Technical Report D

Supplementary noise impact assessment

Viva Energy Gas Terminal Project

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SUPPLEMENTARY NOISE IMPACT ASSESSMENT

Viva Energy Gas Terminal Project - Supplementary Statement

3 September 2024

Viva Energy Australia Pty Ltd

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Melbourne Sydney Brisbane Gold Coast Kuwait Singapore
Renzo Tonin & Associates ABN 30 117 463 297
Level 2, 7 Meaden Street, Southbank VIC 3006
P (03) 9690 6005 melbourne@renzotonin.com.au www.renzotonin.com.au

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Address:	GPO Box 872, Melbourne VIC, 3001

Executive summary

A full assessment of the potential impacts on noise from the project was conducted as part of the Viva Energy Gas Terminal Project (the project) Environment Effects Statement (EES) (Technical Report I: Noise and vibration impact assessment, hereafter referred to as the EES noise study).

The EES noise study predicted that noise levels during dredging and operation of the project are expected to be within limits set by the Environment Protection Regulations 2021 at noise sensitive receivers. The potential for cumulative noise impacts from the existing industries combined with noise emissions from project operation was predicted at Geelong Grammar School at night. However, it was considered highly unlikely that this exceedance would occur as it represented the 'worst case' night time scenario (including noise enhancing weather conditions). The EES noise study concluded that potential cumulative noise impacts would be avoided through scheduling of operational activities to avoid the concurrence of all activities at night.

The EES Inquiry and Advisory Committee (IAC) found that the operational noise modelling undertaken in the EES noise study had been undertaken to an acceptable level and showed that the operational noise effects of the project would be able to be managed to an acceptable level (IAC Report No. 1, section 12.5 (iv)). However, this conclusion was contingent on further assessment of background and cumulative noise effects with the refinery and other industrial sources and the assessment in future of the actual Floating Storage & Regasification Unit (FSRU) and project components (IAC Report No. 1, section 12.4 (iv)).

In March 2023 the Minister for Planning directed that a Supplementary Statement is required for the project. The supplementary Statement is required to provide additional information to inform the Minister's assessment of the project's environmental effects.

This technical report provides a supplementary noise study in response to Recommendation 10 of the Minister's Directions for the project Supplementary Statement.

Recommendation 10:	*Undertake the further assessment of noise impacts set out in mitigation measure MM-NV05 in Appendix G of the Inquiry and Advisory Committee's Report No. 2.*

This technical report focuses on Item 2 in MM-NV05 Regulatory noise limits, pre-existing industry noise and Project Noise Criteria which addresses the further assessment of noise impacts set out in the Minister's Directions. Specifically, Item 2 includes the three points for further assessment work noted by the IAC, namely characterisation of the pre-existing noise environment, determination of appropriate noise limits and demonstration of compliance with those noise limits and the GED.

This further assessment involved characterising the existing noise environment to enable recalculation of the regulatory noise limits, comparing pre-existing noise, project noise and combined pre-existing and project noise against the recalculated noise limits, and the development of project-specific noise criteria.

Background noise monitoring was undertaken at eight noise sensitive locations selected as being representative of Geelong Grammar School (GGS) and other noise sensitive areas surrounding the project and it was verified that background noise levels recorded at Avalon College (BG3 and BG4) and Norlane (BG5) are not influenced by intrusive noise from the refinery or other commercial, industrial or trade premises.

Background noise levels recorded at GGS (BG1 and BG2) are influenced by intrusive noise from the refinery and the surrounding port and industrial area, however background noise levels recorded at Avalon College (BG 3 and BG4) and 240 Avalon Road, Avalon (BG8) are not.

Background noise levels recorded at 12 Myrtle Grove, North Shore (BG6) are influenced by intrusive noise from the surrounding port and industrial area (yet not from the refinery), however background noise levels recorded at 36 Walker Street, Rippleside (BG7) are not.

Through further analysis/justifications on the selection of representative background locations, provided in Section 4.1.1.6., BG4 was used as a representative background location to determine the noise limits at Geelong Grammar School and BG7 was used as a representative background location to determine the noise limits at North Shore.

In accordance with the Noise Protocol (EPA Victoria Publication 1826.4), the background noise levels were used to recalculate the regulatory noise limits.

Assessment of potential noise impacts was undertaken by comparing measurements of pre-existing industrial noise, modelled dredging and project operational noise and cumulative noise from pre-existing industry and the project itself with the recalculated limits. Neutral weather conditions, with wind speeds up to 0.5 metres per second at a height of 10 metres, and noise enhancing weather conditions i.e. conditions favourable to sound propagation, with wind speeds up to 3 metres per second at a height of 10 metres, were considered as part of the assessment.

The following conclusions were made:

- Measured noise, from pre-existing industry, is at or below the recalculated noise limits at all sensitive receivers, under neutral weather conditions for the day, evening and night periods.
- Predicted noise, from dredging, is at or below the recalculated noise limits at all sensitive receiver, under neutral and noise enhancing weather conditions for the day, evening and night periods.
- Predicted noise, from project operation, is below the recalculated noise limits at all sensitive receiver, under neutral and noise enhancing weather conditions for the day, evening and night periods.
- Predicted cumulative noise, from pre-existing industry and dredging activities, is at or below the recalculated noise limits at all sensitive receivers, under neutral and noise enhancing weather conditions, for the day period.
- Predicted cumulative noise, from pre-existing industry and dredging activities, is at or below the recalculated noise limits at all sensitive receivers, under neutral weather conditions for the evening and night periods.
- Predicted cumulative noise, from pre-existing industry and project operation, is at or below the recalculated noise limits at all sensitive receivers, under neutral weather conditions, for the day, evening and night periods.
- Predicted cumulative noise, from pre-existing industry and project operation, is at or below the recalculated noise limits at all sensitive receivers, under noise weather enhancing conditions, during the day and evening periods.

- Measured noise, from pre-existing industry exceeds the recalculated noise limits at GGS, under noise enhancing weather conditions during the night period.
- Whilst, the Geelong refinery was not audible at North Shore, estimated noise* under noise enhancing weather conditions from pre-existing industry was predicted to exceed the recalculated noise limits at Corio and North Shore dwellings during the night period.

  * Per Table 11, the effect of noise enhancing conditions was observed and measured for noise transmission to GGS. That measured level difference effect has been applied to estimate noise under enhanced conditions to other locations.
- Accordingly:
  - At GGS there is a potential cumulative noise exceedance, from pre-existing industry and dredging activities, with the recalculated noise limits, under noise enhancing weather conditions, for the evening and night period.
  - At North Shore and Princes Highway dwellings there is a potential cumulative noise exceedance, from pre-existing industry and dredging activities, with the recalculated noise limits, under noise enhancing weather conditions, for the night period.
  - At GGS and North Shore dwellings there is a potential cumulative noise exceedance, from pre-existing industry and project operational activities, with the recalculated night period noise limit, under noise enhancing weather conditions of up to 3dB (i.e. a just perceptible change in the apparent loudness to the human ear, noting that changes in the character of the noise or its frequency spectrum may result in a more discernible change).

The short duration of the dredging campaign, the infrequent occurrence of noise propagating weather events and the small increase in noise level would mean potential cumulative noise impacts would be temporary in nature and limited in time. However, to reduce as far as reasonably practicable the risk of unreasonable noise due to cumulative impacts Viva Energy would implement contingency measures as per mitigation measure MM-NV04 which states:

> *"Measurements shall be undertaken at the commencement of dredging and during meteorological conditions suitable to favourable noise propagation at Geelong Grammar School and other sensitive receivers. Where assessments conducted in accordance with EPA Publication 1826.4 (Noise Protocol) (as amended or replaced from time to time) indicate cumulative noise impacts (including the contributions from dredging, from the Viva Refinery and from other commercial, Industrial or trade premises) will exceed the evening or night period noise limits determined in accordance with the Noise Protocol, dredging operations shall cease during these periods until the relevant period limits are met"*

Further analysis of the potential cumulative exceedances predicted to occur during project operation under noise enhancing weather conditions showed that, consistent with the conclusion of the EES noise study, it is very unlikely that the project would contribute to the exceedance due primarily to the very infrequent occurrence of the noisiest scenarios. However, Project Noise Criteria, which represent a level 10 dB below the noise limit, have been proposed to ensure that project operations do not contribute to an effective noise level that may exceed the noise limits.

Further detailed analysis of noise attenuation and operational management measures is provided in the ANNEXURE to the technical report which demonstrates that project noise levels are able to be maintained within the Project Noise Criteria.

With consideration to the findings of the assessment and the EPA Regulations definition of unreasonable noise, Renzo Tonin & Associates recommends the following Project Noise Criteria:

Location / sensitive receiver location	Project Noise Criteria, L_{eq} dB(A)		
	Day	Evening	Night
Geelong Grammar School	42	38	35
Macgregor Court etc (Lara dwellings)	61	56	45
12 Myrtle Grove (North Shore dwellings)	41	35	30
19 Zinnia St (Norlane dwellings)	44	38	36
365 Princes Hwy (Corio dwellings)	53	45	37
Avalon College	37	37	33

The above table presents the recommended project noise criteria, where the 'project' noise level would be 10dB below the recalculated noise limits. This will ensure that the 'project' does not contribute to the cumulative noise.

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1 Introduction

This technical report provides a supplementary noise study in response to Recommendation 10 in Table 1 of the Minister's Directions for the Viva Energy Gas Terminal Project (the project) Supplementary Statement.

Viva Energy Gas Australia Pty Ltd (Viva Energy) is planning to develop a gas terminal using a ship known as a floating storage and regasification unit (FSRU), which would be continuously moored at Refinery Pier in Corio Bay, Geelong. The key objective of the project is to facilitate a secure and flexible supply of gas for the south-east Australian gas market where there is a projected supply shortfall in coming years. This project would support the community's energy needs as the energy market transitions to lower emissions alternatives.

The FSRU would store liquefied natural gas (LNG) received from visiting LNG carriers (that would moor directly adjacent to the FSRU) and would convert LNG back into a gaseous state by heating the LNG using seawater (a process known as regasification) as required to meet industrial, commercial, and residential customer demand. A 7-kilometre gas transmission pipeline would transfer the gas from the FSRU to the Victorian Transmission System (VTS) at Lara.

The project would be situated adjacent to, and on, Viva Energy's Geelong refinery, within a heavily developed port and industrial area on the western shores of Corio Bay between the Geelong suburbs of Corio and North Shore. Co-locating the project with the existing Geelong Refinery and within the Port of Geelong offers significant opportunity to minimise potential environmental effects and utilise several attributes that come with the port and industrial setting.

In March 2023, the Victorian Minister for Planning determined that the project Environment Effects Statement (EES) requires a Supplementary Statement to be prepared by Viva Energy, in accordance with sections 5 and 8C(2) of the Environment Effects Act 1978 (Vic). The Supplementary Statement is required to complete the assessment of the project's environmental effects on the marine environment, noise, air quality and Aboriginal cultural heritage in accordance with the Minister's Directions and inform decision making

1.1 Purpose

This supplementary noise study provides a technical response to Recommendation 10 in Table 1 of the Minister's Directions, integrates the findings of the study with key outcomes of the original EES noise impact assessment (refer to Section 5) and provides an update to the noise mitigation measures recommended in the original EES where necessary.

1.2 The project area

The project would be located adjacent to, and on, the Geelong Refinery and Refinery Pier in the City of Greater Geelong, 75 kilometres (km) south-west of Melbourne. The project area is within a heavily developed port and industrial area on the western shores of Corio Bay between the Geelong suburbs of Corio and North Shore. The Geelong central business district is located approximately 7 km south of the project. The project area is shown in Figure 1. Corio Bay is the largest bay in the south-west corner of Port Phillip Bay and is a sheltered, shallow basin at the western end of the Geelong Arm, with an area of 44 square kilometres (km^2). The Point Wilson/Limeburners Bay section of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site is located along the northern shoreline of Corio Bay, approximately one kilometre to the north-east of the project.

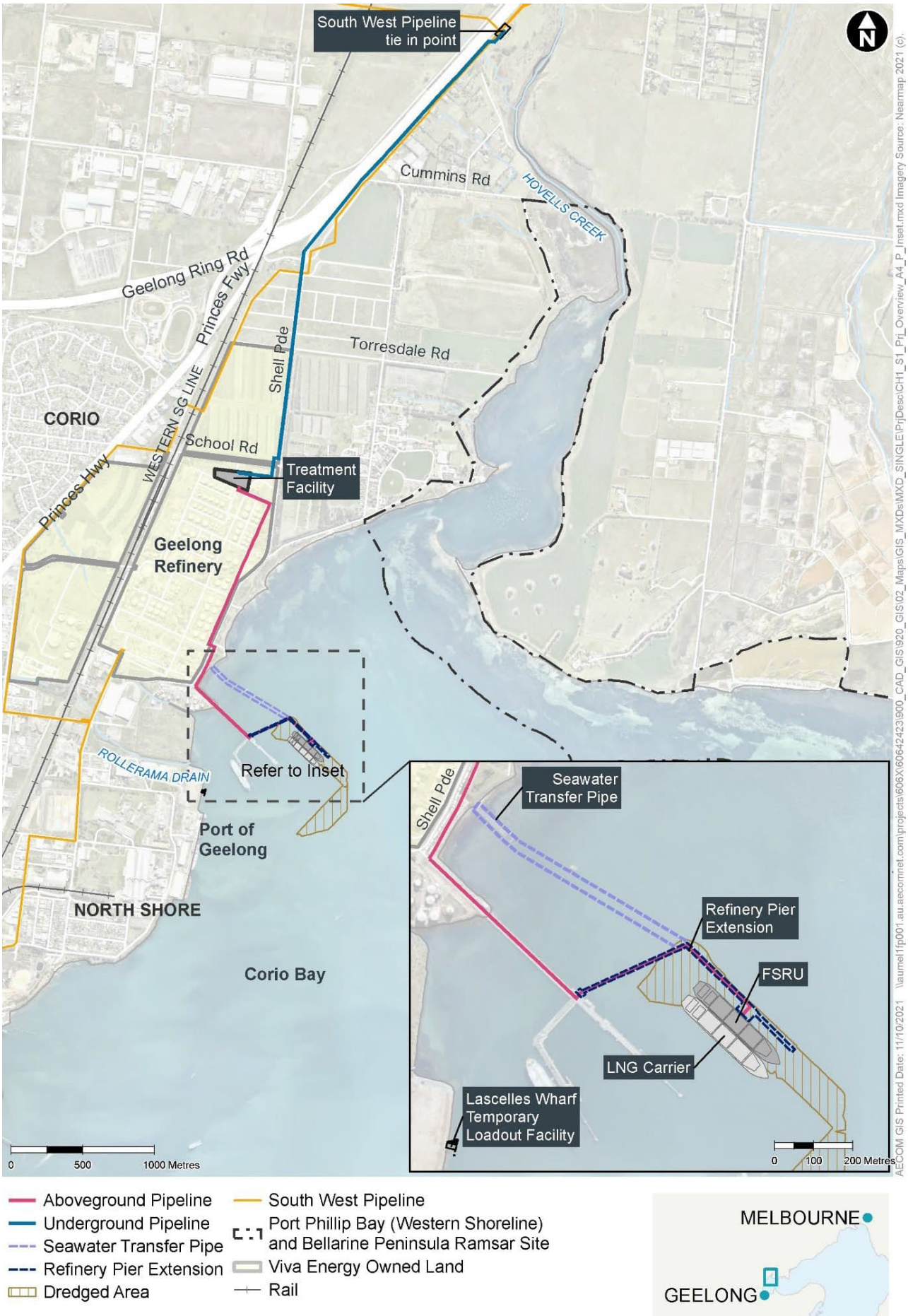
The Port of Geelong has been in operation for over 150 years and is the largest industrial bulk cargo port in Victoria, attracting over 600 ship visits and handling more than 14 million tonnes of product annually. Geelong's shipping channels extend 18 nautical miles through Corio Bay from Point Richards through to Refinery Pier. Ports Victoria manages commercial navigation in the port waters in and around Geelong and is responsible for the safe and efficient movement of shipping, and for maintaining shipping channels and navigation aids. The channels are man-made having been deepened and widened through periodic dredging to support port trade development.

Refinery Pier is the primary location within the Port of Geelong for movement of bulk liquids. Vessels up to 265 metres in length currently utilise the four berths at Refinery Pier which service Viva Energy refinery operations. The majority of ship visits to the port are to Refinery Pier, with Viva Energy accounting for over half of the trade through the Port of Geelong.

The Geelong Refinery has been operating since 1954 with both the refinery and the co-located Lyondell Bassell plant being licensed Major Hazard Facilities (MHFs). A range of industrial activities are situated in the Port environs including wood fibre processing and chemical, fertiliser and cement manufacturing.

To the north of the Geelong Refinery, along the proposed underground pipeline corridor, the area is predominantly rural. There are several other existing Viva Energy-owned underground pipelines running between the refinery and the connection point to the Southwest Pipeline (SWP) at Lara. The proposed pipeline route follows already disturbed pipeline corridors, where possible, through a mix of land uses.

Figure 1: The project overview (courtesy of AECOM Australia Pty Ltd)



1.3 The project description

Key components of the project include:

- Extension of the existing Refinery Pier with an approximately 570 metre (m) long angled pier arm, new berth and ancillary pier infrastructure including high pressure gas marine loading arms (MLAs) and a transfer line connecting the seawater discharge points on the FSRU to the refinery seawater intake
- Continuous mooring of an FSRU at the new Refinery Pier berth to store and convert LNG into natural gas. LNG carriers would moor alongside the FSRU and unload the LNG
- Construction and operation of approximately 3km of gas pipeline on the pier and within the refinery site connecting the FSRU to the new treatment facility
- Construction and operation of a treatment facility on refinery premises including injection of nitrogen and odorant (if required)
- Construction and operation of an underground gas transmission pipeline, approximately 4km in length, connecting to the SWP at Lara.

The Refinery Pier extension would be located to the north-east of Refinery Pier No. 1. The new pier arm would be positioned to allow for sufficient clearance between an LNG carrier berthed alongside the FSRU and a vessel berthed at the existing Refinery Pier berth No. 1. Dredging of approximately 490,000 cubic metres of seabed sediment would be required to allow for the new berth pocket and swing basin.

The FSRU vessel would be up to 300 m in length and 50 m in breadth, with the capacity to store approximately 170,000 cubic metres (m^3) of LNG. The FSRU would receive LNG from visiting LNG carriers and store it onboard in cryogenic storage tanks at about -160 °C.

The FSRU would receive up to 160 PJ per annum (approximately 45 LNG carriers) depending on demand. The number of LNG carriers would also depend on their storage capacity, which could vary from 140,000 to 170,000 m^3.

When gas is needed, the FSRU would convert the LNG back into a gaseous state by heating the LNG using seawater (a process known as regasification). The natural gas would then be transferred through the aboveground pipeline from the FSRU to the treatment facility where odorant and nitrogen would be added, where required, to meet Victorian Transmission System (VTS) gas quality specifications. Nitrogen injection would occur when any given gas cargo needs to be adjusted (diluted) to meet local specifications. Odorant (mercaptan) is added as a safety requirement so that the normally odourless gas can be smelt when in use. From the treatment facility, the underground section of the pipeline would transfer the natural gas to the tie-in point to the SWP at Lara.

1.3.1 Key construction activities

Construction of the project would occur over a period of up to 18 months (please refer to EES Chapter 4 for a more detailed project description including an indicative construction schedule).

The key construction activities relate to:

- Localised dredging of seabed sediments to enable the FSRU and LNG carriers to berth at Refinery Pier and excavation of a shallow trench for the seawater transfer pipe
- Construction of a temporary loadout facility at Lascelles Wharf
- Construction of the new pier arm and berthing infrastructure, and pipeline along Refinery Pier and through the refinery
- Construction of the treatment facility on a laydown area at the northern boundary of the refinery site
- Construction of the buried pipeline
- Construction at the tie-in point to the SWP at Lara.

There are no construction activities required for the FSRU component of the project. The vessel would be built, commissioned and all production and safety systems verified prior to being brought to site.

An estimated 490,000 cubic metres (m^3) of dredging would be required, over an area of approximately 12 hectares (ha), adjacent to the existing shipping channel to provide sufficient water depth at the new berth and within the swing basin for visiting LNG carriers to turn. Dredging within the new berth would be undertaken to a depth of 13.1 metres and the swing basin would be dredged to a depth of 12.7 metres. The dredging footprint is shown in Figure 1. It is planned to deposit the dredged material within Ports Victoria's existing dredged material ground (DMG) in Port Phillip Bay to the east of Point Wilson, approximately 26 km from Refinery Pier.

The temporary loadout facility at Lascelles Wharf would be the first construction activity to take place in order to facilitate the Refinery Pier extension. This would involve the installation of 10 piles using hydraulic hammers.

Construction of the pier arm would be carried out once dredging was complete, primarily from the water using barge-mounted cranes. Steel piles would be driven into the seabed by cranes mounted on floating barges and pre-cast concrete and prefabricated steel components would be transported to site by barge and lifted into position. The installation of pier infrastructure such as the marine loading arms (MLAs), piping from the FSRU to the existing refinery seawater intake (SWI) and aboveground pipeline would also be undertaken from the water using barge-mounted cranes.

Installation of the 3km pipeline along the pier and through the refinery is anticipated to take 3.5 months to complete. The pipeline would run along the pier to the existing pipe track east of Shell Parade within the pier foreshore compound. It would then pass through a road under-crossing to the existing refinery pipe track. The pipeline would then run north along the existing refinery pipe track to an existing laydown area where the treatment facility would be located.

The treatment facility would be located within an existing laydown area in the refinery site and cover an area of approximately 80m x 120m. Construction of the treatment facility would take approximately 6

months and would be undertaken by specialist crews across distinct phases of work. These would include initial earthworks and civil construction, mechanical installation and electrical and instrumentation works.

The 4km underground pipeline would be installed in stages over an approximate 4-month period within a corridor which has been selected so as to avoid the need for trenchless construction beneath watercourses or other environmental sensitivities. Firstly, a construction right of way (ROW) would be established, clearly identified, and fenced off where required. Typically, this would be between 25 and 30m wide, and minimised where possible to reduce disturbance. Once the construction ROW is established, vegetation would be removed, and a trench excavated to a maximum depth of 2m and a maximum width of 1m for the pipeline to be placed. Following the placement of the pipeline, the construction ROW would be rehabilitated to its pre-existing condition as far as practicable for the purposes for which it was used immediately before the construction of that part of the pipeline.

Trenchless construction (including boring or horizontal directional drilling (HDD)) would be used to install the underground pipeline in areas that are not suited to open trenching techniques, such as at intersections with major roads, which would be confirmed during detailed design. Trenchless construction would involve boring or drilling a hole beneath the ground surface at a shallow angle and then pushing or pulling a welded length of pipe through the hole without disturbing the surface. It is anticipated that the maximum depth of the trenchless section would be 25m.

Construction at the tie-in point to the SWP at Lara would be undertaken by specialist crews across the distinct phases of works, as with the treatment facility.

1.3.2 Key operation activities

The project is expected to be in operation for approximately 20 years. Key activities relating to the project operation include:

- Receipt of up to 45 LNG carriers each year at Refinery Pier – the number and frequency of LNG carriers arriving each year would depend on their storage capacity and gas demand
- Regasification of LNG onboard the FSRU using seawater as a heat source, which would then be reused within the refinery as cooling water
- Injection of nitrogen and odorant into the gas prior to distribution via the VTS
- Monitoring and maintenance of the pipeline easement.

1.3.3 Key decommissioning activities

The FSRU, which continues to be an ocean-going vessel throughout the operation of the project, would leave Corio Bay on completion of the project life to be used elsewhere.

It is anticipated that the Refinery Pier berth and facilities would be retained for other port related uses. The underground pipeline would likely remain in situ subject to landholder agreements and either decommissioned completely or placed into care and maintenance arrangements.

Decommissioning activities may be subject to change, subject to legislative requirements at the time and potential repurposing of the infrastructure at the end of the project.

1.3.4 The project activities relevant to the supplementary study

In accordance with Recommendation 10 in Table 1 of the Minister's Directions the focus of the supplementary noise study was to undertake further assessment of the project's operational noise impacts. In addition to revisiting the potential operational phase impacts of the project activities (detailed in Section 4), further consideration has also been given to potential construction phase impacts of dredging which was also assessed in the original EES consistent with the Guidelines for Dredging, EPA Publication 691.

2 Minister's directions

The Minister's Directions require Viva Energy to prepare a Supplementary Statement to provide an assessment of the environmental effects of the project on the marine environment, noise, air quality and Aboriginal cultural heritage with respect to the consolidated recommendations of the IAC for further work. Table 1 of the Minister's Directions presents the IAC's consolidated recommendations for further work.

One item of further work was identified under Recommendation 10 in Table 1 of the Minister's Directions which relates to noise impacts. Recommendation 10 is presented in Table 1 below.

Table 1 Recommendation for further work relevant to this supplementary noise study

Recommendation	Further work to be undertaken	Supplementary study section
Recommendation 10	Undertake the further assessment of noise impacts set out in mitigation measure MM-NV05 in Appendix G of the Inquiry and Advisory Committee's Report No. 2.	Section 4
	MM-NV05 *Establishing and implementing operational noise controls* An operational noise management framework will be prepared that will inform, through all stages of the project, including design, equipment selection, construction, and installation, and operation, how actions will be taken to: • manage emissions of noise and vibration and minimise their impacts, so far as reasonably practicable, and • prevent the emission of unreasonable noise (as defined In the Environment Protection Act 2017), by - not exceeding the noise limits set In Part 5.3, Division 3 of the Environment Protection Regulations 2021; and - having regard to the factors in part (a) of the definition of unreasonable noise; and - managing low frequency noise, in accordance with the Noise guidelines: assessing low frequency noise (EPA Publication 1996) (as amended or replaced from time to time).	
	Regulatory noise limits, pre-existing industry noise and Project Noise Criteria To inform the design, construction and operation of the project: • Background noise levels shall be measured and verified without the inclusion of noise from Viva Refinery and from other commercial, industrial and trade premises, with noise limits of Part 5.3, Division 3 of the Environment Protection Regulations 2021 established accordingly. • Further assessment of the pre-existing noise from commercial, industrial and trade premises (from the Viva Refinery and from other commercial, industrial and trade premises) shall be carried out based on measurements taken over a period of at least 1-week to determine existing $L_{Aeq,30min}$ noise impacts and the likely cumulative noise impacts at Geelong Grammar School and at other noise sensitive areas. If background noise cannot be measured without impacts from Viva Refinery it will be measured during a period of plant shut down. • Establish and justify, supported by documented evidence, Project Noise Criteria to ensure that the noise from the Project, when combined to the pre-existing noise from commercial, industrial and trade premises will not lead to an exceedance of the regulatory noise limits.	

Recommendation	Further work to be undertaken	Supplementary study section
	Plant design and selection • Ensure, via iterative reviews, that all reasonably practicable opportunities to reduce the emission of operational noise have been considered across the design, construction and operation of the project. • Engage a suitably qualified acoustic consultant to review detailed plant designs and noise emission data for plant and vessels and provide noise mitigation advice. • Operational plant selection process must ensure that manufacturers' data or noise measurement data to be verified for all operational equipment to ensure that tonality is not present. • Low frequency noise emissions from operational plants, including (but not limited to) from the following items, which must be assessed and managed in accordance with EPA Publication1996 (as amended or replaced from time to time): - LNG carriers - FSRU vessels - Tugboat exhausts - Regasification boilers *Operational management plan* • Noise from the Project will be managed in accordance with the Environment Protection Regulations 2021, EPA Publication 1826 (as amended or replaced from time to time) and the General Environmental Duty, including cumulative noise impacts from any other industry. • Prepare an operational management plan, supported by documented evidence that details the approach that will be taken to meet the Project Noise Criteria. This plan will include: - how the noise from LNG carriers will be taken into account and managed: - details of equipment selections and mitigation measures adopted; and - scheduling to ensure all activities minimise noise emissions. For example, during the night period, limit the number of activities operating concurrently. • Review and update the operational management plan wherever necessary and relevant, including on the basis of any noise monitoring carried out to assess noise emissions from the Project, cumulative noise impacts or adverse noise character identified. • Additional cumulative impact management strategies will be developed in consultation with the relevant stakeholders.	

Recommendation	Further work to be undertaken	Supplementary study section
	Operational noise monitoring Operational noise monitoring will be undertaken to confirm operational noise levels and verify cumulative noise impacts. • Within the first 3 months of operation, conduct long-term noise monitoring (over a minimum of 1 month) in accordance with the Noise Protocol and the provisions of EPA Publication 1997 (as amended or replaced from time to time), to verify that the Project Noise Criteria and/or regulatory noise limits are not exceeded at Geelong Grammar School and other noise sensitive areas. The measurements shall be undertaken for all operating scenarios to verify the noise emissions. • Measurements will also be undertaken as part of the Environmental Management Plan in response to any community complaints. • Operational noise monitoring will inform ongoing updates to the operational management plan including potential scheduling of activities and mitigation measures if required. • Wherever the noise emissions from the Project are measured to exceed the Project Noise Criteria, or the cumulative Industry noise is measured to exceed the regulatory noise limits, additional attenuation and/or management controls shall be implemented and measurements repeated until compliance is demonstrated. • Further noise monitoring should be conducted to verify the effectiveness of the attenuation and/or management controls to prevent exceedances of the Project Noise Criteria and the regulatory noise limits. Where management and scheduling for the operational activities is changed, the risk of exceedance of the Project Noise Criteria and the regulatory limits must be assessed, and wherever relevant further noise monitoring should also be conducted to verify compliance.	

3 Methodology

This section describes how the supplementary noise study was conducted to address the Minister's Directions related to noise (Recommendation 10). The following sections outline the study methodology.

3.1 Proposed tasks to address Minister's Directions

A description of the proposed tasks to address Recommendation 10, as well as a summary of the expected outcome of each task is provided in Table 2.

Table 2 Noise methodology

Task objective		Task description	Outcomes
10a	*Address MM-NV05 To Inform the design, construction and operation of the project:* • *Background noise levels shall be measured and verified without the inclusion of noise from Viva Refinery and from other commercial, industrial and trade premises, with noise limits of Part 5.3, Division 3 of the Environment Protection Regulations 2021 established accordingly*	Undertake the following measurements and calculations: • Determine a background noise level for Geelong Grammar School (GGS) and other noise sensitive areas without inclusion of 'intrusive; noise from commercial, industrial and trade premises in accordance with Clause 42 of the Noise Protocol, EPA Publication 1826.4. • The identification of Noise Sensitive Areas (NSA) in the EES will be reviewed to ensure these are appropriate for the assessment of noise impacts from dredging activity and operation of the FSRU. • The suitability of the measured levels to represent the background for the relevant noise sensitive areas will be justified and verified. • If a 'background equivalent location' is used its choice will be justified, demonstrating why the measurement of the background level at this location is representative of background level at the relevant noise sensitive area, in accordance with Clause 40 of the Noise Protocol, EPA Publication 1826.4. • Recalculate the regulatory noise limits for GGS and other sensitive areas utilising these background noise levels.	Addressed in Section 4.1
10b	*Address MM-NV05 To Inform the design, construction and operation of the project:* • *Further assessment of the pre-existing noise from commercial, industrial and trade premises (from Viva Refinery and from other commercial, industrial and trade premises) shall be carried out based on measurements taken over a period of at least 1-week to determine existing $L_{Aeq,30min}$ noise impacts and the likely cumulative noise impacts at Geelong Grammar School (GGS) and at other noise sensitive areas. If background noise cannot be measured without impacts from the Viva Refinery, it will be measured during a period of plant shut down.*	Undertake the following measurements and calculations: • Carry out measurements of pre-existing noise over a period of at least one week at GGS and at other noise sensitive areas. Undertake further assessment of noise impacts informed by the results of the additional noise monitoring: • Compare the measured pre-existing noise impacts ($L_{Aeq,30min}$, adjusted where relevant for duration, noise character, and measurement position in accordance with Clause 71 to 90 of the Noise Protocol, EPA Publication 1826.4) at GGS and other noise sensitive areas with the recalculated regulatory noise limits (from 10a). • Compare the predicted noise impacts from dredging activities and FSRU operation at GGS and other noise sensitive areas with the recalculated regulatory noise limits (from 10a). • Compare the predicted cumulative noise impacts of pre-existing noise combined with the project noise from the dredging activity or FSRU operation at GGS and other noise sensitive areas with the recalculated regulatory noise limits (from 10a). Considering the results of the additional noise monitoring and further impact assessment either update the conclusions reached in the EES if the findings change such that potential impacts also change or include a statement confirming that there is no change to the conclusions reached (if appropriate)	Addressed in Section 4.2
10c	*Address MM-NV05 To Inform the design, construction and operation of the project:* • *Establish and justify, supported by documented evidence, The project Noise Criteria to ensure that the noise from the project, when combined with the pre-existing and approved noise from commercial, industrial and trade premises will not lead to an exceedance of the regulatory noise limits.*	• Identify any 'approved' (but not pre-existing) noise emissions which would contribute to cumulative noise impacts. • Compare the predicted cumulative noise impacts of pre-existing and approved noise combined with the project noise at GGS and other noise sensitive areas with the recalculated regulatory noise limits (from 10a). • Establish the project Noise Criteria consistent with the Environment Protection Regulations (in particular R. 119 Cumulative noise), Environment Protection Authority (EPA) Publication 1997 and the General Environmental Duty (GED). • Review noise mitigation measures proposed in the EES and recommend measures to be implemented for dredging and FSRU operation to maintain noise levels within regulatory noise limits.	Addressed in Section 4.3

3.1.1 Study area and sensitive receivers

To quantify the existing noise environment throughout the project study area, Renzo Tonin & Associates has undertaken long-term unattended noise monitoring. Through consultation with key stakeholders, site investigations and available aerial images monitoring location were chosen based on priority and accessibility. The study area and sensitive receivers used in this assessment are shown in Figure 2.

Figure 2: Study area and sensitive receivers

3.2 Stakeholder and community engagement

In accordance with the Minister's Directions, a Technical Reference Group (TRG) has been convened and is chaired by Department of Transport and Planning, Impact Assessment Unit on behalf of the Minister for Planning. The TRG has provided input to Viva Energy's Study Program required to inform the Supplementary Statement and throughout the Supplementary Statement extended assessment process.

Engagement and consultation to support the assessment of the environmental effects of the project on noise, with respect to the recommendations in Table 1 of the Minister's Directions, is being undertaken in accordance with Viva Energy's Supplementary Statement Consultation Activities Plan. The approach, as described in the Supplementary Statement Consultation Activities Plan, has been updated taking on board feedback from stakeholders and the IAC. Activities are focused on facilitating meaningful stakeholder involvement in the extended assessment process and providing opportunities for genuine engagement on the further work required by the Minister's Directions.

As part of the Supplementary Statement Renzo Tonin & Associates conducted an extensive noise monitoring and measurement campaign. A few of the key locations used required consultation including Geelong Grammar School and Avalon College. A summary of these interactions and actions is provided below:

- Viva Energy representative contacted Geelong Grammar School (GGS) with a request to allow Renzo Tonin & Associates access to site to deploy two noise monitors and two weather stations. An email response from GGS (dated 17 August 2023) confirmed access was granted with several specific requirements, including:
  - All monitoring data is to be provided to the school after collected by Renzo Tonin & Associates (RT&A)
  - The deployment and retrieval of equipment must occur by appointment to be arranged with the school
  - Any persons attending will require a valid Working with Children (WWC) Clearance and contractor induction
  - Details of the nature of the equipment to be installed, including recording type, physical dimension, proposed duration etc, to be provided prior to installation
  - Details on the proposed locations of the equipment
  - Clarification on the number of monitoring locations
  - Clarification on why the monitoring is being requested and what it will be used for
- RT&A was provided contact information for GGS and were advised to reach out directly to GGS. GGS was called on the 2 October 2023 and confirmation of a site visit and monitor deployment was made for 18 October 2023. GGS also provided contact details for Avalon College, and RT&A was advised to reach out directly to Avalon College. Avalon College was called on the 2 October 2023 and confirmation of a site visit and monitor deployment was made for 18 October 2023.
- GGS contacted RT&A on 6 October 2023 to provide site contacts details.
- RT&A contacted GGS site contact prior to arrival on site on 18 October 2023, presented relevant WWC Clearance and completed a contractor induction, GGS staff then escorted RT&A to the proposed locations and attended while the equipment was installed. During the site visit RT&A requested to return to site on 25 October 2023 to check equipment and the GGS site contact agreed and suggested RT&A could sign in and do the checks without a school escort. This was also recorded via email correspondence (dated 20 October 2023).

  Furthermore, during the site visit, RT&A discussed and requested access to site during night-time on two occasions to conduct attended measurements. The dates requested were 3 November 2023 and 15 November 2023, between midnight and 2am.
- RT&A attended GGS on 25 October 2023, signed in and conducted a brief inspection and check of the equipment.
- RT&A contacted GGS to confirm access to GGS to conduct attended night-time measurements via email (dated 2 November 2023).

- RT&A attended GGS on 3 November 2023 at 12:30am and was escorted by security to the two onsite locations and remained with RT&A during the attended measurements.
- RT&A contacted GGS to confirm access to GGS to conduct attended night-time measurements on 14 November 2023.
- RT&A attended GGS on 15 November 2023 at 12:30am and was escorted by security to the two onsite locations and remained with RT&A during the attended measurements.
- RT&A attended GGS on 15 November 2023 at approximately 1pm, signed in and proceeded to retrieve all monitoring equipment.
- RT&A provided Viva Energy with the raw data collected at Geelong Grammar School on the 14 December 2023. It is our understanding that Viva Energy hand delivered the data to GGS on 18 December 2023.

3.2.1 Linkages to EES studies and other supplementary studies

This noise supplementary study references sections of the original EES Technical Report I: *Noise and Vibration Impact Assessment*, where relevant.

Supplementary Statement Technical Report B: *Threatened and migratory birds* references measured and predicted noise levels from this study in the supplementary assessment of potential project noise impacts on threatened and migratory bird species.

4 Assessment and results of supplementary study tasks

This section describes how the supplementary noise study was conducted to address the Minister's Directions related to noise (Recommendation 10). The following sections outline the study assessment and results.

4.1 Task 10a response

Address MM-NV05 To Inform the design, construction and operation of the project:

- *Background noise levels shall be measured and verified without the inclusion of noise from Viva Refinery and from other commercial, industrial and trade premises, with noise limits of Part 5.3, Division 3 of the Environment Protection Regulations 2021 established accordingly*

4.1.1 Determine background noise levels at GGS and other noise sensitive areas

4.1.1.1 Unattended noise monitoring

To quantify the existing noise environment throughout the project study area, Renzo Tonin & Associates has undertaken long-term unattended noise monitoring. Through consultation with key stakeholders, site investigations and available aerial images monitoring location were chosen based on priority and accessibility. The noise monitoring locations are shown in Figure 1 and described in Table 3 below. APPENDIX A contains a glossary of acoustic terms used in this report. APPENDIX B presents graphs of the unattended monitored noise levels at these locations.

A summary of the methodology employed to conduct the unattended noise monitoring includes:

- All unattended noise monitoring was conducted in the free field, with the microphone installed at a height of 1.5m above ground level, and at least 3.5m from any reflecting surfaces
- Locations were chosen to minimise extraneous noise impacts (e.g. air conditioners, pool pumps etc)
- At the commencement and conclusion of the monitoring a verification check with the field calibration device was conducted
- The monitor was set to record broadband and spectral noise descriptors, and audio for noise source verification
- Meteorological conditions for all monitoring locations were obtained from the Bureau of Meteorology (BOM) Avalon Airport Weather Station. Additionally, two unattended weather monitoring stations were deployed to measure the local conditions. This information was used to assess if any extraneous noise from wind was present in the measurement, for determination of background levels in accordance with Noise Protocol, EPA Victoria Publication 1826.4.

4.1.1.2 Meteorological conditions

Clause 41 of the Noise Protocol, EPA 1826.4 states:

> *"The background level must be measured during dry conditions with wind conditions satisfying Beaufort Wind Scale 0, 1, 2 or 3"*

Table A2 of EPA 1997 Technical guide - Measuring & Analysing Industry Noise & Music Noise, describes:

Beaufort Wind Scale 0 as a calm with winds of <0.3m/s
Beaufort Wind Scale 1 as a light air with winds of 0.3 to 1.5m/s
Beaufort Wind Scale 2 as a light breeze with winds of 1.6 to 3.3m/s
Beaufort Wind Scale 3 as a gentle breeze with winds of 3.4 to 5.5m/s

Renzo Tonin & Associates understands that 'standard' and 'noise enhancing' (weather conditions favourable to sound propagation) weather conditions were considered in the AECOM modelling as part of the EES assessment, with the following parameters:

- Standard meteorological conditions: Pasquill-Gillford stability categories A-D with wind speed up to 0.5 m/s at 10m.
- Noise enhancing meteorological conditions: Pasquill-Gillford stability categories A-D with wind speed up to 3.0 m/s at 10m and/or stability category F with winds up to 2m/s at 10m.

Using the above input, Renzo Tonin & Associates has conducted an analysis of the Bureau of Meteorology (BoM) Avalon Airport Weather station statistical data for the past five years (2019 to 2023), to determine the significance of the meteorological conditions (i.e. wind and temperature inversions) at GGS and other NSA's.

To assist with a methodology for assessing the frequency of occurrence of temperature inversions, RT&A has taken guidance from NSW Noise Policy for Industry (NPfI, 2017). The NPfI states:

"...allows the susceptibility of an area to inversions to be determined through the use of the relationship developed by the US Atomic Energy Commission between atmospheric stability categories and inversions.'

"...if a stability category is known, then the range of possible temperature gradients may be inferred. A positive temperature gradient signifies a temperature inversion; hence from the table below, inversions occur during E, F and G stability categories."

Stability category	Range of vertical temperature gradient – DT/DZ (degrees Celsius/100 metres)
A	DT/DZ <-1.9
B	-1.9 ≤ DT/DZ <-1.7
C	-1.7 ≤ DT/DZ <-1.5
D	-1.5 ≤ DT/DZ <-0.5
E	-0.5 ≤ DT/DZ <+1.5
F	+1.5 ≤ DT/DZ <+4.0
G	+4.0 ≤ DT/DZ

Using the measurements of sigma-theta (the standard deviation of wind direction, wind speed and time of day, we are able to determine the occurrence of different stability classes at a particular site. Note is made that analysis of three months of meteorological data collected in winter is required, as this is the season during which inversions occur most frequently and are likely to be considered a feature of the area, noting that they can also occur during other seasons. Wind measurements are also required to comply with AS 3580-14-2011: Methods for sampling and analysis of ambient air, Meteorological monitoring for ambient air quality monitoring applications (Standards Australia, 2011).

To assist with a methodology for assessing the source to receiver winds, RT&A has taken guidance from the approach detailed in the NSW Noise Policy for Industry (NPfI, 2017). Notable, the term "Significant

meteorological effects" is defined in the NPfI as: "In relation to wind speeds this means at least 30% of the time of more in any assessment period (day, evening, night) in any season." A detailed sections provides a method for determining the frequency of winds, stating:

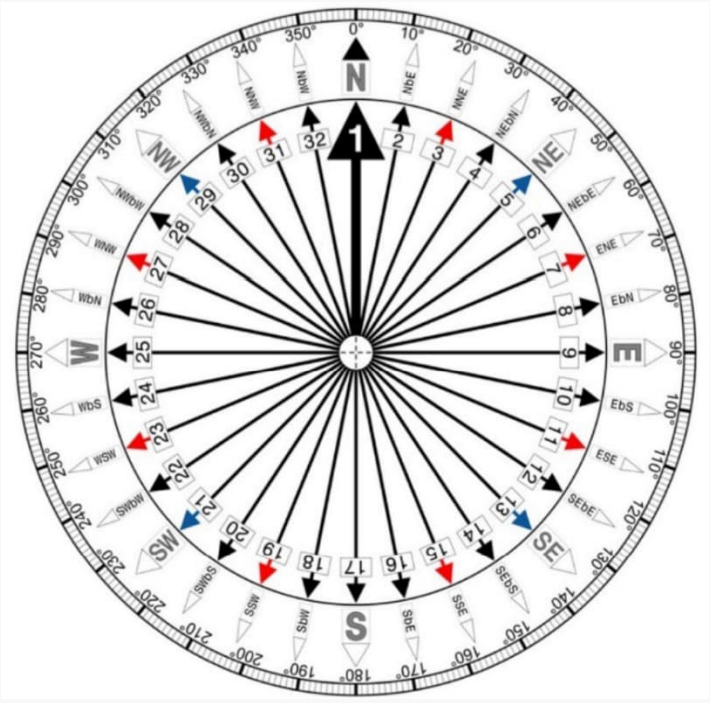
> *"The assessment of the significance of winds needs to consider both the wind speed and direction. The assessment must also consider each of the four seasons and assessment periods (day, evening, and night) individually."*

A few approaches are suggested in the NPfI to determine the frequency of winds up-to-and-including-3m/s. Note is made that other assessment methods can be used, provided full explanation and justification is made, and that a minimum of one year of meteorological data is used in the analysis. Taking all the above into consideration, Renzo Tonin & Associates has conducted the temperature inversion analysis as follows:

- Analysed 5 years of meteorological data from Avalon Airport for the assessment of temperature inversions and wind to determine the significance of noise enhancing weather conditions.
- Temperature inversions were assessed using the Sigma-theta methodology that looks at the standard deviation of wind directions, wind speeds and time of day, to determine the occurrence of positive temperature gradients.

And the wind analysis as follows:

- Adopted the EPA Victoria Publication 1826 &1997 'Beaufort Wind Scale' & assessed winds between 0.3 & 5.5m/s
- Loosely adopted the NSW EPA NPfI approach to determine significant of "Source-to-Receiver (S-R)" winds as a percentage of time, while not relying on a minimum of 30% occurrence, RT&A has separated the data to fit into the 16 meteorological wind directions (i.e. S is represented by all directions between 168.75° (being the midpoint between SSE & S called South by East (SbE) and 191.25° (being the midpoint between S & SSW, called South by West (SbW). See compass chart below). This method was chosen to allow for specific identification of S-R winds that can be assessed as noise enhancing.



The following table presents the percentage of time over a year (365 days), based on 5 years of analysed data, arithmetically averaged, that noise enhancing weather conditions occur. Note is made that while the percentage of time that wind is considered noise enhancing is specific to the 16 cardinal directions,

the percentage of time that temperature inversions are considered noise enhancing are not direction specific and occur more frequently during the winter months and are likely to be considered a feature of the area, noting that they can also occur during other seasons, and only during the night period. Furthermore, the wind analysis has been conducted specifically for the night period only, as the noise assessment shows that the project noise level and the cumulative noise level would be within noise limits during the day and evening, even under noise enhancing weather conditions.

- **Night Period Noise Enhancing Weather Conditions (based on analysis of 5-years data [arithmetically averaged])**

Wind Direction	'Wind' conditions (over a year period)		'Temperature Inversions' (over the winter period)	'Wind' conditions (over the winter period)	
	Percentage occurrence	Corresponding number of days		Percentage occurrence	Corresponding number of days
N	7%	27	20% 18 days	11%	11
NNE	5%	18		8%	7
NE	4%	13		5%	4
ENE	2%	6		2%	1
E	3%	10		3%	3
ESE	2%	6		0%	0
SE	2%	8		1%	1
SSE	4%	13		1%	1
S	5%	18		1%	1
SSW	3%	10		1%	1
SW	2%	7		1%	1
WSW	3%	11		1%	1
W	10%	36		9%	9
WNW	13%	48		15%	14
NW	9%	33		11%	10
NNW	5%	17		7%	6

- To help understand how the above table provides context to the potential for noise enhancing weather conditions at GGS and other sensitive receivers, the below table provides a summary of the sensitive receiver locations, with consideration of the project and existing industry's geographical layout/locations:

Location / sensitive receiver location	Source-to-Receiver Wind Direction	
	From the Project	From the existing refinery
Geelong Grammar School	S & SSW	SW, WSW, W
Macgregor Court etc dwellings	S & SSW	SSW, SW
North Shore dwellings	NE, ENE	N, NNE
Station St, Norlane dwellings	E	NE, ENE
Princes Hwy dwellings	ESE, SE, SSE	ESE,SE, SSE
Avalon College & rural dwellings	WSE, W	W, WNW

The above is a risk analysis to provide context on the likely frequency (amount of time per year) of predicted noise levels at sensitive receivers.

Figure 3: Noise monitoring and measurement overview

Table 3: Unattended noise monitoring locations

ID	Address / Location	GPS Coord's		Details of site selections
		Lat	Long	
BG1	Geelong Grammar School 11 Biddlecombe Avenue, Corio	38.072503ºS	144.396059ºE	• Monitoring period: Wed 18th October to Mon 13th November 2023 • Represents GGS and other noise sensitive receivers nearby the school. • The existing noise environment is comprised of: - Princes Freeway traffic noise - Local traffic noise - Geelong Grammar School activities - Existing refinery noise - V/line train noise - Birds / wildlife and tree noise
BG2	Geelong Grammar School Hermitage Tutors Flat, 4 Tower Road, Corio	38.073183ºS	144.397710ºE	• Monitoring period: Wed 18th October to Fri 10th November 2023 • Represents GGS and other noise sensitive receivers nearby the school. This location used as a direct comparison with BG1 to determine the impacts, from meteorological exposure to Limeburners Bay, on noise. • The existing noise environment is comprised of: - Princes Freeway traffic noise - Local traffic noise - Geelong Grammar School activities - Existing refinery noise - V/line train noise - Birds / wildlife and tree noise
BG3	Avalon College north	38.081658ºS	144.413345ºE	• Monitoring period: Wed 18th October to Wed 25th November 2023 • Represents Avalon College and other noise sensitive receivers near the school. • Potentially provide representative background noise levels at GGS without the inclusion of 'intrusive' noise. • The existing noise environment is comprised of: - Avalon College school activities - Princes Freeway traffic noise - Local traffic noise - Birds / wildlife and tree noise
BG4	Avalon College south	38.083957ºS	144.414250ºE	• Monitoring period: Wed 18th October to Mon 13th November 2023 • Represents Avalon College and other noise sensitive receivers near the school. This location used as a direct comparison with BG3 to determine the impacts, from meteorological exposure to Limeburners Bay, on noise. • Potentially provide representative background noise levels at GGS without the inclusion of 'intrusive' noise. • The existing noise environment is comprised of: - Avalon College school activities - Princes Freeway traffic noise - Local traffic noise - Birds / wildlife and tree noise

ID	Address / Location	GPS Coord's		Details of site selections
		Lat	Long	
BG5	19 Zinnia Street, Norlane	38.085189ºS	144.365903ºE	• Monitoring period: Wed 18th October to Thurs 2nd November 2023 • Represents residences and other noise sensitive receivers within the vicinity. • The existing noise environment is comprised of: - Local traffic noise - Existing refinery and other industry noise - V/line train noise - Princes Highway traffic noise - Birds and tree noise
BG6	12 Myrtle Grove, North Shore	38.098512ºS	144.373430ºE	• Monitoring period: Wed 18th October to Fri 3rd November 2023 • Represents residences and other noise sensitive receivers within the vicinity. • The existing noise environment is comprised of: - Princes Highway traffic noise - Local traffic noise - Other existing industry noise (other than the refinery) - Existing Geelong Port terminal noise - V/line train noise - Birds and tree noise
BG7	36 Walker Street, Rippleside	38.125425ºS	144.355357ºE	• Monitoring period: Wed 18th October to Fri 3rd November 2023 • Potentially represents a location for comparison with GGS, and for use of representative background noise levels at GGS without the inclusion of 'intrusive' noise. • The existing noise environment is comprised of: - Princes Highway traffic noise - Local traffic noise - V/line train noise - Birds and tree noise
BG8	240 Avalon Road Avalon	38.055101ºS	144.419534ºE	• Monitoring period: Wed 18th October to Fri 3rd November 2023 • Potentially represents a location for comparison with GGS, and for use of representative background noise levels at GGS without the inclusion of 'intrusive' noise. • The existing noise environment is comprised of: - Princes Freeway traffic noise - Local traffic noise - Birds / wildlife and tree noise

A summary of the measured background noise levels for the daytime, evening and night time periods at each unattended monitoring locations are shown in Table 4. APPENDIX B.3 & B.4 presents graphs of the unattended monitored noise levels at these locations.

Table 4: Summary of period average background noise levels

ID	Location	Background noise level, L_{90} dB(A)[1]		
		Day	Evening	Night
BG1	Geelong Grammar School (11 Biddlecombe Avenue, Corio)	42	41	40
BG2	Geelong Grammar School (4 Tower Road, Corio)	42	41	39
BG3	Avalon College (North)	41	37	38
BG4	Avalon College (South)	39	39	38
BG5	19 Zinnia Street, Norlane	46	43	43
BG6	12 Myrtle Grove, North Shore	42	37	37
BG7	36 Walker Street, Rippleside	40	39	35
BG8	240 Avalon Road, Avalon	39	38	35

EPA 1826 Period Definitions:
Day: Monday-to-Saturday 7am-to-6pm; Sundays NA
Evening: Monday-to-Saturday 6pm-to-10pm; Sundays 7am-to-10pm
Night: All days 10pm-to-7am

Notes: See Figure 1 for monitor locations.

1. Arithmetically averaged hourly L_{90} data for each period, where the L_{A90} is the A-weighted noise level exceeded for 90% of the measurement period.
2. The following key measurement dates were used in the determination of the background noise levels are as follows:

Location	Day	Evening	Night
BG1	Thursday 19 October 2023	Wednesday 08 November 2023	Friday 27 October 2023
BG2	Thursday 09 November 2023	Friday 20 October 2023	Friday 27 October 2023
BG3	Friday 20 October 2023	Thursday 19 October 2023	Friday 20 October 2023
BG4	Friday 27 October 2023	Thursday 19 October 2023	Tuesday 07 November 2023
BG5	Friday 27 October 2023	Friday 27 October 2023	Tuesday 31 October 2023
BG6	Wednesday 01 November 2023	Thursday 02 November 2023	Thursday 02 November 2023
BG7	Friday 27 October 2023	Friday 27 October 2023	Wednesday 01 November 2023
BG8	Wednesday 01 November 2023	Wednesday 01 November 2023	Wednesday 01 November 2023

4.1.1.3 Attended noise measurements

To assist with identifying the existing noise sources in the area, Renzo Tonin & Associates conducted attended noise measurements on two separate occasions: Friday 3rd and Wednesday 15th November 2023 between 12:00am and 3:15am. The measurement locations (A1-A12) are shown in Figure 3 and described in Table 5 below. On both occasions concurrent measurements were conducted (i.e. A1 & A2, A3 & A4 etc) at the same times. These measurements provide a greater understanding of the surrounding environment, local noise sources and the potential noise impacts at sensitive receiver locations.

Table 5: Attended noise measurement locations

ID	Location	GPS Coordinates		Measured noise level[1], dB(A)		Details of site selections
		Lat	Long	L_{Aeq}	L_{A90}	
A1	Avalon Road, Avalon	38.082126°S	144.422713°E	30	25	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 12:00am & 12:15am • Provide context for unattended noise monitoring at Avalon College. • Wind was a 'light breeze' at <3m/s from S/SW direction and calm at <1.5m/s from S direction • Noise sources observed included: - Birds / wildlife noise
A2	Avalon Foreshore Road, Avalon	38.084569°S	144.422561°E	30	26	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 12:00am & 12:15am • Provide context for unattended noise monitoring at Avalon College. • Wind was a 'light breeze' at <3m/s from S/SW direction and a 'light air' at <1.5m/s from S direction • Noise sources observed included: - Birds / wildlife noise
A3	Geelong Grammar School, Cameron Close, Corio	38.067174°S	144.400552°E	36	34	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 1:00am & 1:15am • Provide general context for unattended noise monitoring at GGS. • Wind was a 'light air' at <1m/s from S direction and was not present (NIL wind) on Wednesday 15th • Noise sources observed included: - Existing refinery noise (clearly audible) - V/line train noise (clearly audible) - Princes Highway traffic noise (distant hum) - Birds and tree noise (intermittent)
A4	Foreshore Road, Corio	38.071813°S	144.405222°E	38	36	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 1:00am & 1:15am • Provide general context for unattended noise monitoring at GGS. • Wind was a 'light breeze' at <2m/s from SW direction and was not present (NIL wind) on Wednesday 15th • Noise sources observed included: - Existing refinery noise (clearly audible) - V/line train noise (audible) - birds and tree noise (intermittent)

ID	Location	GPS Coordinates		Measured noise level[1], dB(A)		Details of site selections
		Lat	Long	L_{Aeq}	L_{A90}	
A5	Geelong Grammar School oval (cricket), Corio	38.072305°S	144.395774°E	43	43	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 1:30am & 1:45am • Provide general context for unattended noise monitoring at GGS. • Wind was a 'light breeze' at <2m/s from SW direction and was not present (NIL wind) on Wednesday 15th • Noise sources observed included: - Existing refinery noise (dominant noise) - V/line train noise (faintly audible) - Princes Highway traffic noise (distant hum) - Birds and tree noise (intermittent)
A6	Foreshore Road & Tower Road, Corio	38.073407°S	144.397543°E	43	40	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 1:30am & 1:45am • Provide general context for unattended noise monitoring at GGS. • Wind was a 'light breeze' at <3m/s from S/SW direction on both occasions • Noise sources observed included: - Existing refinery noise (dominant noise) - Birds and tree noise (intermittent)
A7	School Road, Corio	38.070235°S	144.388364°E	55	47	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 2:00am & 2:15am • Provide general context for unattended noise monitoring at GGS. • Wind was a 'light breeze' at <2m/s from S/SW direction on both occasions • Noise sources observed included: - Existing refinery noise (dominant noise) - V/line train noise (clearly audible) - Local traffic noise (clearly audible) - Princes Highway traffic noise (distant hum)
A8	Shell Parade & Foreshore Road, Corio	38.076154°S	144.388896°E	58	50	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 2:00am & 2:15am • Provide general context for unattended noise monitoring at GGS. • Wind was a 'light breeze' at <3m/s from S direction on Friday 3rd and a 'light air' at <1.5m/s from S direction on Wednesday 15th • Noise sources observed included: - Existing refinery noise (dominant noise) - Local traffic noise (clearly audible)

ID	Location	GPS Coordinates		Measured noise level[1], dB(A)		Details of site selections
		Lat	Long	L_{Aeq}	L_{A90}	
A9	Refinery Road (truck loop), Corio	38.076711°S	144.376510°E	60	59	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 2:30am & 2:45am • Provide general context for unattended noise monitoring at the refinery. • Wind was Calm at <0.3m/s from SE direction on Friday 3rd and a 'light air' at <1.5m/s from SE direction • Noise sources observed included: - Existing refinery noise (dominant noise)
A10	Wharf Road, Corio	38.083876°S	144.381492°E	68	66	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 2:30am & 2:45am • Provide general context for unattended noise monitoring at the refinery. • Wind was a 'light breeze' at <2m/s from SE direction on both occasions • Noise sources observed included: - Existing refinery noise (dominant noise)
A11	St Georges Road, Norlane	38.085075°S	144.366668°E	58	37	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 3:00am & 3:15am • Provide general context for unattended noise monitoring in the area. • Wind was a 'light air' at <1m/s from SW direction on Friday 3rd and was not present (NIL wind) on Wednesday 15th • Noise sources observed included: - Local traffic noise (dominant noise) - Other industry noise (other than refinery) - Existing refinery noise (occasionally audible, $L_{Aeq,10sec}$ 35-40) - V/line train noise (clearly audible) - Princes Highway traffic noise (distant hum) - Birds and tree noise (intermittent)
A12	Myrtle Grove, North Shore	38.098426°S	144.374001°E	37	33	• Conducted on Friday 3rd and Wednesday 15th November 2023 between 3:00am & 3:15am • Provide general context for unattended noise monitoring in the area. • Wind was Calm at <0.3m.s to Nil on both occasions • Noise sources observed included: - Other industry noise (dominant) - Existing Geelong Port terminal noise (clearly audible) - Birds and tree noise (intermittent)

Notes: See Figure 1 for monitor locations.

1. Arithmetically averaged L_{90} data for both visits; and logarithmically averaged L_{Aeq} data for both visits

4.1.1.4 Pre-existing refinery noise monitoring

To further assist with quantifying the existing noise environment throughout the project study area, Renzo Tonin & Associates has undertaken long-term unattended noise monitoring at key locations at the Geelong refinery. Through consultation with key stakeholders, site investigations and available aerial

images monitoring location were chosen based on priority and accessibility. The noise monitoring locations are shown in Figure 1 and described in Table 6 below.

Table 6: Noise monitoring locations

ID	Address / Location	GPS Coordinates		Details of site selections
		Lat	Long	
EX1	Refinery Pier	38.087492°S	144.387387°E	• Monitoring period: Wednesday 25th October to Thursday 2nd November 2023 • Microphone was located 1.5m above ground level (pier) and approximately 3m above sea level. • Represents the noise environment at the existing pier with ambient noise levels for the day, evening and night period of L_{eq} 60 dB(A) (logarithmically averaged hourly L_{Aeq} data for each period). • The existing noise environment is comprised of: - Wharf activity and existing refinery noise
EX2	Refinery (south)	38.082799°S	144.381386°E	• Monitoring period: Wednesday 18th October to Monday 13th November 2023 • Microphone was located approx.11.5m above ground level to capture the ambient environment (in the general area) without being adversely affected by small localised events. • Represents the noise environment at a key location on the refinery site (main noise source at southern end of site), with ambient noise levels for the day, evening and night period of L_{eq} 77 dB(A) (logarithmically averaged hourly L_{Aeq} data for each period). • The existing noise environment is comprised of: - Existing refinery noise
EX3	Refinery (middle)	38.076271°S	144.382993°E	• Monitoring period: Wednesday 18th October to Monday 13th November 2023 • Microphone was located approx. 11.5m above ground level to capture the ambient environment (in the general area) without being adversely affected by small localised events. • Represents the noise environment at a key location on the refinery site (main noise source in the middle of the site), with ambient noise levels for the day, evening and night period of L_{eq} 74 dB(A) (logarithmically averaged hourly L_{Aeq} data for each period). • The existing noise environment is comprised of: - Existing refinery noise
EX4	Refinery (eastern boundary)	38.075926°S	144.388129 °E	• Monitoring period: Wednesday 18th October to Monday 13th November 2023 • Microphone was located approx. 4.5m above ground level to capture the ambient environment (in the general area) without being adversely affected by small localised events. • Represents the noise environment at a key location on the refinery site (boundary area between refinery and closest GGS sensitive receiver), with ambient noise levels for the day, evening and night period of L_{eq} 60 dB(A) (logarithmically averaged hourly L_{Aeq} data for each period). • The existing noise environment is comprised of: - Existing refinery noise

4.1.1.5 Analysis of monitoring and measurements

Renzo Tonin & Associates has conducted a detailed analysis of the noise monitoring and measurement campaign data, using audio software to listen to the recordings for each location. The software allows for time-trace analysis of 1-second increments for all audio descriptors and spectral data, which allows for direct correlation between attended measurements and observations with unattended monitoring data, as well as quick identification of a-typical events and/or anomalies (i.e. that may need to be excluded).

The attended measurements provided the clearest verification of the noise levels and the main contributions to those noise levels received at GGS and other noise sensitive areas. For example, observations and results from the attended measurements at GGS (A5) where the background noise level for the two 15-minute measurements was, L_{90} of 43 & 44 dB(A) respectively compared with the long-term unattended measurements (at the same location) (BG1) clearly indicate that the background noise levels are completely driven by noise from the refinery, with average background noise levels of L_{90} 44 dB(A) for the day, evening and night periods. This consistency in background noise level also correlates closely with the levels measured at the refinery (see EX2, EX3 & EX4), where ambient noise remains constant and steady over any 24-hour period.

The purpose of the analysis is to provide clarity on what alternative background noise monitoring locations are appropriate to use as background noise levels to represent GGS and other noise sensitive areas, in the absence of intrusive industry noise. If the analysis determined the noise monitoring location was not affected by intrusive noise, then it is considered appropriate to use in the determination of the noise limits for that noise sensitive area/ monitoring location. However, if the analysis determined the noise monitoring location was affected by intrusive industry noise, then further investigations would be required, such that analysis of other noise monitoring locations that might be considered appropriate as alternative background noise levels to use in the determination of the noise limits.

Further to the above, using the observations and measurements from the attended measurements, the unattended noise monitoring data at other noise sensitive areas was analysed and the following summary of conclusions were made:

- Background noise levels recorded at GGS (BG1 & BG2) are influenced by intrusive noise from the existing industry, therefore in accordance with EPA Publication 1826, are not able to be used to represent the background at GGS without the influence of extraneous noise, and to determine the noise limits.
- Background noise levels recorded at Avalon College (BG3 & BG4) are not influenced by noise from the refinery, therefore are able to be used as a 'representative background location' to determine the noise limits at GGS and other sensitive areas.
- At 19 Zinnia Street, Norlane (BG5), RT&A observed that on some nights the refinery was inaudible and did not contribute to the background noise environment; and on other nights the refinery noise was audible and occasionally measurable between L_{Aeq} 35-40 when ambient noise occasionally subsided. The most dominant consistent noise, which dominated the noise environment, was heavy vehicle traffic along St Georges Road and Station Street. On this basis, background noise levels from quietest periods at 19 Zinnia Street, Norlane are considered suitable for determining EPA 1826 noise limits.
- Background noise levels recorded at 12 Myrtle Grove, North Shore (BG6) are influenced by intrusive noise from 'other' commercial, industrial or trade premises noise, yet not from the refinery (determined from attended measurements and audio analysis of unattended monitoring), therefore are not able to be used to determine the noise limits.

- Background noise levels recorded at 36 Walker Street, Rippleside (BG7) are not influenced by refinery noise or other intrusive industry noise, therefore are able to be used as a 'representative background location' to determine the noise limits at GGS and other sensitive areas.
- Background noise levels recorded at 240 Avalon Road, Avalon (BG8) are not influenced by refinery noise or other intrusive industry noise, therefore are able to be used as a 'representative background location' to determine the noise limits at GGS and other sensitive areas.

In summary, background noise levels recorded at GGS and 12 Myrtle Grove, North Shore are influenced by intrusive industry noise and therefore further analysis/ justification on the selection of representative background locations is provided in Section 4.1.1.6.

4.1.1.6 Justification of background equivalent locations

From the summary of conclusions made in Section 4.1.1.5, further investigation has been conducted to determine the viability of those conclusions in relation to 'representative background levels'.

EPA Victoria Publication 1826.4 defines 'background levels' (for the purpose of determining limits) as "... the background sound in a noise sensitive area, in the absence of noise from any commercial, industrial or trade premises which appear to be intrusive at the point where the background levels is measured…". It's Clause 99 goes on to refer to 'representative background locations as "the background level must be measured within a noise sensitive area or at an alternative assessment location where the background levels is representative of the background occurring within the noise sensitive area".

The analysis detailed in Section 4.1.1.5 provides a summary of the background noise monitoring locations and a statement on the viability of the data based on the guidance in EPA Publication 1997 and in accordance with EPA Publication 1826 (and summarised above).

Further to this, RT&A provide detail of each of the monitoring locations that require an alternative assessment location, and the justifications, where appropriate, for the use of measured background levels at that alternative location, to be used as representative background noise levels:

- With consideration for GGS (BG1 & BG2):
  - Avalon College (BG3 & BG4) are in a Farming Zone (FZ1) surrounded by farming, public and rural conservation zones, and the college campus building including residential dwellings. The Princes Freeway is in the distance and may superficially contribute to the ambient environment during the day.
  - 36 Walker Street, Rippleside (BG7) is in a General Residential Zone (GRZ1), with residential dwellings (typically single and two-storey buildings), with public parks and recreation close by. The Princes Highway is set back (approximately 250m to South Bound (SB) and 270m to North Bound (NB)), with intervening dwellings to provide significant shielding. Audio analysis confirms that the while traffic noise from the Princes Highway may contribute to the ambient environment during the day period, the traffic volume decreases significantly during the evening and is relatively low during the night period.
  - 240 Avalon Road, Avalon (BG8) is in a Farming Zone (FZ1) surrounded by public and rural conservation zones. This is farming land with open fields, sparsely located trees and negligible buildings and structure in relation to the open land. The Princes Freeway is in the distance (approximately 1.6km) and audio analysis confirms that there is a superficial contribution to the ambient environment.

  BG3 & BG4 locations reflect the two GGS locations (BG1 & BG2), with one monitor closer to the coast and the other located further inland, to minimise the influence of the ocean. Both are in farming zone, close to the coast and Avalon College is essentially a similar rural school with students residing within the school grounds. There is no industry around Avalon College, and is not influenced by existing industry noise, as observed during attended measurements and audio analysis of unattended noise monitoring. Table 5 provides a summary of the attended measurement observations, with all attended measurements at Avalon under calm to light breeze meteorological conditions with the only noise sources observed to be local birds/wildlife.

  With respect to the above, RT&A has derived the noise limits for GGS (BG1 & BG2) based on the background noise monitoring from Avalon College (BG4). BG4 has been chosen over BG3 for the following reasons:
  - BG4 is closer to the coast, the audio and data suggest that this location is not materially any more affected by meteorological conditions (i.e. wind) than BG3.
  - BG3 was observed to be influenced by farming equipment/activity noise and only recorded for a period of 7 days.
  - BG4 was not observed to be influenced by any farming equipment/activity noise and recorded for nearly 4 weeks.
  - The ambient environment at Avalon College and GGS contain similar characteristics, including the intermittent noise from birds/wildlife, and the rustling of leaves from trees. Audio analysis of the unattended noise monitoring at both locations provides evidence that these noise sources are present in the ambient environment generally for similar durations and at similar time periods and with similar audible characteristics.BG4 is materially located at a comparable distance to the coast as is BG2 (GGS); accordingly, RT&A has relied on BG4 as a directly representative alternative background location for GGS in the derivation of noise limits.

- With consideration for 12 Myrtle Grove, North Shore (BG6):
    - 36 Walker Street, Rippleside (BG7) is in a General Residential Zone (GRZ1), with residential dwellings (typically single and two-storey buildings), with public parks and recreation close by. The Princes Highway is set back (approximately 250m to South Bound (SB) and 270m to North Bound (NB)), with intervening dwellings to provide significant shielding. Audio analysis confirms that the while traffic noise from the Princes Highway may contribute to the ambient environment during the day period, the traffic volume decreases significantly during the evening and is relatively low during the night period.

  Furthermore, while 12 Myrtle Grove (BG6) does not have the same traffic volume as BG7, there is traffic noise influence from Corio Quay Road (approximately 220m away), which is also an arterial road, and is used as an alternate route to the Princes Hwy, mainly for heavy vehicles. Other local roads, including Seabeach Parade (120m away), Phosphate Rd (300m away) and The Esplanade (230m away) all carry a higher than typical percentage of heavy vehicles, due to the location and nearby industrial areas, and through early morning observations (on numerous occasions), and audio analysis of the long-term monitoring, RT&A confirm that influence of traffic noise throughout the day, evening and night periods.

  Based on the above, RT&A has used the background monitoring at 36 Walker Street, Rippleside (BG7) which reflects the most representative location for 12 Myrtle Grove, North Shore (BG6), in the absence of intrusive noise from the refinery and 'other' commercial, industrial or trade premises noise.

  Therefore, the derivation of noise limits for 12 Myrtle Grove, North Shore (BG6) have been based on the background noise monitoring from 36 Walker Street, Rippleside (BG7). Note is made that the evening background level at BG6 is lower than the proposed alternative location at BG7, despite the claim that BG6 background noise monitoring is affected by intrusive noise from industry. RT&A's audio analysis and observations confirms that while BG6 does have intrusive noise (which technically cannot be used for noise limit derivation, consistent with EPA Publication 1826), the intrusive noise was not always dominant, and only audible at different times over the duration of the monitoring (and attended measurements). As the calculation of noise limits at this location is driven by the zoning levels by way of a 'neutral' background classification, per EPA Publication 1826, using either evening location background level will give the same noise limit. Furthermore, BG7 is in an area that has the lowest zoning levels of all monitoring locations, indicating that expected background noise and ambient noise levels are conducive of a quiet residential location, which RT&A consider as a conservative approach to use as the alternative location.

4.1.1.7 Recalculated noise limits

The recalculated noise limits for the surrounding noise sensitive areas have been differentiated between Major Urban and Rural areas in Table 7.

Table 7: EPA 1826 Major Urban or Rural area classification

Location ID	Area Classification	Noise Sensitive Receivers
BG1	*Major Urban*	Geelong Grammar School (Oval)
BG2	*Major Urban*	Geelong Grammar School (Hermitage Garden)
BG3	*Rural*	Avalon College (North)
BG4	*Rural*	Avalon College (South)
BG5	*Major Urban*	19 Zinnia Street, Norlane
BG6	*Major Urban*	12 Myrtle Grove, North Shore
BG7	*Major Urban*	36 Walker Street, Rippleside
BG8	*Rural*	240 Avalon Road Avalon

The background noise monitoring was conducted at eight locations in the area between 18 October 2023 and 25 November 2023 (specific monitoring detail presented in Table 3). Measurements and calculations of background noise levels were conducted in general accordance with EPA Publication 1826.4 Noise limit and assessment protocol for the control of noise from commercial,

industrial and trade premises and entertainment venues and EPA Publication 1997 Technical Guide: Measuring and analysing industry noise and music noise.

A summary of the noise limit derivation for noise sensitive areas which are located within the Major Urban area are presented in Table 8, with detailed calculations and zoning maps for these noise sensitive areas presented in APPENDIX B.2.

Table 8: EPA 1826-P1 noise limit derivation – major urban area

Period	Zoning level, L_{eq} dB(A)	Background noise level, L_{90} dB(A)[1,3,4]	Classification	EPA 1826-P1 limit, L_{eq} dB(A)
BG1 – Geelong Grammar School (Oval)				
Day	*59*	*39 (42[2])*	*Low background*	**54**
Evening	*52*	*39 (41[2])*	*Low background*	**49**
Night	*47*	*38 (40[2])*	*Low background*	**45**
BG2 – Geelong Grammar School (Hermitage Garden)				
Day	*56*	*39 (42[2])*	*Low background*	**52**
Evening	*50*	*39 (41[2])*	*Low background*	**48**
Night	*45*	*38 (39[2])*	*Neutral*	**45**
BG5 – 19 Zinnia Street, Norlane				
Day	*54*	*46*	*Neutral*	**54**
Evening	*48*	*43*	*Neutral*	**48**
Night	*43*	*43*	*High background*	**46**
BG6 – 12 Myrtle Grove, North Shore				
Day	*51*	*40 (42[2])*	*Neutral*	**51**
Evening	*45*	*39 (37[2])*	*Neutral*	**45**
Night	*40*	*35 (37[2])*	*Neutral*	**40**

EPA Pub. 1826 period definitions:
Day: Monday-to-Saturday 7am-to-6pm; Sundays N/A
Evening: Monday-to-Saturday 6pm-to-10pm; Sundays 7am-to-10pm
Night: All days 10pm-to-7am

Notes:
1. Background noise levels per Table 4 and specific changes from the EES Technical Report I detailed in Section 4.1.1.5.
2. Levels shown in ( ) indicate actual measured background levels at that location, identified as inclusive of 'intrusive' noise from commercial, industrial (including the refinery) or trade premises, therefore not used in the derivation of the noise limit.
3. Per EPA Pub 1997, Saturdays are considered as normal operations and therefore have been included in the weekday comparison for the day, evening and night periods.
4. Per EPA Pub 1997, Sundays (including Public Holidays) are considered as the evening period between 7am and 10pm, with the period-average $L_{A90,1hour}$ for Sunday determined separately. However as all derived limits for Sundays are at or above the weekday evening limit, the Sunday limit is satisfactorily address under the weekday evening limit presented above.

A summary of the noise limit derivation for noise sensitive areas which are located within the Rural area are presented in Table 9, with detailed calculations and zoning maps for these noise sensitive areas presented in APPENDIX B.2.

Table 9: EPA 1826-P1 noise limit derivation – rural area

Period	Zoning level, L_{eq} dB(A)[1]	Background noise level, L_{90} dB(A)[2]	Noise limit base on background level assessment, L_{eq} dB(A)[3]	Distance Adjusted level, L_{eq} dB(A)[4]	Base noise limit, L_{eq} dB(A)[5]	EPA 1826-P1 limit, L_{eq} dB(A)
BG3 – Avalon College (North)[6]						
Day	*53*	41	*49*	*44*	*45*	**49**[3]
Evening	*48*	37	*45*	*39*	*37*	**45**[3]
Night	*43*	38	*43*	*34*	*32*	**43**[3]
BG4 – Avalon College (South)[6]						
Day	*53*	39	*47*	*44*	*45*	**47**[3]
Evening	*48*	39	*47*	*39*	*37*	**47**[3]
Night	*43*	38	*43*	*34*	*32*	**43**[3]

EPA Pub. 1826 period definitions:
Day: Monday-to-Saturday 7am-to-6pm; Sundays N/A
Evening: Monday-to-Saturday 6pm-to-10pm; Sundays 7am-to-10pm
Night: All days 10pm-to-7am

Notes:
1. Per Table B-1 of the Noise Protocol, EPA Pub 1826.4
2. Background noise levels per Table 4 and specific changes from the EES Technical Report I detailed in Section 4.1.1.5.
3. Derived in accordance with Clause 21 to 24 of the Noise Protocol, EPA Pub 1826.4
4. Derived in accordance with Clause 19 & 20 of the Noise Protocol, EPA Pub 1826.4
5. Per r118 of EP Regulations 2021
6. Based on site observations, attended measurement and audio analysis of background noise monitoring, noise sensitive receivers located at Avalon College are located in a 'background relevant area' given their proximity to the ocean.

Table 8 provides the derived limits using the major urban area method for those specific monitoring locations, including two limits associated with GGS and Table 9 provides the derived limits using the rural area method for those specific monitoring locations, including two limits associated with Avalon College.

To provide a single noise limit for each of the sensitive receiver locations, the following further justifications are made:

- With consideration for GGS, the two monitoring locations (BG1 & BG2) provide valuable context to the background levels in so far as there is very little difference in background noise levels across the day, evening and night periods. With regards to the closest and likely most affected receiver at GGS from either existing industry noise and/or predicted project noise, RT&A considers the dwelling located at 1 Biddlecombe Avenue as representative. Renzo Tonin & Associates considers that BG2 monitoring location represents this receiver more so than BG1 monitoring location, due to zoning and exposure to Limeburners Bay meteorological conditions (i.e. wind). Furthermore, dwellings along Biddlecombe Avenue (further inland) that are located completely in Farming Zone (FZ1) benefit from shielding from buildings and fences that are not representative of the background monitoring at BG1 (in the open field of the GGS oval, located there due to denied access to residential back yards). Therefore, using the derived limits for BG2 are considered appropriate for assessment of noise impacts.
- With consideration for Avalon College, the two monitoring locations (BG3 & BG4) provide valuable context to the background levels in so far as there is very little difference in background noise levels across the day, evening and night periods. While both BG3 and BG4 monitoring locations are very similar distances from the dwellings at Avalon College, they are also very similar distances from either existing industry noise and/or predicted project noise. RT&A considers that BG4 monitoring location (closer to the coast) to materially not be any more affected by meteorological conditions (i.e. wind), however audio analysis confirms the influence of farming equipment at BG3, as well as BG3 only recording for 1 week, whereas BG4 recorded for nearly 4 weeks, therefore using the derived limits for BG4 are considered appropriate for assessment of noise impacts.

4.1.2 Identification of Noise Sensitive Areas in EES (for review) to ensure appropriate assessment of the project impacts from dredging & FSRU operations

As part of this supplementary assessment, Renzo Tonin & Associates has reviewed the EES Technical Report I Section 4.1, and considers the identification of the relevant zoning, land use, and study area to be appropriate.

No Noise Sensitive Area (NSA) have been identified which could be reasonably developed in the foreseeable future without a planning permit. As shown below current port and industrial land use zonings preclude future development of sensitive land uses on any vacant land in close proximity. The farm zone to the north in which Geelong Grammar School is located and to the east in which Avalon College is located, and the environmental significance overlays (i.e. Corio Native Grassland Reserve and Limeburners Bay/east coast) similarly preclude development of sensitive uses without planning permission. Furthermore, categorisation of the existing refinery and proposed FSRU as registered/licensed Major Hazard Facilities under Regulation 5 of the Occupational Health and Safety Regulations 2017 protects these facilities from encroachment of sensitive land uses under Clause 13.07 of the Greater Geelong Planning Scheme.

Figure 4: Overview of planning zones (extracted from EES Technical Report M: *Land use impact assessment)*

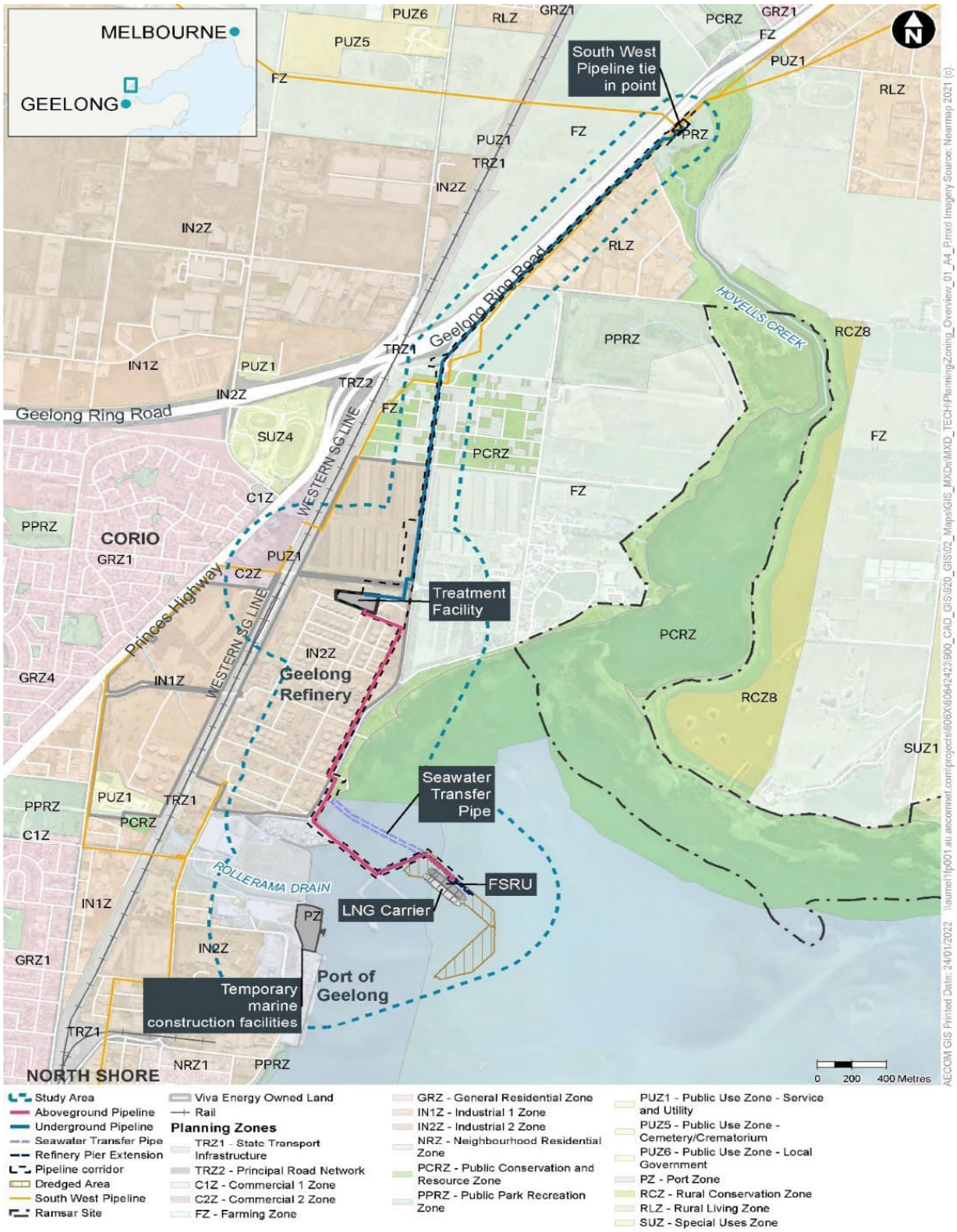
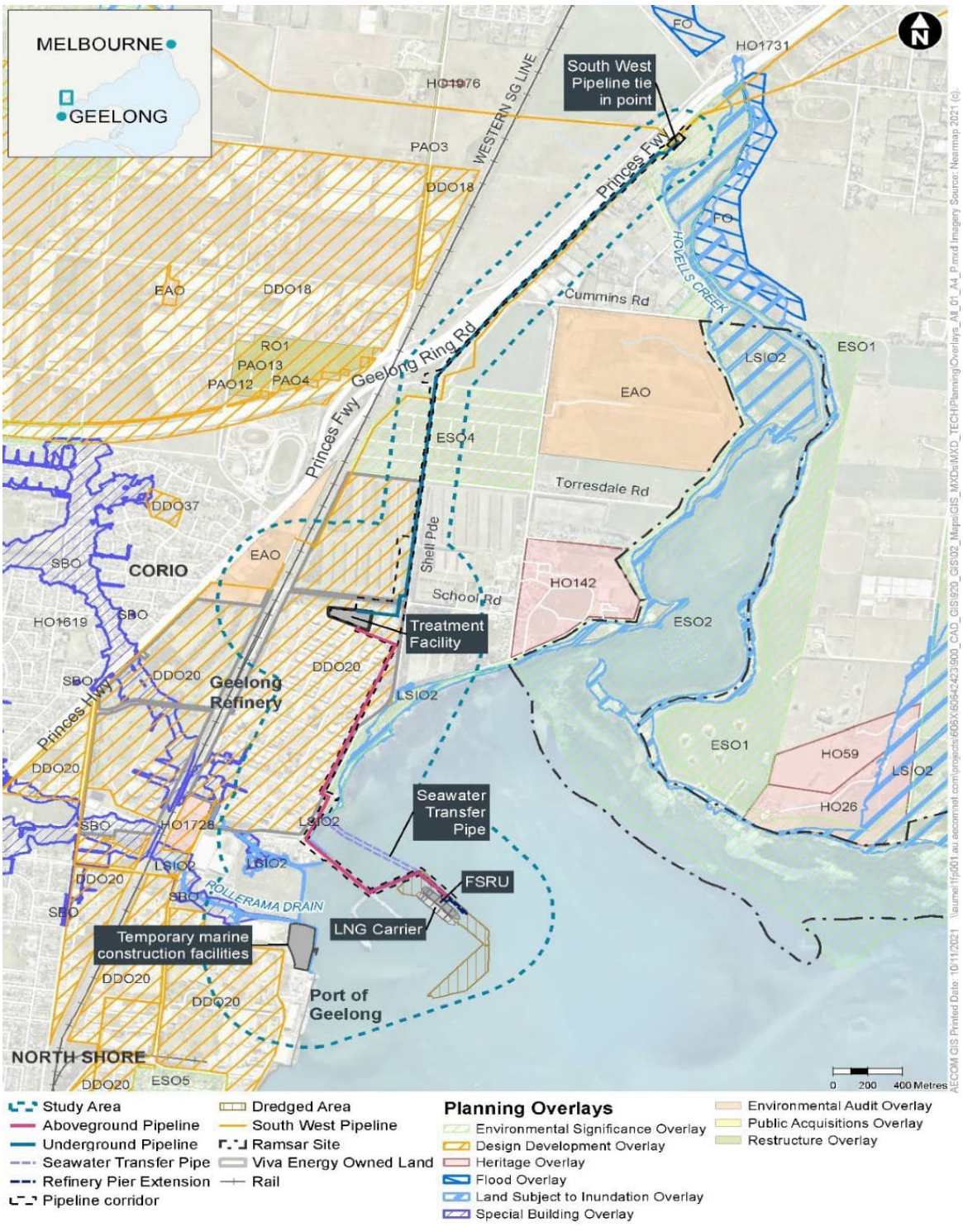


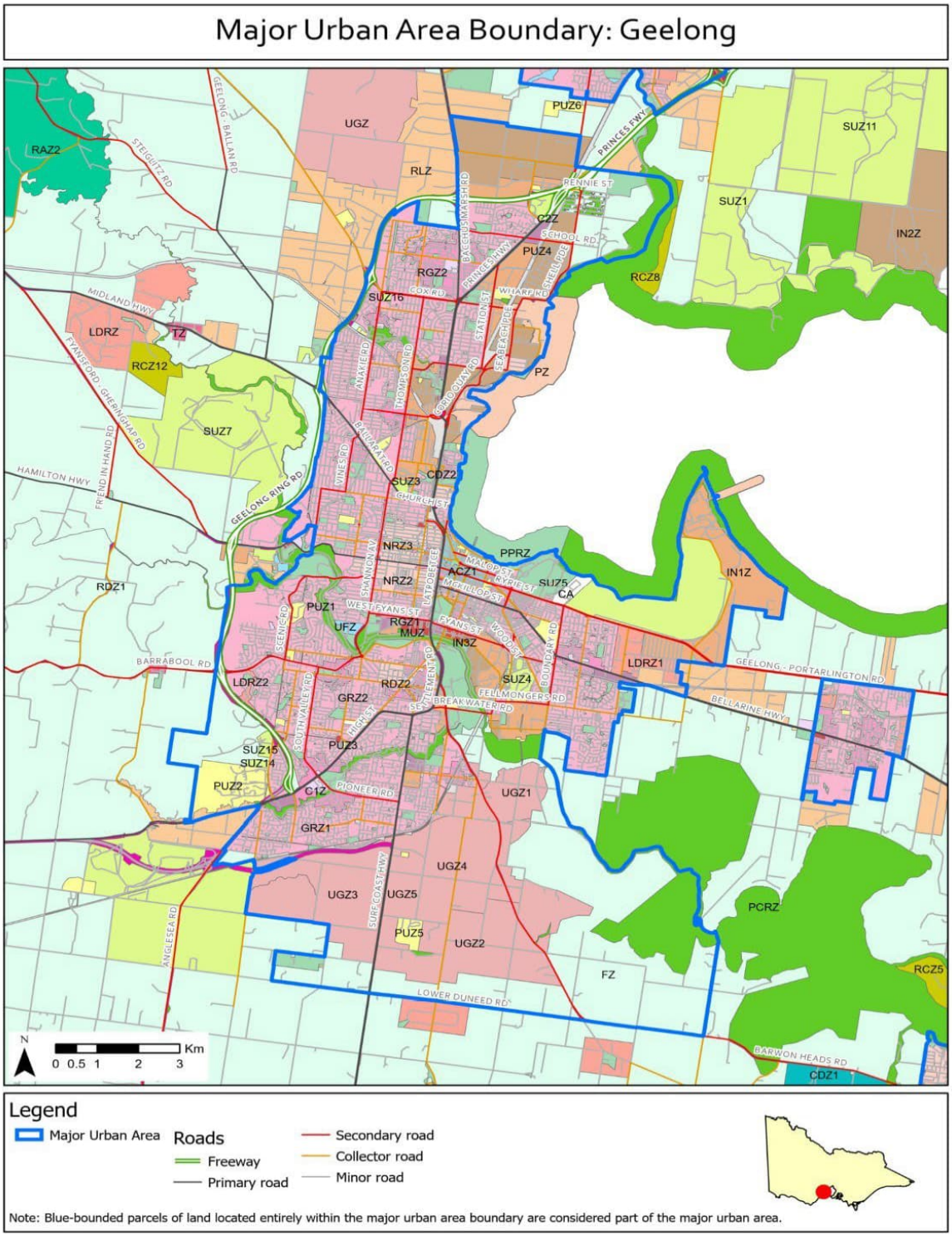
Figure 5: Overview of planning overlays (extracted from EES Technical Report M: *Land use impact assessment)*



The major urban area has been identified and provided context regarding the rural dwellings on Macgregor Court, Lara, and Avalon College and the Avalon rural dwellings, which are not within the major urban area, and therefore the noise limit derivation uses a separate methodology.

Figure 6 shows the boundary of the major urban area relevant to this project.

Figure 6: Major urban area boundary – Geelong (extracted from EES Technical Report I: *Noise and Vibration Impact Assessment*)



4.1.3 Suitability of measured background noise levels for relevant sensitive receivers needs to be justified and verified

The findings of task 10a are consistent with the findings of the noise technical study completed as part of the original EES. Renzo Tonin & Associates conducted an initial review of the EES monitoring locations, and found that while some provided adequate representation, others required a different approach. The following summarises the locations used and why there are differences to the EES locations

- BG1 location (at the edge of the oval, exposed) was chosen as a compromise to the rear yard of the residential property at 19-21 Biddlecombe Avenue (for which access was not permitted). BG1 was additional to the EES monitoring, and originally was proposed to capture the most affected residential receivers, without the direct exposure to Limeburners Bay weather effects. However, the compromise on location, and proximity to the proposed project, made the data not useful for the assessment; and therefore not used as part of the assessment.
- BG2 location is materially the same as the GGS location within the EES, and the location is considered representative of the most affected residential receivers at GGS (to the existing industry and the proposed project)
- BG3 & BG4 locations were chosen specifically as a direct comparison with BG1 & BG2 (GGS) without the influence of industry noise. However, as BG1 was not located where originally intended, and it direct comparison logger at Avalon (BG3) only monitored for one week, while BG4 provided a full four weeks of clean logging measurements and is materially located at a comparable distance to the coast as is BG2 (GGS); accordingly, RT&A has relied on BG4 as a directly representative alternative background location for GGS in the derivation of noise limits.
- BG5 location is not in the same as the Norlane location within the EES. RT&A chose this location based on access, topography, and exposure to local traffic, whereas the EES Norlane location was considered to be overly exposed in an open area, with a higher chance of theft/tampering (i.e. in an insecure location). Furthermore, RT&A's attended measurement observations support our chose in monitoring location for Norlane, with RT&A's determined background levels lower than those within the EES.
- BG6 location is not the same as the North Shore location within the EES. RT&A chose this location based on access, and siting (located within the suburban street, not directly exposure to Limeburners Bay and associated noise sources, including industry in direct line-of-sight which the EES location appear to have been). The background noise levels at these locations are noticeably different, with RT&A location having lower background levels than those with the EES.
- BG7 location was chosen to capture the background noise levels close to the coast, without the influence of the industry noise. This location was additional to the EES monitoring and is used as representative alternative background location for North Shore in the derivation of noise limits.
- BG8 location (open field of farm land) was chosen to potentially represent GGS, as the location is similar distance from the main traffic noise source (i.e. Princes Fwy/Prince Hwy) This location was additional to the EES monitoring and via audio analysis has helped understand the noise environment (i.e. traffic noise during the night is not materially contributing the background – no influence), while not specifically being required for use in derivation of noise limits at any of the sensitive receiver locations.

Further to the above, the attended measurements provide valuable context regarding the influence on the background noise environment at GGS and other sensitive areas from existing commercial, industrial or trade premises noise.

- Section 4.1.1.7 provides the recalculated noise limits and further context to the appropriate monitoring location to use in this assessment. GGS and Avalon both had two monitoring locations, with slightly different derived limits, and justifications have been made and presented to provide a single noise limit for each receiver. The justifications for GGS provide confirmation that RT&A's derived noise limits are consistent with the EES.
- The background noise monitoring within the EES for the Avalon College appears to have used the rural method correctly and correlates well with Renzo Tonin & Associates monitoring (BG3 & BG4).

- The background noise monitoring within the EES for the Norlane dwellings (based on monitoring at Site-05-80 St Georges Road) correlate well with Renzo Tonin & Associates monitoring at a very similar location. At 19 Zinnia Street, Norlane, RT&A observed that on some nights the refinery was inaudible and did not contribute to the background noise environment; and on other nights the refinery noise was audible and occasionally measurable between L_{Aeq} 35-40 when ambient noise occasionally subsided. The most dominant consistent noise, which dominated the noise environment, was heavy vehicle traffic along St Georges Road and Station Street during the day, evening and night periods. On this basis, background noise levels from the quietest periods at 19 Zinnia Street, Norlane are considered suitable for determining EPA 1826 noise limits for Norlane dwellings.
- The background noise monitoring within the EES for the North Shore dwelling (based on monitoring at Site 06 – 3 Phosphate Road) does not correlate well with Renzo Tonin & Associates monitoring (BG6). RT&A's monitoring location (BG6) provided less exposure to the foreshore which resulted in much lower background levels that those detailed in the EES. However, the background noise was still affected by occasional intrusive noise from the existing 'other' commercial, industrial or trade premises. Therefore, the use of background noise monitoring from 36 Walker Street, Rippleside (BG7), which is similarly positioned to major roads and the foreshore, yet is not impacted by commercial, industrial or trade premises noise, was chosen as an appropriate 'representative' background location for the North Shore dwellings.
- While RT&A have not conducted additional noise monitoring at the northern end of the study area (towards the Lara City Gate), the monitoring conducted in the EES noise study (Site– 01 - Macgregor Court monitoring location) has been reviewed and the noise limits appear to have been calculated incorrectly. RT&A note that AECOM has provided the updated calculations and noise limits, using the rural area method that have been reviewed and RT&A confirm are correct. This data was taken from Document No. MG1668.01-PMT-REG-XXX-020, entitled '*Response to RFI003648 for application (APP024263), Ultra-Low Sulphur Gasoline Project*', dated 05.09.2023. Furthermore, as this location has significant distance between source and receiver, all noise predictions are well below limits (including cumulative impacts).
- The noise monitoring conducted in the EES, along the Princes Highway (Site 04 – 365 Princes Highway) has been reviewed and has been compared with monitoring data (conducted at 307 Princes Highway by RT&A on a separate occasion for an unrelated project). The results are comparable and are consistent with observations during attended measurement in the surrounding areas.

To summarise the EES and this Supplementary Study (SS), Table 10 provides a comparison of the derived noise limits. Noise limits recalculated using the results from the extended monitoring campaign were generally consistent with those determined in the EES noise study.

Table 10: Comparison of EES and this Supplementary Study (SS) EPA 1826-P1 noise criteria

Period	Zoning level, L_{eq} dB(A)		Background noise level, L_{90} dB(A)		EPA 1826-P1 limit, L_{eq} dB(A)	
	EES	SS	EES	SS[1]	EES	SS
Geelong Grammar School						
Day	*57*	*56*	*43*	*39*	**54**	**52**
Evening	*50*	*50*	*42*	*39*	**50**	**48**
Night	*45*	*45*	*41*	*38*	**45**	**45**
North Shore dwellings						
Day	*54*	*51*	*48*	*39*	**54**	**51**
Evening	*48*	*45*	*47*	*39*	**50**	**45**
Night	*43*	*40*	*44*	*38*	**47**	**40**
Norlane dwellings[4]						
Day	*55*	*54*	*48*	*46*	**55**	**54**
Evening	*49*	*48*	*47*	*43*	**50**	**48**
Night	*44*	*43*	*44*	*43*	**47**	**46**
Corio (Princes Hwy) dwellings[2]						
Day	*56*	*58*	*57*	*57*	**63**	**63**
Evening	*50*	*52*	*52*	*54*	**55**	**57**
Night	*45*	*47*	*44*	*48*	**47**	**51**
Lara (Macgregor Court etc) dwellings (Rural Area Method)[3]						
Day	*50*	-	*63*	-	**71**	**71**
Evening	*45*	-	*61*	-	**66**	**66**
Night	*40*	-	*53*	-	**55**	**55**
Avalon College & rural dwellings (Rural Area Method)[3]						
Day	*53*	*53*	-	*39*	**53**	**47**
Evening	*48*	*48*	-	*39*	**48**	**47**
Night	*43*	*43*	-	*38*	**43**	**43**

Notes:

1. SS background noise levels based on alternative "representative" background location, as per Section 4.1.1.6.
2. As detailed above the table, the SS utilized EES derived noise limits as a conservative approach.
3. Note that the EES did not conduct monitoring at Avalon, while the SS did conduct monitoring at Avalon. The SS limits are derived using the rural area method in accordance with the Noise Protocol, EPA Pub 1826.4 and detailed in the notes from Table 9.
4. The background noise monitoring within the EES for the North Shore dwelling (based on monitoring at Site 06 – 3 Phosphate Road) does not correlate well with Renzo Tonin & Associates monitoring (BG6). RT&A's monitoring location provided less exposure to the foreshore which resulted in much lower background levels that those detailed in the EES.

4.2 Task 10b response

Address MM-NV05 To Inform the design, construction and operation of the project:

- *Further assessment of the pre-existing noise from commercial, industrial and trade premises (from Viva Refinery and from other commercial, industrial and trade premises) shall be carried out based on measurements taken over a period of at least 1-week to determine existing $L_{Aeq,30min}$ noise impacts and the likely cumulative noise impacts at Geelong Grammar School (GGS) and at other noise sensitive areas. If background noise cannot be measured without impacts from the Viva Refinery, it will be measured during a period of plant shut down.*

4.2.1 Noise characteristic considerations

From Renzo Tonin & Associates measurements and assessment at the surrounding sensitive receiver locations, no pre-existing industry noise characteristics such as tonality, impulsiveness or intermittency were identified. Additionally, low frequency noise from attended measurements of the pre-existing industry noise, show that levels are below the threshold levels detailed in EPA Publication 1996, which is provided to assess the potential risk of problematic frequencies.

At the receivers, observed industrial noise levels were below EPA Pub. 1996 thresholds, the noise spectrum was both objectively and subjectively not tonal (using EPA Pub. 1826 tonality equation), nor intermittent nor impulsive. The noise from the pre-existing industry observed to be broadband and continuous in nature. Further observations of the noise at the source shows individual noises and noise characteristics blend together as incoherent noise sources (more so as distance increases), with characteristics such as intermittency, impulsiveness and tonality, all masking the noise character of each other. Accordingly my observations and analysis result in no character adjustments.

Using EPA Publication 1996 outdoor low frequency threshold criterion (Table 3 of the publication), we have compared our measurements at GGS, with attended measurement location A6 recording the highest levels, with measurements within 30 metres of the unattended noise monitoring location BG2 (which is considered representative of the most affected sensitive receivers at GGS).

Using 1/3 octave spectral data from our attended measurements, we calculated the predicted spectrum, which shows levels below those in the 1/3 octave low frequency noise threshold levels from 10Hz to 160Hz (see below).

Outdoor 1/3 octave low frequency noise comparison													
1/3 Octave (Hz)	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Threshold levels, L_{eq} (dB)	92	89	86	77	69	61	54	50	50	48	48	46	44
Predicted levels, L_{eq} (dB)	62	60	58	56	54	54	52	50	49	47	44	42	41
Complies (✓/✗)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

EPA Publication 1826 requires that noise characteristics be considered when assessing noise from commercial, industrial and trade premises. Noise character adjustments are assessed, and the adjustments are combined to provide an Effective Noise Level (ENF) as a $L_{Aeq,30min}$ sound pressure level.

Character adjustments relate to the following features that increase annoyance and are relevant to:

- Tonal noise (such as humming, droning, whining or squealing)
- Impulsive noise (such as banging or hammering)
- Intermittent noise (when noise varies, getting louder then drops back, however doesn't apply to a single noise emitted then stops, even several times across the 30-minute assessment period)

Renzo Tonin & Associates understands that within the EES Technical Report I, Section 7.3.6 that no tonality adjustment was applied to the predicted project noise levels. Section 7.3.7 does provide a low frequency analysis, however only octave band data was available, and the worst-case scenario project noise level was used. From review of EES Technical Report I and the AECOM Revised Noise Modelling Assessment (APPENDIX C), it appears that predicted project noise levels would not exceed relevant low frequency thresholds per EPA Publication 1996: 'Noise Guideline - Assessing Low Frequency Noise'.

As such, for the purposes of this Supplementary Study, noise from pre-existing and the project sources are considered to be broadband without noise characteristics. As such, no character adjustments to the noise are required as the predicted noise levels do not contain tonal, intermittent or impulsive characteristics.

It is advised that during the final operational plant selection process, manufacturers data or noise measurement data be verified to eliminate the risk of low frequency noise and/or noise characteristics. MM-NV05, which includes this requirement for all further stages of the project when the relevant project specifications are available as part of the design, provides for iterative reviews to ensure all reasonably practicable opportunities to reduce operational noise emissions have been considered across the design, construction and operation of the project. At plant selection when manufacturer's data is available these reviews include verification of any noise characteristics, and assessment and management of low frequency noise emissions if present.

4.2.2 Compare measured pre-existing industry noise to the recalculated limits (from 4.1.1.4)

As part of this assessment, during the background noise monitoring campaign, long-term unattended noise monitoring was conducted at key locations at the refinery to capture the overall pre-existing noise impacts. Figure 3 provides a markup of the locations used for the monitoring, while Table 6 summarise the methodology and results. Noise characteristics, in accordance with clause 71 to 90 of the Noise Protocol, EPA Pub. 1826.4) have been considered (see Section 4.2.1), with no adjustments considered applicable nor made.

The outcome of this comparison of pre-existing noise from the refinery and the recalculated noise limits is summarised in Table 11.

Table 11: Comparison summary of measured and estimated pre-existing industry noise to the recalculated limits

Location / sensitive receiver location[1]	Measured and estimated[5] pre-existing industry noise (night), $L_{eq,30min}$ dB(A) (and noise enhancing weather conditions shown in brackets)[6]	Below recalculated EPA 1826-P1 limit, L_{eq} dB(A)? (✓/~)		
		Day	Evening	Night
Geelong Grammar School	43 (47)[2]	52 (✓/ ✓)	48 (✓/ ✓)	45 (✓/ ~)
Macgregor Court etc (Lara dwellings)	29 (33)[8]	71 (✓/ ✓)	66 (✓/ ✓)	55 (✓/ ✓)
12 Myrtle Grove (North Shore dwellings)	37 (41)[5,7]	51 (✓/ ✓)	45 (✓/ ✓)	40 (✓/ ~)
19 Zinnia St (Norlane dwellings)	40[3] (45)[5]	54 (✓/ ✓)	48 (✓/ ✓)	46 (✓/ ✓)
365 Princes Hwy (Corio dwellings)	44[4] (48)[5]	63 (✓/ ✓)	55 (✓/ ✓)	47 (✓/ ~)
Avalon College	Not audible	47 (✓/ ✓)	47 (✓/ ✓)	43 (✓/ ✓)

Notes:
1. Location considered representative of the most affected sensitive receiver for that location/area. Noise levels at other sensitive receivers are lower than the noise levels presented above, because of greater distance from the refinery.
2. Measured noise levels under 'noise enhancing weather conditions' taken from RT&A attended measurements and analysis of unattended noise monitoring.
3. Based on attended measurements and analysis of unattended noise monitoring, using highest measured night period level (See Section 4.1.3 for detail)
4. Based on unattended noise monitoring at (Site 04-365 Princes Highway from the EES Technical Report I) for night-time background noise recorded levels (lowest 10th percentile 30-minute measurements)
5. Estimated noise levels for 'noise enhancing conditions' based on comparable differences at other measurement locations, due to no measurements under these conditions recorded at this location. The effect of noise enhancing conditions was observed and measured for noise transmission to GGS. That measured level difference effect has been applied to estimate noise under enhanced conditions to other locations.
6. Night period levels are used, as the analysis of existing industry noise shows constant noise emission (24/7) and is the most stringent assessment period, with measurements and analysis conducted using unattended noise monitoring and attended measurements.
7. Note is made that the estimated pre-existing industry noise under noise enhancing weather conditions "(41)" is identified as noise from other industrial premises, not Geelong refinery, which could not be heard at this location.
8. Estimated noise levels (neutral & noise enhancing conditions) based on measured levels at other locations and basic distance loss calculations.

4.2.3 Compare predicted noise impacts from dredging activities to the recalculated limits

We provide a comparison of the predicted dredging noise levels extracted from within the EES Technical Report I: Noise and Vibration Impact Assessment (Section 6.11.3 / Table 68) to the recalculated noise limits, summarised in Table 12.

Table 12: Comparison summary of predicted noise impacts from dredging to the recalculated limits

Location / sensitive receiver location	Predicted dredging noise, $L_{eq,30min}$ dB(A) (and noise enhancing weather conditions shown in brackets)	Below recalculated EPA 1826-P1 limit, L_{eq} dB(A)? (✓/~)		
		Day	Evening	Night
Geelong Grammar School	37 (45)	52 (✓/✓)	48 (✓/✓)	45 (✓/✓)
Macgregor Court etc (Lara dwellings)	<30[1] (30)	71 (✓/✓)	66 (✓/✓)	55 (✓/✓)
12 Myrtle Grove (North Shore dwellings)[2]	32 (40)	51 (✓/✓)	45 (✓/✓)	40 (✓/✓)
Station St (Norlane dwellings)	30 (38)	54 (✓/✓)	48 (✓/✓)	46 (✓/✓)
Princes Hwy (Corio dwellings)	30 (38)	63 (✓/✓)	55 (✓/✓)	47 (✓/✓)
Avalon College (& rural dwellings)	35 (43)	47 (✓/✓)	47 (✓/✓)	43 (✓/✓)

Notes:
1. Estimated as 22 based on comparable differences at other measurement locations, to assist with cumulative predictions shown in Table 13.
2. These predictions are taken from (Site 06-3 Phosphate Road, North Shore, from the EES Technical Report I), which is located closer to the coast, with less shielding to the dredging activities, than 12 Myrtle Grove. Furthermore The background noise monitoring within the EES for the North Shore dwelling (based on monitoring at Site 06 – 3 Phosphate Road) does not correlate well with Renzo Tonin & Associates monitoring (BG6). RT&A's monitoring location provided less exposure to the foreshore which resulted in much lower background levels that those detailed in the EES. Therefore these predictions are likely to be overly conservative.

Renzo Tonin & Associates understands that dredging activities are undertaken as part of a construction noise assessment, however, are to be assessed under the Environment Protection Regulation operational noise limit as per EPA Publication 691. Noise levels from dredging are not predicted to exceed the EPR noise limits at any noise sensitive receivers during day, evening, or night-time periods.

Table 13: Comparison summary of predicted noise impacts from pre-existing industry and dredging to the recalculated limits

Location / sensitive receiver location	Predicted pre-existing industry + dredging noise, $L_{eq,30min}$ dB(A) (and noise enhancing weather conditions shown in brackets)	Below recalculated EPA 1826-P1 limit, L_{eq} dB(A)? (✓/~)		
		Day	Evening	Night
Geelong Grammar School	44 (49)	52 (✓/✓)	48 (✓/~)	45 (✓/~)
Macgregor Court etc (Lara dwellings)	30 (35)	71 (✓/✓)	66 (✓/✓)	55 (✓/✓)
12 Myrtle Grove (North Shore dwellings)	38 (44)	51 (✓/✓)	45 (✓/✓)	40 (✓/~)
Station St (Norlane dwellings)	41 (46)	54 (✓/✓)	48 (✓/✓)	46 (✓/✓)
Princes Hwy (Corio dwellings)	44 (48)	63 (✓/✓)	55 (✓/✓)	47 (✓/~)
Avalon College (& rural dwellings)	35 (43)	47 (✓/✓)	47 (✓/✓)	43 (✓/✓)

While technically, noise from dredging is predicted to contribute to the cumulative noise exceedance of the night time noise limit under noise enhancing weather conditions at Princes Highway (Corio dwellings), the contribution is in the order of 0.5 dB. However, as the cumulative noise levels are required to be rounded, the overall cumulative level remains the same (i.e. logarithmic addition of the whole integer 38 dB & 48 dB results in a cumulative level of 48.4 dB, which is required to be rounded to a whole integer as per EPA Pub. 1997, with the decimal between 0.1 to 0.4 rounded down to the nearest integer, being 48 dB). The pre-existing industrial noise level at night under noise enhancing weather conditions at Princes Highway (Corio dwellings) is 48 dB (already 1 dB above the noise limit) and the

same as the predicted cumulative noise level under noise enhancing weather conditions at Princes Highway (Corio Dwellings).

Whilst, as shown in Table 13, an exceedance of the noise limit could theoretically occur during the evening or at night as a result of cumulative noise (i.e. pre-existing industry noise and dredging noise) at GGS and at night at North Shore and Princes Highway ,under noise enhancing weather conditions, it is understood that dredging is likely to only occur during an 8 week period in autumn/ winter, which coincides with a time of the year where, noise enhancing weather conditions have been shown (see Section 4.1.1.2) to generally occur less than during spring/summer.

Even in the event that noise enhancing weather conditions did occur during the dredging campaign, the short duration of the campaign, the infrequent occurrence of the weather events and the small increase in noise level would mean potential cumulative noise impacts would be temporary in nature and limited in time.

However, to reduce as far as reasonably practicable the risk of cumulative noise impacts Viva Energy would implement contingency measures as per mitigation measure MM-NV04 which states:

> *"Measurements shall be undertaken at the commencement of dredging and during meteorological conditions suitable to favourable noise propagation at Geelong Grammar School and other sensitive receivers. Where assessments conducted in accordance with EPA Publication 1826.4 (Noise Protocol) (as amended or replaced from time to time) indicate cumulative noise impacts (including the contributions from dredging, from the Viva Refinery and from other commercial, Industrial or trade premises) will exceed the evening or night period noise limits determined in accordance with the Noise Protocol, dredging operations shall cease during these periods until the relevant period limits are met"*

4.2.4 Compare predicted noise from the project operations to the recalculated limits

As part of this assessment, the EES noise modelling inputs have been revised to better reflect the proposed operations and noise mitigations to further attenuate noise.

RT&A note that the same model has been applied with the inputs updated to reflect design optimisation and clarification of typical operational conditions (e.g. n+1 spares for critical equipment) that have been identified through further review of equipment specifications in accordance with EPA RFI 002392 and GED, with the section updated to clarify model inputs as opposed to a new noise model generated. RT&A has been provided a copy of the revised noise modelling undertaken by AECOM, which is provided in APPENDIX C. APPENDIX C provides a full update to the modelling scenarios, design optimisation and operational condition inputs, the assessment (including meteorological conditions) and the revised predicted noise levels, which have been collated into a summary table showing the results for the various scenarios.

To assist with understanding the operational details for each scenario, Table 14 is a summary from the revised noise modelling assessment (AECOM). Operational scenarios are based on a maximum occurrence of additional noise emitting activities beyond the stand alone FSRU operation.

The comparison of the project operational predictions extracted from AECOM's updated modelling, provided in APPENDIX C to the recalculated noise limits summarised in Table 15.

Table 14: The project operational scenarios

Scenario	Stage	Description	Frequency and duration	Number of days in a calendar year scenario expected to occur	% of days in a calendar year scenario expected to occur
1	FSRU (open loop) operation only	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • Nitrogen injection at the treatment facility	Standard operation	254.779	69.80%
2	FSRU (open loop) operation with LNG carrier berthed	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • LNG carrier moored next to FSRU • Nitrogen injection at the treatment facility	LNG carrier berthed 36 hours for up to 45 times per year (every 8 days during peak demand period)	58.174	15.94%
3	FSRU (open loop) operation with nitrogen offloading	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility	Anticipated that up to five nitrogen trucks per day would travel to site for 120 days of the year (winter months) and up to three nitrogen trucks per day would travel to site for a further 120 days of the year. There would be no nitrogen truck deliveries/unloading for the remaining days of the year, unloading activities to take one hour and 15 minutes each delivery.	40.441	11.08%
4	FSRU (open loop) operation with LNG carrier berthed & nitrogen offloading	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • LNG carrier moored next to FSRU • Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility	LNG carrier berthed 36 hours for up to 45 times per year (every 8 days during peak demand period), Anticipated that five nitrogen trucks per day would travel to site for 120 days of the year (winter months) and three nitrogen trucks per day would travel to site for a further 120 days of the year. There would be no nitrogen truck deliveries/unloading for the remaining days of the year, unloading activities to take one hour and 15 minutes each delivery.	9.234	2.53%

Scenario	Stage	Description	Frequency and duration	Number of days in a calendar year scenario expected to occur	% of days in a calendar year scenario expected to occur
5	FSRU (open loop) operation with LNG carrier berthing	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • LNG carrier mooring with four tugs • Nitrogen injection at the treatment facility	LNG carrier berthing for less than one hour up to 45 times (every 8 days during peak demand period).	1.616	0.44%
6	FSRU (open loop) operation, LNG carrier berthing and nitrogen unloading	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • LNG carrier mooring with four tugs • Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility	LNG carrier berthing for less than one hour up to 45 times (every 8 days during peak demand period), Anticipated that five nitrogen trucks per day would travel to site for 120 days of the year (winter months) and three nitrogen trucks per day would travel to site for a further 120 days of the year. There would be no nitrogen truck deliveries/unloading for the remaining days of the year, unloading activities to take one hour and 15 minutes each delivery.	0.256	0.07%
6a	FSRU (closed loop) operation, LNG carrier berthing and nitrogen unloading	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • LNG carrier mooring with four tugs • Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility	FSRU closed loop operation occurs only in an 'emergency' should the seawater transfer pipe not be operational. LNG carrier berthing for less than one hour up to 45 times (every 8 days during peak demand period), Anticipated that five nitrogen trucks per day would travel to site for 120 days of the year (winter months) and three nitrogen trucks per day would travel to site for a further 120 days of the year. There would be no nitrogen truck deliveries/unloading for the remaining days of the year Unloading activities to take one hour and 15 minutes each delivery.	0.0004	0.0001%

Table 15: Comparison summary of predicted noise from the project to recalculated limits

Location / sensitive receiver location	Predicted the project noise, $L_{eq,30min}$ dB(A) (and noise enhancing weather conditions shown in brackets) Below recalculated EPA 1826-P1 limit, L_{eq} dB(A)? (✓/~)							Recalculated EPA 1826-P1 noise limit, L_{eq} dB(A), Day/Evening/Night
	Scenario 1 (FSRU open loop only)	Scenario 2 (FSRU open loop + LNG carrier moored)	Scenario 3 (FSRU open loop + nitrogen offloading)	Scenario 4 (FSRU open loop+ LNG carrier moored + nitrogen offloading)	Scenario 5 (FSRU open loop+ LNG carrier berthing)	Scenario 6 (FSRU open loop+ LNG carrier berthing + nitrogen offloading)	Scenario 6a (FSRU closed loop + LNG carrier berthing + nitrogen offloading)	
Geelong Grammar School	35 (39) ✓/✓/✓ (✓/✓/✓)	38 (42) ✓/✓/✓ (✓/✓/✓)	36 (39) ✓/✓/✓ (✓/✓/✓)	38 (42) ✓/✓/✓ (✓/✓/✓)	39 (43) ✓/✓/✓ (✓/✓/✓)	40 (43) ✓/✓/✓ (✓/✓/✓)	40 (43) ✓/✓/✓ (✓/✓/✓)	52/48/45
Macgregor Court etc (Lara dwellings)	22 (25) ✓/✓/✓ (✓/✓/✓)	26 (28) ✓/✓/✓ (✓/✓/✓)	25 (28) ✓/✓/✓ (✓/✓/✓)	27 (30) ✓/✓/✓ (✓/✓/✓)	28 (30) ✓/✓/✓ (✓/✓/✓)	28 (31)[1] ✓/✓/✓ (✓/✓/✓)	27 (29) ✓/✓/✓ (✓/✓/✓)	71/66/55
12 Myrtle Grove (North Shore dwellings)	26 (29) ✓/✓/✓ (✓/✓/✓)	34 (37) ✓/✓/✓ (✓/✓/✓)	26 (29) ✓/✓/✓ (✓/✓/✓)	34 (37) ✓/✓/✓ (✓/✓/✓)	35 (38) ✓/✓/✓ (✓/✓/✓)	35 (38) ✓/✓/✓ (✓/✓/✓)	35 (38) ✓/✓/✓ (✓/✓/✓)	51/45/40
19 Zinnia St (Norlane dwellings)	27 (30) ✓/✓/✓ (✓/✓/✓)	35 (38) ✓/✓/✓ (✓/✓/✓)	28 (31) ✓/✓/✓ (✓/✓/✓)	35 (38) ✓/✓/✓ (✓/✓/✓)	37 (40) ✓/✓/✓ (✓/✓/✓)	37 (40) ✓/✓/✓ (✓/✓/✓)	37 (40) ✓/✓/✓ (✓/✓/✓)	54/48/46
365 Princes Hwy (Corio dwellings)	25 (28) ✓/✓/✓ (✓/✓/✓)	31 (34) ✓/✓/✓ (✓/✓/✓)	31 (34) ✓/✓/✓ (✓/✓/✓)	32 (35) ✓/✓/✓ (✓/✓/✓)	34 (36) ✓/✓/✓ (✓/✓/✓)	34 (37) ✓/✓/✓ (✓/✓/✓)	34 (37)[1] ✓/✓/✓ (✓/✓/✓)	63/55/47
Avalon College (& Avalon rural dwellings)	32 (36) ✓/✓/✓ (✓/✓/✓)	35 (39) ✓/✓/✓ (✓/✓/✓)	32 (36) ✓/✓/✓ (✓/✓/✓)	35 (39) ✓/✓/✓ (✓/✓/✓)	36 (40) ✓/✓/✓ (✓/✓/✓)	36 (40) ✓/✓/✓ (✓/✓/✓)	37 (40) ✓/✓/✓ (✓/✓/✓)	47/47/43

Notes: 1. Highest predicted noise levels at Lara dwellings and Corio dwellings are 10 dB lower than the noise limit, therefore would have no measurable impact on the cumulative noise level.

4.2.5 Compare predicted cumulative pre-existing industry noise and 'the project' noise impacts to the recalculated limits

The comparison of 'the project' operational predictions extracted from AECOM's updated noise modelling, provided in APPENDIX C, to the recalculated noise limits is summarised in Table 16. Note should be made that the predicted $L_{Aeq,30min}$ is typically measured with contributions from all noise at the measurement location over the duration of the measurement, which is likely to include contributions from road traffic, other industry, wind-induced noise from trees, wildlife as well as the ocean. Therefore, the predicted cumulative noise impacts for neutral and noise enhancing weather conditions could be seen as worst-case scenarios in themselves.

Table 16: Comparison summary of predicted cumulative noise from pre-existing industry noise and 'the project' noise to recalculated limits

Location / sensitive receiver location	Predicted cumulative pre-existing industry noise and 'the project' noise, $L_{eq,30min}$ dB(A) (and noise enhancing weather conditions shown in brackets) Below recalculated EPA 1826-P1 limit, L_{eq} dB(A)? (✓/~)							Recalculated EPA 1826-P1 noise limit, L_{eq} dB(A), Day/Evening/Night
	Scenario 1 (FSRU open loop only)	Scenario 2 (FSRU open loop + LNG carrier moored)	Scenario 3 (FSRU open loop + nitrogen offloading)	Scenario 4 (FSRU open loop+ LNG carrier moored + nitrogen offloading)	Scenario 5 (FSRU open loop+ LNG carrier berthing)	Scenario 6 (FSRU open loop+ LNG carrier berthing + nitrogen offloading)	Scenario 6a (FSRU closed loop + LNG carrier berthing + nitrogen offloading)	
Geelong Grammar School	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	45 (48) ✓/✓/✓ (✓/✓/~)	45 (48) ✓/✓/✓ (✓/✓/~)	52/48/45
Macgregor Court etc (Lara dwellings)	22 (25) ✓/✓/✓ (✓/✓/✓)	26 (28) ✓/✓/✓ (✓/✓/✓)	25 (28) ✓/✓/✓ (✓/✓/✓)	27 (30) ✓/✓/✓ (✓/✓/✓)	28 (30) ✓/✓/✓ (✓/✓/✓)	28 (31) ✓/✓/✓ (✓/✓/✓)	27 (29) ✓/✓/✓ (✓/✓/✓)	71/66/55
12 Myrtle Grove (North Shore dwellings)	37 (41) ✓/✓/✓ (✓/✓/~)	39 (42) ✓/✓/✓ (✓/✓/~)	37 (41) ✓/✓/✓ (✓/✓/~)	39 (42) ✓/✓/✓ (✓/✓/~)	39 (43) ✓/✓/✓ (✓/✓/~)	39 (43) ✓/✓/✓ (✓/✓/~)	39 (43) ✓/✓/✓ (✓/✓/~)	51/45/40
19 Zinnia St (Norlane dwellings)	41 (45) ✓/✓/✓ (✓/✓/✓)	42 (46) ✓/✓/✓ (✓/✓/✓)	41 (45) ✓/✓/✓ (✓/✓/✓)	42 (46) ✓/✓/✓ (✓/✓/✓)	42 (46) ✓/✓/✓ (✓/✓/✓)	42 (46) ✓/✓/✓ (✓/✓/✓)	42 (46) ✓/✓/✓ (✓/✓/✓)	54/48/46
365 Princes Hwy (Corio dwellings)	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	44 (48) ✓/✓/✓ (✓/✓/~)	63/55/47
Avalon College (& Avalon rural dwellings)	32 (36) ✓/✓/✓ (✓/✓/✓)	35 (39) ✓/✓/✓ (✓/✓/✓)	32 (36) ✓/✓/✓ (✓/✓/✓)	35 (39) ✓/✓/✓ (✓/✓/✓)	36 (40) ✓/✓/✓ (✓/✓/✓)	36 (40) ✓/✓/✓ (✓/✓/✓)	37 (40) ✓/✓/✓ (✓/✓/✓)	47/47/43

Project operational noise does not contribute to the cumulative noise exceedance of the night time noise limit under noise enhancing weather conditions at Princes Highway (Corio dwellings). The pre-existing industrial noise level at night under noise enhancing weather conditions at Princes Highway (Corio Dwellings) is 48 dB, already 1 dB above the noise limit.

4.2.6 Discussion of results

Considering the results of the additional noise monitoring and further impact assessment, the findings of this task, detailed above in Section 4.2, Renzo Tonin & Associates have shown that:

- Measured noise, from pre-existing industry, is at or below the recalculated noise limits at all sensitive receivers, under neutral weather conditions for the day, evening and night periods.
- Predicted noise, from dredging, is at or below the recalculated noise limits at all sensitive receiver, under neutral and noise enhancing weather conditions for the day, evening and night periods.
- Predicted noise, from project operation is below the recalculated noise limits at all sensitive receiver, under neutral and noise enhancing weather conditions for the day, evening and night periods.
- Predicted cumulative noise, from pre-existing industry and dredging activities, is at or below the recalculated noise limits at all sensitive receivers, under neutral and noise enhancing weather conditions, for the day period.
- Predicted cumulative noise, from pre-existing industry and dredging activities, is at or below the recalculated noise limits at all sensitive receivers, under neutral weather conditions for the evening and night periods.
- Predicted cumulative noise, from pre-existing and project operation, is at or below the recalculated noise limits at all sensitive receivers, under neutral weather conditions, for the day, evening and night periods.
- Predicted cumulative noise, from pre-existing and project operation, is at or below the recalculated noise limits at all sensitive receivers, under noise weather enhancing conditions, during the day and evening periods.
- Measured noise, from pre-existing industry exceeds the recalculated noise limits at GGS, under noise enhancing weather conditions during the night period.
- Whilst, the Geelong refinery was not audible at North Shore, estimated noise* under noise enhancing weather conditions from pre-existing industry was predicted to exceed the recalculated noise limits at Corio and North Shore dwellings during the night period.

  * Per Table 11, the effect of noise enhancing conditions was observed and measured for noise transmission to GGS. That measured level difference effect has been applied to estimate noise under enhanced conditions to other locations. Accordingly:

  - At GGS there is a potential cumulative noise exceedance, from pre-existing industry and dredging activities, with the recalculated noise limits, under noise enhancing weather conditions, for the evening and night periods.
  - At North Shore and Princes Highway dwellings there is a potential cumulative noise exceedance, from pre-existing industry and dredging activities, with the recalculated noise limits, under noise enhancing weather conditions, for the night period.
  - At GGS and North Shore dwellings there is a potential cumulative noise exceedance, from pre-existing industry and project operational activities, with the recalculated night period noise limit, under noise enhancing weather conditions, of up to 3dB (i.e. a just perceptible change in the apparent loudness to the human ear, noting that changes in the character of the noise or its frequency spectrum may result in a more discernible change).
- Furthermore, a well-regarded acoustics reference book (referenced in EPA Victoria Publication 1997, NSW EPA Noise Policy for Industry) entitled '*Engineering Noise Control – Theory & Practice 3rd Edition'* [Bies & Hansen, 2006] provides some context to the subjective response to variations in noise levels. Bies & Hansen states:

  "The subjective response of a group of normal subjects to variations in sound pressure has been investigated (Stevens, 1957, 1972; Zwicker, 1958; Zwicker & Scharf, 1965). This table summarise the results."

Change in sound level (dB)	***Change in apparent loudness***
+3	*Just perceptible*
5	*Clearly noticeable*
10	*Half or twice as loud*
20	*Much quieter or louder*

  Note that these results were obtained from investigations considering "a single fixed frequency' or 'a narrow band of noise' for the 'mid-frequency range', therefore variations in the character of the noise or its frequency spectrum may result in a more discernible change.

Further work has been undertaken to investigate how noise emissions from the project can be further reduced, consistent with the GED.

The noise attenuation and contingency measures which would ensure that 'project' operational noise levels are maintained within Project Noise Criteria are highlighted in the ANNEXURE to this report.

4.3 Task 10c response

Address MM-NV05 To Inform the design, construction and operation of the project:

- *Establish and justify, supported by documented evidence, The project Noise Criteria to ensure that the noise from the project, when combined with the pre-existing and approved noise from commercial, industrial and trade premises will not lead to an exceedance of the regulatory noise limits.*

4.3.1 Identify any 'approved' (but not pre-existing) noise emissions that would contribute to cumulative noise impacts

The project is located at and adjacent to the existing Geelong Refinery with both the refinery and surrounding land subject to multiple planning zones and overlays, as shown in Figure 4 and Figure 5 in Section 4.1.2., which would trigger the requirement for planning permission to be obtained.

Acknowledging that City of Greater Geelong planning permits would be required for developments surrounding the project area, through engagement with Viva Energy, Renzo Tonin & Associates understands that there are only two 'approved' (but not pre-existing) projects, which could contribute to cumulative noise impacts, which include:

- Viva Energy Ultra Low Sulphur Gasoline (ULSG) Project
  - The EPA's DL application APP024263 assessment summary states:

    "Minimal impact as the new installations have been designed to emit at least 10 dB noise levels below the limit"
  - The noise assessment conducted by AECOM (Ref. 60678849, dated 09.03.2023) in support of the DL application predicts noise levels of <30 dB(A) for all locations, except for two locations; 36 dB(A) on Station St (Norlane dwelling) and 37 dB(A) on Princes Hwy (Corio dwellings) i.e., predicted noise levels at least 10 dB below the respective night period noise limits.
- Viva Energy Hydrogen Refuelling Station Project
  - Renzo Tonin & Associates understands that no feedback from Council on the acoustic report (dated 25 Jan 2024) has been received
  - The noise assessment conducted by Renzo Tonin & Associates (ref. ME160-01F01 Town Planning Acoustic Report (r2), dated 11.07.2023) does not include any of the specific locations referred to in this supplementary noise study, however, the prediction model indicates that the two closest receivers would be Station St (Norlane dwelling) – likely to predict a noise level less than 30 dB(A) and Princes Hwy (Corio dwelling) – likely to predict a noise level less than 35 dB(A) i.e., predicted noise levels of at least 16 dB and 12 dB respectively less than the night period noise limits.

4.3.2 Compare predicted cumulative pre-existing industry noise and approved (but not pre-existing) and 'the project' noise impacts to the recalculated limits

Further to the above, as these levels indicate predictions that are 10 dB lower than the noise limit, therefore no measurable impact on the cumulative noise from any 'approved' (but-not pre-existing) projects is predicted.

4.3.3 Establish the project noise criteria consistent with EPR R.119, EPA Pub 1997 & GED

As part of this supplementary study Renzo Tonin & Associates has undertaken an assessment of the noise impacts from pre-existing industry noise and 'the project' noise with reference to Recommendation 10 of the Minister's Directions related to noise. As part of the supplementary study, RT&A has:

- Determined background levels at Geelong Grammar School (GGS) and other sensitive areas, via:
  - An extensive unattended long-term noise monitoring campaign, including weather monitoring at GGS
  - A detailed analysis of long-term meteorological data obtained from the Bureau of Meteorology's website for the Avalon Airport Weather Station
  - Attended short-term measurements during the night-time period on two separate occasions
  - Unattended long-term noise monitoring of pre-existing industry noise
  - Analysis of the monitoring and measurement data (including audio recordings)
  - An assessment of the suitability of the measured background noise levels. Where appropriate, justification of representative 'background equivalent' locations for several sensitive receivers, with consideration of influence by intrusive noise from commercial, industrial and trade premises
  - Review of noise sensitive areas (within the EES Technical Report I) to ensure appropriate assessment, including zoning.

  Recalculated the regulatory noise limits based on background noise levels (measured or representative)
- Compared noise levels with the recalculated noise limits, including:
  - A comparison of the measured pre-existing industry noise
  - A comparison of the predicted dredging (associated with 'the project') noise
  - A comparison of the revised predicted 'the project' operational noise
  - A comparison of the revised predicted cumulative noise from pre-existing industry noise and 'the project' operational noise.

  Conducted detailed analysis of 'the project' operational noise, including:
  - Operational scenarios (used in the modelling predictions) to determine frequency of activities
  - Noise enhancing weather conditions to determine applicability and likelihood of impacts for GGS and other noise sensitive areas
  - Cross-referenced both operation scenarios and noise enhancing weather conditions to narrow down the percentage of time per year that noise impacts from the project are likely to occur that have the potential to cause an exceedance of the noise limit specifically during the night period.
  - Provided a summary of the assessment and the conclusions reached regarding the noise impacts and the recalculated noise limits.

In accordance with Regulation 119:

> *"If 2 or more commercial, industrial and trade premises (whether existing or proposed) emit, or are likely to emit, noise that contributes to the effective noise level, a person in management or control of one or more of those premises must take all reasonable steps to ensure that the contribution from each premises, when combined, does not exceed the noise limit for the noise sensitive area."*

Renzo Tonin & Associates acknowledges that the project continues to be reviewed and demonstrates that all reasonable steps have been completed such that the noise emissions from the project are reduced as far as reasonably practicable and the noise from the project does not contribute to the effective noise level. The executive summary has been updated summarising this process, with the further attenuation and contingency measures which would ensure that 'project' operational noise levels are maintained within Project Noise Criteria are highlighted in the ANNEXURE.

With consideration to the assessment and the EPA Regulations definition of unreasonable noise, Renzo Tonin & Associates recommends the following project noise criteria:

Location / sensitive receiver location	Project Noise Criteria , L_{eq} dB(A)		
	Day	Evening	Night
Geelong Grammar School	42	38	35
Macgregor Court etc (Lara dwellings)	61	56	45
12 Myrtle Grove (North Shore dwellings)	41	35	30
19 Zinnia St (Norlane dwellings)	44	38	36
365 Princes Hwy (Corio dwellings)	53	45	37
Avalon College	37	37	33

The above table presents the recommended project criteria, where the 'project' noise level is 10dB below the recalculated noise limits. This will ensure that the 'project' does not contribute to the cumulative noise.

4.3.4 Review noise mitigation proposed in EES and recommend measures for the project impacts from dredging & FSRU to maintain levels within noise limits

The noise and vibration mitigation measures originally proposed in the EES Environmental Management Framework were revised throughout the course of the EES Inquiry process. A set of noise and vibration mitigation measures for submission to the IAC was discussed at the pre-hearing expert conclave. These mitigation measures were further refined based on the expert evidence presented during the hearing, including submissions from EPA, with the IAC providing their final recommended mitigation measures in IAC Report No. 2, Appendix G.

The mitigation measures relevant to dredging or operational activities and revised in accordance with recommendations from the pre-hearing expert conclave, EPA submissions and the IAC are provided in Table 17.

As required by Recommendation 10 of the Minister's Directions to undertake further assessment of noise impacts, this supplementary study has completed part 2 of MM-NV05 Regulatory noise limits, pre-existing industry noise and Project Noise Criteria, and therefore those requirements have been deleted from the Supplementary Statement mitigation register (shown as red strikethrough below).

Through the continued implementation of mitigation measure MM-NV05 the noise mitigation and contingency measures described in the annexure to this report will be further refined to ensure that project noise levels are maintained within Project Noise Criteria. Furthermore this study has revisited the assessment of potential noise impacts from dredging in accordance with MM-NV01a. Mitigation measure MM-NV04 contains contingency measures which would ensure that noise levels from dredging are maintained within the noise limits.

Changes to the mitigation measures from those in Appendix G of IAC Report No. 2 are shown in red.

Table 17: EES mitigation measures review

MM ID	Mitigation measures
MM-NV01a	*Managing and assessing dredging noise* Dredging noise must be managed and assessed consistent with EPA Publication 691 (Guidelines for dredging) (as amended or replaced from time to time), assess noise from dredging activities as constituting noise from commercial, industrial and trade premises. A dredging noise management plan (DNMP) will be prepared and implemented that will inform how actions will be taken to: • manage emissions of noise and vibration and minimise their impacts, so far as reasonably practicable, and • prevent the emission of unreasonable noise (as defined In the Environment Protection Act 2017) by: - maintaining dredging noise levels within the Project Noise, to ensure the noise limits set in Part 5.3, Division 3 of the Environment Protection Regulations 2021 are not exceeded; and - having regard to the factors in part (a) of the definition of unreasonable noise; and - managing low frequency noise, in accordance with EPA Publication 1996 (Noise guidelines: assessing low frequency noise) (as amended or replaced from time to time).
MM-NV04	*Construction noise and vibration monitoring* Noise and vibration monitoring will be undertaken during construction at: • The nearest noise sensitive residential property or properties impacted by out-of-hours works to confirm the effective implementation of noise mitigation measures, per their design, and verify that levels set as criteria In the CNVMP are not exceeded • The nearest building or assets that are within derived set back distances for human response or in response to a complaint • •here an asset owner's utility standards are at risk of being exceeded; Frequency & duration (sic) • Attended measurements will be undertaken at the earliest stage (within the first 24 hours) for each construction activity identified to impact sensitive receiver locations during out of hours works • The measurement duration will be adequate to represent a typical 15-minute period for the applicable evening or night period • Continuous monitoring will be undertaken for any works scheduled outside of normal working hours (including unavoidable works) previously measured to be within 3dB or exceeding the low-impact and managed-impact noise levels • For onshore pipeline construction, where the noise sources will be transient, measurements will be required for works at representative sensitive receivers where noise has been identified as a risk. Where noise levels modelled or measured at Geelong Grammar School or at other sensitive receivers, exceed the levels set in the CNVMP (as required in MM-NV01 and MM-NV02) these works will not be carried out other than during normal working hours, unless mitigation measures are applied to meet the requirements of MM-NV01 and MM-NV02 • Measurements shall be undertaken at the commencement of dredging and during meteorological conditions suitable to favourable noise propagation at Geelong Grammar School and other sensitive receivers. Where assessments conducted in accordance with EPA Publication 1826.4 (Noise Protocol) (as amended or replaced from time to time) indicate cumulative noise impacts (including the contributions from dredging, from the Viva Refinery and from other commercial, Industrial or trade premises) will exceed the evening or night period noise limits determined in accordance with the Noise Protocol, dredging operations shall cease during those periods until the relevant period limits are met • Measurements will be undertaken in response to any community complaints, where noise emissions need to be verified to resolve the issue i.e., where the activity cannot simply be stopped or mitigated to avoid the risk due to noise A response plan will be developed to manage potential impacts if construction noise criteria are not met, including: • Actions taken to rectify exceedance of nominated criteria e.g., stop works until noise monitoring confirms the exceedance is resolved or implement mitigation measures to manage impacts • Actions to minimise risk of reoccurrence e.g., provide mitigation measures or alternative methods • Name of person(s) responsible for undertaking the required actions.

MM-NV05	*Establishing and implementing operational noise controls* An operational noise management framework will be prepared that will inform, through all stages of the project, including design, equipment selection, construction, and installation, and operation, how actions will be taken to: • manage emissions of noise and vibration and minimise their impacts, so far as reasonably practicable, and • prevent the contribution of the project to cause cumulative emission of unreasonable noise (as defined In the Environment Protection Act 2017), by - not exceeding the noise limits set In Part 5.3, Division 3 of the Environment Protection Regulations 2021 taking into consideration cumulative noise impacts from existing and approved industrial, commercial and trade premises; and - having regard to the factors in part (a) of the definition of unreasonable noise; and - managing low frequency noise, in accordance with the Noise guidelines: assessing low frequency noise (EPA Publication 1996) (as amended or replaced from time to time). *Plant design and selection* • Ensure, via iterative reviews, that all reasonably practicable opportunities to reduce the emission of operational noise have been considered across the design, construction, and operation of the project • Engage a suitably qualified acoustic consultant to review detailed plant designs and noise emission data for plant and vessels and provide noise mitigation advice • Operational plant selection process must ensure that manufacturers' data or noise measurement data to be verified for all operational equipment to ensure that tonality is not present • Low frequency noise emissions from operational plants, including (but not limited to) the following items, which must be assessed and managed in accordance with EPA Publication 1996 (as amended or replaced from time to time): - LNG carriers - FSRU vessels - Tugboat exhausts - Regasification boilers. *Operational management plan* • Noise from the project will be managed in accordance with the Environment Protection Regulations 2021, EPA Publication 1826 (as amended or replaced from time to time) and the General Environmental Duty, including cumulative noise impacts from any other industrial, commercial or trade premises • Prepare an operational management plan, supported by documented evidence that details the approach that will be taken to meet the project Noise Criteria. This plan should include: - how the noise from LNG carriers will be taken into account and managed: - details of equipment selection~~s~~ and mitigation measures adopted; and - scheduling to ensure all activities minimise noise emissions. For example, during the night period, limit the number of activities operating concurrently. • Review and update the operational management plan wherever necessary and relevant, including on the basis of any noise monitoring carried out to assess noise emissions from the project, cumulative noise impacts or adverse noise character identified • Additional cumulative impact management strategies will be developed in consultation with the relevant stakeholders. *Operational noise monitoring* Operational noise monitoring will be undertaken to confirm operational noise levels and verify cumulative noise impacts. • Within the first 3 months of operation, conduct long-term noise monitoring (over a minimum of 1 month) in accordance with the Noise Protocol and the provisions of EPA Publication 1997 (as amended or replaced from time to time), to verify that the project Noise Criteria and/or regulatory noise limits are not exceeded at Geelong Grammar School and other noise sensitive areas. The measurements shall be undertaken for all operating scenarios to verify the noise emissions • Where operational compliance relies on the ongoing scheduling or managed hours of sources, permanent real-time noise monitoring shall be installed and carried out at any impacted receptors identified during the monitoring undertaken within the first 3 months of operation. Real-time monitoring data shall be made available to those relevant stakeholders

MM ID	Mitigation measures
	• Measurements will also be undertaken as part of the Environmental Management Plan in response to any community complaints • Operational noise monitoring will inform ongoing updates to the operational management plan including potential scheduling of activities and mitigation measures if required • Wherever the noise emissions from the project are measured to exceed the Project Noise Criteria, or the cumulative Industry noise is measured to exceed the regulatory noise limits, additional attenuation and/or management controls shall be implemented, and measurements repeated until compliance is demonstrated • Further noise monitoring should be conducted at least every 6 months to verify the effectiveness of the attenuation and/or management controls to prevent exceedances of the project Noise Criteria and the regulatory noise limits • Where management and scheduling for the operational activities is changed, the risk of exceedance of the project Noise Criteria and the regulatory limits must be assessed, and wherever relevant further noise monitoring must also be conducted to verify compliance.

Renzo Tonin & Associate understands that AECOM has updated the noise modelling (rev G dated 13/08/2024) with refinements to both the operational scenarios and equipment operation/selection, provided in APPENDIX C. These scenarios and associated equipment have been through an iterative process to reflect the actual operational activities that could occur simultaneously, actual equipment operations (such as FSRU engines simultaneously operating is now 3 maximum, not all 4) and design optimisation such as reduction in number or removal of plant items. The updated noise modelling also considered Treatment Facility noise attenuation through further engineering design optimisation.

Renzo Tonin & Associates review of the original EES, including all subsequent updates to the noise modelling, considers the mitigation measures provided to be appropriate. The review process, including consultation with Viva Energy engineers, has highlighted how much effort has been made to reduce noise levels.

4.3.4.1 General Environmental Duty (GED)

In accordance with the General Environmental Duty (GED) all reasonable and feasible measures to reduce noise emissions have been considered for the project regardless of compliance with regulatory noise limits. Table 20 provides a summary of the evaluation of the six factors to be considered when assessing the minimisation of risk so far as reasonably practicable (EPA Publication 1856: Reasonably Practicable).

4.3.4.1.1 Environment Protection Act 2017 (EP Act)

The Environment Protection Act aims to protect Victoria's air, water and land by adopting the 'general environmental duty' (GED) which requires all individuals and businesses to take proactive steps to reduce the risk of harm to human health and the environment from pollution or waste. The Environment Protection Authority administers the Environment Protection Act and subordinate legislation.

Provisions under the Environment Protection Act include the GED and an obligation to not emit or permit to emit 'unreasonable noise'. Meeting the regulatory noise limits does not mean the GED has been met. The GED requires all reasonably practicable steps be taken to eliminate or reduce the risk from noise from the construction and operation of the project. Even if the GED is met, the noise may be unreasonable if it exceeds the noise limits or considering the factors in the definition of unreasonable noise in section 3(1) of the Environment Protection Act.

4.3.4.1.2 EPA Publication 1856 reasonably practicable

EPA Victoria Publication 1856 provides an overview on how to determine and apply what is reasonably practicable under the GED. The following six factors are to be considered:

1. Eliminate risk – consider whether the risk can be eliminated
2. Likelihood of risk – determine how likely it is that harm will occur
3. Degree of harm – determine the severity of harm to human health or the environment
4. Knowledge of the risk – determine what is known and what can be known about the identified risks
5. Availability and suitability – identify available and suitable technology, processes or equipment that may be utilised to control the risk
6. Cost – compare the cost of controls to their effectiveness at reducing the risk

The above factors have been considered when determining proportionate controls to mitigate or minimise the risk of harm due to operational noise.

4.3.4.2 Assessment of reasonably practicable mitigation measures (EPA Publication 1856)

Several noise mitigation measures have been considered for the project proposed operations. Table 18 presents the assessment of these measures to determine proportionate controls to mitigate or minimise the risk of harm from noise.

Table 18: Assessment of reasonably practicable mitigation

Mitigation measure	Factor (per EPA 1856)	Commentary on practicability	Commentary on effectiveness	Mitigation measure adopted?
Perimeter noise walls or noise mounds	Elimination	Not possible	Low The distance between noise sources, the site perimeter and sensitive receivers results in perimeter barriers being ineffective at reasonable heights (e.g. up to 6m), plus the impracticability of barriers at the pier.	No
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge	High		
	Availability/ suitability	Low		
	Cost	Very high		
Sheds for noisy activities	Elimination	Not possible	Low Sheds are very effective at containing noise, particularly from high noise impact activities, however due to the gaseous products conveyed within the project, location of equipment in sheds will create confined environments and increase process and personal safety issues for operations and maintenance activities. Additionally contributing noise sources are widely distributed making enclosure sizes impractical	No
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge	High		
	Availability/ suitability	Low		
	Cost	High		
Localised noise wall / barrier for noisy equipment/ activities	Elimination	Not possible	Medium Localised noise walls/barriers have been implemented into the noise modelling predictions at the Treatment Facility, where they are effective at reducing the overall noise emissions from the external valves and pumps.	Yes Updated modelling has incorporated attenuation of noise from the Treatment Facility into the predictions
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge	High		
	Availability/suitability	High		
	Cost	Moderate		
Treatment Facility noise attenuation	Elimination	Not possible	Low Noise modelling predictions have confirmed reduced noise emissions through attenuating the noise from the flow of gas through the pipeline.	Yes Updated modelling has incorporated the attenuation of noise from the pipeline into the predictions.
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge	High		
	Availability/suitability	High		
	Cost	High		
Scheduling of noisy operations	Elimination	Not possible	Potentially High The project would be a 24/7 operation. Scheduling to avoid the concurrence of multiple noisy activities could potentially be highly effective however there are other considerations such as shipping logistics and safety of port operations.	Under consideration. Please refer to the annexure.
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge	Moderate		
	Availability/suitability	Low		
	Cost	Low		
Quieter equipment	Elimination of risk	Not possible	Low Exchanging for equipment or design from alternate suppliers is not anticipated to make a material difference to the equipment types and noise generated.	No Equipment selection is based on criteria including equipment suitability, vendor
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge of risk	High		

Mitigation measure	Factor (per EPA 1856)	Commentary on practicability	Commentary on effectiveness	Mitigation measure adopted?
	Availability/suitability	Low		performance and experience, and time frames for delivery. Noting that in accordance with MM-NV05 noise emissions (including noise character e.g. tonality and the frequency spectrum e.g., low frequency noise) would be a consideration in equipment selection.
	Cost	High		
Site orientation	Elimination of risk	Not possible	Low Due to the physical constraints of working on a pier, and the distance between the noise sources and the nearest sensitive receiver is greater compared to any benefits in exact location of the project footprint. Therefore, altering the layouts to reduce noise would not lead to an appreciable reduction at the receiver.	No
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge of risk	High		
	Availability/suitability	Low		
	Cost	High		
Site location	Elimination of risk	Not possible	Potentially high However, the location of the project is dictated by factors other than noise.	No Whilst factors other than noise dictated the site selection, location considerations did include that the location is within a heavily developed port and industrial area.
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge of risk	High		
	Availability/suitability	Low		
	Cost	Very High		
Quieter tug boats	Elimination of risk	Not possible	Moderate	Yes Please refer to the annexure.
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge of risk	High		
	Availability/suitability	High		
	Cost	Very High		
Localised physical attenuation, enclosures/ barriers	Elimination of risk	Not possible	High	Yes Please refer to the annexure.
	Likelihood	Low		
	Degree/consequence	Low		
	Knowledge of risk	High		
	Availability/suitability	High		
	Cost	Moderate		

5 Integrated assessment

For context the IAC found the following with respect to Operational Noise:

"The operational noise modelling has been undertaken to an acceptable level for this stage of the project and appears to show that the operational noise effects of the project will be able to be managed to an acceptable level.

The above finding is contingent on further assessment of background and cumulative noise with the Refinery and other industrial sources and the assessment in future of the actual FSRU and the project components."

This Supplementary Statement therefore focuses on Item 2 in MM-NV05 Regulatory noise limits, pre-existing industry noise and the project Noise Criteria which addresses the further assessment of noise impacts set out in the Minister's Directions. Specifically Item 2 includes the three points for further assessment work noted by the IAC namely characterisation of the pre-existing noise environment, determination of appropriate noise limits and demonstration of compliance with those noise limits and the GED.

The EES concluded the following:

- Predicted noise levels from dredging would not exceed the established (operational) noise limits at any noise sensitive area during daytime, evening or night-time periods
- Predicted noise levels from all modelled operational scenarios would not exceed the established noise limits at any noise sensitive area during daytime, evening or night-time periods
- Predicted cumulative noise levels from existing industries and the modelled 'worst case' operational scenario could exceed the established noise limits at some noise sensitive areas during the night-time period but this would be avoided through scheduling of night-time operational activities, noting that standard weather conditions or noise enhancing weather conditions were not reported separately in the EES, only the highest noise level was reported.

In order to further assess the project's noise impacts as required by the Minister's Directions, a number of sections of EES Technical Report I: Noise and vibration impact assessment were revisited in this supplementary study, namely:

- Section 5 Existing conditions (in particular Section 5.3 Unattended noise monitoring and Section 5.4 Attended noise and vibration measurements (with respect to noise measurements only)) which contained details of the measured background and ambient noise levels at noise sensitive areas
- Section 6.11 Dredging works (in particular Section 6.11.3 Predicted noise levels and 6.11.4 Discussion of noise impacts) which contained the established noise limits and an assessment of potential operational noise impacts from dredging at noise sensitive areas
- Section 7 Operational impact assessment (in particular Section 7.1 Operational noise criteria, Section 7.4 Predicted operational noise levels and Section 7.5 Cumulative operational noise impacts) which contained the established noise limits and an assessment of potential noise impacts at noise sensitive areas.

This supplementary noise impact assessment provides an updated assessment of the project's operational noise impacts. Conclusions reached following consideration of the results of the additional noise measurements and updated assessment are provided in Sections 4 of this supplementary study report.

This further work concluded the following:

- Dredging
  - Consistent with the findings of the original EES, predicted dredging noise levels would not exceed the recalculated (operational) noise limits at any noise sensitive receivers under neutral and noise enhancing weather conditions during daytime, evening or night-time periods.
  - Cumulative noise levels (i.e. dredging noise levels combined with pre-existing industry noise levels) are predicted to be at or below the recalculated noise limits at all sensitive receivers, under neutral and noise enhancing weather conditions for the day period. During the evening and night, cumulative noise levels at all sensitive receivers are predicted to be at or below noise limits under neutral or noise enhancing weather conditions. There is a cumulative exceedance of the evening and night time limits under noise enhancing weather conditions at GGS sensitive receiver, and a cumulative exceedance of the night time limit under noise enhancing weather conditions at North Shore and Corio sensitive receivers.
  - Management and mitigation measures, consistent with those in the original EES, have been proposed to reduce the risk of unreasonable noise due to cumulative impacts during the evening and at night and in noise enhancing weather conditions.
- 'Project' operations
  - Consistent with the findings of the original EES, predicted operational noise levels would not exceed the recalculated noise limits at any noise sensitive receiver under neutral and noise enhancing weather conditions during daytime, evening and night-time periods.
  - Cumulative noise levels (i.e. 'the project' noise levels combined with pre-existing industry noise levels) are predicted to be within recalculated regulatory noise limits, at all sensitive receivers under neutral and noise enhancing weather conditions during the day and evening periods.
  - Under noise enhancing weather conditions cumulative noise levels are predicted to exceed the night time noise limits at two noise sensitive receivers GGS and North Shore dwellings. The cumulative noise exceedance is predicted to be up to 3dB (i.e. a just perceptible change in apparent loudness to the human ear, noting that changes in the character of the noise or its frequency spectrum may result in a more discernible change).
  - Further analysis of the predicted cumulative noise level exceedance showed that, consistent with the original EES, it is very unlikely that the project would contribute to the cumulative exceedance due primarily to the very infrequent occurrence of the noisiest scenarios. Potential cumulative noise impacts in noise enhancing weather conditions could be avoided through the implementation of contingency measures i.e., scheduling of operational activities to avoid the concurrence of all project activities at night.

6 Conclusion

Further work to assess project noise impacts has been undertaken as required by Recommendation 10 of the Minister's Directions.

A comprehensive noise measurement campaign was undertaken to further assess background noise and pre-existing noise from industrial, commercial and trade premises including the Geelong refinery. Regulatory noise limits were recalculated based on the results of the noise monitoring.

Predicted noise from dredging (extracted from the EES noise study) is at or below the recalculated noise limits at all sensitive receivers.

Predicted cumulative noise levels from pre-existing and dredging noise are at or below the recalculated noise limits at all sensitive receivers, under neutral and noise enhancing weather conditions for the day period. During the evening and night, cumulative noise levels at all sensitive receivers are predicted to be at or below noise limits under neutral weather conditions. At GGS there is a cumulative exceedance of the evening and night time limits under noise enhancing weather conditions and at North Shore and Princes Highway dwellings there is a cumulative exceedance of the night time limits under noise enhancing weather conditions.

The short duration of the dredging campaign, the infrequent occurrence of noise propagating weather events and the small increase in noise level would mean potential cumulative noise impacts would be temporary in nature and limited in time. However, to reduce as far as reasonably practicable the risk of unreasonable noise due to cumulative impacts Viva Energy would implement contingency measures as per mitigation measure MM-NV04 which states:

> *"Measurements shall be undertaken at the commencement of dredging and during meteorological conditions suitable to favourable noise propagation at Geelong Grammar School and other sensitive receivers. Where assessments conducted in accordance with EPA Publication 1826.4 (Noise Protocol) (as amended or replaced from time to time) indicate cumulative noise impacts (including the contributions from dredging, from the Viva Refinery and from other commercial, Industrial or trade premises) will exceed the evening or night period noise limits determined in accordance with the Noise Protocol, dredging operations shall cease during these periods until the relevant period limits are met"*

Noise emissions from the 'project' operations are within recalculated noise limits.

Cumulative noise levels (pre-existing industry + 'project' operations) are predicted to be at or below recalculated noise limits under neutral and noise enhancing weather conditions during the day and evening.

Pre-existing industry noise levels exceed the night period noise limit under noise enhancing weather conditions at three locations. Accordingly, this supplementary noise study predicted a cumulative noise exceedance of up to 3dB, a just perceptible change in apparent loudness to the human ear, at two locations GGS and North Shore dwellings, although changes in the character of the noise or its frequency spectrum may result in a more noticeable change. While the 'project' potentially contributes to the predicted night time cumulative noise impact at these locations, these operational scenarios

occur very infrequently and are of short duration meaning any potential contribution of the project to the cumulative noise impact would occur very infrequently and be short term.

With consideration to the assessment and the EPA Regulations definition of unreasonable noise, Renzo Tonin & Associates recommends the following Project Noise Criteria:

Location / sensitive receiver location	Project Noise Criteria, L_{eq} dB(A)		
	Day	Evening	Night
Geelong Grammar School	42	38	35
Macgregor Court etc (Lara dwellings)	61	56	45
12 Myrtle Grove (North Shore dwellings)	41	35	30
19 Zinnia St (Norlane dwellings)	44	38	36
365 Princes Hwy (Corio dwellings)	53	45	37
Avalon College	37	37	33

The above table presents the recommended project criteria, where the 'project' noise level would be 10dB below the recalculated noise limits. This will ensure that the 'project' does not contribute to the cumulative noise.

The ANNEXURE contains a detailed analysis of noise attenuation and contingency measures. Consistent with the requirements of mitigation measure MM-NV05 the ANNEXURE describes the iterative review of all reasonably practicable opportunities to reduce operational noise emissions and demonstrates that compliance with the proposed Project Noise Criteria is able to be achieved.

Continued implementation of mitigation measure MM-NV05 will ensure that noise emissions from project operational activities are managed such that Project Noise Criteria are met and the project does not contribute to cumulative noise impacts.

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment Point	A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of common sounds in our daytime environment:

threshold of hearing	0 dB	The faintest sound we can hear
	10 dB	Human breathing
almost silent	20 dB	
	30 dB	Quiet bedroom or in a quiet national park location
generally quiet	40 dB	Library
	50 dB	Typical office space or ambience in the city at night
moderately loud	60 dB	CBD mall at lunch time
	70 dB	The sound of a car passing on the street
loud	80 dB	Loud music played at home
	90 dB	The sound of a truck passing on the street
very loud	100 dB	Indoor rock band concert
	110 dB	Operating a chainsaw or jackhammer
extremely loud	120 dB	Jet plane take-off at 100m away
threshold of pain	130 dB	
	140 dB	Military jet take-off at 25m away

dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz) but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch, and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.

L_{max}	The maximum sound pressure level measured over a given period.
L_{min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Noise enhancing weather conditions	Weather effects, that is wind and temperature inversions, that increase noise at sensitive areas (weather conditions favourable to sound propagation).
NSA	Noise Sensitive Area means: the part of the land within the apparent boundaries of any piece of land which is within a distance of 10 metres outside the external wall of a residential building
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L_{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Background noise monitoring

B.1 Instrumentation

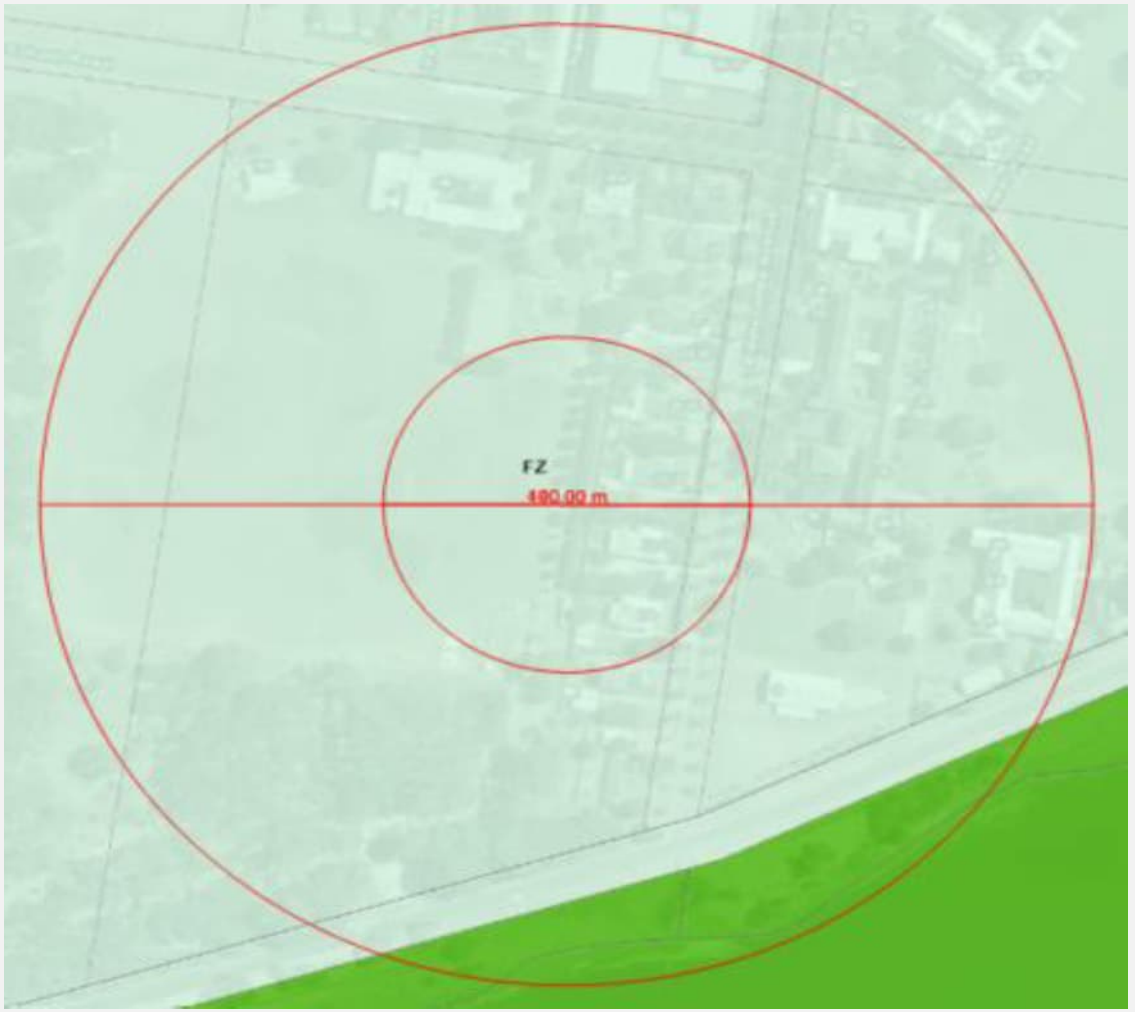
The instrumentation used for the background noise monitoring is summarised below. All equipment was calibrated in accordance with the relevant standards at the time of the measurements.

A Brüel & Kjær Calibrator (S/N 3001565) was used for field verification, with all noise monitors calibrating to 94 dB(A) ± 0.5 dB using a 94 dB at 1kHz reference tone at the start and end of each measurement.

Location ID	Make/model	Serial number (S/N)	Laboratory calibration expiry
EX1	NTi Audio XL2	A2A-18460-E0	28/10/2022
EX2	NTi Audio XL2	A2A-14499-E0	18/01/2023
EX3	NTi Audio XL2	A2A-11158-E0	16/03/2023
EX4	NTi Audio XL2	A2A-16449-E0	09/08/2022
BG1	NTi Audio XL2	A2A-06378-E0	29/08/2022
BG2	NTi Audio XL2	A2A-10987-E0	24/03/2022
BG3	NTi Audio XL2	A2A-15751-E0	05/09/2023
BG4	NTi Audio XL2	A2A-18302-E0	08/12/2022
BG5	NTi Audio XL2	A2A-19144-E0	01/02/2024
BG6	NTi Audio XL2	A2A-16552-E0	06/02/2024
BG7	NTi Audio XL2	A2A-20041-E0	16/02/2024
BG8	NTi Audio XL2	A2A-08520-E0	18/08/2023

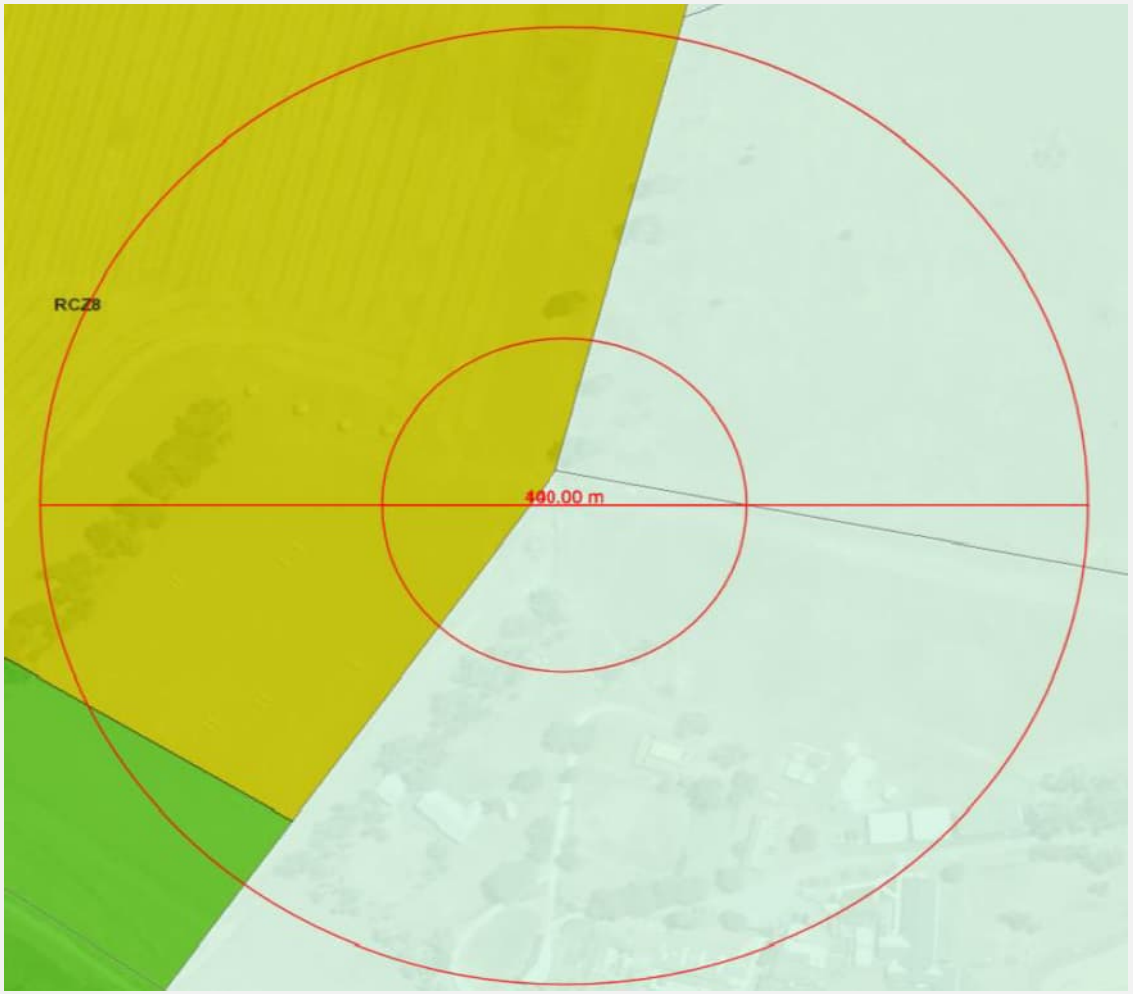
B.2 Calculating background noise levels (including zoning)

Address			
BG1 Geelong Grammer School (Oval)			
Measured Background			
Day	**Evening**	**Night**	
39	39	38	
Influencing Factor Calculations			
140m diameter circle		**400m diameter circle**	
Area type 3:	0	Area type 3:	0
Area type 2:	15394	Area type 2:	118156
Total area:	15394	Total area:	125664
Partial influencing factor:	0.25	Partial influencing factor:	0.24
Influencing factor		0.49	
Zoning Noise Level			
Day	**Evening**	**Night**	
59	52	47	
Classification			
Day	**Evening**	**Night**	
Low background	Low background	Neutral	
Project Noise Limits			
Day	**Evening**	**Night**	
54	49	47	

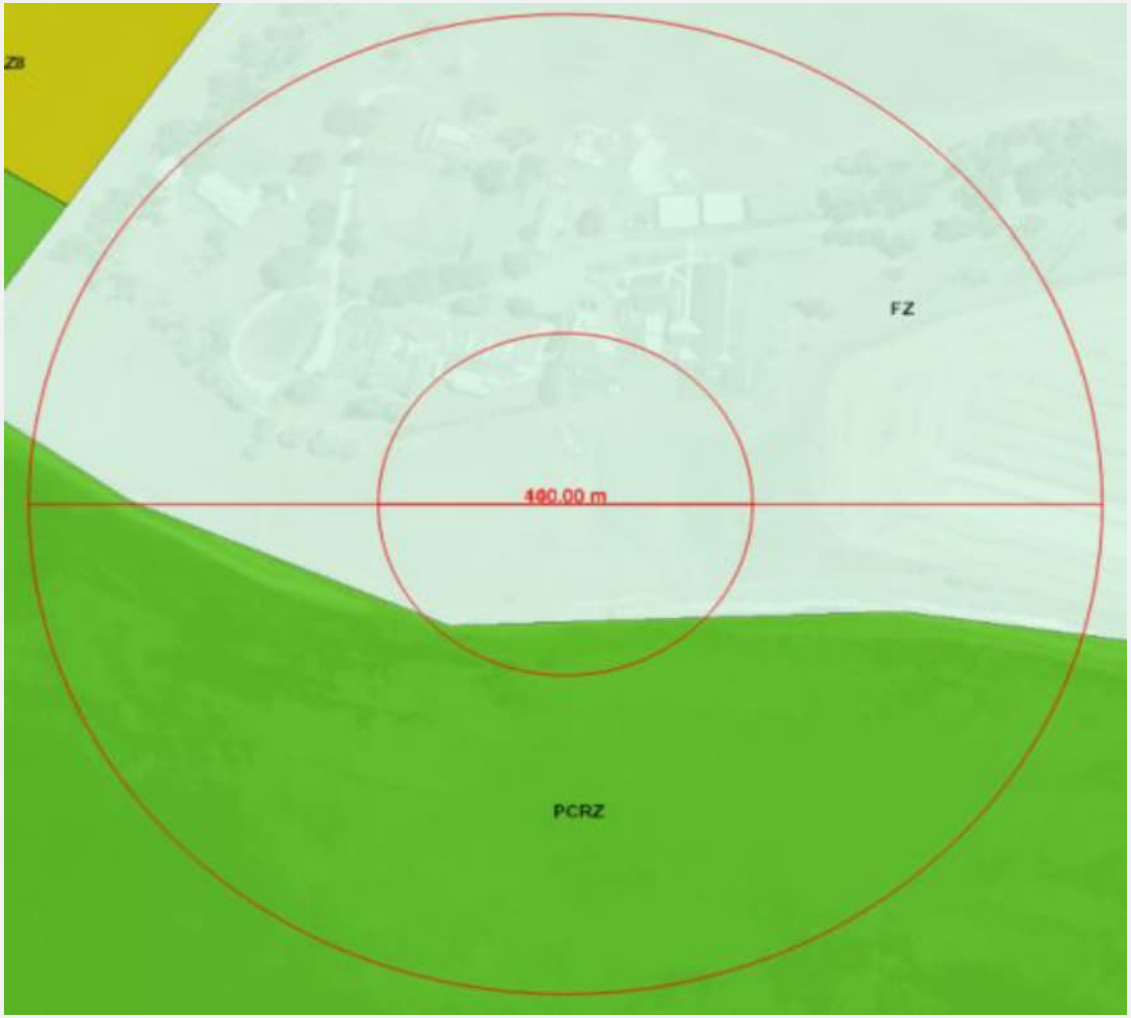


Address			
BG2 Geelong Grammer School (Hermitage garden)			
Measured Background			
Day	**Evening**	**Night**	
39	39	38	
Influencing Factor Calculations			
140m diameter circle		**400m diameter circle**	
Area type 3:	0	Area type 3:	0
Area type 2:	12115	Area type 2:	72650
Total area:	15394	Total area:	125664
Partial influencing factor:	0.20	Partial influencing factor:	0.14
Influencing factor		0.34	
Zoning Noise Level			
Day	**Evening**	**Night**	
56	50	45	
Classification			
Day	**Evening**	**Night**	
Low background	Low background	Neutral	
Project Noise Limits			
Day	**Evening**	**Night**	
52	48	45	

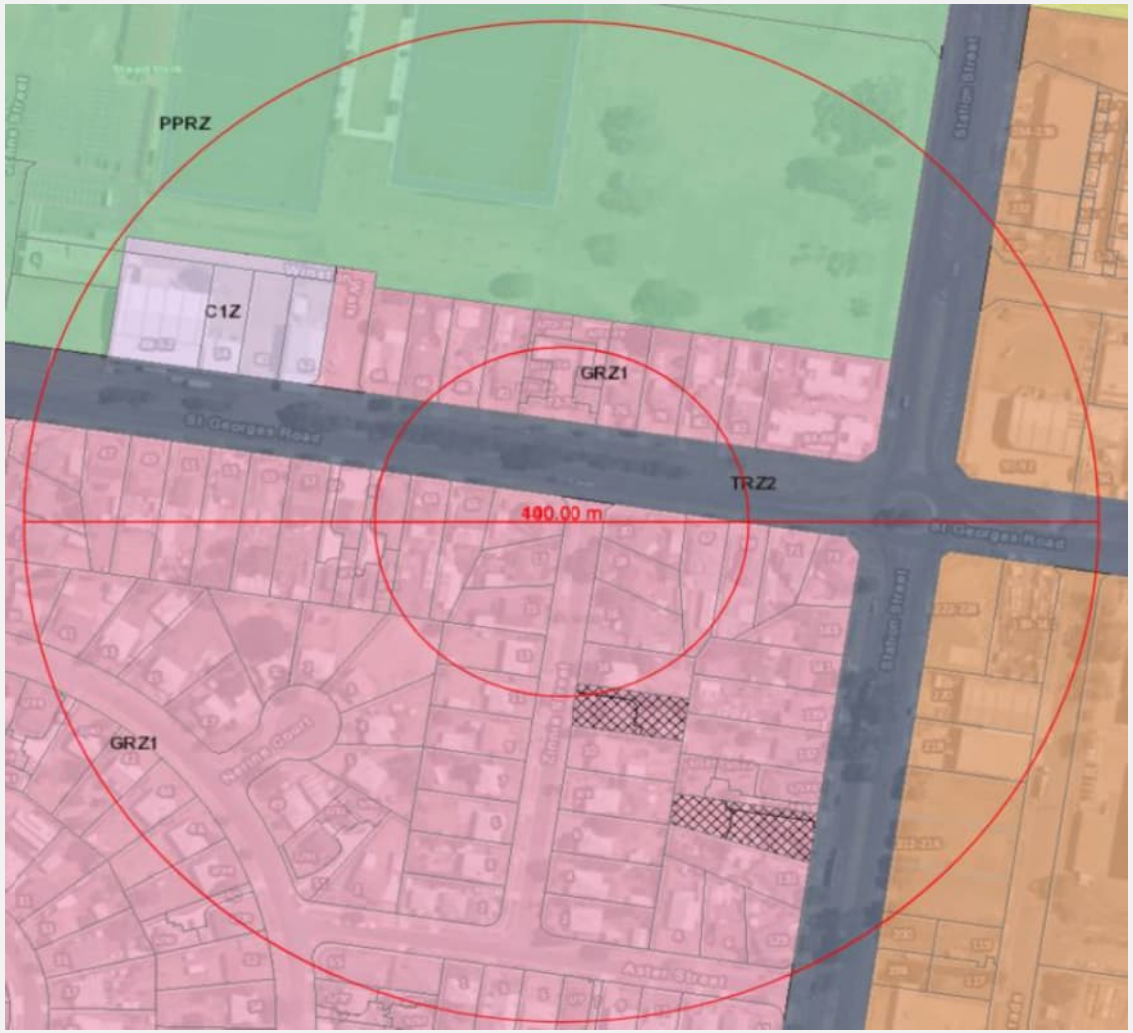
Address			
BG3 Avalon College (North)			
Measured Background			
Day	**Evening**	**Night**	
41	37	38	
Influencing Factor Calculations			
140m diameter circle		**400m diameter circle**	
Area type 3:	0	Area type 3:	0
Area type 2:	9574	Area type 2:	72650
Total area:	15394	Total area:	125664
Partial influencing factor:	0.16	Partial influencing factor:	0.14
Influencing factor		0.30	
Zoning Noise Level			
Day	**Evening**	**Night**	
55	49	44	
Classification			
Day	**Evening**	**Night**	
Low background	Low background	Neutral	
Project Noise Limits			
Day	**Evening**	**Night**	
53	46	44	



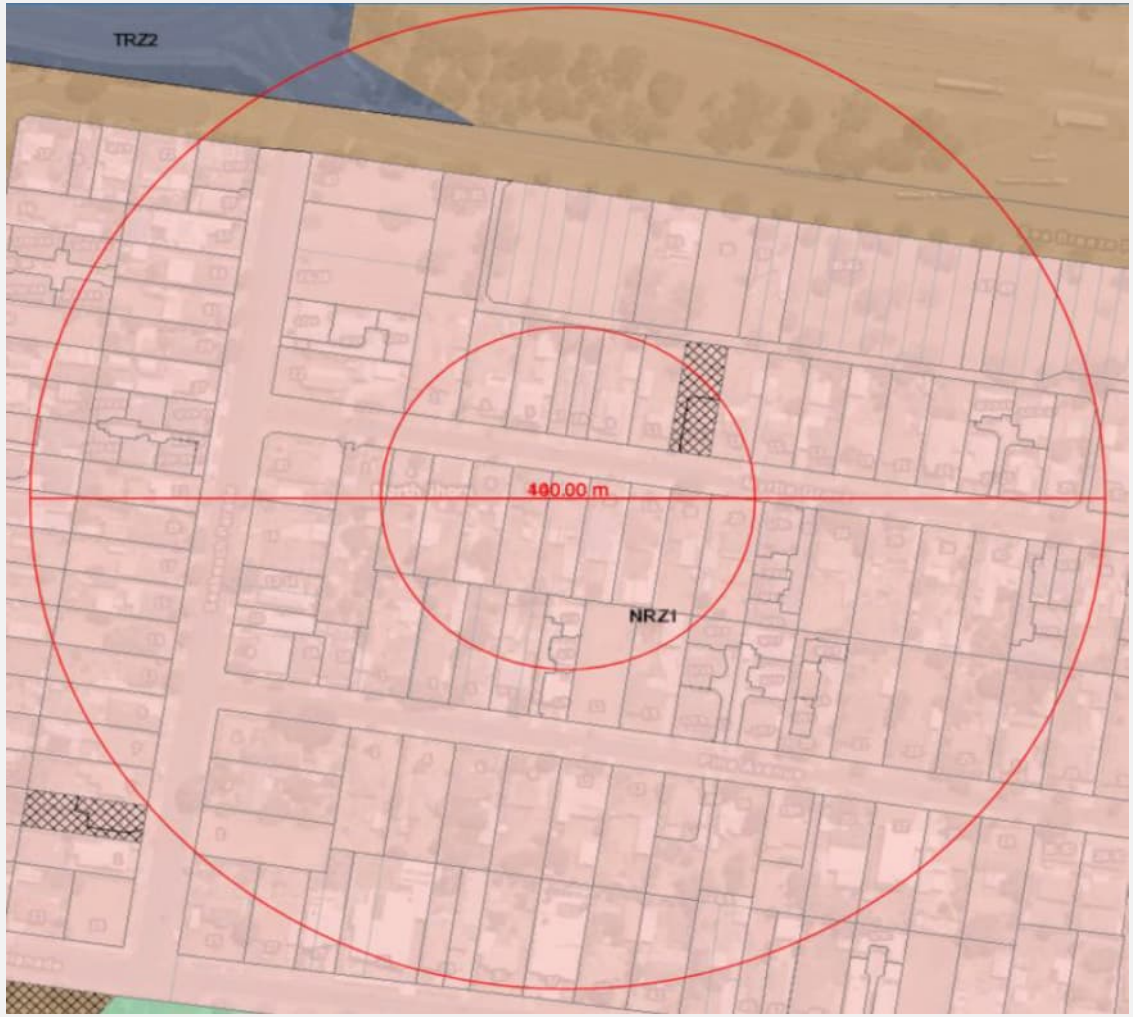
Address			
BG4 Avalon College (South)			
Measured Background			
Day	**Evening**	**Night**	
39	39	38	
Influencing Factor Calculations			
140m diameter circle		**400m diameter circle**	
Area type 3:	0	Area type 3:	0
Area type 2:	13971	Area type 2:	76964
Total area:	15394	Total area:	125664
Partial influencing factor:	0.23	Partial influencing factor:	0.15
Influencing factor		0.38	
Zoning Noise Level			
Day	**Evening**	**Night**	
57	50	45	
Classification			
Day	**Evening**	**Night**	
Low background	Low background	Neutral	
Project Noise Limits			
Day	**Evening**	**Night**	
53	48	45	



Address			
BG5 Resident (19 Zinnia Street, Norlane VIC 3214)			
Measured Background			
Day	**Evening**	**Night**	
46	43	43	
Influencing Factor Calculations			
140m diameter circle		**400m diameter circle**	
Area type 3:	3895	Area type 3:	20231
Area type 2:	0	Area type 2:	3825
Total area:	15394	Total area:	125664
Partial influencing factor:	0.13	Partial influencing factor:	0.09
Influencing factor		0.21	
Zoning Noise Level			
Day	**Evening**	**Night**	
54	48	43	
Classification			
Day	**Evening**	**Night**	
Neutral	Neutral	High background	
Project Noise Limits			
Day	**Evening**	**Night**	
54	48	46	

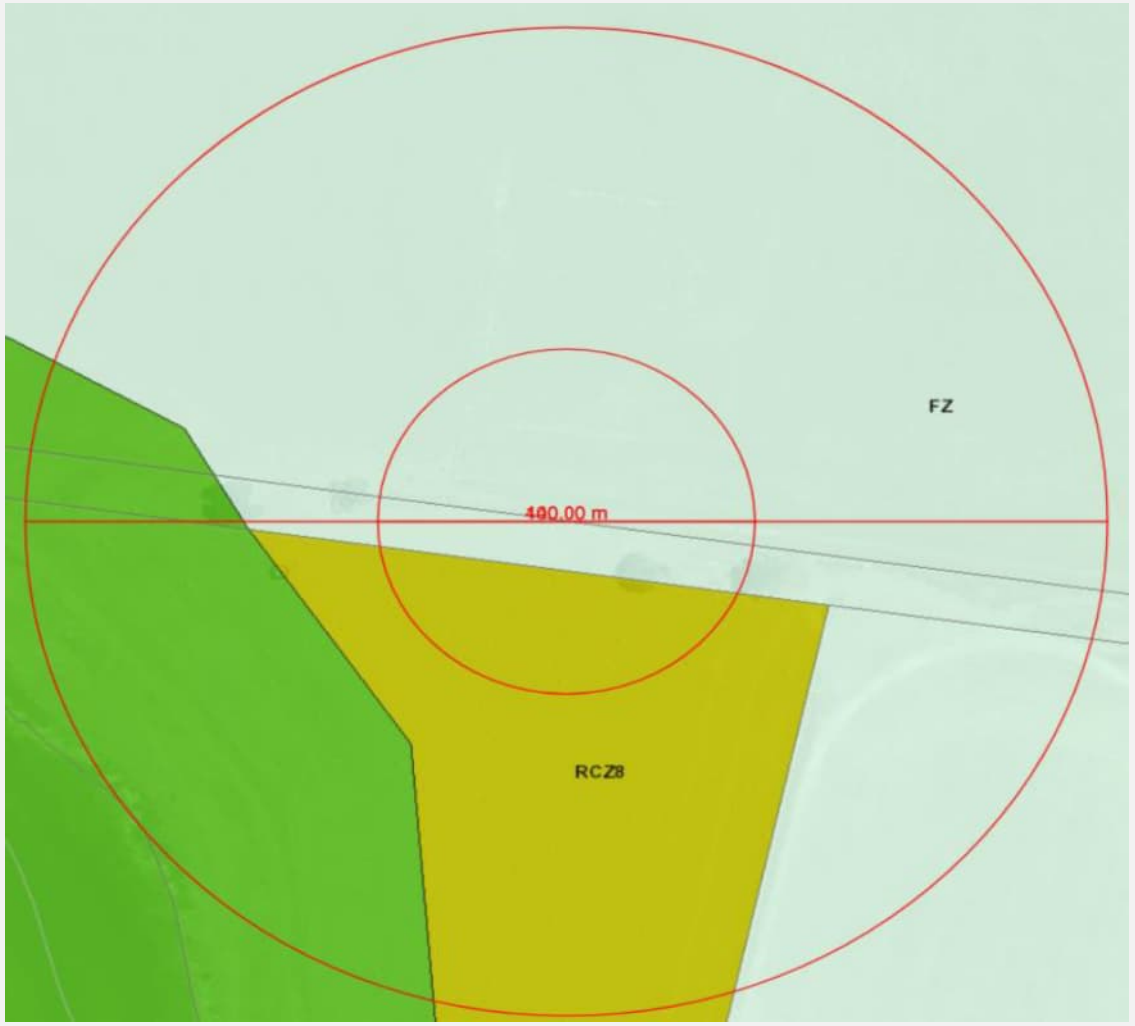


Address			
BG6 Resident (12 Myrtle Grove, North Shore VIC 3214)			
Measured Background			
Day	**Evening**	**Night**	
40	39	35	
Influencing Factor Calculations			
140m diameter circle		**400m diameter circle**	
Area type 3:	0	Area type 3:	18408
Area type 2:	0	Area type 2:	0
Total area:	15394	Total area:	125664
Partial influencing factor:	0.00	Partial influencing factor:	0.07
Influencing factor		0.07	
Zoning Noise Level			
Day	**Evening**	**Night**	
51	45	40	
Classification			
Day	**Evening**	**Night**	
Neutral	Neutral	Neutral	
Project Noise Limits			
Day	**Evening**	**Night**	
51	45	40	



Address			
BG7 Resident (36 Walker Street, Rippleside VIC 3215)			
Measured Background			
Day	**Evening**	**Night**	
40	39	35	
Influencing Factor Calculations			
140m diameter circle		**400m diameter circle**	
Area type 3:	0	Area type 3:	142
Area type 2:	0	Area type 2:	5423
Total area:	15394	Total area:	125664
Partial influencing factor:	0.00	Partial influencing factor:	0.01
Influencing factor		0.01	
Zoning Noise Level			
Day	**Evening**	**Night**	
50	44	39	
Classification			
Day	**Evening**	**Night**	
Neutral	Neutral	Neutral	
Project Noise Limits			
Day	**Evening**	**Night**	
50	44	39	

Address			
BG8 Farm land (240 Avalon Road, Avalon VIC 3212)			
Measured Background			
Day	**Evening**	**Night**	
39	38	35	
Influencing Factor Calculations			
140m diameter circle		**400m diameter circle**	
Area type 3:	0	Area type 3:	0
Area type 2:	10311	Area type 2:	80877
Total area:	15394	Total area:	125664
Partial influencing factor:	0.17	Partial influencing factor:	0.16
Influencing factor		0.33	
Zoning Noise Level			
Day	**Evening**	**Night**	
56	50	45	
Classification			
Day	**Evening**	**Night**	
Low background	Low background	Low background	
Project Noise Limits			
Day	**Evening**	**Night**	
52	47	43	

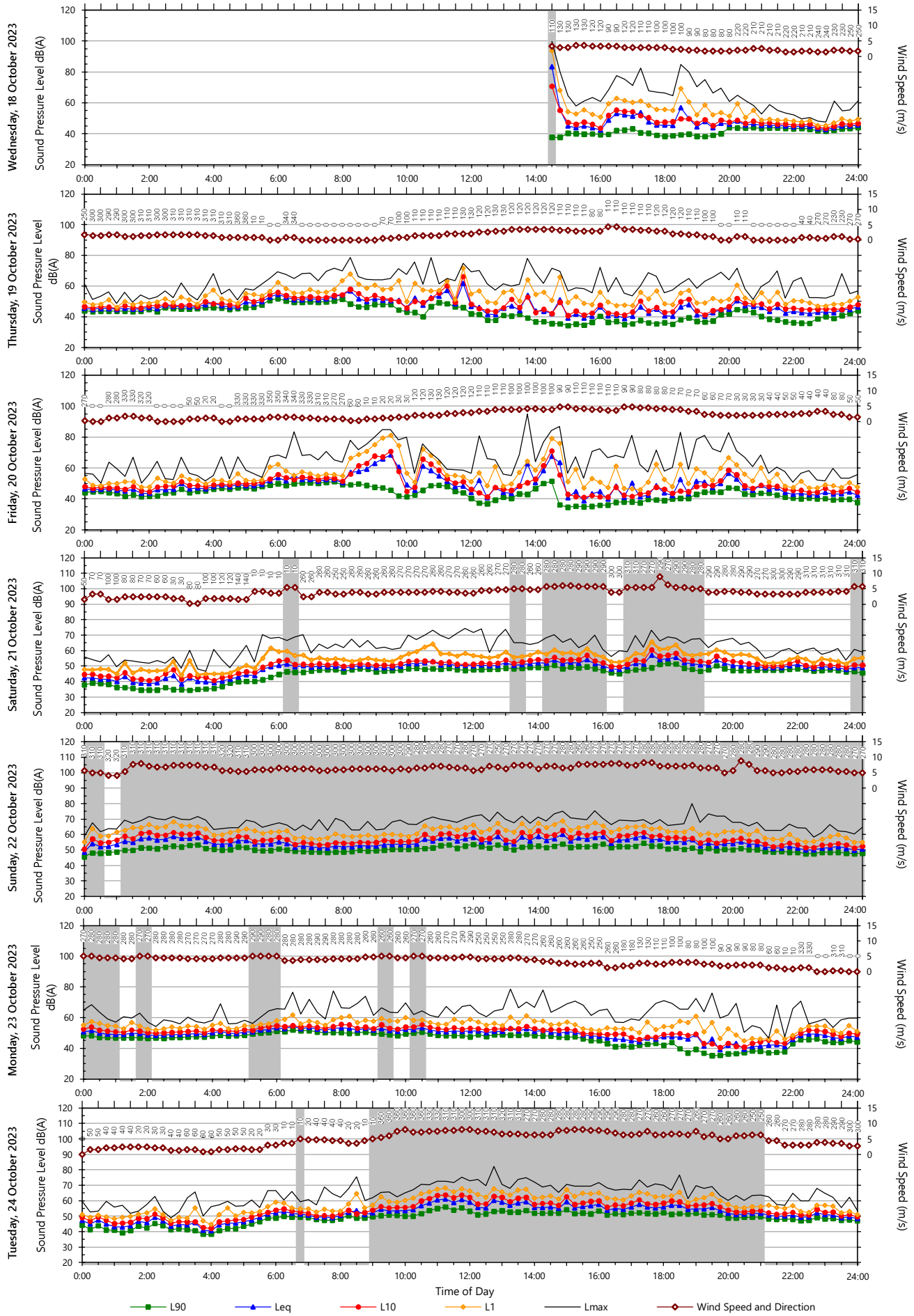


B.3 Background noise monitoring (All descriptors)

Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations and referenced from Bureau of Meteorology Avalon Airport Weather Station.

Unattended Monitoring Results

Location: BG1 - Geelong Grammer School (Oval) - Free Field

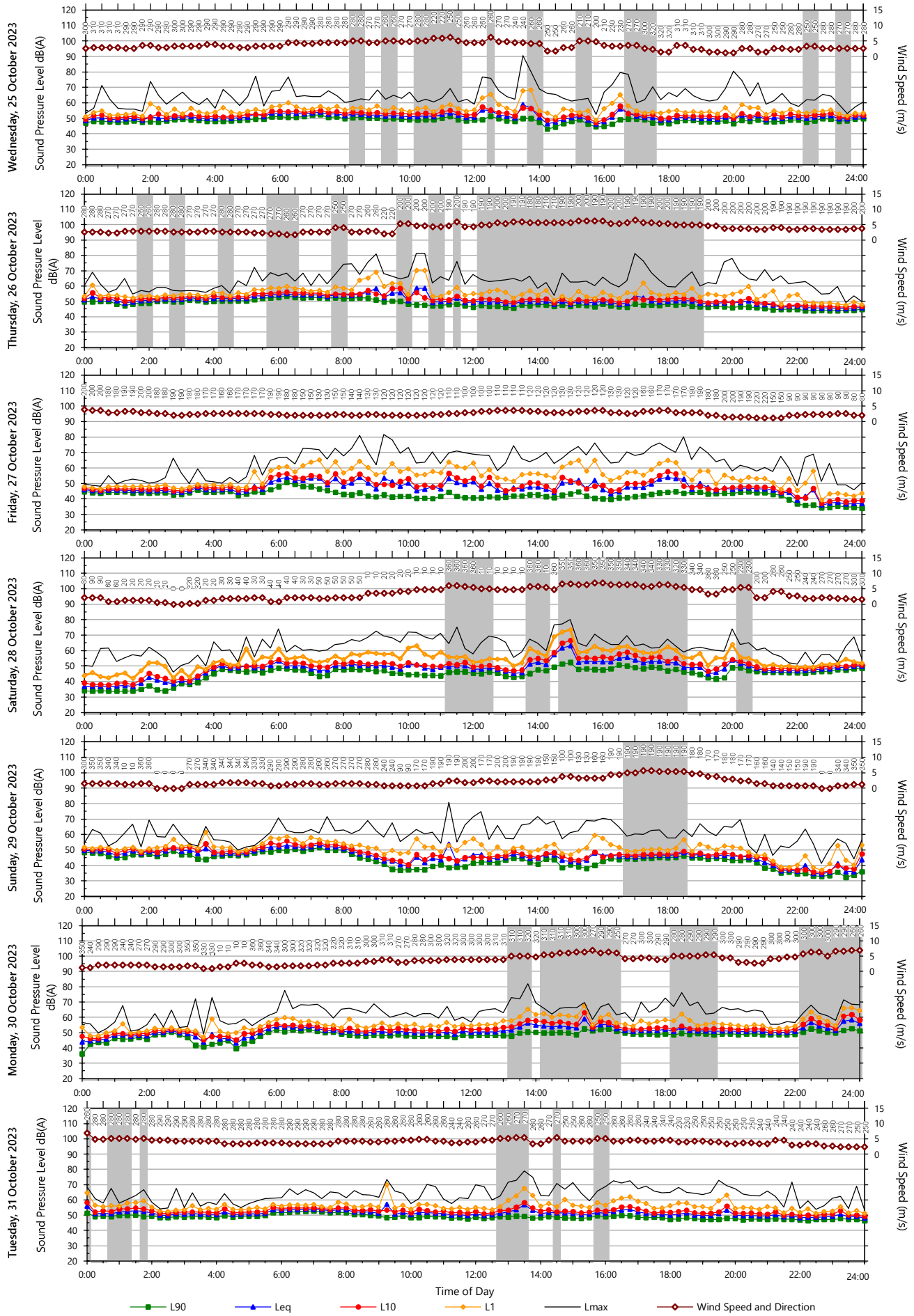


Data File: 2023-10-18_SLM_001_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG1 - Geelong Grammer School (Oval) - Free Field

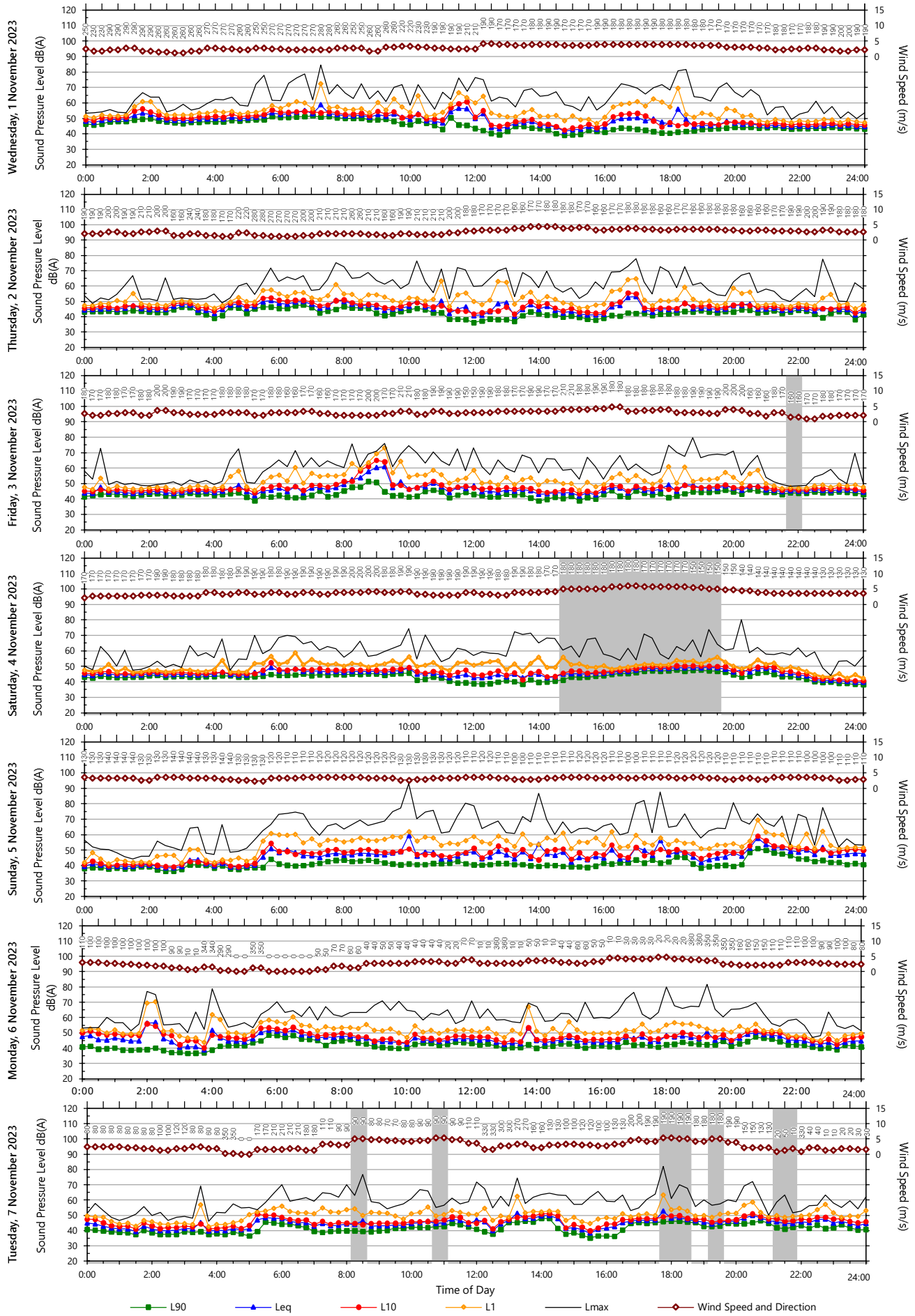


Data File: 2023-10-18_SLM_001_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG1 - Geelong Grammer School (Oval) - Free Field



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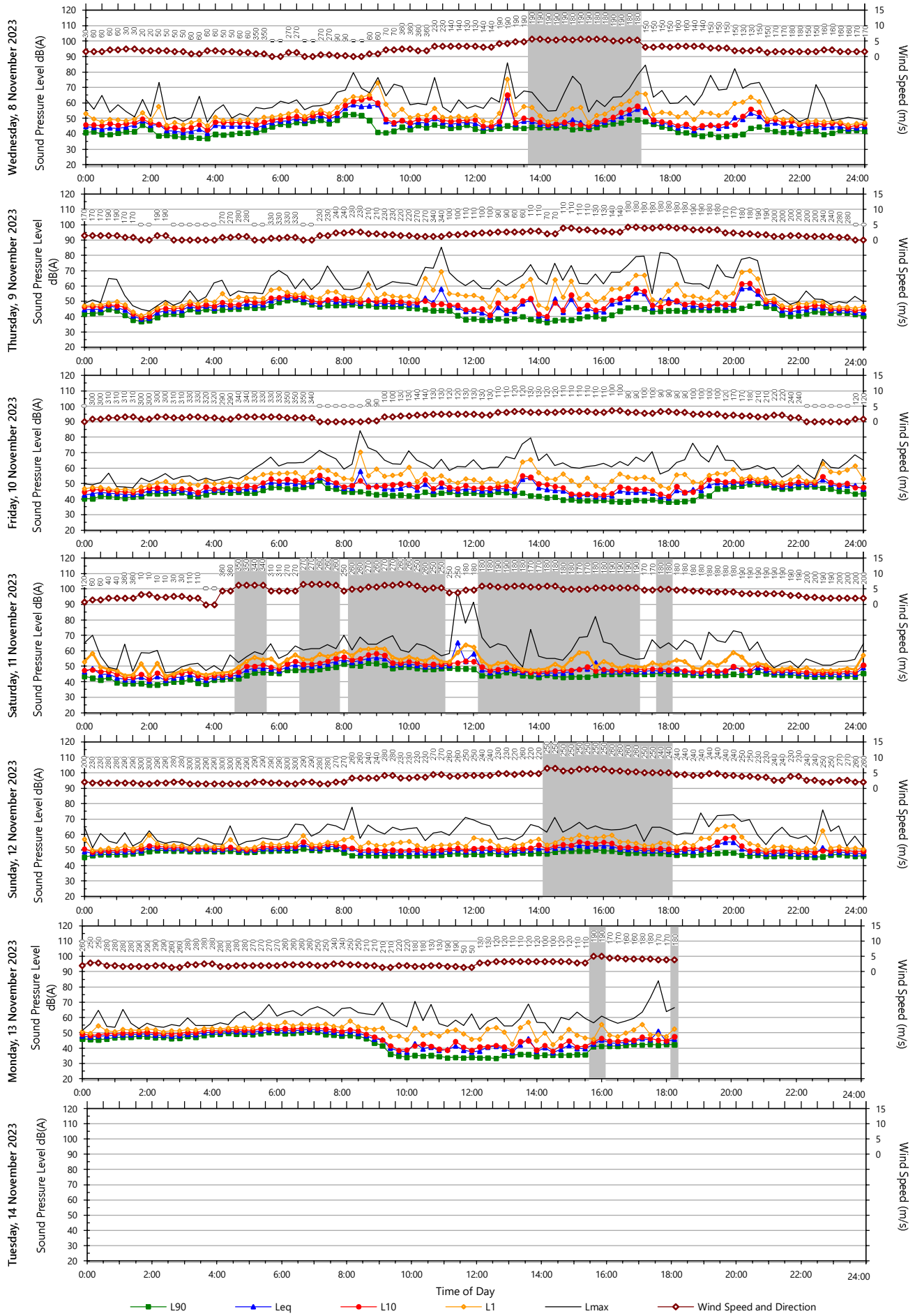
Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG1 - Geelong Grammer School (Oval) - Free Field

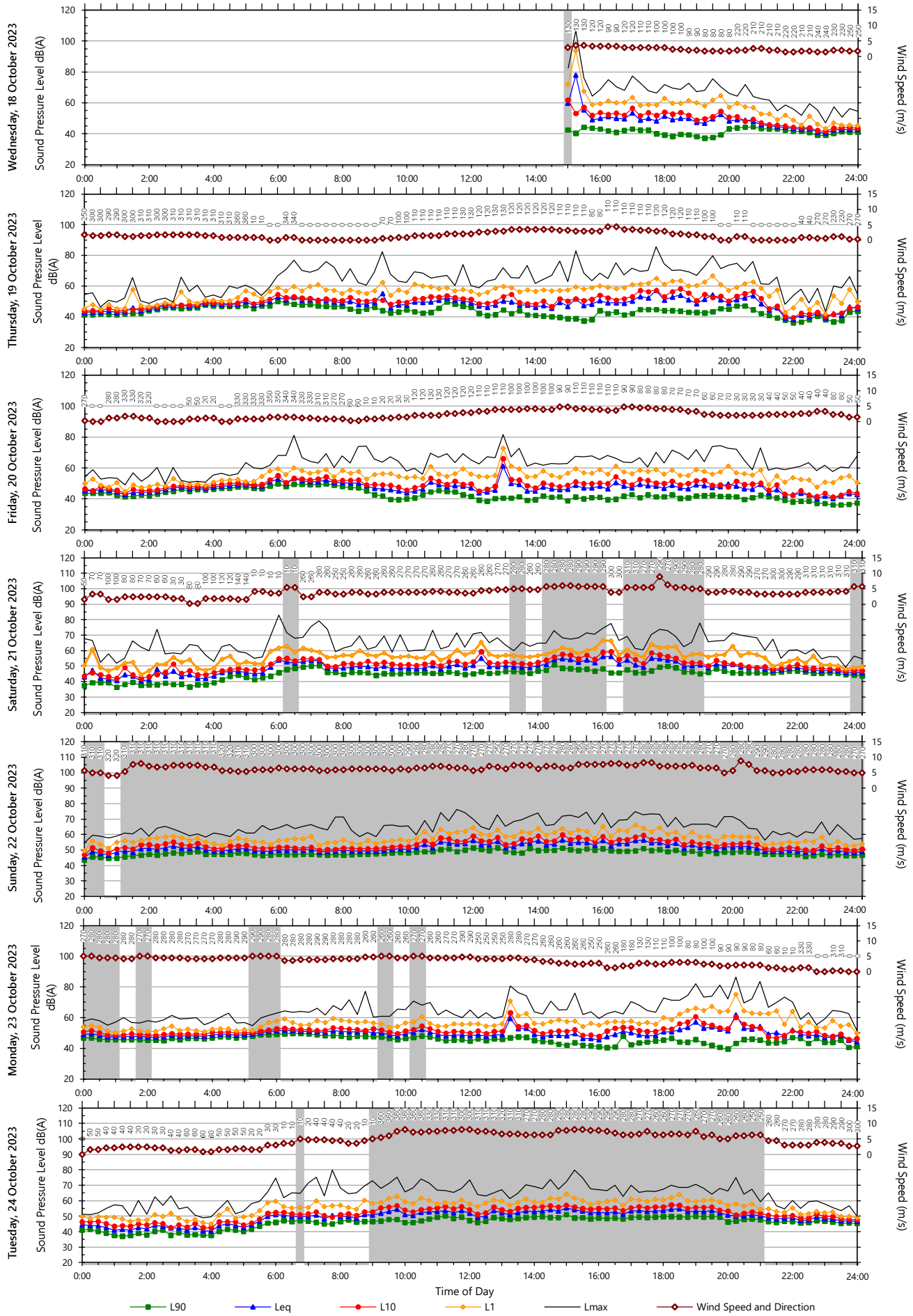


Data File: 2023-10-18_SLM_001_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG2 - Geelong Grammer School (Hermitage garden) - Free Field



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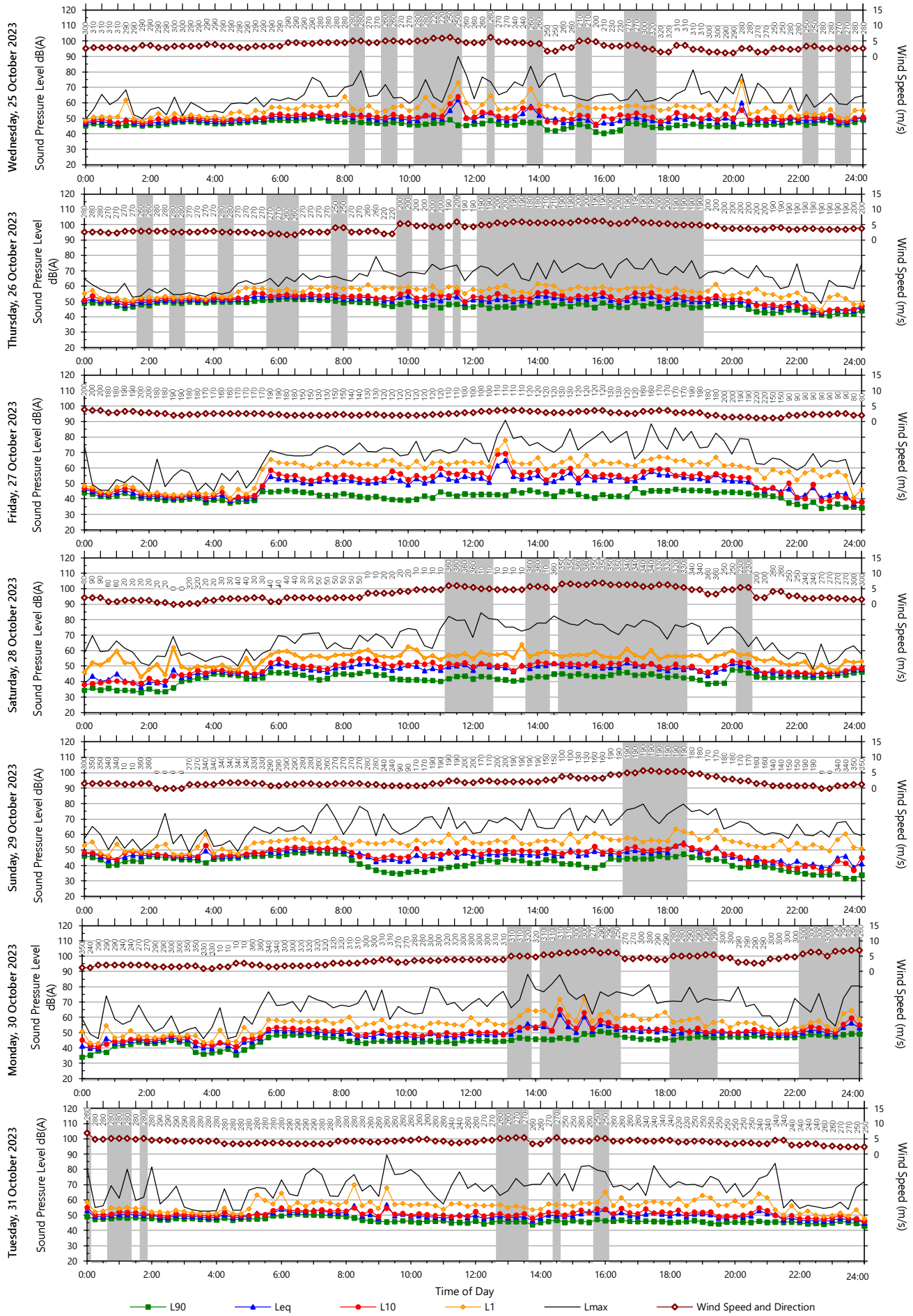
Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG2 - Geelong Grammer School (Hermitage garden) - Free Field



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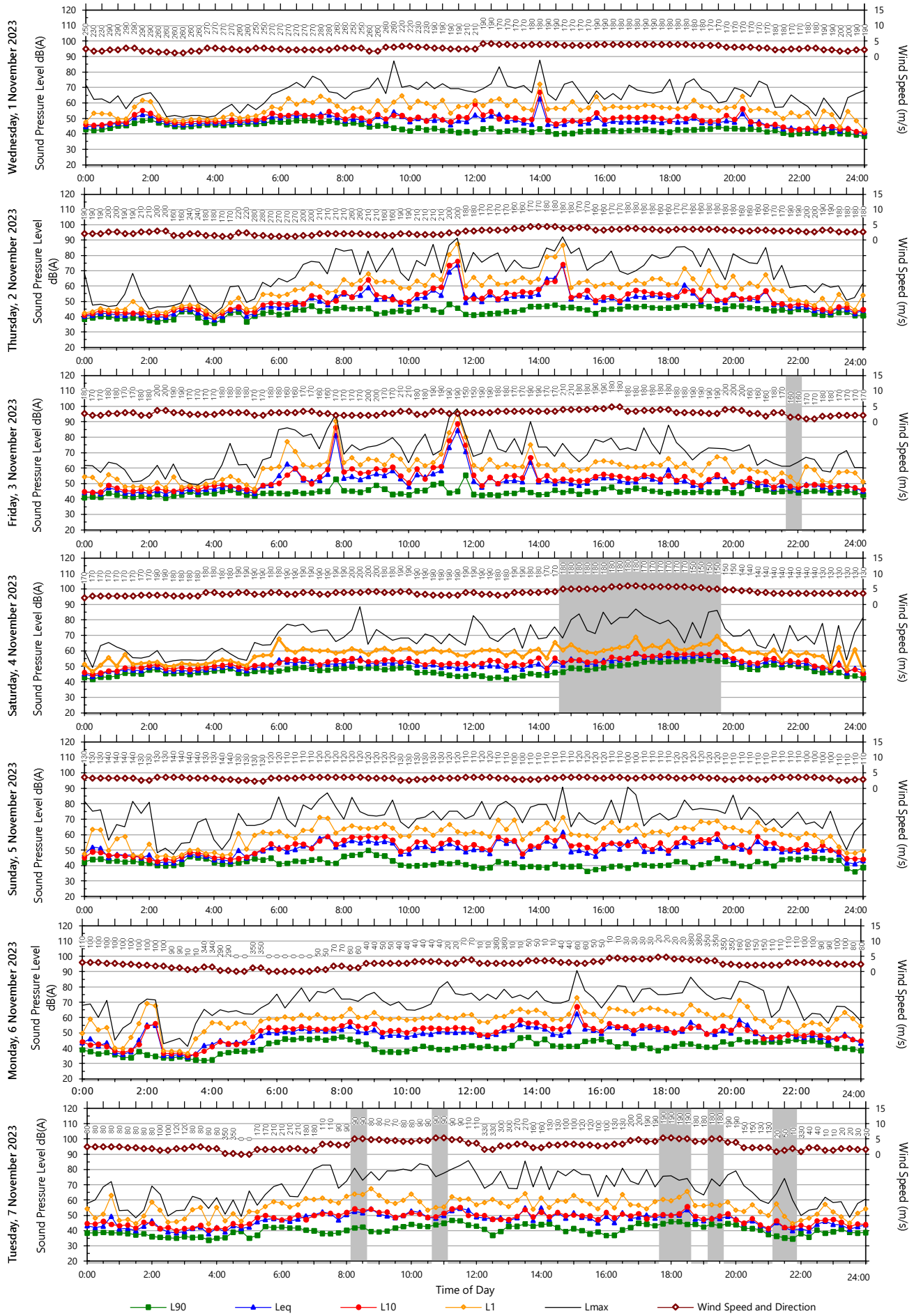
Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG2 - Geelong Grammer School (Hermitage garden) - Free Field



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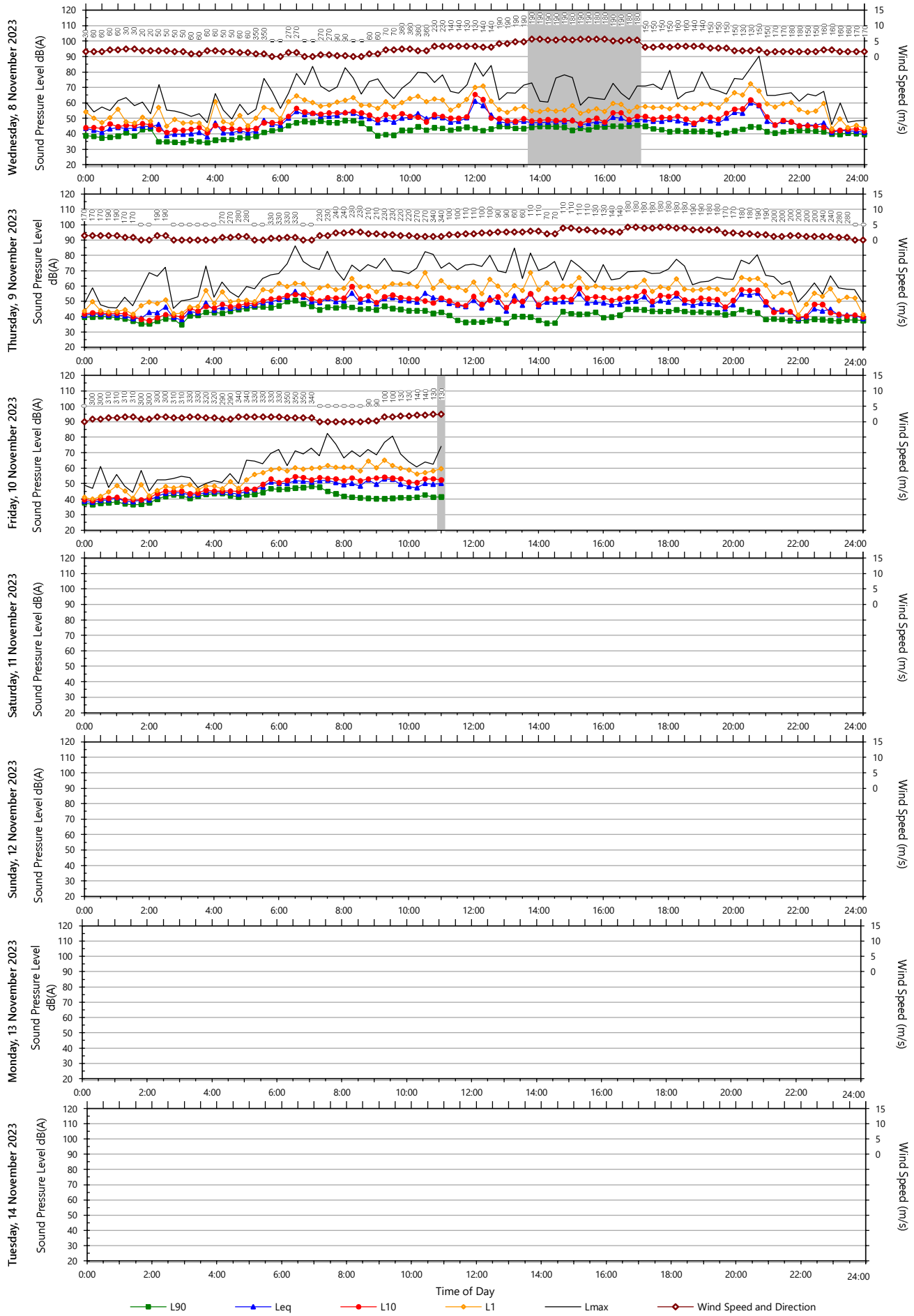
Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG2 - Geelong Grammer School (Hermitage garden) - Free Field

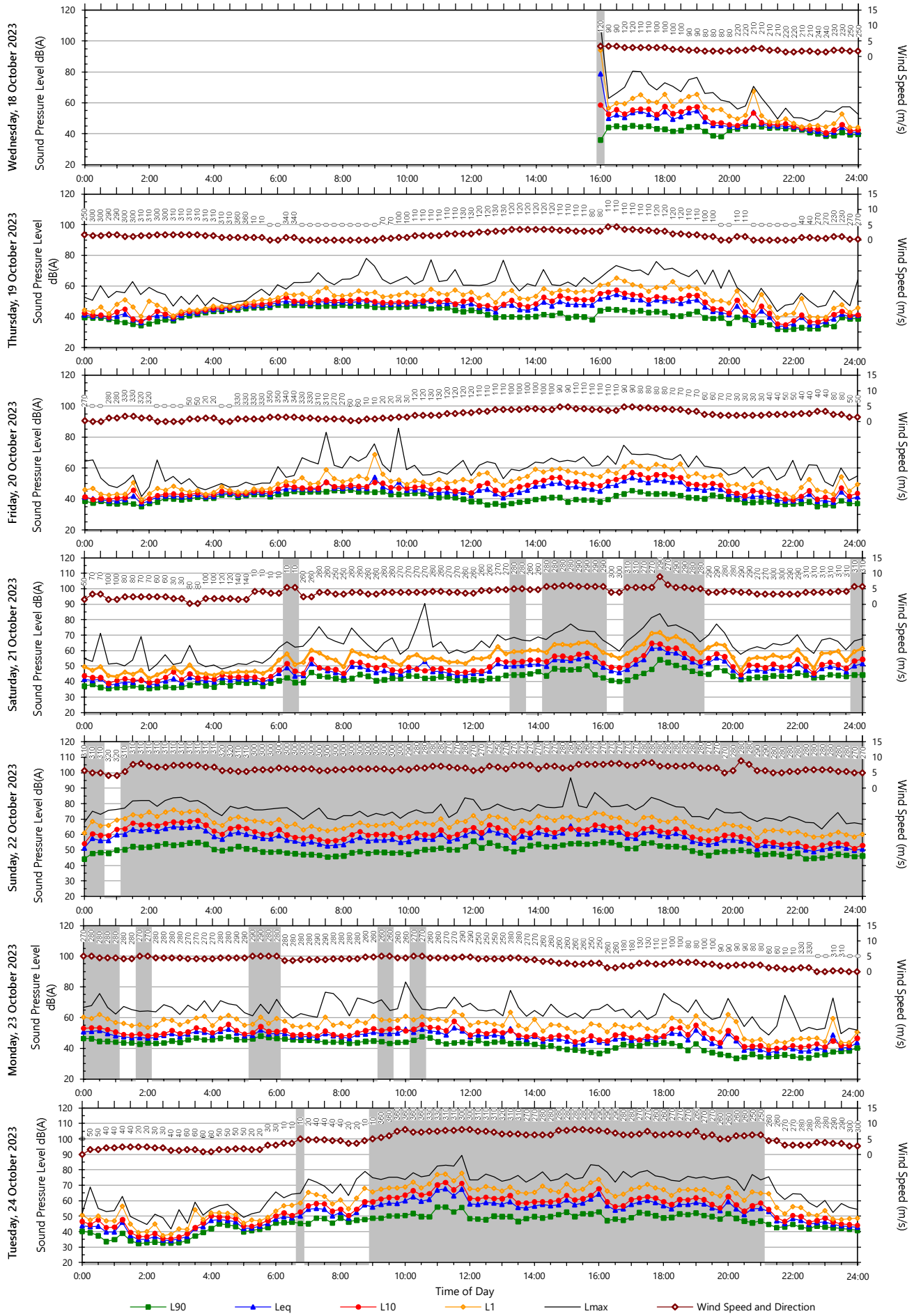


Data File: 2023-10-18_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG3 - Avalon College (North) - Free Field



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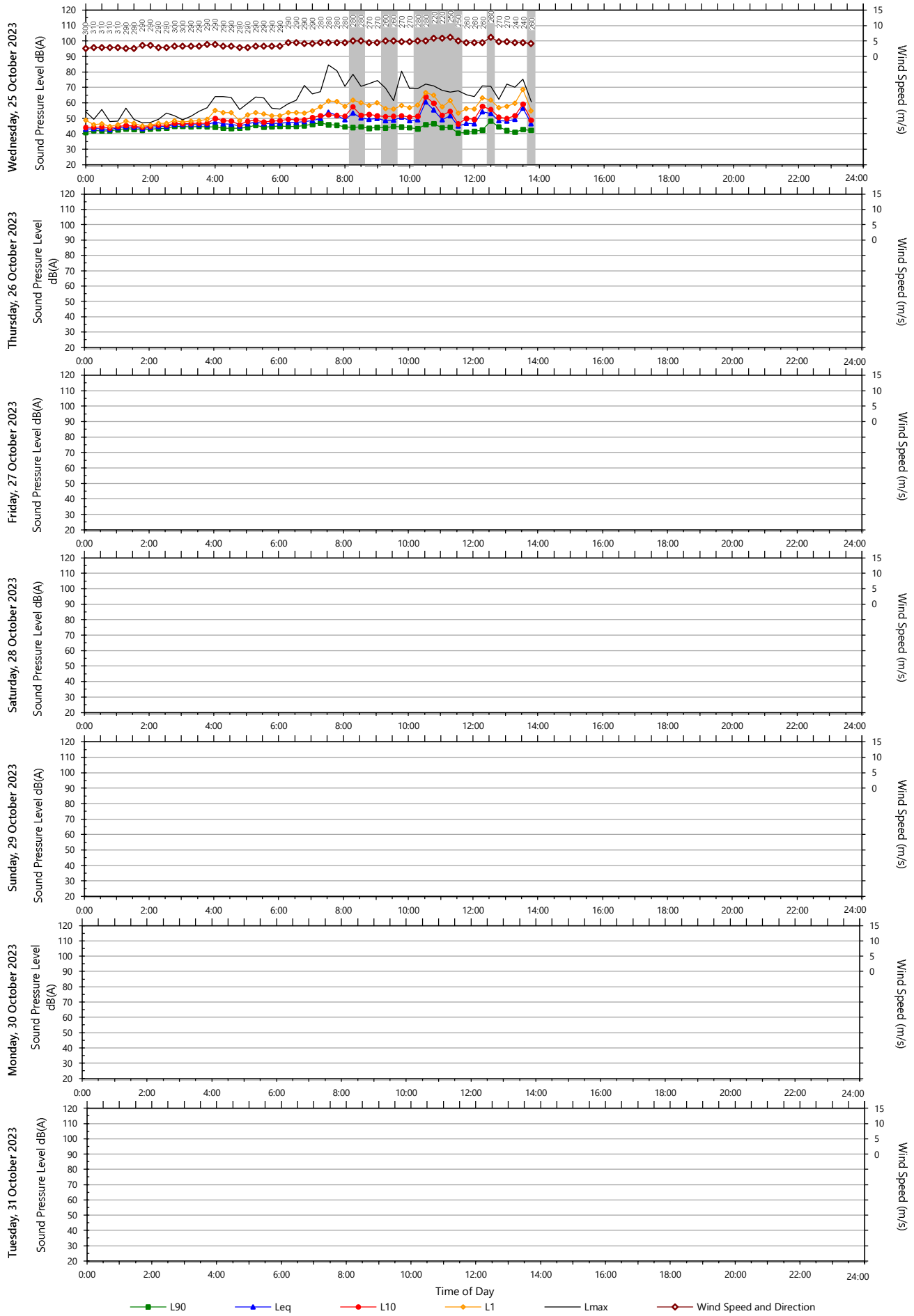
Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG3 - Avalon College (North) - Free Field

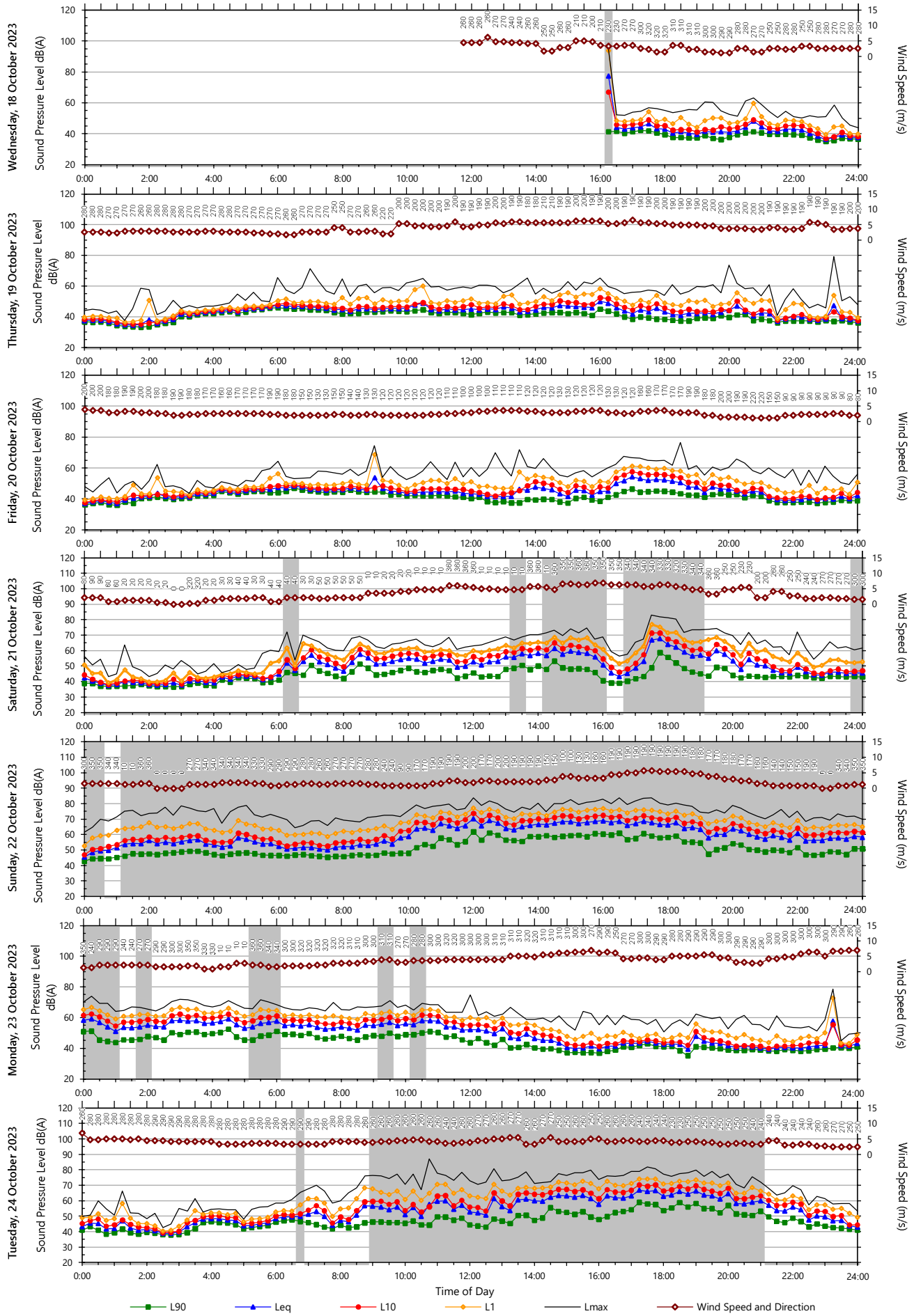


Data File: 2023-10-18_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG4 - Avalon College (South) - Free Field

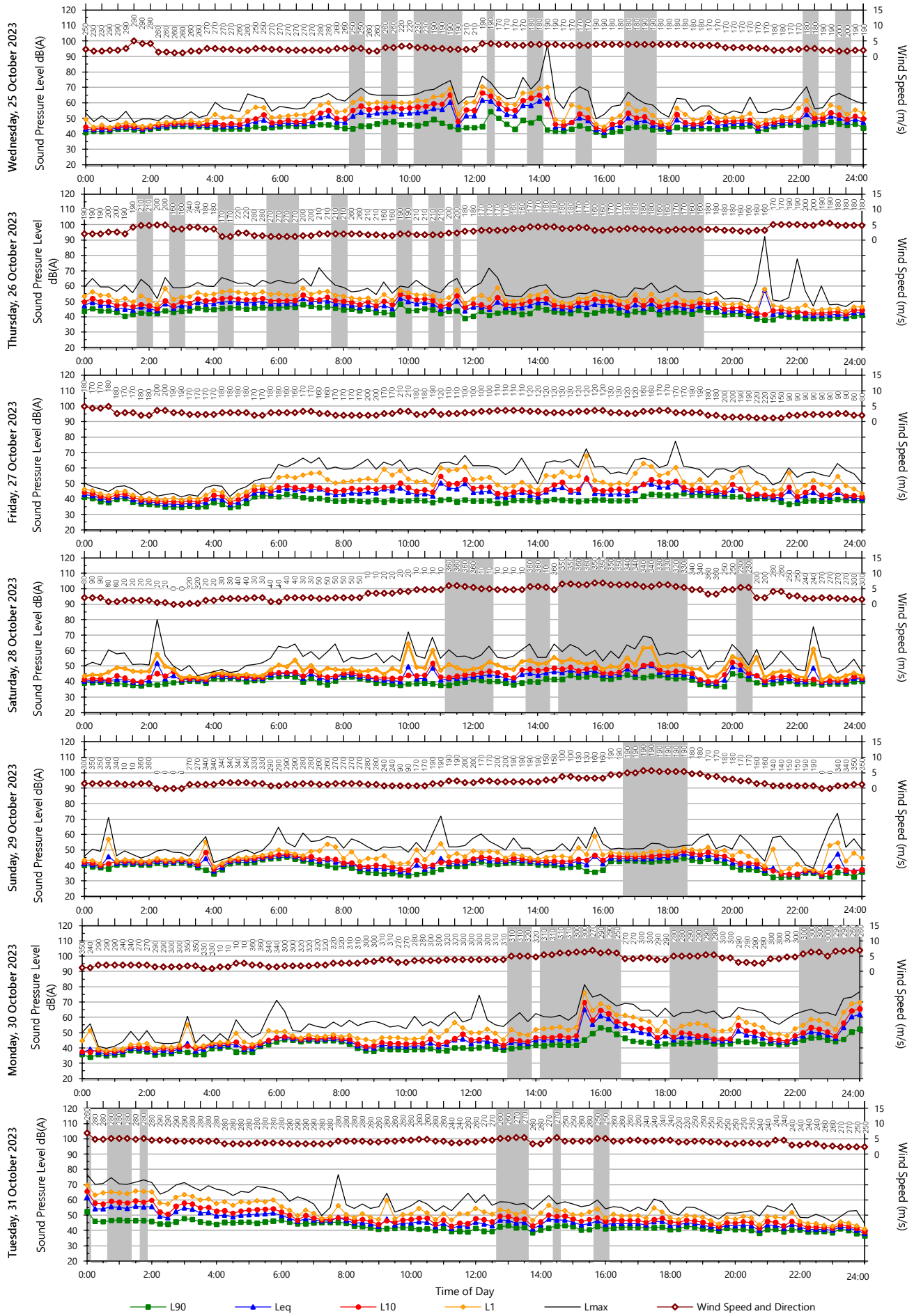


Data File: 2023-10-18_SLM_002_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG4 - Avalon College (South) - Free Field

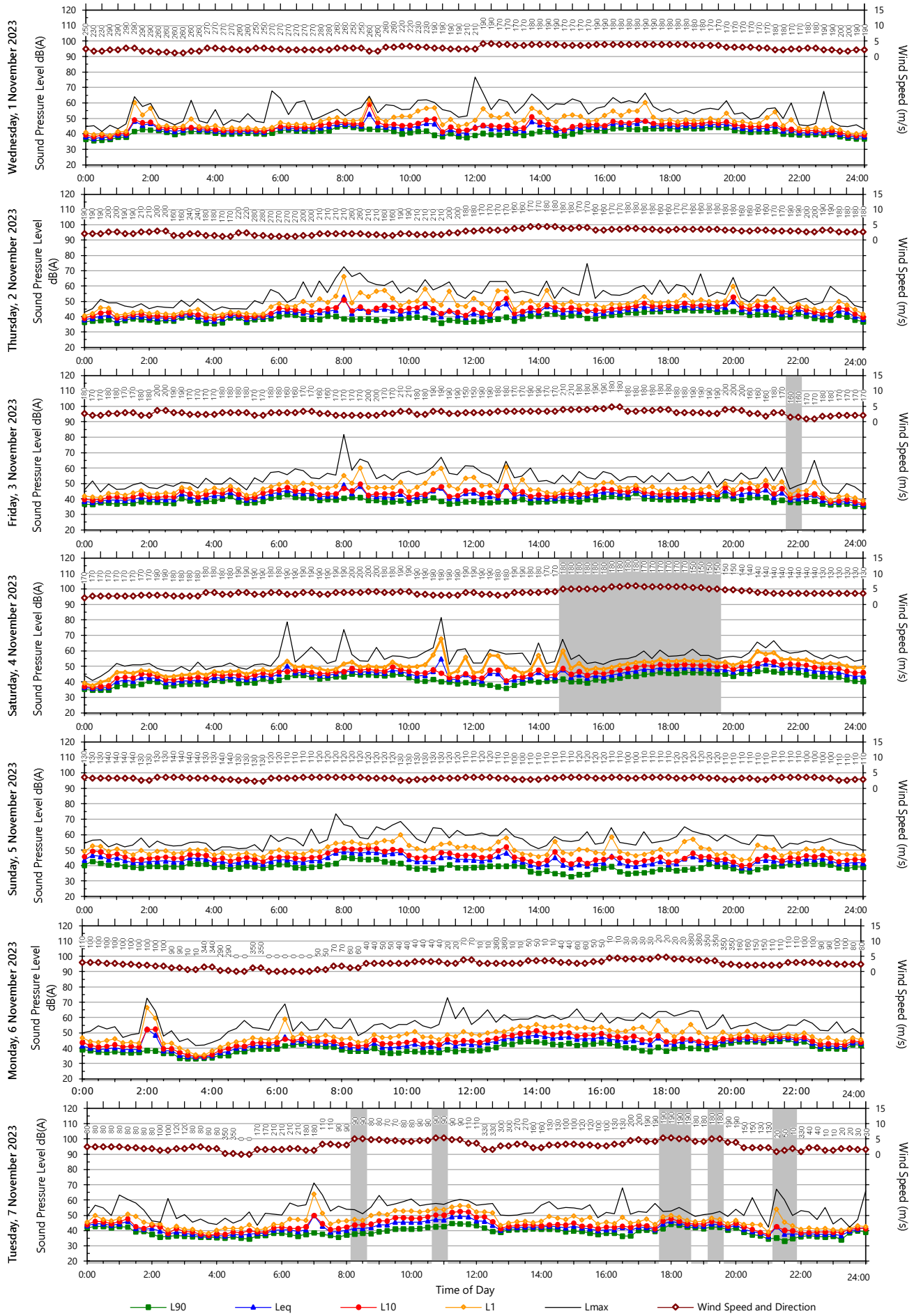


Data File: 2023-10-18_SLM_002_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG4 - Avalon College (South) - Free Field

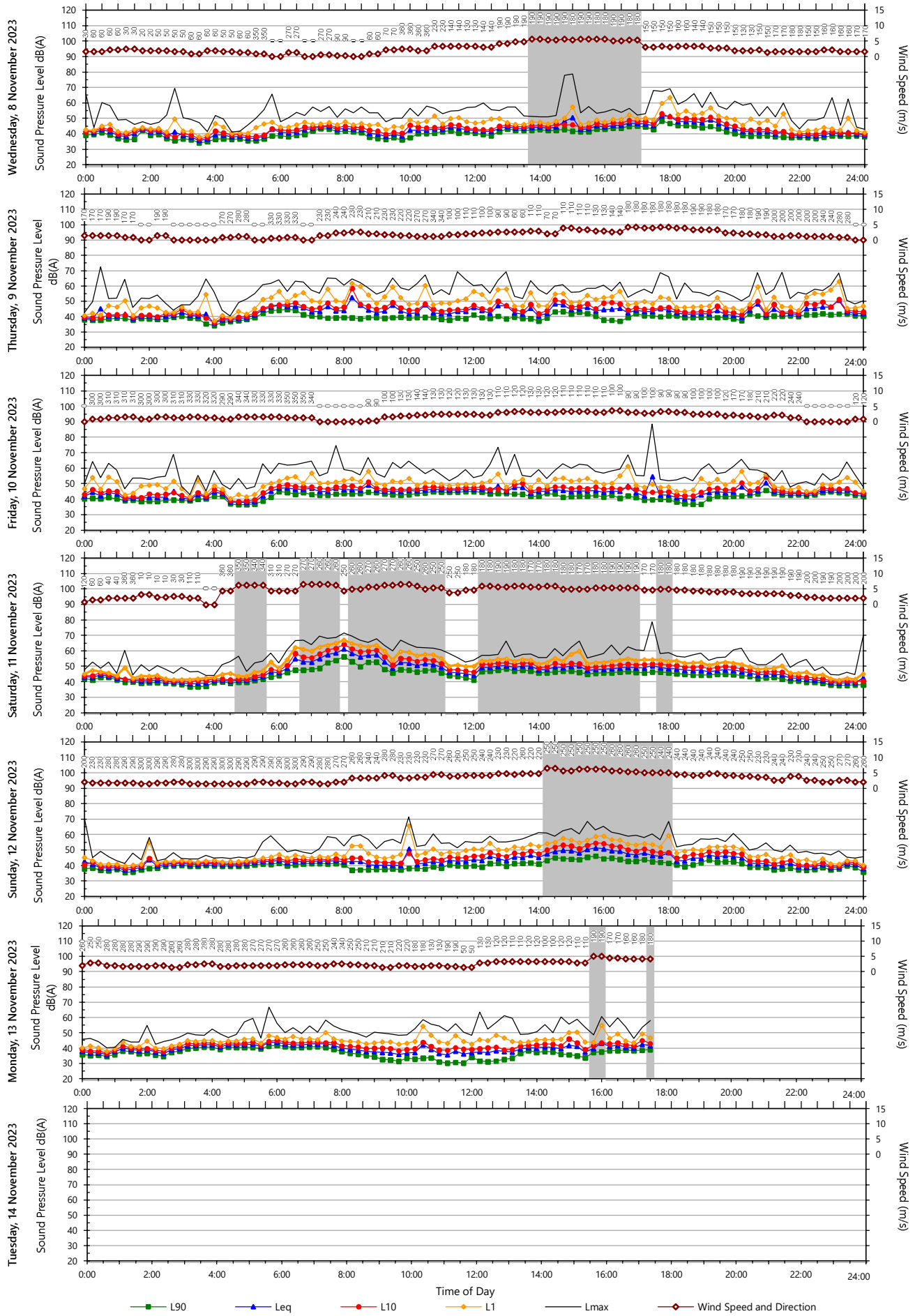


Data File: 2023-10-18_SLM_002_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG4 - Avalon College (South) - Free Field

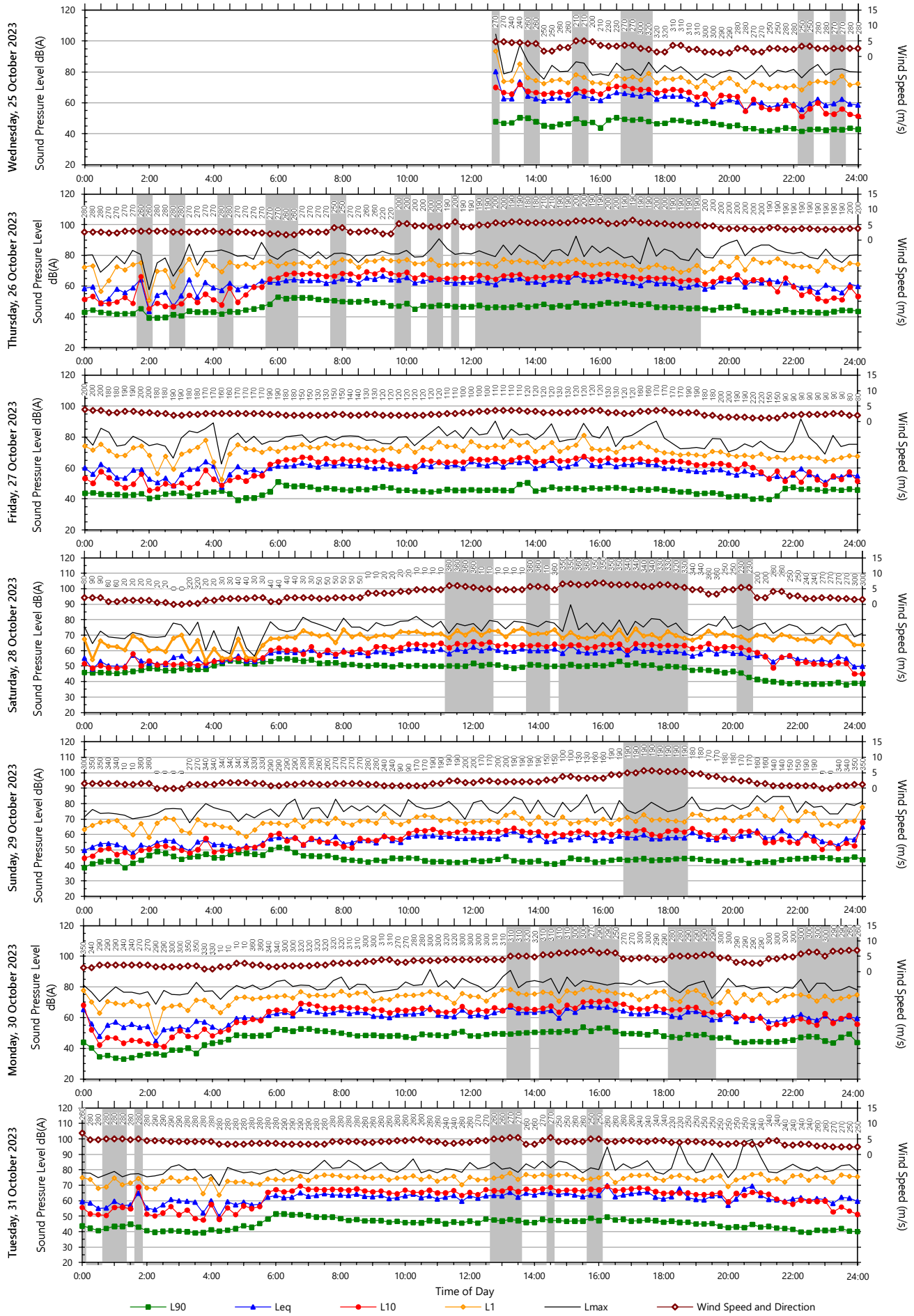


Data File: 2023-10-18_SLM_002_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG5 - 19 Zinnia Street, Norlane VIC 3214 - Free Field

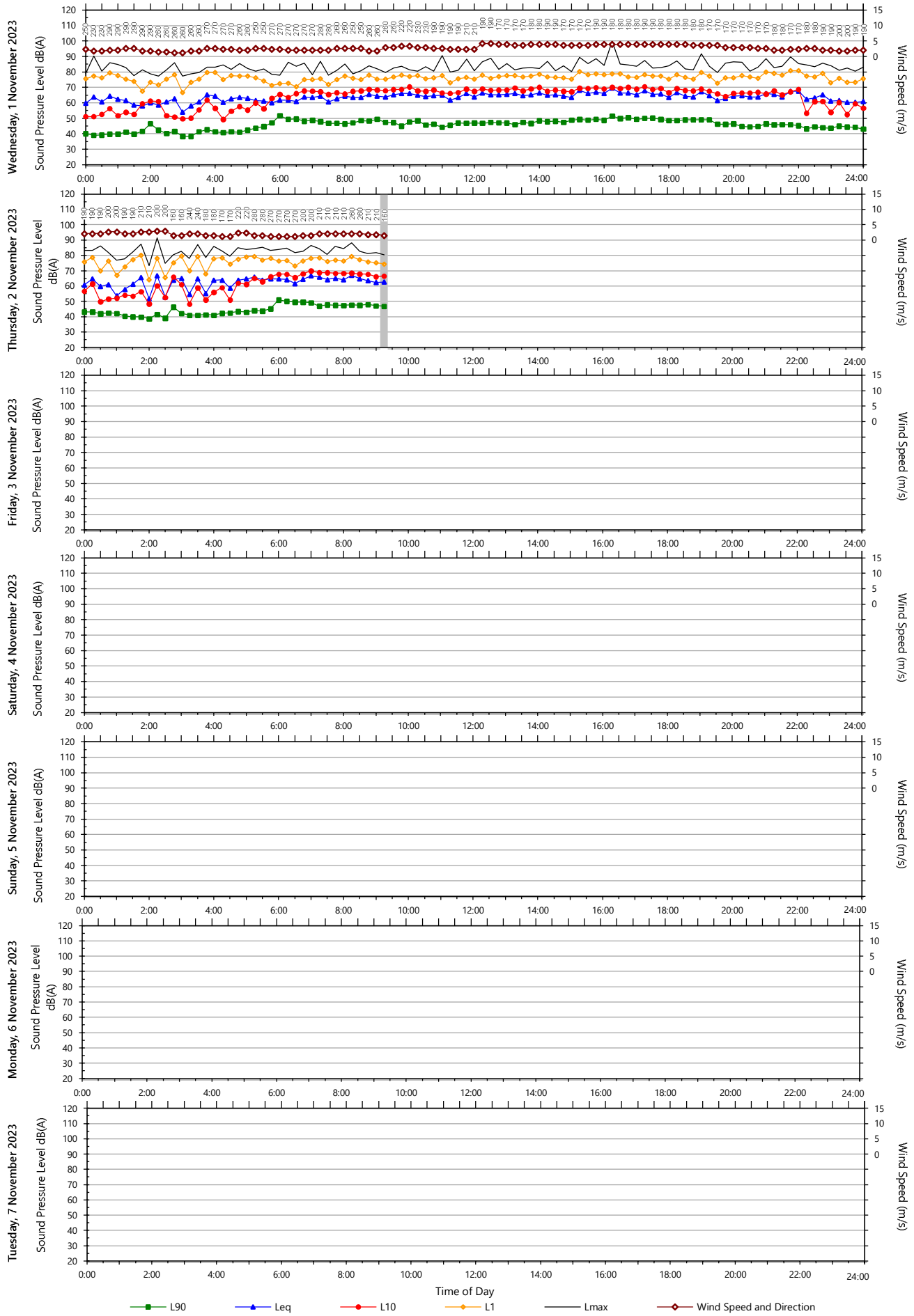


Data File: 2023-10-25_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG5 - 19 Zinnia Street, Norlane VIC 3214 - Free Field

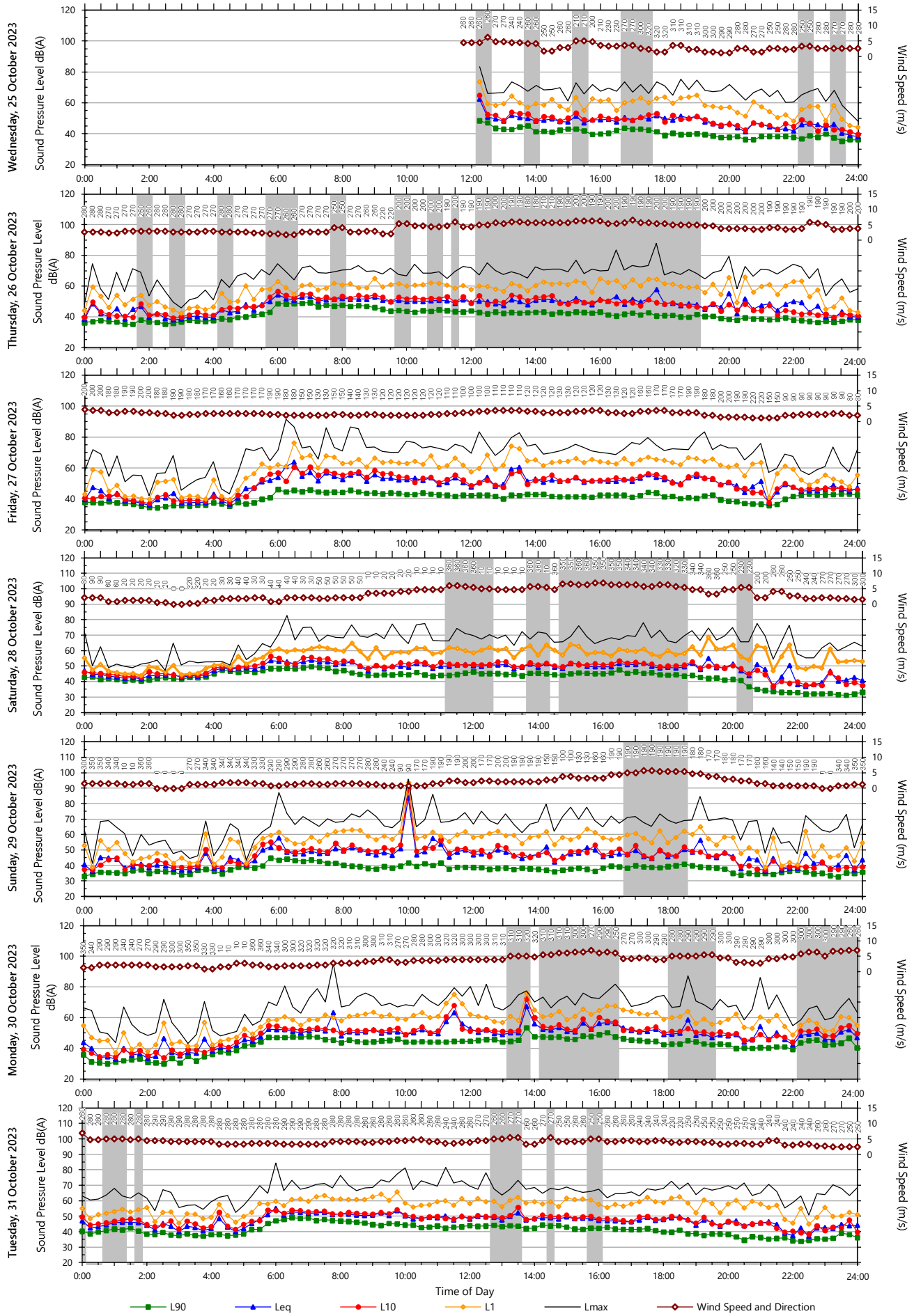


Data File: 2023-10-25_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG6 - 12 Myrtle Grove, North Shore VIC 3214 - Free Field



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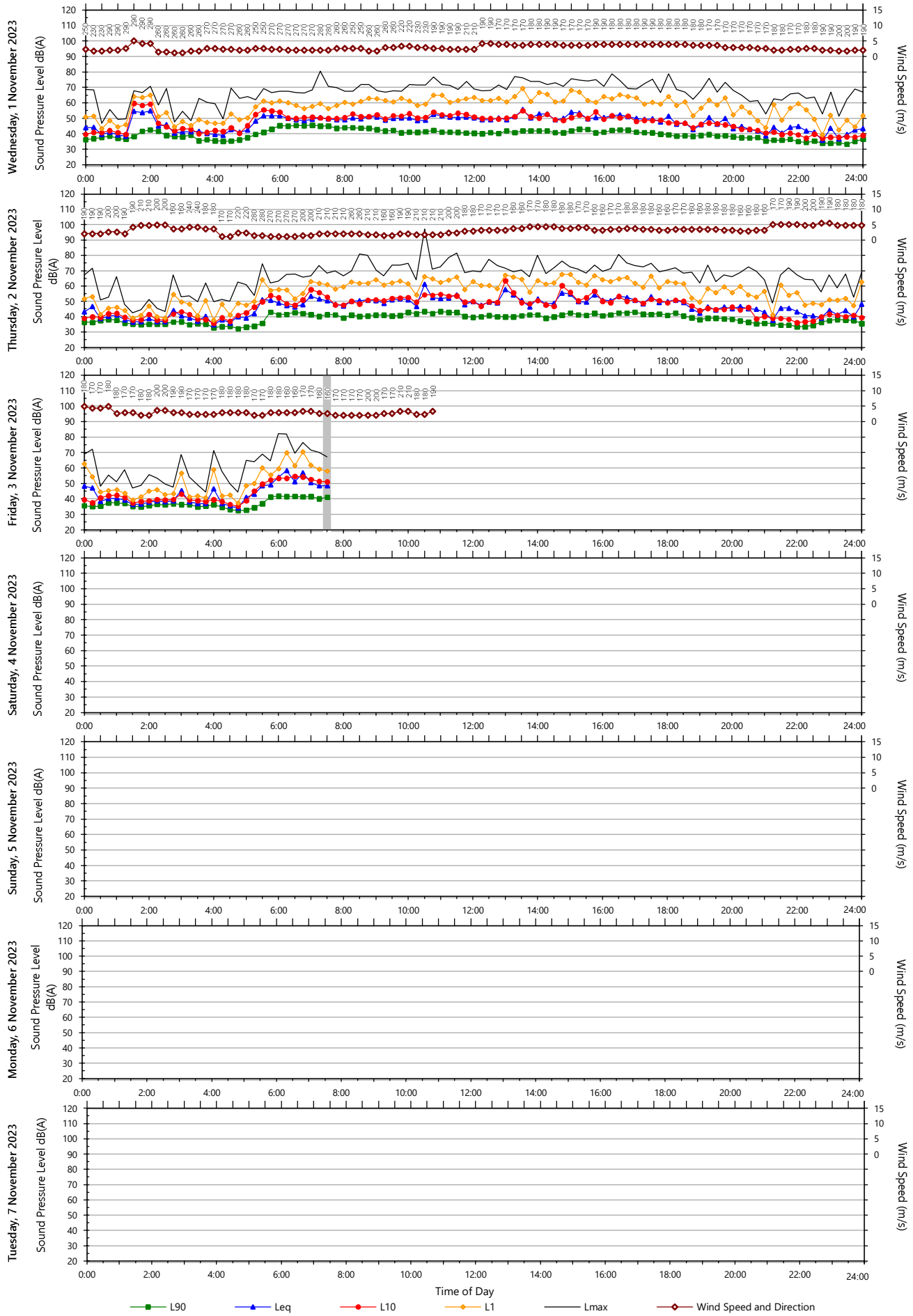
Unattended Monitoring Results

Location: BG6 - 12 Myrtle Grove, North Shore VIC 3214 - Free Field



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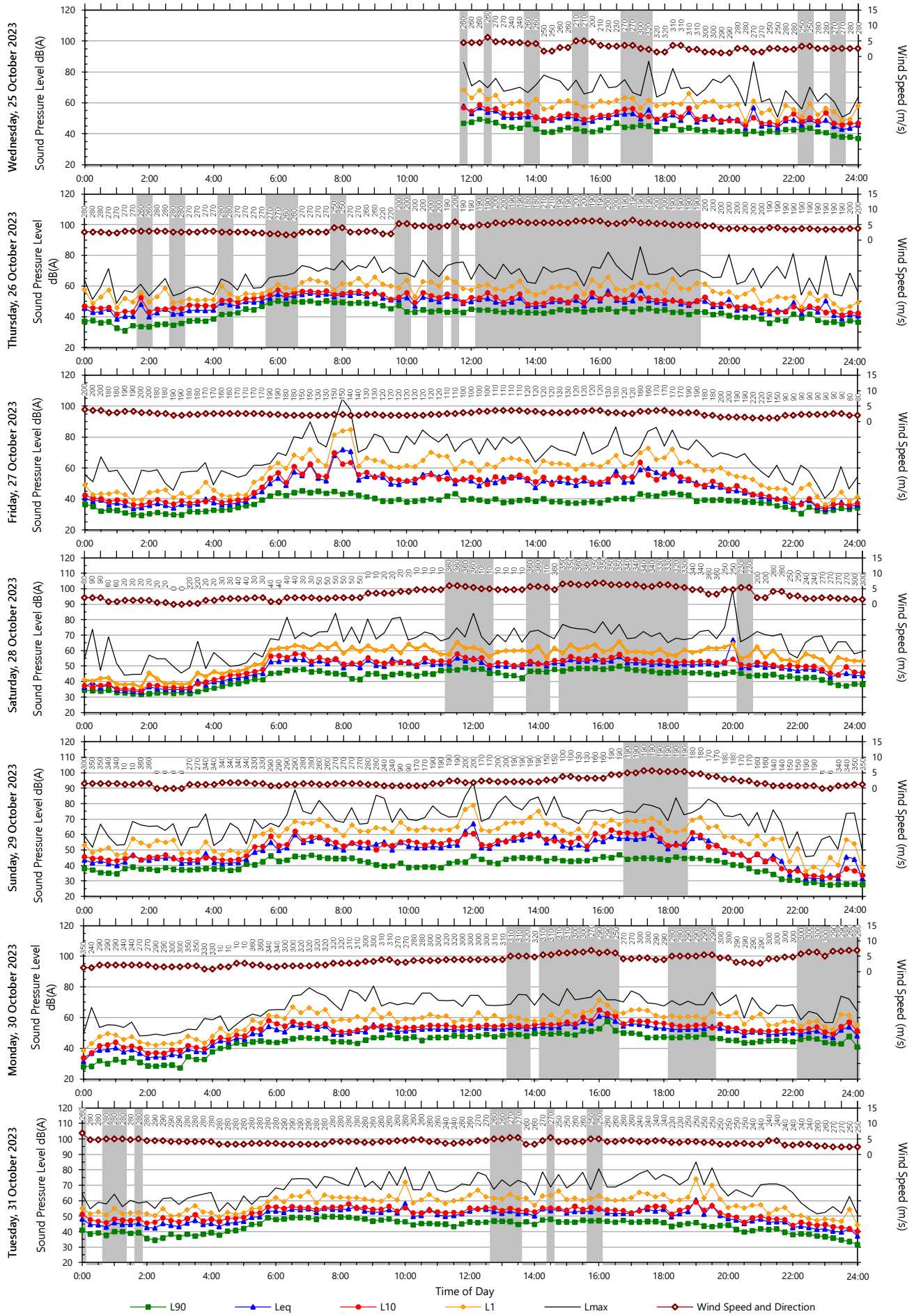
Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG7 - 36 Walker Street, Rippleside VIC 3215 - Free Field

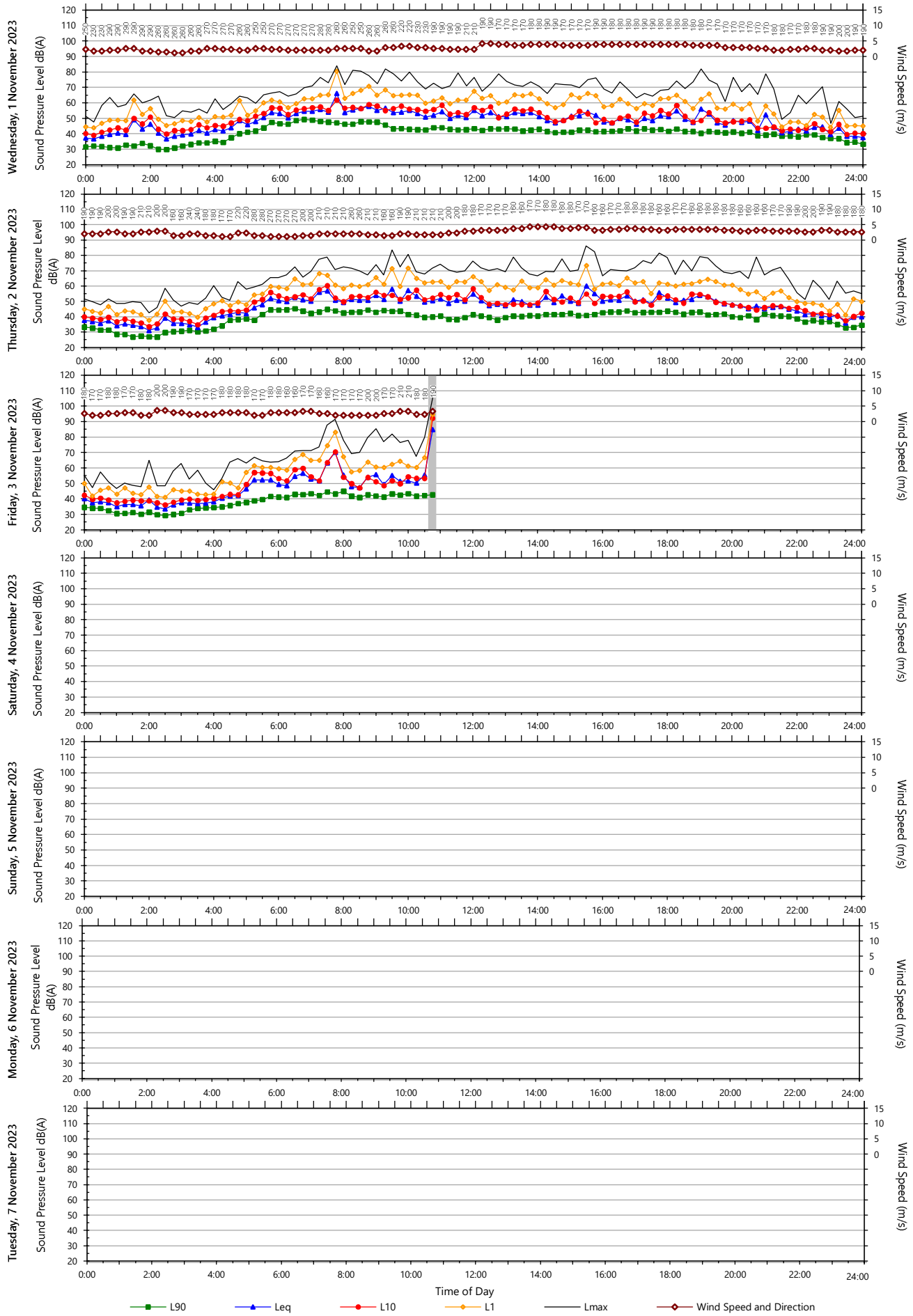


Data File: 2023-10-25_SLM_002_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG7 - 36 Walker Street, Rippleside VIC 3215 - Free Field

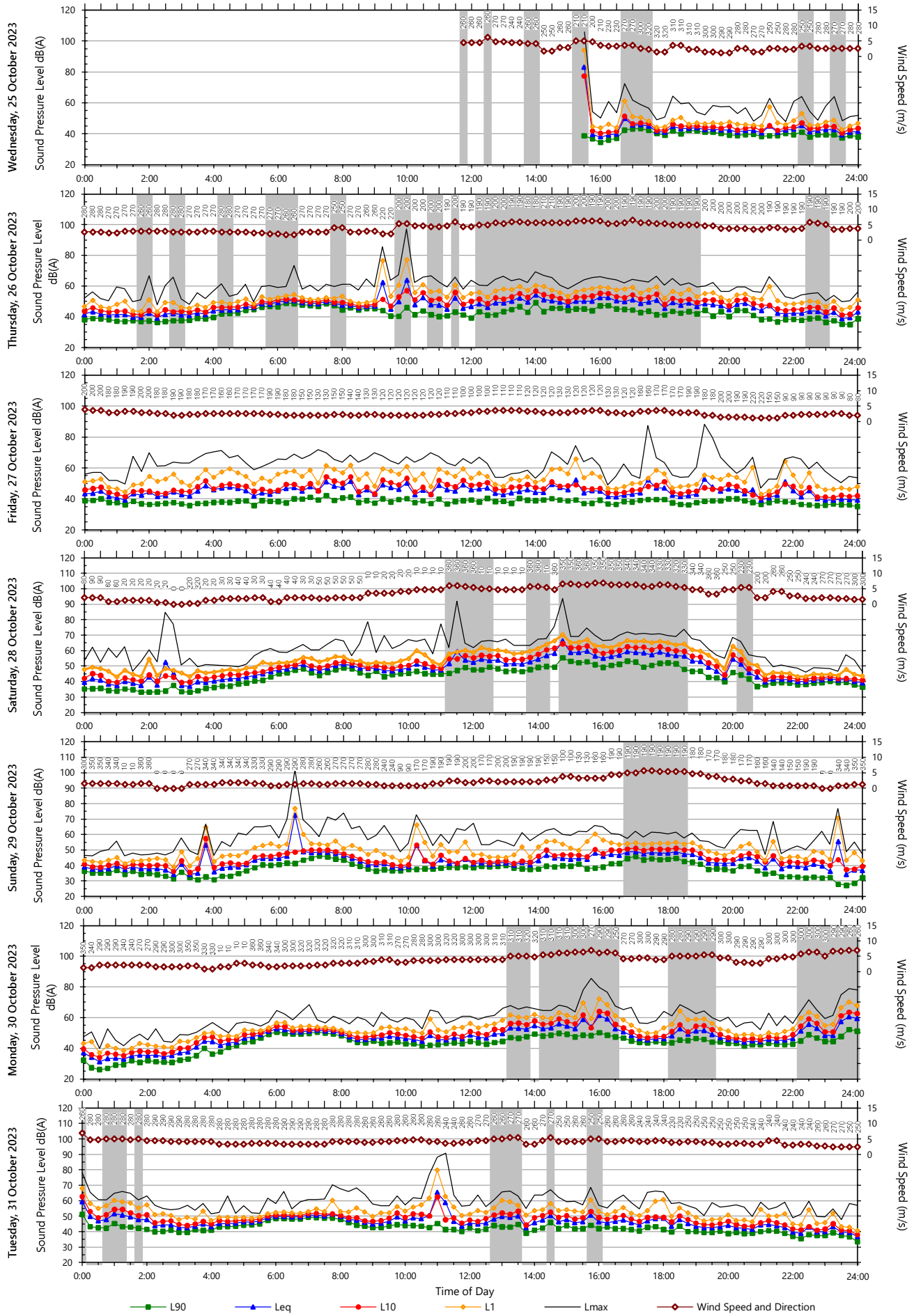


Data File: 2023-10-25_SLM_002_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

Location: BG8 - 240 Avalon Road, Avalon VIC 3212 - Free Field

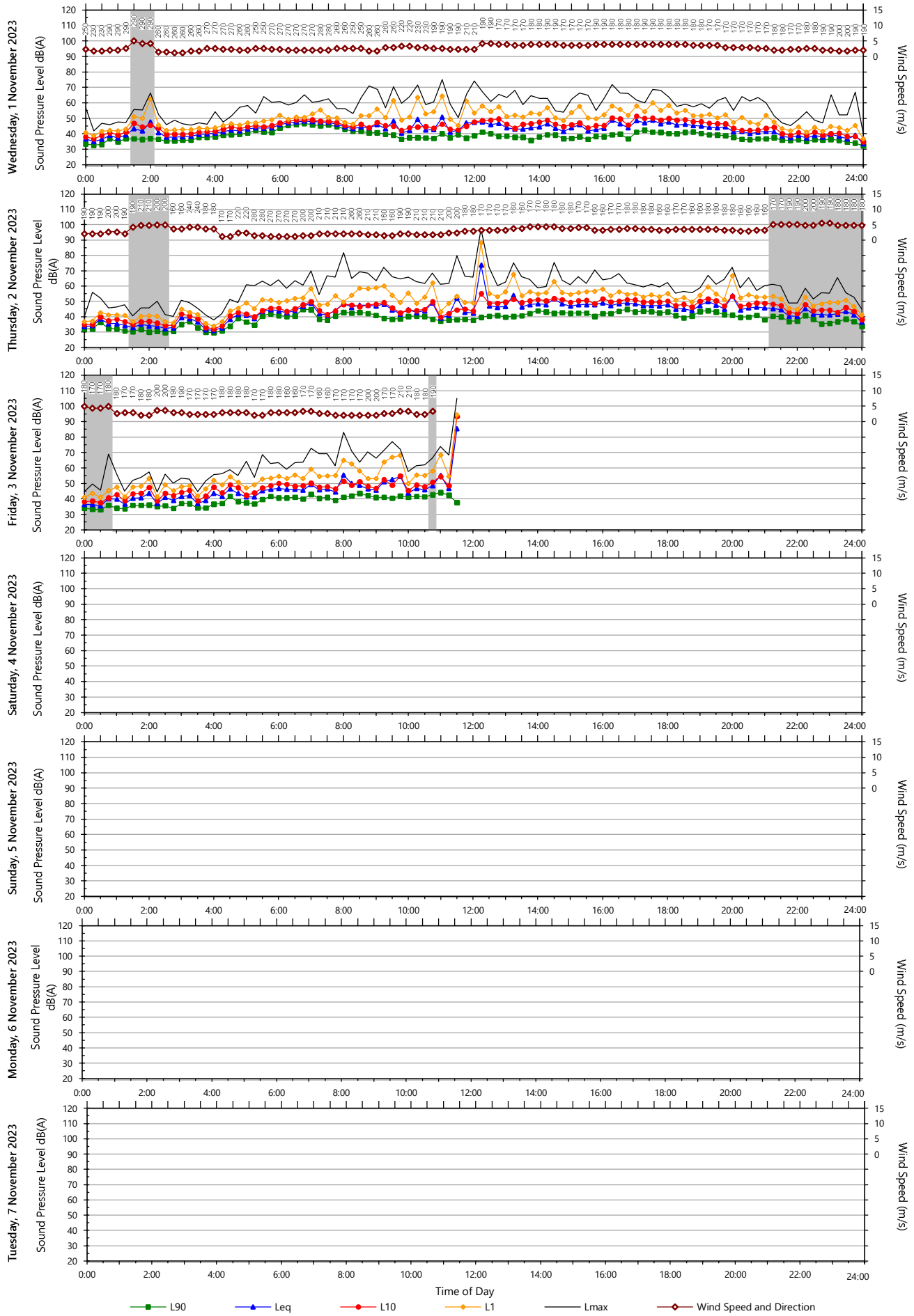


Data File: 2023-10-25_SLM_001_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

Unattended Monitoring Results

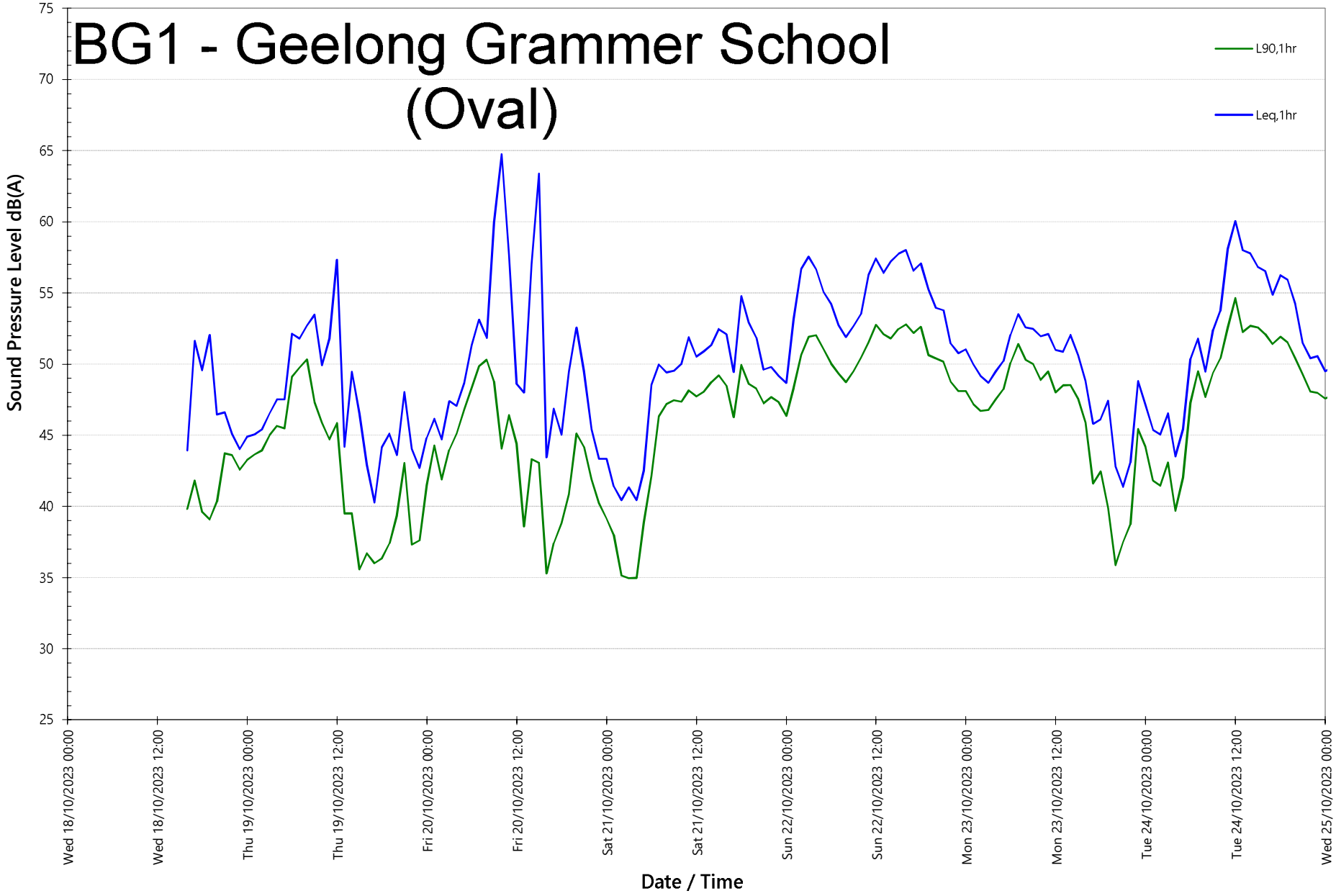
Location: BG8 - 240 Avalon Road, Avalon VIC 3212 - Free Field

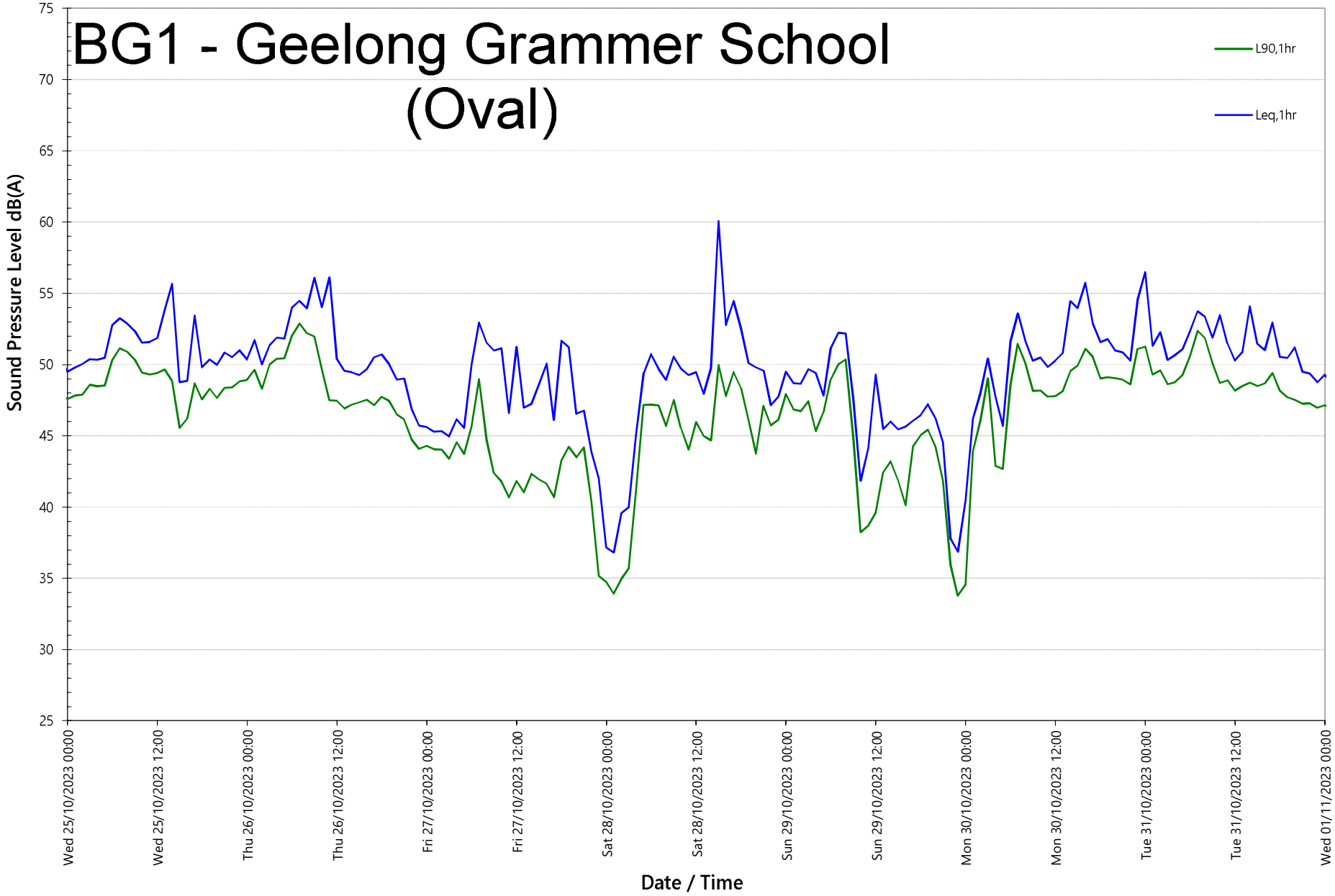


Data File: 2023-10-25_SLM_001_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r44)

B.4 Background noise monitoring ($L_{eq, 1hr}$ & $L_{90, 1hr}$)


BG1 - Geelong Grammer School (Oval)
L90,1hr
Leq,1hr
Sound Pressure Level dB(A)
75
70
65
60
55
50
45
40
35
30
25
Wed 18/10/2023 00:00
Wed 18/10/2023 12:00
Thu 19/10/2023 00:00
Thu 19/10/2023 12:00
Fri 20/10/2023 00:00
Fri 20/10/2023 12:00
Sat 21/10/2023 00:00
Sat 21/10/2023 12:00
Sun 22/10/2023 00:00
Sun 22/10/2023 12:00
Mon 23/10/2023 00:00
Mon 23/10/2023 12:00
Tue 24/10/2023 00:00
Tue 24/10/2023 12:00
Wed 25/10/2023 00:00
Date / Time


BG1 - Geelong Grammer School (Oval)
L90,1hr
Leq,1hr
Sound Pressure Level dB(A)
75
70
65
60
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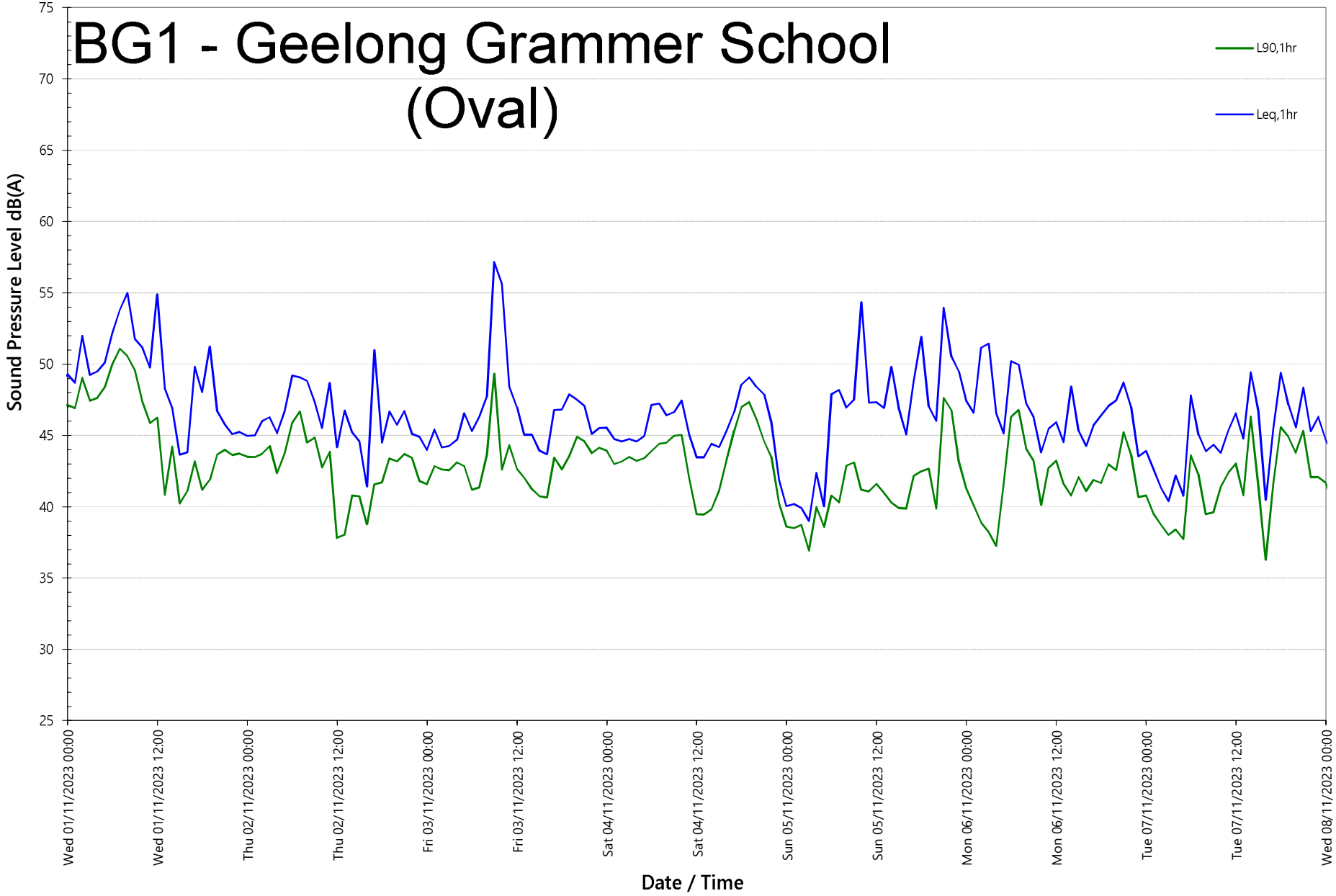
25
Wed 25/10/2023 00:00
Wed 25/10/2023 12:00
Thu 26/10/2023 00:00
Thu 26/10/2023 12:00
Fri 27/10/2023 00:00
Fri 27/10/2023 12:00
Sat 28/10/2023 00:00
Sat 28/10/2023 12:00
Sun 29/10/2023 00:00
Sun 29/10/2023 12:00
Mon 30/10/2023 00:00
Mon 30/10/2023 12:00
Tue 31/10/2023 00:00
Tue 31/10/2023 12:00
Wed 01/11/2023 00:00
Date / Time


BG1 - Geelong Grammer School (Oval)
L90,1hr
Leq,1hr
Sound Pressure Level dB(A)
75
70
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60
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25
Wed 01/11/2023 00:00
Wed 01/11/2023 12:00
Thu 02/11/2023 00:00
Thu 02/11/2023 12:00
Fri 03/11/2023 00:00
Fri 03/11/2023 12:00
Sat 04/11/2023 00:00
Sat 04/11/2023 12:00
Sun 05/11/2023 00:00
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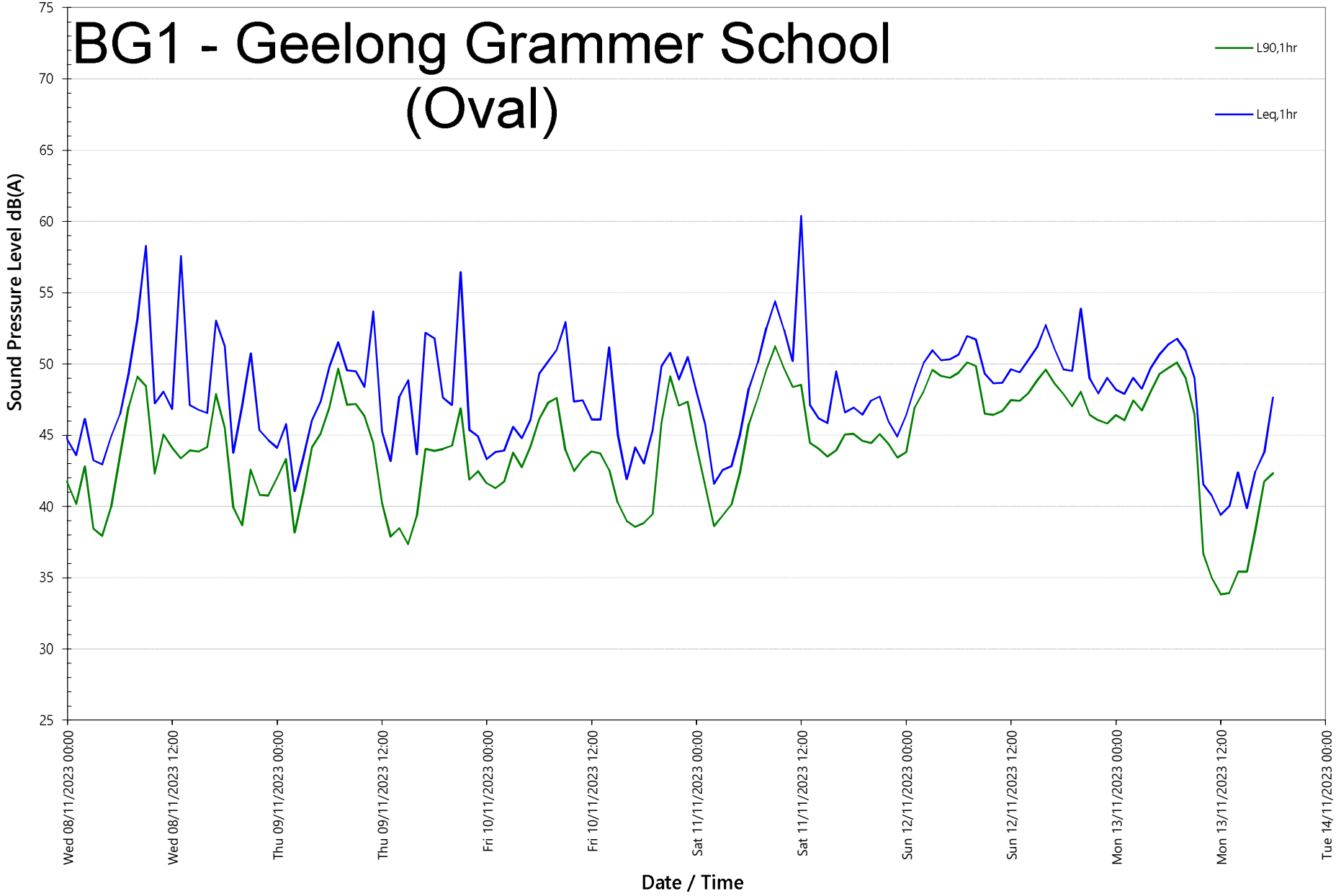
Mon 06/11/2023 00:00
Mon 06/11/2023 12:00
Tue 07/11/2023 00:00
Tue 07/11/2023 12:00
Wed 08/11/2023 00:00
Date / Time


BG1 - Geelong Grammer School (Oval)
L90,1hr
Leq,1hr
Sound Pressure Level dB(A)
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Wed 08/11/2023 00:00
Wed 08/11/2023 12:00
Thu 09/11/2023 00:00
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Sat 11/11/2023 00:00
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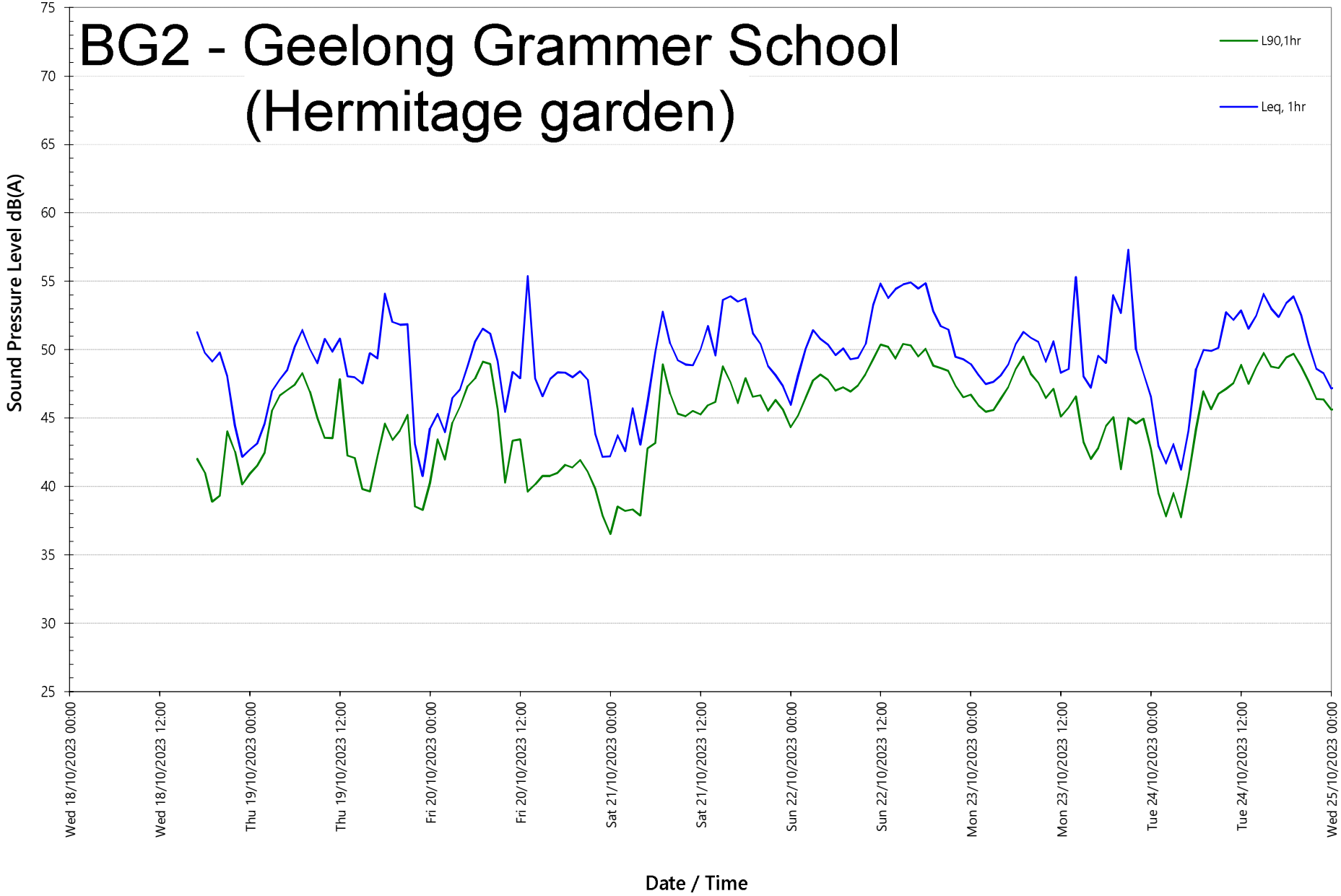
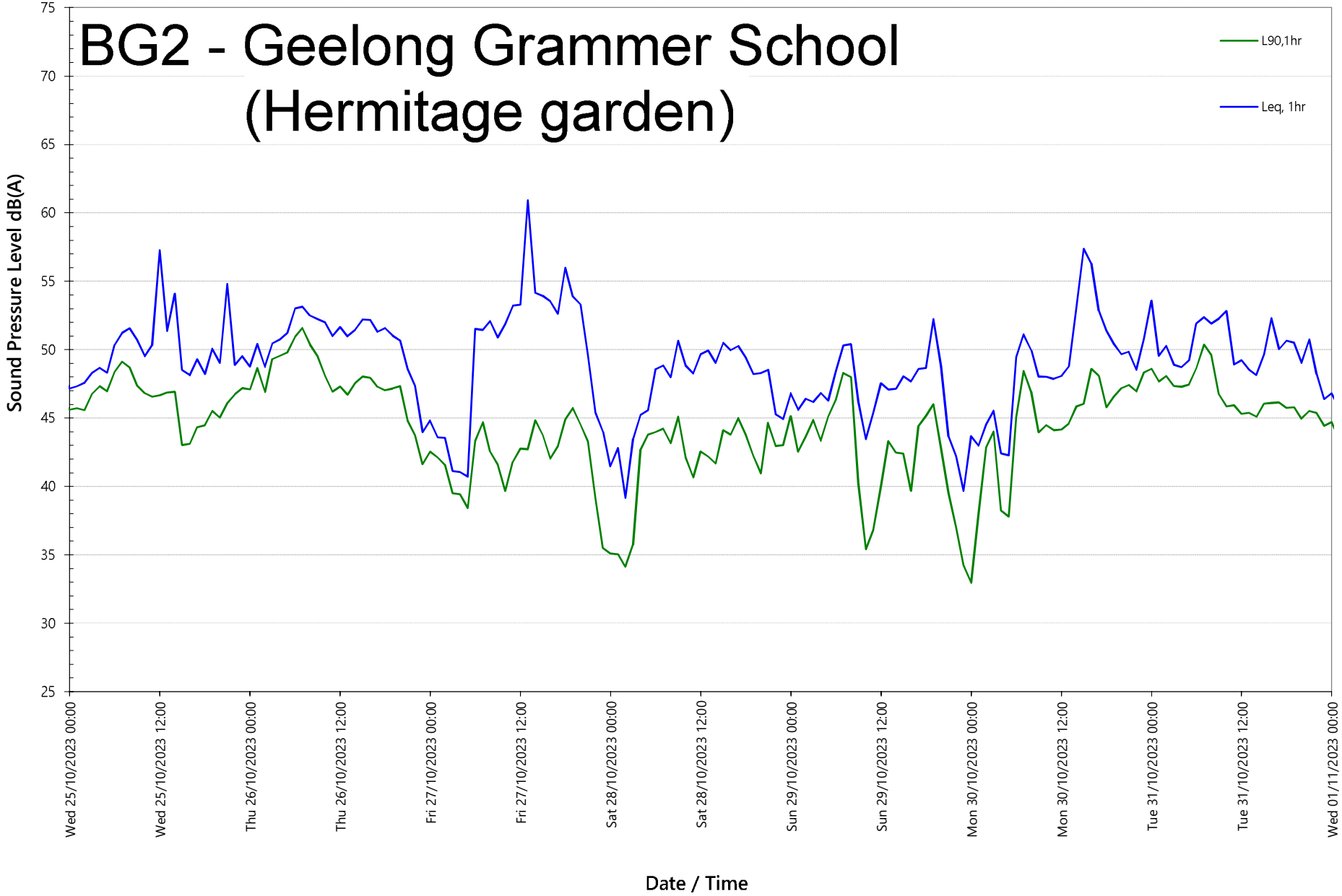
Mon 13/11/2023 12:00
Tue 14/11/2023 00:00
Date / Time


BG2 - Geelong Grammer School
(Hermitage garden)
L90,1hr
Leq, 1hr
Sound Pressure Level dB(A)
75
70
65
60
55
50
45
40
35
30
25
Wed 18/10/2023 00:00
Wed 18/10/2023 12:00
Thu 19/10/2023 00:00
Thu 19/10/2023 12:00
Fri 20/10/2023 00:00
Fri 20/10/2023 12:00
Sat 21/10/2023 00:00
Sat 21/10/2023 12:00
Sun 22/10/2023 00:00
Sun 22/10/2023 12:00
Mon 23/10/2023 00:00
Mon 23/10/2023 12:00
Tue 24/10/2023 00:00
Tue 24/10/2023 12:00
Wed 25/10/2023 00:00
Date / Time


BG2 - Geelong Grammer School
(Hermitage garden)
L90,1hr
Leq, 1hr
Sound Pressure Level dB(A)
75
70
65
60
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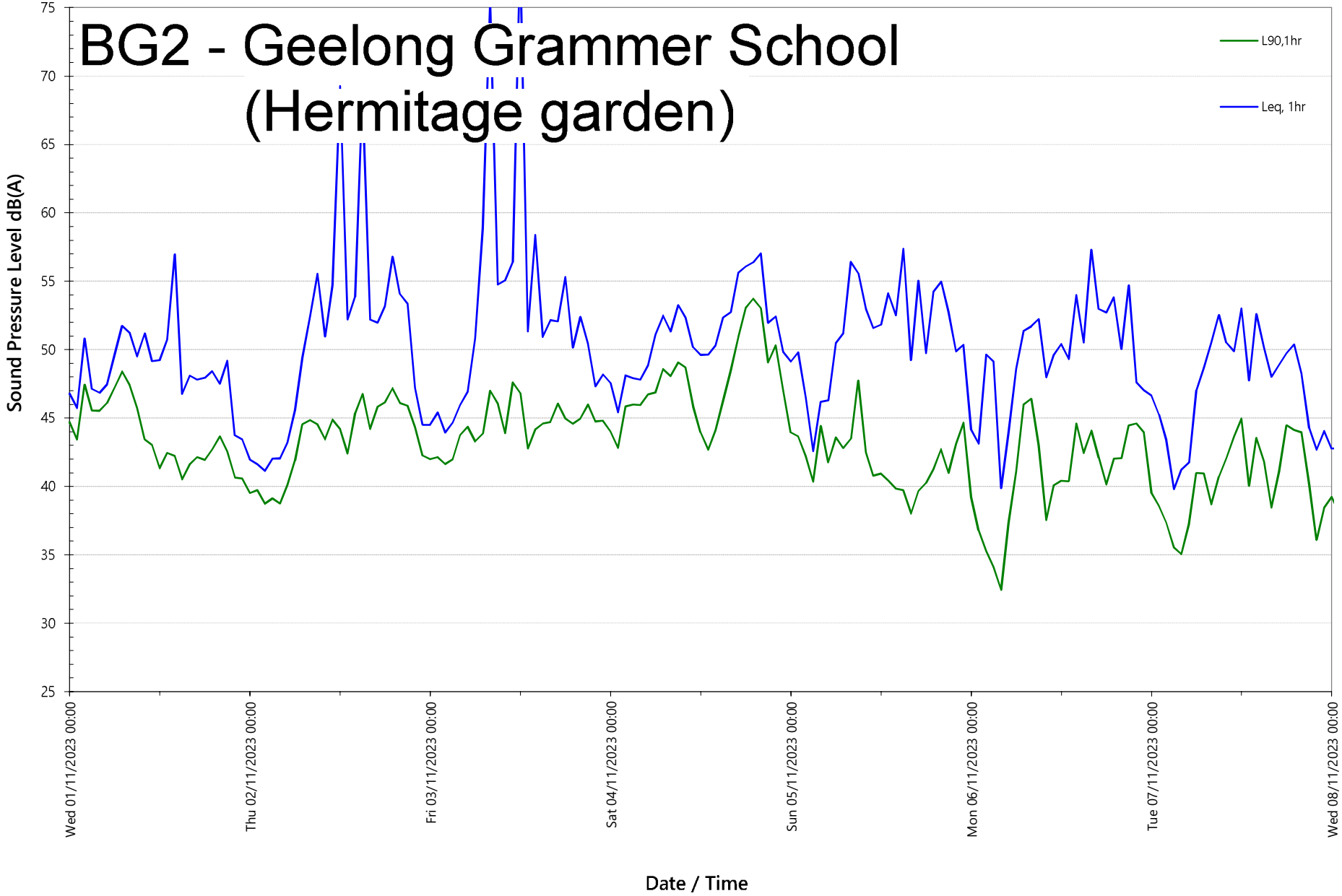
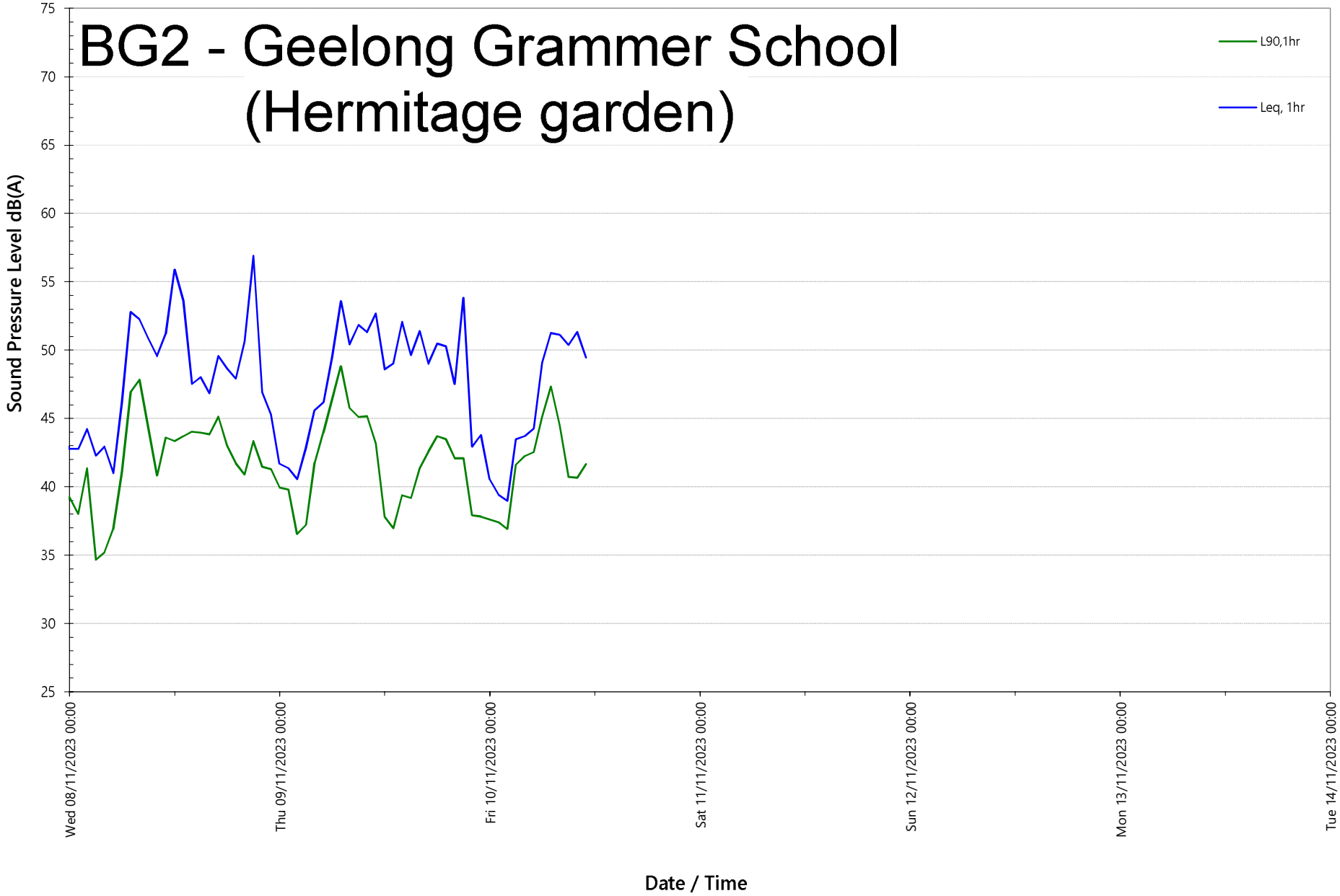
50
45
40
35
30
25
Wed 25/10/2023 00:00
Wed 25/10/2023 12:00
Thu 26/10/2023 00:00
Thu 26/10/2023 12:00
Fri 27/10/2023 00:00
Fri 27/10/2023 12:00
Sat 28/10/2023 00:00
Sat 28/10/2023 12:00
Sun 29/10/2023 00:00
Sun 29/10/2023 12:00
Mon 30/10/2023 00:00
Mon 30/10/2023 12:00
Tue 31/10/2023 00:00
Tue 31/10/2023 12:00
Wed 01/11/2023 00:00
Date / Time


BG2 - Geelong Grammer School
(Hermitage garden)
L90,1hr
Leq, 1hr
Sound Pressure Level dB(A)
75
70
65
60
55
50
45
40
35
30
25
Wed 01/11/2023 00:00
Thu 02/11/2023 00:00
Fri 03/11/2023 00:00
Sat 04/11/2023 00:00
Sun 05/11/2023 00:00
Mon 06/11/2023 00:00
Tue 07/11/2023 00:00
Wed 08/11/2023 00:00
Date / Time


BG2 - Geelong Grammer School
(Hermitage garden)
L90,1hr
Leq, 1hr
Sound Pressure Level dB(A)
75
70
65
60
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50
45
40
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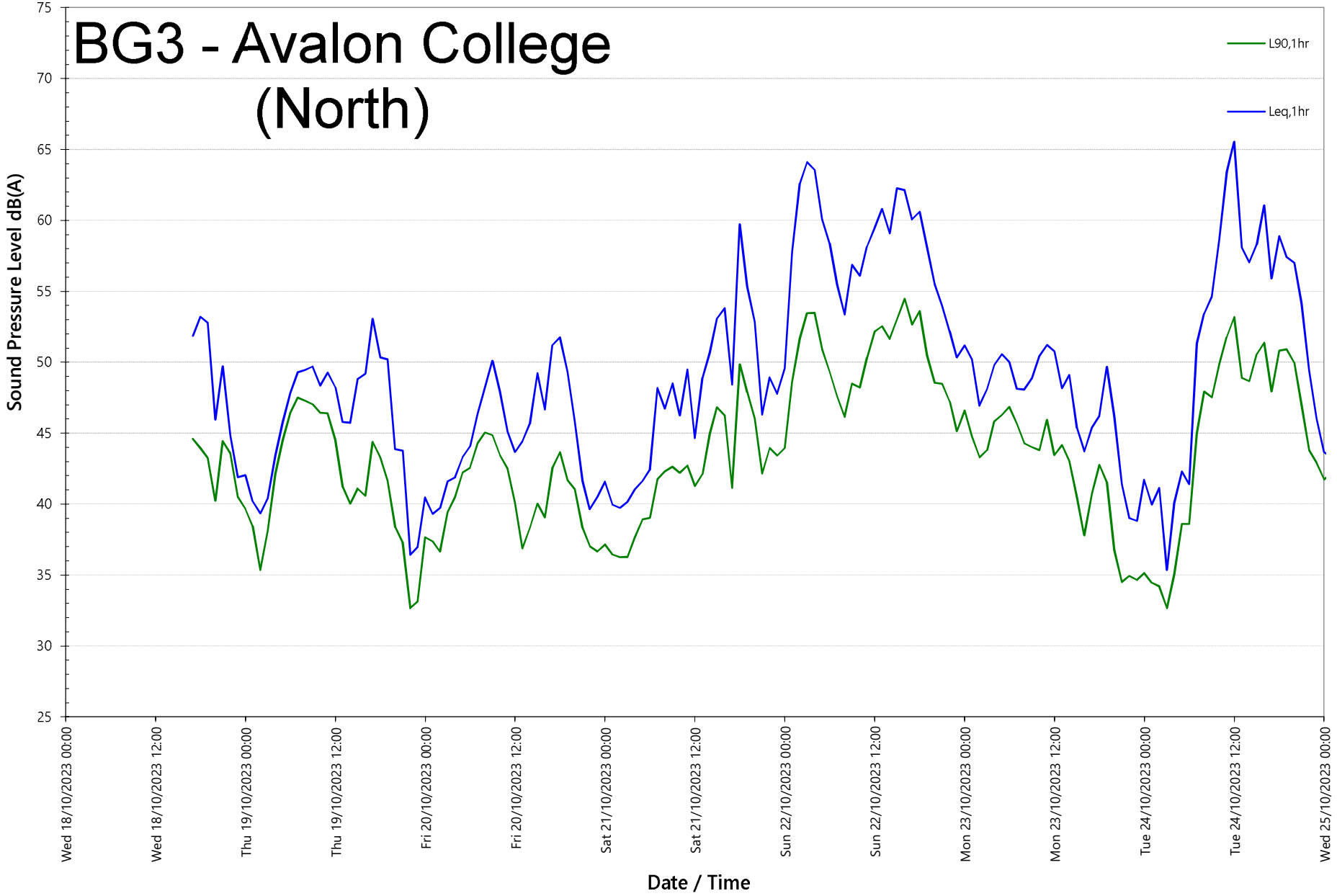
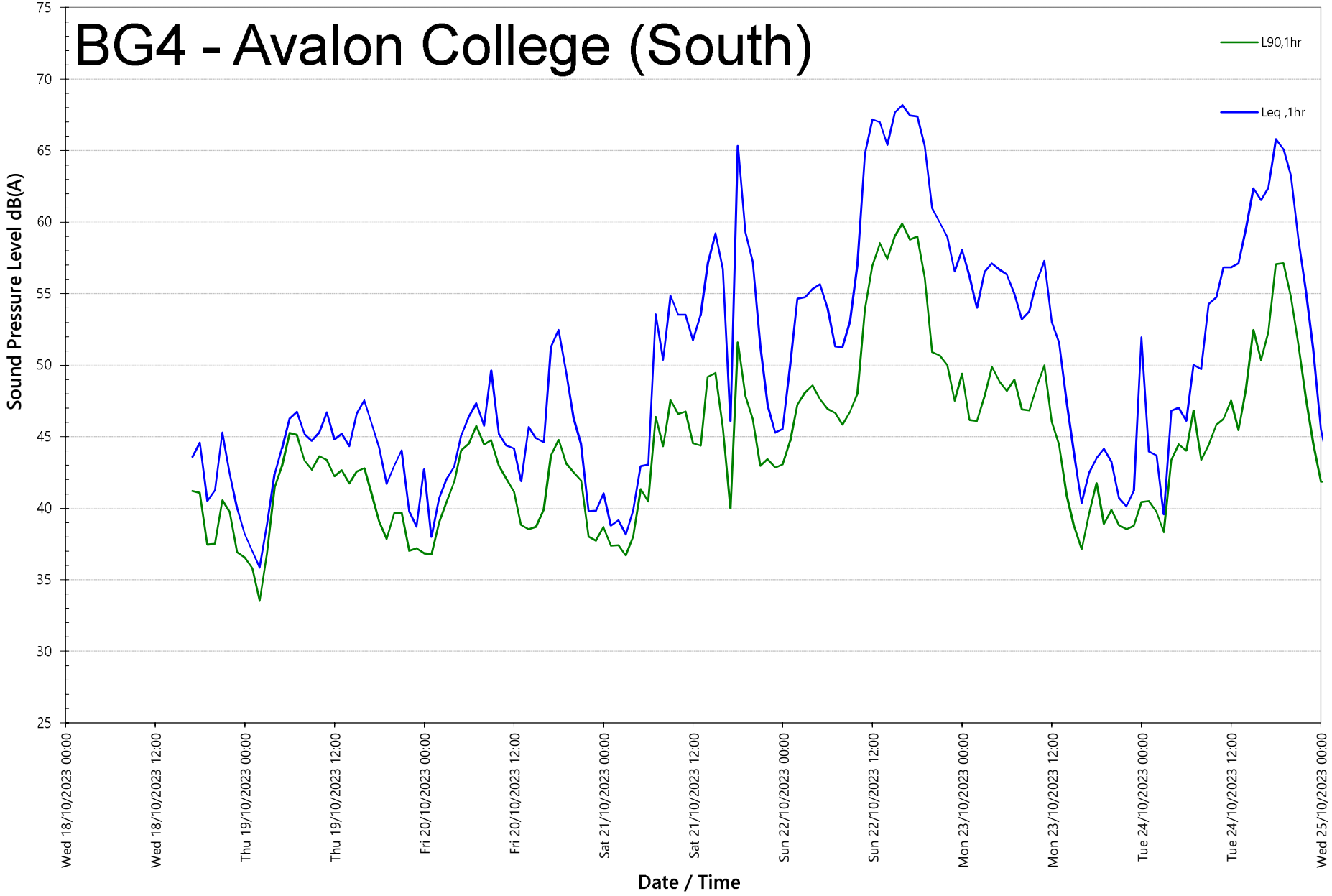
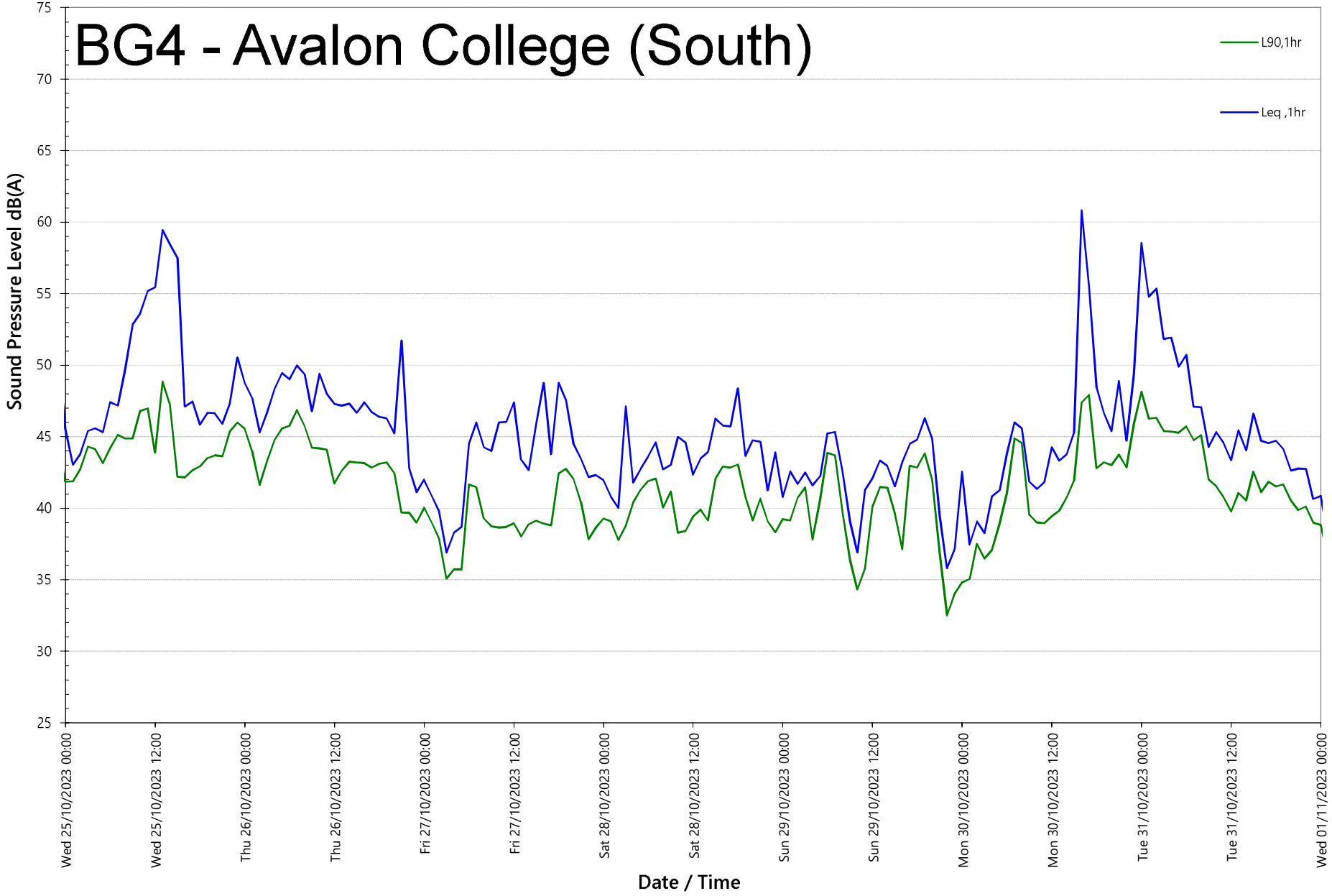
30
25
Wed 08/11/2023 00:00
Thu 09/11/2023 00:00
Fri 10/11/2023 00:00
Sat 11/11/2023 00:00
Sun 12/11/2023 00:00
Mon 13/11/2023 00:00
Tue 14/11/2023 00:00
Date / Time


BG3 - Avalon College (North)
L90,1hr
Leq,1hr
Sound Pressure Level dB(A)
75
70
65
60
55
50
45
40
35
30
25
Wed 18/10/2023 00:00
Wed 18/10/2023 12:00
Thu 19/10/2023 00:00
Thu 19/10/2023 12:00
Fri 20/10/2023 00:00
Fri 20/10/2023 12:00
Sat 21/10/2023 00:00
Sat 21/10/2023 12:00
Sun 22/10/2023 00:00
Sun 22/10/2023 12:00
Mon 23/10/2023 00:00
Mon 23/10/2023 12:00
Tue 24/10/2023 00:00
Tue 24/10/2023 12:00
Wed 25/10/2023 00:00
Date / Time


BG4 - Avalon College (South)
L90,1hr
Leq ,1hr
Sound Pressure Level dB(A)
75
70
65
60
55
50
45
40
35
30
25
Wed 18/10/2023 00:00
Wed 18/10/2023 12:00
Thu 19/10/2023 00:00
Thu 19/10/2023 12:00
Fri 20/10/2023 00:00
Fri 20/10/2023 12:00
Sat 21/10/2023 00:00
Sat 21/10/2023 12:00
Sun 22/10/2023 00:00
Sun 22/10/2023 12:00
Mon 23/10/2023 00:00
Mon 23/10/2023 12:00
Tue 24/10/2023 00:00
Tue 24/10/2023 12:00
Wed 25/10/2023 00:00
Date / Time


BG4 - Avalon College (South)
L90,1hr
Leq ,1hr
Sound Pressure Level dB(A)
75
70
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60
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50
45
40
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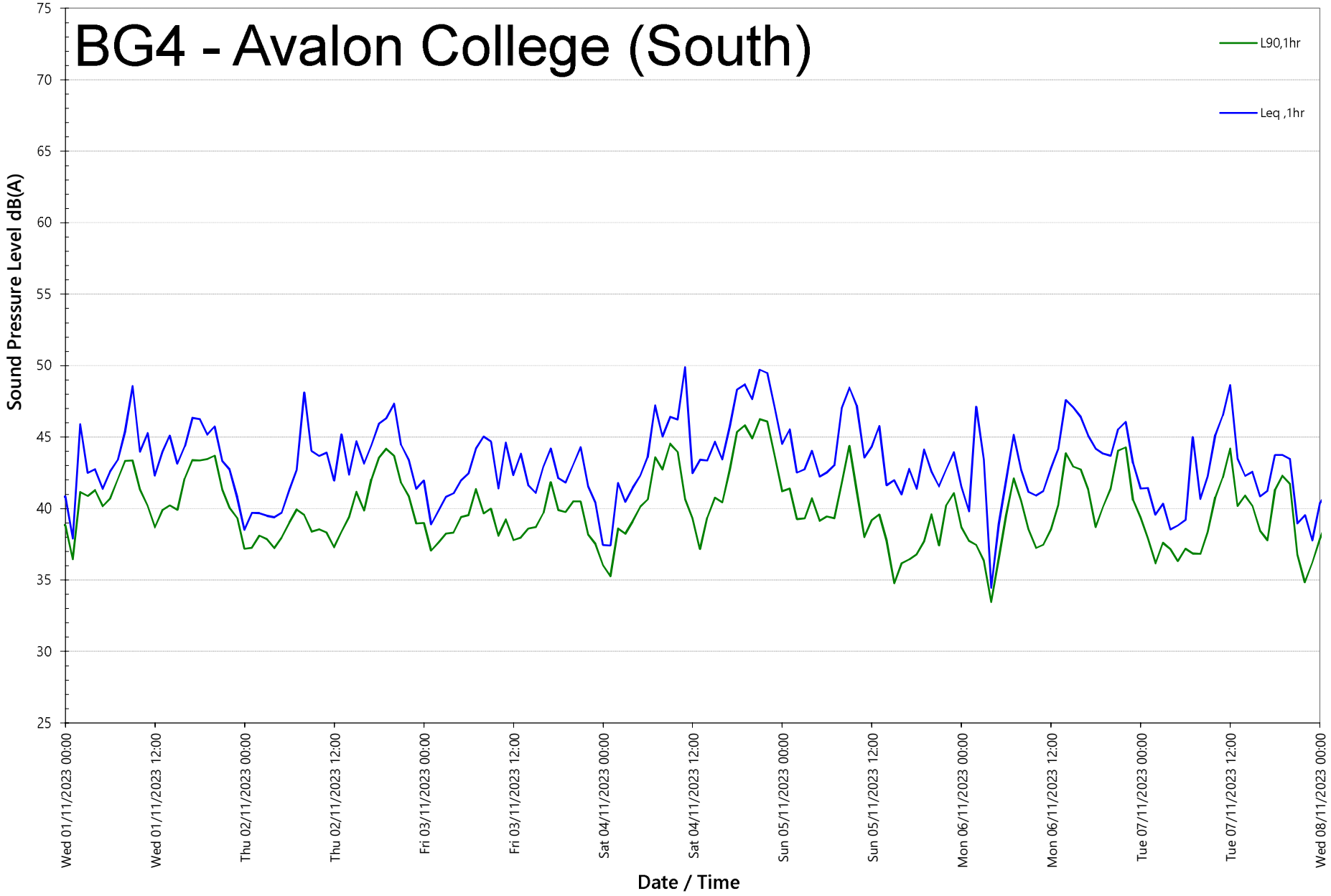
25
Wed 25/10/2023 00:00
Wed 25/10/2023 12:00
Thu 26/10/2023 00:00
Thu 26/10/2023 12:00
Fri 27/10/2023 00:00
Fri 27/10/2023 12:00
Sat 28/10/2023 00:00
Sat 28/10/2023 12:00
Sun 29/10/2023 00:00
Sun 29/10/2023 12:00
Mon 30/10/2023 00:00
Mon 30/10/2023 12:00
Tue 31/10/2023 00:00
Tue 31/10/2023 12:00
Wed 01/11/2023 00:00
Date / Time


BG4 - Avalon College (South)
L90,1hr
Leq ,1hr
Sound Pressure Level dB(A)
75
70
65
60
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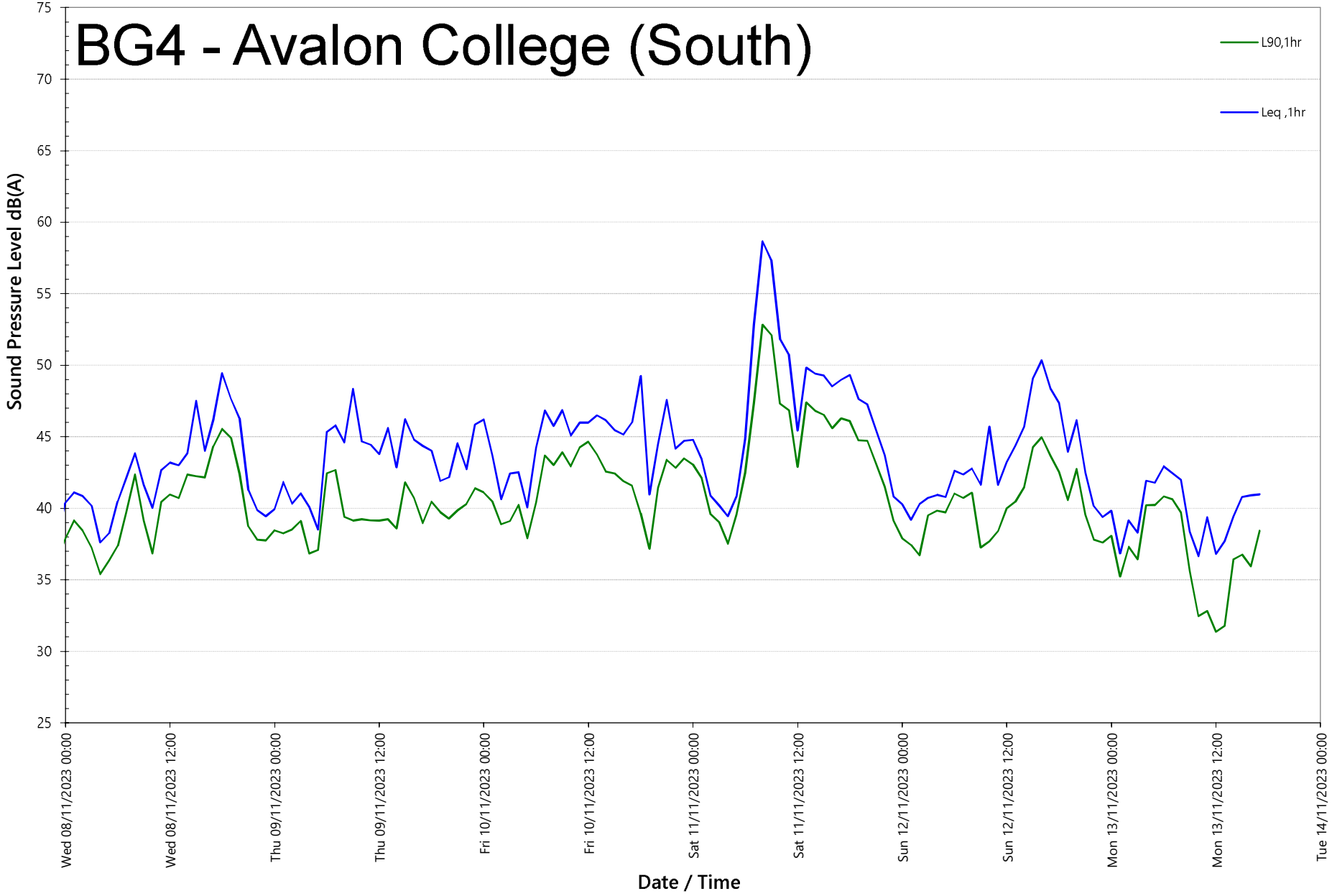
40
35
30
25
Wed 01/11/2023 00:00
Wed 01/11/2023 12:00
Thu 02/11/2023 00:00
Thu 02/11/2023 12:00
Fri 03/11/2023 00:00
Fri 03/11/2023 12:00
Sat 04/11/2023 00:00
Sat 04/11/2023 12:00
Sun 05/11/2023 00:00
Sun 05/11/2023 12:00
Mon 06/11/2023 00:00
Mon 06/11/2023 12:00
Tue 07/11/2023 00:00
Tue 07/11/2023 12:00
Wed 08/11/2023 00:00
Date / Time


BG4 - Avalon College (South)
L90,1hr
Leq ,1hr
Sound Pressure Level dB(A)
75
70
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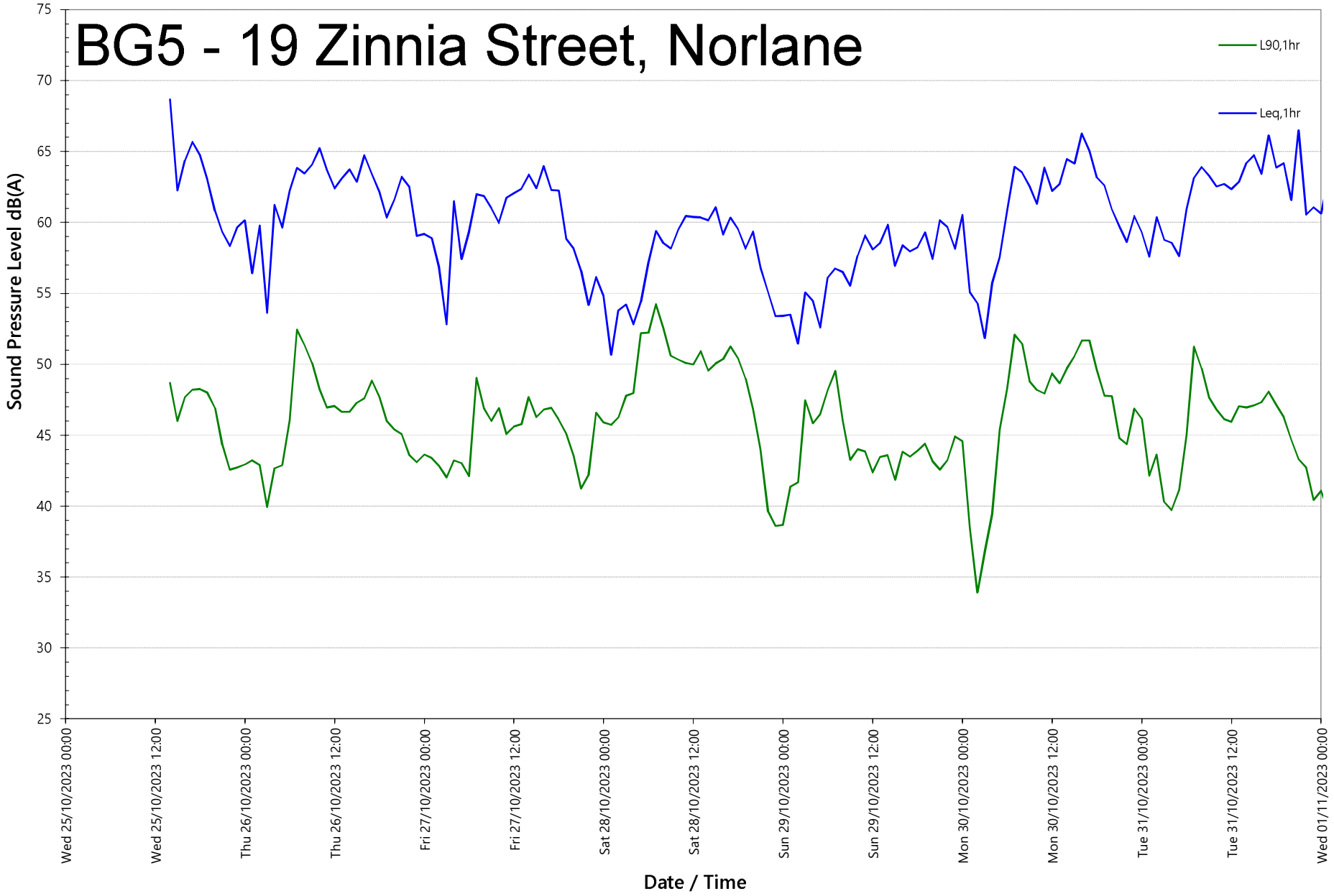
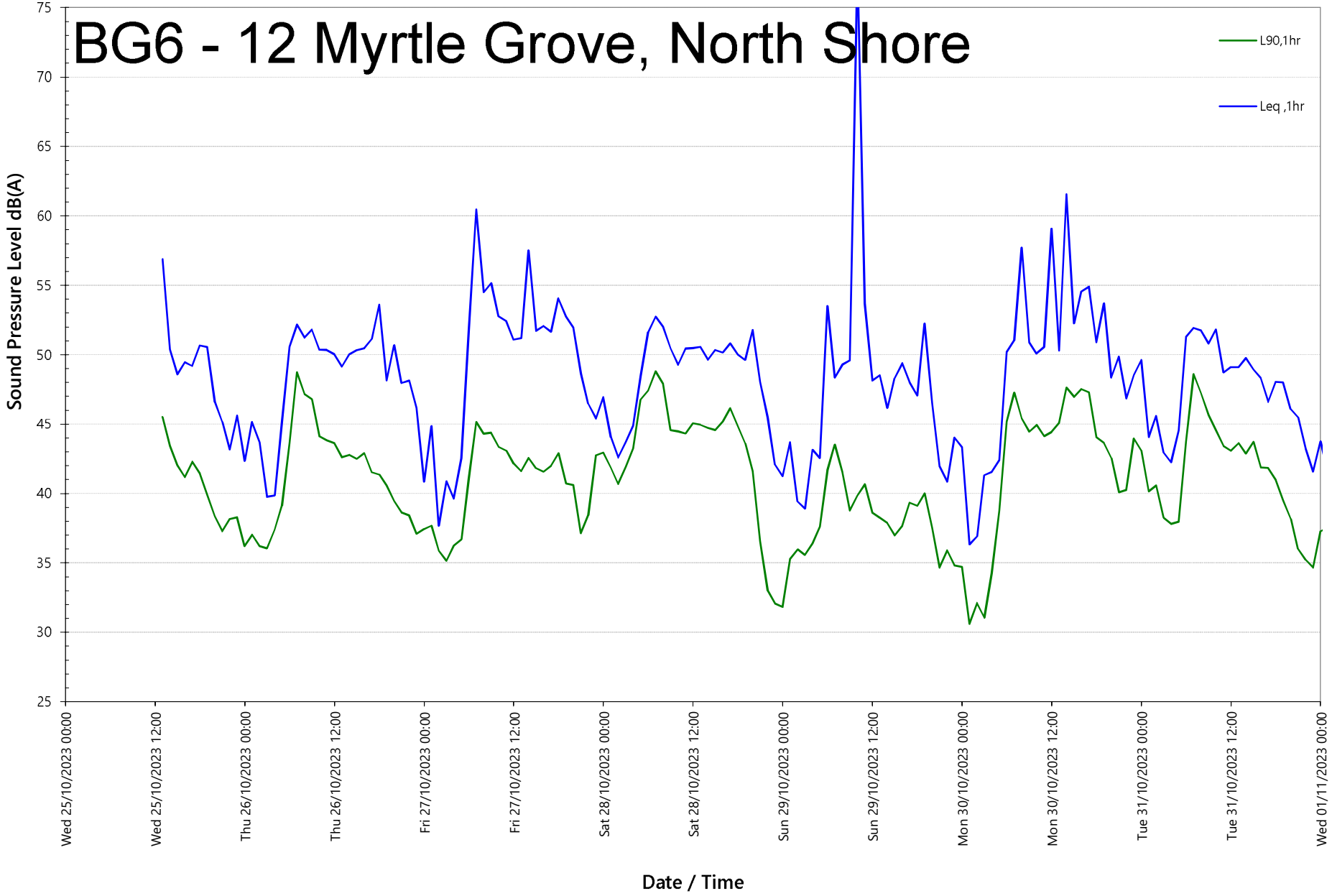
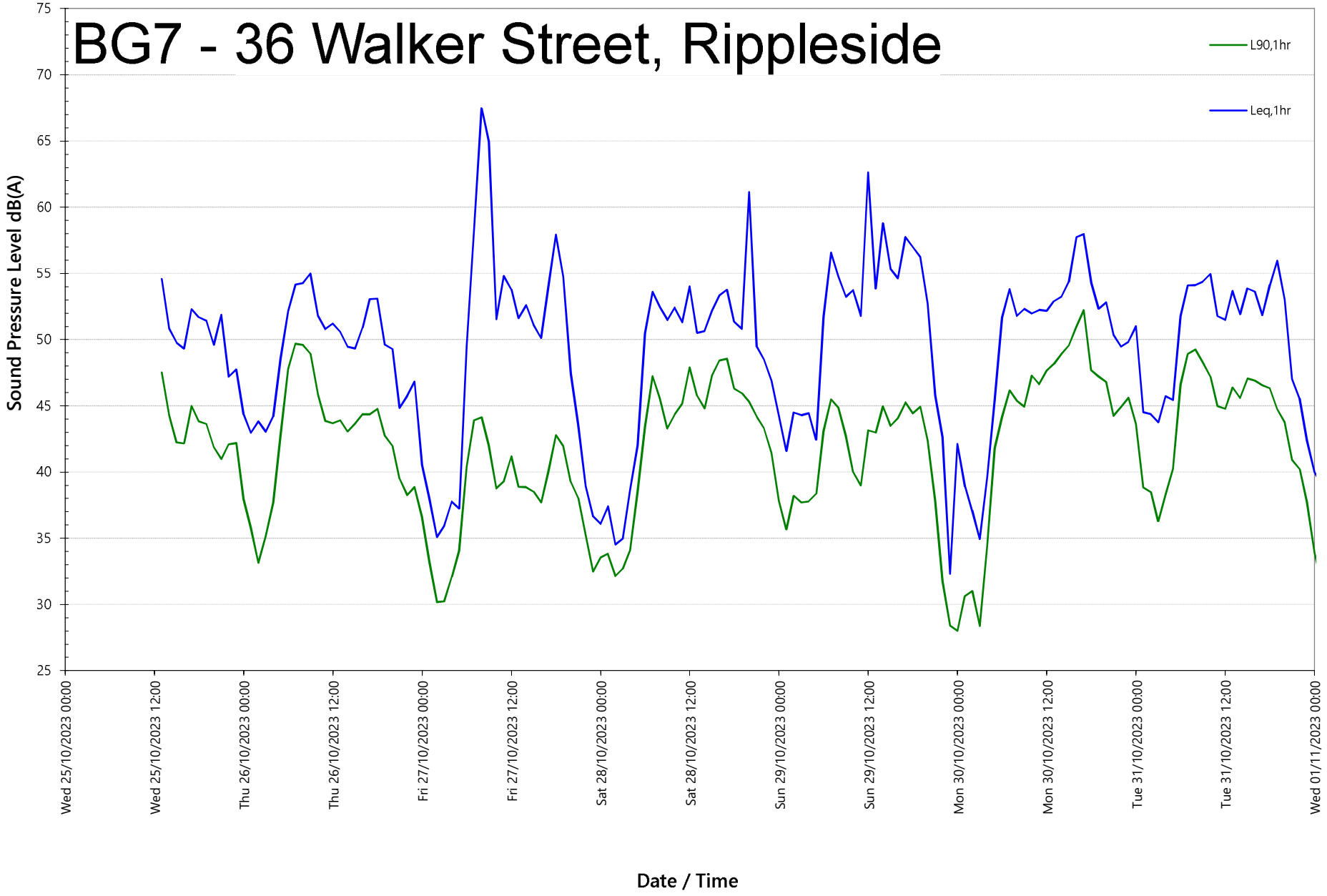
40
35
30
25
Wed 08/11/2023 00:00
Wed 08/11/2023 12:00
Thu 09/11/2023 00:00
Thu 09/11/2023 12:00
Fri 10/11/2023 00:00
Fri 10/11/2023 12:00
Sat 11/11/2023 00:00
Sat 11/11/2023 12:00
Sun 12/11/2023 00:00
Sun 12/11/2023 12:00
Mon 13/11/2023 00:00
Mon 13/11/2023 12:00
Tue 14/11/2023 00:00
Date / Time


BG5 - 19 Zinnia Street, Norlane
L90,1hr
Leq,1hr
Sound Pressure Level dB(A)
75
70
65
60
55
50
45
40
35
30
25
Wed 25/10/2023 00:00
Wed 25/10/2023 12:00
Thu 26/10/2023 00:00
Thu 26/10/2023 12:00
Fri 27/10/2023 00:00
Fri 27/10/2023 12:00
Sat 28/10/2023 00:00
Sat 28/10/2023 12:00
Sun 29/10/2023 00:00
Sun 29/10/2023 12:00
Mon 30/10/2023 00:00
Mon 30/10/2023 12:00
Tue 31/10/2023 00:00
Tue 31/10/2023 12:00
Wed 01/11/2023 00:00
Date / Time


BG6 - 12 Myrtle Grove, North Shore
L90,1hr
Leq ,1hr
Sound Pressure Level dB(A)
75
70
65
60
55
50
45
40
35
30
25
Wed 25/10/2023 00:00
Wed 25/10/2023 12:00
Thu 26/10/2023 00:00
Thu 26/10/2023 12:00
Fri 27/10/2023 00:00
Fri 27/10/2023 12:00
Sat 28/10/2023 00:00
Sat 28/10/2023 12:00
Sun 29/10/2023 00:00
Sun 29/10/2023 12:00
Mon 30/10/2023 00:00
Mon 30/10/2023 12:00
Tue 31/10/2023 00:00
Tue 31/10/2023 12:00
Wed 01/11/2023 00:00
Date / Time


BG7 - 36 Walker Street, Rippleside
L90,1hr
Leq,1hr
Sound Pressure Level dB(A)
75
70
65
60
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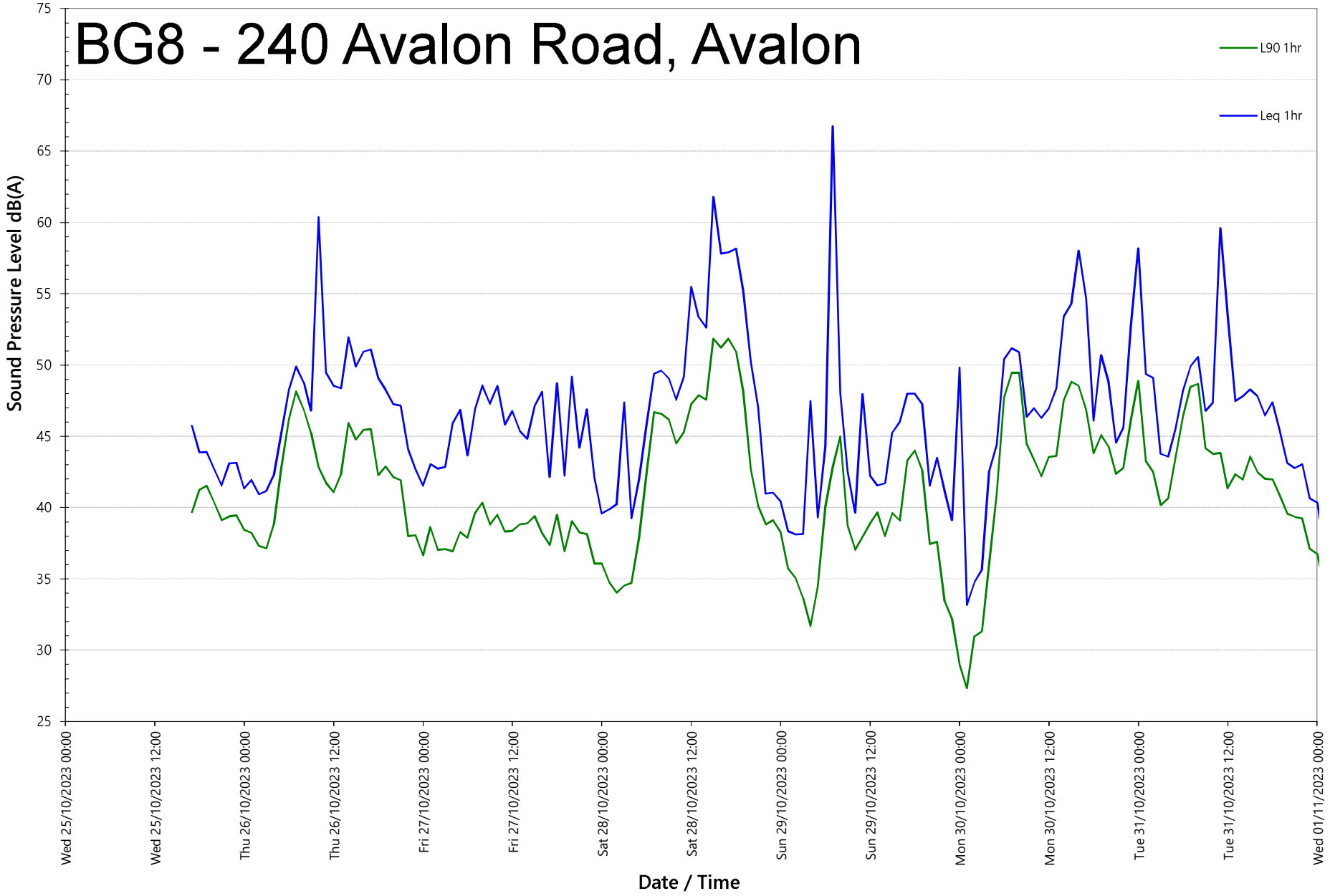
40
35
30
25
Wed 25/10/2023 00:00
Wed 25/10/2023 12:00
Thu 26/10/2023 00:00
Thu 26/10/2023 12:00
Fri 27/10/2023 00:00
Fri 27/10/2023 12:00
Sat 28/10/2023 00:00
Sat 28/10/2023 12:00
Sun 29/10/2023 00:00
Sun 29/10/2023 12:00
Mon 30/10/2023 00:00
Mon 30/10/2023 12:00
Tue 31/10/2023 00:00
Tue 31/10/2023 12:00
Wed 01/11/2023 00:00
Date / Time


BG8 - 240 Avalon Road, Avalon
L90 1hr
Leq 1hr
Sound Pressure Level dB(A)
75
70
65
60
55
50
45
40
35
30
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Wed 25/10/2023 00:00
Wed 25/10/2023 12:00
Thu 26/10/2023 00:00
Thu 26/10/2023 12:00
Fri 27/10/2023 00:00
Fri 27/10/2023 12:00
Sat 28/10/2023 00:00
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Mon 30/10/2023 00:00
Mon 30/10/2023 12:00
Tue 31/10/2023 00:00
Tue 31/10/2023 12:00
Wed 01/11/2023 00:00
Date / Time

APPENDIX C AECOM revised noise modelling assessment

Prepared for
Viva Energy
ABN: 46 004 610 459

Revised Noise Modelling Results

27-Jun-2024

Table of Contents

1.0 Revised Assessment

This noise modelling assessment has been revised to reflect changes in the design and clarifications on typical operational conditions, plus to reduce the noise emissions so far as reasonably practicable.

1.1 Modelling Scenarios

The operational scenarios modelled in the EES are shown below in Table 1-1. EES Scenario 1 is the equivalent of Scenario 6a in Table 1-2 and EES Scenario 4 is the equivalent of Scenario 2 in Table 1-2 noting that the naming convention used in the EES has been replaced with most frequently occurring operating scenarios listed first e.g. in Table 1-2 Scenario 1 would occur the most days throughout the year and Scenarios 6 and 6a the least days.

Scenario 6a (formerly EES Scenario 1) remains the 'worst case' operating scenario. However as explained in the EES, closed loop is not the preferred FSRU operating mode and this scenario would only occur under 'emergency' conditions should the seawater transfer pipe from the FSRU to the refinery cooling water intake not be operational.

All scenarios in both the EES and revised modelling include nitrogen injection at the treatment facility.

All scenarios in the revised modelling include peak regasification send-out which continues a conservative approach. The revised modelling also includes an additional scenario (Scenario 3 in Table 1-2) involving FSRU operation and nitrogen unloading at the treatment facility.

Table 1-2 also presents the expected frequency and duration of each modelled scenario in a typical year.

Table 1-1 Operational scenarios modelled in the EES

Scenario	Stage	Description
1	FSRU operation (closed loop), LNG carrier berthing and nitrogen unloading	• FSRU operation in closed loop mode • Peak regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • LNG carrier mooring with four tugs • Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility
2	FSRU operation (closed loop) and LNG carrier berthed	• FSRU operation in closed loop mode • Peak regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • LNG carrier moored next to FSRU • Nitrogen injection at the treatment facility
3	FSRU operation (closed loop) only	• FSRU operation in closed loop mode • Typical regasification send-out (Two trains / up to 300,000 m^3/day seawater consumption)

Scenario	Stage	Description
		• Nitrogen injection at the treatment facility
4	FSRU operation (open loop) and LNG carrier berthed	• FSRU operation in open loop mode • Peak regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • LNG carrier moored next to FSRU • Nitrogen injection at the treatment facility
5	FSRU operation (closed loop), LNG carrier berthed and nitrogen unloading	• FSRU operation in closed loop mode • Peak regasification send-out (Three trains / up to 350,000 m^3/day seawater consumption) • LNG carrier moored next to FSRU • Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility

Table 1-2 Operational scenarios modelled for the supplementary noise impact assessment

Scenario	Stage	Description	Frequency and duration	Days per year scenario occurs	% of days in a calendar year scenario occurs
1	FSRU operation (open loop) only	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m3/day seawater consumption) • Nitrogen injection at the treatment facility	Standard operation	254.779	69.80%
2	FSRU operation (open loop) with LNG carrier berthed	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m3/day seawater consumption) • LNG carrier moored next to FSRU • Nitrogen injection at the treatment facility	LNG carrier berthed 36 hours for up to 45 times per year (every 8 days during peak demand period),	58 .174	15.94%
3	FSRU operation (open loop) and nitrogen unloading	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m3/day seawater consumption) • Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility.	Anticipated that five nitrogen trucks per day would travel to site for 120 days of the year (winter months) and three nitrogen trucks per day would travel to site for a further 120 days of the year. There would be no nitrogen truck deliveries/unloading for the remaining days of the year Unloading activities to take one hour and 15 minutes each delivery.	40.441	11.08%

Scenario	Stage	Description	Frequency and duration	Days per year scenario occurs	% of days in a calendar year scenario occurs
4	FSRU operation (open loop), LNG carrier berthed and nitrogen unloading	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m3/day seawater consumption) • LNG carrier moored next to FSRU • Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility	LNG carrier berthed 36 hours for up to 45 times per year (every 8 days during peak demand period). Anticipated that five nitrogen trucks per day would travel to site for 120 days of the year (winter months) and three nitrogen trucks per day would travel to site for a further 120 days of the year. There would be no nitrogen truck deliveries/unloading for the remaining days of the year Unloading activities to take one hour and 15 minutes each delivery.	9.234	2.53%
5	FSRU operation (open loop) and LNG carrier berthing	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m3/day seawater consumption) • LNG carrier mooring with four tugs • Nitrogen injection at the treatment facility	LNG carrier berthing for less than one hour up to 45 times (every 8 days during peak demand period),	1.616	0.44%
6	FSRU operation (open loop), LNG carrier berthing and nitrogen unloading	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m3/day seawater consumption) • LNG carrier mooring with four tugs • Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility	LNG carrier berthing for less than one hour up to 45 times (every 8 days during peak demand period). Anticipated that five nitrogen trucks per day would travel to site for 120 days of the year (winter months) and three nitrogen trucks per day would travel to site for a further 120 days of the year. There would be no nitrogen truck deliveries/unloading for the remaining days of the year Unloading activities to take one hour and 15 minutes each delivery.,	0.256	0.07%
6a	FSRU operation (closed loop), LNG carrier berthing and nitrogen unloading	• FSRU operation • Regasification send-out (Three trains / up to 350,000 m3/day seawater consumption) • LNG carrier mooring with four tugs	FSRU closed loop operation occurs only in an 'emergency' should the seawater transfer pipe not be operational. LNG carrier berthing for less than one hour up to 45	0.0004	0.0001%

Scenario	Stage	Description	Frequency and duration	Days per year scenario occurs	% of days in a calendar year scenario occurs
		• Nitrogen injection at the treatment facility • Nitrogen unloading at the treatment facility	times (every 8 days during peak demand period). Anticipated that five nitrogen trucks per day would travel to site for 120 days of the year (winter months) and three nitrogen trucks per day would travel to site for a further 120 days of the year. There would be no nitrogen truck deliveries/unloading for the remaining days of the year Unloading activities to take one hour and 15 minutes each delivery.		

1.2 Updates to the Noise Model

The following updates have been applied to the noise model to reflect design optimisation and clarifications on operational conditions:

- The number of FSRU engine exhaust stacks reduced from 4 sources to 3, to reflect redundancy.
- The number of FSRU boiler exhaust stacks reduced from 3 sources to 2, to reflect redundancy.
- The number of LNG carrier engine exhaust stacks reduced from 4 sources to 3, to reflect redundancy.
- Marine loading arm reduced from 2 noise sources to 1 source, to reflect redundancy.
- Pierhead air compressor and transformer removed from the model due to design optimisation.
- Treatment Facility Nitrogen Tanker Pump reduced from 2 sources to 1 source (only one will be operational during any 30-minute period).).
- Treatment Facility electric trim heater and gantry ventilation fans removed from model due to design optimisation.
- Treatment Facility Liquid Nitrogen Pump reduced from 4 sources to 3, to reflect redundancy.
- Tug noise source locations relocated to reflect the mooring scenario more accurately.

The revised tug locations were extracted from a LNG Carrier Simulation report dated 12 March 2021 provided by Viva Energy. The figure used to determine the location of tugs during LNG carrier berthing extracted from the report is presented in Figure 1. Noting that the modelled locations of the FSRU, LNG carrier, pierhead and treatment facility are as described in the EES.

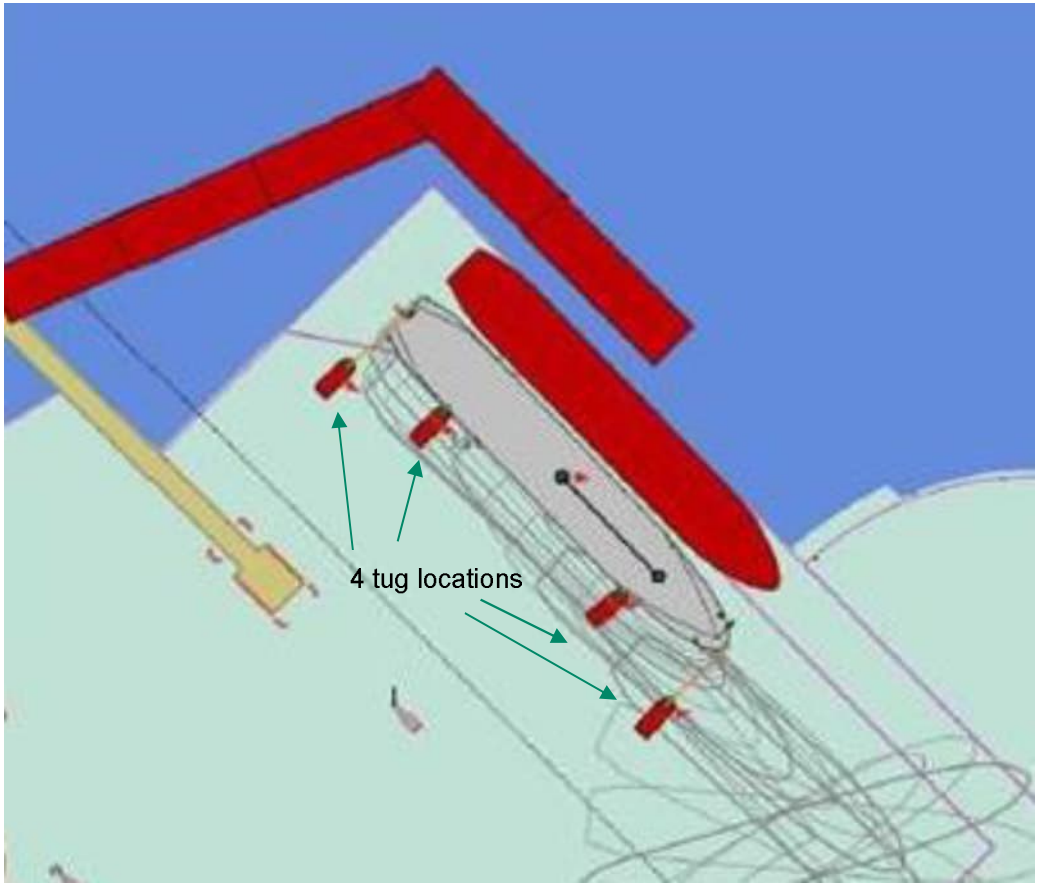

Figure 1 Tug Berthing Locations (Data Source: Viva Energy)

Note, Table 1-3 reflects the changes to the noise model inputs based on the revised project scenarios detailed in Table 1-2. These scenarios update the operational noise level information for project plant and equipment provided in the Noise and Vibration Impact Assessment Report for the EES.

Table 1-3 Operational sound power level for project plant and equipment

Ref	Source	Assumed Sound Power Level	Sound Power Level (dB) per Octave Band (Hz)							Scenario						
			63	125	250	500	1000	2000	4000	1	2	3	4	5	6	6a
FSRU																
F1	FSRU Engine room walls and roof	50 dBA per m^2	41	49	46	51	47	36	24	✓	✓	✓	✓	✓	✓	✓
F2	FSRU Engine exhaust[1] (3 of 4)	100 dBA per flue	98	99	96	98	90	96	89	✓	✓	✓	✓	✓	✓	✓
F3	FSRU Regasification boiler exhaust[1] (2 of 3)	99 dBA per flue	107	102	96	95	93	91	91							✓[2]
F4	Control valves	93 dBA per valve	52	60	68	76	84	89	88	✓	✓	✓	✓	✓	✓	✓
LNG Carrier																
L1	LNG carrier Engine room walls and roof	50 dBA per m^2	41	49	46	51	47	36	24		✓		✓	✓	✓	✓
L2	LNG carrier Engine exhaust via flues [1] (3 of 4)	100 dBA per flue	98	99	96	98	90	96	89		✓		✓	✓	✓	✓
L3	Tugboat exhaust	105 dBA per boat	121	116	108	100	92	90	88					✓	✓	✓
Pierhead 2																
L4	Step-up transformer[1] (removed)	90 dBA	93	95	90	90	84	79	74	-	-	-	-	-	-	-
L5	Instrument air compressor[1] (removed)	91 dBA	91	92	91	81	85	86	81	-	-	-	-	-	-	-

Ref	Source	Assumed Sound Power Level	Sound Power Level (dB) per Octave Band (Hz)							Scenario						
			63	125	250	500	1000	2000	4000	1	2	3	4	5	6	6a
L6	Marine loading arm[1] (1 of 2)	100 dBA	100	107	106	98	88	77	65	✓	✓	✓	✓	✓	✓	✓
Treatment Facility																
T1	Gas pipework	68 dBA per metre	42	46	52	61	64	61	61	✓	✓	✓	✓	✓	✓	✓
T2	Control valve at nitrogen mixing point	83 dBA	41	49	57	65	73	78	77	✓	✓	✓	✓	✓	✓	✓
T3	Vaporiser fans	85 dBA per fan	87	83	83	80	81	77	73	✓	✓	✓	✓	✓	✓	✓
T4	Electric TRIM heater[1] (removed)	93 dBA	99	98	95	91	87	81	76	-	-	-	-	-	-	-
T5	Liquid nitrogen pumps[1] (3 of 4)	93 dBA per pump	83	84	86	86	89	86	82			✓	✓		✓	✓
T6	Nitrogen unloading tanker pump [1] (1 of 2)	101[1] dBA per tanker pump	103	98	95	95	97	94	88			✓	✓		✓	✓
T7	Nitrogen tanker movement	68 dBA per metre	71	65	63	67	64	59	51			✓	✓		✓	✓
T8	Gantry Ventilation Fans x 2[1] (removed)	88 dBA per fan	90	86	86	83	84	80	76	-	-	-	-	-	-	-

Notes

1. Noise source change from EES assessment shown in red.
2. FSRU Regasification Boiler exhaust only used during closed loop operating mode.

1.2.1 Noise Attenuation Measures

To further reduce the noise emissions at the closest noise sensitive receivers, the following noise attenuation measures have been incorporated into the noise model:

- The pipeline from the shoreline to the treatment facility is treated as being underground. The pipeline extending from the shoreline to the Refinery Pier extension Pierhead remains aboveground.
- A 3 metre high noise wall located at the treatment facility to remove line of sight from the Control valve, Vaporiser fans and Liquid nitrogen pumps to the noise sensitive receivers located to the east, west and north of the facility.

It should be noted the anticipated nitrogen tanker movement/unloading is a conservative estimation and would be dependent on how rich or lean incoming LNG cargoes are. The anticipated tanker movements are based on a worst-case amount of nitrogen required for cargoes. The higher frequency of tanker movements would occur during the winter months. To reduce the risk of noise emissions from the anticipated tanker movement and nitrogen unloading activities, an additional proposed contingency measure is to restrict nighttime deliveries of nitrogen to the treatment facility.

The predicted noise levels in Table 1-4 assume the above measures are implemented.

1.3 Assessment

1.3.1 Meteorological Conditions

Both neutral and noise enhancing meteorological conditions were considered, with the following parameters:

- Neutral meteorological conditions – Pasquill-Gillford stability category D with wind speed up to 0.5 m/s at 10 m.
- Noise enhancing meteorological conditions – Pasquill-Gillford stability category D with wind speed up to 3 m/s at 10 m.

1.3.2 Revised Predicted Noise Levels

Table 1-4 presents the results of the updated noise modelling and the predicted noise levels at the noise sensitive receiver locations based on the inputs outlined above in Section 1.2.

The predicted operational noise levels include measures discussed in Section 1.2.1. Noise levels predicted with noise enhancing meteorological conditions are provided in brackets () in Table 1-4.

Table 1-4 Predicted noise modelling results

Location	Noise Sensitive Receiver Locations	Predicted Noise Levels LAeq,30min dB (Noise Enhancing Conditions)						
		Scenario 1 open loop	Scenario 2 open loop	Scenario 3 open loop	Scenario 4 open loop	Scenario 5 open loop	Scenario 6 open loop	Scenario 6a closed loop
1	Geelong Grammar, Biddlecombe Avenue and School Road dwellings	35 (39)	38 (42)	36 (39)	38 (42)	39 (43)	40 (43)	40 (43)
2	Macgregor Court, Cummins Road and Rennie Street dwellings	22 (25)	26 (28)	25 (28)	27 (30)	27 (29)	28 (30)	28 (31)
3	North Shore dwellings	28 (31)	38 (42)	28 (31)	38 (42)	39 (43)	39 (43)	40 (43)
	Myrtle Grove, North Shore dwellings	26 (29)	34 (37)	26 (29)	34 (37)	35 (38)	35 (38)	35 (38)
4	Norlane dwellings	27 (30)	35 (38)	28 (31)	35 (38)	37 (40)	37 (40)	37 (40)
5	Princes Highway dwellings	25 (28)	31 (34)	31 (34)	32 (35)	34 (36)	34 (37)	34 (37)
6	Avalon College and Avalon rural dwellings	32 (36)	35 (39)	32 (36)	35 (39)	36 (40)	36 (40)	37 (40)
7	Corio Bay Motel	25 (28)	32 (35)	27 (30)	33 (35)	34 (37)	35 (37)	35 (38)
8	Gateway Hotel	23 (26)	29 (32)	23 (26)	29 (32)	31 (33)	31 (34)	31 (34)

ANNEXURE

Viva Energy Gas Terminal Project

Annexure 1: Noise assessment mitigation and contingency measures

Version	Prepared By	Reviewed By	Date
01	[redacted]	[redacted]	4 July 2024
02	[redacted]	[redacted]	13 August 2024

Contents

1.0 Introduction

Viva Energy is proposing to develop a Gas Terminal at, and adjacent to, the existing Geelong Refinery in an industrial port in Corio Bay (**Project**).

An assessment of the potential noise impacts of the Project was undertaken, and mitigation measures proposed, as part of the original EES in Technical Report I Noise and Vibration Impact Assessment prepared by AECOM (**EES Noise Study**).

Viva Energy has prepared a Supplementary Statement, which has involved the commissioning of a supplementary noise technical report to respond to Recommendation 10 in Table 1 of the Minister for Planning's Directions for the Supplementary Statement.

The preparation of the Supplementary Noise Technical Report involved iterative processes as noise criteria were progressively established and confirmed / refined and noise minimisation was investigated.
The Supplementary Noise Technical Report includes noise predictions which indicate that cumulative noise from existing industries plus the Project are likely to result in effective noise levels set by the Regulations that exceed applicable noise limits at two receiver areas, relevantly receivers at Geelong Grammar School (**GGS**) and within the North Shore area. Moreover, the Supplementary Noise Technical Report identifies that noise from existing industry is likely to exceed noise limits at these receivers currently.

In light of the above, for the Project to not contribute to the effective noise level set by the Regulations at GGS and in the North Shore area, the noise from the Project at those receivers needs to be 10dB below the recalculated noise limits. The same approach to setting targets has been applied at other receivers to ensure that the Project's noise does not contribute to an effective noise level that may exceed the noise limits set by the Regulations at that receiver. These targets of 10dB below the noise limits for the project noise levels (i.e., noise levels at receivers from the noise emissions of the Project only) are referred to as the 'Project Noise Criteria' in the Supplementary Noise Technical Report.

'Baseline' noise modelling predictions from the Supplementary Noise Technical Report are presented in Appendix C of that report. That 'baseline' assessment shows reductions in noise from the Project from the modelling presented in the original EES, but still shows a contribution from the Project to effective noise levels above the noise limits at GGS and North Shore. Accordingly, further mitigations needed to be developed and tested to determine what is needed to achieve the Project Noise Criteria for all receivers. This Annexure reports upon that further work. It shows the project refinements, mitigations and contingency measures that will enable the Project to meet the Project Noise Criteria for all receivers.

2.0 Assessment process

2.1 EES Noise Study

The EES Technical Report I: Noise and Vibration Impact Assessment (EES Noise Study) modelled scenarios were based on worst case operating scenarios and conservative estimates for operating parameters and sound power levels. The assumptions in EES Noise Study section 7.3 included:

- Prevailing weather conditions for worst case source to receiver noise propagation.

- Closed loop FSRU operation for the majority of scenarios, noting open loop is the preferred operating mode whereas closed loop is only needed during emergency maintenance situations (specifically, if the seawater transfer pipe requires maintenance).
- All noise sources occurring concurrently.
- All assumed noise inputs were taken from the most conservative source data available.

2.2 Supplementary Noise Study

The supplementary noise modelling assessment (prepared by AECOM and reported on in Appendix C of the Supplementary Noise Technical Report) was revised from the modelling in the original EES to reflect design optimisation and closer analysis of realistic operational scenarios.

2.3 Application of further mitigations and contingency measures

The modelling reported on in Appendix C of the Supplementary Noise Technical Report shows reductions in noise from the original EES Noise Study, but still shows a contribution from the Project to effective noise levels above the noise limits at GGS and North Shore. Accordingly, it was necessary to develop and assess further mitigations.

The process of the further work was to:

- Identify all key noise sources.
- Rank the emissions from each of the key sources based on contribution to offsite noise (i.e. at the noise sensitive receiver) as either Low (L), Medium (M), or High (H). Refer to section 2.3.1 for detail.
- If possible, remove any noise sources that are possible to be designed out.
- Identify any potential mitigations for the key noise emission contributors.
- Review operating parameters to determine if there are any opportunities to improve noise emissions based on operational requirements.
- Re-run model.
- Propose any additional contingency measures required to ensure Project does not contribute to the effective noise level that may exceed the noise limits set by the Regulations.

The process is iterative and to be completed at each stage of project design to ensure all reasonably practicable measures have been considered to reduced noise emissions. The findings of these elements of further work are explained below.

2.3.1 Identify and rank all noise sources

The sound power levels for Project plant and equipment[1] were ranked based on the Leq dB(A) that would be experienced under noise enhancing weather conditions. The ranking system was determined by the potential contribution of the plant and equipment to the overall noise level at GGS and North Shore dwellings.

Table 1: Noise source ranking levels

Ranking	Leq dB(A)
H	>30dB
M	20-30dB
L	<20dB

[1] as specified in Appendix D: Revised Noise Modelling Assessment.

2.3.2 Removal of noise sources

Through front end engineering design review, noise sources were able to be identified and removed from the Project design. These are listed below (with their Source Reference No.):

- Step-up transformer on the pier head (L4).
- Instrument air compressor on the pier head (L5).
- Electric trim heater at the treatment facility (T4).
- Gantry ventilation fans (T8).
- Nitrogen offloading at the treatment facility: Only one pump would be required to be operational. In addition, nitrogen offloading (i.e. tanker pumping) and nitrogen tanker movements cannot occur simultaneously. Nitrogen tanker movement is the higher contributing noise source and therefore has been modelled (T6).

2.3.3 Operating parameter assumptions

A number of noise sources were reviewed based on Project operational requirements and redundancy in design. The design of the Project includes spare equipment so that the Project can operate with some redundancy, but which is not actually operated concurrently. The Project design review has identified the following reductions in plant operation that result in reductions from the modelling assumptions in Appendix C. An operational management plan will be developed, supported by documented evidence that details the approach that will be taken to meet the Project Noise Criteria in accordance to MM-NV05:

- FSRU engine exhaust (F2): To meet peak winter demand, only 2 trains would be required to run (summer months demand less). Therefore 2 trains have been modelled instead of 3 as per Appendix C.
- Regasification boiler (F3): Boiler is required for closed loop operation only. In the unlikely event that closed loop operation is required only one boiler would be required and has therefore been modelled, instead of two as per Appendix C.
- LNG carrier engine exhaust (L2): 2 ship engines required for LNG offloading activities, instead of 3 as per Appendix C.
- Treatment facility vapouriser fan (T3): 2 fans are required to run, instead of 3 as per Appendix C.
- Liquid nitrogen pumps (T5): Only 2 liquid nitrogen pumps are required to run with one on standby, instead of 3 as per Appendix C.

2.3.4 Attenuation assumptions

Acoustic enclosures/boxes/wrapping are proposed where possible around all H or M rated noise sources. These measures (with the exception of the noise wall at the treatment facility) were not considered in the modelling in Appendix C.

Marine Loading arms (L6): Acoustic enclosures / boxing would be installed around the marine loading arm. Further design work including management of velocities through the linework can also be optimised to minimise noise. Acoustic enclosure design will be able to reduce the noise from the marine loading arms. Acoustic panel specification sheets from Flexshield industrial noise control demonstrate potential sound reduction index of up to 37dB therefore to allow for operating parameters and design refinement, a 20dB reduction has been assumed.

Control Valves (F4): According to Fluid Controls Institute (FCI) Control Valve / Regulator Section attenuation of up to 20dB is achievable through acoustic insulation, therefore a noise reduction measure of 15dB has been applied.

Tugboat exhausts (L3): Two new tugboats will be required for the LNG carriers. Damen ASD Tug specification indicate silencers can be fitted to the tug engine room exhaust for a possible attenuation of 45dB therefore a conservative 35dB reduction has been used.

Treatment facility: A 3-metre-high noise wall is proposed at the treatment facility to remove line of sight from the facility plant and equipment to the noise sensitive receivers. The sound wall will be designed to achieve a 10dB reduction from treatment facility at GGS.

FSRU Engine exhaust (F2): Silencers have been assumed on the FSRU engine exhaust. Warsila datasheet specification is for a 35dB reduction with the silencer. A conservative 20dB has been applied.

LNG carrier engine exhaust (L2): The LNG carrier engine exhaust sound power level in the EES Noise Study was based on full load of the LNG carrier as it was berthing. Four tugboats will be in use while the LNG carriers are berthing with the LNG carrier engine under idle conditions. For scenarios 5, 6 and 6a, where the LNG carrier is berthing with tugs, a 5dB reduction has been assumed from the Appendix C modelling to account for the changed assumption to an idling rather than full load LNG carrier. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Handbook outlines a calculation for predictions of dB level reduction for full-to-idle measurements. A 'likely' level of conservatism has been applied which equates to a 5dB noise reduction as under idle conditions 20% of the power output is being utilised.

A summary of the source ranking, number of each source modelled at each stage of the assessment and further mitigation measures are outlined below in **Table *1***.

Table 1: Noise source attenuation assessment and mitigation measures

Ref	Source	Assumed sound power level	Rank	No. modelled			Further Work Mitigation and Attenuation Measures
				EES	SS	Further Work	
FSRU							
F0	FSRU deck		M	1	1	1	
F1	Engine room walls and roof	50 dBA per m^2	L	5			
F2	Engine exhaust	100 dBA per flue	H	4	3	2	To meet winter demand, only 2 trains would be required to run (and in summer months demand is less). Therefore 2 trains have been modelled. The engine exhaust is capable of being fitted with a silencer. Warsila datasheet specification is for a 35dBA reduction for the silencer. A conservative 20dBA has been applied.
F3	Regasification boiler exhaust	99 dBA per flue	M	3	2	1	Only a single boiler would be required to run in the highly unlikely event of closed loop operation.
F4	Control valves	93 dBA per valve	M	3	3	3	Acoustic enclosure/boxing would be installed around control valves assuming a 15dB noise reduction based on acoustic insulation specification.
LNG carrier							

L0	LNG Carrier Deck		H	1	1	1	
L1	LNG carrier Engine room walls and roof	50 dBA per m^2	L	5			
L2	LNG carrier Engine exhaust via flues	100 dBA per flue	H	4	3	2	Only 2 engines are required to run to meet demand. During the berthing scenarios, a 5dB reduction has been assume as the LNG carrier engine would be idle and not peak load.
L3	Tugboat exhaust	105 dBA per boat	H/M/L	4	4	2	2 new tugboats will be required as part of the proposal for the LNG Carriers. New tugboats can be fitted with silencers. Possible attenuation of 45dB however a conservative 35dB has been used.
Pierhead							
L4	Step-up transformer	90 dBA	N/A	1	0	0	Removed due to design optimisation.
L5	Instrument air compressor	91 dBA	N/A	1	0	0	Removed due to design optimisation.
L6	Marine loading arm	100 dBA	H	2	1	1	Acoustic enclosure/boxing would be installed around the Marine loading arm, assuming a 20dB noise reduction. This could also be managed through increased diameter for high velocity or reduced throughput.
Treatment Facility							
T1	Gas pipework	68 dBA per metre	M	1	1	1	Acoustic reduction due to pipework in below-grade culvert or potential to bury pipework 15dB attenuation assumed.
T2	Control valve at mixing point	83 dBA	N/A	1	1	0	Through further work control valve not required and removed from scope.
T3	Vaporiser fans	85 dBA per fan	L	4	4	2	Only one fan bank (2 fans) is required to run, due to low noise contribution no further attenuation has been modelled.
T4	Electric Trim heater	93 dBA	N/A	1	0	0	Removed from model due to design optimisation.
T5	Liquid nitrogen pumps	93 dBA per pump	M/L	4	3	2	Only two pumps are required to run. 10dB reduction included due to noise wall at the treatment facility.
T6	Nitrogen offloading tanker pump	101 dBA per tanker	L	2	1	0	The nitrogen tanker will not be moving and pumping at the same time. Higher contributing noise source is the tanker movement (T7) than the tanker pumping (T6) therefore, tanker movement has been modelled.
T7	Nitrogen tanker movement	68 dBA per metre	H	1	1	1	Noise reduction due to gantry mitigation measures 10dB.
T8	Gantry ventilation fans	88 dBA per fan	N/A	2	0	0	Removed from model due to design optimisation.

2.3.5 Predicted project noise levels with mitigation measures

Table 3 below presents the results of the noise modelling with the revised inputs documented in Table 2 above.

With the inclusion of the operating parameter and attenuation assumptions outlined in **Table *1***:

- Scenario 1, scenario 3 and scenario 5 comply with the Project Noise Criteria.

- Scenario 2 has been assessed in two modes, one with the LNG carrier crane in operation required for the connection of the LNG hoses and a second (shown with *) and no crane operation. The second mode of operation also complies with the Project Noise Criteria.
- The remaining scenarios (2 [in part], 4 and 6) remain above the Project Noise Criteria. These scenarios are estimated to occur approximately 10 days per year. Accordingly, to meet the Project Noise Criteria it is expected that further contingency measures will need to be applied. These measures are summarised in Table 4 below.

Table 2: Comparison of predicted noise levels from the project for supplementary statement to predicted noise levels with further mitigation measures.

Location / sensitive receiver location	Predicted project noise levels, $L_{eq,30min}$dB(A) (noise enhancing weather conditions) Complies with Project Noise Criteria (✓/~)														Project Noise Criteria (10 dB below EPA 1826-P1 night noise limit, L_{eq}dB(A)
	Scenario 1 FSRU only		Scenario 2 FSRU + LNG carrier		Scenario 3 FSRU + nitrogen offloading		Scenario 4 FSRU + LNG carrier + nitrogen offloading		Scenario 5 FSRU + LNG carrier berthing		Scenario 6 FSRU + LNG carrier berthing + nitrogen offloading)		Scenario 6a FSRU closed loop + LNG carrier berthing + nitrogen offloading)		
	SS	**Further Work**	SS	**Further Work**	SS	**Further Work**	SS	Further Work	SS	**Further Work**	SS	**Further Work**	SS	**Further Work**	
Geelong Grammar School	35 (39) ✓ (~)	**(22) (✓)**	38 (42) ~ (~)	(37) / **(33*)** (~) / **(✓)**	36 (39) ~ (~)	**(24) (✓)**	38 (42) ~ (~)	(38) (~)	39 (43) ~ (~)	**(30) (✓)**	40 (43) ~ (~)	(37) (~)	40 (43) ~ (~)	(37) (~)	35
12 Myrtle Grove (North Shore dwellings)	26 (29) ✓ (✓)	**(10) (✓)**	34 (37) ~ (~)	(36) / **(26*)** (~) / **(✓)**	26 (29) ✓ (✓)	**(12) (✓)**	34 (37) ~ (~)	(36) (~)	35 (38) ~ (~)	(30) (□)	35 (38) ~ (~)	(37) (~)	35 (38) ~ (~)	(37) (~)	30

2.3.6 Predicted project noise levels with contingency measures

The following table documents the continency measures to satisfy the Project Noise Criteria and corresponding predicted noise levels.

Table 3: Predicted project noise levels with project contingency measures for noise enhancing weather conditions.

Scenario	Activity	Days per year scenario occurs	% of days per year scenario occurs	Predicted project noise level at Geelong Grammar School under noise enhancing weather conditions, Leq,30min dB(A) Complies with Project Noise Criteria (✓/~)	Predicted project noise level at North Shore Dwellings under noise enhancing weather conditions, Leq,30min dB(A) Complies with Project Noise Criteria (✓/~)	Contingency measure
2	FSRU operation open loop with LNG carrier berthed	58 .174	15.94%	33 ✓	26 ✓	Crane operations to cease at night during noise enhancing weather conditions. Crane operation is the main noise source on deck (L0). Cranes are only required to connect LNG carrier hoses. This task would occur for less than 1hr. This would decrease Project noise levels at GGS

						from 37dB to 33dB and from 36 dB to 26 dB at North Shore dwellings under noise enhancing weather conditions.
4	FSRU operation open loop, LNG carrier berthed and nitrogen offloading	9.234	2.53%	33 ✓	26 ✓	Nitrogen offloading to cease during noise enhancing weather conditions. Project operations would revert to Scenario 2.
6	FSRU operation open loop, LNG carrier berthing and nitrogen offloading	0.256	0.07%	34 ✓	30 ✓	Nitrogen offloading to cease during noise enhancing weather conditions and the Project operations to revert to Scenario 5.
6a	FSRU operation closed loop, LNG carrier berthing and nitrogen offloading	0.0004	0.00%	34 ✓	30 ✓	Nitrogen offloading to cease during noise enhancing weather conditions and the Project operations to revert to Scenario 5.

3.0 Conclusion

Further work has been undertaken to investigate how noise emissions from the project can be further reduced consistent with the GED.

This Annexure demonstrates that with the implementation of mitigation and contingency measures such as equipment silencers, acoustic enclosures/wrapping and scheduling of night time activities, such as crane activities and nitrogen deliveries, noise from the Project can be maintained within the Project Noise Criteria for all receivers.

An operational management plan will be developed, supported by documented evidence that details the approach that will be taken to meet the Project Noise Criteria in accordance with mitigation measure MM-NV05.

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