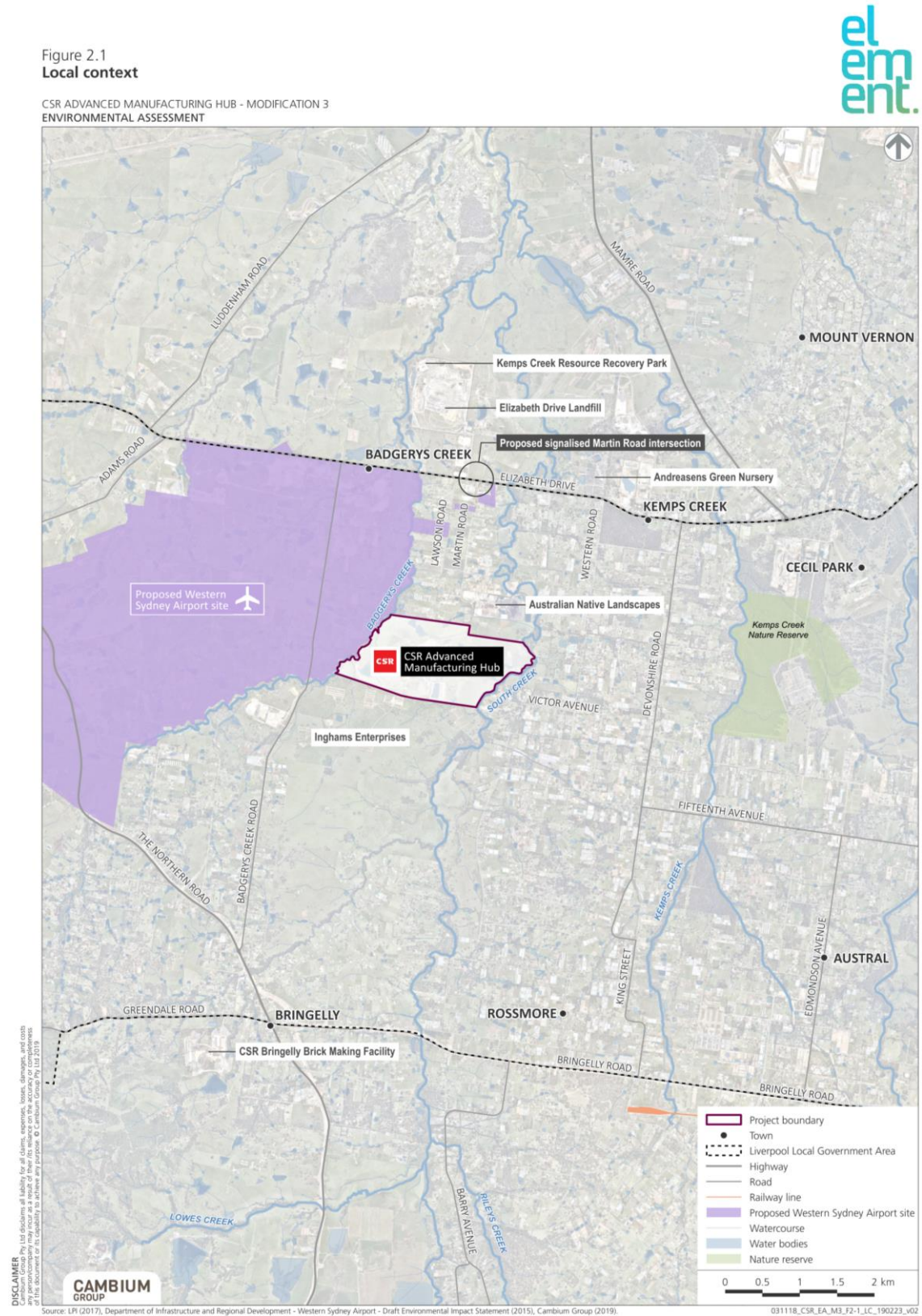
Remaining land at the site is vacant, of which areas to the north and east of the brick making facility are leased for livestock grazing. The site is generally cleared of native vegetation except for the creek lines and some isolated stands of trees scattered across the site.

Access to the site is via a private road off Martin Road which runs off Elizabeth Drive (a designated B-double route). The internal road network consists of several unsealed haul roads.

**Figure 1-1 Regional Context**



**Figure 1-2 Local Context**



## 2 EXISTING OPERATIONS

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### 2.1 Operational and Planning Approval History

Boral Bricks Pty Limited (Boral) owned and operated the Badgerys Creek Quarry and Brick Making Facility at Badgerys Creek for over 30 years.

On 27 September 2011, project approval was issued under Section 75J of the EP&A Act for the ongoing production of bricks and the expansion of the existing quarrying operations at the Badgerys Creek site.

Due to uncertain economic conditions and a downturn in residential housing activity, Boral reviewed its bricks production capacity in NSW. Following this review, Boral determined to 'mothball' its operations at Badgerys Creek effective from 30 March 2012. Shutting down the site gave Boral the option to review its commercial position at a future stage and, if market conditions and business needs allow, recommence production. During the shutdown period, the Boral Bringelly Brick Making Facility (now owned by CSR) supplied the Sydney market.

Because of the shutdown, Boral was unable to comply with the conditions of approval and applied to modify the Project Approval under Section 75W of the EP&A Act.

Modification application (10\_0014 Mod 1) requested that post-March 2012 activities be limited to:

- Minor maintenance and inspection (e.g. water management, equipment testing);
- Operation of the retail display facility; and
- Irregular and occasional dispatch of bricks from the inventory remaining on-site.

In 2015, Boral and CSR formed a joint venture brick business called Boral CSR Bricks Pty Ltd. The assets held by the respective companies were transferred into the joint venture. At the end of October 2016, CSR acquired Boral's share of the brick business and with it, the Badgerys Creek Brick Making Facility.

### 2.2 Approved Project

The approved quarrying and brick making activities, outlined in the Project Approval are to:

- Extract 420,000 tonnes of clay per calendar year;
- Produce 252,000 tonnes of bricks per calendar year;
- Extract any clay shale or carry out any work in the extraction area no deeper than 35 metres below the pre-existing natural surface of the ground;
- Receive 20,000 tonnes of raw material for brick making per calendar year; and
- Dispatch more than 275,000 tonnes of raw materials from the site in any calendar year.

Product from the quarry and brick making facility is approved for transport entirely by road. The Project Approval limits the number of truckloads/heavy vehicle movements that can exit the site per day to:

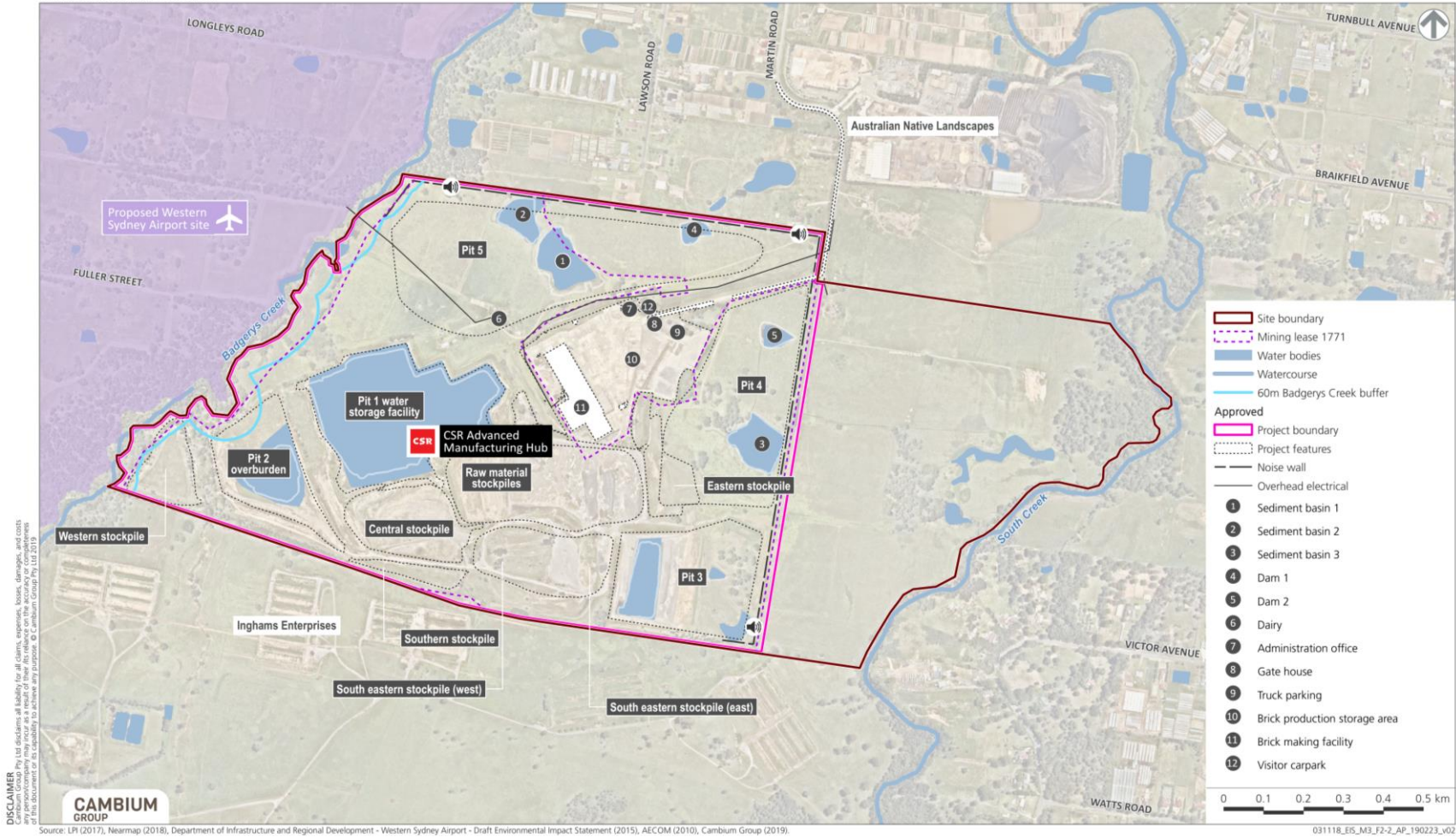
- A maximum of 60 laden brick trucks (i.e. 120 movements), Monday to Friday; and
- A maximum of 20 laden brick trucks (i.e. 40 movements) on Saturdays.

Figure 2-1 Approved Project



Figure 2.2  
Approved project

CSR ADVANCED MANUFACTURING HUB - MODIFICATION 3  
ENVIRONMENTAL ASSESSMENT



## 2.3 Quarry Activities

Approved quarrying activities involve the eastward progression of Pit 3 (where quarrying had already commenced), followed by the establishment of Pit 4 and then Pit 5. The establishment of a new pit involves the following works:

- Exploratory core drilling to a depth of 35 m below ground surface (bgs) across a 50m square grid;
- Assessment of cores for suitability for brick making;
- If the core is suitable, the area is fenced off and appropriate signage placed around the area;
- Removal of overburden and topsoil;
- Breaking up raw materials using a bulldozer with ripping attachment;
- Collection of raw materials with an excavator and placement into a 40-tonne dump truck;
- Transport and deposit of raw materials to the Raw Materials Stockpile area to the south of the brick making facility;
- Transport and deposit of unusable material to either the Central Stockpile or to an open void (Pit 2); and
- Creation of new stormwater drainage systems and/or drainage pathways (where required) to be incorporated into and consistent with the Water Management Plan for the site.

Upon completion of quarrying in the nominated areas, the disturbed area would be rehabilitated.

### 2.3.1 Brick Production

The primary machinery and equipment involved in the approved brick manufacturing process includes:

- Clay preparation equipment (crushing and grinding);
- Brick forming and handling equipment;
- Gas-fired kiln;
- Brick dryer;
- Brick unloading machine (Dehacker); and
- Compressor building.

The brick manufacturing process is generally described as follows:

- The as-mined clay material is crushed from approximately 500 mm to 1 mm through a four-stage crushing process. This includes a profiled roll crusher, a wet pan and two sets of high-speed smooth rolls. Water is added at the wet pan to take the material from 6-10% moisture content to 12-14% moisture content;
- To make bricks, the crushed raw material has more water added to bring the mixture to 14-15% and is then extruded. Various sands, frits and clay suspensions are applied to the column to add aesthetic appeal. The extruded column is cut into brick sized units and fed into drying racks on trays. The drying racks pass through an eight-laned drying chamber over the course of three days during which the moisture content is reduced to <1%. The dry bricks are stacked 16-rows high onto a refractory decked kiln car;

- The bricks are fired using kiln cars stacked with dry stock, which are fed into the entrance of a gas-fired tunnel kiln at the rate of one half car every 20-30 minutes. One kiln car holds approximately 6,000 bricks (or 10 brick stacks) stacked with gaps between them to allow the hot air to circulate between them and fire evenly. The stock is then raised to above 1,000°C and cooled back to room temperature in less than two days. Waste heat is drawn from the initially produced heat and is used in the dryer to dry the bricks; and
- The fired stock is unloaded from the kiln car and split into brick packs by the Dehacker within the brick making facility. The Dehacker was previously installed at the plant to improve efficiencies in the packing and transportation of bricks. It allows for a greater number of bricks to be transported per truckload, thereby reducing the number of truck movements needed to dispatch the same amount of product. The Dehacker unpacks the bricks into individual units and then repacks them into pallet size packs for transport to customers, strapping them together with plastic belly strap. Once the belly strap is attached, the complete brick packs travel along a driven roller conveyor where they are picked up by forklift and transported to the storage yard. The unloading conveyor is external to the brick making facility. All equipment is housed within the brick making facility except for the unloading conveyor.

Previous additions and alterations to the brick making facility were approved by Liverpool City Council to enable an increase in the efficiency of the existing brick making process. The additions and alterations included a dust collector, air receiver and brick dipping tanks. The additions and alterations were aimed at reducing dust in the brick making process and reducing the incidence of cracking in bricks, hence yielding a higher quantity and quality of product for export.

#### 2.3.2 Transport of Raw Materials and Finished Product

Raw materials required for brick making that cannot be extracted on site, were imported by truck and stockpiled in the Raw Materials Stockpile area to the south of the brick making facility.

The brick product storage yard is located to the north-east of the brick making facility. Forklifts loaded the bricks from the yard on to trucks for transport off site.

#### 2.3.3 Stockpiles

Stockpile areas within the site include:

- Raw material stockpiles situated in the centre of the site, which provided the feedstock for the brick making process;
- Overburden stockpiles which contain upper level excavated materials that was not suitable for brick making;
- Unusable material stockpiles which contain deeper level excavated material that was not suitable for brick making, but may be suitable in the future if upgrades were made to the clay preparation equipment; and
- Rehabilitated stockpiles in the far west and along the southern boundary of the site.

#### 2.3.4 Operating Hours and Workforce

Approved operating hours for the site are outlined in detail in Table 2-1.

**Table 2-1 Approved Operating Hours**

| Activity                                                                                    | Day                                                                                                                                                | Time              |
|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Quarrying operations (excluding removal of overburden, truck arrival, loading and dispatch) | Monday-Saturday                                                                                                                                    | 7:00am to 6:00pm  |
|                                                                                             | Sunday and public holidays                                                                                                                         | None              |
| Removal of overburden and construction of noise bunds                                       | Monday-Friday                                                                                                                                      | 7:00am to 6:00pm  |
|                                                                                             | Saturday                                                                                                                                           | 8:00am to 1:00pm  |
|                                                                                             | Sunday and public holidays                                                                                                                         | None              |
| Brick making facility and storage yard                                                      | Monday-Sunday                                                                                                                                      | 24 hours          |
| Truck arrival and dispatch (excluding finished building products)                           | Monday-Friday                                                                                                                                      | 6:00am to 10:00pm |
|                                                                                             | Saturday                                                                                                                                           | 6:00am to 6:00pm  |
|                                                                                             | Sunday and public holidays                                                                                                                         | None              |
| Truck arrival and dispatch (finished building products only)                                | Monday-Saturday                                                                                                                                    | 7:00am to 10:00pm |
|                                                                                             | Sunday and public holidays                                                                                                                         | None              |
| Maintenance                                                                                 | At any time, provided that these activities are not audible at any privately-owned residence outside of permissible hours for quarrying operations |                   |

At the height of previous operations, there were 56 people employed in the brick making facility and 20 in the administration/sales office. Up to ten contractors worked two to four months per annum on a campaign basis to complete the quarrying activities.

#### 2.3.5 Environmental Protection Licence

The *Protection of the Environment Operations Act 1997* provides for an integrated system of licensing and contains a core list of activities requiring Environmental Protection Licences (EPL) from the NSW Environment Protection Authority (EPA). The activities are called 'scheduled activities' and are listed in Schedule 1 of the Act.

The site currently operates under EPL No. 684, for the scheduled activities of ceramic works, extractive activities and mining for minerals.

#### 2.3.6 Environmental Management

An Environmental Management Strategy and the following associated management plans were previously prepared in accordance with PA10\_0014:

- Environmental Management Strategy;
- Noise Management Plan;
- Air Quality & Greenhouse Gas Management Plan;
- Water Management Plan which includes:
  - Site Water Balance;
  - Surface Water Management Plan; and

- Ground Water Management Plan.
- Aboriginal Heritage Management Plan;
- Transport Management Plan;
- Waste Management Plan;
- Rehabilitation Strategy; and
- Rehabilitation Management Plan.

The Environmental Management Strategy and associated management plans will need to be reviewed, revised and submitted to the DP&E for approval, prior to recommencing operations at the site.

### 3 PROPOSED MODIFICATIONS

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#### 3.1 Brick Making Facility

Under this Modification 3 to the Project Approval (10\_0014) CSR is seeking permission to allow the following additional development or changes to the approved project:

##### 3.1.1 Reconstruction and Expansion of Brick Manufacturing Plant

The existing brick manufacturing plant is designed to produce what is referred to as 'commons' or common utility bricks, which is a red brick that is predominantly used for internal walls, for supporting structures, or can be used externally when rendered or painted. The recent progression in alternative building methodologies and products and an increase in multi dwelling residential developments, has resulted in a significant decrease in the demand for common bricks. As face bricks are now more sought after and are likely to continue to be for aesthetic applications, CSR needs to ensure its brick making facilities can manufacture face bricks.

Due to the age of the Badgerys Creek brick manufacturing plant and its inability to produce face bricks, CSR are proposing to replace the existing manufacturing equipment in the brick manufacturing plant and retain the existing building.

CSR are also proposing to extend the existing brick manufacturing building to the north and east with an additional footprint of 10,600 m<sup>2</sup>.

CSR are also proposing an increase in brick production from the approved 252,000 tonnes to 300,000 tonnes per calendar year. At an average weight of approximately 3 kg per brick, CSR will produce up to 100 million single brick units per calendar year.

##### 3.1.2 Administration Offices

An approximately 515 m<sup>2</sup> westward extension of the existing administration building is proposed to support all administration functions required at the site. The building extension will be located on existing concrete hardstand that forms part of the brick product storage yard.

##### 3.1.3 NATA Laboratory

An approximately 450 m<sup>2</sup> NATA Accredited Advanced Testing Laboratory is proposed adjacent the administration offices. Activities likely to be undertaken in the laboratory include brick and clay testing involving fixing and firing of clay samples, and measurements of brick dimensions and other properties. Firing will be within a small 1 - 2 m<sup>3</sup> electric fired kiln. Brick sawing may also take place in laboratory building. The NATA laboratory will be located immediately west of the administration offices on existing concrete hardstand that forms part of the brick product storage yard.

##### 3.1.4 Innovation Centre

CSR's Velocity Business has an innovation work stream, which is proposing an external test structure on an approximately 30 m x 30 m site (900 m<sup>2</sup>) immediately east of the truck drivers parking and gate house. CSR are looking for a mechanism to rapidly experiment with structural and external systems so that CSR can offer better whole of house solutions to builders.

Implementing new ideas on residential homes requires builder sign off and a real live demonstration on what the idea looks like and takes to build. Currently this is performed by asking builders to trial on current jobs which can take a number of months to find.

Best practice shows that the combining of experimentation and commercial operations results in compromise of one or the other. From a development perspective, the compromise is usually in the form of:

- Reduced experimentation resulting in a sub optimal offer being presented to the builder;
- Creation of builder bias towards the idea - if the trial is poor the builder retains that view and despite further refinement the value proposition is weakened and met with low enthusiasm for implementation;

Experimentation and development taking 6 months longer than needed.



Additionally, home designs are increasingly having multiple elements being used on home facades and to a lesser extent roofs and floors. CSR's traditional BU approach looks to maximise volume per home but conflicts with the builders aesthetic requirement. Moreover, this tactic increases CSR's cost to serve and reduces margins in the attempt to gain business on what is a smaller volume per house.

Alternatively, CSR could position all its structural and cladding offers and target whole of house solutions using tested variants that deliver design flexibility coupled with construction simplicity. This is a far better VP but needs more coordinated approach in the development, testing and marketing of these offers.

CSR are looking to deepen their knowledge around buildability and aesthetics of structural and external systems without having to disrupt the operations of building existing contracts or display homes.



The innovation centre will:

- Reduce product innovation time frame to 6 months (50% improvement);
- Facilitate CSR whole of house offer built in a traditional or prefabricated manner.

### 3.1.5 Parking

Parking of heavy and light vehicles at the brick making facility will be accommodated in the following existing and proposed parking areas:

- Visitors parking: The proposed extension to the existing visitor's carpark to the east of the display centre and north of the gate house, will provide 50 light vehicle parking spaces;
- Truck drivers parking: 20 spaces for truck parking is provided in the existing truck drivers parking area immediately east of the gate house; and
- Factory staff parking: 60 light vehicle parking spaces for staff working in the brick making facility are proposed in a formalised light vehicle carpark adjacent (east) of the brick manufacturing plant on existing concrete hardstand that forms part of the brick product storage yard.

### 3.1.6 New Access Road

A new access road is proposed to the south of the brick making facility. This new access road branches off the existing access road (driveway) prior to the truck drivers parking and gate house and will be used by light vehicles accessing the factory staff parking area and heavy vehicles delivering or dispatching bulk raw material.

### 3.1.7 Weighbridge

A weighbridge is proposed on the existing access road and will be used to check tonnages of bulk material trucks and finished brick product delivery trucks.

### 3.1.8 Rain Water Tanks

Rainwater tanks are proposed to the west of the brick manufacturing building adjacent to the existing waste water process tanks. Captured rainwater from the roof of the brick manufacturing building will be used to supplement the brick plant water demand.

Associated infrastructure including the brick product storage area, and the display centre are likely to remain unchanged.

### 3.1.9 Capital Investment and Workforce

The reconstruction of the brick manufacturing plant and establishment of all other associated buildings and infrastructure would cost approximately \$155 million.

The brick making facility will employ approximately 70 personnel.

## 3.2 Roof Products Manufacturing Facility

CSR currently manufactures roof products at their Monier facility at 10 Grand Ave, Rosehill, NSW. Due to surrounding urban development pressure, CSR need to move their Sydney roof tile manufacturing operations and have identified their Badgerys Creek site as an ideal location.

CSR propose to construct and operate the roof products manufacturing facility on CSR owned land, outside the approved project boundary, immediately east of Pit 4 (refer to Figure 3-1). The new roof products manufacturing facility and associated infrastructure would cover a total site area of 45,275 m<sup>2</sup>, which would include:

- Approximately 5,810 m<sup>2</sup> factory for housing the roof products manufacturing plant including the storage of raw materials (e.g. sand, cement, flyash and liquid additives). An administration office, control room, technical centre, laboratory and workshop is also proposed within the factory building;
- Approximately 42,890 m<sup>2</sup> concrete hardstand area for the storage of finished products;
- Yard/batten storage shed footprint of approximately 1,000 m<sup>2</sup>;
- Guardhouse of approximately 75 m<sup>2</sup>;
- Storage Shed and Drivers Amenities of approximately 1,000 m<sup>2</sup>;
- Wind tunnel of approximately 100 m<sup>2</sup>;
- Two 100,000 litre rainwater tanks;
- 49 light vehicle car parking spaces;
- Weighbridge; and
- Access road (1,821 m<sup>2</sup> bitumen sealed).

The new roof products manufacturing facility would produce up to 132,000 tonnes of roof products per annum and would cost approximately \$45 million to construct.

Monier's Sydney operations will employ approximately 107 personnel, with a maximum of 80 on site at any time.

A detailed description of the roof products manufacturing process is included in the Modification 3 Environmental Assessment (Element Environment, 2018).

### 3.3 Increase in Importation of Raw Materials

The site is approved to receive 20,000 tonnes of raw material for brick making per calendar year. CSR propose to increase the importation of raw materials for brick production to 215,000 tonnes per calendar year.

CSR also propose the importation of 124,000 tonnes of raw materials for roof product production per calendar year.

### 3.4 Comparison against Approved Project

A comparison of the approved operations at the site and the proposed modification to the approved project is set out in Table 3-1 and Table 3-2.

**Table 3-1 Comparison of Approved Project and Proposed Modifications.**

| Aspect                       | Existing Project Approval                                                          | Proposed Modification                                                                                                                | Variance to Approved Project                                                                                 |
|------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Brick Production             | 252,000 tonnes of bricks per calendar year                                         | 300,000 tonnes of bricks per calendar year                                                                                           | 48,000 tonnes of bricks per calendar year                                                                    |
| Roof Products Production     | Nil                                                                                | 132,000 tonnes of roof products per calendar year                                                                                    | Increased production of 132,000 roof products per calendar year                                              |
| Quarrying                    | Extract 420,000 tonnes of clay shale per calendar year                             | No change                                                                                                                            | Nil                                                                                                          |
| Receival of raw materials    | Receive 20,000 tonnes of raw materials for brick production per calendar year      | Importation of 215,000 tonnes of raw materials for brick production and 124,000 tonnes for roof product production per calendar year | Increase of 319,000 tonnes of imported raw materials for brick and roof product production per calendar year |
| Dispatching of raw materials | Dispatch more than 275,000 tonnes of raw materials from the site per calendar year | No change                                                                                                                            | Nil                                                                                                          |

| Aspect                       | Existing Project Approval                                                                               | Proposed Modification                                                   | Variance to Approved Project                                                                                                                                                                                                                                                                                                                                   |
|------------------------------|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Truck Movements              | Maximum of 60 laden brick trucks (i.e. 120 vehicle movements) exiting the site per day Monday to Friday | Maximum of 272 heavy vehicles exiting the site per day Monday to Friday | Increase of 212 heavy vehicles exiting the site per day Monday to Friday                                                                                                                                                                                                                                                                                       |
|                              | Maximum of 20 laden brick trucks (i.e. 40 vehicle movements) exiting the site per day on Saturday       | Maximum of 79 heavy vehicles exiting the site per day on Saturday       | Increase of 59 heavy vehicles exiting the site per day on Saturday                                                                                                                                                                                                                                                                                             |
| Duration of Project Approval | 27 September 2031                                                                                       | 30 years from date of approval of Modification 3                        | As the quarry and brick making facility would have been in a mothballed state over the first six years of the Project Approval and the Project Approval is only for a 20 year period, CSR wishes to include an extension of the Project Approval duration to 30 years and requests that the 30 years commences from the date of the approval of Modification 3 |

**Table 3-2 Comparison of Approved Hours of Operation and Proposed Modifications.**

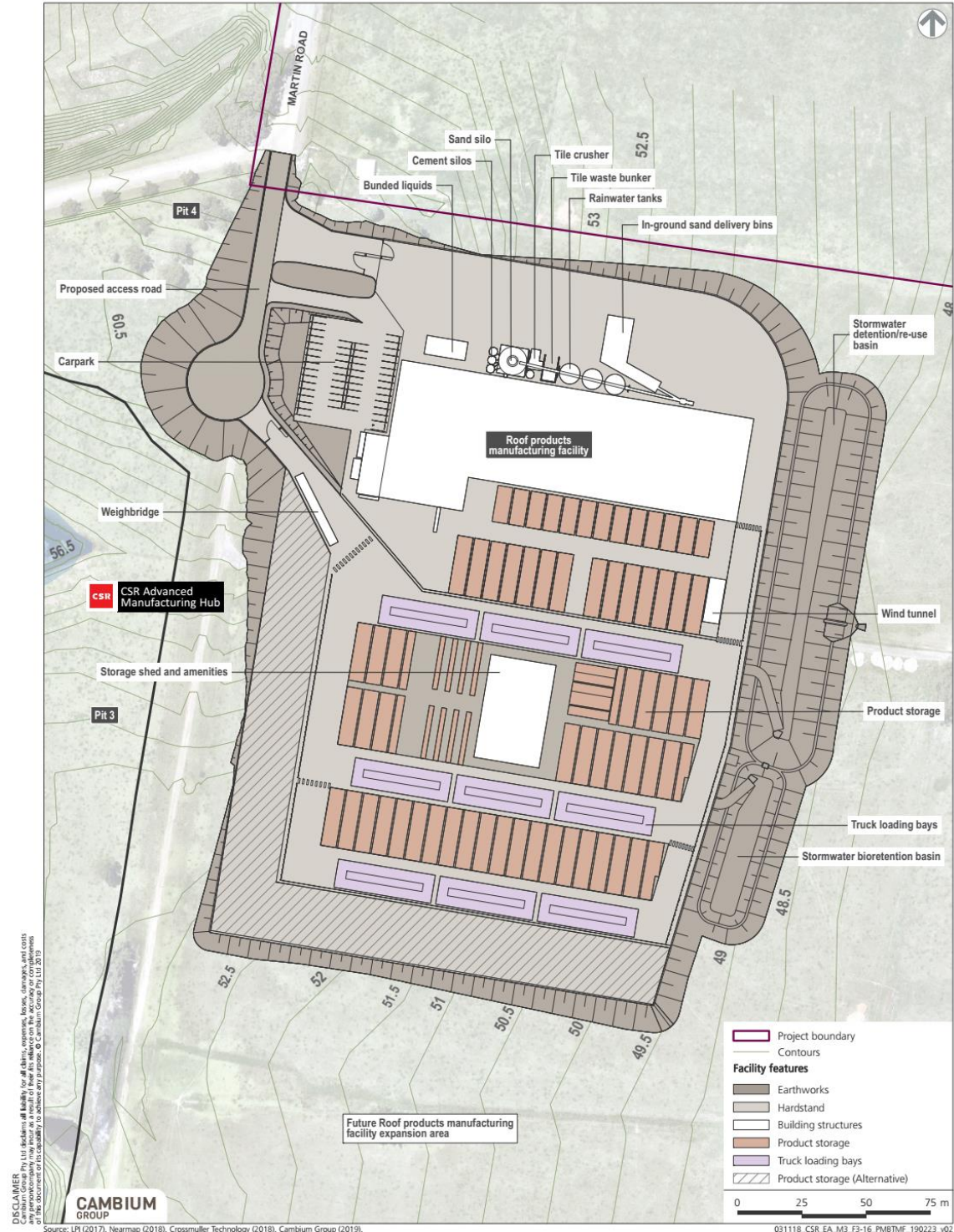
| <b>Activity</b>                                                                                | <b>Existing Project Approval</b>                                                                                              | <b>Proposed Modification</b>                                                                                                  | <b>Variance to Approved Project</b>                                                                                                                                               |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Quarrying operations<br>(excluding removal of overburden, truck arrival, loading and dispatch) | <b>Monday-Saturday</b><br>7:00am to 6:00pm<br><b>Sunday and public holidays</b><br>None                                       |                                                                                                                               | No change                                                                                                                                                                         |
| Removal of overburden and construction of noise bunds                                          | <b>Monday-Friday</b><br>7:00am to 6:00pm<br><b>Saturday</b><br>8:00am to 1:00pm<br><b>Sunday and public holidays</b><br>None  |                                                                                                                               | No change                                                                                                                                                                         |
| Brick making facility and storage yard                                                         | <b>Monday-Sunday</b><br>24 hours                                                                                              |                                                                                                                               | No change                                                                                                                                                                         |
| Roof products manufacturing facility and storage yard                                          | <b>Nil</b>                                                                                                                    | <b>Monday-Sunday</b><br>24 hours                                                                                              | Roof products manufacturing facility and storage yard to operate 24 hours Monday-Sunday                                                                                           |
| Truck arrival and dispatch<br>(excluding finished building products i.e. raw materials)        | <b>Monday-Friday</b><br>6:00am to 10:00pm<br><b>Saturday</b><br>6:00am to 6:00pm<br><b>Sunday and public holidays</b><br>None | <b>Monday-Friday</b><br>6:00am to 10:00pm<br><b>Saturday</b><br>6:00am to 6:00pm<br><b>Sunday and public holidays</b><br>None | No change                                                                                                                                                                         |
| Truck arrival and dispatch<br>(finished building products only)                                | <b>Monday-Saturday</b><br>7:00am to 10:00pm<br><b>Sunday and public holidays</b><br>None                                      | <b>Monday-Friday</b><br>5:00am to 10:00pm<br><b>Saturday</b><br>6:00am to 6:00pm<br><b>Sunday and public holidays</b><br>None | Deliveries and dispatch to be extended by one hour earlier in the morning to allow finished product trucks to arrive at site at 5:00am, load, and be ready for dispatch at 6:00am |
| Sales Selection / Cash Sales                                                                   | <b>Nil</b>                                                                                                                    | <b>Monday-Saturday</b><br>6:00am to 6:00pm                                                                                    | Additional operating hours for sales                                                                                                                                              |

| Activity                | Existing Project Approval | Proposed Modification                                                      | Variance to Approved Project                                                   |
|-------------------------|---------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------|
|                         |                           | <b>Sunday and public holidays</b><br>None                                  | selection and cash sales activities for finished brick products                |
| Customer Display Centre | Nil                       | <b>Monday-Sunday</b><br>8:00am to 5:00pm<br><b>Public Holidays</b><br>None | Additional operating hours for finished brick products customer display centre |

**Figure 3-1 Proposed Roof Products Manufacturing Facility**

Figure 3.16  
**Proposed Monier roof products manufacturing facility**

CSR ADVANCED MANUFACTURING HUB - MODIFICATION 3  
ENVIRONMENTAL ASSESSMENT



## 4 EXISTING ENVIRONMENT

### 4.1 Sensitive Receivers

The nearest and most potentially affected receivers are a number of rural residential properties surrounding the site. These receivers have previously been identified in the *Noise Assessment Addendum Report* included in the *Responses to Submissions Report* for the current Project Approval, prepared by AECOM and dated 31 May 2011. These receivers are shown on Figure 4-1 and summarised in Table 4-1.

Identified receivers to the west of the Project site, on the opposite side of Badgerys Creek are situated on the Western Sydney Airport site. The majority of these dwellings have been demolished, and it is understood that none of these buildings would be used as residential dwellings in the future. These receivers are identified on Figure 4-1; however, operational noise levels associated with the Proposal are not assessed at these receiver locations.

Receiver R10 is situated on land owned by CSR. Therefore, operational noise levels at R10 have not been assessed.

Review of aerial photography indicates that a second dwelling may be situated on property of receiver R12. This dwelling has been identified as receiver R12a and included in this assessment.

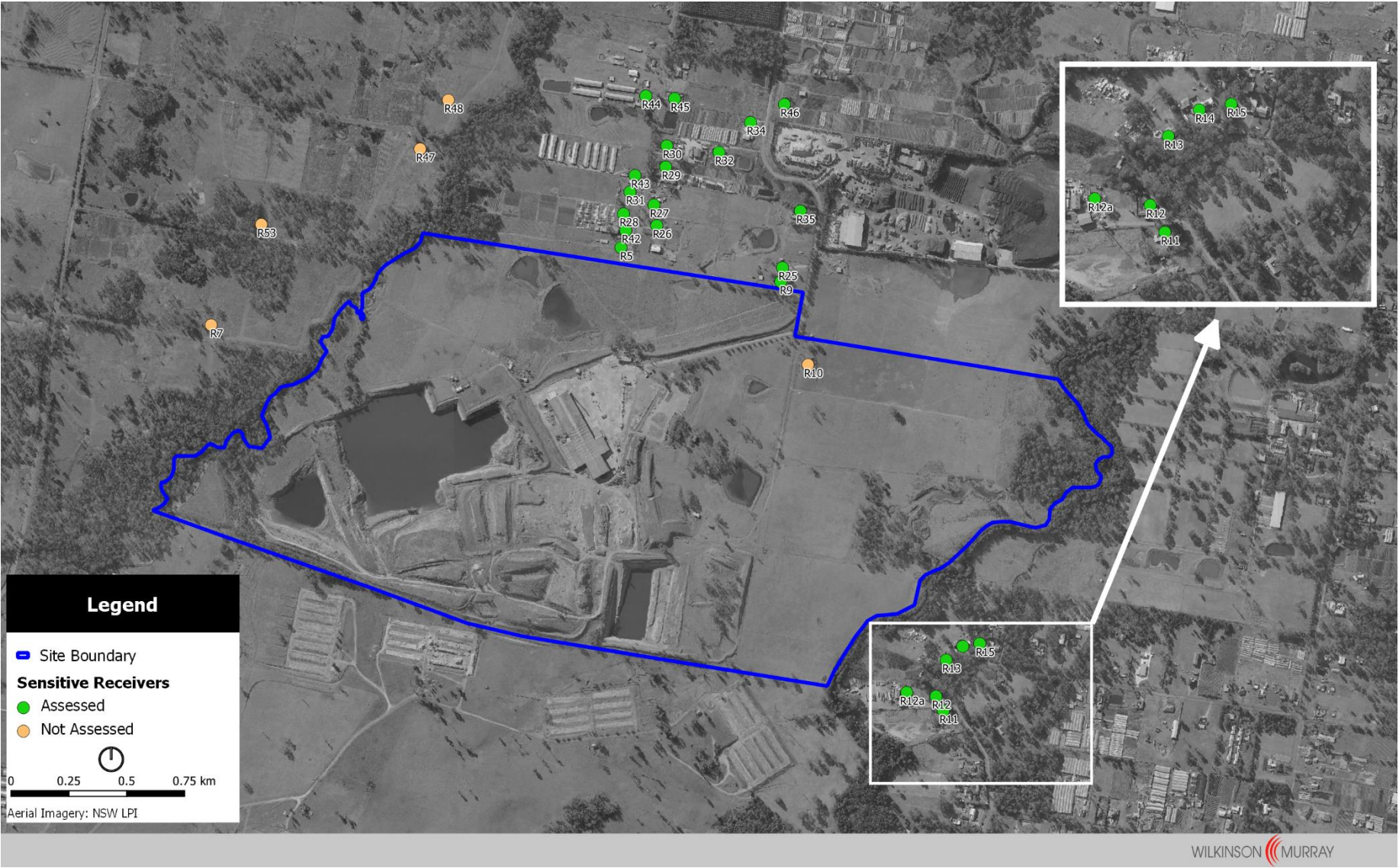
**Table 4-1 Sensitive Receivers**

| Receiver         | Address                              | Lot/DP Number |
|------------------|--------------------------------------|---------------|
| R5               | 255 Lawson Road, Badgerys Creek      | 19 DP 3050    |
| R7 <sup>a</sup>  | Lot 77 Fuller Street, Badgerys Creek | 1 DP 838361   |
| R9               | 217 Martin Road, Badgerys Creek      | 3 DP 589918   |
| R10 <sup>b</sup> | 225 Martin Road, Badgerys Creek      | 16 DP 28050   |
| R11              | 22 Victor Avenue, Kemps Creek        | 17 DP 28050   |
| R12              | 50 Victor Avenue, Kemps Creek        | 19 DP 28050   |
| R12a             | 50 Victor Avenue, Kemps Creek        | 19 DP 28050   |
| R13              | 70 Victor Avenue, Kemps Creek        | 20 DP 28050   |
| R14              | 80 Victor Avenue, Kemps Creek        | 21 DP 28050   |
| R15              | 82 Victor Avenue, Kemps Creek        | 3 DP 589918   |
| R25              | 211 Martin Road, Badgerys Creek      | 2 DP 589918   |
| R26              | 210 Lawson Rd, Badgerys Creek        | 1 DP 589918   |
| R27              | 200 Lawson Road, Badgerys Creek      | 18 DP 3050    |
| R28              | 245 Lawson Road, Badgerys Creek      | 1 DP 237229   |
| R29              | 190 Lawson Road, Badgerys Creek      | 2 DP 237229   |
| R30              | 180 Lawson Road, Badgerys Creek      | BORAL         |
| R31              | 235 Lawson Road, Badgerys Creek      | 17 DP 3050    |
| R32              | 180 Martin Road, Badgerys Creek      | 2 DP 237229   |
| R34              | 170 Lawson Road, Badgerys Creek      | 3 DP 237229   |
| R35              | 195 Martin Road, Badgerys Creek      | 4 DP 589918   |

| Receiver         | Address                                    | Lot/DP Number |
|------------------|--------------------------------------------|---------------|
| R42              | 245 Lawson Road, Badgerys Creek            | 18 DP 3050    |
| R43              | 225 Lawson Road, Badgerys Creek            | 16 DP 3050    |
| R44              | 205 Lawson Road, Badgerys Creek            | 14 DP 3050    |
| R45              | 160 Lawson Road, Badgerys Creek            | 4 DP 237229   |
| R46              | 170 Martin Road, Badgerys Creek            | 1 DP 567860   |
| R47 <sup>a</sup> | 255 (Lot 60) Longleys Road, Badgerys Creek | 1 DP 838361   |
| R48 <sup>a</sup> | 42 Longleys Road, Badgerys Creek           | 1 DP 838361   |
| R53 <sup>a</sup> | 65 Leggo St, Badgerys Creek                | 1 DP 838361   |

- a. Dwelling within Western Sydney Airport site and not assessed.  
b. Residence on CSR owned land.

Figure 4-1 Sensitive Receivers



## 4.1 Existing Ambient Noise Levels

In order to quantify the existing ambient noise environment of the area, noise monitoring was conducted. Unattended noise monitoring was conducted between 16 June and 2 August 2017 to determine the existing ambient noise levels at the most potentially affected residential receivers in the area surrounding the site. The monitoring was undertaken at three locations, each considered representative of nearby residential receivers, as shown in Figure 4-2 and described in Table 4-2.

**Table 4-2 Noise Monitoring Locations**

| Location | Address                         |
|----------|---------------------------------|
| L1       | 217 Martin Road, Badgerys Creek |
| L2       | 245 Lawson Road, Badgerys Creek |
| L3       | 48 Victor Avenue, Kemps Creek   |

### 4.1.1 Ambient Noise Monitoring Results

The noise monitoring equipment used for these measurements consisted of an environmental noise logger set to A-weighted, fast response. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

From the background noise levels ( $L_{A90}$ ) the Rating Background Levels (RBLs) were determined using the methodology recommended in the NSW *Noise Policy for Industry* (NPfI). In addition to RBLs being established for the day, evening and night assessment periods, as defined in the NPfI, a "morning shoulder" period has been established to appropriately assess potential noise impacts between 5:00am and 7:00am when finished building products are proposed to be transported off-site.

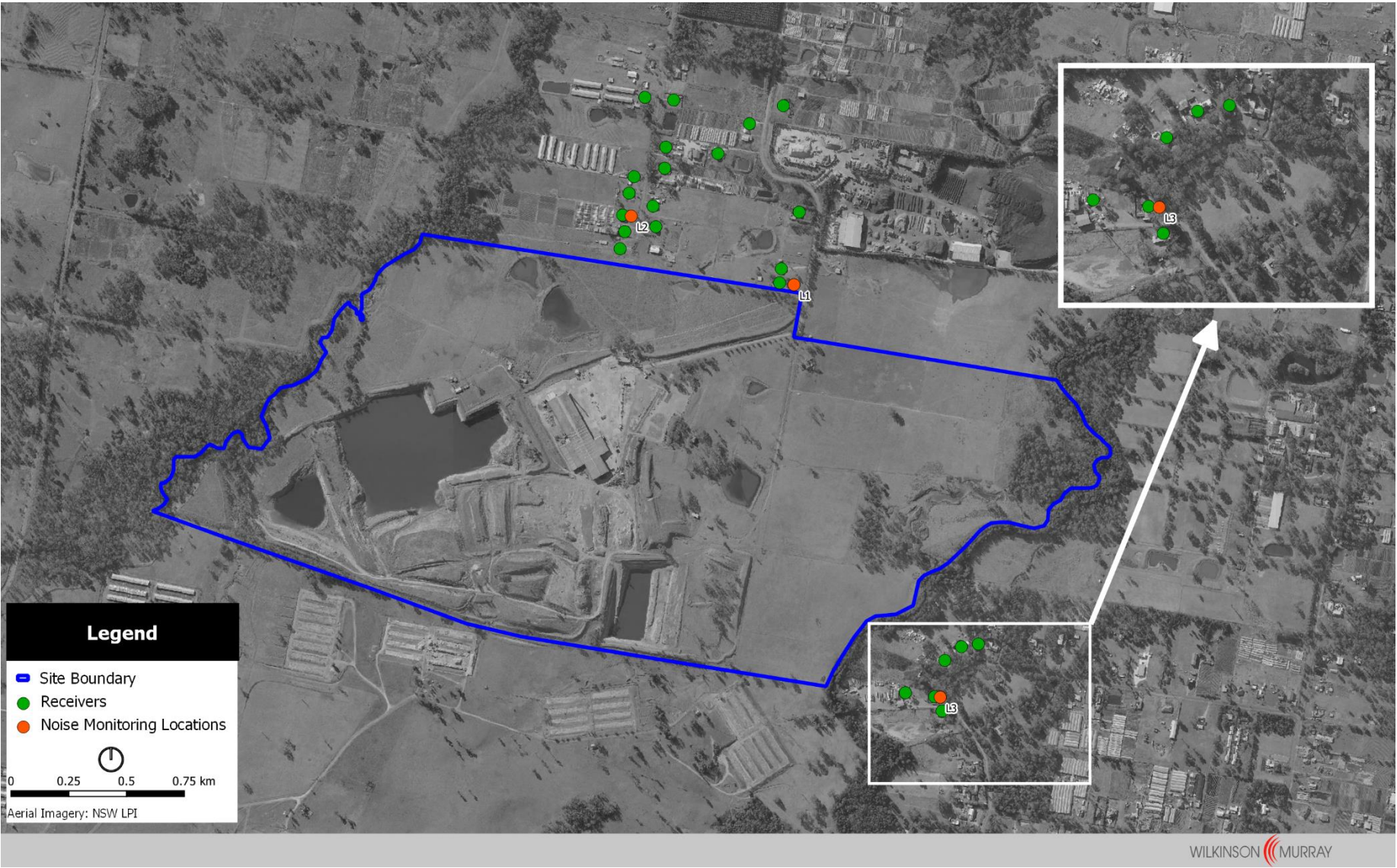
The existing ambient noise levels are presented in Table 4-3 below. Daily plots of the noise logger data are presented in Appendix A.

**Table 4-3 Existing Ambient Noise Levels**

| Monitoring location | Represented Receivers    | Time of Day <sup>a</sup> | Noise Levels (dBA) |                  |
|---------------------|--------------------------|--------------------------|--------------------|------------------|
|                     |                          |                          | RBL                | L <sub>Aeq</sub> |
| L1                  | R9, R25, R35             | Morning shoulder         | 38                 | 47               |
|                     |                          | Day                      | 40                 | 50               |
|                     |                          | Evening                  | 35                 | 43               |
|                     |                          | Night                    | 34                 | 43               |
| L2                  | R5, R26-R32, R34, R42-46 | Morning shoulder         | 38                 | 45               |
|                     |                          | Day                      | 37                 | 51               |
|                     |                          | Evening                  | 36                 | 43               |
|                     |                          | Night                    | 34                 | 42               |
| L3                  | R11-R15                  | Morning shoulder         | 41                 | 47               |
|                     |                          | Day                      | 38                 | 47               |
|                     |                          | Evening                  | 38                 | 43               |
|                     |                          | Night                    | 37                 | 45               |

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.

Figure 4-2 Noise Monitoring Locations



## 5 OPERATIONAL NOISE ASSESSMENT

### 5.1 Operational Noise Trigger Levels

The *Noise Policy for Industry* (NPfI) (EPA, 2017) provides a framework for assessing environmental noise impacts from industrial premises and industrial development proposals in New South Wales.

The NPfI recommends the development of project noise trigger levels, which provide a benchmark for assessing a proposal or site. The project noise trigger levels should not be interpreted as mandatory noise criteria but, rather, as noise levels that, if exceeded, would indicate a potential noise impact on the community.

The project noise trigger level is the lower value of the project intrusiveness noise level and the project amenity noise level. The project intrusiveness noise level assesses the likelihood of noise being intrusive above the ambient noise level and is applied to residential receivers only. The project amenity noise level ensures the total industrial noise from all sources in the area does not rise above a maximum acceptable level.

#### 5.1.1 Project Intrusiveness Noise Levels

The intrusiveness noise level is the noise level 5 dBA above the background noise level for each time period (daytime, evening or night time) of interest at a residential receiver. The background noise level is derived from the measured  $L_{A90}$  noise levels.

The NPfI stipulates that project intrusiveness noise levels should not be set below 40 dBA during the daytime and 35 dBA in the evening and night time. Additionally, the NPfI recommends that the project intrusiveness noise level for evening is set at no greater than that for the daytime, and that the project intrusiveness level for night time is set at no greater than that for the evening and daytime. Although not explicitly stated in the NPfI, Wilkinson Murray considers that limiting the intrusiveness noise level in the morning shoulder to no greater than that during the daytime is an approach consistent with the intent of the NPfI.

Intrusiveness noise levels for the project are calculated from the RBLs in Section 4.1 of this report and are presented in Table 5-1.

**Table 5-1 Project Intrusiveness Noise Levels**

| Receiver                 | Time of Day <sup>a</sup> | RBL | Project Intrusiveness Noise Level ( $L_{Aeq,15min}$ dBA) |
|--------------------------|--------------------------|-----|----------------------------------------------------------|
| R9, R25, R35             | Morning shoulder         | 38  | 43                                                       |
|                          | Day                      | 40  | 45                                                       |
|                          | Evening                  | 35  | 40                                                       |
|                          | Night                    | 34  | 39                                                       |
| R5, R26-R32, R34, R42-46 | Morning shoulder         | 38  | 42                                                       |
|                          | Day                      | 37  | 42                                                       |
|                          | Evening                  | 36  | 41                                                       |
|                          | Night                    | 34  | 39                                                       |

| Receiver                                                                                                            | Time of Day <sup>a</sup> | RBL | Project Intrusiveness<br>Noise Level ( $L_{Aeq,15min}$ dBA) |
|---------------------------------------------------------------------------------------------------------------------|--------------------------|-----|-------------------------------------------------------------|
| R11-R15                                                                                                             | Morning shoulder         | 41  | 43                                                          |
|                                                                                                                     | Day                      | 38  | 43                                                          |
|                                                                                                                     | Evening                  | 38  | 43                                                          |
|                                                                                                                     | Night                    | 37  | 42                                                          |
| a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am. |                          |     |                                                             |

### 5.1.2 Project Amenity Noise Levels

Project amenity noise levels aim to set a limit on continuing increases in noise levels from all industrial noise sources affecting a variety of receiver types; that is, the ambient noise level in an area from all industrial noise sources remains below recommended amenity noise levels.

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include transportation noise (when on public transport corridors), noise from motor sport, construction noise, community noise, blasting, shooting ranges, occupational workplace noise, wind farms, amplified music/patron noise.

The amenity noise level aims to limit continuing increases in noise levels which may occur if the intrusiveness level alone is applied to successive development within an area.

The recommended amenity noise level represents the objective for total industrial noise at a receiver location. The project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To prevent increases in industrial noise due to the cumulative effect of several developments, the project amenity noise level for each new source of industrial noise is set at 5dBA below the recommended amenity noise level.

The following exceptions apply to determining the project amenity noise level:

- For high-traffic areas the amenity criterion for industrial noise becomes the  $L_{Aeq,period(traffic)}$  minus 15dBA.
- In proposed developments in major industrial clusters.
- If the resulting project amenity noise level is 10dB or more, lower than the existing industrial noise level, the project amenity noise level can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.
- Where cumulative industrial noise is not a consideration because no other industries are present in, or likely to be introduced into the area, the relevant amenity noise level is assigned as the project amenity noise level for the development.

Amenity noise levels are not used directly as regulatory limits. They are used in combination with the project intrusiveness noise level to assess the potential impact of noise, assess mitigation options and determine achievable noise requirements.

The project amenity noise levels are calculated from the recommended amenity noise levels presented in Table 5-2.

**Table 5-2 Recommended Amenity Noise Levels**

| Receiver                                                                                      | Noise Amenity Area | Time of Day <sup>a</sup>           | Recommended Amenity Noise Level (dBA L <sub>Aeq,period</sub> )                                                        |
|-----------------------------------------------------------------------------------------------|--------------------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Residential                                                                                   | Rural              | Day                                | 50                                                                                                                    |
|                                                                                               |                    | Evening                            | 45                                                                                                                    |
|                                                                                               |                    | Night                              | 40                                                                                                                    |
|                                                                                               | Suburban           | Day                                | 55                                                                                                                    |
|                                                                                               |                    | Evening                            | 45                                                                                                                    |
|                                                                                               |                    | Night                              | 40                                                                                                                    |
|                                                                                               | Urban              | Day                                | 60                                                                                                                    |
|                                                                                               |                    | Evening                            | 50                                                                                                                    |
|                                                                                               |                    | Night                              | 45                                                                                                                    |
| Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks | See column 4       | See column 4                       | 5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day. |
| School classroom-internal                                                                     | All                | Noisiest 1-hour period when in use | 35                                                                                                                    |
| Hospital ward internal external                                                               | All                | Noisiest 1-hour                    | 35                                                                                                                    |
|                                                                                               | All                | Noisiest 1-hour                    | 50                                                                                                                    |
| Place of worship-internal                                                                     | All                | When in use                        | 40                                                                                                                    |
| Area specifically reserved for passive recreation (e.g. national park)                        | All                | When in use                        | 50                                                                                                                    |
| Active recreation area (e.g. school playground, golf course)                                  | All                | When in use                        | 55                                                                                                                    |
| Commercial premises                                                                           | All                | When in use                        | 65                                                                                                                    |
| Industrial premises                                                                           | All                | When in use                        | 65                                                                                                                    |
| Industrial interface (applicable only to residential noise amenity areas)                     | All                | All                                | Add 5dB(A) to recommended noise amenity area                                                                          |

a. Day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 7:00am.

Recommended amenity noise levels presented in Table 5-2 above represent the objective for total industrial noise at a receiver location. In the case of a single new noise source being proposed, the project amenity noise level represents the objective for noise from a single industrial development at the receiver location. This is calculated as the recommended amenity noise level minus 5dBA.

Due to different averaging periods for the  $L_{Aeq,15min}$  and  $L_{Aeq,period}$  noise descriptors, the values of project intrusiveness and amenity noise levels cannot be compared directly when identifying noise trigger levels i.e.; the most stringent values of each category. In order to make a comparison between descriptors, the NPFI assumes that the  $L_{Aeq,15min}$  equivalent of an  $L_{Aeq,period}$  noise level is equal to the  $L_{Aeq,15min}$  level plus 3dB.

**Table 5-3 Project Amenity Noise Levels**

| Noise Amenity Area | Time of Day <sup>a</sup> | Recommended Amenity Noise Level ( $L_{Aeq,period}$ ) | Project Amenity Noise Level ( $L_{Aeq,15min}$ dBA) |
|--------------------|--------------------------|------------------------------------------------------|----------------------------------------------------|
| Rural              | Day                      | 50                                                   | 48                                                 |
|                    | Evening                  | 45                                                   | 43                                                 |
|                    | Night                    | 40                                                   | 38                                                 |

b. Day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 7:00am.

### 5.1.3 Project Noise Trigger Levels

Table 5-4 below shows the project noise levels for sensitive receivers, with the project noise trigger levels shown in bold.

**Table 5-4 Project Noise Trigger Levels**

| Receiver                 | Time of Day <sup>a</sup> | Project Intrusiveness Noise Levels ( $L_{Aeq,15min}$ dBA) | Project Amenity Noise Levels ( $L_{Aeq,15min}$ dBA) |
|--------------------------|--------------------------|-----------------------------------------------------------|-----------------------------------------------------|
| R9, R25, R35             | Morning shoulder         | <b>43</b>                                                 | n/a                                                 |
|                          | Day                      | <b>45</b>                                                 | 48                                                  |
|                          | Evening                  | <b>40</b>                                                 | 43                                                  |
|                          | Night                    | 39                                                        | <b>38</b>                                           |
| R5, R26-R32, R34, R42-46 | Morning shoulder         | <b>42</b>                                                 | n/a                                                 |
|                          | Day                      | <b>42</b>                                                 | 48                                                  |
|                          | Evening                  | <b>41</b>                                                 | 43                                                  |
|                          | Night                    | 39                                                        | <b>38</b>                                           |
| R11-R15                  | Morning shoulder         | <b>43</b>                                                 | n/a                                                 |
|                          | Day                      | <b>43</b>                                                 | 48                                                  |
|                          | Evening                  | <b>43</b>                                                 | 43                                                  |
|                          | Night                    | 42                                                        | <b>38</b>                                           |

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.

#### 5.1.4 Maximum Noise Trigger Levels

Noise sources at night occurring over a short duration have the potential to cause sleep disturbance despite complying with project noise trigger levels. The manufacturing facilities are intended to operate on a 24-hour basis as required. Therefore, maximum noise level events need to be considered for potential sleep disturbance.

The NPfI recommends that, where the night time  $L_{Amax}$  receiver noise levels from a development exceeds 52 dBA or the RBL plus 15 dBA, whichever is the greater, then a more detailed assessment of potential sleep disturbance impacts is warranted. Table 5-5 presents the maximum noise trigger levels for the receivers identified in this assessment. These noise levels are typically addressed at the façade of potentially affected dwellings and should consider multiple storey dwellings.

**Table 5-5 Maximum Noise Trigger Levels**

| Receiver                 | RBL (dBA) | RBL + 15 dBA | Maximum Noise Trigger Level (dBA) |
|--------------------------|-----------|--------------|-----------------------------------|
| R9, R25, R35             | 34        | 49           | 52                                |
| R5, R26-R32, R34, R42-46 | 34        | 49           | 52                                |
| R11-R15                  | 37        | 52           | 52                                |

Additionally, in instances where night time  $L_{Aeq,15min}$  noise levels exceed 40 dBA or the prevailing RBL plus 5 dBA, whichever is the greater, then a detailed assessment of potential sleep disturbance impacts is warranted. Since the night time project noise trigger level is less than 40 dBA for all nearby receivers, compliance with these noise trigger levels will ensure that no further assessment of night time  $L_{Aeq,15min}$  noise levels, with regard to sleep disturbance, would be required.

## 5.2 Operational Noise Modelling Methodology

### 5.2.1 Computer Noise Model

Operational noise emissions associated with the Proposal were modelled using the CadnaA acoustic noise prediction software and the CONCAWE noise prediction algorithm. The CONCAWE noise propagation model is used around the world and is widely accepted as an appropriate model for predicting noise over significant distances. Factors that were addressed in the noise modelling are:

- Equipment noise level emissions and locations;
- Shielding from ground topography and structures;
- Noise attenuation due to geometric spreading;
- Ground absorption;
- Atmospheric absorption; and,
- Noise enhancing meteorology.

### 5.2.2 Ground Topography and Structures

Within the site, topographical data has been provided by CSR at 1 metre height intervals. Beyond the site boundary, 2 metre ground contours from NSW Land and Property Information (LPI) have been incorporated in the model.

The existing topography within the site includes a noise bund along the main driveway, and also a partially constructed noise bund in the south eastern corner of the site, near Pit 3.

As identified in previous noise impact assessments, quarrying activities in Pit 5 have the potential to cause exceedances of criteria at sensitive receivers to the north of the site, and a noise bund of up to 10 metres in height has been proposed along the northern boundary of the site. The noise modelling presented herein includes an 8 metre high noise bund near a section of the northern boundary of the site. The location of this bund, which is proposed to be constructed prior to quarrying activities occurring in Pit 5, is shown in Figure 5-1.

The existing and proposed structures associated with the brick and roof products facilities are also included in the noise model. These structures are shown in Figure 5-1.

**Figure 5-1 Noise Bunds and Structures**



### 5.2.3 Ground Absorption

A ground absorption factor of 0.75 has been applied to the entire model. This global ground absorption value conservatively represents the mix of hard ground (absorption = 0) and soft ground (absorption = 1) on and around the site.

### 5.2.4 Meteorological Effects

At relatively large distances from a source, the resultant noise levels at receivers can be influenced by meteorological conditions, particularly temperature inversions and gradient winds. Where these factors are a feature of an area their effect on resultant noise levels should be taken into account.

Noise enhancing meteorology adopted in this assessment, denoted as "NE" in results tables, are described below.

#### **Temperature Inversions**

Temperature inversions are considered likely to be a feature of the area, particularly during winter nights. Therefore, the following default temperature inversion parameters recommended in the NPfI have been included in the assessment:

- Stability category F with 2 m/s winds.

These parameters have been applied during night time and the morning shoulder period.

The CadnaA noise modelling software includes a feature that allows the model to be run with the "worst-case wind direction". This option produces the highest noise level for each receiver due to noise-enhancing winds and has been used in the modelling.

#### **Wind**

Prevailing winds have been identified in general accordance with "Fact Sheet D" of the NPfI, based on hourly wind speed and direction observations taken during 2017 at the Bringelly Air Quality Monitoring Station (AQMS), operated by the NSW Office of Environment and Heritage (OEH).

Table 5-6 presents the percentage of time where light winds up to 3.0 m/s are blowing from a particular direction, plus or minus 45 degrees, during the day, evening and night time in each season. Where the percentage is 30% or more, denoted in bold text, the winds are considered a feature of the area, and should be included in the assessment.

**Table 5-6 Identification of Prevailing Winds**

| Direction | Percentage of Time |           |           |           |           |           |           |           |           |       |           |           |
|-----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------|-----------|-----------|
|           | Summer             |           |           | Autumn    |           |           | Winter    |           |           | Night |           |           |
|           | Day                | Eve       | Night     | Day       | Eve       | Night     | Day       | Eve       | Night     | Day   | Eve       | Night     |
| N         | 21                 | 9         | 7         | 16        | 3         | 1         | 18        | 4         | 4         | 21    | 3         | 2         |
| NNE       | 24                 | 16        | 7         | 17        | 3         | 2         | 17        | 2         | 4         | 23    | 7         | 2         |
| NE        | 25                 | 22        | 6         | 16        | 7         | 2         | 11        | 2         | 2         | 24    | 16        | 2         |
| ENE       | 21                 | 29        | 4         | 12        | 10        | 4         | 5         | 2         | 2         | 19    | 23        | 3         |
| E         | 21                 | <b>38</b> | 5         | 18        | 12        | 5         | 7         | 2         | 2         | 19    | 32        | 3         |
| ESE       | 20                 | <b>45</b> | 7         | 20        | 13        | 6         | 8         | 4         | 1         | 18    | 34        | 4         |
| SE        | 19                 | <b>43</b> | 10        | 22        | 10        | 6         | 10        | 3         | 1         | 14    | 27        | 5         |
| SSE       | 18                 | <b>41</b> | 28        | 28        | 24        | 17        | 17        | 14        | 14        | 12    | 29        | 17        |
| S         | 16                 | <b>35</b> | <b>48</b> | <b>34</b> | <b>46</b> | <b>40</b> | 26        | <b>40</b> | <b>36</b> | 11    | <b>32</b> | <b>38</b> |
| SSW       | 13                 | 22        | <b>48</b> | <b>35</b> | <b>48</b> | <b>45</b> | <b>33</b> | <b>43</b> | <b>43</b> | 10    | 28        | <b>42</b> |
| SW        | 12                 | 14        | <b>45</b> | <b>31</b> | <b>46</b> | <b>45</b> | <b>33</b> | <b>46</b> | <b>43</b> | 10    | 26        | <b>41</b> |
| WSW       | 7                  | 8         | 27        | 23        | <b>32</b> | <b>32</b> | 28        | <b>38</b> | <b>31</b> | 9     | 20        | 29        |
| W         | 6                  | 3         | 5         | 10        | 8         | 7         | 17        | 15        | 10        | 7     | 8         | 7         |
| WNW       | 7                  | 3         | 3         | 7         | 5         | 2         | 11        | 12        | 3         | 6     | 6         | 3         |
| NW        | 8                  | 5         | 4         | 9         | 5         | 1         | 14        | 9         | 5         | 10    | 5         | 2         |
| NNW       | 17                 | 7         | 6         | 16        | 4         | 1         | 18        | 6         | 4         | 17    | 3         | 2         |

Table 5-6 indicates the potential for prevailing winds in the area surrounding the Proposal. Therefore, in accordance with the NPfI, the following meteorological conditions have been incorporated into the noise model during the daytime and evening:

- D-class stability; and,
- 3 m/s wind.

Similar to the modelling of drainage winds during temperature inversions, winds during the daytime and evening are modelled to result in the highest noise levels at each receiver. However, it is noted that winds from westerly to east-north-easterly are not prevalent in any period during any season. Therefore, noise enhancement due to prevailing winds is unlikely to occur at receivers located in an arc from easterly to west-south-westerly of the site. This arc includes receivers on Victor Avenue. Therefore, noise-enhanced predicted noise levels during the daytime and evening at receivers R11 – R15 will be ignored.

### 5.3 Operational Noise Sources

#### 5.3.1 Source Sound Power Levels

Major fixed sources of operational noise emissions from the existing brick making facility were previously measured by AECOM and presented in previous noise assessments, most notably the assessments accompanying the 2010 EIS and RtS. CSR advises that any new fixed plant to be installed at the brick making facility is anticipated to have similar noise emissions to the existing equipment.

A small number of fixed plant items at the brick making facility, specifically the box feed and primary crusher, were not identified as noise sources in previous assessments. This is most likely due to these items being located at the southern end of the brick making facility and having a small contribution to receiver noise levels. Notwithstanding, sound power levels measured by Wilkinson Murray at another brick making facility in Western Sydney have been applied to these items.

The roof product facility features many items of fixed plant that are similar to the brick making facility. The detailed design of the roof products facility is not yet complete, and in most cases, equipment sound power level data is not yet available. However, CSR advises that the equipment to be installed in the roof products facility would have similar source levels to the equipment in the brick making facility.

Source sound power levels for most items of mobile plant have been taken from previous measurements of similar equipment conducted by Wilkinson Murray on similar sites.

Table 5-7 summarises the operational noise sources associated with the various elements of the Proposal and their respective SWL.

**Table 5-7 Operational Noise Sources and Sound Power Levels**

| Item                 | Description     | Quantity       | SWL (dBA) per item | Reference        |
|----------------------|-----------------|----------------|--------------------|------------------|
| <b>Brickworks</b>    |                 |                |                    |                  |
| Kiln Stack           | Northern end    | 2              | 92                 | Previous EIS/RtS |
| Vent                 | Western side    | 1              | 98                 | Previous EIS/RtS |
| Exhaust              | Middle of roof  | 3              | 96                 | Previous EIS/RtS |
| Hydraulics           | Western side    | 1              | 102                | Previous EIS/RtS |
| Compressor           | Western side    | 1              | 96                 | Previous EIS/RtS |
| Primary Crusher      | Southern side   | 1              | 94                 | WM database      |
| Box Feeder           | Southern side   | 1              | 94                 | WM database      |
| Mobile Jaw Crusher   | Sandvik QJ341   | 1              | 115                | WM database      |
| Forklift             | 5 tonne         | 7 <sup>a</sup> | 99                 | WM database      |
| Road Truck           | e.g. Semi       | See Table 5-8  | 103                | WM database      |
| Front End Loader     | Komatsu WA500   | 2              | 107                | Previous EIS/RtS |
| <b>Roof Products</b> |                 |                |                    |                  |
| Burner exhaust       | Eastern end     | 2              | 78                 | Manufacturer     |
| Tile Crusher         | Northern side   | 1              | 94                 | WM database      |
| Front End Loader     | Komatsu WA380   | 1              | 107                | Previous EIS/RtS |
| Forklift             | Linde HT45T-394 | 8              | 99                 | WM database      |
| Road Truck           | e.g. Semi       | See Table 5-9  | 103                | WM database      |
| <b>Quarrying</b>     |                 |                |                    |                  |
| Grader               | Cat 140H        | 1              | 108                | WM database      |
| Dozer                | Komatsu D375A-5 | 1              | 116                | WM database      |
| Excavator (45t)      | Komatsu PC450   | 1              | 113                | Previous EIS/RtS |

| Item            | Description                                                                                                        | Quantity       | SWL (dBA) per item | Reference   |
|-----------------|--------------------------------------------------------------------------------------------------------------------|----------------|--------------------|-------------|
| Excavator (30t) | Komatsu PC300                                                                                                      | 1              | 104                | WM database |
| Compactor       | Cat 825                                                                                                            | 1              | 112                | WM database |
| Dump Truck      | Cat 740                                                                                                            | 5 <sup>b</sup> | 110                | WM database |
| Water Cart      | Cat 740                                                                                                            | 1              | 110                | WM database |
| a.              | One forklift to remain inside at all times.                                                                        |                |                    |             |
| b.              | 3 dump trucks used during normal quarrying operations, 2 additional dump trucks used for engineered fill of Pit 2. |                |                    |             |

## 5.4 Modelled Activities and Assessment Scenarios

Receiver noise levels associated with the operation of the Proposal have been predicted for a range of scenarios. These scenarios include times when quarrying activities are being conducted, and times where only the brick and roof products facilities are operating.

### 5.4.1 Brick Making Facility

Operating parameters for the brick making facility and associated storage yard have been provided by CSR. These operations involve 24/7 operation of the brick making facility, and varied operation of the storage yard across the work day.

Table 5-8 summarises the operation of the brick making facility and storage yard across the working day. The numbers of mobile plant in Table 5-8 represent typical worst-case operating conditions.

The modelled locations of these noise sources are presented in Figure 5-2.

**Table 5-8 Operational Noise Sources – Brick Making Facility**

| Item               | Modelled Source Description   |                                                    |                                                    |                           |
|--------------------|-------------------------------|----------------------------------------------------|----------------------------------------------------|---------------------------|
|                    | Morning shoulder <sup>a</sup> | Day <sup>a</sup>                                   | Evening <sup>a</sup>                               | Night <sup>a</sup>        |
| Kiln Stack         |                               |                                                    |                                                    |                           |
| Vent               |                               |                                                    |                                                    |                           |
| Exhaust            |                               | Continuous operations                              |                                                    |                           |
| Hydraulics         |                               |                                                    |                                                    |                           |
| Compressor         |                               |                                                    |                                                    |                           |
| Mobile Jaw Crusher | Nil                           | Continuous operation                               | Nil                                                | Nil                       |
| Forklift           | 6 units operating in yard     | 6 units operating in yard                          | 6 units operating in yard                          | 3 units operating in yard |
| Road Truck         | 15 brick trucks per hour      | 17 brick trucks and 6 raw material trucks per hour | 13 brick trucks and 4 raw material trucks per hour | Nil                       |

| Item                                                                                                                | Modelled Source Description    |                                 |                                 |                                |
|---------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------|---------------------------------|--------------------------------|
|                                                                                                                     | Morning shoulder <sup>a</sup>  | Day <sup>a</sup>                | Evening <sup>a</sup>            | Night <sup>a</sup>             |
| Front End Loader                                                                                                    | 1 unit in continuous operation | 2 units in continuous operation | 2 units in continuous operation | 1 unit in continuous operation |
| a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am. |                                |                                 |                                 |                                |

#### 5.4.2 Roof Products Facility

Operating parameters for the roof products facility and associated storage yard have been provided by CSR. These operations involve 24/7 operation of the roof products facility, and varied operation of the storage yard across the work day.

The modelled locations of these noise sources are presented in Figure 5-2.

Table 5-9 summarises the operation of the roof products facility and storage yard across the working day. The numbers of mobile plant in Table 5-8 represent typical worst-case operating conditions.

The modelled locations of these noise sources are presented in Figure 5-2.

**Table 5-9 Operational Noise Sources – Roof Products Manufacturing Facility**

| Item                                                                                                                | Modelled Source Description   |                                                            |                                             |                           |
|---------------------------------------------------------------------------------------------------------------------|-------------------------------|------------------------------------------------------------|---------------------------------------------|---------------------------|
|                                                                                                                     | Morning shoulder <sup>a</sup> | Day <sup>a</sup>                                           | Evening <sup>a</sup>                        | Night <sup>a</sup>        |
| Burner Exhaust                                                                                                      | Continuous operations         |                                                            |                                             |                           |
| Tile Crusher                                                                                                        |                               |                                                            |                                             |                           |
| Forklift                                                                                                            | 8 units operating in yard     | 8 units operating in yard                                  | 8 units operating in yard                   | 8 units operating in yard |
| Road Truck                                                                                                          | 14 tile trucks per hour       | 10 tile trucks, 1 cement tanker and 3 sand trucks per hour | 10 tile trucks and 1 cement tanker per hour | Nil                       |
| Front End Loader                                                                                                    | Nil                           | 1 unit in continuous operation                             | 1 unit in continuous operation              | Nil                       |
| a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am. |                               |                                                            |                                             |                           |

**Figure 5-2 Modelled Noise Sources – Brick Making and Roof Products Facilities**



#### 5.4.3 Quarrying

Noise impacts associated with quarrying activities would vary as the nature and location of the works change over the life of the Proposal. To present the range of potential noise impacts over the life of the Proposal, quarrying activities have been modelled in areas of the pits that are likely to result in the highest noise levels at sensitive receivers, as follows:

- The easternmost area of Pit 3;
- The northernmost area of Pit 4; and,
- The easternmost area of Pit 5.

In each of these worst-case areas, both overburden removal (OB) and raw material extraction (RM) activities have been modelled. Additionally, during the removal of overburden from Pit 3, engineered filling activities would be occurring in Pit 2. These activities are described below. Figures showing the locations of modelled noise sources for each quarrying scenario are included in Appendix B.

#### **Overburden Removal**

Overburden removal involves the use of a grader and an excavator to strip material and transfer it into dump trucks. The dump trucks would then transfer the material to other areas of the site as may be needed to back-fill previously quarried areas or to construct noise bunds.

Overburden removal would commence at the existing ground level and would continue downwards to a level approximately 4 metres below the existing ground level. The highest receiver noise levels during overburden removal would coincide with activities occurring at the existing ground level, where shielding from nearby topography is at a minimum. Accordingly, the noise modelling assumes that overburden removal is conducted at the existing ground level.

At the location where the overburden is placed, it will be spread with a compactor to either fill a previously extracted area or to construct noise bunds.

#### **Raw Material Extraction**

Once the overburden has been removed, and desirable material has been exposed, a dozer would be used to rip this material and an excavator would load the material into dump trucks. The dump trucks would haul the material from the pit to the raw material stockpiles.

As described previously, overburden would be removed down to approximately 4 metres below the existing ground level. Therefore, noise modelling assumes that raw material extraction would begin at approximately 4 metres below existing ground level.

#### **Engineered Fill of Pit 2**

The overburden stripped and hauled from the eastern half of Pit 3 would be dumped into the central and southern sections of Pit 2. A compactor and a water cart would be used to achieve the required compaction.

Additionally, a single excavator would be used to strip previously emplaced overburden from the northern third of Pit 2. This material would be loaded into one of 2 dump trucks and hauled to the central and southern sections of Pit 2 for compaction.

## 5.5 Predicted $L_{Aeq,15min}$ Operational Noise Levels

The predicted  $L_{Aeq,15min}$  operational noise levels at sensitive receivers for the proposed site activities outlined in the preceding sections are presented in Table 5-10 and Table 5-11. Contour plots of predicted operational noise levels are presented in Appendix C.

### 5.5.1 Operational Noise Levels from Manufacturing Only

Table 5-10 presents the predicted  $L_{Aeq,15min}$  operational noise levels while no quarrying activities are being undertaken. As outlined in Section 5.4, these activities can vary across the morning shoulder, day, evening and night time assessment periods.

Review of Table 5-10 indicates that the predicted operational noise levels at sensitive receivers, while no quarrying activities are being undertaken, comply with the project noise trigger levels at all nearby receivers during both calm and noise-enhancing meteorological conditions, except at R9 and R25 where the predicted noise levels are predicted to exceed the daytime project noise trigger level by 1 dBA during noise-enhancing meteorological conditions.

### 5.5.2 Operational Noise Levels from all Operational Activities

Table 5-11 presents the predicted  $L_{Aeq,15min}$  operational noise levels at sensitive receivers during the various quarrying activities outlined in Section 5.4. As discussed in Section 5.4, quarrying activities would occur during daytime hours only.

Review of Table 5-11 indicates that the predicted operational noise levels at sensitive receivers during all operating activities comply with the project noise trigger levels at most nearby receivers during both calm and noise-enhancing meteorological conditions. However, exceedances of the project noise trigger levels are predicted at receivers R5, R9, R25 and R26 across a range of quarrying scenarios. These exceedances, which occur only during noise-enhancing meteorological conditions, range from 1 to 4 dBA.

Close inspection of Table 5-11 indicates that the predicted noise level at receiver R12a during overburden removal in Pit 3 exceeds the project noise trigger level by 1 dBA under noise-enhancing meteorological conditions. However, as discussed in Section 5.2.4, prevailing winds in the area would not result in enhancement of noise levels at receivers to the south-east of the site.

**Table 5-10 Predicted Noise Levels from Manufacturing Only (while not Quarrying)**

| Receiver | AM Shoulder <sup>a</sup> |                 |               |           | Day <sup>a</sup>  |                 |               |           | Evening <sup>a</sup> |                 |               |           | Night <sup>a</sup> |                 |               |           |
|----------|--------------------------|-----------------|---------------|-----------|-------------------|-----------------|---------------|-----------|----------------------|-----------------|---------------|-----------|--------------------|-----------------|---------------|-----------|
|          | Predicted Level          |                 | Trigger Level | Complies? | Predicted Level   |                 | Trigger Level | Complies? | Predicted Level      |                 | Trigger Level | Complies? | Predicted Level    |                 | Trigger Level | Complies? |
|          | Calm <sup>b</sup>        | NE <sup>c</sup> |               |           | Calm <sup>b</sup> | NE <sup>c</sup> |               |           | Calm <sup>b</sup>    | NE <sup>c</sup> |               |           | Calm <sup>b</sup>  | NE <sup>c</sup> |               |           |
| R5       | 34                       | 38              | 42            | Yes       | 35                | 40              | 42            | Yes       | 34                   | 39              | 41            | Yes       | 33                 | 37              | 38            | Yes       |
| R9       | 31                       | 35              | 43            | Yes       | 42                | <b>46</b>       | 45            | <b>No</b> | 35                   | 39              | 40            | Yes       | 30                 | 34              | 38            | Yes       |
| R11      | 28                       | 34              | 43            | Yes       | 29                | 34              | 43            | Yes       | 28                   | 34              | 43            | Yes       | 28                 | 33              | 38            | Yes       |
| R12      | 29                       | 34              | 43            | Yes       | 29                | 34              | 43            | Yes       | 29                   | 34              | 43            | Yes       | 28                 | 33              | 38            | Yes       |
| R12a     | 30                       | 35              | 43            | Yes       | 30                | 35              | 43            | Yes       | 30                   | 35              | 43            | Yes       | 29                 | 34              | 38            | Yes       |
| R13      | 31                       | 36              | 43            | Yes       | 31                | 36              | 43            | Yes       | 31                   | 36              | 43            | Yes       | 30                 | 35              | 38            | Yes       |
| R14      | 30                       | 35              | 43            | Yes       | 30                | 35              | 43            | Yes       | 30                   | 35              | 43            | Yes       | 29                 | 34              | 38            | Yes       |
| R15      | 30                       | 35              | 43            | Yes       | 30                | 35              | 43            | Yes       | 30                   | 35              | 43            | Yes       | 29                 | 34              | 38            | Yes       |
| R25      | 31                       | 35              | 43            | Yes       | 42                | <b>46</b>       | 45            | <b>No</b> | 34                   | 38              | 40            | Yes       | 29                 | 34              | 38            | Yes       |
| R26      | 31                       | 36              | 42            | Yes       | 33                | 38              | 42            | Yes       | 32                   | 37              | 41            | Yes       | 31                 | 35              | 38            | Yes       |
| R27      | 30                       | 35              | 42            | Yes       | 32                | 37              | 42            | Yes       | 31                   | 36              | 41            | Yes       | 29                 | 34              | 38            | Yes       |
| R28      | 31                       | 35              | 42            | Yes       | 33                | 37              | 42            | Yes       | 31                   | 36              | 41            | Yes       | 30                 | 35              | 38            | Yes       |
| R29      | 28                       | 33              | 42            | Yes       | 31                | 36              | 42            | Yes       | 28                   | 33              | 41            | Yes       | 27                 | 32              | 38            | Yes       |
| R30      | 26                       | 31              | 42            | Yes       | 30                | 35              | 42            | Yes       | 27                   | 32              | 41            | Yes       | 26                 | 31              | 38            | Yes       |
| R31      | 29                       | 34              | 42            | Yes       | 32                | 36              | 42            | Yes       | 30                   | 35              | 41            | Yes       | 29                 | 34              | 38            | Yes       |
| R32      | 27                       | 32              | 42            | Yes       | 34                | 39              | 42            | Yes       | 28                   | 33              | 41            | Yes       | 26                 | 31              | 38            | Yes       |
| R34      | 25                       | 30              | 42            | Yes       | 30                | 35              | 42            | Yes       | 26                   | 31              | 41            | Yes       | 24                 | 29              | 38            | Yes       |
| R35      | 30                       | 35              | 43            | Yes       | 38                | 43              | 45            | Yes       | 30                   | 35              | 40            | Yes       | 25                 | 30              | 38            | Yes       |
| R42      | 32                       | 36              | 42            | Yes       | 34                | 38              | 42            | Yes       | 33                   | 37              | 41            | Yes       | 31                 | 36              | 38            | Yes       |
| R43      | 28                       | 33              | 42            | Yes       | 31                | 36              | 42            | Yes       | 29                   | 34              | 41            | Yes       | 28                 | 33              | 38            | Yes       |
| R44      | 24                       | 29              | 42            | Yes       | 27                | 33              | 42            | Yes       | 25                   | 30              | 41            | Yes       | 24                 | 29              | 38            | Yes       |

| Receiver | AM Shoulder <sup>a</sup> |                 |               |           | Day <sup>a</sup>  |                 |               |           | Evening <sup>a</sup> |                 |               |           | Night <sup>a</sup> |                 |               |           |
|----------|--------------------------|-----------------|---------------|-----------|-------------------|-----------------|---------------|-----------|----------------------|-----------------|---------------|-----------|--------------------|-----------------|---------------|-----------|
|          | Predicted Level          |                 | Trigger Level | Complies? | Predicted Level   |                 | Trigger Level | Complies? | Predicted Level      |                 | Trigger Level | Complies? | Predicted Level    |                 | Trigger Level | Complies? |
|          | Calm <sup>b</sup>        | NE <sup>c</sup> |               |           | Calm <sup>b</sup> | NE <sup>c</sup> |               |           | Calm <sup>b</sup>    | NE <sup>c</sup> |               |           | Calm <sup>b</sup>  | NE <sup>c</sup> |               |           |
| R45      | 25                       | 30              | 42            | Yes       | 28                | 33              | 42            | Yes       | 26                   | 31              | 41            | Yes       | 24                 | 29              | 38            | Yes       |
| R46      | 24                       | 29              | 42            | Yes       | 29                | 34              | 42            | Yes       | 25                   | 30              | 41            | Yes       | 23                 | 28              | 38            | Yes       |

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.

b. D-class stability, no wind

c. 3 m/s source to receiver wind during day & evening; F-class stability and 2 m/s source to receiver wind during night & AM shoulder.

d. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.

**Table 5-11 Predicted Daytime Noise Levels During all Operational Activities**

| Receiver | Trigger Level | Pit 3 OB          |                 |                  |  | Pit 3 RM          |                 |           |  | Pit 4 OB          |                 |           |  | Pit 4 RM          |                 |           |  | Pit 5 OB          |                 |           |  | Pit 5 RM          |                 |           |  |
|----------|---------------|-------------------|-----------------|------------------|--|-------------------|-----------------|-----------|--|-------------------|-----------------|-----------|--|-------------------|-----------------|-----------|--|-------------------|-----------------|-----------|--|-------------------|-----------------|-----------|--|
|          |               | Predicted Level   |                 | Comp?            |  | Predicted Level   |                 | Comp?     |  | Predicted Level   |                 | Comp?     |  | Predicted Level   |                 | Comp?     |  | Predicted Level   |                 | Comp?     |  | Predicted Level   |                 | Comp?     |  |
|          |               | Calm <sup>a</sup> | NE <sup>a</sup> |                  |  | Calm <sup>a</sup> | NE <sup>a</sup> |           |  | Calm <sup>a</sup> | NE <sup>a</sup> |           |  | Calm <sup>a</sup> | NE <sup>a</sup> |           |  | Calm <sup>a</sup> | NE <sup>a</sup> |           |  | Calm <sup>a</sup> | NE <sup>a</sup> |           |  |
| R5       | 42            | 36                | 40              | Yes              |  | 36                | 41              | Yes       |  | 39                | <b>43</b>       | <b>No</b> |  | 34                | 38              | Yes       |  | 35                | 38              | Yes       |  | 33                | 37              | Yes       |  |
| R9       | 45            | 42                | <b>46</b>       | <b>No</b>        |  | 42                | <b>46</b>       | <b>No</b> |  | 44                | <b>48</b>       | <b>No</b> |  | 45                | <b>49</b>       | <b>No</b> |  | 42                | <b>46</b>       | <b>No</b> |  | 42                | <b>46</b>       | <b>No</b> |  |
| R11      | 43            | 37                | 42              | Yes              |  | 35                | 40              | Yes       |  | 36                | 41              | Yes       |  | 36                | 41              | Yes       |  | 31                | 36              | Yes       |  | 30                | 35              | Yes       |  |
| R12      | 43            | 38                | 43              | Yes              |  | 36                | 41              | Yes       |  | 37                | 42              | Yes       |  | 36                | 42              | Yes       |  | 31                | 36              | Yes       |  | 31                | 36              | Yes       |  |
| R12a     | 43            | 39                | 44              | Yes <sup>c</sup> |  | 37                | 42              | Yes       |  | 37                | 43              | Yes       |  | 37                | 43              | Yes       |  | 32                | 37              | Yes       |  | 32                | 37              | Yes       |  |
| R13      | 43            | 37                | 42              | Yes              |  | 36                | 41              | Yes       |  | 37                | 43              | Yes       |  | 37                | 43              | Yes       |  | 32                | 37              | Yes       |  | 32                | 37              | Yes       |  |
| R14      | 43            | 36                | 41              | Yes              |  | 35                | 40              | Yes       |  | 37                | 42              | Yes       |  | 37                | 42              | Yes       |  | 32                | 37              | Yes       |  | 31                | 36              | Yes       |  |
| R15      | 43            | 36                | 41              | Yes              |  | 35                | 40              | Yes       |  | 37                | 42              | Yes       |  | 36                | 42              | Yes       |  | 31                | 36              | Yes       |  | 31                | 36              | Yes       |  |
| R25      | 45            | 42                | <b>46</b>       | <b>No</b>        |  | 42                | <b>46</b>       | <b>No</b> |  | 44                | <b>48</b>       | <b>No</b> |  | 45                | <b>48</b>       | <b>No</b> |  | 42                | <b>46</b>       | <b>No</b> |  | 42                | <b>46</b>       | <b>No</b> |  |
| R26      | 42            | 34                | 39              | Yes              |  | 35                | 40              | Yes       |  | 38                | <b>43</b>       | <b>No</b> |  | 38                | <b>43</b>       | <b>No</b> |  | 34                | 38              | <b>No</b> |  | 33                | 37              | Yes       |  |
| R27      | 42            | 34                | 39              | Yes              |  | 34                | 39              | Yes       |  | 37                | 41              | Yes       |  | 37                | 41              | Yes       |  | 34                | 39              | Yes       |  | 33                | 38              | Yes       |  |
| R28      | 42            | 33                | 38              | Yes              |  | 34                | 39              | Yes       |  | 36                | 41              | Yes       |  | 36                | 40              | Yes       |  | 35                | 39              | Yes       |  | 34                | 39              | Yes       |  |

| Receiver | Trigger Level | Pit 3 OB          |                 |       | Pit 3 RM          |                 |       | Pit 4 OB          |                 |       | Pit 4 RM          |                 |       | Pit 5 OB          |                 |       | Pit 5 RM          |                 |       |
|----------|---------------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|
|          |               | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? |
|          |               | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       |
| R29      | 42            | 32                | 37              | Yes   | 32                | 37              | Yes   | 35                | 40              | Yes   | 35                | 40              | Yes   | 32                | 37              | Yes   | 32                | 37              | Yes   |
| R30      | 42            | 31                | 36              | Yes   | 31                | 37              | Yes   | 34                | 39              | Yes   | 34                | 39              | Yes   | 31                | 36              | Yes   | 31                | 36              | Yes   |
| R31      | 42            | 33                | 38              | Yes   | 33                | 38              | Yes   | 35                | 40              | Yes   | 35                | 40              | Yes   | 34                | 39              | Yes   | 33                | 38              | Yes   |
| R32      | 42            | 34                | 40              | Yes   | 34                | 40              | Yes   | 36                | 41              | Yes   | 37                | 42              | Yes   | 34                | 40              | Yes   | 34                | 39              | Yes   |
| R34      | 42            | 31                | 36              | Yes   | 31                | 37              | Yes   | 34                | 39              | Yes   | 34                | 39              | Yes   | 31                | 36              | Yes   | 31                | 36              | Yes   |
| R35      | 45            | 38                | 43              | Yes   | 38                | 43              | Yes   | 39                | 44              | Yes   | 40                | 45              | Yes   | 38                | 43              | Yes   | 38                | 43              | Yes   |
| R42      | 42            | 34                | 39              | Yes   | 35                | 40              | Yes   | 37                | 42              | Yes   | 37                | 41              | Yes   | 35                | 40              | Yes   | 34                | 39              | Yes   |
| R43      | 42            | 32                | 37              | Yes   | 32                | 37              | Yes   | 35                | 40              | Yes   | 34                | 39              | Yes   | 33                | 38              | Yes   | 32                | 37              | Yes   |
| R44      | 42            | 29                | 34              | Yes   | 30                | 35              | Yes   | 31                | 37              | Yes   | 31                | 36              | Yes   | 30                | 35              | Yes   | 30                | 35              | Yes   |
| R45      | 42            | 30                | 35              | Yes   | 30                | 35              | Yes   | 32                | 37              | Yes   | 32                | 37              | Yes   | 30                | 35              | Yes   | 30                | 35              | Yes   |
| R46      | 42            | 29                | 35              | Yes   | 30                | 35              | Yes   | 32                | 37              | Yes   | 33                | 38              | Yes   | 30                | 35              | Yes   | 29                | 34              | Yes   |

- a. D-class stability, no wind  
b. 3 m/s source to receiver wind during daytime.  
c. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.

### 5.5.3 Mitigation of Operational Noise Levels

The preceding section has identified that exceedances of the daytime project noise trigger levels are predicted during noise-enhancing meteorological conditions. These exceedances are identified at receivers R9 and R25 during only manufacturing activities and at receivers R5, R9, R25 and R26 when all operational activities are occurring simultaneously.

The exceedances at R9 and R25 are a result of the operation of the front end loader at the roof products manufacturing facility and quarrying activities in Pit 4. To mitigate these exceedances, a 5.5 metre high barrier could be erected in the north-eastern corner of the site, as shown in Figure 5-3.

Exceedances of up to 1 dBA are predicted to occur at R26 occur during quarrying activities in Pit 4. These exceedances could be mitigated by erecting a 2 metre high noise wall along the top of a section of the existing noise bund that runs along the driveway, as shown in Figure 5-3.

Finally, it is noted a 1 dBA exceedance is predicted at receiver R5 during overburden removal in Pit 4. The construction of the Pit 5 noise wall is proposed to occur during this phase of quarrying operations, as discussed in Section 7.3.2. Therefore, it is anticipated that this exceedance, if it eventuated, would only do so for a short time until the Pit 5 noise bund begins to provide shielding.

The predicted  $L_{Aeq,15min}$  operational noise levels for all operational activities, with the aforementioned mitigation measures, are presented in Table 5-12.

Review of Table 5-12 indicates that, with the implementation of the above mitigation measures, the predicted  $L_{Aeq,15min}$  operational noise levels comply with the project noise trigger levels at all sensitive receivers.

Compliance with the project noise trigger levels has been demonstrated based on the implementation of several noise barriers. However, the noise barriers identified in this assessment may not represent the most desirable barrier designs based on other factors such as cost and ease of construction. Therefore, should more desirable barrier designs be identified during the detailed design phase, which are demonstrated to effectively mitigate operational noise levels down to the project noise trigger levels, then these alternative barrier designs should be incorporated into the Project. For instance, the noise bund to the north of Pit 5 may be extended eastwards, parallel to the northern boundary, and joined with the barrier in the north-eastern corner of the site, allowing the additional 2 m barrier on top of the driveway bund to be omitted. Additionally, the barriers identified in this assessment are each modelled at a fixed height. The detailed design process may also identify sections of some noise bunds that may be reduced in height without compromising compliance with noise trigger levels.

### 5.5.4 Voluntary Land Acquisition and Mitigation Policy

The Proposal is classified as a State significant mining/extractive industry development and therefore, the *Voluntary Land Acquisition and Mitigation Policy* (VLAMP) must be considered.

The predicted noise levels associated with the operation of the Proposal comply with the established noise trigger levels at all sensitive receivers. Additionally, the predicted noise levels associated with the operation of the Proposal do not exceed the acceptable noise level plus 5 dB in Table 2.2 of the NPFI on more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be build under existing planning controls.

Therefore, no voluntary mitigation or land acquisition rights, as prescribed by the VLAMP, would be applicable to the Proposal.

Figure 5-3 Operational Noise Mitigation



**Table 5-12 Predicted Daytime Noise Levels During all Operational Activities – with Mitigation**

| Receiver | Trigger Level | Pit 3 OB          |                 |                  | Pit 3 RM          |                 |       | Pit 4 OB          |                 |       | Pit 4 RM          |                 |       | Pit 5 OB          |                 |       | Pit 5 RM          |                 |       |
|----------|---------------|-------------------|-----------------|------------------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|
|          |               | Predicted Level   |                 | Comp?            | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? |
|          |               | Calm <sup>a</sup> | NE <sup>a</sup> |                  | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       |
| R5       | 42            | 36                | 40              | Yes              | 36                | 41              | Yes   | 38                | 42              | Yes   | 34                | 38              | Yes   | 35                | 38              | Yes   | 33                | 37              | Yes   |
| R9       | 45            | 35                | 39              | Yes              | 36                | 39              | Yes   | 40                | 43              | Yes   | 42                | 45              | Yes   | 36                | 40              | Yes   | 35                | 39              | Yes   |
| R11      | 43            | 37                | 42              | Yes              | 35                | 40              | Yes   | 36                | 41              | Yes   | 36                | 41              | Yes   | 31                | 36              | Yes   | 30                | 36              | Yes   |
| R12      | 43            | 38                | 43              | Yes              | 36                | 41              | Yes   | 37                | 42              | Yes   | 37                | 42              | Yes   | 31                | 36              | Yes   | 31                | 36              | Yes   |
| R12a     | 43            | 39                | 44              | Yes <sup>c</sup> | 37                | 42              | Yes   | 37                | 43              | Yes   | 37                | 43              | Yes   | 32                | 37              | Yes   | 32                | 37              | Yes   |
| R13      | 43            | 37                | 42              | Yes              | 36                | 41              | Yes   | 37                | 43              | Yes   | 37                | 43              | Yes   | 32                | 37              | Yes   | 32                | 37              | Yes   |
| R14      | 43            | 36                | 41              | Yes              | 35                | 40              | Yes   | 37                | 42              | Yes   | 37                | 42              | Yes   | 32                | 37              | Yes   | 31                | 36              | Yes   |
| R15      | 43            | 36                | 41              | Yes              | 35                | 40              | Yes   | 37                | 42              | Yes   | 37                | 42              | Yes   | 31                | 36              | Yes   | 31                | 36              | Yes   |
| R25      | 45            | 35                | 39              | Yes              | 36                | 39              | Yes   | 39                | 43              | Yes   | 41                | 45              | Yes   | 36                | 40              | Yes   | 35                | 39              | Yes   |
| R26      | 42            | 34                | 39              | Yes              | 35                | 40              | Yes   | 37                | 42              | Yes   | 38                | 42              | Yes   | 34                | 39              | Yes   | 33                | 37              | Yes   |
| R27      | 42            | 33                | 38              | Yes              | 34                | 39              | Yes   | 36                | 40              | Yes   | 36                | 41              | Yes   | 33                | 38              | Yes   | 33                | 38              | Yes   |
| R28      | 42            | 33                | 38              | Yes              | 34                | 39              | Yes   | 36                | 41              | Yes   | 35                | 40              | Yes   | 35                | 39              | Yes   | 34                | 39              | Yes   |
| R29      | 42            | 32                | 37              | Yes              | 32                | 37              | Yes   | 34                | 39              | Yes   | 34                | 39              | Yes   | 32                | 37              | Yes   | 31                | 36              | Yes   |
| R30      | 42            | 31                | 36              | Yes              | 31                | 36              | Yes   | 33                | 38              | Yes   | 33                | 38              | Yes   | 31                | 36              | Yes   | 30                | 36              | Yes   |
| R31      | 42            | 32                | 37              | Yes              | 33                | 38              | Yes   | 35                | 40              | Yes   | 34                | 39              | Yes   | 34                | 38              | Yes   | 33                | 38              | Yes   |
| R32      | 42            | 32                | 37              | Yes              | 32                | 37              | Yes   | 34                | 39              | Yes   | 35                | 40              | Yes   | 32                | 37              | Yes   | 32                | 37              | Yes   |
| R34      | 42            | 31                | 36              | Yes              | 31                | 36              | Yes   | 33                | 39              | Yes   | 34                | 39              | Yes   | 31                | 36              | Yes   | 31                | 36              | Yes   |
| R35      | 45            | 38                | 43              | Yes              | 38                | 43              | Yes   | 39                | 44              | Yes   | 40                | 44              | Yes   | 38                | 43              | Yes   | 38                | 43              | Yes   |
| R42      | 42            | 34                | 39              | Yes              | 35                | 40              | Yes   | 37                | 41              | Yes   | 36                | 40              | Yes   | 35                | 40              | Yes   | 34                | 39              | Yes   |
| R43      | 42            | 32                | 37              | Yes              | 32                | 37              | Yes   | 34                | 39              | Yes   | 34                | 38              | Yes   | 33                | 37              | Yes   | 32                | 37              | Yes   |
| R44      | 42            | 29                | 34              | Yes              | 29                | 34              | Yes   | 30                | 36              | Yes   | 31                | 36              | Yes   | 30                | 35              | Yes   | 30                | 35              | Yes   |
| R45      | 42            | 29                | 35              | Yes              | 30                | 35              | Yes   | 32                | 37              | Yes   | 32                | 37              | Yes   | 30                | 35              | Yes   | 30                | 35              | Yes   |

| Receiver | Trigger Level | Pit 3 OB          |                 |       | Pit 3 RM          |                 |       | Pit 4 OB          |                 |       | Pit 4 RM          |                 |       | Pit 5 OB          |                 |       | Pit 5 RM          |                 |       |
|----------|---------------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|-------------------|-----------------|-------|
|          |               | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? | Predicted Level   |                 | Comp? |
|          |               | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       | Calm <sup>a</sup> | NE <sup>a</sup> |       |
| R46      | 42            | 29                | 35              | Yes   | 30                | 35              | Yes   | 32                | 37              | Yes   | 33                | 37              | Yes   | 30                | 35              | Yes   | 29                | 34              | Yes   |

- a. D-class stability, no wind  
b. 3 m/s source to receiver wind during daytime.  
c. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.

## 5.6 Predicted $L_{Amax}$ Operational Noise Levels

Pneumatic parking brakes on trucks are considered the most likely potential source of maximum noise levels during the morning shoulder period. Based on measurements previously conducted by Wilkinson Murray, the  $L_{Amax}$  sound power level of pneumatic parking brakes is typically up to 122 dBA.

The predicted  $L_{Amax}$  noise levels at sensitive receivers due to the operation of truck parking brakes on the site are presented in Table 5-13. The predicted  $L_{Amax}$  noise levels in Table 5-13 do not incorporate any of the operational noise mitigation measures identified in Section 5.5.3.

**Table 5-13 Predicted  $L_{Amax}$  Noise Levels During Morning Shoulder**

| Receiver | Predicted Level   |                 | Maximum Noise<br>Trigger Level | Complies? |
|----------|-------------------|-----------------|--------------------------------|-----------|
|          | Calm <sup>a</sup> | NE <sup>b</sup> |                                |           |
| R5       | 37                | 42              | 52                             | Yes       |
| R9       | 45                | 50              | 52                             | Yes       |
| R11      | 40                | 45              | 52                             | Yes       |
| R12      | 41                | 46              | 52                             | Yes       |
| R12a     | 42                | 47              | 52                             | Yes       |
| R13      | 43                | 48              | 52                             | Yes       |
| R14      | 42                | 48              | 52                             | Yes       |
| R15      | 42                | 47              | 52                             | Yes       |
| R25      | 43                | 48              | 52                             | Yes       |
| R26      | 37                | 42              | 52                             | Yes       |
| R27      | 35                | 40              | 52                             | Yes       |
| R28      | 35                | 40              | 52                             | Yes       |
| R29      | 33                | 38              | 52                             | Yes       |
| R30      | 31                | 36              | 52                             | Yes       |
| R31      | 34                | 39              | 52                             | Yes       |
| R32      | 33                | 38              | 52                             | Yes       |
| R34      | 33                | 38              | 52                             | Yes       |
| R35      | 44                | 49              | 52                             | Yes       |
| R42      | 36                | 42              | 52                             | Yes       |
| R43      | 33                | 37              | 52                             | Yes       |
| R44      | 28                | 33              | 52                             | Yes       |
| R45      | 29                | 34              | 52                             | Yes       |
| R46      | 36                | 41              | 52                             | Yes       |

a. D-class stability, no wind

b. F-class stability and 2 m/s source to receiver wind.

Table 5-13 indicates that the predicted  $L_{Amax}$  operational noise levels comply with the maximum noise trigger level at all receivers. Therefore, no further assessment of potential sleep disturbance impacts is warranted.

## 6 ROAD NOISE ASSESSMENT

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The Proposal will generate additional traffic along the surrounding public road network. The increase will be most prominent along Martin Road and will largely be due to heavy vehicles transporting goods to and from the Proposal site. The traffic generated by the Proposal is significant when compared to the existing flows along Martin Road. Accordingly, a detailed assessment of potential road noise impact at all sensitive receivers along Martin Road has been conducted.

Additionally, the Proposal will generate additional traffic on Elizabeth Drive. However, these movements will be relatively minor compared to the existing traffic flows on Elizabeth Drive. Therefore, a high-level assessment of potential impacts at the most potentially affected receivers along Elizabeth Drive has been conducted.

### 6.1 Martin Road – Elizabeth Drive Intersection Upgrade

The traffic impact assessment for the proposal has found that the Martin Road – Elizabeth Drive intersection would need to be signalised. In addition to the introduction of traffic signals, turning lanes at the intersection would be revised.

The changes to the horizontal alignment of the “through lanes” at the intersection are not significant when compared to the setback distance to nearby receivers. Therefore, the intersection upgrade would have a negligible effect on road noise from traffic continuing straight on Elizabeth Drive.

*CoRTN* (Calculation of Road Traffic Noise) is the road noise model approved for use in NSW. This model does not account for noise associated with vehicles accelerating and decelerating at intersections. These effects are considered unlikely to cause unacceptable road noise impacts at nearby receivers, but are not able to be predicted using the approved model. To protect the acoustic amenity of receivers potentially affected by road noise impacts associated with the intersection upgrade, it is recommended that the existing levels of road noise are quantified prior to the upgrade works. In the event that receivers near the intersection complain of increased road noise after the upgrade, road noise levels at these receivers should be re-measured. If the measurements indicate that the intersection upgrade has caused exceedances of applicable road noise criteria, then appropriate architectural treatments should be offered to affected receivers.

### 6.2 Road Noise Criteria

The *NSW Road Noise Policy* (RNP) (DECCW, 2011) sets out criteria for assessment of noise from traffic on public roads. The RNP sets out noise assessment criteria for “freeways”, “arterial”, “sub-arterial” and “local roads”.

Martin Road would typically be classified as a local road. However, in addition to standard road classifications, the RNP also identifies “principal haulage routes” whereby some local public roads servicing industries such as mines and extractive industries carry a different level and mix of traffic to typical local roads in residential areas. The RNP advises that the noise criteria for principal haulage routes should match those for arterial/sub-arterial roads, noting that they carry a different level and mix of traffic to most local roads.

Martin Road is an approved B-Double route and, in addition to the CSR site, services other heavy traffic generating activities such as the Australian Native Landscapes (ANL) site at 210 Martin

Road and resource recovery facilities at 25 and 55 Martin Road. As discussed further in Section 6.3.2, heavy vehicles contribute approximately 43% of the existing traffic flows on Martin Road. Therefore, the use of Martin Road is consistent with that of a principal haulage route and has been assessed as such in accordance with the RNP.

In accordance with the RNP, Elizabeth Drive is considered a sub-arterial road.

The RNP impact assessment criteria for residential land uses impacted by additional traffic on arterial/sub-arterial roads are presented in Table 6-1

**Table 6-1 RNP Impact Assessment Criteria**

| Road        | Category                                        | Assessment Criteria - dBA                |                                         |
|-------------|-------------------------------------------------|------------------------------------------|-----------------------------------------|
|             |                                                 | Day <sup>a</sup>                         | Night <sup>a</sup>                      |
| Martin Road | Principal haulage route (arterial/sub-arterial) | L <sub>Aeq</sub> , 15 hour 60 (external) | L <sub>Aeq</sub> , 9 hour 55 (external) |

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am

With regard to the permissible increase in road traffic noise from a land use development the RNP states:

*"For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'."*

Additionally, the RNP defines a "relative increase criterion" which limits the total increase in road noise levels from any development to 12 dB.

### 6.3 Road Noise Impacts Along Martin Road

#### 6.3.1 Sensitive Receivers Potentially Affected by Road Noise

Road noise impacts associated with traffic generated by the Proposal are assessed at all residences adjacent to Martin Road. These receivers are summarised in Table 6-2 and shown in Figure 6-1.

**Table 6-2 Road Noise Receivers**

| Receiver ID <sup>a</sup> | Address                             |
|--------------------------|-------------------------------------|
| RN1                      | 1970 Elizabeth Drive Badgerys Creek |
| RN2                      | 10 Martin Road Badgerys Creek       |
| RN3                      | 30 Martin Road Badgerys Creek       |
| RN4                      | 40 Martin Road Badgerys Creek       |
| RN5                      | 50 Martin Road Badgerys Creek       |
| RN6                      | 55 Martin Road Badgerys Creek       |
| RN7                      | 50a Martin Road Badgerys Creek      |

| Receiver ID <sup>a</sup> | Address                         |
|--------------------------|---------------------------------|
| RN8                      | 60 Martin Road Badgerys Creek   |
| RN9                      | 65 Martin Road Badgerys Creek   |
| RN10                     | 70 Martin Road Badgerys Creek   |
| RN11                     | 80 Martin Road Badgerys Creek   |
| RN12                     | 90 Martin Road Badgerys Creek   |
| RN13                     | 100 Martin Road Badgerys Creek  |
| RN14                     | 110 Martin Road Badgerys Creek  |
| RN15                     | 75 Martin Road Badgerys Creek   |
| RN16                     | 120 Martin Road Badgerys Creek  |
| RN17                     | 85 Martin Road Badgerys Creek   |
| RN18                     | 140 Martin Road Badgerys Creek  |
| RN19                     | 150 Martin Road Badgerys Creek  |
| RN20                     | 160 Martin Road Badgerys Creek  |
| RN21                     | 170 Martin Road Badgerys Creek  |
| RN22 (R34)               | 165 Martin Road Badgerys Creek  |
| RN23                     | 165A Martin Road Badgerys Creek |
| RN24 (R32)               | 180 Lawson Road Badgerys Creek  |
| RN25 (R35)               | 195 Martin Road Badgerys Creek  |
| RN26 (R25)               | 211 Martin Road Badgerys Creek  |
| RN27 (R9)                | 211a Martin Road Badgerys Creek |

a. Receiver labels in brackets denote receivers identified in construction and operational noise assessments.

**Figure 6-1 Road Noise Receivers**



### 6.3.2 Existing Road Noise Levels and Traffic Volumes

Wilkinson Murray has undertaken noise monitoring along Martin Road to establish the existing traffic noise levels at sensitive receivers and to facilitate validation/calibration of the noise model. Unattended noise monitoring, accompanied by contemporaneous traffic counting conducted by Austraffic Pty Ltd, was undertaken at two locations along Martin Road between Thursday 16 August and Thursday 30 August 2018. The noise monitoring and traffic counting locations are shown in Figure 6-2. The noise loggers were placed in "free-field" locations.

The results of the noise monitoring and traffic count surveys are summarised in Table 6-4 and Table 6-4, respectively.

**Table 6-3 Existing Traffic Noise Levels**

| Monitoring Location | Façade/Free-Field | Day <sup>a</sup>           | Night <sup>a</sup>        |
|---------------------|-------------------|----------------------------|---------------------------|
|                     |                   | L <sub>Aeq</sub> , 15 hour | L <sub>Aeq</sub> , 9 hour |
| L1                  | Free-field        | 53.1                       | 47.9                      |
| L2                  | Free-field        | 54.1                       | 48.4                      |

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am.

**Table 6-4 Existing Traffic Volumes**

| Location | Direction  | Day <sup>a</sup>   |                    | Night <sup>a</sup> |                    |
|----------|------------|--------------------|--------------------|--------------------|--------------------|
|          |            | Light <sup>b</sup> | Heavy <sup>b</sup> | Light <sup>b</sup> | Heavy <sup>b</sup> |
| T1       | Northbound | 212                | 144                | 11                 | 21                 |
|          | Southbound | 143                | 152                | 74                 | 20                 |
|          | Total      | 355                | 296                | 85                 | 41                 |

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am.

b. Light = Austroads vehicle classifications 1 & 2; heavy = Austroads vehicle classifications 3-12.

The traffic volumes measured during the survey are considered representative of the existing conditions along Martin Road, north of the Australian Native Landscapes (ANL) site at 210 Martin Road. South of the ANL site, the only potential sources of traffic on Martin Road are three residential properties. Therefore, the existing traffic flows and associated road noise levels at Martin Road residences south of ANL are assumed to be negligible.

**Figure 6-2 Traffic Noise and Volume Monitoring Locations**



### 6.3.3 Road Noise Modelling Methodology

The following factors have been considered during the assessment process:

- Traffic volume and proportions of heavy vehicles;
- Vehicle speed;
- Road surface type;
- Road gradient;
- Different noise emission levels and source heights;
- Ground topography;
- Location of potentially affected receivers; and,
- Allocation of traffic to different lanes

Noise levels from the introduced traffic movements were calculated using procedures based on the *CoRTN (Calculation of Road Traffic Noise)* (UK Department of Transport, 1988) prediction algorithms. The standard prediction procedures were modified as follows:

- $L_{Aeq}$  values were calculated from the  $L_{A10}$  values predicted by the *CoRTN* algorithms using the well-validated approximation  $L_{Aeq,1hr} = L_{A10,1hr} - 3$  (NSW RTA, 2001). It is worth noting the predicted  $L_{Aeq,1hr}$  is equivalent to the  $L_{Aeq,period}$  as required by the noise criteria since the input is the "average" traffic flow per hour over the given daytime and night time periods.
- Noise source heights were set at 0.5m for cars, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representative of typical values for Australian vehicles (*Road Traffic Noise: Interim Traffic Noise Policy*, 1992).
- Noise from a heavy vehicle exhaust is 8dBA lower than the (steady continuous) noise from the engine.

The model was implemented using SoundPLAN v8.0 using CoRTN Australia (NSW). Table 6-5 summarises other variables used in the noise model.

**Table 6-5 Variables used for modelling**

| Parameter         | Comment                                                                      |
|-------------------|------------------------------------------------------------------------------|
| Roads             | Manually generated                                                           |
| Traffic Speed     | 60 km/h                                                                      |
| Road surfaces     | +0dB DGA                                                                     |
| Traffic Volume    | Current traffic volumes have been provided by Austraffic traffic consultants |
| Terrain           | 2m Contours                                                                  |
| Road Alignment    | Manually generated                                                           |
| Noise Barriers    | Not applicable                                                               |
| Buildings         | Manually generated                                                           |
| Receivers         | Generated in SoundPLAN at each façade of each noise-sensitive building       |
| Ground Absorption | Ground absorption factor was set to 75% for the entire area                  |
| Façade Correction | +2.5 dB in accordance with CoRTN                                             |

Table 6-6 shows the measured and predicted road noise levels at both road noise monitoring locations.

**Table 6-6 Model Validation Results**

| Location | L <sub>Aeq,15hr</sub> dBA |           |            | L <sub>Aeq,9hr</sub> dBA |           |            |
|----------|---------------------------|-----------|------------|--------------------------|-----------|------------|
|          | Measured                  | Predicted | Difference | Measured                 | Predicted | Difference |
| Logger 1 | 53.1                      | 53.9      | -0.8       | 47.9                     | 48.7      | -0.8       |
| Logger 2 | 54.1                      | 53.2      | 0.9        | 48.4                     | 48        | 0.4        |

If the difference between measured and predicted results are within 2 dB, they are generally considered acceptable given the expected accuracy of standard noise monitoring and modelling procedures in conjunction with variability in traffic speeds and variability in pavement wear along the whole alignment. Therefore, the model validation results for both locations are considered satisfactory.

#### 6.3.4 Traffic Generated by the Development

The anticipated traffic movements generated by the development have been provided by the client and are summarised in Table 6-7. It should be noted that these traffic movements represent the total traffic generated by the Project as it would operate under the Proposal and are not incremental to movements allowed under any existing consent.

**Table 6-7 Traffic Movements Generated by the Proposal**

| Direction  | Day <sup>a</sup>   |                    | Night <sup>a</sup> |                    |
|------------|--------------------|--------------------|--------------------|--------------------|
|            | Light <sup>b</sup> | Heavy <sup>b</sup> | Light <sup>b</sup> | Heavy <sup>b</sup> |
| Northbound | 104                | 247                | 68                 | 29                 |
| Southbound | 147                | 247                | 25                 | 44                 |

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am.

b. Light = Austroads vehicle classifications 1 & 2; heavy = Austroads vehicle classifications 3-12.

#### 6.3.5 Predicted Road Noise Levels

The predicted road noise levels at sensitive receivers are summarised in Table 6-8. Noise levels are presented for the existing traffic volumes along Martin Road and for future traffic volumes which include traffic generated by the Proposal. These scenarios are termed the “no-build” and “build” scenarios, respectively.

Table 6-8 identifies those receivers where, based on the most affected façade on the property, the predicted “build” noise levels exceed the impact assessment criteria, and the increase in road noise levels due to the Proposal are greater than 2 dB. When these conditions are met, all reasonable and feasible mitigation measures should be implemented to reduce noise levels down to the impact assessment criteria.

**Table 6-8 Predicted Road Noise Levels at the Most Affected Residential Facades**

| Receiver |                      | Predicted $L_{Aeq,period}$ Noise Levels |                |             |             | Criteria |       | Increase |       | Exceed Criteria? |       | Increase > 2dB? |       | Mitigate? | Treatment Package |
|----------|----------------------|-----------------------------------------|----------------|-------------|-------------|----------|-------|----------|-------|------------------|-------|-----------------|-------|-----------|-------------------|
| ID       | Address              | No Build Day                            | No Build Night | Build Day   | Build Night | Day      | Night | Day      | Night | Day              | Night | Day             | Night |           |                   |
| RN1      | 1970 Elizabeth Drive | 45.6                                    | 39.7           | 50.1        | 44.2        | 60       | 55    | 4.5      | 4.5   | N                | N     | Y               | Y     | N         | Nil               |
| RN2      | 10 Martin Road       | 49.1                                    | 43.2           | 53.5        | 47.6        | 60       | 55    | 4.4      | 4.4   | N                | N     | Y               | Y     | N         | Nil               |
| RN3      | 30 Martin Road       | 46.9                                    | 41             | 51.3        | 45.5        | 60       | 55    | 4.4      | 4.5   | N                | N     | Y               | Y     | N         | Nil               |
| RN4      | 40 Martin Road       | 47.6                                    | 41.7           | 52          | 46.1        | 60       | 55    | 4.4      | 4.4   | N                | N     | Y               | Y     | N         | Nil               |
| RN5      | 50 Martin Road       | 55.4                                    | 49.5           | 59.8        | 53.9        | 60       | 55    | 4.4      | 4.4   | N                | N     | Y               | Y     | N         | Nil               |
| RN6      | 55 Martin Road       | 53.9                                    | 48.1           | 58.4        | 52.5        | 60       | 55    | 4.5      | 4.4   | N                | N     | Y               | Y     | N         | Nil               |
| RN7      | 50a Martin Road      | 38.8                                    | 32.9           | 43.4        | 37.6        | 60       | 55    | 4.6      | 4.7   | N                | N     | Y               | Y     | N         | Nil               |
| RN8      | 60 Martin Road       | 42.2                                    | 36.3           | 46.7        | 40.8        | 60       | 55    | 4.5      | 4.5   | N                | N     | Y               | Y     | N         | Nil               |
| RN9      | 65 Martin Road       | 56.2                                    | 50.3           | <b>60.6</b> | 54.8        | 60       | 55    | 4.4      | 4.5   | Y                | N     | Y               | Y     | <b>Y</b>  | <b>1</b>          |
| RN10     | 70 Martin Road       | 48.8                                    | 42.9           | 53.2        | 47.3        | 60       | 55    | 4.4      | 4.4   | N                | N     | Y               | Y     | N         | Nil               |
| RN11     | 80 Martin Road       | 41.9                                    | 36             | 46.4        | 40.5        | 60       | 55    | 4.5      | 4.5   | N                | N     | Y               | Y     | N         | Nil               |
| RN12     | 90 Martin Road       | 50.7                                    | 44.8           | 55.2        | 49.2        | 60       | 55    | 4.5      | 4.4   | N                | N     | Y               | Y     | N         | Nil               |
| RN13     | 100 Martin Road      | 51.8                                    | 45.9           | 56.2        | 50.3        | 60       | 55    | 4.4      | 4.4   | N                | N     | Y               | Y     | N         | Nil               |
| RN14     | 110 Martin Road      | 57.4                                    | 51.6           | <b>61.8</b> | <b>55.9</b> | 60       | 55    | 4.4      | 4.3   | Y                | Y     | Y               | Y     | <b>Y</b>  | <b>1</b>          |
| RN15     | 75 Martin Road       | 54.2                                    | 48.4           | 58.7        | 52.8        | 60       | 55    | 4.5      | 4.4   | N                | N     | Y               | Y     | N         | Nil               |
| RN16     | 120 Martin Road      | 57.8                                    | 52             | <b>62.2</b> | <b>56.3</b> | 60       | 55    | 4.4      | 4.3   | Y                | Y     | Y               | Y     | <b>Y</b>  | <b>1</b>          |
| RN17     | 85 Martin Road       | 52.6                                    | 46.7           | 57          | 51.2        | 60       | 55    | 4.4      | 4.5   | N                | N     | Y               | Y     | N         | Nil               |
| RN18     | 140 Martin Road      | 41.8                                    | 35.9           | 46.4        | 40.6        | 60       | 55    | 4.6      | 4.7   | N                | N     | Y               | Y     | N         | Nil               |
| RN19     | 150 Martin Road      | 45.4                                    | 39.5           | 49.8        | 44          | 60       | 55    | 4.4      | 4.5   | N                | N     | Y               | Y     | N         | Nil               |

| Receiver   |                  | Predicted $L_{Aeq,T}$ period Noise Levels |       |             |             | Criteria |       | Increase |       | Exceed Criteria? |       | Increase > 2dB? |       | Mitigate? | Treatment Package |
|------------|------------------|-------------------------------------------|-------|-------------|-------------|----------|-------|----------|-------|------------------|-------|-----------------|-------|-----------|-------------------|
|            |                  | No Build                                  |       | Build       |             |          |       |          |       |                  |       |                 |       |           |                   |
| ID         | Address          | Day                                       | Night | Day         | Night       | Day      | Night | Day      | Night | Day              | Night | Day             | Night |           |                   |
| RN20       | 160 Martin Road  | 47.5                                      | 41.6  | 51.9        | 46.1        | 60       | 55    | 4.4      | 4.5   | N                | N     | Y               | Y     | N         | Nil               |
| RN21       | 170 Martin Road  | 56                                        | 50.1  | 60.4        | 54.5        | 60       | 55    | 4.4      | 4.4   | N                | N     | Y               | Y     | N         | Nil               |
| RN22 (R34) | 165 Martin Road  | 57.5                                      | 51.7  | <b>61.9</b> | <b>56.1</b> | 60       | 55    | 4.4      | 4.4   | Y                | Y     | Y               | Y     | <b>Y</b>  | <b>1</b>          |
| RN23       | 165A Martin Road | 54.2                                      | 48.3  | 58.6        | 52.8        | 60       | 55    | 4.4      | 4.5   | N                | N     | Y               | Y     | N         | Nil               |
| RN24 (R32) | 180 Lawson Road  | 44.7                                      | 38.8  | 49.5        | 43.7        | 60       | 55    | 4.8      | 4.9   | N                | N     | Y               | Y     | N         | Nil               |
| RN25 (R35) | 195 Martin Road  | 47                                        | 41    | 54.4        | 48.6        | 60       | 55    | 7.4      | 7.6   | N                | N     | Y               | Y     | N         | Nil               |
| RN26 (R25) | 211 Martin Road  | 39.2                                      | 33.2  | 44.1        | 38.3        | 60       | 55    | 4.9      | 5.1   | N                | N     | Y               | Y     | N         | Nil               |
| RN27 (R9)  | 211a Martin Road | 37.7                                      | 31.7  | 42.6        | 36.8        | 60       | 55    | 4.9      | 5.1   | N                | N     | Y               | Y     | N         | Nil               |

### 6.3.6 Mitigation of Road Noise

There are four receivers identified as qualifying for mitigation of the increases in noise levels due to the operation of the Proposal. For each of these receivers, the exceedance of the impact assessment criteria is less than 2 dB and the increase in road noise levels due to the operation of the Proposal is less than 5 dB.

Architectural treatments to properties are considered the most appropriate means of achieving the required reductions in road noise levels at receivers qualifying for mitigation. The RMS *Draft At-Receiver Treatment Guideline* provides deemed-to-comply construction solutions for a range of "treatment package types". All receivers qualifying for mitigation would require the "Type 1" treatment package, outlined below:

- For all dwelling construction types:
  - Optional ceiling fans;
  - Mechanical ventilation;
  - New acoustic seals for windows;
  - Seals around window architraves and door jambs; and,
  - Seal all vents and openings.
- For brick homes:
  - 6.38mm laminated glass, or equivalent, on all glass sliding doors.
- For lightweight (i.e. weatherboard) homes:
  - Subfloor sealing; and,
  - Roof insulation (R4.0, 215 mm thick).

It is noted that, where truck movements generated by the Proposal are not greater than those allowed under the current Project Approval, no architectural treatments would be warranted at receivers on Martin Road.

## 6.4 Road Noise Impacts Along Elizabeth Drive

The traffic impact assessment for the Proposal advises that approximately 75% of the traffic movements to and from the site will travel along the section of Elizabeth Drive that is east of Martin Road. Therefore, the assessment of potential road noise impacts will focus on this section of Elizabeth Drive.

### 6.4.1 Traffic Volume and Percent Heavy Vehicles

The traffic impact assessment advises that the existing peak hour traffic volume along Elizabeth Drive is approximately 1200 vehicles, with heavy vehicles contributing 12% of the total traffic flow. To assess 15-hour daytime and 9-hour night time road traffic noise levels, it assumed that the peak hourly traffic volume accounts for 10% of the average daily traffic volume and that the night time traffic volume accounts for 10% of the average daily traffic volume.

Table 6-9 presents the existing ("no build") and future ("build") traffic volumes and percent heavy vehicles ("mix") along Elizabeth Drive, east of Martin Road.

**Table 6-9 Traffic Volume and Mix – Elizabeth Drive**

| Road                             | Time <sup>a</sup> | Existing<br>(no build) |     | Future<br>(build) |     |
|----------------------------------|-------------------|------------------------|-----|-------------------|-----|
|                                  |                   | Volume                 | Mix | Volume            | Mix |
| Elizabeth Drive – East of Martin | Day               | 10,800                 | 12% | 11,358            | 15% |
| Road                             | Night             | 1,200                  | 12% | 1,324             | 15% |

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am

Using the traffic data in Table 6-9, the no-build and build road traffic noise levels have been predicted at the front façade of potentially affected receivers along Elizabeth Drive. These noise levels have been predicted using the CoRTN model and are based on the following additional inputs:

- The posted speed limit along Elizabeth Drive is 80 km/h;
- The front façade of the most potentially affected receivers is approximately 90 metres from the nearest edge of Elizabeth Drive; and,
- A +2.5 dBA façade correction has been applied.

Table 6-10 presents the predicted road noise levels at the most potentially affected receiver locations along Elizabeth Drive with and without the Proposal.

**Table 6-10 Predicted  $L_{Aeq,period}$  Road Noise Levels – Elizabeth Drive**

| Road                                     | No Build         |                    | Build            |                    | Criteria         |                    | Difference       |                    |
|------------------------------------------|------------------|--------------------|------------------|--------------------|------------------|--------------------|------------------|--------------------|
|                                          | Day <sup>a</sup> | Night <sup>a</sup> | Day <sup>a</sup> | Night <sup>a</sup> | Day <sup>a</sup> | Night <sup>a</sup> | Day <sup>a</sup> | Night <sup>a</sup> |
| Elizabeth Drive – East of Martin<br>Road | 57.7             | 50.4               | 58.4             | 51.3               | 60               | 55                 | 0.7              | 0.9                |

Review of Table 6-10 indicates that the predicted  $L_{Aeq,period}$  road noise levels at the façade of the most potentially affected receivers along Elizabeth Drive comply with the RNP impact assessment criteria and that the increase in traffic noise levels due to the Proposal is less than 2 dBA.

## 7 CONSTRUCTION NOISE ASSESSMENT

The following section presents an assessment of potential noise impacts associated with the construction of the Proposal.

The construction of the Proposal would likely begin in June 2020 and the works would take approximately 18 months to complete.

In addition to the construction works proposed to be undertaken within the Proposal site, potential noise impacts associated with the construction of the proposed signalised intersection have also been assessed. The most potentially affected sensitive receivers near the intersection works are 1970 Elizabeth Drive and 10 Martin Road. These receivers were identified in the detailed road noise assessment as receivers RN1 and RN2, respectively. These receiver designations will be used in this construction noise assessment.

### 7.1 Construction Noise Management Levels

The *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) recommends noise management levels (NML) to reduce the likelihood of noise impacts arising from construction activities. The ICNG NML for residential receivers are shown in Table 7-1.

**Table 7-1 Construction NMLs at Residences**

| Time of Day                                                                                                                             | Management Level<br>$L_{Aeq,15min}$<br>(dBA) | How to Apply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Recommended Standard Hours:</b><br>Monday to Friday<br>7am to 6pm<br>Saturday<br>8am to 1pm<br>No work on Sundays or Public Holidays | Noise affected<br>RBL + 10dBA                | <p>The noise affected level represents the point above which there may be some community reaction to noise.</p> <p>Where the predicted or measured <math>L_{Aeq,(15min)}</math> is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise.</p> <p>The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.</p>                                                                     |
|                                                                                                                                         | Highly noise affected<br>75dBA               | <p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <p>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.</p> <p>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.</p> |
| Outside recommended standard hours                                                                                                      | Noise affected<br>RBL + 5 dB                 | <p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.</p> <p>For guidance on negotiating agreements see section 7.2.2.</p>                                                                                                   |

It is expected that all construction activities will be conducted within standard construction hours.

Based on the established RBLs, construction noise management levels for residential receivers near the Proposal site are presented in Table 7-2.

**Table 7-2 Project-specific construction NML**

| Receiver                 | Acceptable $L_{Aeq,15min}$<br>Noise Level<br>(Standard daytime<br>construction hours) | Highly Affected<br>Noise Level<br>(dBA) |
|--------------------------|---------------------------------------------------------------------------------------|-----------------------------------------|
| R9, R25, R35             | 50                                                                                    | 75                                      |
| R5, R26-R32, R34, R42-46 | 47                                                                                    | 75                                      |
| R11-R15                  | 48                                                                                    | 75                                      |

Background noise monitoring location L1 (see Section 4.1) is considered most representative of the existing ambient noise environment at receivers RN1 and RN2, located near the intersection works. Therefore, the applicable construction NML at these receivers is 50 dBA.

## 7.2 Construction Noise Modelling Methodology

Site-related noise emissions were modelled with the "CadnaA" noise prediction software using the CONCAWE noise prediction algorithms. Factors that are addressed in the noise model are:

- equipment sound level emissions and location;
- screening effects from barriers;
- receiver locations;
- ground topography;
- noise attenuation due to geometric spreading;
- ground absorption; and
- atmospheric absorption.

Noise predictions have been made based on the likely worst-case impacts taking into consideration the anticipated construction scenarios. This has been made based on Wilkinson Murray's previous experience with similar scale construction projects. As a worst-case scenario, this assumes that most of the relevant plant would be operating during most of the 15-minute assessment period.

## 7.3 Assessment of Construction Activities within the Proposal Site

### 7.3.1 Construction Plant, Activities and Sound Power Levels

The main activities and noisiest plant items to be used for construction are listed in Table 7-3. The table also provides typical sound power levels of the equipment, based on measurements previously conducted by Wilkinson Murray, and the resultant total sound power for each

construction activity.

**Table 7-3 Sound Power Levels for Construction Plant**

| Construction Activity           | Plant         | Individual Sound Power Level (dBA) | Activity Sound Power Level (dBA) |
|---------------------------------|---------------|------------------------------------|----------------------------------|
| Clearing and Earthworks         | Dozer         | 116                                | Piling: 123<br>No piling: 118    |
|                                 | Roller        | 109                                |                                  |
|                                 | Backhoe       | 105                                |                                  |
|                                 | Excavator     | 110                                |                                  |
|                                 | Piling rig    | 121                                |                                  |
|                                 | Generator     | 95                                 |                                  |
|                                 | Trucks        | 105                                |                                  |
|                                 | Water cart    | 105                                |                                  |
| Construction of New Buildings   | Compressor    | 100                                | 116                              |
|                                 | Generator     | 95                                 |                                  |
|                                 | Concrete pump | 103                                |                                  |
|                                 | Agitators     | 105                                |                                  |
|                                 | Concrete saw  | 112                                |                                  |
|                                 | Mobile crane  | 110                                |                                  |
|                                 | Forklift      | 100                                |                                  |
|                                 | Trucks        | 105                                |                                  |
|                                 | Welder        | 90                                 |                                  |
|                                 | Compressor    | 100                                |                                  |
| Additions to Existing Buildings | Generator     | 95                                 | 112                              |
|                                 | Mobile crane  | 110                                |                                  |
|                                 | Forklift      | 100                                |                                  |
|                                 | Trucks        | 105                                |                                  |
|                                 | Welder        | 90                                 |                                  |
|                                 | Compressor    | 100                                |                                  |

The activity sound power is considered to represent the typical worst-case level in a given 15-minute period. It is important to note that this sound power level is unlikely to be sustained at such a level for the duration of the activity. As a result, many 15-minute periods will be at lower levels.

The clearing and earthworks construction activity was modelled within the roof products site where buildings and hardstand areas are to be located and within the brick making site where the noise barriers are proposed in the north eastern corner and on top of the existing bund along the driveway. Where these activities are associated with the construction of noise bunds, piling activities would not be conducted. Construction of new buildings was modelled within the roof products site where buildings are to be located and within the brick making site where the new admin buildings and the north eastern corner and driveway noise barriers are to be located. Alterations to existing buildings were modelled at the main building within the brick making site.

In addition to the construction activities outlined above, which will occur prior to the operation of the brick and roof products manufacturing facilities, the construction of the Pit 5 noise bund has also been modelled. However, these construction activities have been modelled as occurring concurrently with other site operations; specifically, during manufacturing activities and overburden removal in Pit 4. Therefore, the predicted  $L_{Aeq,15min}$  noise levels during the construction of the Pit 5 noise bund represent the worst-case cumulative noise levels from the Proposal.

### 7.3.2 Predicted Construction Noise Levels

The predicted  $L_{Aeq,15min}$  construction noise levels at sensitive receivers are presented in Table 7-4 for construction activities that will occur prior to operations. Predicted noise levels are presented for each of the identified construction activities occurring at the relevant locations within the brick making and roof products sites. Exceedances of the NML are highlighted in bold text, and the range of predicted exceedances is presented for each receiver.

**Table 7-4 Predicted  $L_{Aeq,15min}$  Construction Noise Levels**

| Receiver | NML | Predicted Level       |      |                               |      |                                 |      | Pit 5 Noise Bund | Exceedances |
|----------|-----|-----------------------|------|-------------------------------|------|---------------------------------|------|------------------|-------------|
|          |     | Clearing & Earthworks |      | Construction of New Buildings |      | Additions to Existing Buildings |      |                  |             |
|          |     | Brick                 | Roof | Brick                         | Roof | Brick                           | Roof |                  |             |
| R5       | 47  | 43                    | 36   | 41                            | 32   | 39                              | n/a  | 62               | 15 dB       |
| R9       | 50  | 74                    | 48   | 72                            | 47   | 28                              | n/a  | 43               | 24 dB       |
| R11      | 48  | 27                    | 42   | 25                            | 36   | 21                              | n/a  | 35               | -           |
| R12      | 48  | 28                    | 43   | 25                            | 37   | 22                              | n/a  | 36               | -           |
| R12a     | 48  | 28                    | 43   | 26                            | 37   | 21                              | n/a  | 37               | -           |
| R13      | 48  | 28                    | 44   | 26                            | 38   | 23                              | n/a  | 37               | -           |
| R14      | 48  | 29                    | 43   | 27                            | 38   | 22                              | n/a  | 37               | -           |
| R15      | 48  | 30                    | 42   | 28                            | 38   | 22                              | n/a  | 36               | -           |
| R25      | 50  | 72                    | 48   | 70                            | 47   | 28                              | n/a  | 44               | 22 dB       |
| R26      | 47  | 50                    | 37   | 49                            | 35   | 37                              | n/a  | 59               | 12 dB       |
| R27      | 47  | 44                    | 36   | 42                            | 35   | 35                              | n/a  | 52               | 5 dB        |
| R28      | 47  | 40                    | 35   | 38                            | 32   | 35                              | n/a  | 52               | 5 dB        |
| R29      | 47  | 42                    | 36   | 40                            | 34   | 32                              | n/a  | 43               | -           |
| R30      | 47  | 41                    | 35   | 39                            | 33   | 29                              | n/a  | 41               | -           |
| R31      | 47  | 42                    | 35   | 40                            | 33   | 34                              | n/a  | 46               | -           |
| R32      | 47  | 48                    | 37   | 46                            | 38   | 31                              | n/a  | 41               | 1 dB        |
| R34      | 47  | 44                    | 38   | 42                            | 36   | 29                              | n/a  | 38               | -           |
| R35      | 50  | 56                    | 43   | 54                            | 45   | 25                              | n/a  | 41               | 6 dB        |
| R42      | 47  | 43                    | 36   | 41                            | 33   | 37                              | n/a  | 58               | 11 dB       |
| R43      | 47  | 41                    | 34   | 39                            | 33   | 32                              | n/a  | 44               | -           |
| R44      | 47  | 37                    | 32   | 35                            | 31   | 28                              | n/a  | 37               | -           |

| Receiver | NML | Predicted Level       |      |                               |      |                                 |      | Pit 5 Noise Bund | Exceedances |
|----------|-----|-----------------------|------|-------------------------------|------|---------------------------------|------|------------------|-------------|
|          |     | Clearing & Earthworks |      | Construction of New Buildings |      | Additions to Existing Buildings |      |                  |             |
|          |     | Brick                 | Roof | Brick                         | Roof | Brick                           | Roof |                  |             |
| R45      | 47  | 39                    | 34   | 37                            | 32   | 28                              | n/a  | 38               | -           |
| R46      | 47  | 40                    | 37   | 38                            | 34   | 26                              | n/a  | 35               | -           |

The results in Table 7-4 indicate the potential for construction noise levels to exceed the NML at several receivers. The predicted exceedances range from 1 dB to 24 dB. No exceedances of the 75 dBA highly affected level are predicted.

## 7.4 Assessment of Construction Noise from Intersection Works

### 7.4.1 Construction Plant, Activities and Sound Power Levels

The main activities and noisiest plant items likely to be used for the intersection works are listed in Table 7-5. The table also provides typical sound power levels of the equipment, as published by RMS, and the resultant total sound power for each construction activity.

**Table 7-5 Sound Power Levels for Construction Plant**

| Construction Activity | Description                                                                      | Plant                     | Individual Sound Power Level (dBA) | Activity Sound Power Level (dBA) |
|-----------------------|----------------------------------------------------------------------------------|---------------------------|------------------------------------|----------------------------------|
| Bulk Earthworks       | Formation of road alignment.                                                     | Dozer                     | 116                                | 118                              |
|                       |                                                                                  | Scraper                   | 110                                |                                  |
|                       |                                                                                  | Excavator                 | 110                                |                                  |
|                       | Excavation of soil and rock, loading, haulage, compaction of fill areas, grading | Grader                    | 113                                |                                  |
|                       |                                                                                  | Dump truck                | 110                                |                                  |
|                       |                                                                                  | Compactor                 | 106                                |                                  |
|                       |                                                                                  | Roller                    | 109                                |                                  |
|                       |                                                                                  | Water cart                | 107                                |                                  |
| Paving/asphalting     | Delivery of raw materials, placement of surface material, saw cutting.           | Pavement laying machine   | 114                                | 118                              |
|                       |                                                                                  | Dump truck                | 110                                |                                  |
|                       |                                                                                  | Asphalt truck and sprayer | 103                                |                                  |
|                       |                                                                                  | Concrete truck            | 109                                |                                  |
|                       |                                                                                  | Smooth drum roller        | 107                                |                                  |
|                       |                                                                                  | Concrete saw              | 118                                |                                  |

| Construction Activity       | Description                  | Plant              | Individual Sound Power Level (dBA) | Activity Sound Power Level (dBA) |
|-----------------------------|------------------------------|--------------------|------------------------------------|----------------------------------|
| Road furniture installation | Signposting and line marking | Road truck         | 108                                | 111                              |
|                             |                              | Scissor lift       | 98                                 |                                  |
|                             |                              | Franna crane       | 98                                 |                                  |
|                             |                              | Line marking truck | 108                                |                                  |

The activity sound power is considered to represent the typical worst-case level in a given 15-minute period. It is important to note that this sound power level is unlikely to be sustained at such a level for the duration of the activity. As a result, many 15-minute periods will be at lower levels.

Construction plant were modelled as operating within the construction footprint shown in Figure 7-1. This footprint is based on the concept design of the intersection for traffic volumes generated by the Modification 4 Proposal and is therefore considered to be a worst case scenario.

**Figure 7-1 Intersection Works Footprint**



#### 7.4.2 Predicted Construction Noise Levels

The predicted  $L_{Aeq,15min}$  noise levels at sensitive receivers associated with the proposed intersection works are presented in Table 7-6. Exceedances of the NML are highlighted in bold text, and the range of predicted exceedances is presented for each receiver.

**Table 7-6 Predicted  $L_{Aeq,15min}$  Construction Noise Levels**

| Receiver | NML | Predicted Level |                   |                        | Exceedance |
|----------|-----|-----------------|-------------------|------------------------|------------|
|          |     | Bulk Earthworks | Paving/Asphalting | Furniture Installation |            |
| RN1      | 50  | 73              | 71                | 65                     | 23 dB      |
| RN2      | 50  | 71              | 69                | 63                     | 21 dB      |

The results in Table 7-6 indicate the potential for construction noise levels to exceed the NML by up to 23 dBA at nearby receivers during the proposed intersection works. No exceedances of the 75 dBA highly affected level are predicted.

## 7.5 Construction Noise Mitigation

As outlined above, there is potential for noise levels associated with the construction of the Proposal to exceed the established NML. Therefore, all reasonable and feasible measures should be applied to manage noise levels down to the NML. These measures should be documented in a *Construction Noise Management Plan* (CNMP) and should include:

- Identification of nearby residences and other sensitive land uses;
- Description of approved hours of work;
- Description and identification of construction activities, including work areas, equipment and duration;
- Description of what work practices (generic and specific) will be applied to minimise noise and vibration;
- Consider the selection of plant and processes with reduced noise emissions;
- A complaints handling process;
- Noise monitoring procedures;
- Overview of community consultation required for identified high impact works;
- Induction and training will be provided to relevant staff and sub- contractors outlining their responsibilities with regard to noise; and,
- Procedures for approval of any works undertaken outside of the following hours:
  - Standard hours of 7:00 am to 6:00 pm Monday to Friday, and 8:00am to 1:00 pm Saturday

Examples of typical construction noise mitigation measures are provided in Table 7-7, along with the likely reduction in noise levels. Where reasonable and feasible, these measures should be employed during the construction of the Proposal.

**Table 7-7 Indicative Construction Noise Mitigation Measures**

| Mitigation Measure                                                                                                                                                                    | Anticipated Noise Reduction, dBA |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| <b>Administrative Controls</b>                                                                                                                                                        |                                  |
| Operate during approved hours                                                                                                                                                         | N/A                              |
| Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers                                                                                  | N/A                              |
| Appropriate training of onsite staff                                                                                                                                                  | N/A                              |
| Undertake community consultation and respond to complaints in accordance with established project procedures                                                                          | N/A                              |
| Turning off machinery when not in use                                                                                                                                                 | 0-5                              |
| Respite periods for pile drivers and rock breakers                                                                                                                                    | N/A                              |
| <b>Engineering Controls</b>                                                                                                                                                           |                                  |
| Portable temporary screens                                                                                                                                                            | 5-10                             |
| Screen or enclosure for stationary equipment                                                                                                                                          | 10-15                            |
| Maximising the offset distance between noisy plant items and sensitive receivers                                                                                                      | 3-6                              |
| Avoiding using noisy plant simultaneously and / or close together, adjacent to sensitive receivers                                                                                    | 2-3                              |
| Orienting equipment away from sensitive receivers                                                                                                                                     | 3-5                              |
| Carrying out loading and unloading away from sensitive receivers                                                                                                                      | 3-5                              |
| Using dampened tips on rock breakers                                                                                                                                                  | 3-6                              |
| Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks | 5-10                             |
| Selecting site access points and roads as far as reasonably practicable away from sensitive receivers                                                                                 | 3-6                              |
| Using spotters, closed circuit television monitors, "smart" reversing alarms, or "squawker" type reversing alarms in place of traditional reversing alarms                            | 2-5                              |
| Employ non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers                                                                    | 5-10                             |

## 8 CONCLUSION

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In October 2016, CSR Building Products Limited (CSR) acquired Boral Bricks Pty Limited (Boral) brick business along the eastern seaboard of Australia and with it, the Badgerys Creek Brick Making Facility site ('the site'), which is strategically placed in the Western Sydney Priority Growth Area and borders on the proposed Western Sydney Airport precinct.

CSR is seeking to modify the Project Approval (10\_0014) to permit or allow the following additional development or changes to the approved project:

- Upgrades and additions to the existing brick making facility;
- Construction of a new roof products manufacturing facility on a parcel of land immediately to the east of the existing site boundary; and,
- Recommencement of quarrying operations in general accordance with the Project Approval.

Wilkinson Murray has been engaged by Element Environment, on behalf of CSR, to prepare a Noise Impact Assessment for the Proposal.

Existing ambient noise levels have been established at nearby sensitive receivers via long-term unattended noise monitoring. The noise monitoring data has been processed in accordance with the NPfI to establish the RBLs at sensitive receivers.

Noise impacts associated with the operation of the Proposal have been assessed in accordance with the NPfI. Project noise trigger levels have been established for the morning shoulder, day, evening and night time periods.

A computer noise model has been developed to predict the  $L_{Aeq,15min}$  operational noise levels at sensitive receivers. Meteorological data from the nearby Bringelly AQMS has been analysed to identify the potential for noise-enhancing meteorology. Both temperature inversions and gradient winds are considered to be a feature of the area and have been incorporated into the noise model.

Based on information from CSR and previous noise assessments of the site, operating parameters, equipment and source sound power levels have been developed to describe several noise assessment scenarios for the Proposal.

$L_{Aeq,15min}$  operational noise levels have been predicted at sensitive receivers for each assessment scenario, for both calm and noise-enhancing meteorological conditions. The predicted noise levels comply with the established project noise trigger levels for all scenarios during calm meteorological conditions.

During noise-enhancing meteorological conditions, the predicted  $L_{Aeq,15min}$  operational noise levels exceed the daytime project noise trigger levels at a number of receivers to the north of the site. Options to mitigate these exceedances, comprising additional noise barriers, have been identified.

Noise impacts from the construction of the Modification 3 Proposal have been assessed in accordance with the ICNG. Construction NMLs have been established for sensitive receivers based on the established RBL. A computer noise model has been developed to predict  $L_{Aeq,15min}$  construction noise levels at sensitive receivers.

Construction noise levels have been predicted for a range of construction activities, including the construction of noise barriers and the proposed works at the Elizabeth Drive – Martin Road Intersection. The predicted  $L_{Aeq,15min}$  construction noise levels exceed the established NML at

several receivers, but no exceedances of the 75 dBA highly affected level were predicted. It is recommended that a CNMP be developed and that all reasonable and feasible measures be implemented to manage construction noise levels down towards the NML.

The Proposal will generate additional traffic along the surrounding public road network. The increase will be most prominent along Martin Road, and will largely be due to heavy vehicles transporting goods to and from the Proposal site.

Road noise impacts associated with the operation of the Proposal have been assessed in accordance with the RNP.

Martin Road services a number of industrial sites and has significantly more heavy vehicle traffic than a typical local road. Therefore, as recommended in the RNP, Martin Road is considered a principal haul route and is to be assessed using impact assessment criteria for arterial/sub-arterial roads.

Existing traffic volumes and road noise levels along Martin road have been established using long-term unattended noise logging and contemporaneous traffic counting. A computer noise model has been developed and calibrated using the monitoring data.

Traffic noise levels during the operation of the Proposal have been predicted, and at four receivers, have been found to exceed the impact assessment criteria and increase by more than 2 dB compared to the 'no-build' noise levels.

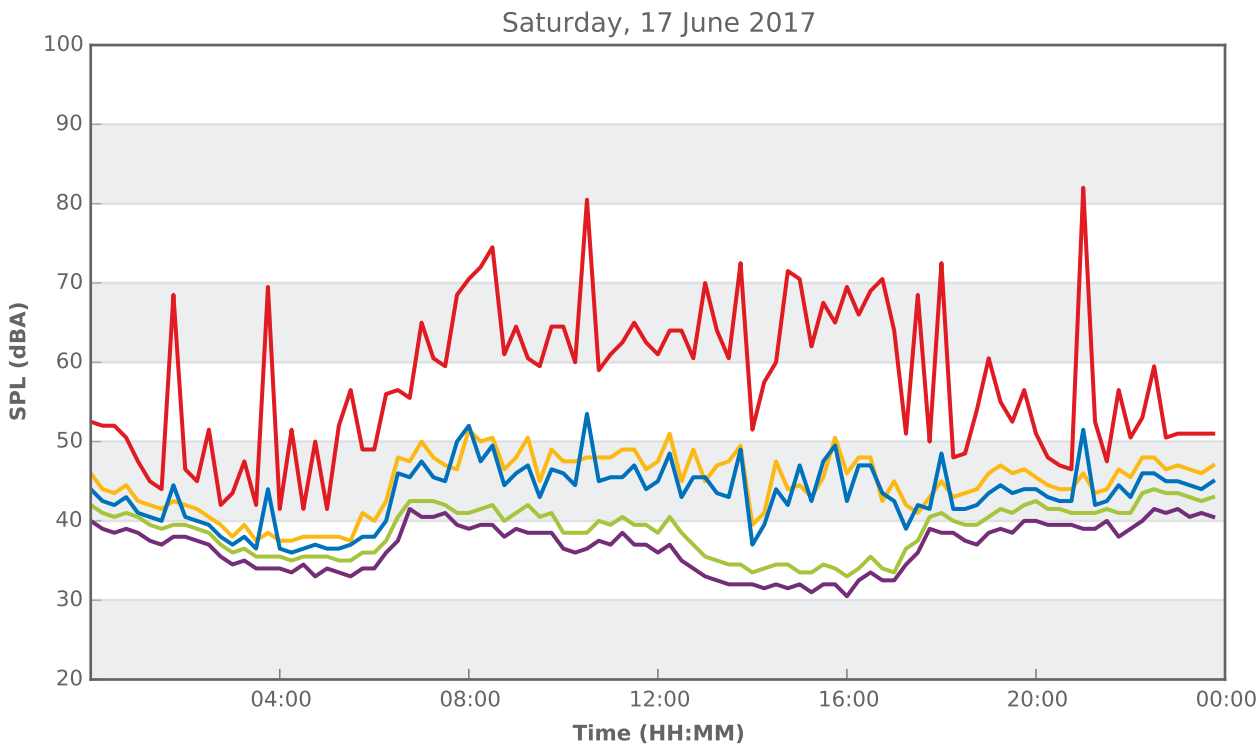
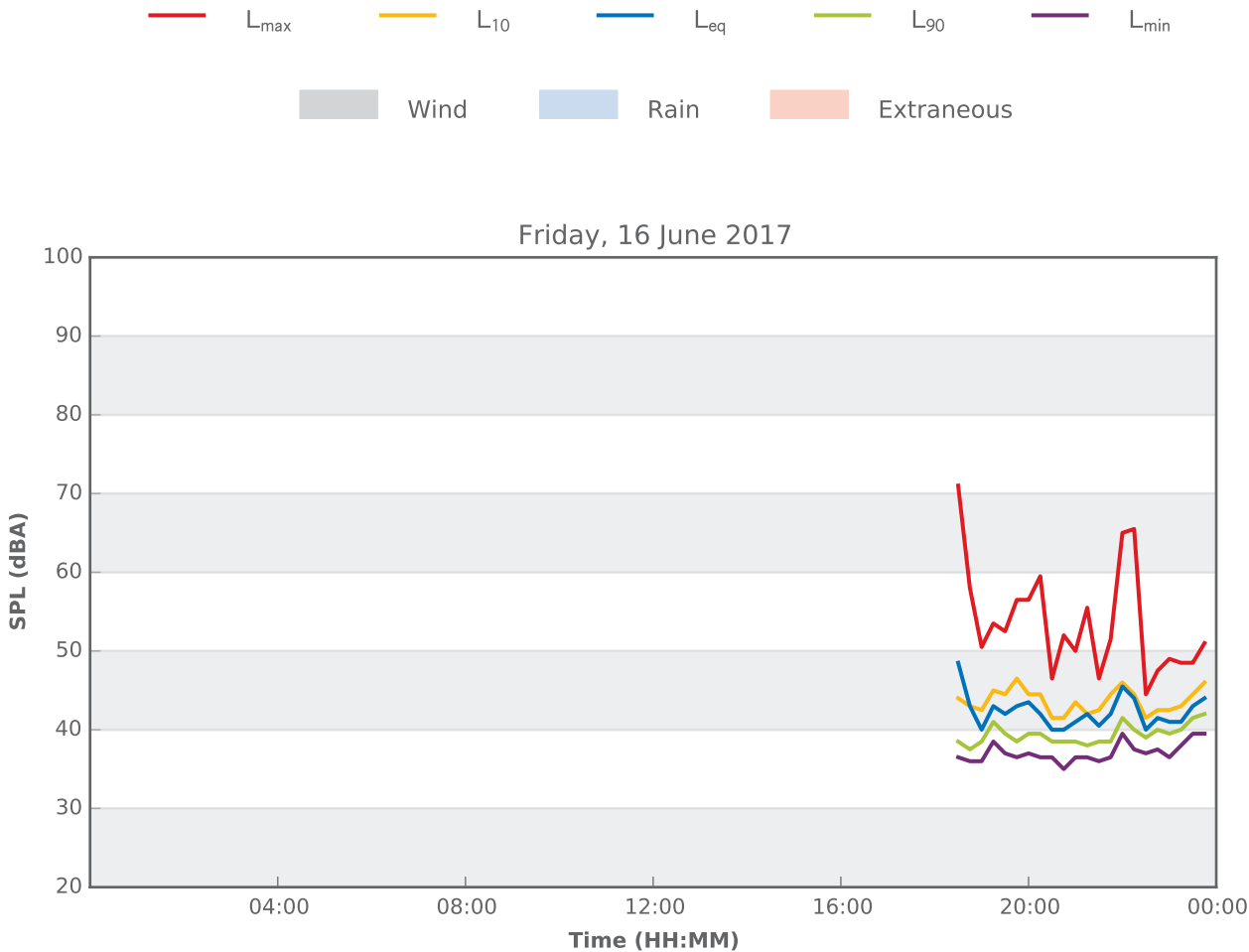
Appropriate architectural treatments to reduce road noise levels have been recommended for receivers qualifying for mitigation.

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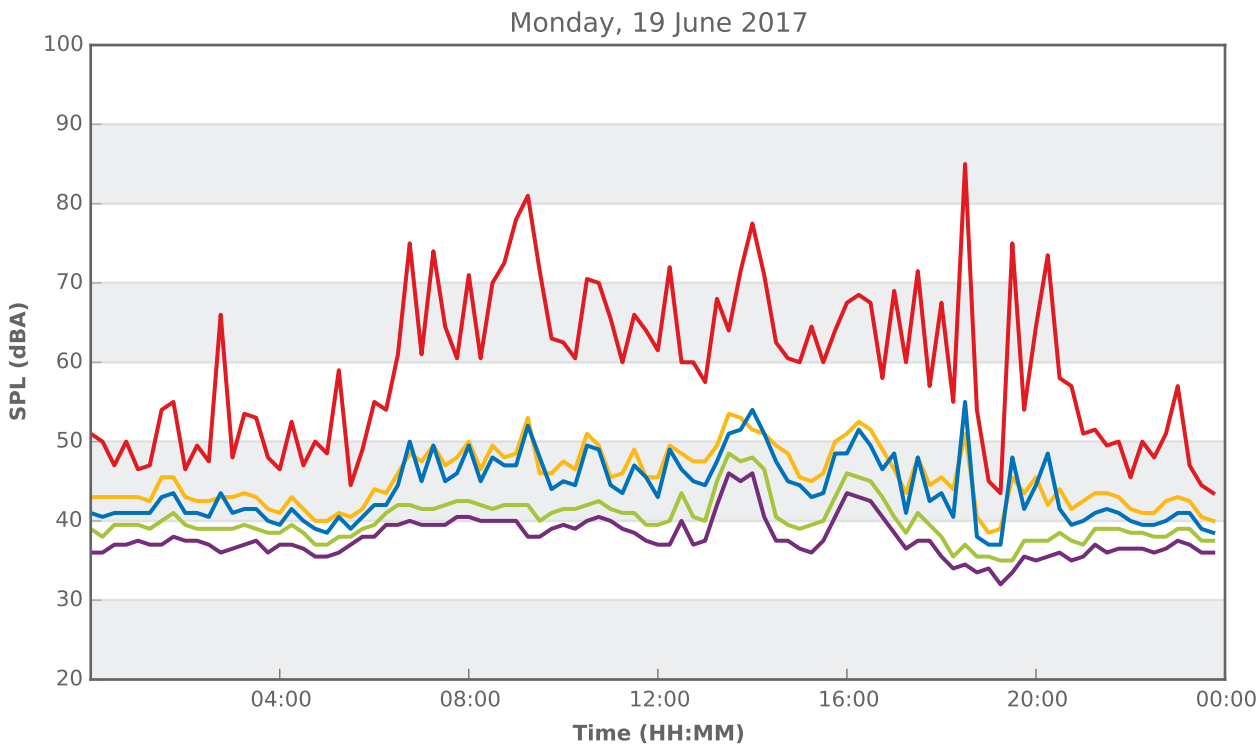
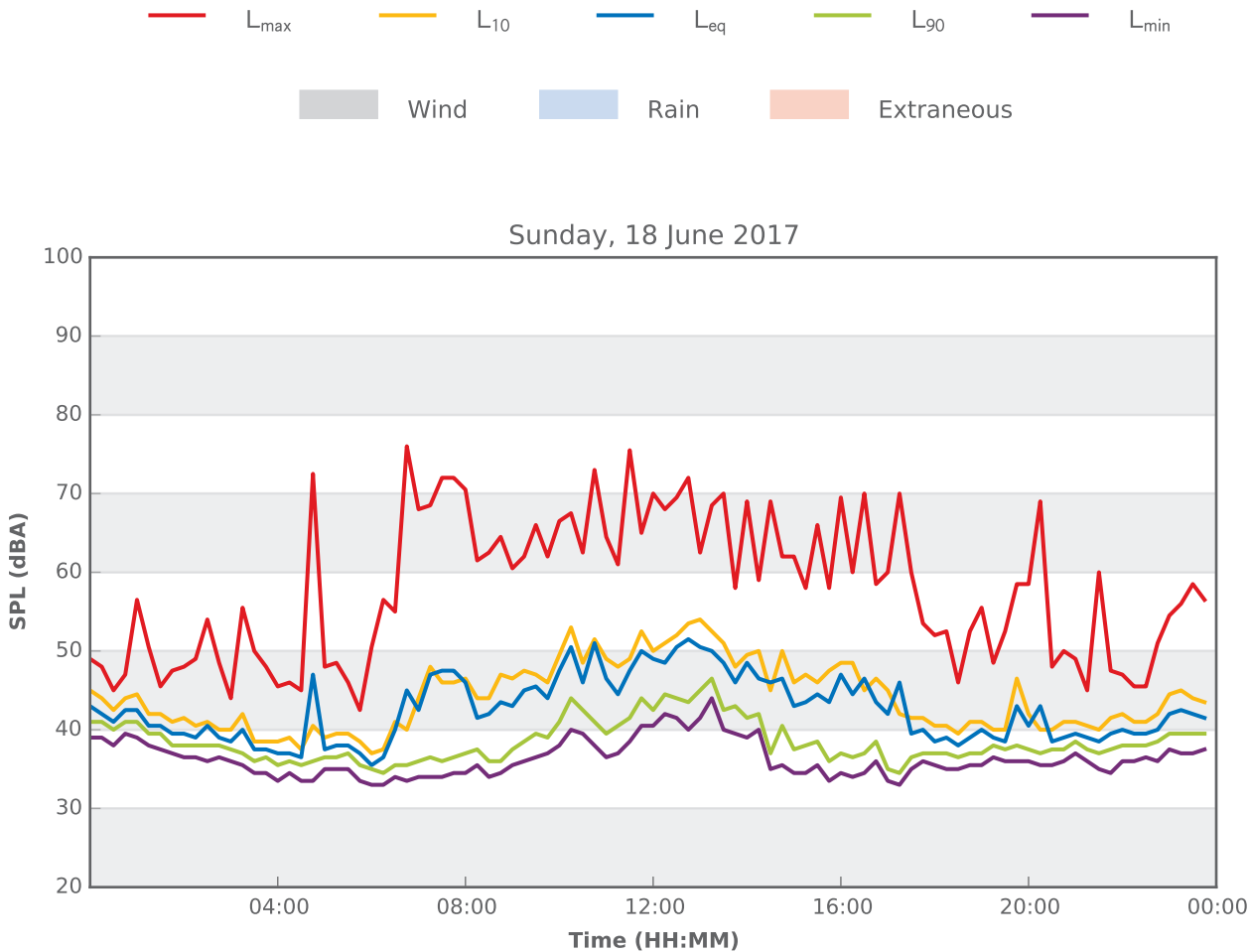
## APPENDIX A

### NOISE MEASUREMENT RESULTS

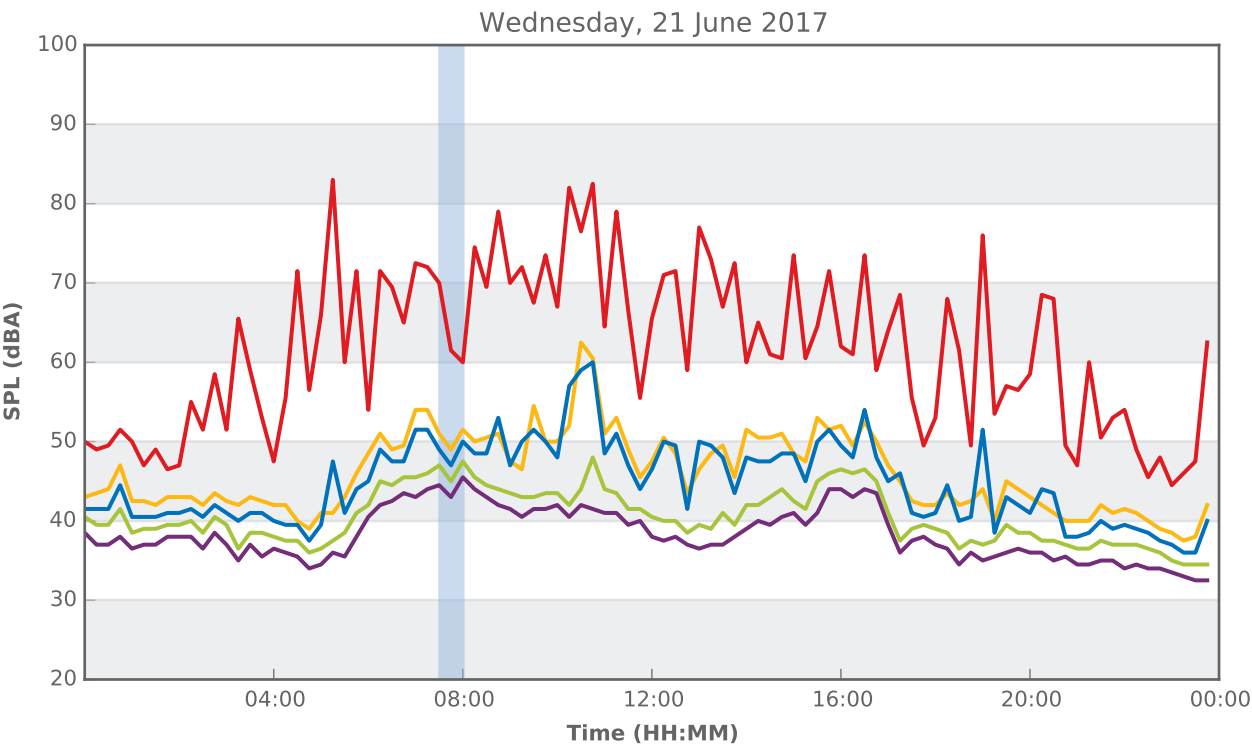
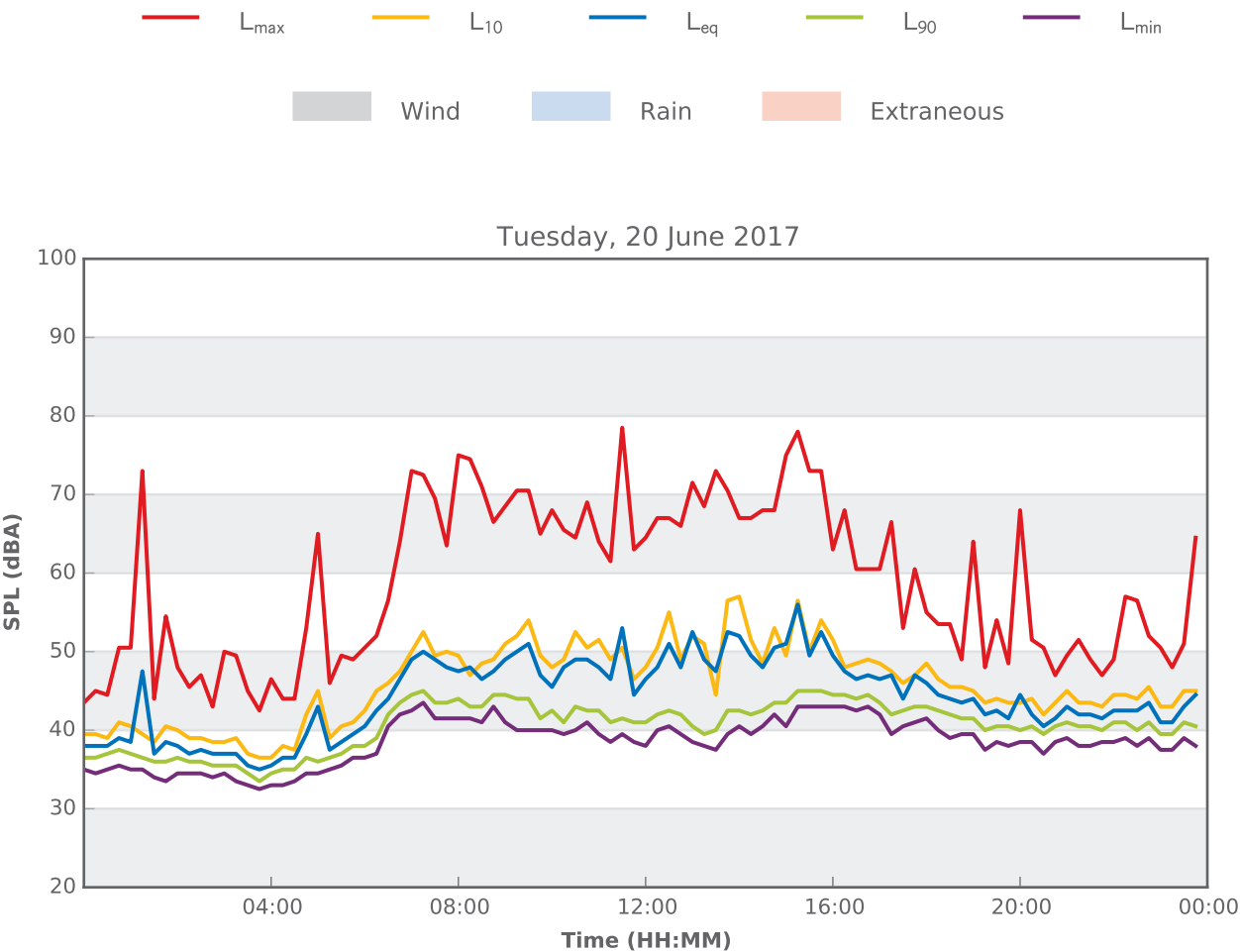
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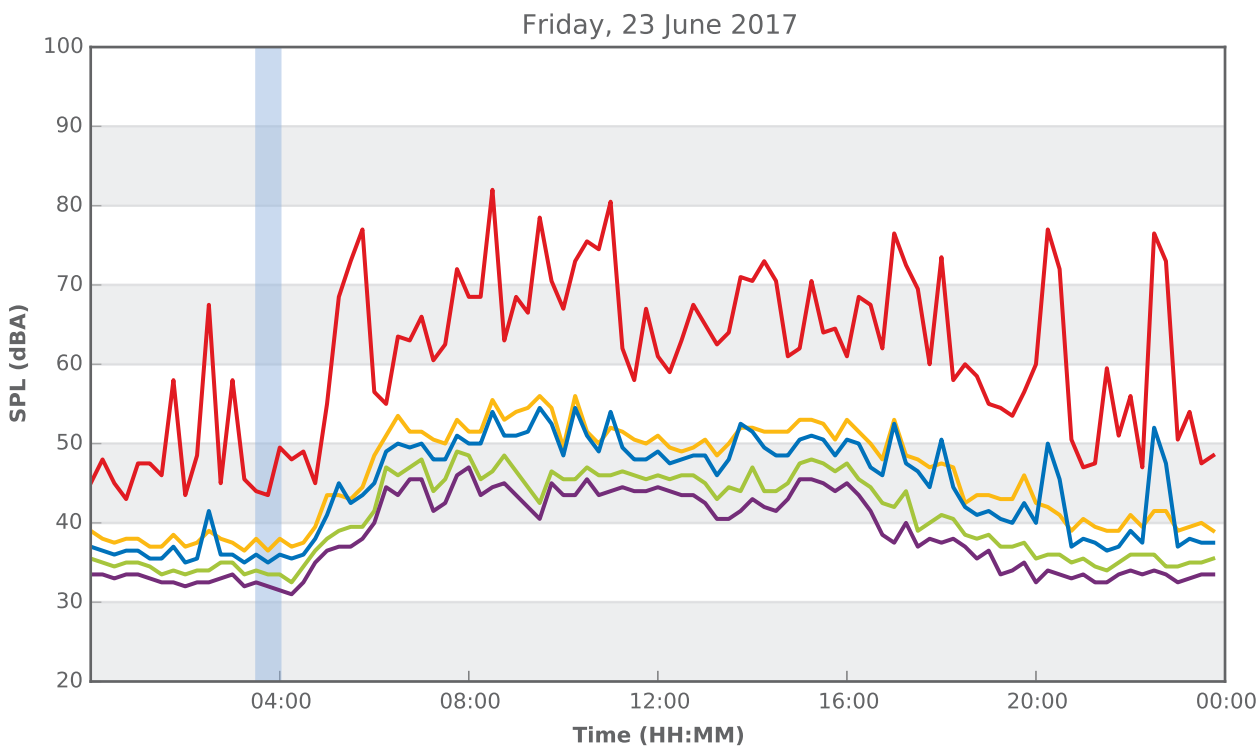
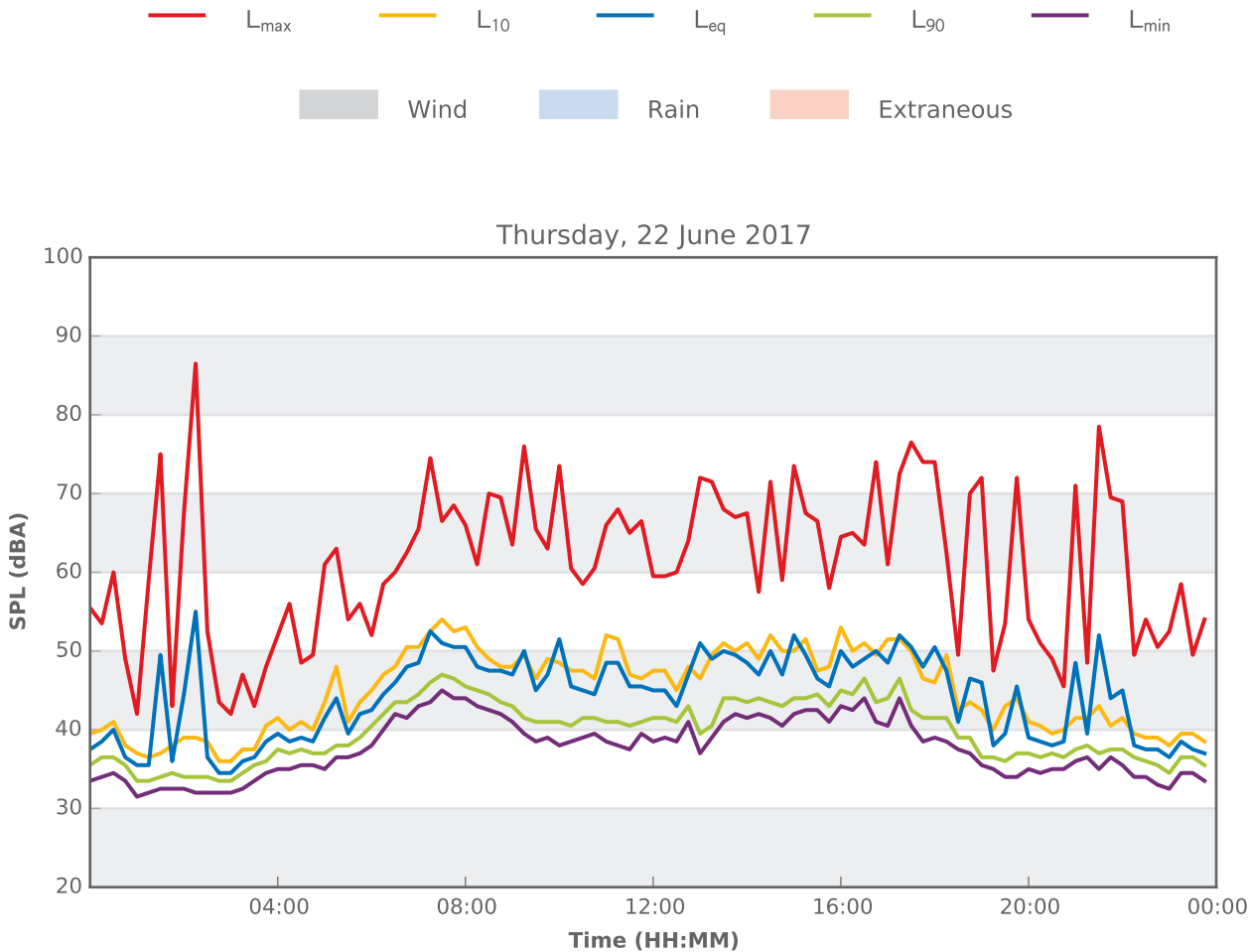
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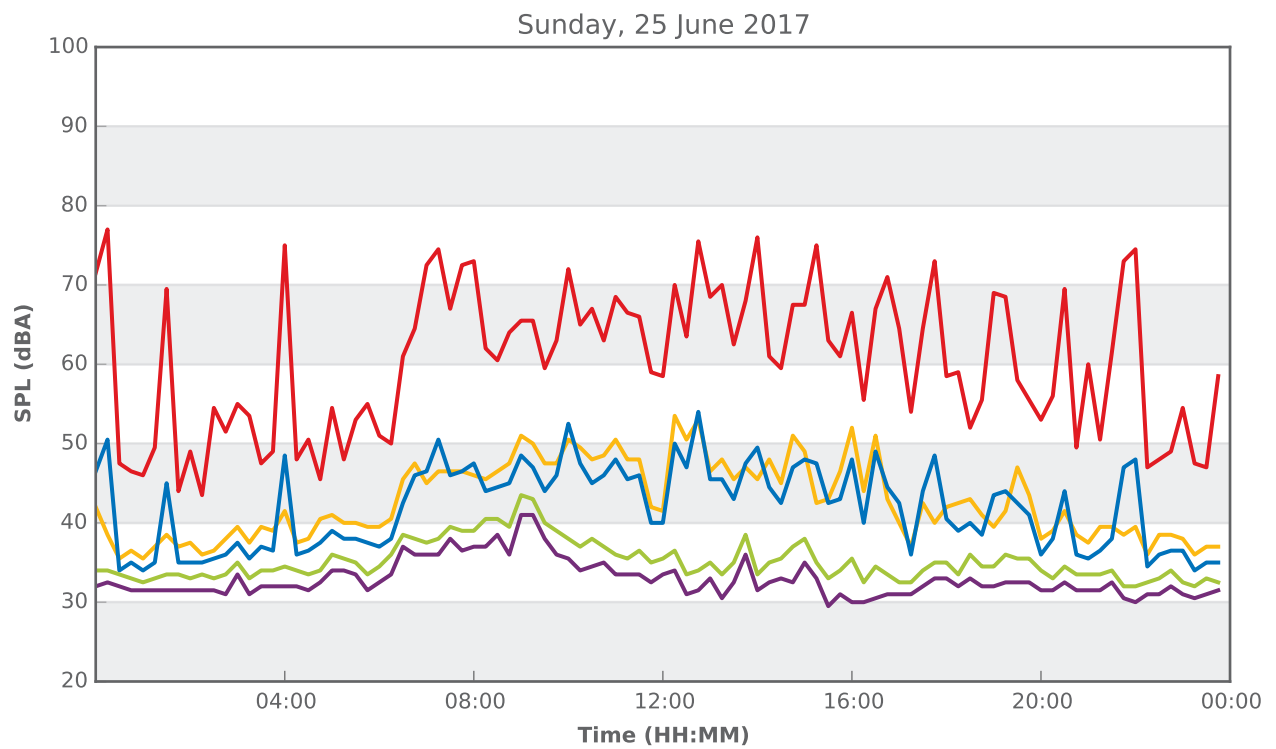
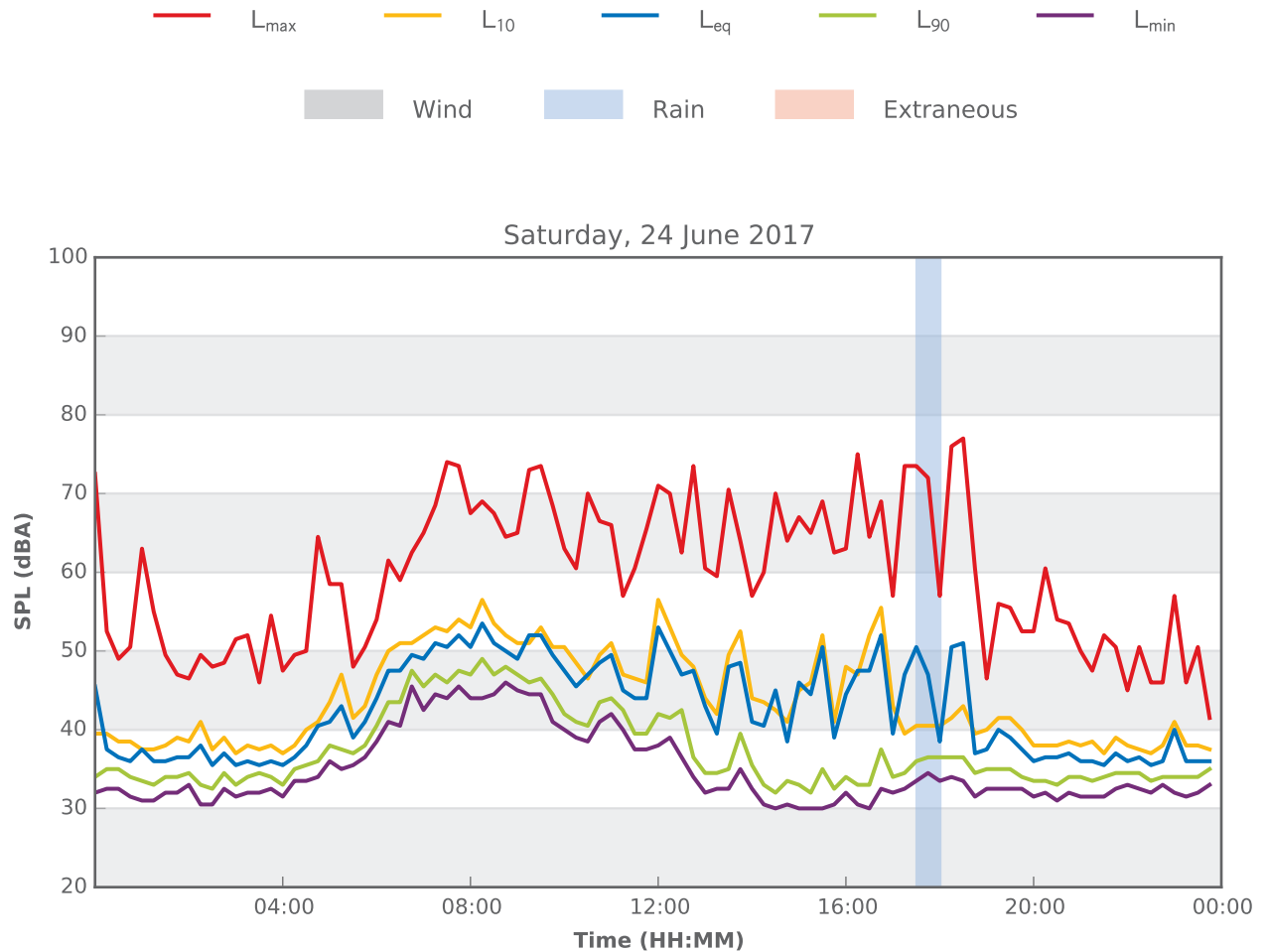
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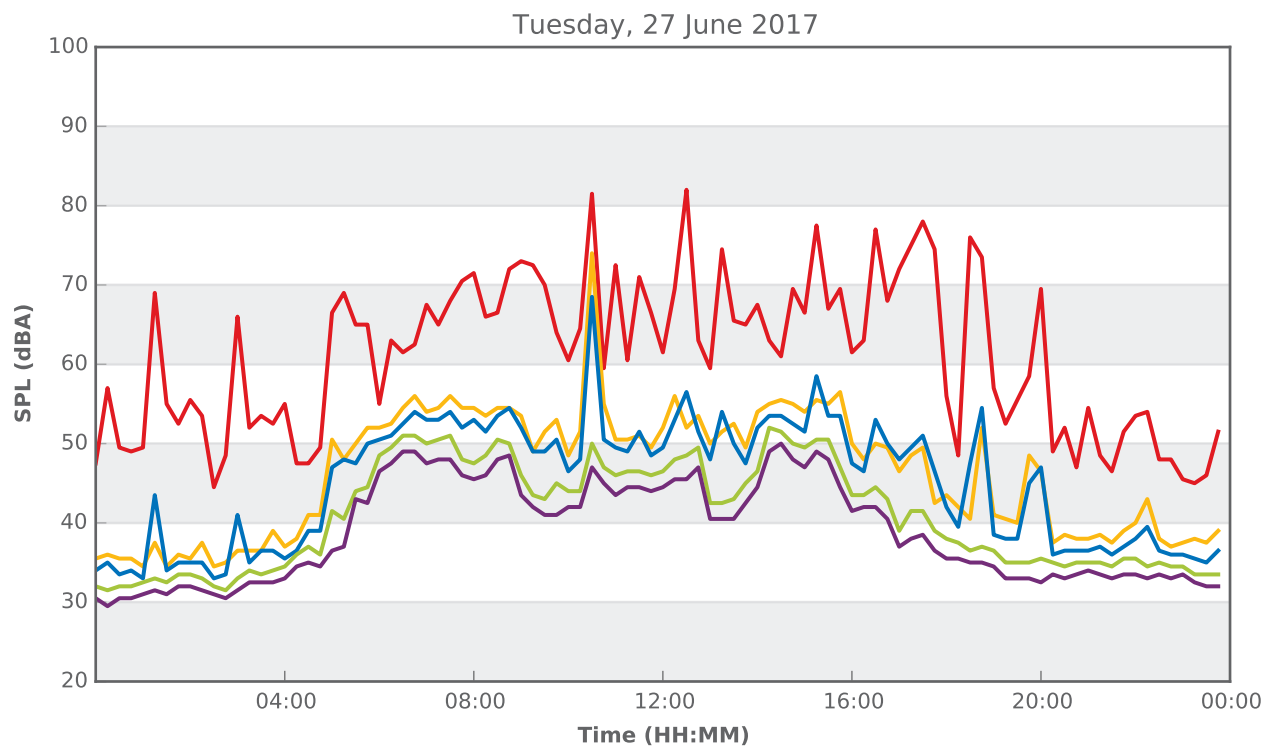
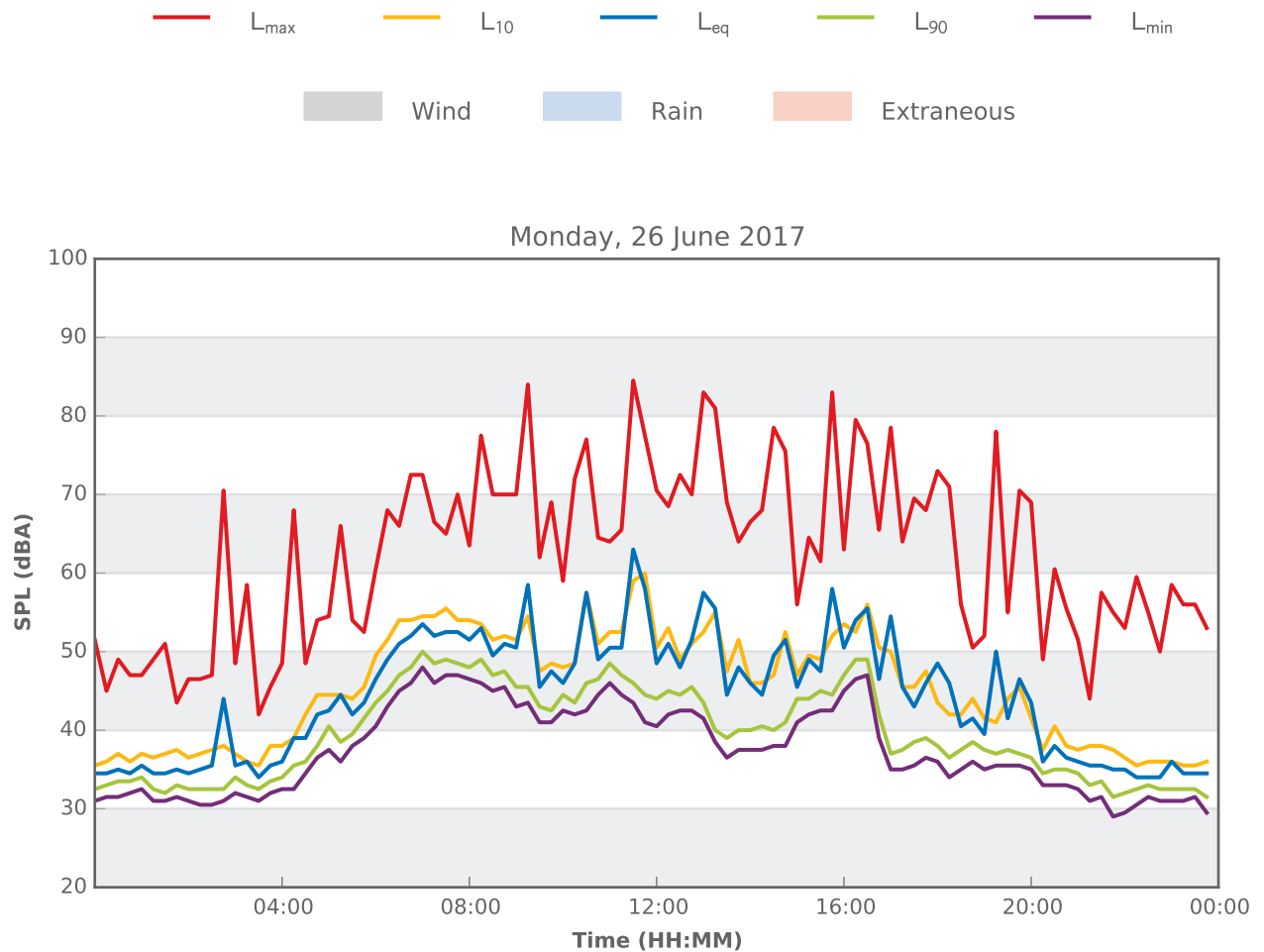
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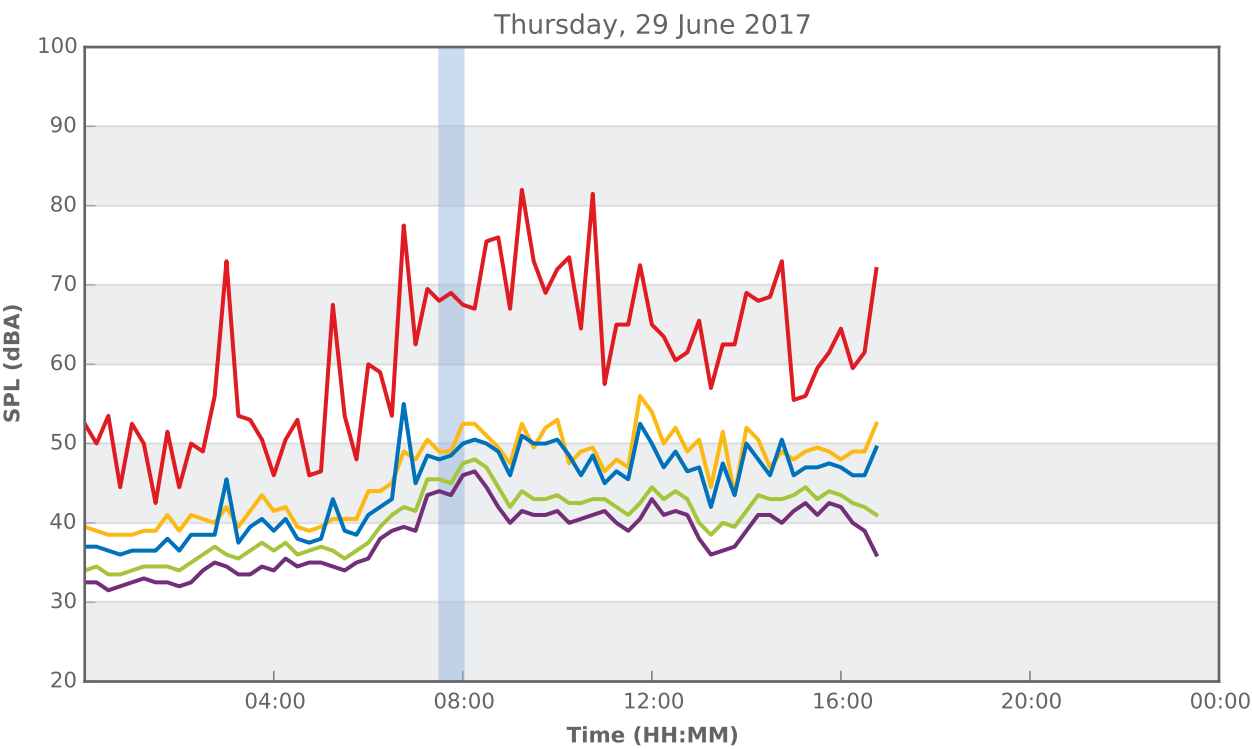
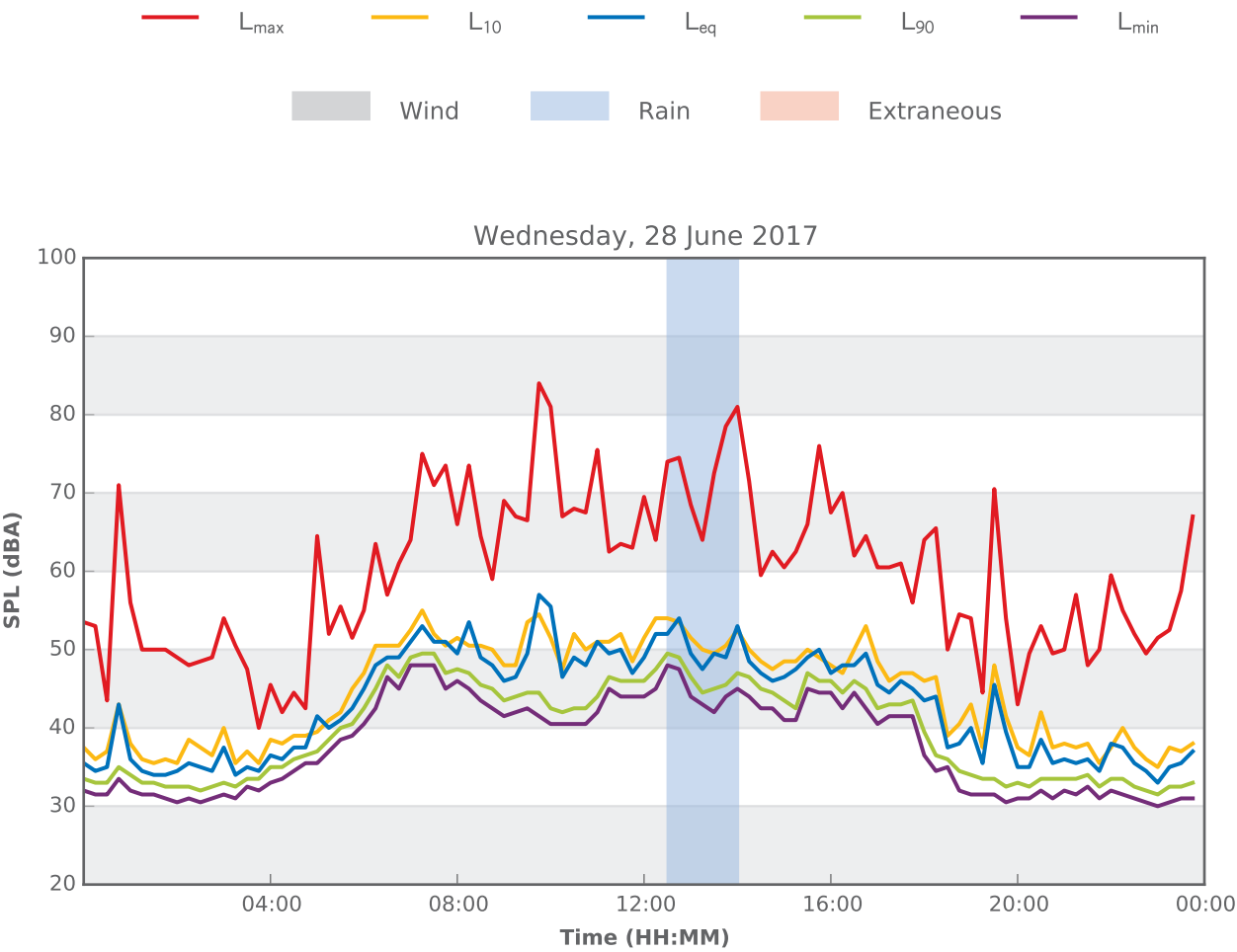
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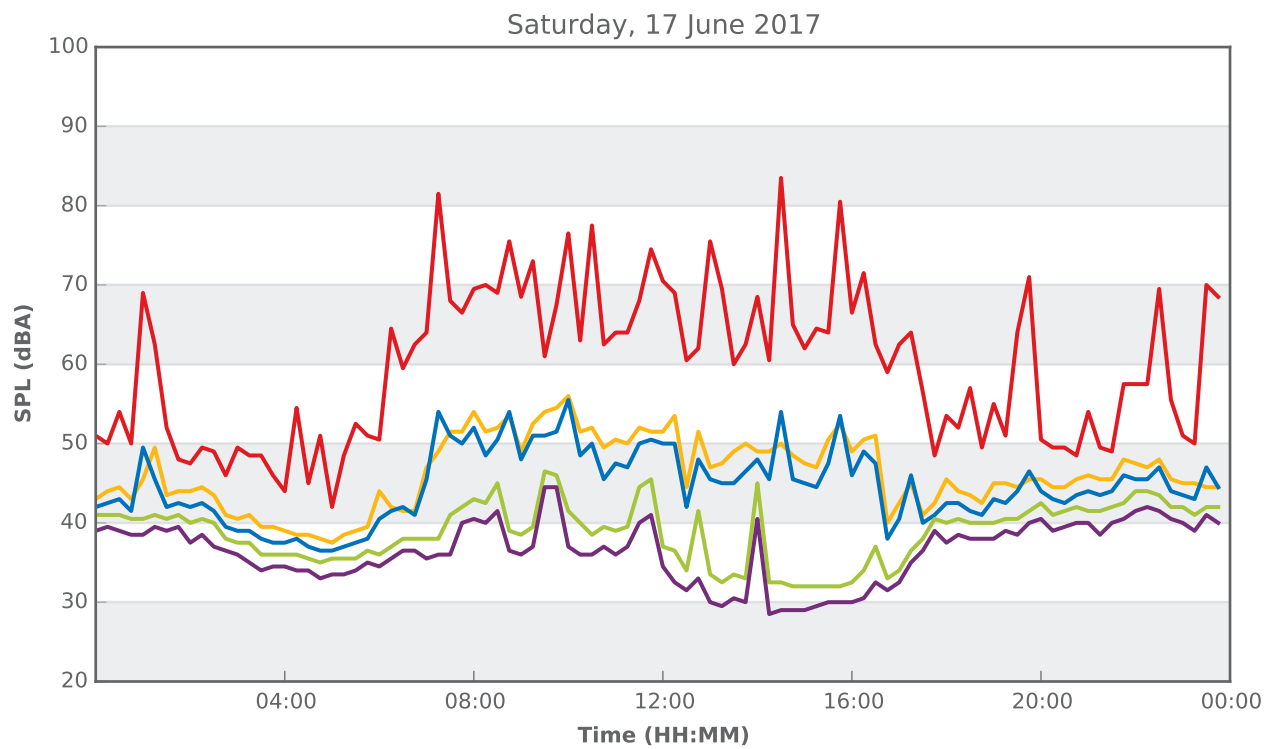
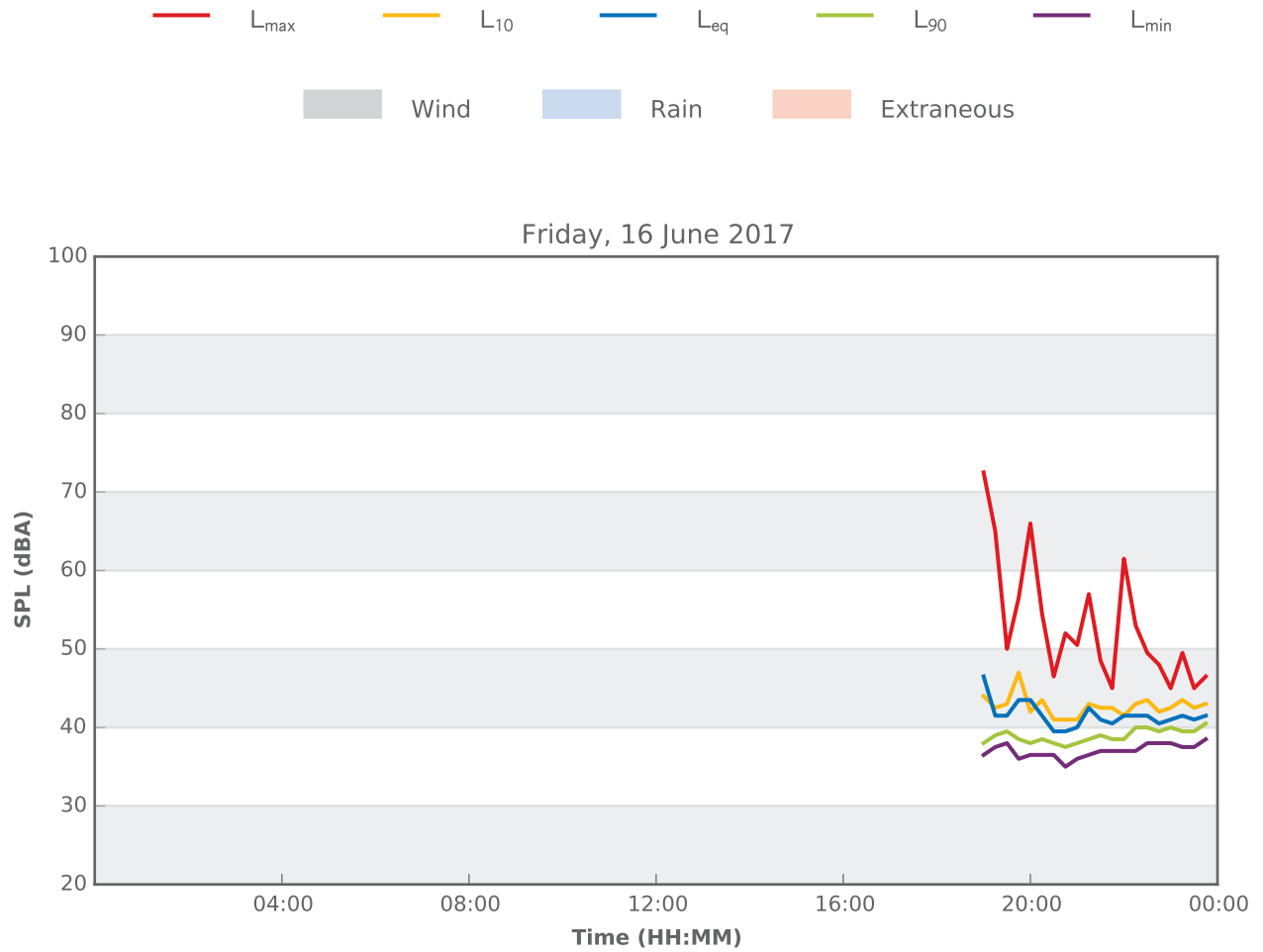
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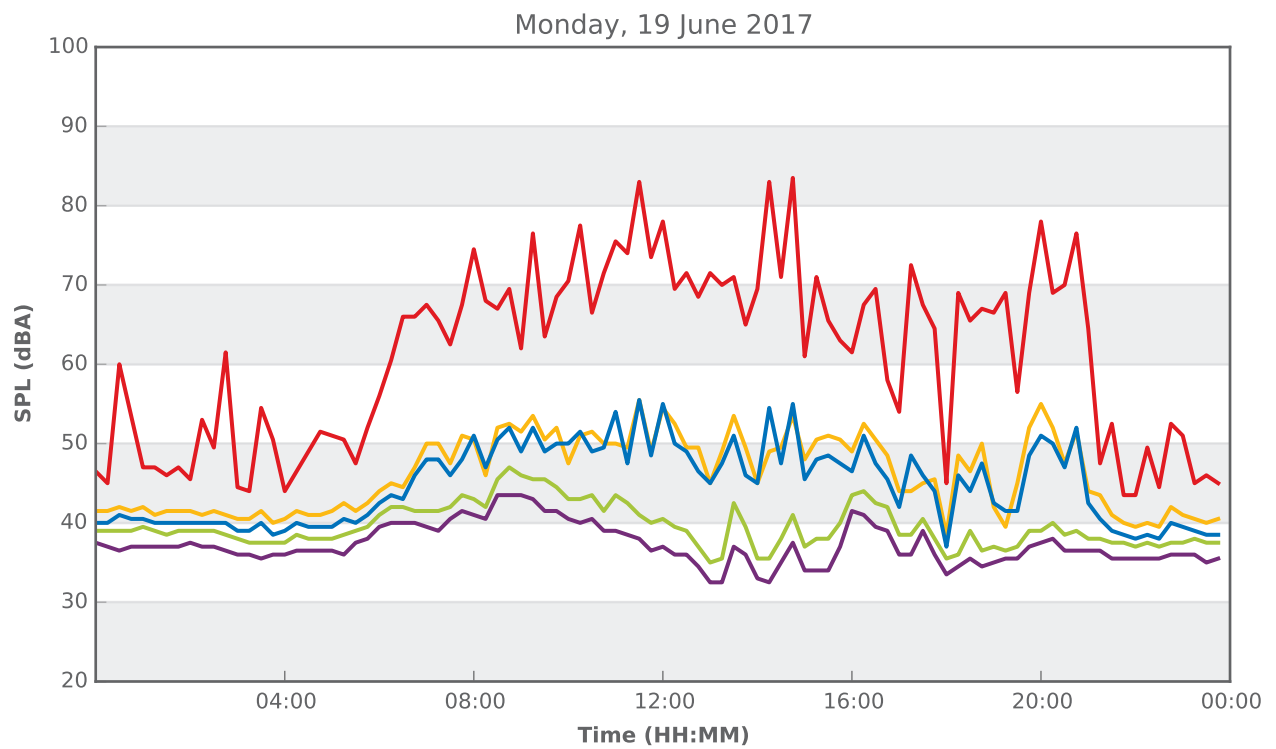
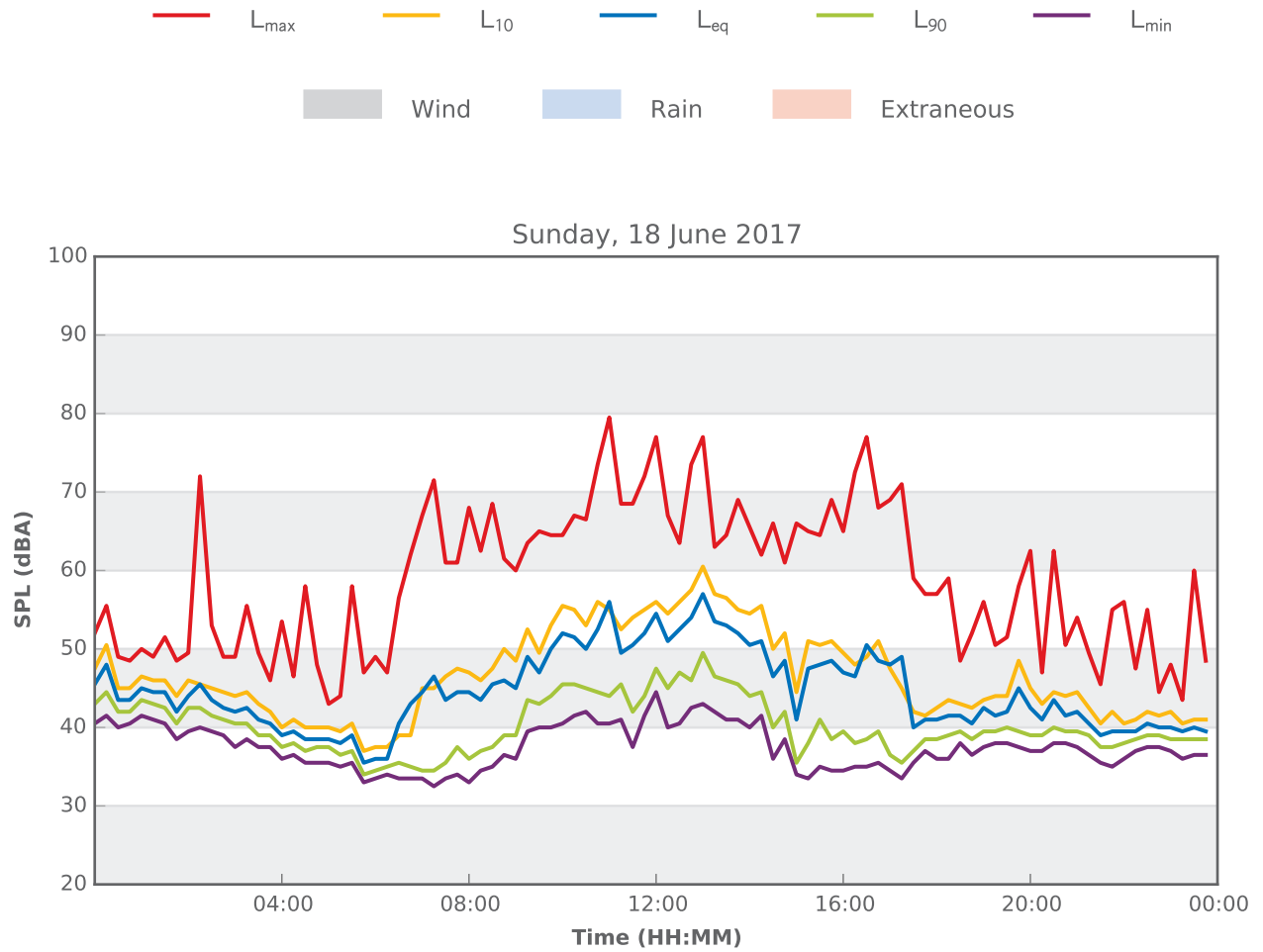
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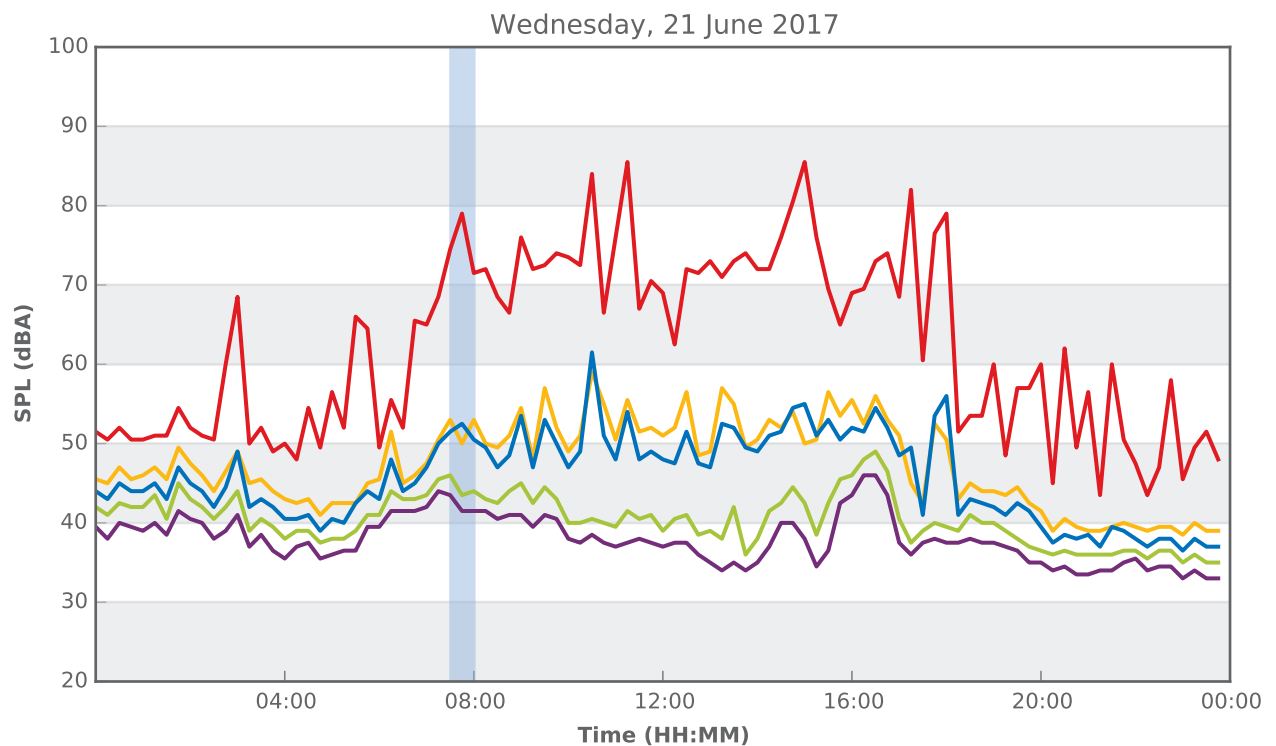
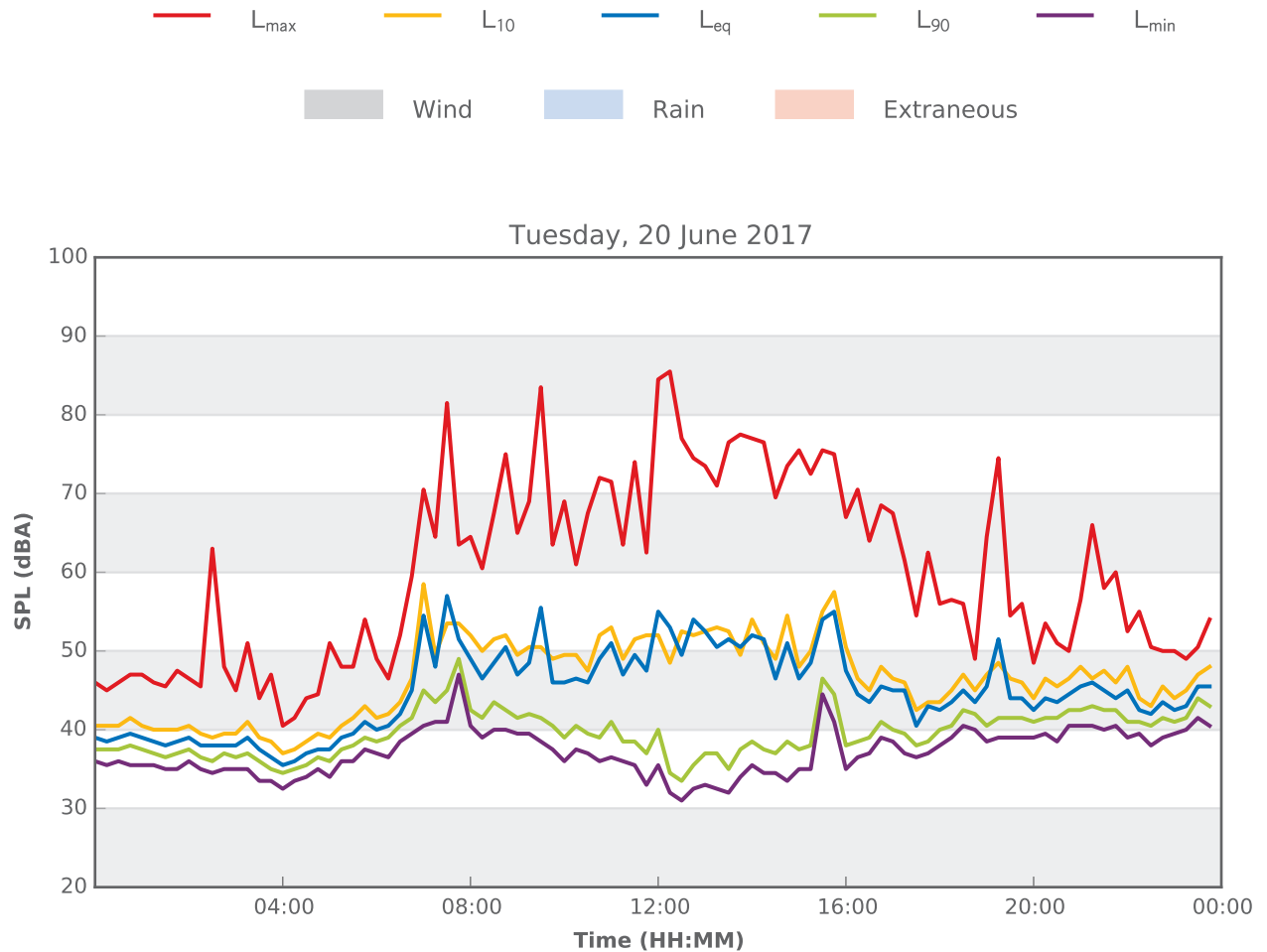
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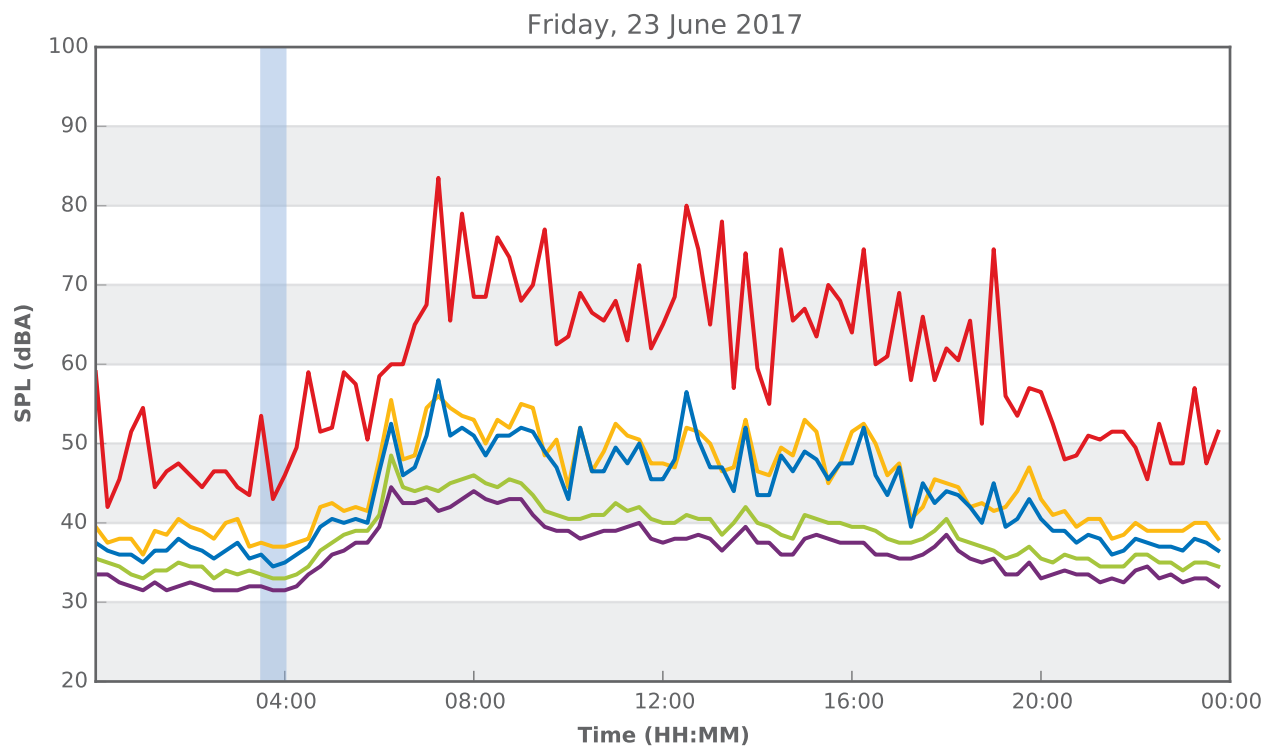
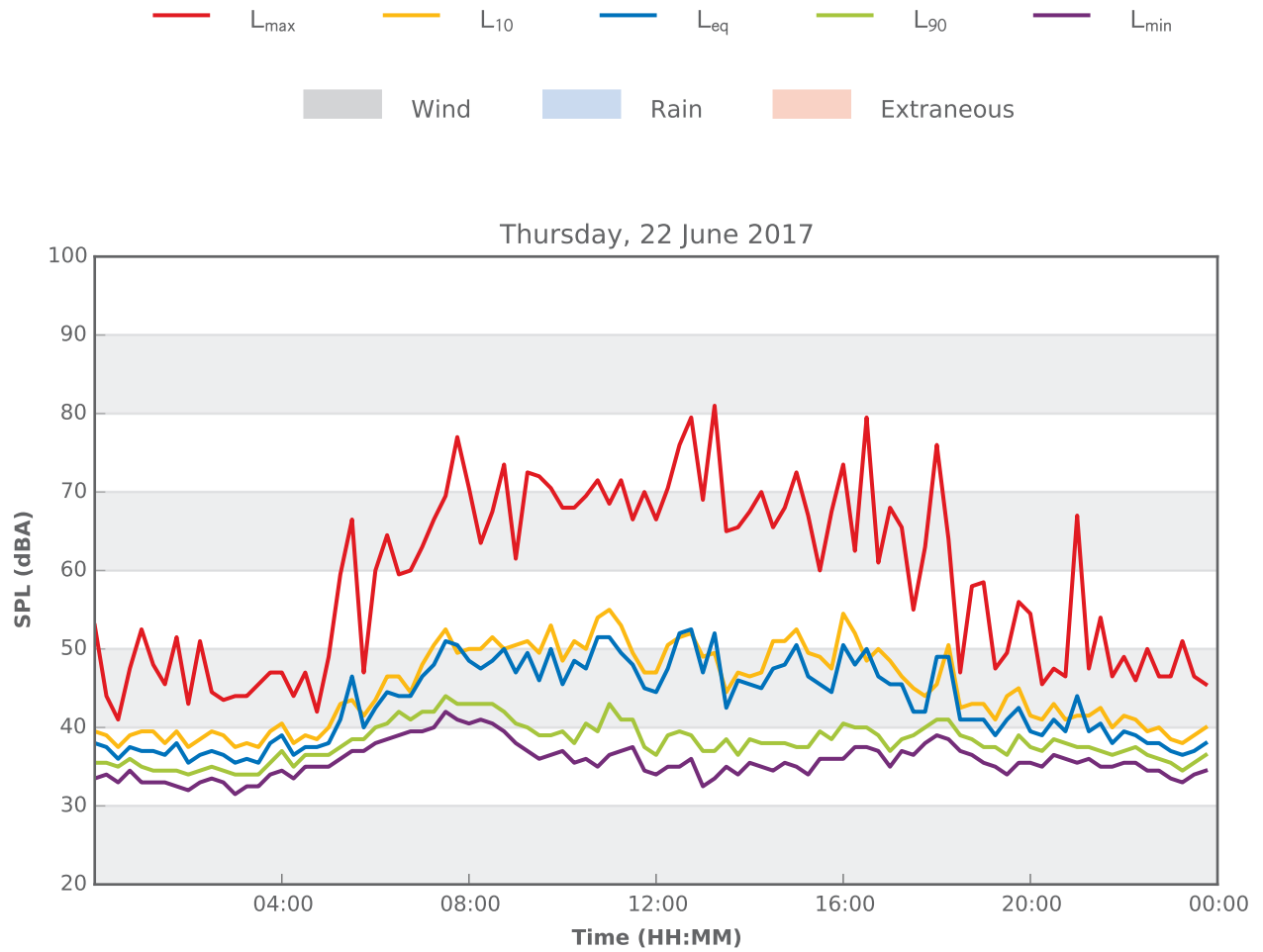
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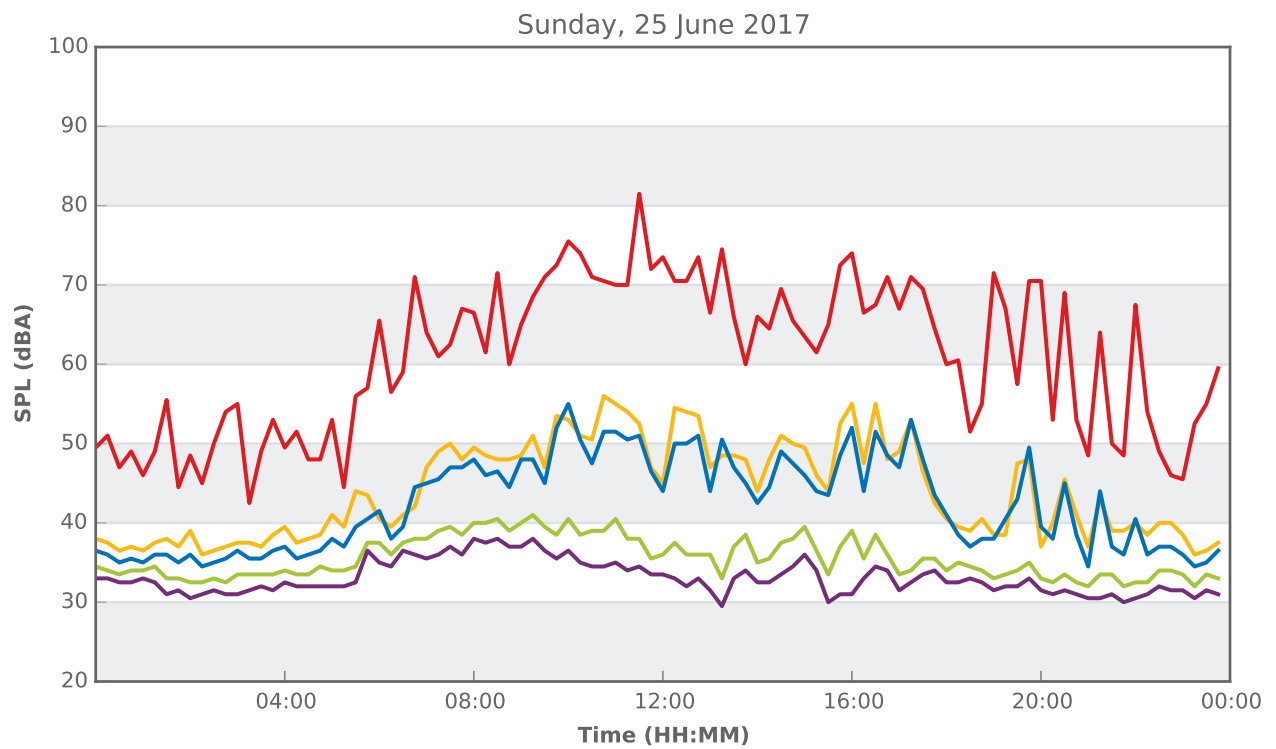
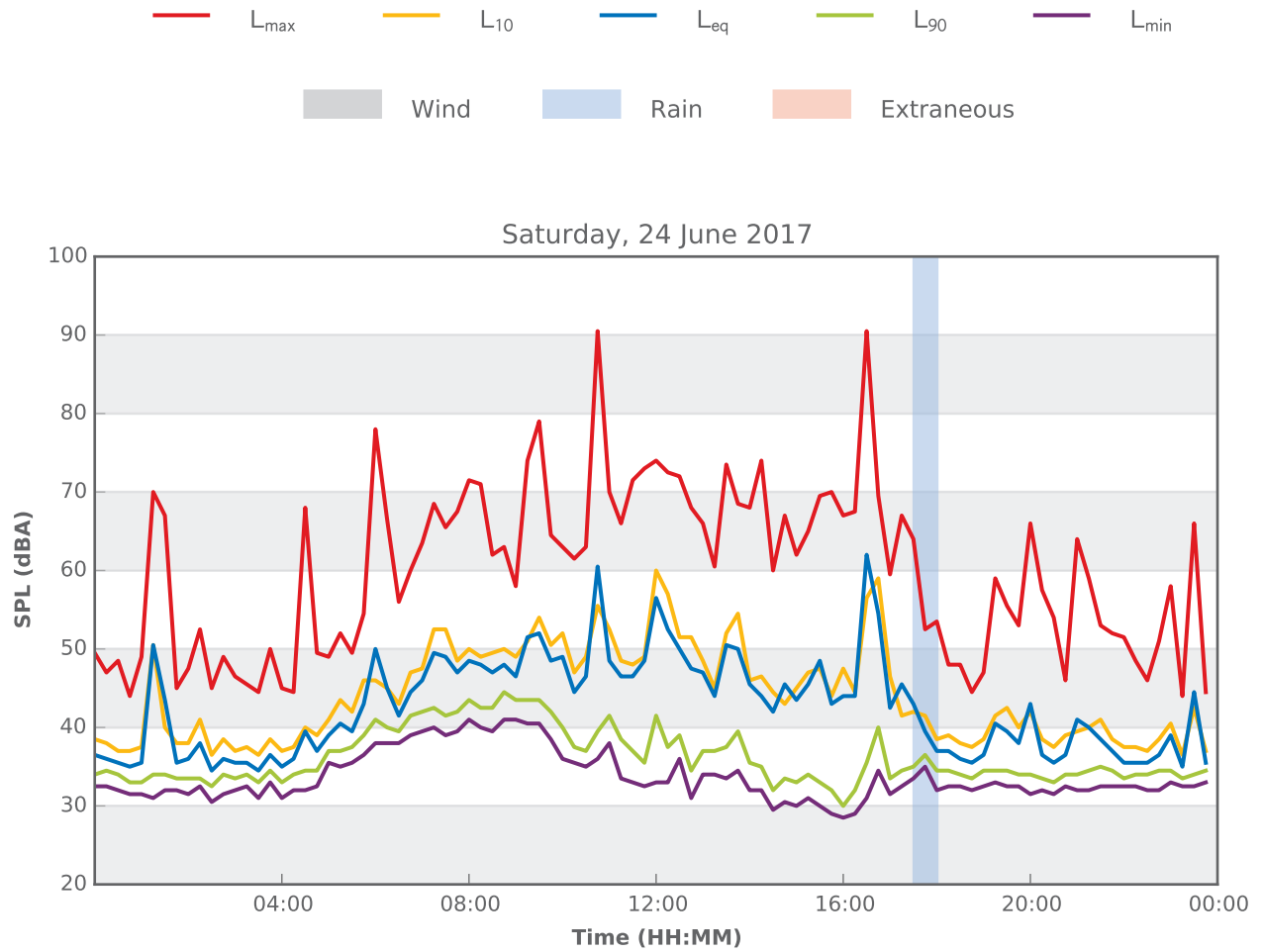
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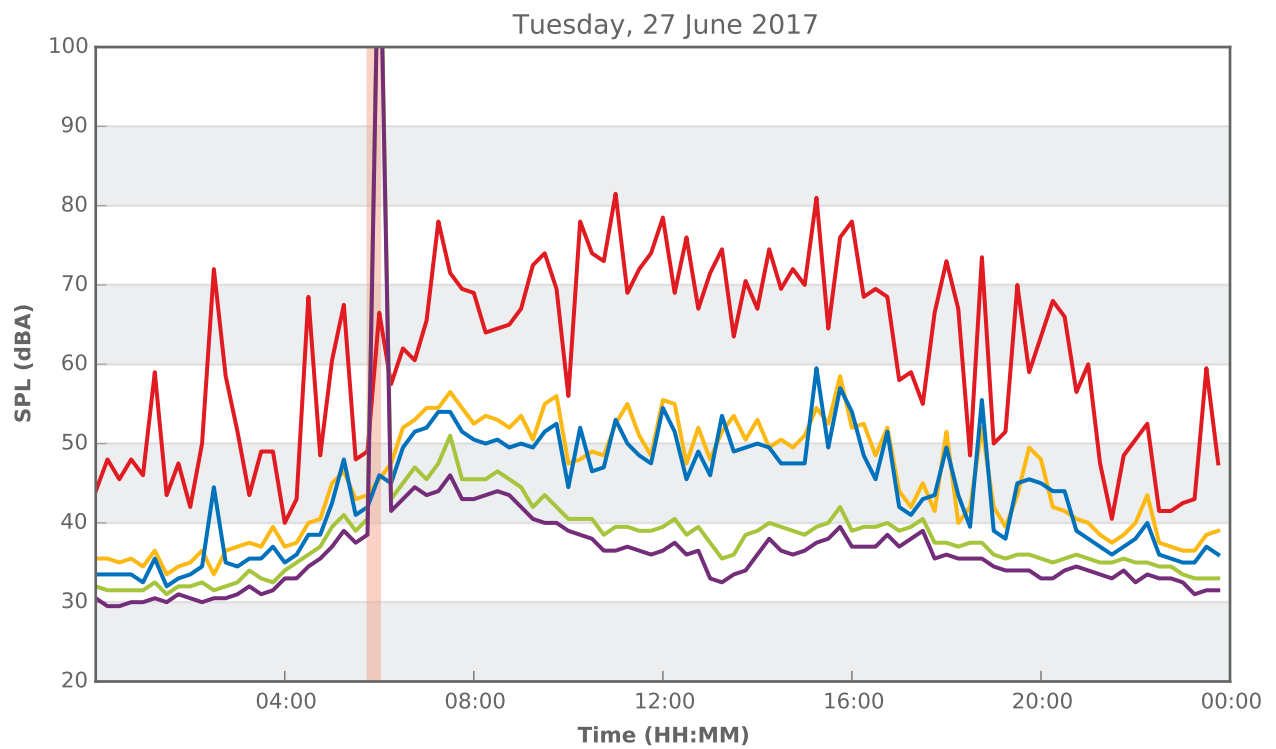
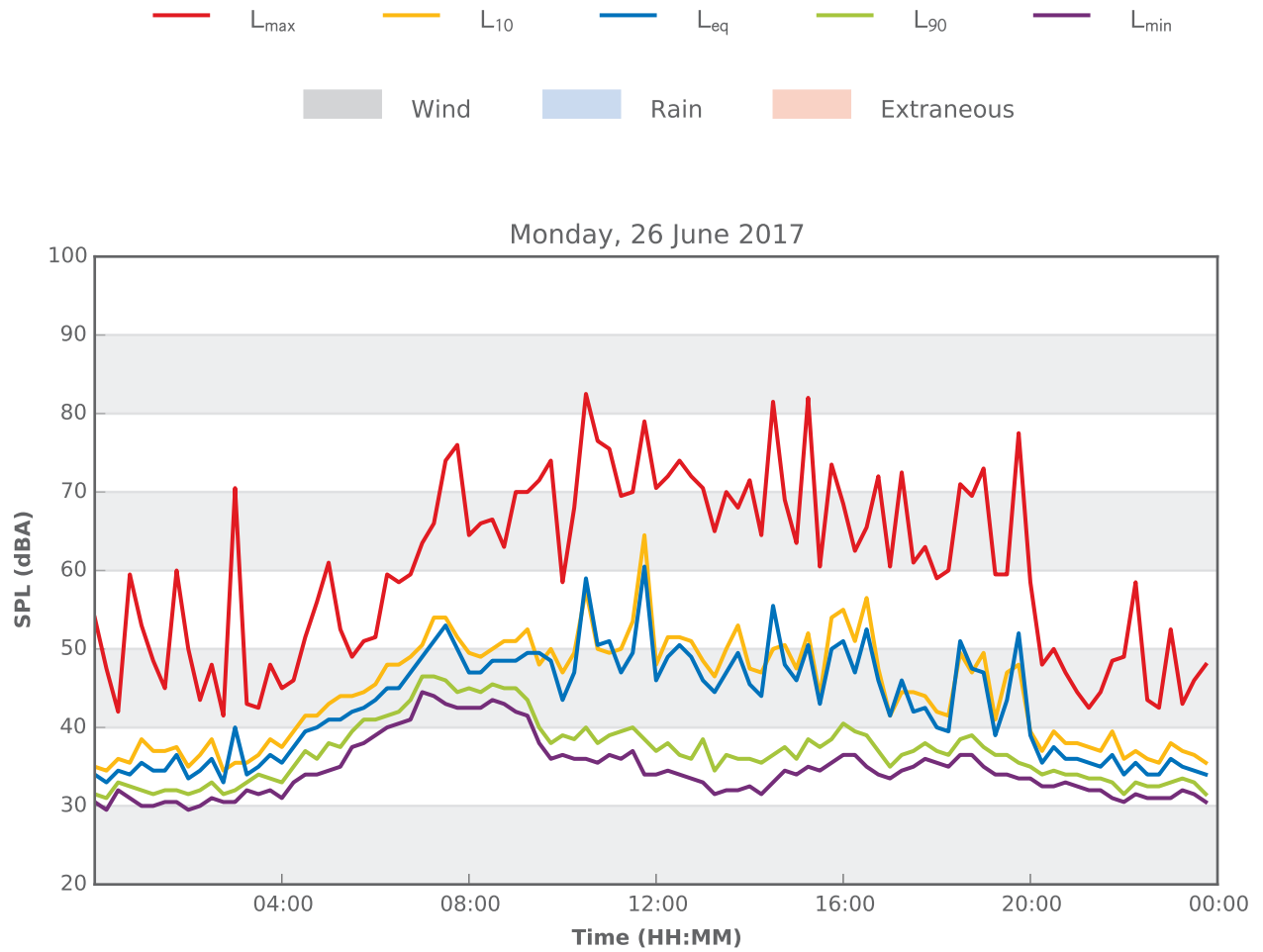
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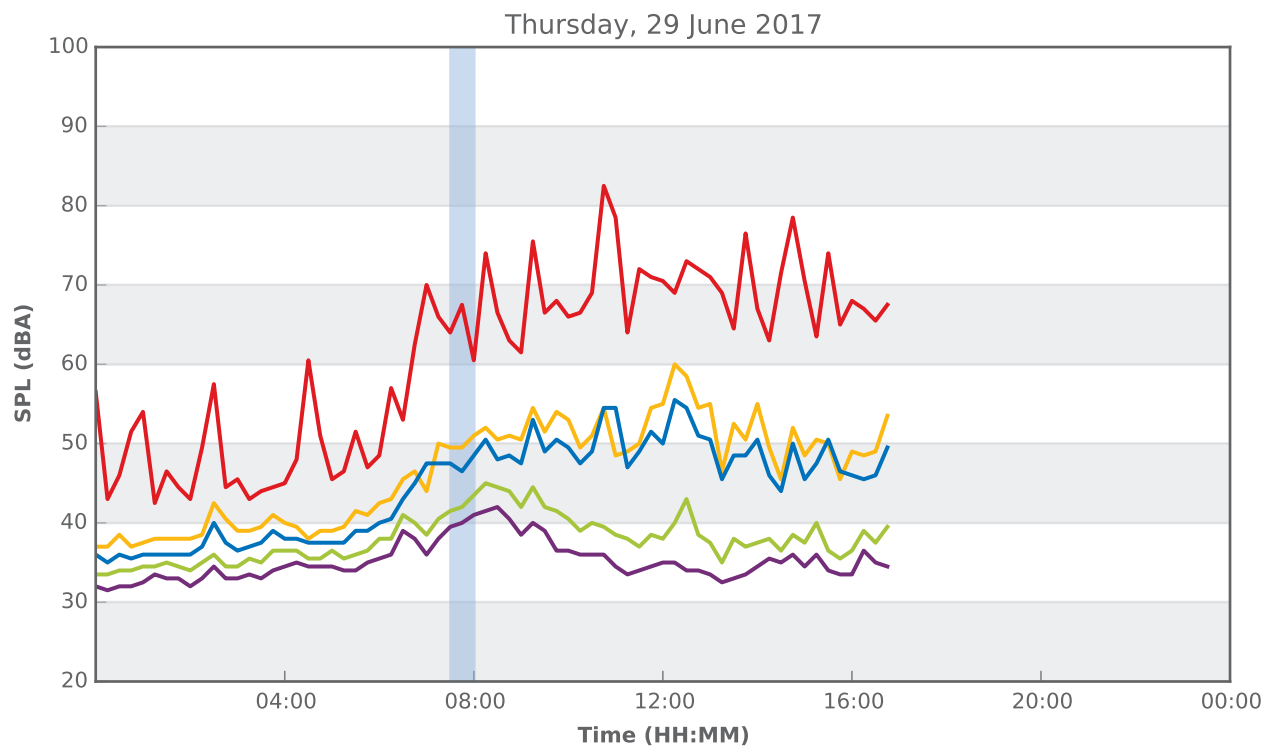
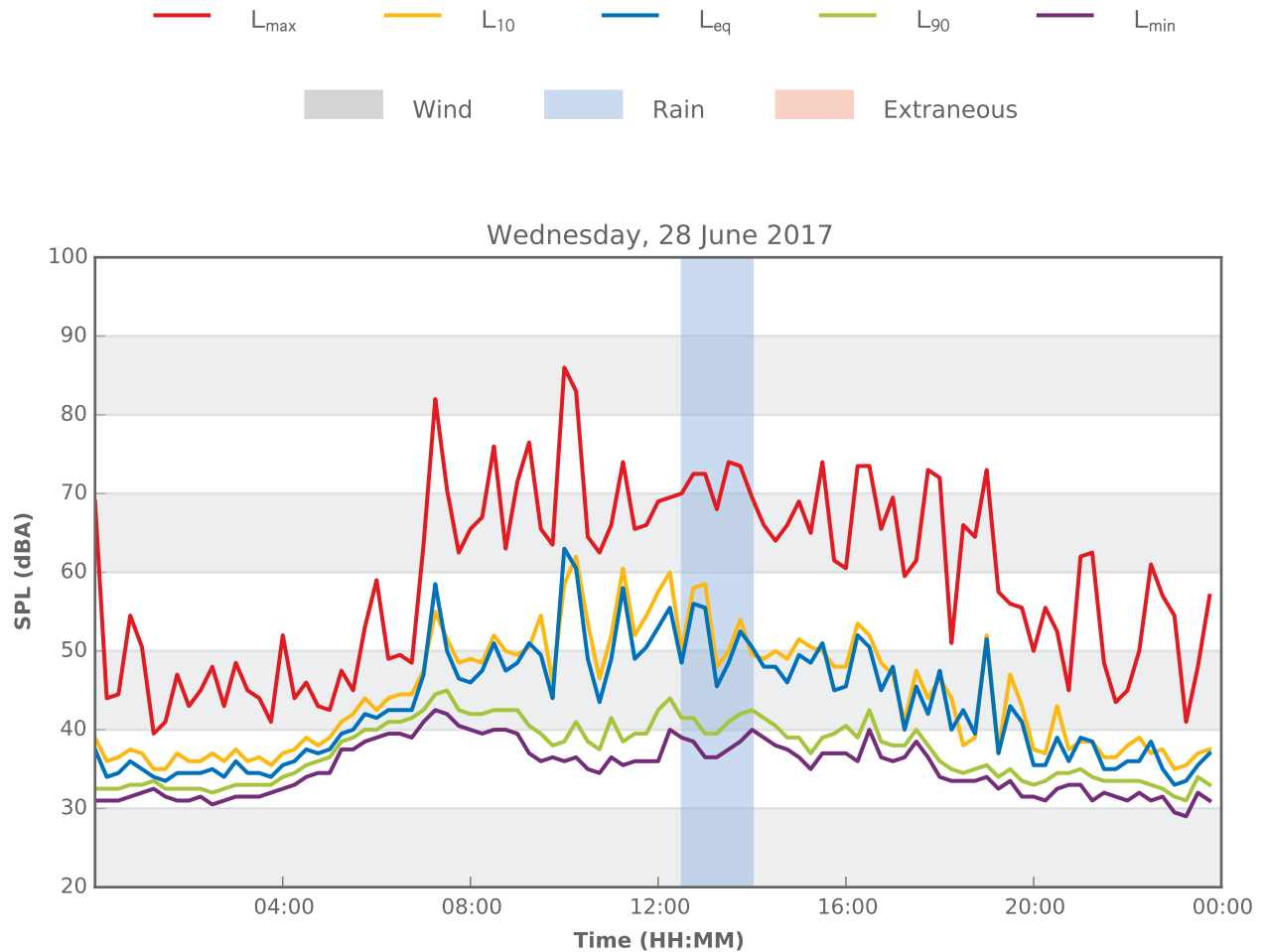
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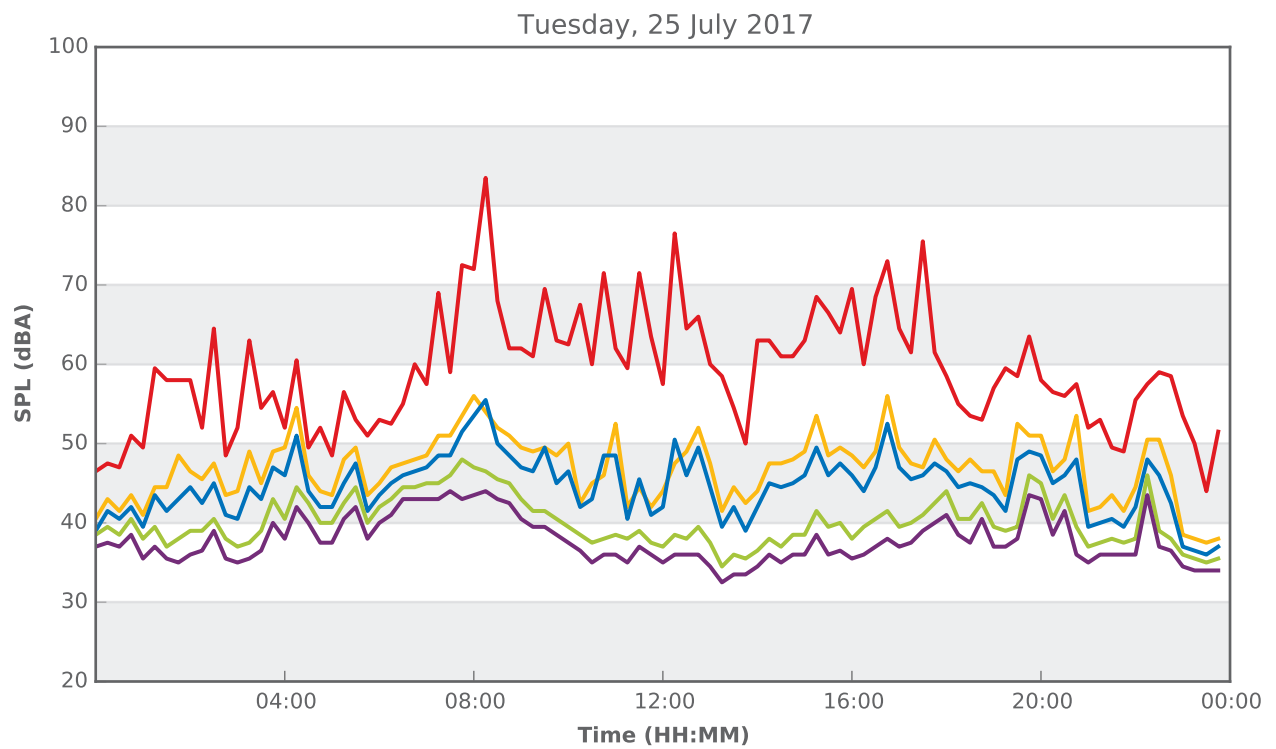
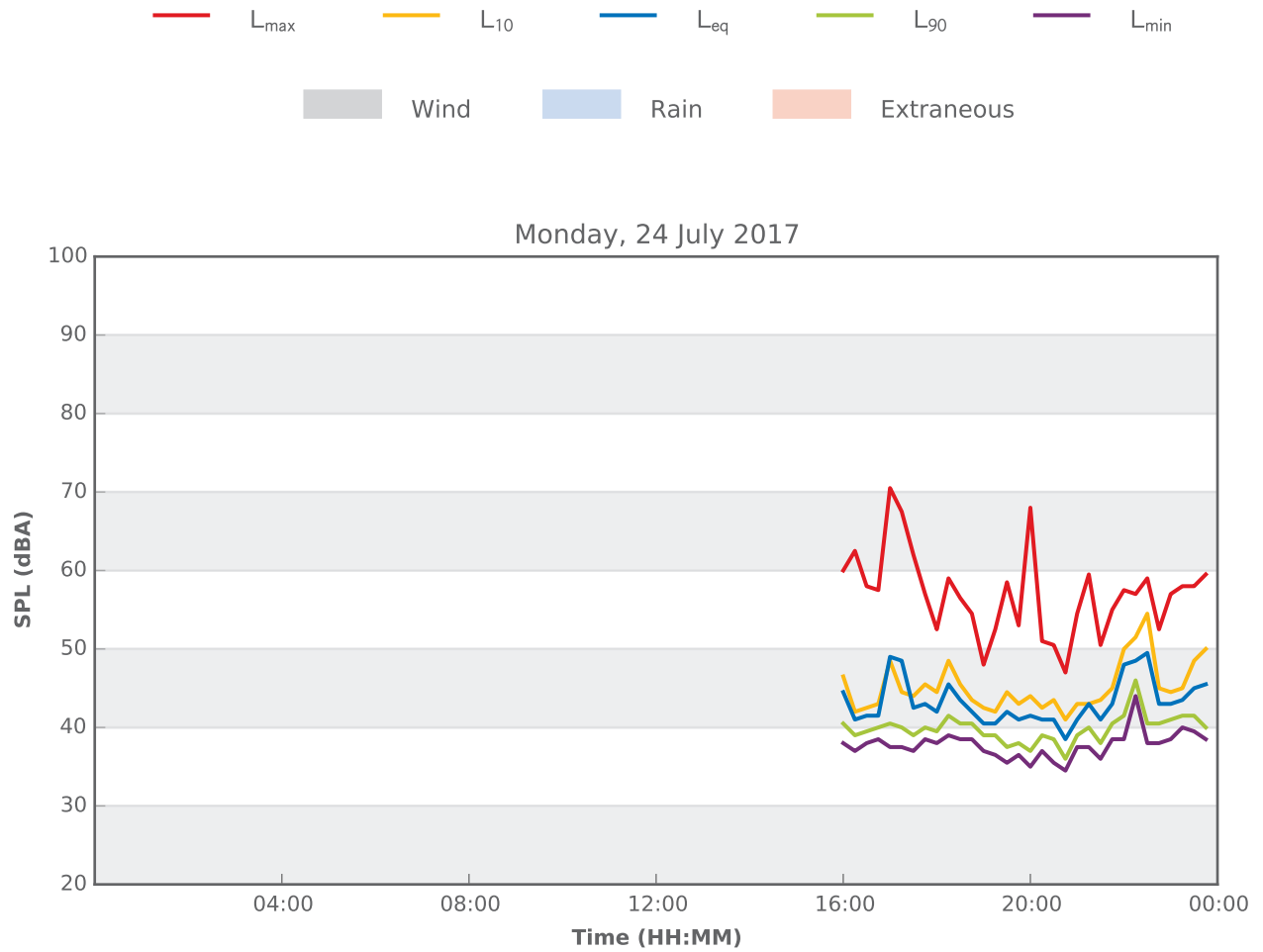
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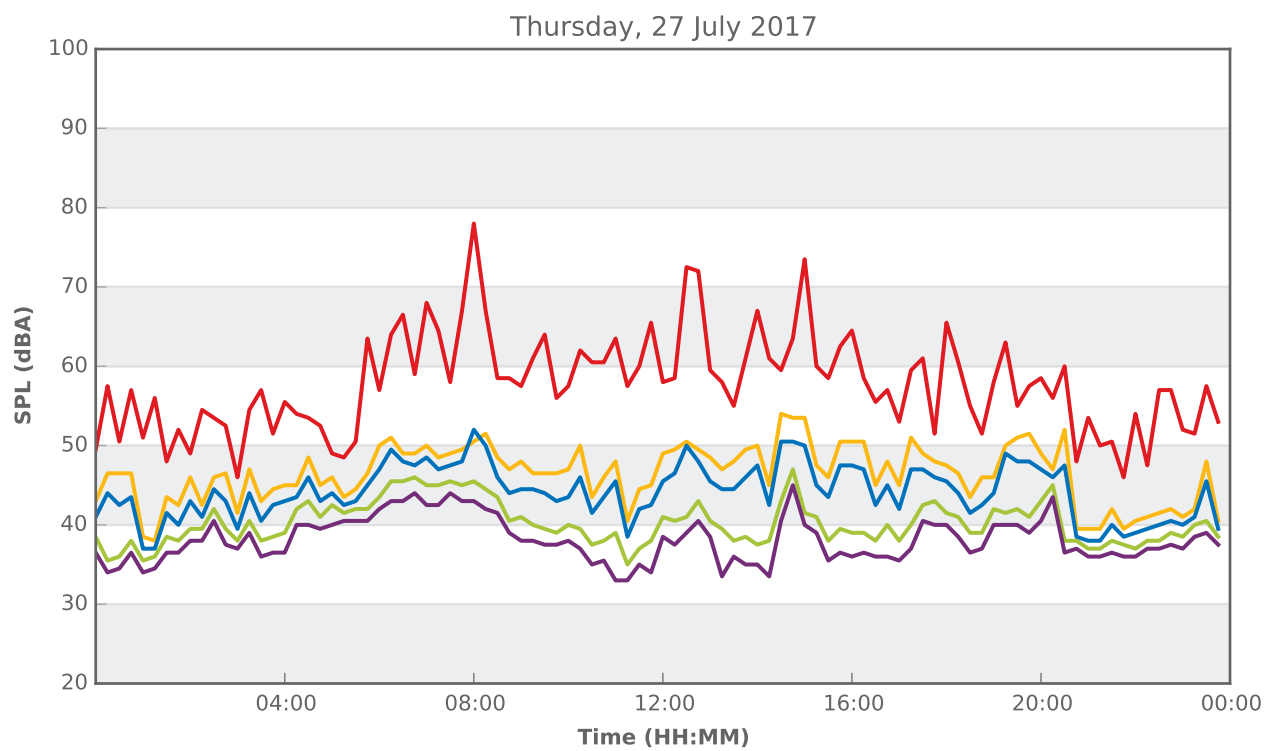
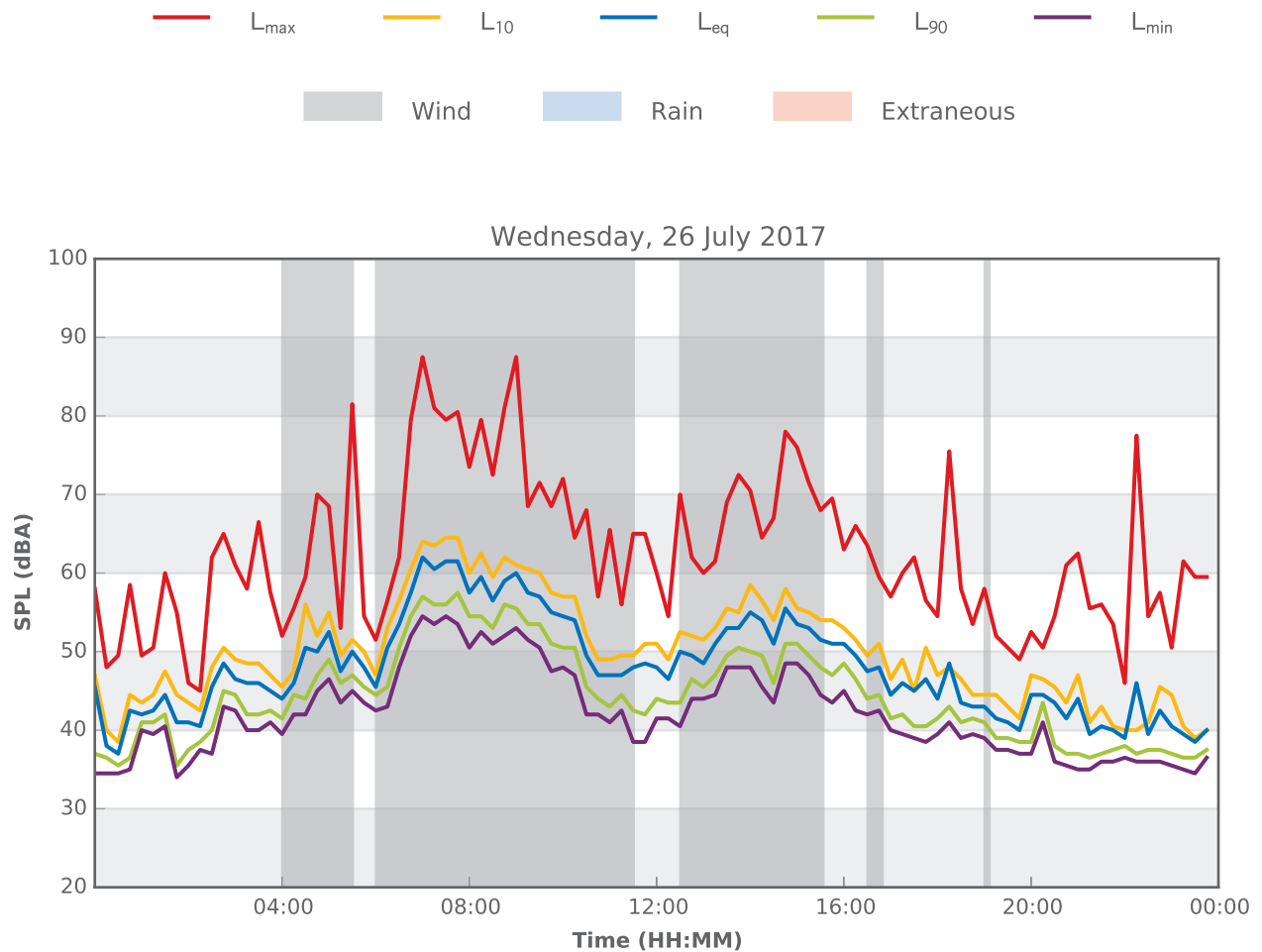
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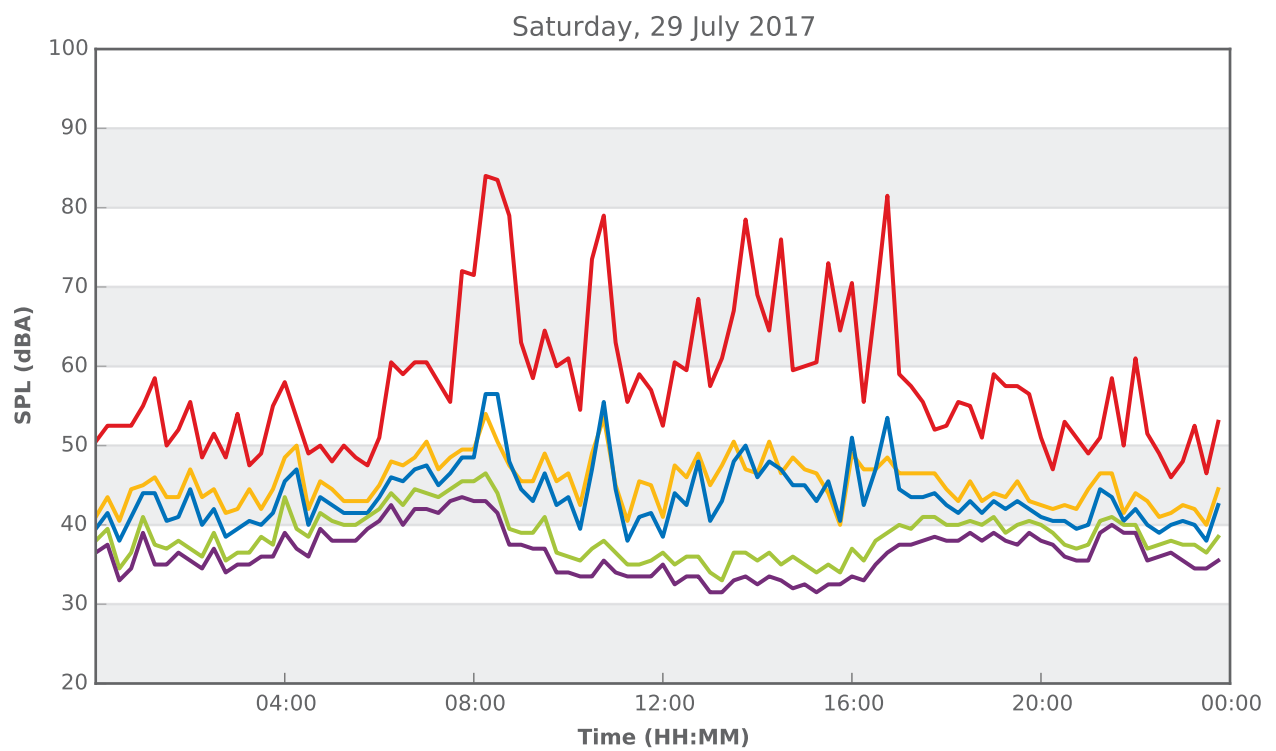
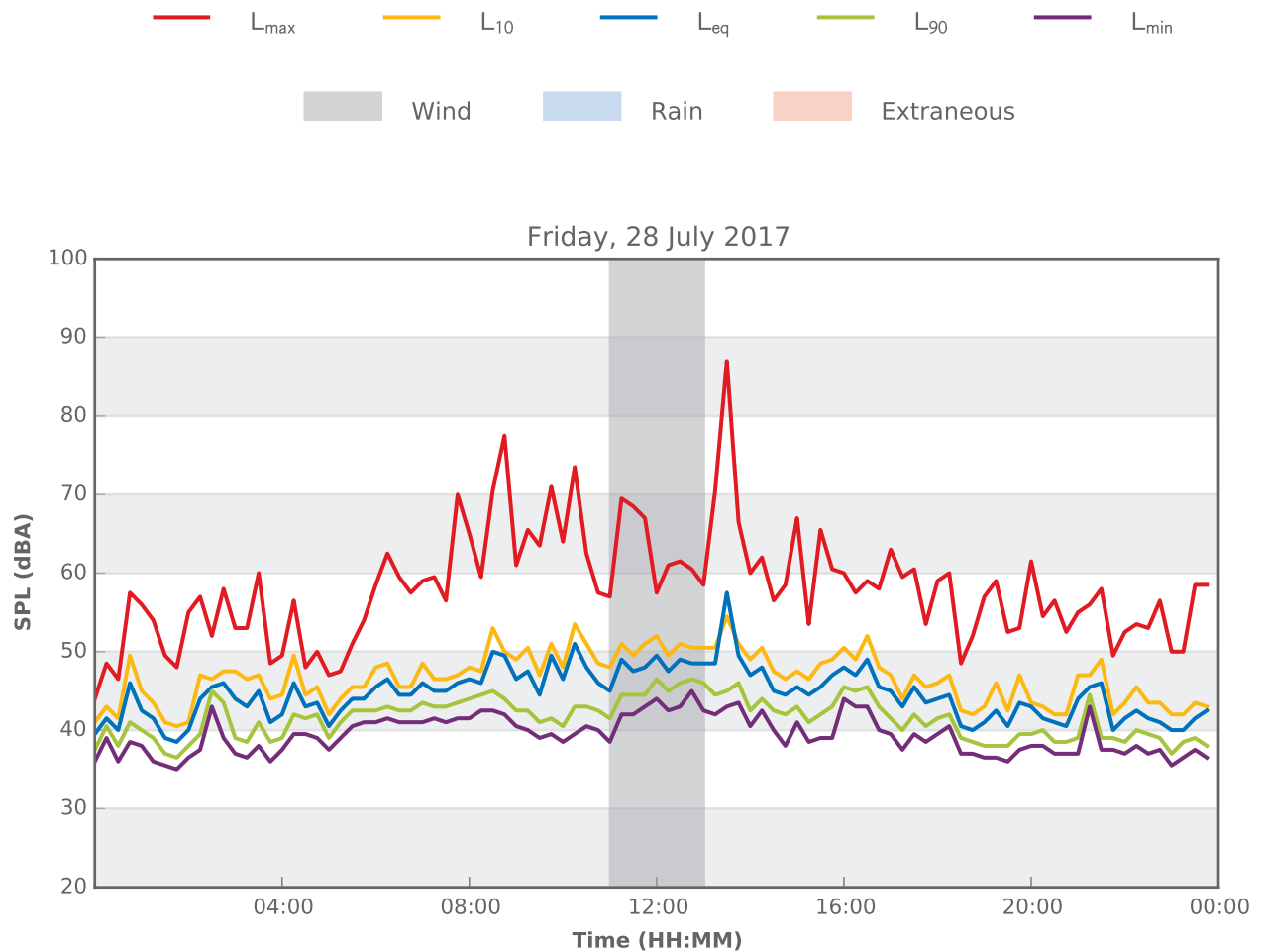
## 48 Victor Avenue, Kemp's Creek



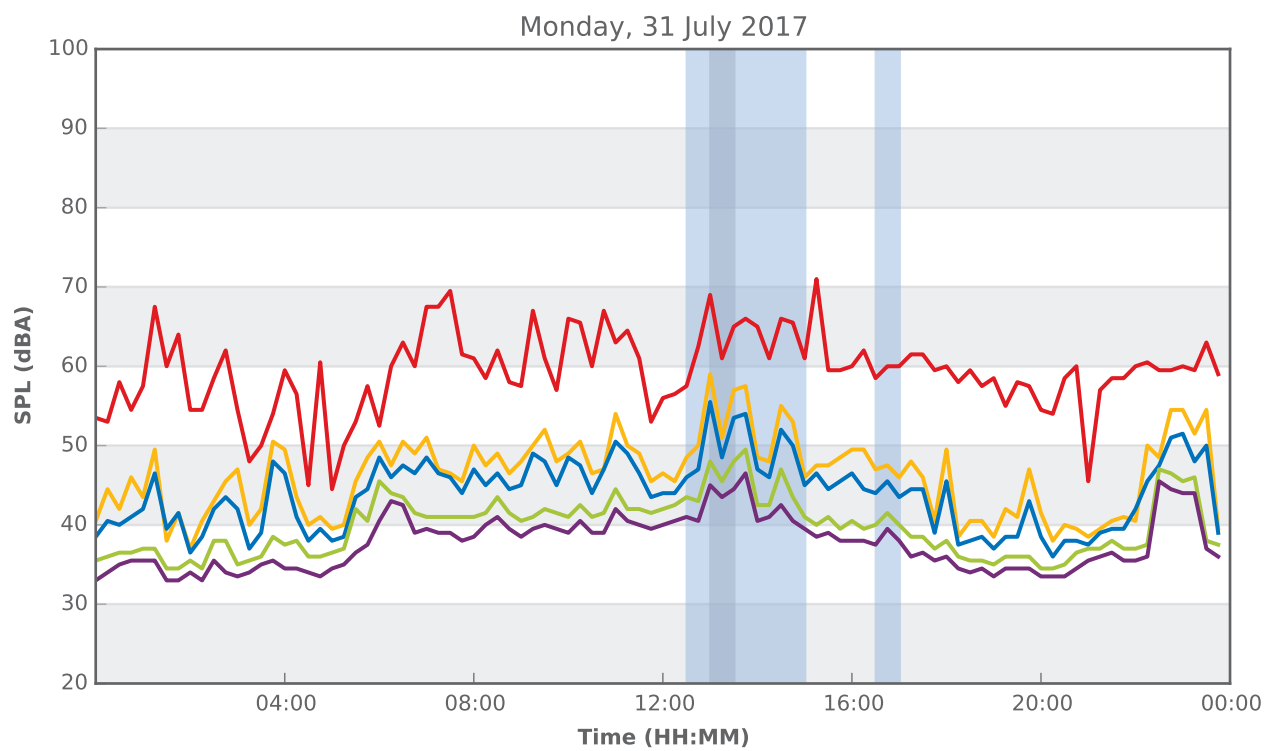
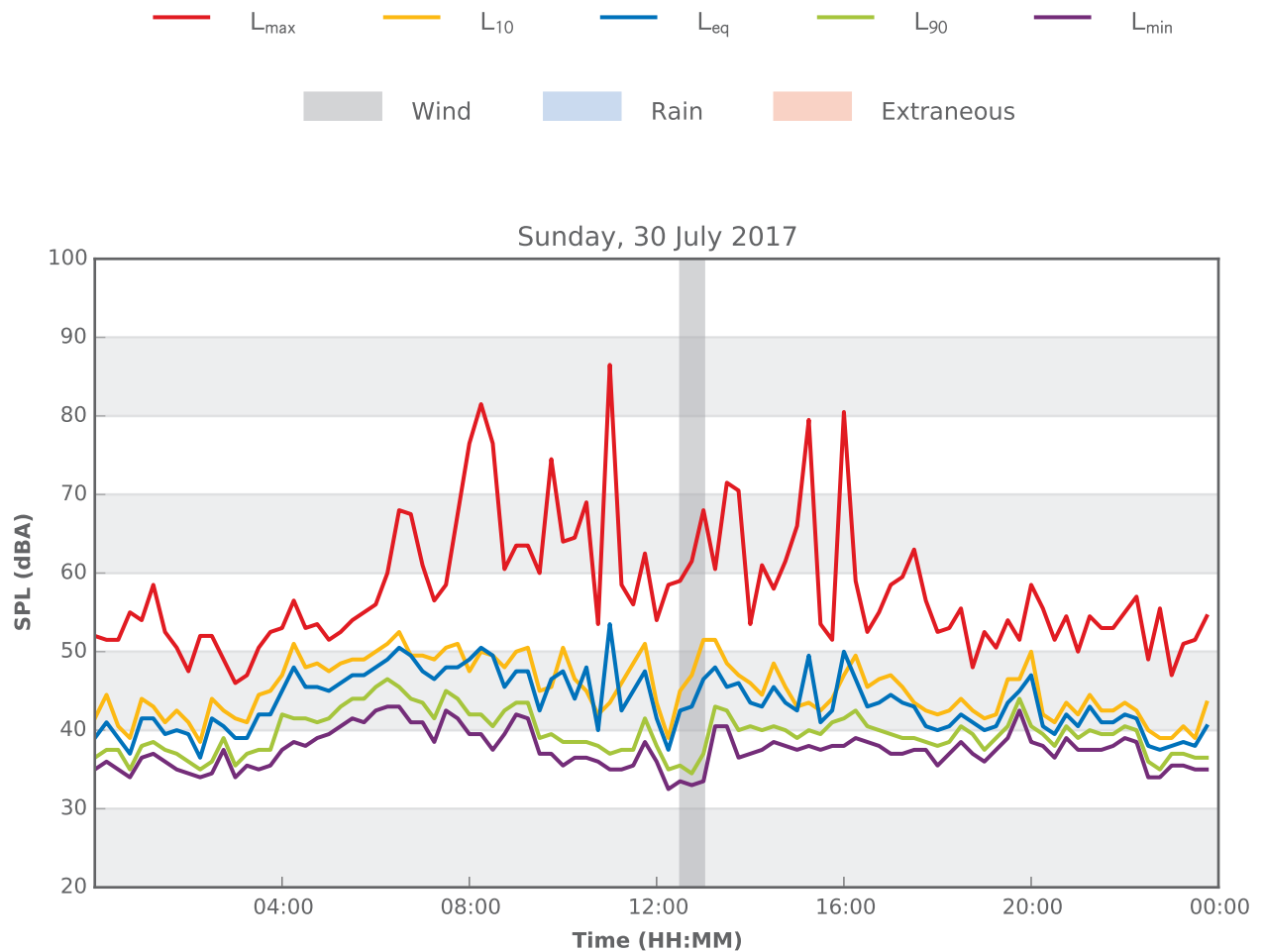
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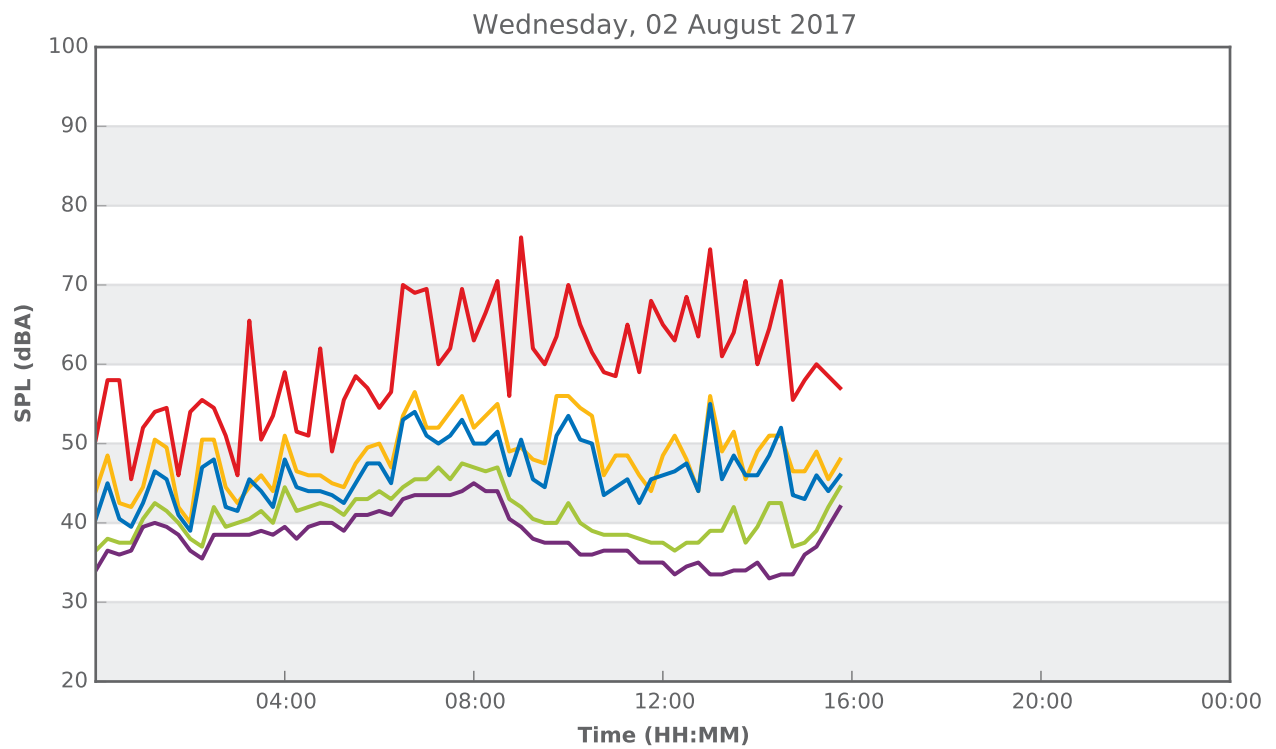
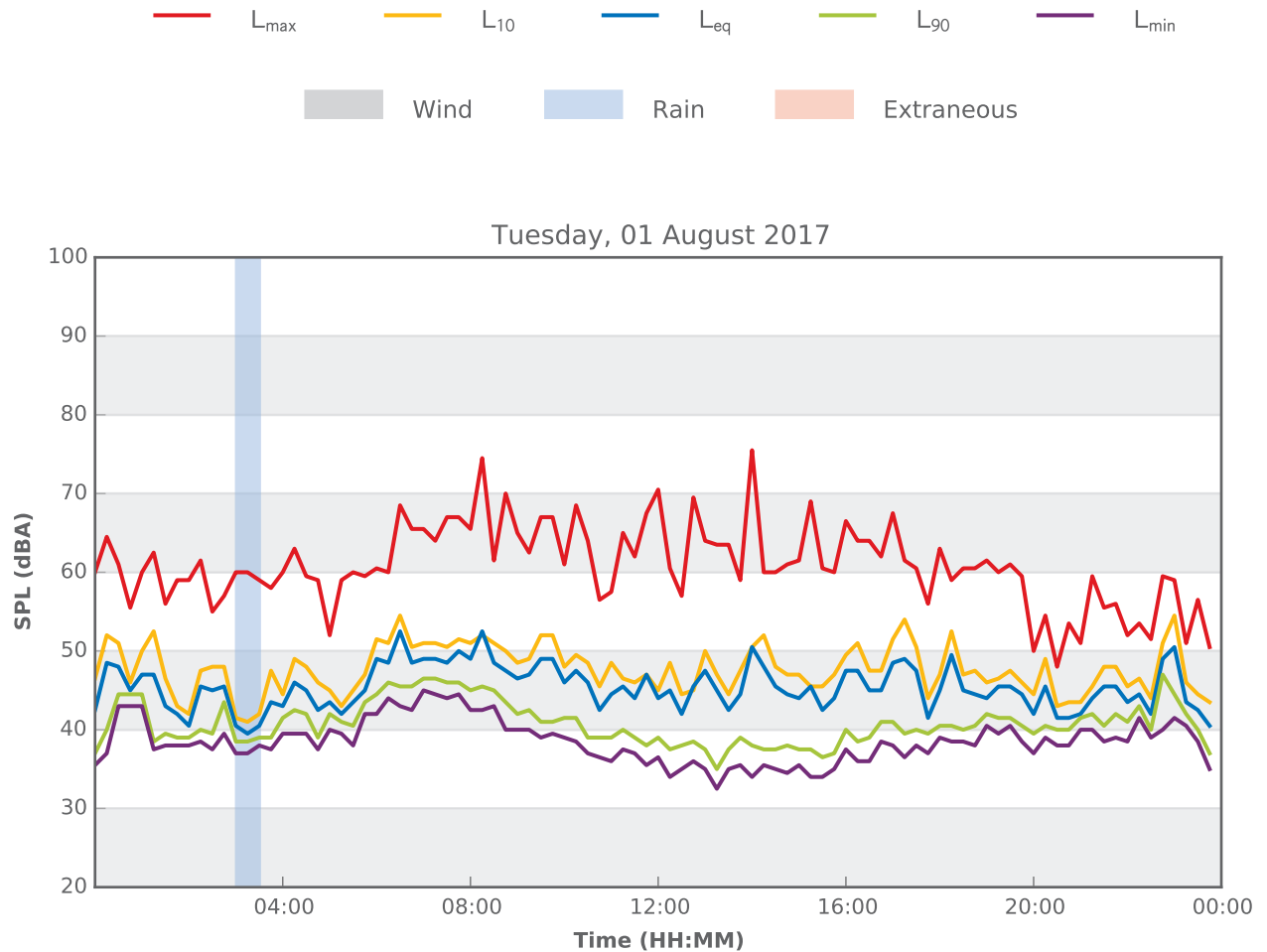
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## 48 Victor Avenue, Kemps Creek



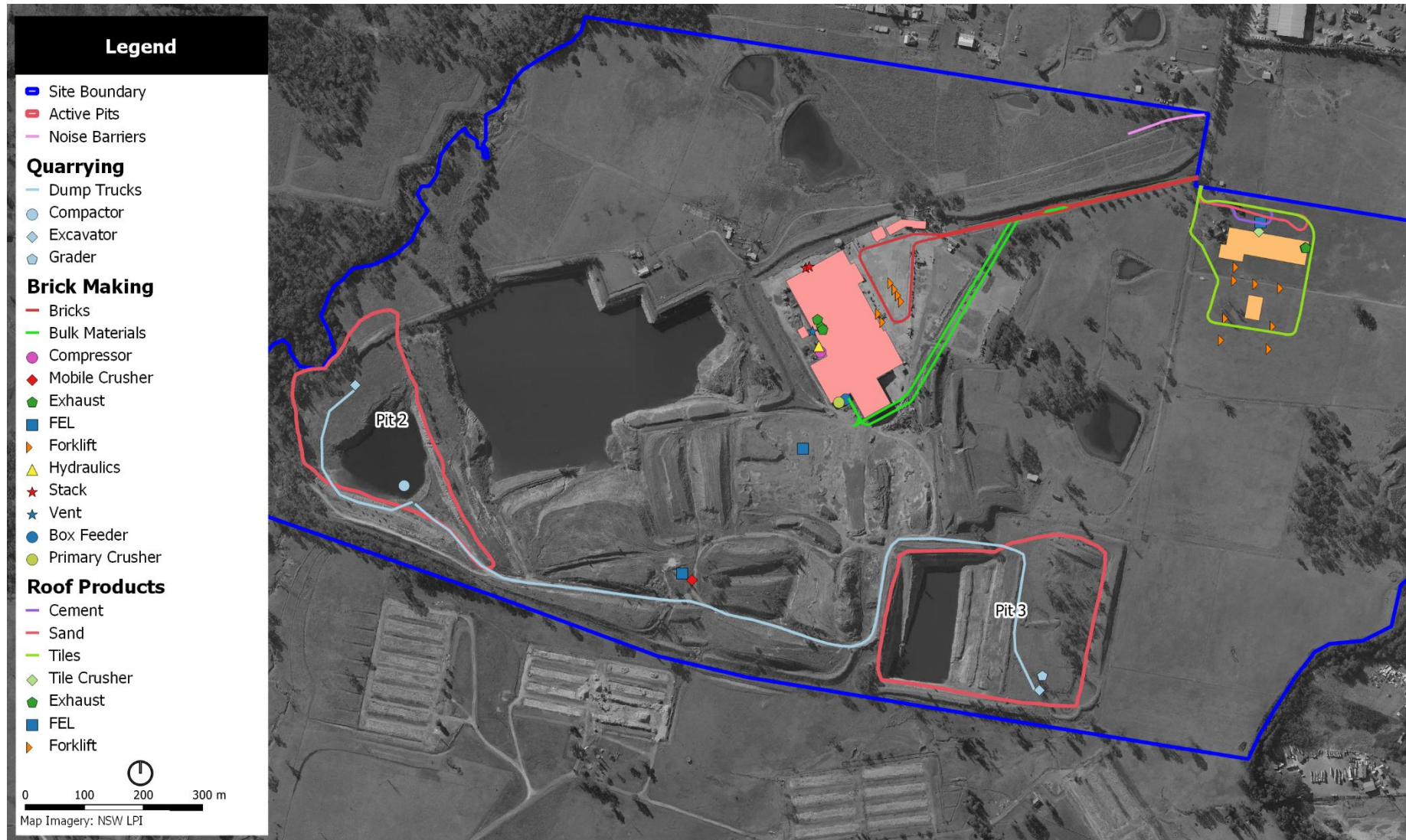
## 48 Victor Avenue, Kemp's Creek



## APPENDIX B

### NOISE MODELLING SOURCE LOCATIONS

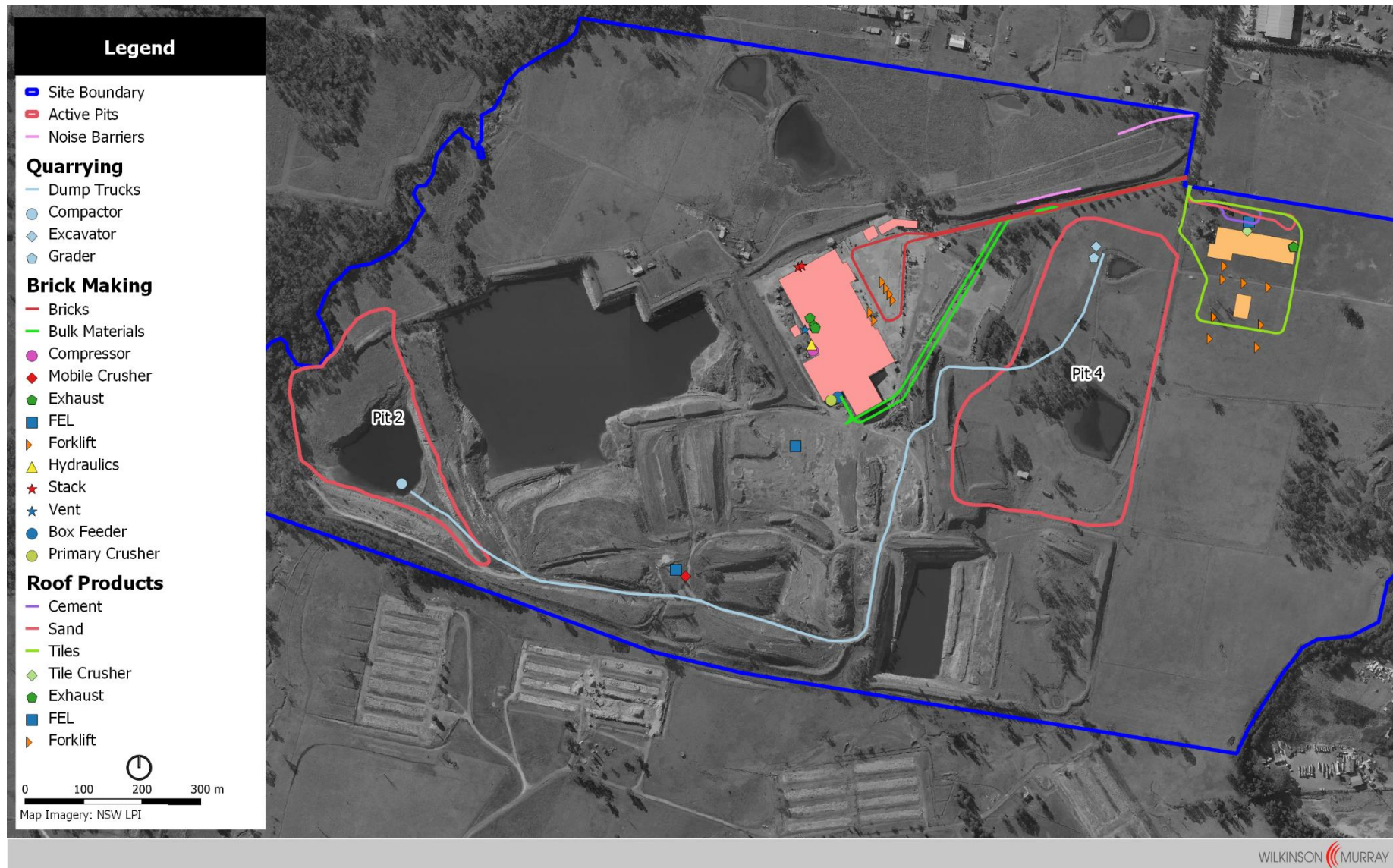
**Figure B-1 Modelled Noise Sources – Pit 3 OB**



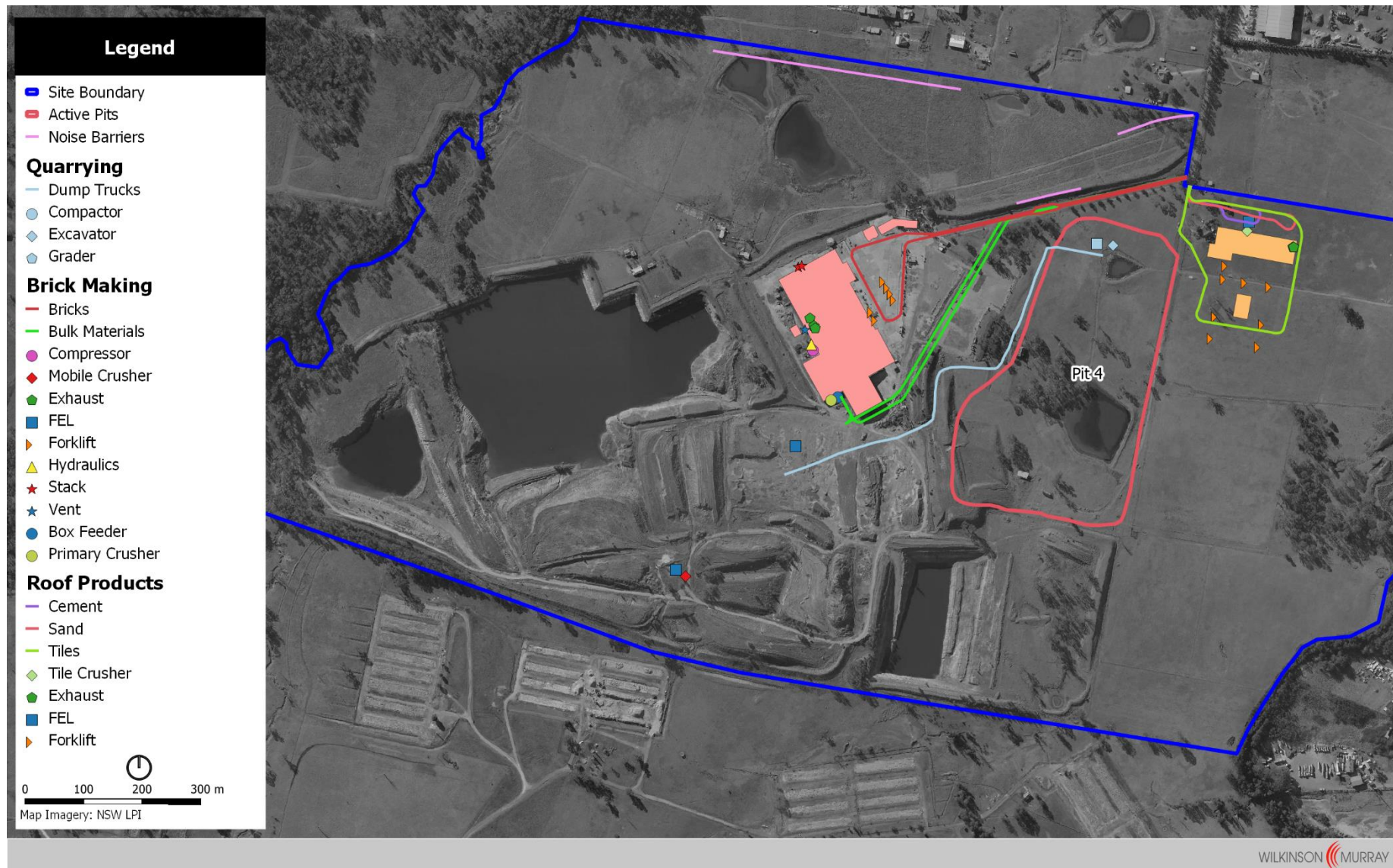
**Figure B-2 Modelled Noise Sources – Pit 3 RM**



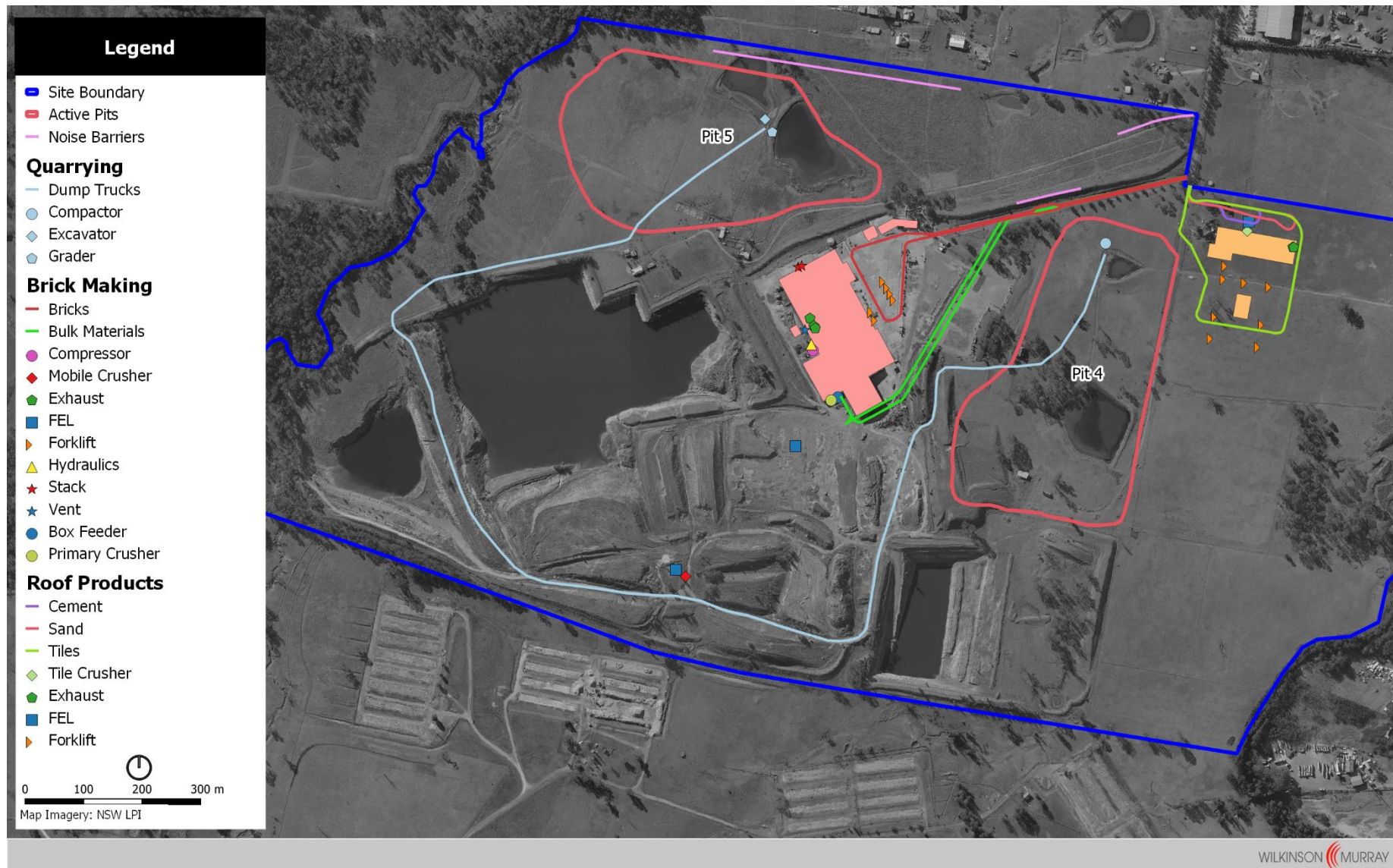
**Figure B-3 Modelled Noise Sources – Pit 4 OB**



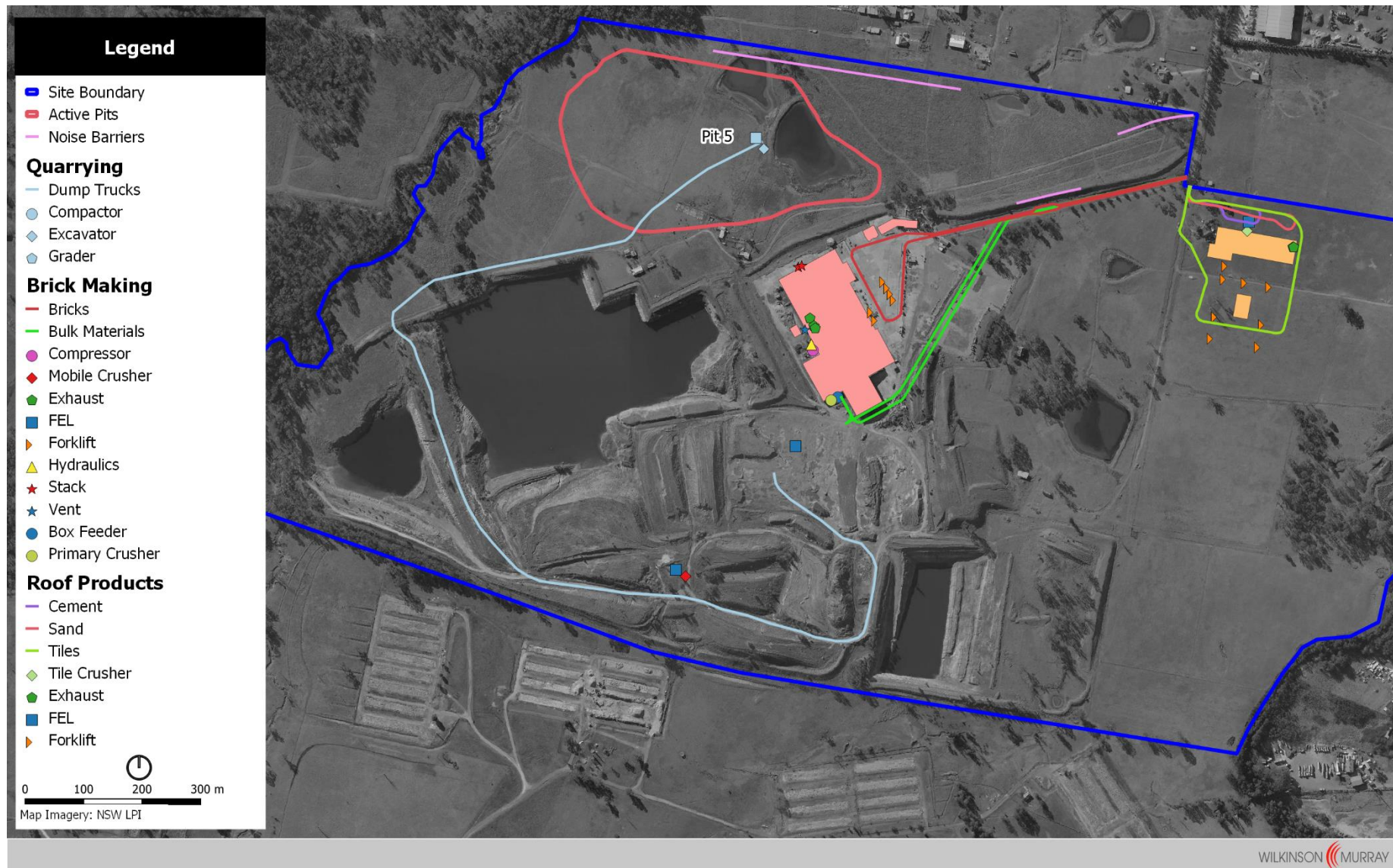
**Figure B-4 Modelled Noise Sources – Pit 4 RM**



**Figure B-5 Modelled Noise Sources – Pit 5 OB**



**Figure B-6 Modelled Noise Sources – Pit 5 RM**

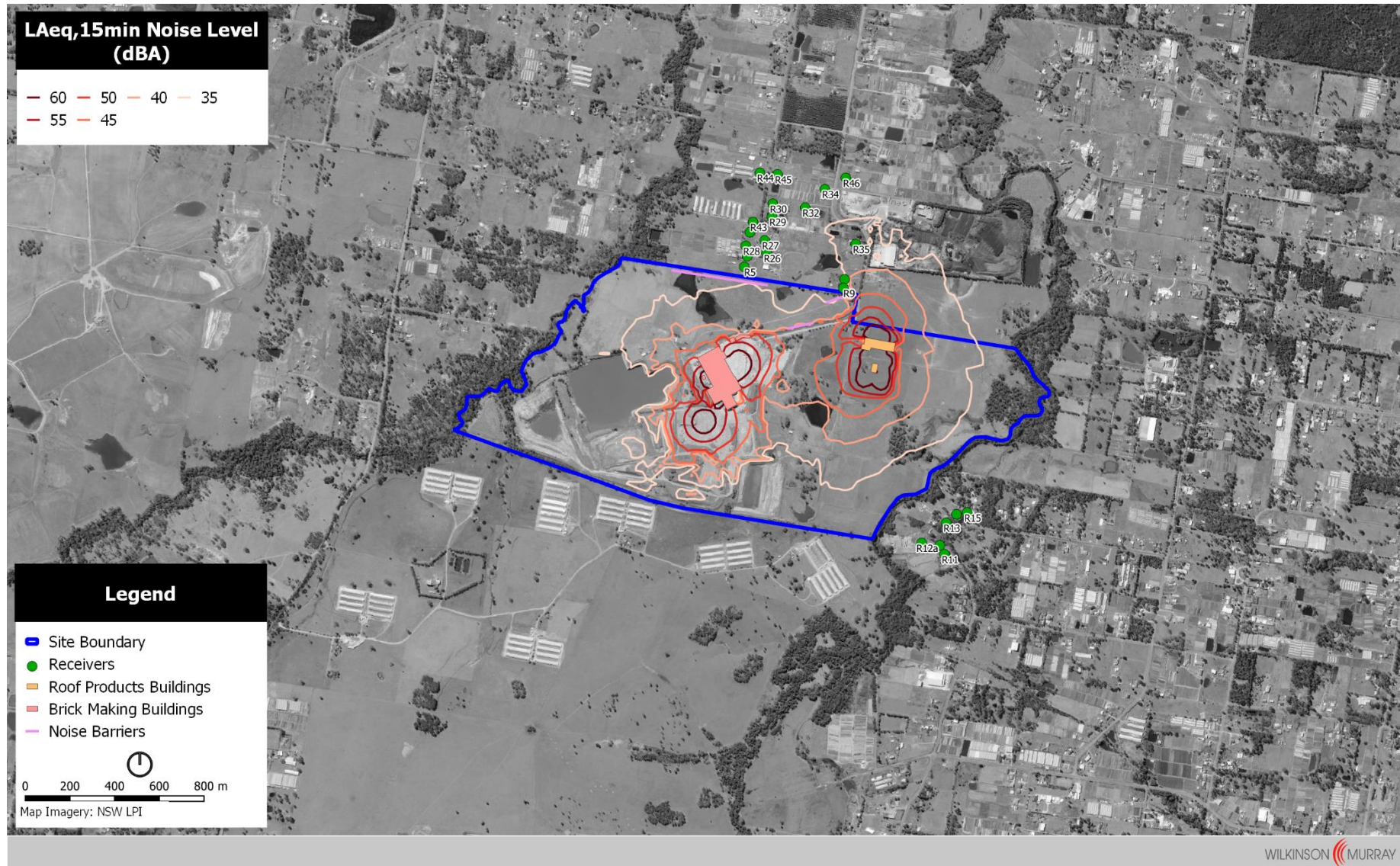


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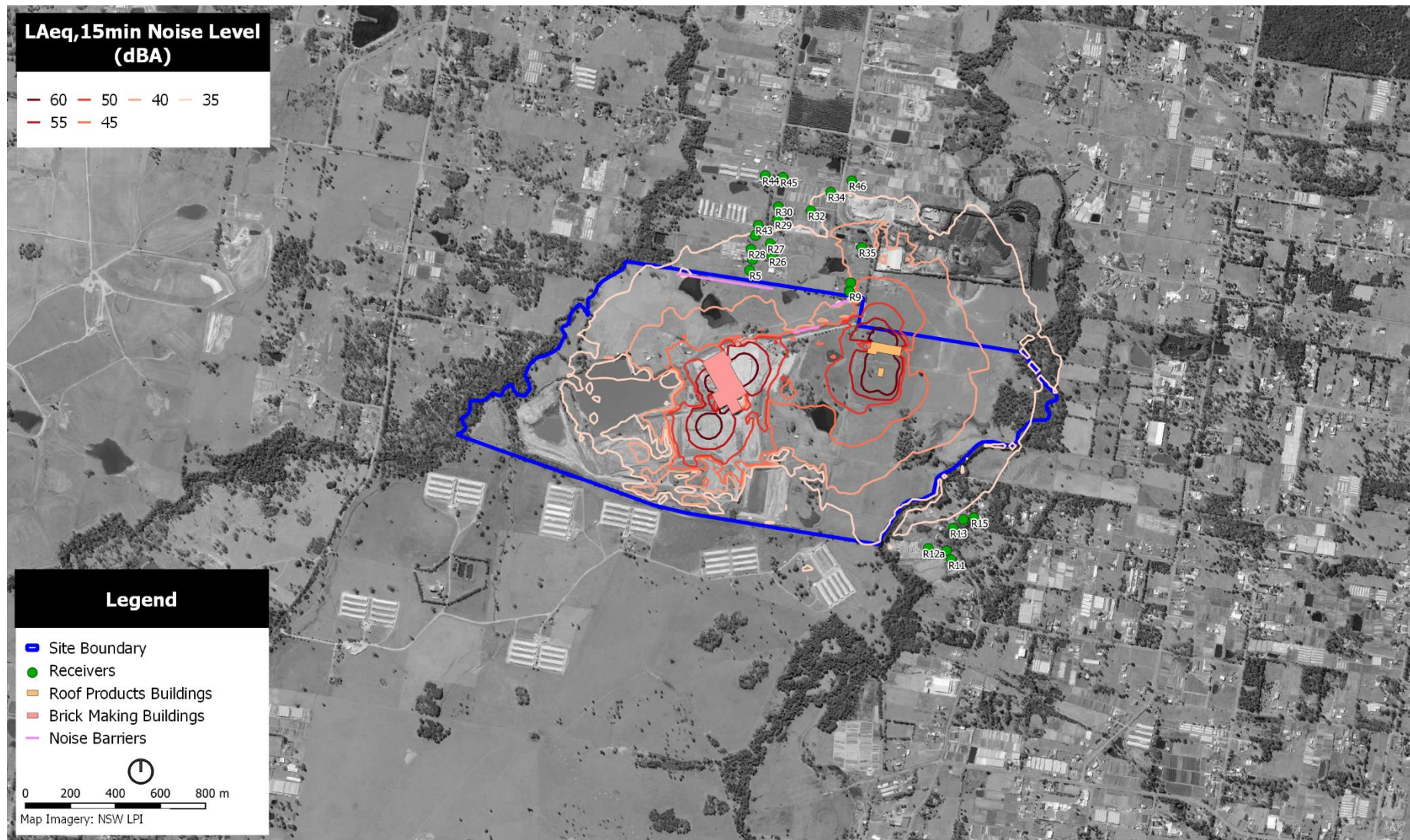
## APPENDIX C

### OPERATIONAL NOISE CONTOUR PLOTS

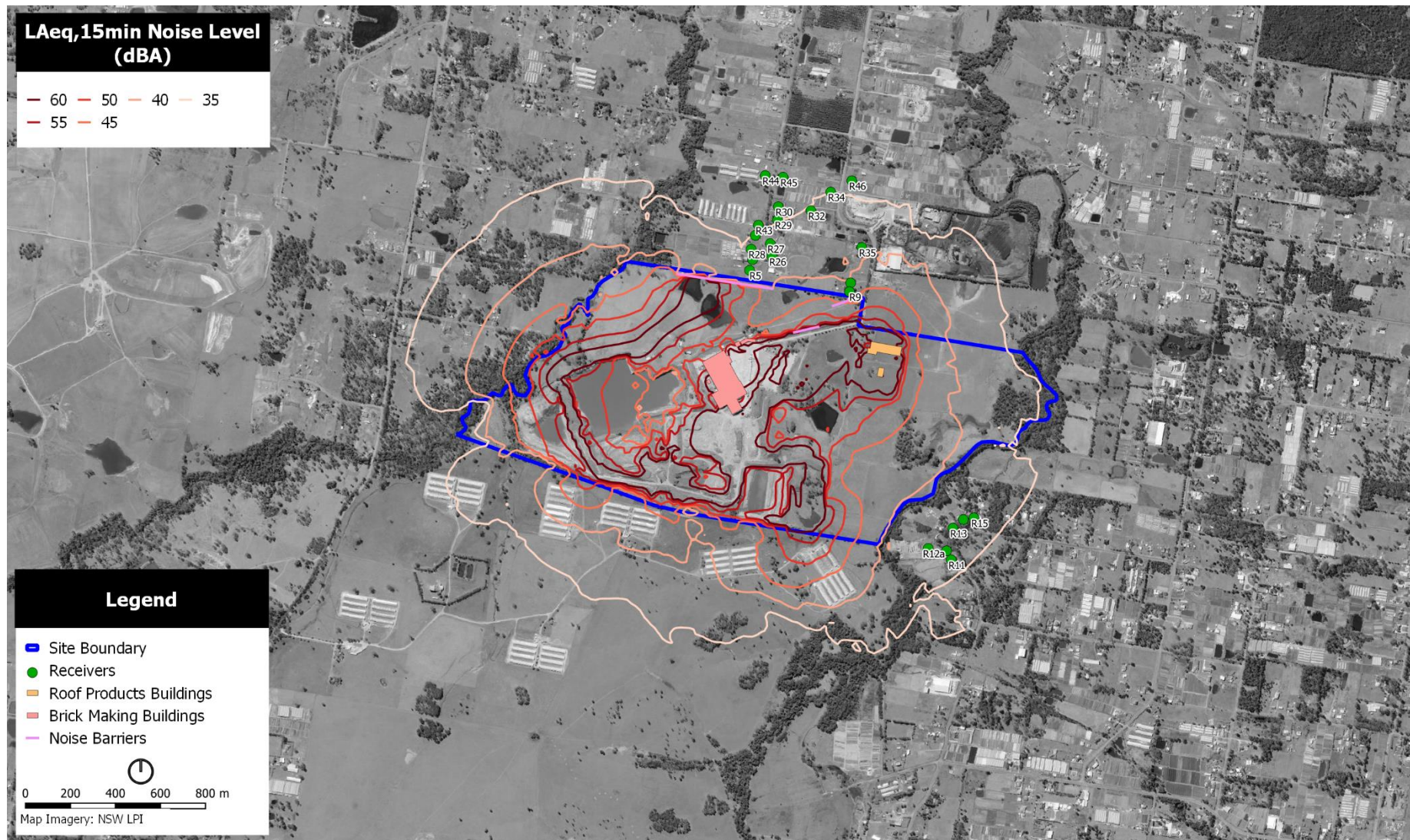
**Figure C-1**  $L_{Aeq,15min}$  Noise Levels – Morning Shoulder, Calm Meteorology



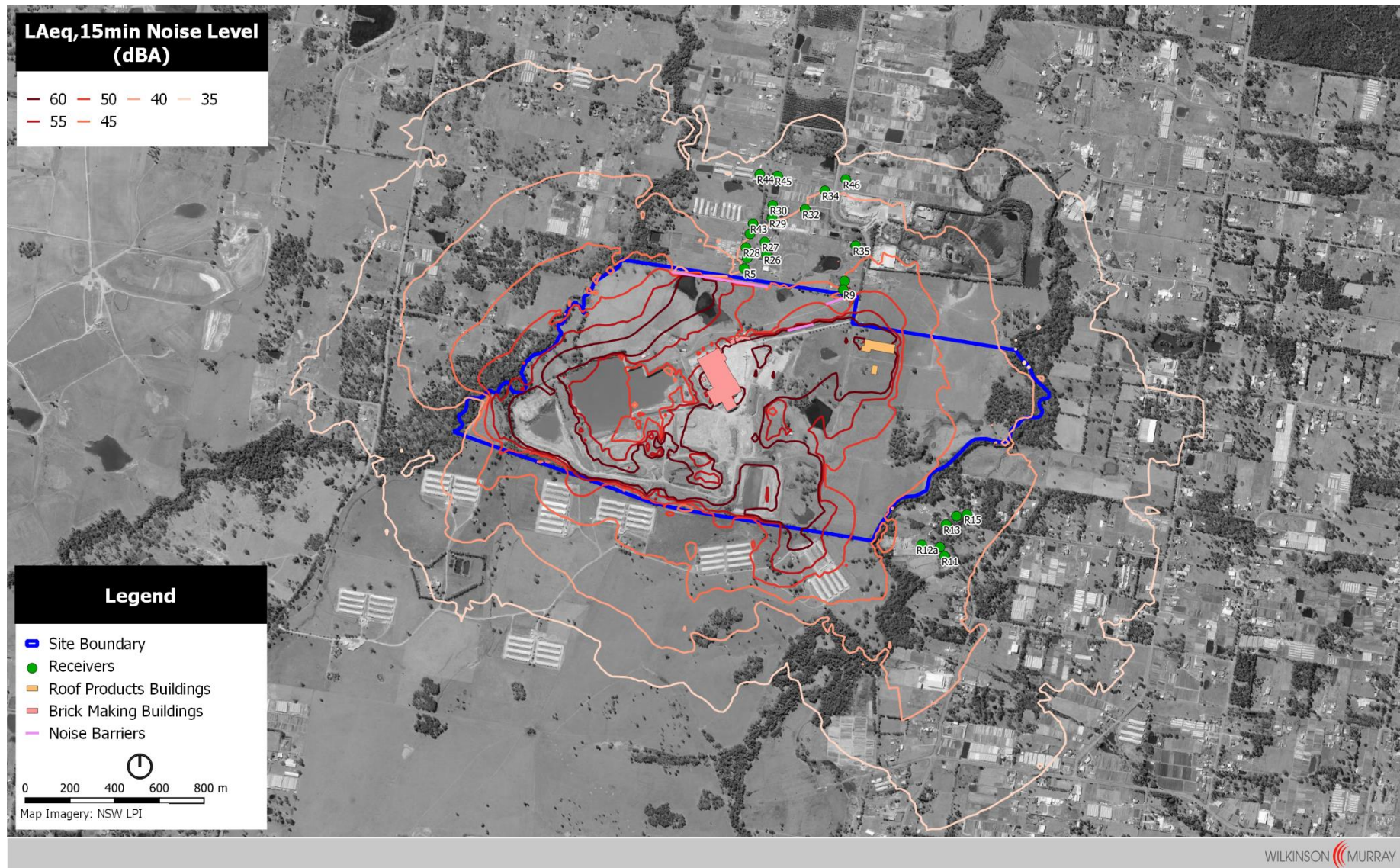
**Figure C-2**  $L_{Aeq,15min}$  Noise Levels – Morning Shoulder, Noise Enhancing Meteorology



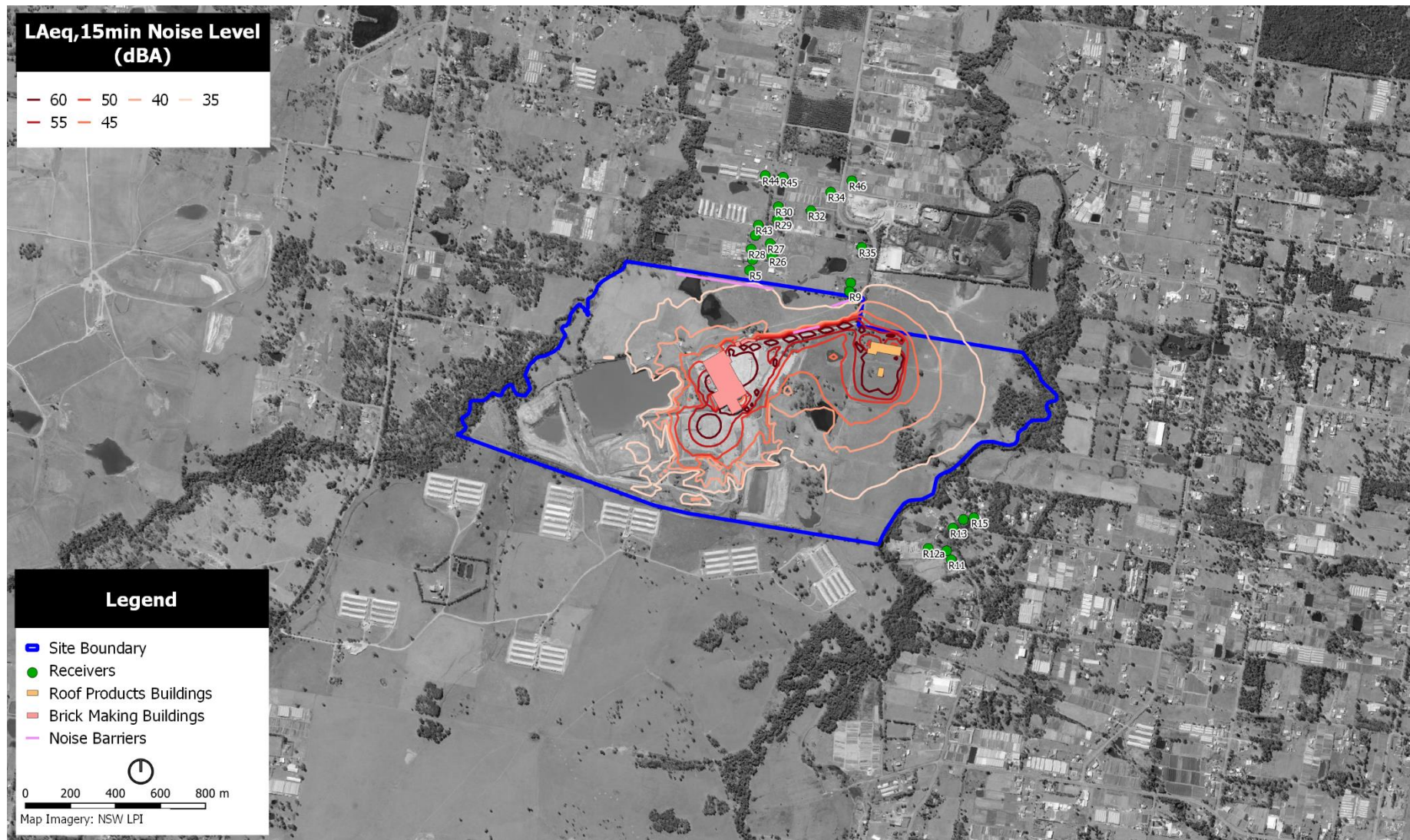
**Figure C-3**  $L_{Aeq,15min}$  Noise Levels – Daytime, Calm Meteorology



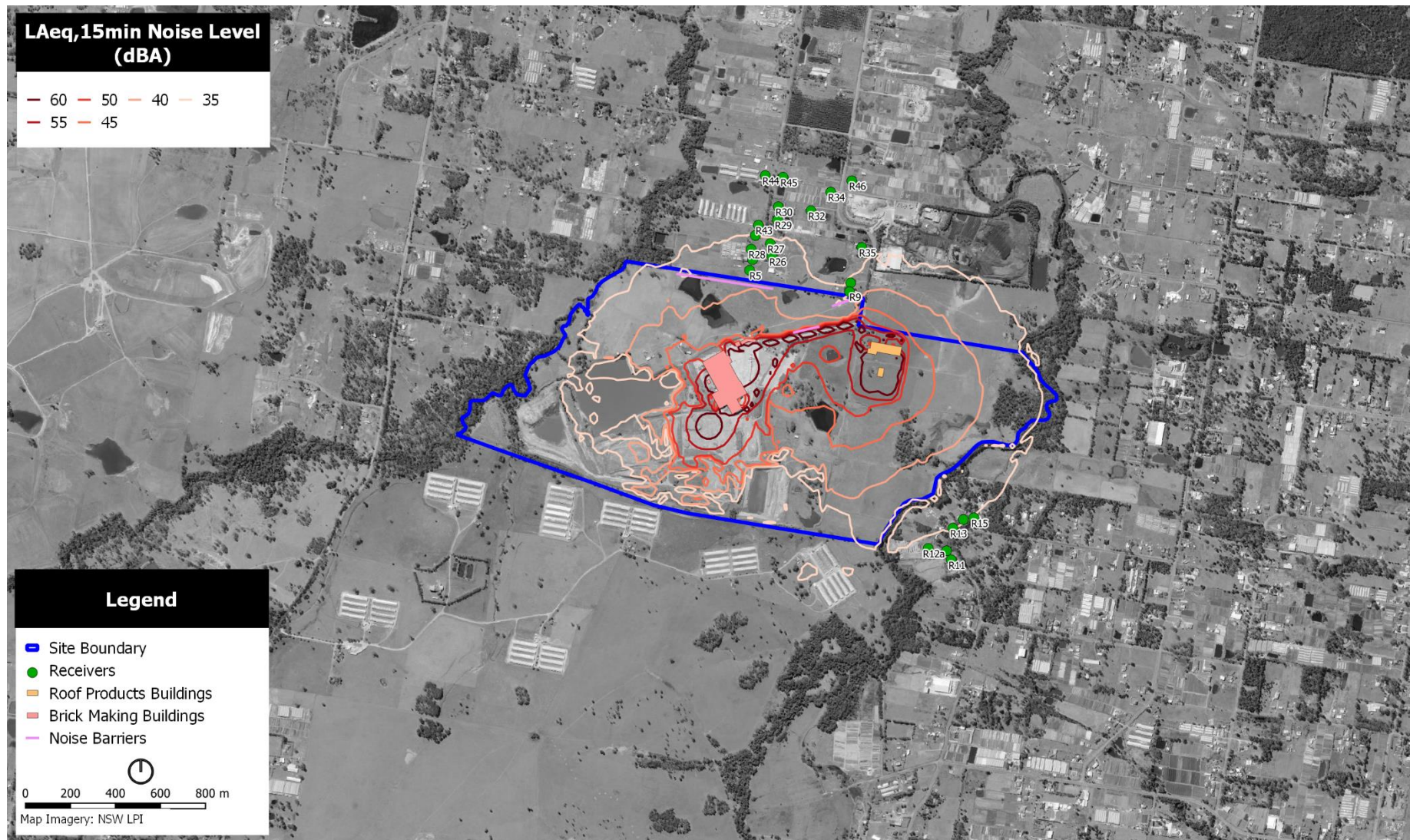
**Figure C-4**  $L_{Aeq,15min}$  Noise Levels – Daytime, Noise Enhancing Meteorology



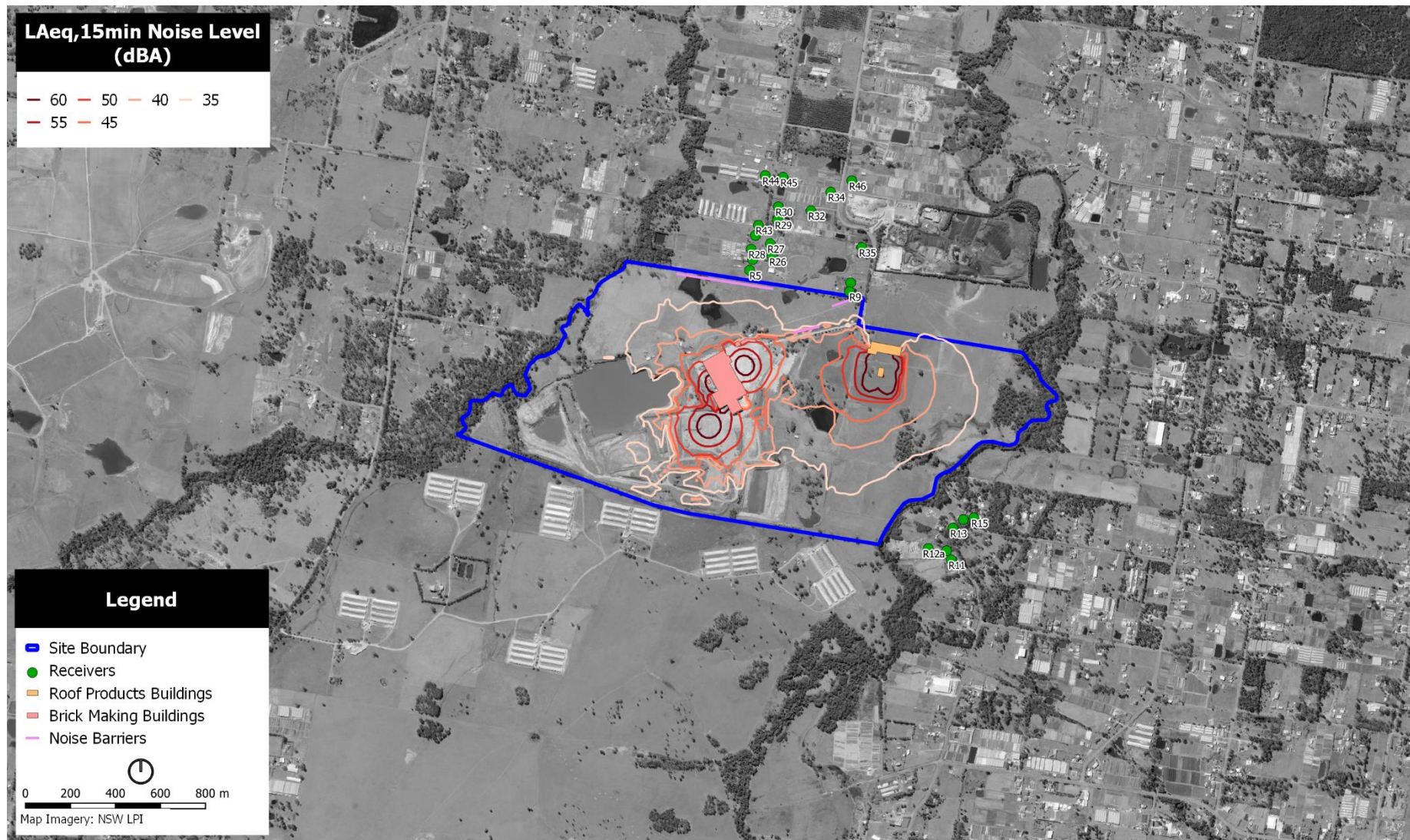
**Figure C-5**  $L_{Aeq,15min}$  Noise Levels – Evening, Calm Meteorology



**Figure C-6**  $L_{Aeq,15min}$  Noise Levels – Evening, Noise Enhancing Meteorology



**Figure C-7**  $L_{Aeq,15min}$  Noise Levels – Night, Calm Meteorology



**Figure C-8**  $L_{Aeq,15min}$  Noise Levels –Night, Noise Enhancing Meteorology

