

Attachment 3





CDC HA1

178-196 Bushmead Road WA

Acoustic Report for Development Application

Project No. P03161

Revision 6

Issued 26 August 2026

Client CDC

E-LAB Consulting

Where science and engineering inspire design.

Document QA and Revisions

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Authorised by:

E-LAB Consulting



André Verstappen | Technical Director
Acoustics & Vibration

EXECUTIVE SUMMARY

This Noise Impact Assessment has been prepared for the proposed CDC Hazelmere (HA1) development at 178-196 Bushmead Road, Hazelmere, WA, to address EPA guidelines.

The assessment included:

- Determination of site-specific noise limits in accordance with Western Australian Environmental Protection (Noise) Regulations 1997 (WA EPNR).
- Detailed 3D noise modelling of project plant, built form, and recommended acoustic treatments.

Predicted noise emissions from project equipment are expected to comply with applicable EPNR limits at all sensitive receiver locations under typical operation and maintenance testing scenarios provided the recommended acoustic treatments are adopted.

An additional assessment under total power failure conditions has also been undertaken to assess noise impact at nearby residential uses during the night period. The assessment has found that EPNR limits are predicted to be met at these locations provided the recommended acoustic treatments are adopted.

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1 INTRODUCTION

E-LAB Consulting has been engaged by Canberra Data Centres (CDC) to assess the environmental noise impacts for a Development Application associated with the proposed data centre development located at 178-196 Bushmead Road, Hazelmere, WA.

This acoustic report presents the environmental noise criteria for the development and assesses the anticipated noise emissions resulting from operation of the site against the applicable noise emission criteria.

This report has been prepared considering the following documents:

- Western Australian Environmental Protection (Noise) Regulations 1997 (WA EPNR)
- Draft Hazelmere Special Use Zone 16 Structure Plan
- Architectural drawings provided by CDC and project consultants
- Indicative equipment selections, quantity, and acoustic performance data as provided by CDC

This report is based on our understanding of the proposed project, application of the relevant standards and guidelines, and professional experience within the acoustic field.

This report relates to this particular project and must not be applied to any other project without consultation with E-LAB Consulting. Project designs and conditions can vary between projects, causing significant variations in acoustic performance, and relevant subsequent advice to one project may not apply to another.



2 PROJECT OVERVIEW

2.1 SITE DESCRIPTION

The subject site is situated at 178-196 Bushmead Road, Hazelmere, in an area that includes both industrial and residential land uses.

The development includes two interconnected buildings, and the layout of the project site is shown in Figure 1 below.

Figure 1: Site Plan



Source: EJE Architects



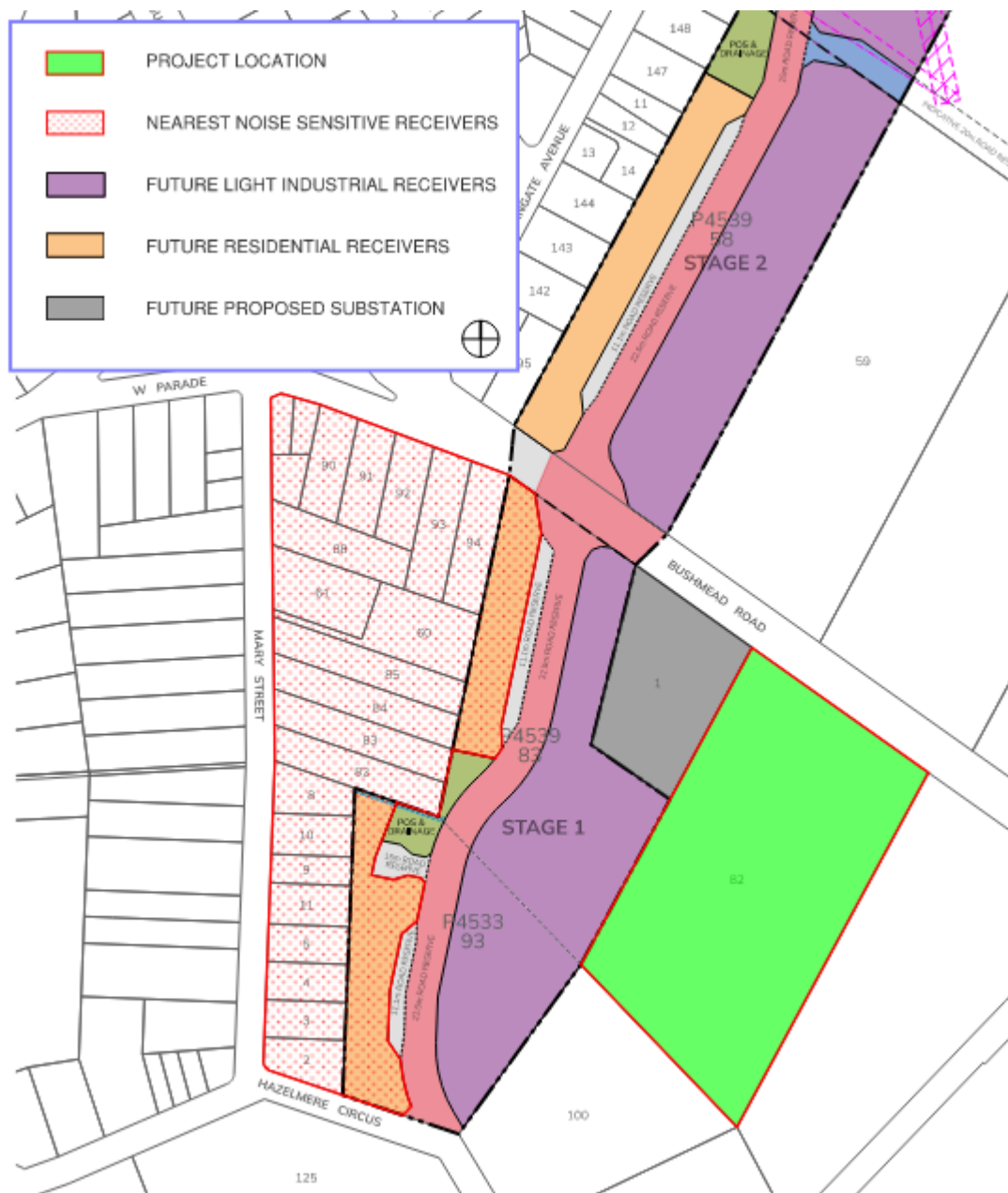
2.2 SITE SURROUNDINGS

The project interfaces with Industrial developments to the north and east, special use zoned land to the immediate west and south, and residential uses further to the west.

It is noted that 167, 170, and 178 Bushmead Road fall under a special use zone in accordance with the City of Swan's Local Planning Scheme No. 17, and Draft Special Use Zone 16 Structure Plan. The SUZ16 plan identifies the proposed Eric Lumsden Drive, which will bisect Lot 83 Bushmead Rd and Lot 93 Hazelmere Circus as shown in Figure 2 below. Under this structure plan, the land to the west of the proposed Eric Lumsden Drive is designated for residential use, while the land to the east is allocated for light industrial development.

Consequently, the nearest noise sensitive receivers to the project site have been taken as the future residential uses to the west of the new road.

Figure 2: Site Map



Source: URPS / E-LAB



2.3 HOURS OF OPERATION

The proposed facility is designed for continuous operation to ensure uninterrupted service delivery. Associated office areas are expected to function in line with standard business hours, accommodating typical administrative and support activities.

2.4 KEY ACOUSTIC ISSUES

The dominant sources of operational noise for the proposed development are expected to include:

- Standby generators housed within acoustic enclosures
- Rooftop air-cooled chillers serving the data halls

Noise emission criteria applicable to mechanical plant are outlined in Section 3.1, and the results of the noise modelling assessment are presented in Section 4.6.



3 NOISE EMISSION CRITERIA

3.1 WA ENVIRONMENTAL PROTECTION(NOISE) REGULATIONS 1997

Environmental noise emissions resulting from the development are addressed through the *Environmental Protection Act 1986* with the prescribed standards detailed in the *Environmental Protection (Noise) Regulations 1997* (WA EPNR). The regulations are based on maximum allowable noise levels termed the 'assigned noise level'.

According to the EPNR, noise emissions from any premises are deemed not to significantly impact the receiver if the emissions are 5 dB or less below the assigned levels. In summary, assigned noise levels are set by evaluating the presence of commercial and industrial zones, major transport routes, and sporting venues around noise-sensitive premises.

The assigned levels apply at premises receiving the noise (noise sensitive receiver) and not to areas within the project site or lot. In addition, the Environmental Protection (Noise) Regulations 1997 identify the following in Schedule 3, clause 2A.

- *"If the land within either of the circles is categorised on the land use map as land in respect of which mixed uses are permitted, the use of that land that results in the highest influencing factor is to be used in the determination of the influencing factor."*

Proportions of land use have been extracted from City of Swan's online mapping system (Local Planning Scheme LPS 17) and provided mapping of future land uses associated with the Hazelmere Special Use Zone 16 (SUZ16) Structure Plan. The influencing factor at the nearest noise sensitive receivers has been calculated based on these maps.

As the nearest noise sensitive receivers are located within the future SUZ16 residentially zoned land, and consequently do not have associated street addresses, a description of their location relative to existing addresses has been provided below and their locations provided in Figure 3 to Figure 6.

- Receiver 1: Immediately east of 1 W Parade, Hazelmere WA 6055
- Receiver 2: Immediately east of 9 Mary St, Hazelmere WA 6055
- Receiver 3: Immediately east of 23 Mary St, Hazelmere WA 6055
- Receiver 4: Immediately east of 31 Mary Street, Hazelmere WA 6055

Traffic data for roads surrounding the nearest noise sensitive receiver were obtained from Main Roads Western Australia (MRWA). Table 1 presents the traffic data of the nearby roads.

It has been assumed that the proposed Eric Lumsden Drive (designated District Distributor in the Special Use Area 16 Structure plan) will not carry sufficient traffic volume to be classified as a Major or Secondary Road.

Table 1: Traffic Data (Main Roads WA)

ROAD	WA EPNR CLASSIFICATION	ANNUAL AVERAGE DAILY TRAFFIC VOLUMES / YEAR
Bushmead Road (West of Janet Street)	Secondary Road	6,604 (2021 -22)



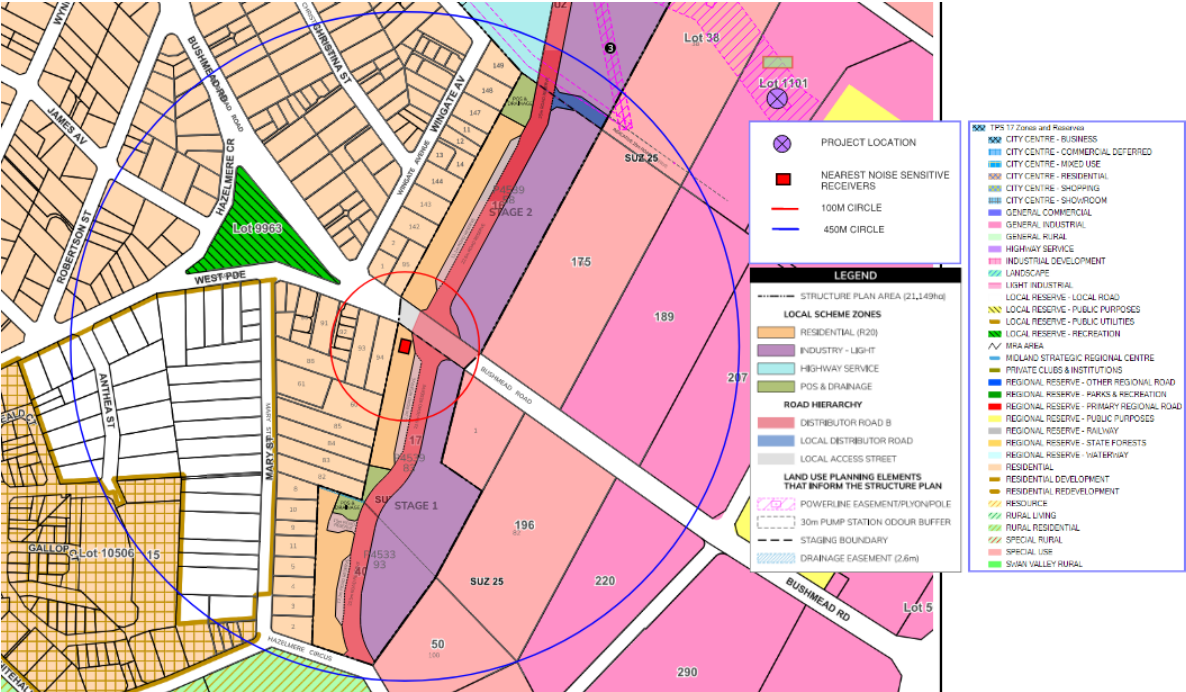
2.1.1 INFLUENCING FACTOR

The influencing factor for results from identifying major roads, commercial and industrial areas for the nearest noise sensitive receivers is detailed in Table 2. The zoning maps used for the calculation of influencing factor showing the land use types has been presented in Figure 3 to Figure 6.

Table 2: Influencing factor (IF) noise sensitive receiver

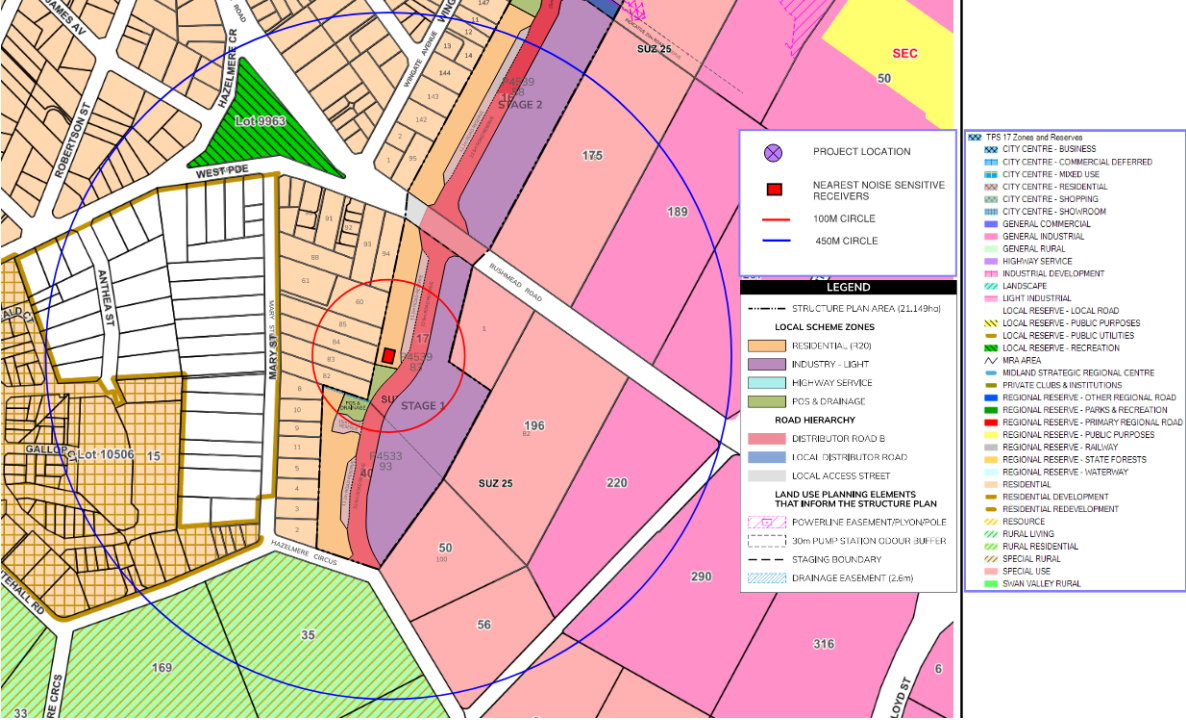
NOISE SENSITIVE RECEIVERS	COMMERCIAL	INDUSTRIAL	ROAD	INFLUENCING FACTOR
Receiver 1	0 % within 100m radius 0 % within 450m radius	14 % within 100m radius 38 % within 450m radius	Bushmead Road within 100m radius	7 dB
Receiver 2	0 % within 100m radius 0 % within 450m radius	27 % within 100m radius 37 % within 450m radius	-	6 dB
Receiver 3	0 % within 100m radius 0 % within 450m radius	26 % within 100m radius 32 % within 450m radius	-	6 dB
Receiver 4	0 % within 100m radius 0 % within 450m radius	21 % within 100m radius 31 % within 450m radius	-	5 dB

Figure 3: Zoning map for the project and surrounding areas – 1 West Parade



Source City of Swan's Intramaps & E-LAB

Figure 4: Zoning map for the project and surrounding areas – 5b Mary St



Source City of Swan's Intramaps & E-LAB



Figure 5: Zoning map for the project and surrounding areas – 15 Mary St

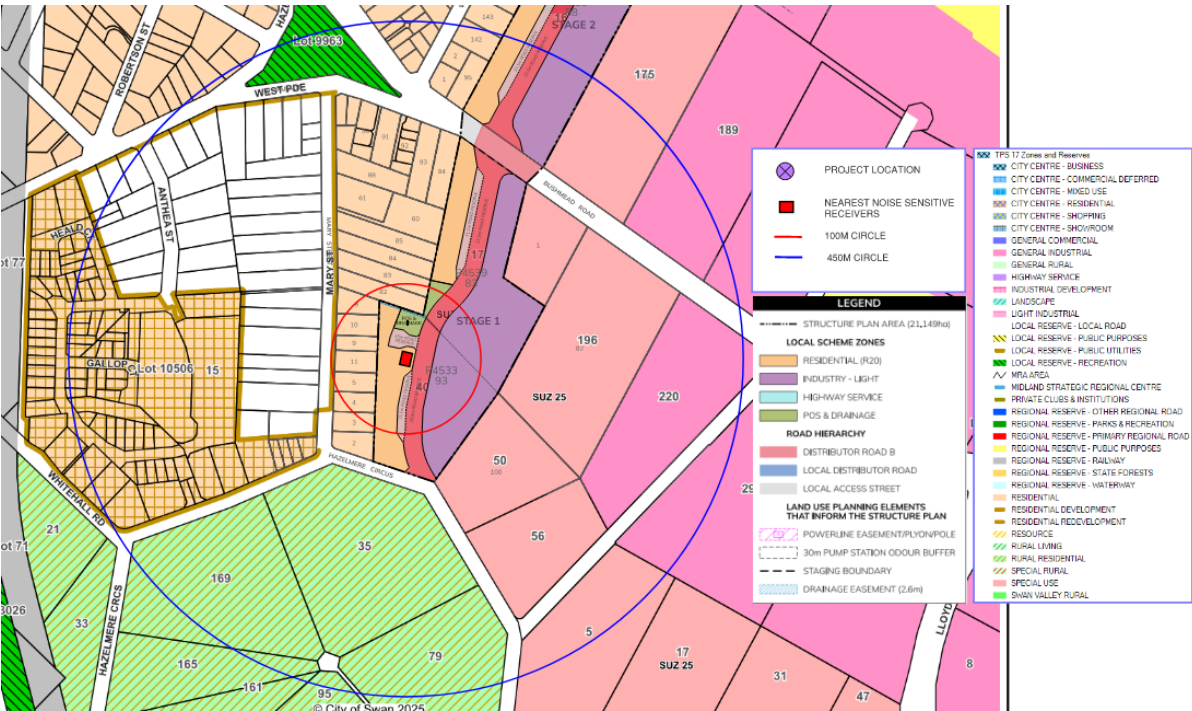
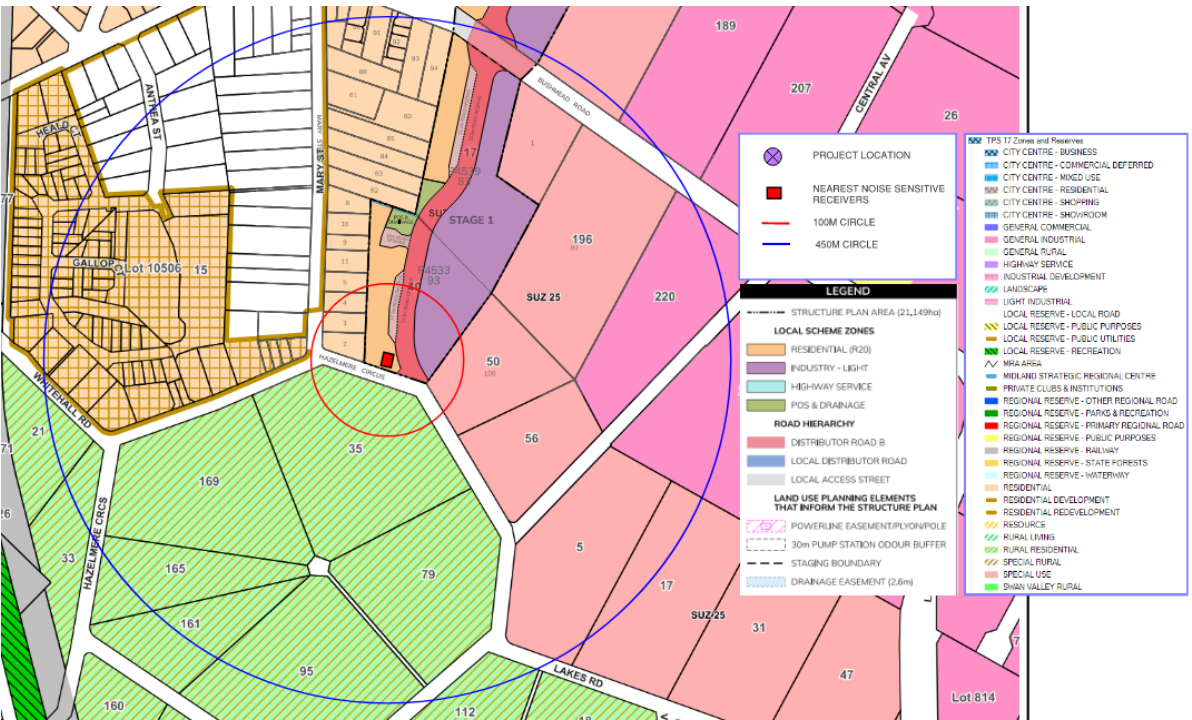


Figure 6: Zoning map for the project and surrounding areas – 31 Mary St



3.1.1 ASSIGNED NOISE LEVELS – NOISE SENSITIVE RECEIVERS

Table 3 summarises the assigned levels at the nearest noise sensitive receivers. Noise emissions from the development are not to exceed the assigned level criteria for all defined time periods. Assigned levels are applicable within the boundary of residential uses, or within 15m from any associated building where residential uses are located at a distance from the interface boundary.

Table 3: Assigned levels – Nearest noise sensitive receivers

LOCATION	TYPE OF PREMISES RECEIVING NOISE	TIME OF DAY	ASSIGNED LEVEL (dBA)		
			LA10	LA1	L _{Amax}
Receiver 1 East of 1 W Parade, Hazelmere WA 6055	Noise sensitive premises: Highly sensitive area	0700 to 1900 hours Monday to Saturday	52	62	72
		0900 to 1900 hours Sunday & public holidays	47	57	72
		1900 to 2200 hours all days	47	57	62
		2200 hours on any day to 0700 hours Monday to Saturday, and 0900 hours Sunday & public holidays	42	52	62
Receiver 2 East of 9 Mary St, Hazelmere WA 6055	Noise sensitive premises: Highly sensitive area	0700 to 1900 hours Monday to Saturday	51	61	71
		0900 to 1900 hours Sunday & public holidays	46	56	71
		1900 to 2200 hours all days	46	56	61
		2200 hours on any day to 0700 hours Monday to Saturday, and 0900 hours Sunday & public holidays	41	51	61
Receiver 3 East of 23 Mary St, Hazelmere WA 6055	Noise sensitive premises: Highly sensitive area	0700 to 1900 hours Monday to Saturday	51	61	71
		0900 to 1900 hours Sunday & public holidays	46	56	71
		1900 to 2200 hours all days	46	56	61
		2200 hours on any day to 0700 hours Monday to Saturday, and 0900 hours Sunday & public holidays	41	51	61
Receiver 4 East of 31 Mary Street, Hazelmere WA 6055	Noise sensitive premises: Highly sensitive area	0700 to 1900 hours Monday to Saturday	50	60	70
		0900 to 1900 hours Sunday & public holidays	45	55	70
		1900 to 2200 hours all days	45	55	60
		2200 hours on any day to 0700 hours Monday to Saturday, and 0900 hours Sunday & public holidays	40	50	60
TYPICAL	Noise sensitive premises: any area other than highly sensitive areas	All Hours	60	75	80
	Commercial premises	All Hours	60	75	80
	Industrial and utility premises	All Hours	65	80	90



3.1.2 NOISE CHARACTER ADJUSTMENTS

Regulation 7 of WA EPNR states that the noise character must be “free” of annoying characteristics, namely

- Tonality, e.g. whining, droning;
- Modulation, e.g. like a siren; and
- Impulsiveness, e.g. banging, thumping.

Regulation 9 (1) establishes the methodology for determining noise characteristics. If these characteristics cannot be reasonably and practicably removed, a series of adjustments to the measured levels are required, indicated in Table 4.

Table 4: Noise character adjustment

ADJUSTMENT WHERE NOISE EMISSION IS NOT MUSIC THESE ADJUSTMENTS ARE CUMULATIVE TO A MAXIMUM OF 15 dB		
Where tonality is present	Where modulation is present	Where impulsiveness is present
+ 5 dB	+ 5 dB	+ 10 dB



4 NOISE IMPACT ASSESSMENT

4.1 METHODOLOGY

In order to assess the noise emission impacts for the development, the following methodology has been applied:

1. Identify the statutory noise regulations for the site
2. Identify the nearest affected residential receivers
3. Establish the project specific noise emission criteria
4. Produce a 3D acoustic model for the project site based on provided indicative equipment selections, quantities, locations, and operating conditions, along with provided built form of the site.

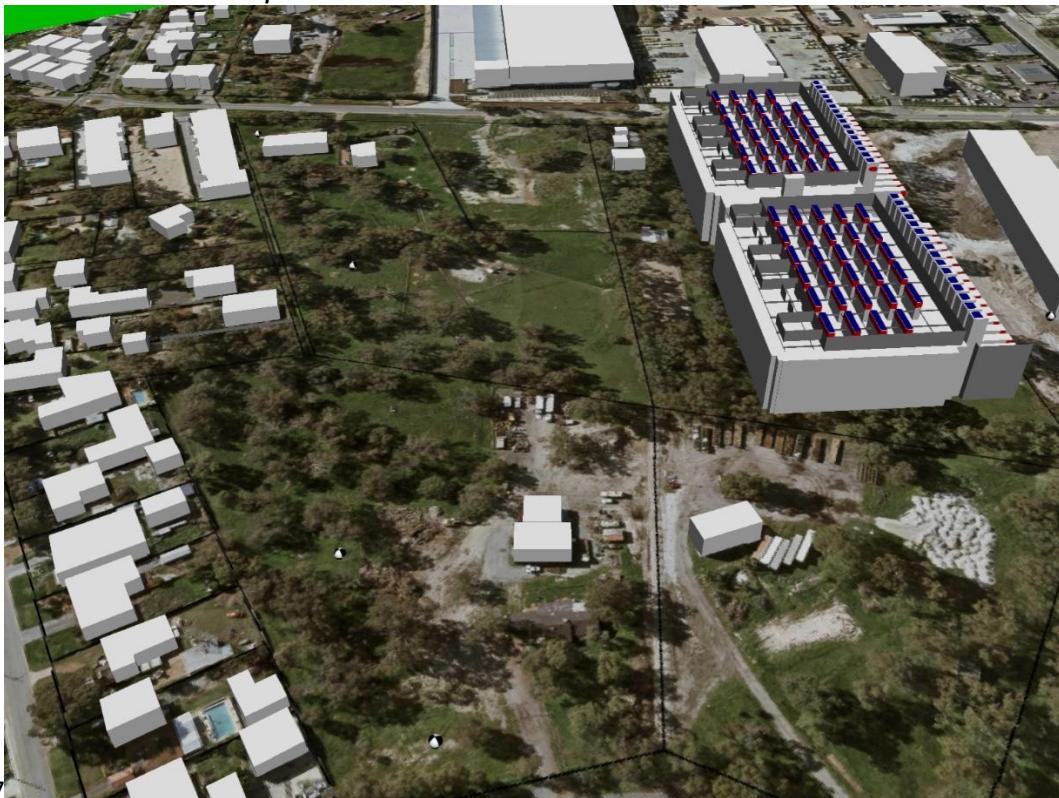
Noise levels from the site were modelled using Cadna-A noise modelling software employing the ISO 9613 protocol (*Acoustics — Attenuation of sound during propagation outdoors*). The ISO 9613 protocol includes the influence of wind effects and atmospheric conditions suitable for the distances between the project site and nearest sensitive receivers.

The modelling method includes:

- Local topography
- Screening by buildings and development built form (including acoustic barriers)
- Geometrical divergence
- Meteorological effects including light downwind propagation, and atmospheric absorption based on reference conditions of 20°C and 50% humidity (day) and 15°C and 50% humidity (night)
- Ground absorption effects – mixed ground absorption, 0.9 for porous ground associated with grassland and vegetation, and 0.1 for hard surfaces such as concrete, hard pack or paved areas.

Figure 7 below show a snapshot of the acoustic model.

Figure 7: Cadna-A noise model snapshot



4.2 NOISE SOURCES

The primary sources of noise associated with the development include:

- Air cooled chillers
- Enclosed standby generators

The design includes air-cooled chillers located on the rooftop plant decking of each building. All operational chillers have been included in the noise modelling.

Enclosed generators are fitted with acoustic attenuation for intake, discharge, and exhaust. The generators are located on a gantry structure, and each generator is connected to a discharge plenum shared with vertically adjacent generators. The discharge plenums run to approximately the same height as plant rooms located on the chiller deck. Exhaust flues are situated between the discharge plenums and run to a height lower than the chiller deck acoustic screening.

Generators are intended for standby use during power failure events only, with all generators operating only during emergency circumstances (total grid failure). For routine testing and maintenance, it is anticipated that only a single generator may operate at full load during daytime hours; however, this is subject to operational requirements and may vary as the design and maintenance strategy evolves.

Indicative acoustic data for the primary noise sources is provided Table 5 below for convenience.

Important: The provided values have been used as preliminary selections only. Further refinement of selections and operating conditions is expected as the project design progresses.

Table 5: Summary of major noise sources

EQUIPMENT	QUANTITY	SOUND POWER LEVELS, dB OCTAVE BAND CENTRE FREQUENCY, Hz								TOTAL SWL, dB(A)
		63	125	250	500	1000	2000	4000	8000	
Generator Discharge ^[1]	96	96	91	82	62	58	53	61	88	87
Generator Intake ^[1]		103	95	90	71	64	62	72	96	95
Generator Exhaust ^[1]		87	94	88	77	84	85	80	66	90
Air Cooled Chiller ^[2]	58	94	95	93	92	92	88	80	74	96

Note 1: Includes acoustic attenuation. Calculated from and calibrated against SPL @ 1m data (see Appendix B).

Note 2: Data is provided for 100% equipment capacity with assumed 2dB reduction for supplementary equipment acoustic treatment. Assumptions regarding reduced loading noise emissions are provided below.

All plant and equipment associated with the development shall be selected and installed such that noise emitted to noise sensitive premises is free of tonality or other characteristics which attract a penalty under the applicable noise regulations.

Plant selections and associated acoustic attenuation options are to be adopted to ensure compliance to the assigned noise levels is maintained.



4.2.1 AIR COOLED CHILLER OPERATION

Cooling plant equipment will operate to continuously maintain data hall temperature requirements, and the operating settings of the cooling plant will vary depending on both the internal thermal load within data halls, and external environmental conditions (temperature).

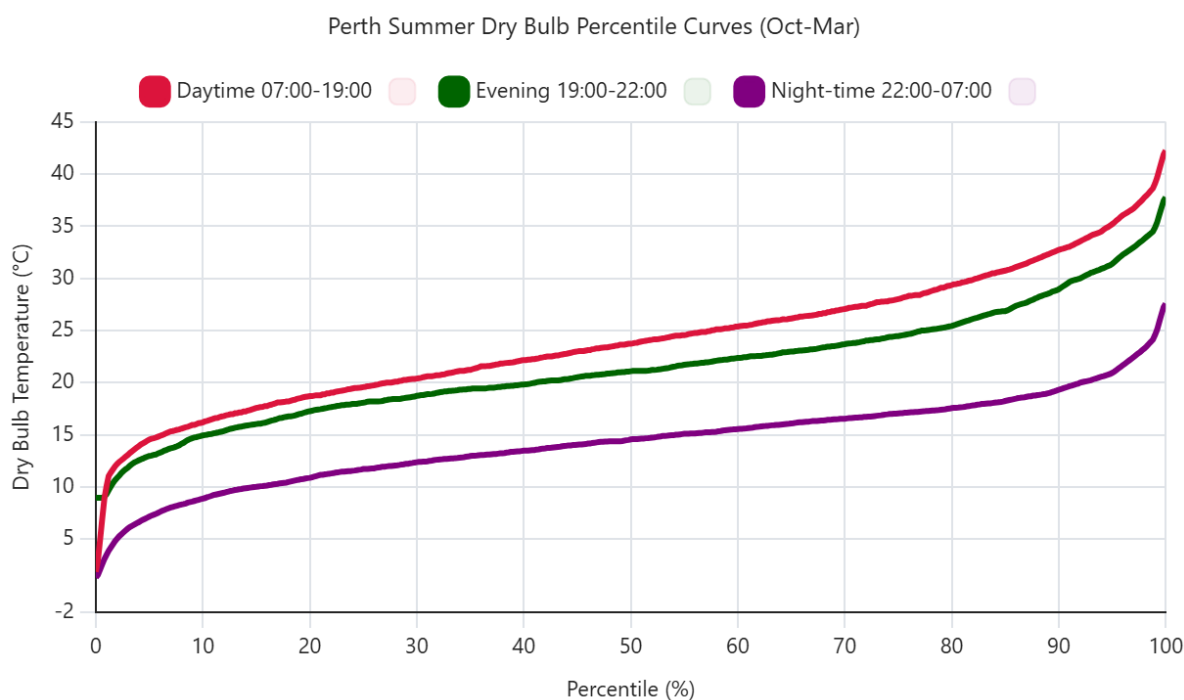
Cooling plant is designed to meet worst case operating conditions (maximum internal load, maximum external temperature) with additional redundancy.

Lower internal thermal load results in less heat requiring extraction, and lower external temperature results in greater heat rejection efficiency. Both factors result in reductions to required chiller operating speeds to meet the required cooling demand.

This results in lower chiller noise emission due to the reduced fan RPM and compressor speeds, along with reduction in the required numbers of operating plant required to meet the thermal demand.

External temperature conditions for Hazelmere have been provided by CDC, as sourced from 20 years of Typical Meteorological Year (TMY2) data. Temperature statistics are provided in Appendix C and the data associated with warmer months, and to the time periods applicable to acoustic assessment (Day, Evening, and Night) are provided in Figure 8 below.

Figure 8: October to March temperature statistics for Day, Evening and Night



Source CDC

With ambient external temperatures below the maximum design condition, noise emissions can reduce by approximately 2–8dB.

Additionally, not all equipment will be required to operate during reduced internal thermal load, and lower external temperature periods. To account for variability in operating conditions, the adjustments presented in Table 6 have been applied within the model.

Table 6: Chiller Operational Settings

PERIOD	UNITS OPERATING	APPROXIMATE HEAT REJECTION LOAD (INTERNAL LOAD & EXTERNAL TEMPERATURE)	TOTAL NOISE EMISSION REDUCTION (REDUCED CHILLER NUMBERS + LOAD)
Day	58	100%	0 dB
Evening	58	75%	-2 dB
Night	36	50%	-5 dB

These values are presented for the most stringent temperature conditions associated with summer months.

Under average temperature conditions, and in the cooler months, these reductions will be larger, resulting in lower total noise emissions from cooling plant.

4.2.2 STANDBY GENERATOR OPERATION

Standby generators associated with the development may operate under the following conditions:

- Routine maintenance testing
- Site power failure (grid failure)

The site will be supplied from Western Power's 330kV transmission network via Guildford Terminal Station. CDC has undertaken an analysis of the power supply reliability using publicly available reliability data and engineering interpretation where station specific outage logs are not publicly published.

Guildford Terminal Station forms part of the South West Interconnected System (SWIS) and benefits from multiple transmission connections, a meshed network topology, advanced protection systems and transmission-level operating standards, all of which reduce the likelihood of sustained supply interruptions.

The analysis review of Western Power and ERA WA performance reporting found no identified material transmission outages affecting the Guildford/Hazelmere network segment over the last three financial years, with reliability indicators consistently performing within benchmark expectations.

While the assessment acknowledges that station-specific outage logs are not publicly available and therefore some conclusions rely on engineering judgement, the overall evidence supports a low outage risk profile for the site.

Consequently, the assessment concludes that operation of the emergency diesel generation plant is expected to be limited to routine testing and maintenance activities at designated hours.

Notwithstanding this conclusion, acoustic assessment has been undertaken for the unlikely event of total power failure to the site.

Under the worst-case scenario of complete loss of utility power to the site, all generators would operate simultaneously to maintain full site load. Due to redundancy design in the generator system, the site electrical demand can be provided by operation of 3 out of every 4 generators, or in practice, all generators running at approximately 75% capacity. This represents a conservative and unlikely operating condition, with all plant running concurrently at maximum demand (full load at peak summer temperatures).

Under routine maintenance testing, individual generators will be operated at 100%, one at a time. Additionally, maintenance testing is to be limited to day period hours only.

The noise emission adjustments presented in Table 7 have been applied within the model to account for generator operating capacities under each operating condition.



Table 7: Generator Operational Settings

POWER CONDITION	UNITS OPERATING	OPERATING CAPACITY (PER GENERATOR)	TOTAL NOISE EMISSION REDUCTION (PER GENERATOR)
Maintenance Testing	1	100%	0 dB
Grid Failure	96	75%	-1.2 dB

Lower site electrical demand (e.g. during cooler months) would result in further reductions in generator operating requirements, and further noise reductions. Greater reductions have not been incorporated in this assessment.

4.3 SHIELDING PROVIDED BY PLANT MASSING AND BUILT FORM

The acoustic assessment considers shielding effects from the built form of the development, rooftop plant enclosures, and plant massing.

Plant massing has been represented as follows:

- **Generator Plant:** Generators, stacked three (3) high, are located on gantries with each generator located within an acoustic enclosure with a louvre opening at the intake end. Generators have been modelled as reflective elements with partial acoustic transparency to account for the open gantry separating each generator.
- **Generator Discharge Plenums:** Each generator is connected to a discharge plenum shared with vertically adjacent generators. Discharge plenums are of solid construction and run to a height equivalent to the top of chiller deck plant rooms. The generator plenums are modelled as solid reflective elements. Exhaust flues are located between discharge plenums and run to a height 1.6m below the top of chiller deck acoustic screening. The exhaust flues are located such that they are shielded from the site northern and southern boundaries by the generator plenums, and to the west by acoustic screening on the chiller deck.
- **Chiller Plant:** Modelled as reflective elements with partial acoustic transparency to account for typical equipment massing.
- **Rooftop Plantrooms and Tanks:** Modelled as solid reflective elements

Plant locations are based on current site plans. It should be noted that acoustic results are sensitive to equipment positioning; relocation during detailed design will require a revised acoustic assessment.

4.4 ACOUSTIC TREATMENT

Current mitigation measures for the development include:

- **Generator Equipment:** Acoustic attenuation via intake and discharge attenuators, and exhaust flue mufflers. Generator discharges will be contained within vertical discharge plenums.
- **Placement of Generator Exhaust Flues:** Generator exhaust flues are to be situated between generator discharge plenums, shielded to north and south, and run to a height of 1.6m below the top of chiller deck acoustic screening.
- **Operational Controls:** Generator maintenance and testing restricted to daytime hours.
- **Acoustic Screening – Stacked Generator Zone:** Installation of acoustic screening to the southern-most edge of the Portion 2 building generator gantry structure. The Barrier is required to span the length of the gantry southern face and connect back to the generator plenum. See Section 4.4.1 for further details.
- **Acoustic Screening – Air Cooled Plant Zone:** Installation of acoustic screening to the development roof plant area, extending below the chiller deck. Rooftop plant area barriers to be fitted with acoustic absorption to the interior face. See Section 4.4.1 for further details.



- **Acoustic Screening – Secondary Zone:** Installation of acoustic screening cantilevered from the side of portion 1 building western façade, and portion 2 building western and southern façade. The secondary barriers are to screen the zone between the air cooled plant platform and roof of buildings below. Secondary barriers are to be fitted with acoustic absorption to the interior face. See Section 4.4.1 for further details.
- **Chiller Operation:** Reduced capacity during off-peak periods: approximately 75% in the evening and 50% at night, with reduced operating chiller numbers at night.

It is critical that major plant items do not exceed the noise levels specified in the preceding section. Attenuation requirements for generator intake, radiator, and exhaust flue may vary provided further acoustic assessment confirms compliance with emission limits.

4.4.1 ACOUSTIC SCREENING

A solid acoustic barrier is proposed to the locations presented in Figure 9 below. The barrier is to be continuous, free from all gaps, and be internally lined with an acoustic absorption facing achieving NRC 1.0 performance.

The acoustic barrier to air cooled plant zone will be required to extend 5 meters above the Chiller Deck level, and 1.6 meters below the Chiller Deck.

The secondary acoustic barrier is to be cantilevered approximately 2.5m away from the building façade to facilitate airflow requirements and permit reticulation of services attached to the building façade. The secondary barrier is to run from 1.4m above the air cooled plant platform to 1.5m below the parapet of the roof.

Figure 9: Acoustic Screening Locations

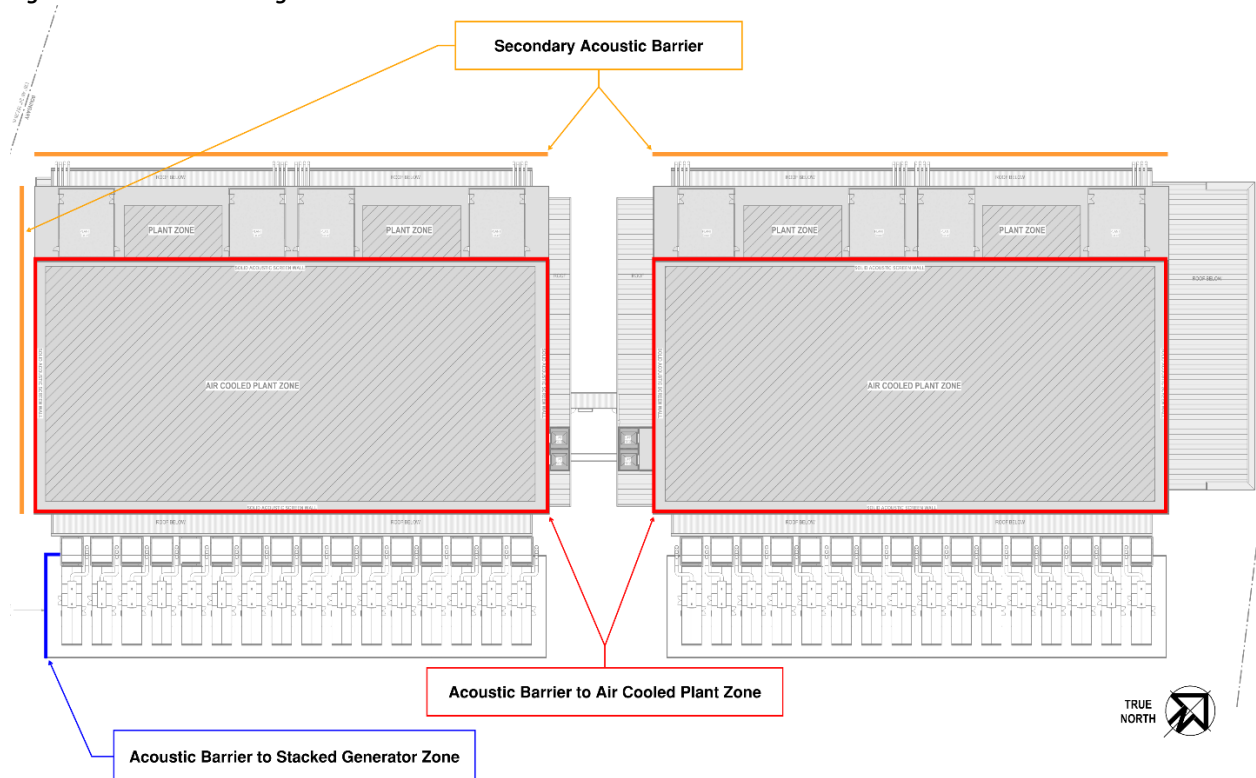
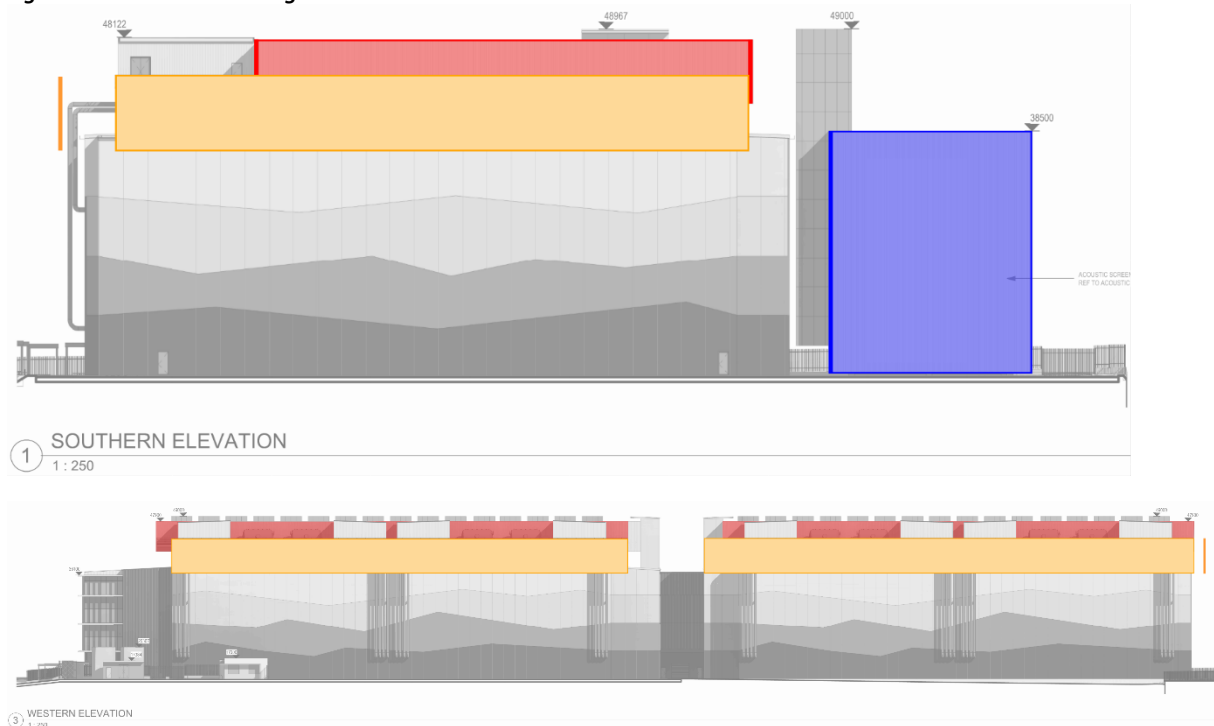


Figure 10: Acoustic Screening Vertical Extent



4.5 SCENARIOS

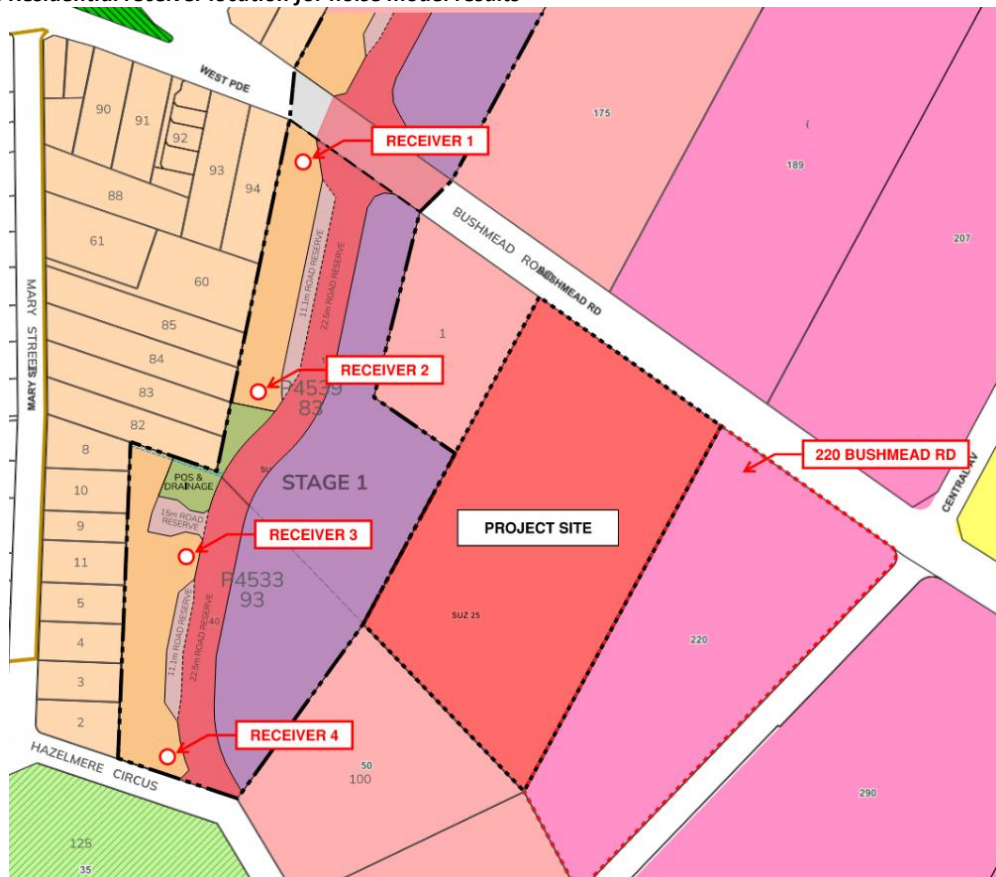
The following operational scenarios are applicable to the project site:

- Scenario 1: Typical operations: Cooling plant operating only, with operating capacities and plant numbers as to achieve the associated noise reductions during night periods.
- Scenario 2: Day period generator testing: Cooling plant and a single generator (maintenance testing) operating simultaneously.
- Scenario 3: Night period total grid failure (worst case for residential uses to the west): Cooling plant running and all generators running to meet site demand.

4.6 NOISE MODEL RESULTS

Noise emission from the site have been predicted at the nearest residential properties to the west of the site, and at the adjacent commercial property to the east of the site. Four residences were selected to represent the coverage across the length of the western interface with the project site. The location of the receivers is provided in Figure 11.

Figure 11: Residential receiver location for noise model results



The predicted noise emission results from the project site, including all nominated acoustic mitigation measures, are provided in Table 8.

Table 8: 3D Noise Modelling Results

Receiver	Applicable Criterion (L _{A10}) dB(A)	Predicted Noise Level dB(A)	Complies? (Y/N)
Scenario 1 – Typical Operation (Day / Evening^[1] / Night)			
Receiver 1	52 / 47 / 42	43 / 42 / 38	Y
Receiver 2	51 / 46 / 41	44 / 42 / 39	Y
Receiver 3	51 / 46 / 41	43 / 42 / 38	Y
Receiver 4	50 / 45 / 40	43 / 41 / 38	Y
220 Bushmead Rd	65 / 65 / 65	48 / 47 / 43	Y
Scenario 2 – Generator Testing (Day)			
Receiver 1	52	43	Y
Receiver 2	51	44	Y
Receiver 3	51	43	Y
Receiver 4	50	43	Y
220 Bushmead Rd	65	55	Y
Scenario 3 – Grid Failure (Night)			
Receiver 1	42	39	Y
Receiver 2	41	40	Y
Receiver 3	41	39	Y
Receiver 4	40	39	Y

Note 1: Sunday and Public Holidays 'Day' period are assessed to 'Evening' criteria.

As shown in Table 8 above, when all nominated acoustic measures outlined in the preceding sections are incorporated, the predicted noise levels at nearby noise sensitive receivers are expected to comply with EPNR noise limits. It is noted that the predicted noise levels are in some circumstances are approaching the limit of compliance under total grid failure conditions. Ongoing acoustic review is required as the project design progresses to ensure compliance is maintained, and where possible, additional mitigations measures be implemented to present additional safety margin. Such measures may include chiller discharge deflectors, additional acoustic baffling, and the like.

During cooler months, or on more statistically average summer days, noise emission levels from cooling plant are expected to reduce further below the noise emission limit.

5 CONCLUSION

Computational modelling of the CDC Hazelmere development has been undertaken to determine the expected noise emission impact from the site.

Results from the assessment show that, with appropriate equipment selections and acoustic mitigation strategies, the site is expected to comply with the applicable WA EPNR noise emission criteria.

The following acoustic mitigation measures are expected to be required to achieve the applicable limits:

- Installation of acoustic screening to the rooftop air cooled plant zone.
- Installation of acoustic screening to the zone between the rooftop air cooled plant deck and building roof to the western edge of Portion 1 building, and western and southern edge of the Portion 2 building.
- Installation of acoustic screening to the southern end of the Portion 2 building generator gantry.
- Enclosed generator sets with acoustic attenuation applied to intake, discharge, and exhaust. Final attenuation requirements to be confirmed; preliminary values provided in Appendix B.
- Location of generator exhaust flues to 1.6m below the top of the air-cooled plant acoustic screening, and between generator discharge plenums to be shielded from north and south site boundaries.
- Limiting the testing and maintenance of generators to the day period only, and operating a single 1 at a time.
- Selection of air-cooled chillers to achieve acoustic emission performance no higher than that detailed in Section 4.2.
- Air cooled chiller cooling load reductions during evening and night periods due to cooler ambient conditions
- Reduced number of chillers operating at nighttime.

Further review of equipment specifications and layouts for the development will be required as the design progresses to ensure compliance with noise emission limits is maintained.



Appendix A

Glossary of Acoustic Terms

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.
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 LA90 noise level.
Decibel [dB]	The units of sound pressure level.
dB(A)	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Intermittent Noise	Level that drops to the background noise level several times during the period of observation.
L_{AFmax}	The maximum A-weighted sound pressure level measured over a period. 'F'(fast) time weighting - Sound level meter design-goal time constant which is 0.125 seconds.
L_{A90}	A-weighted, sound level just exceeded 90% of the measurement period and calculated by statistical analysis. See also the background noise level.
L_{Aeq,T}	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection	Sound wave changed in direction of propagation due to a solid object met on its path.
R_w	The Sound Insulation Rating R-w is a measure of the noise reduction performance of the partition.
Sound Pressure Level, L_p	The level of sound measured on a sound level meter and expressed in decibels (dB). Where $L_p = 10 \log_{10}$ $(P_a/P_o)^2$ dB (or $20 \log_{10} (P_a/P_o)$ dB) where P_a is the rms sound pressure in Pascal and P_o is a reference sound pressure conventionally chosen is $20 \mu\text{Pa}$ (20×10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.



Sound Power Level, L_w

The sound power level of a noise source is the inherent noise of the device. Therefore, sound power level does not vary with distance from the noise source or with a different acoustic environment. $L_w = L_p + 10 \log_{10} 'a' \text{ dB}$,

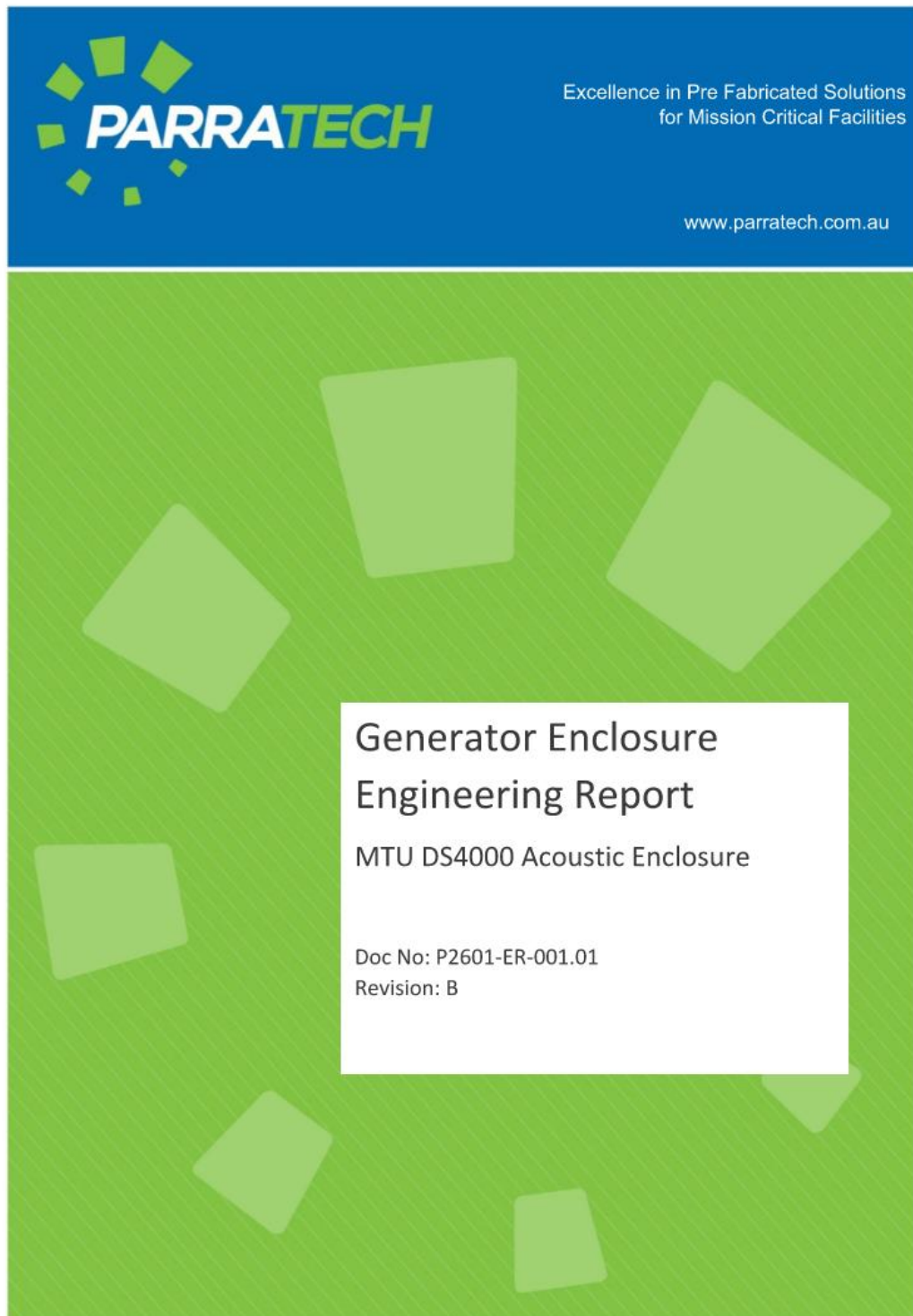
re: 1pW, (10-12 watts) where 'a' is the measurement noise-emission area (m²) in a free field.

Tonal Noise

For example, humming or whining from equipment. The presence of tonal characteristics creates additional annoyance.



Appendix B **Generator Tech Data Sheets**



Document prepared by:

Parratech Group Pty Ltd
71 Anzac Street, Chullora, NSW, 2190
T +61 2 9890 4425
E info@parratech.com.au
W www.parratech.com.au

Document prepared for:

Penske Power Systems
78-82 Riverside Rd
Chipping Norton
NSW 2170



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Author Signature	<i>Grant Stofberg</i>	Approver Signature	<i>Jason Fooks</i>
Name	Grant Stofberg	Name	Jason Fooks
Title	Head of Design and Engineering	Title	Director

1 Description

The purpose of this report is to outline the acoustic and ventilation performance for the enclosure design proposed for the project CDC EC5.

2 Project Details

Model	MTU DS4000
Engine:	MTU DS4000
Combustion Air Flow:	4.5 m ³ /sec
Radiator Flow:	57 m ³ /sec
Maximum Enclosure Ventilation Restriction:	250 Pa
Acoustic Design Performance:	68 dB(A) @ 7mtr

2.1 Mechanical Noise

Raw genset mechanical noise data sound pressure level @ 1 meter [dB] (diesel operation 100%):

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dB	84.4	94.1	95.0	97.2	99.8	100.1	98.8	108.0	110.1

Raw radiator mechanical noise data sound pressure level @ 1 meter [dB] (diesel operation 100%):

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dB	96.2	90.2	100.2	100.2	97.2	95.2	92.2	86.2	105.7

Combined radiator and generator mechanical noise @ 1 meter [dB]:

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dB	96.5	95.6	101.4	102.0	101.7	101.3	99.6	108.1	111.4

2.2 Exhaust Noise

Raw Exhaust Noise Data Sound Pressure Level @ 1 meter [dB] (Diesel Operation 100%):

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dB	113.1	123.8	123.0	114.3	116.3	114.1	106.6	90.9	127.5

3 Proposed Acoustic Solution

To achieve the using Parratech exhaust system, ventilation air attenuators and acoustically lined generator enclosure.

3.1 Exhaust System Acoustic Calculations

Raw Exhaust Noise Data Sound Pressure Level @ 1 meter [dB] (Diesel Operation 100%):

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dB	113.1	123.8	123.0	114.3	116.3	114.1	106.6	90.9	127.5

The generator exhaust shall include a single Parratech FLCS exhaust silencer.

The Parratech FLCS exhaust silencer has the following insertion losses:

Hz	63	125	250	500	1000	2000	4000	8000
dB	34	38	43	45	40	37	35	33

The resultant Exhaust noise at 1mtr from the discharge free field is:

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dBA	52.9	69.7	71.4	66.1	76.3	78.3	72.6	56.8	81.9

The noise requirement is **68 dBA @ 7m** from exhaust discharge. The calculations show **81.9 dBA @ 1m** from exhaust discharge.

Using the inverse square law equation shown below where L is the sound pressure and r is the distance to source the calculated noise at **7m** is **64.99dBA**

$$L_2 = L_1 - \left| 20 \cdot \log \left(\frac{r_1}{r_2} \right) \right|$$

Inverse Square Law

With the tolerance of **+3dB** from the exhaust data the result would be **68 dBA @ 7m** therefore the design is suitable.

3.2 Enclosure Ventilation Intake Acoustic Calculations

Raw genset + radiator mechanical noise data sound pressure level @ 1 meter (diesel operation 100%):

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dB	96.5	95.6	101.4	102.0	101.7	101.3	99.6	108.1	111.4

There shall be Parratech, S-50 internal lining to cover approximately 70% (all exposed wall areas excluding the doors and penetrations) of the internal walls of the engine compartment within the enclosure. The Parratech S-50 wall lining has an NRC of 1.0 and the sound absorption coefficients is as follows:

Hz	63	125	250	500	1000	2000	4000	8000
dB	2.0	3.0	4.6	4.9	4.6	4.7	4.4	4.4

The resultant internal noise at the internal face of the intake attenuator is calculated to be:

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dB	94.6	92.6	96.8	97.1	97.1	96.6	95.2	103.7	107.1

The intake will be installed with a 373618 attenuator.

This attenuator has the following insertion losses:

Hz	63	125	250	500	1000	2000	4000	8000
dB	7	13	22	42	49	50	39	23

The resultant enclosure noise at 1mtr free field from the intake is:

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dBA	61.4	63.5	66.2	51.9	48.1	47.8	57.2	79.6	79.9

The noise requirement is **68 dBA @ 7m** from exhaust discharge. The calculations show **79.9 dBA @ 1m** from exhaust discharge.

Using the inverse square law equation shown below where L is the sound pressure and r is the distance to source the calculated noise at **7m** is **63dBA**

$$L_2 = L_1 - \left| 20 \cdot \log \left(\frac{r_1}{r_2} \right) \right|$$

Inverse Square Law

With the tolerance of **+2dB** from the exhaust data the result would be **65 dBA @ 7m** therefore the design is suitable.

3.3 Enclosure Ventilation Discharge Acoustic Calculations

Raw genset + radiator mechanical noise data sound pressure level @ 1 meter (diesel operation 100%):

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dB	96.5	95.6	101.4	102.0	101.7	101.3	99.6	108.1	111.4

The losses between the plantroom and the discharge attenuator comprise of the losses through the radiator bank and the turning duct.

The figures for the losses through the radiator bank used in these calculations are based on test figures with the losses capped at 6dB. Losses used are as follows:

Hz	63	125	250	500	1000	2000	4000	8000
dB	2.2	3.2	3.0	3.5	6.0	5.6	6.0	6.0

The resultant figures for the internal noise at the internal face of the discharge attenuator are:

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dB	94.3	92.4	98.4	98.5	95.7	95.7	93.6	102.1	106.5

The discharge will be installed with a 373624 attenuator.

This attenuator has the following insertion losses:

Hz	63	125	250	500	1000	2000	4000	8000
dB	11	14	29	49	51	56	46	27

The resultant enclosure noise at 1mtr free field from the discharge is:

Hz	63	125	250	500	1000	2000	4000	8000	Overall
dBA	57.1	62.3	60.8	46.3	44.7	40.9	48.6	74.0	74.5

The noise requirement is **68 dBA @ 7m** from exhaust discharge. The calculations show **74.5 dBA @ 1m** from exhaust discharge.

Using the inverse square law equation shown below where L is the sound pressure and r is the distance to source the calculated noise at **7m** is **57.6dBA**

$$L_2 = L_1 - \left| 20 \cdot \log \left(\frac{r_1}{r_2} \right) \right|$$

Inverse Square Law

With the tolerance of **+2dB** from the exhaust data the result would be **59.6 dBA @ 7m** therefore the design is suitable.

Appendix C Perth Temperature Statistical Data

C.1 DAY PERIOD DATA

Figure 12: Perth Warmer Months (Oct – Mar) Daytime Temperature Data (07:00 to 19:00)

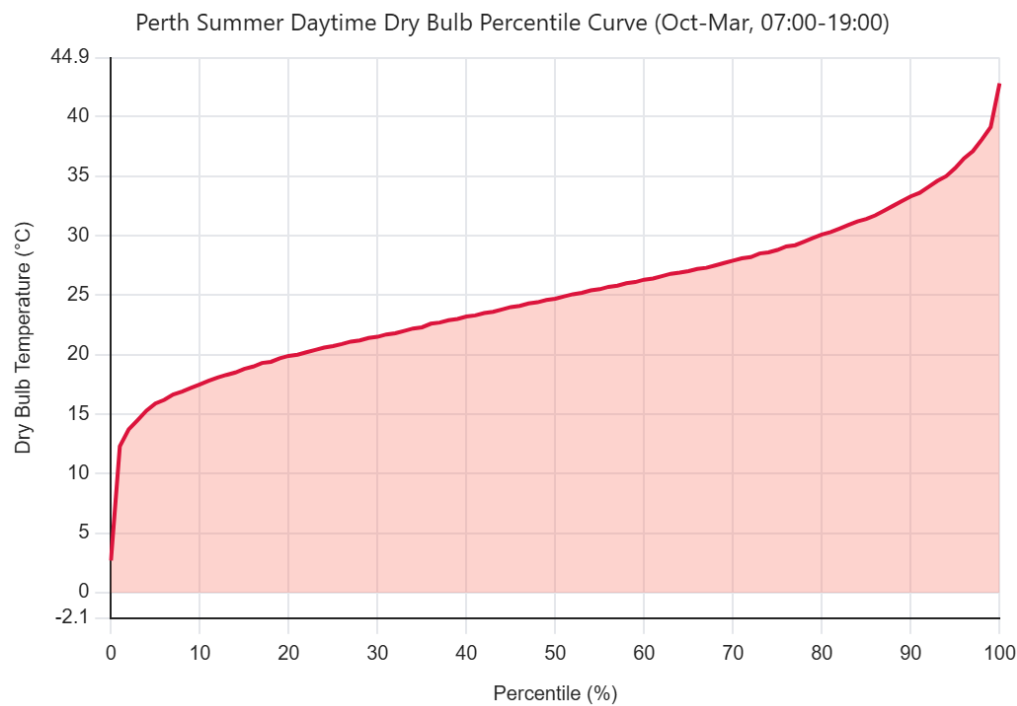
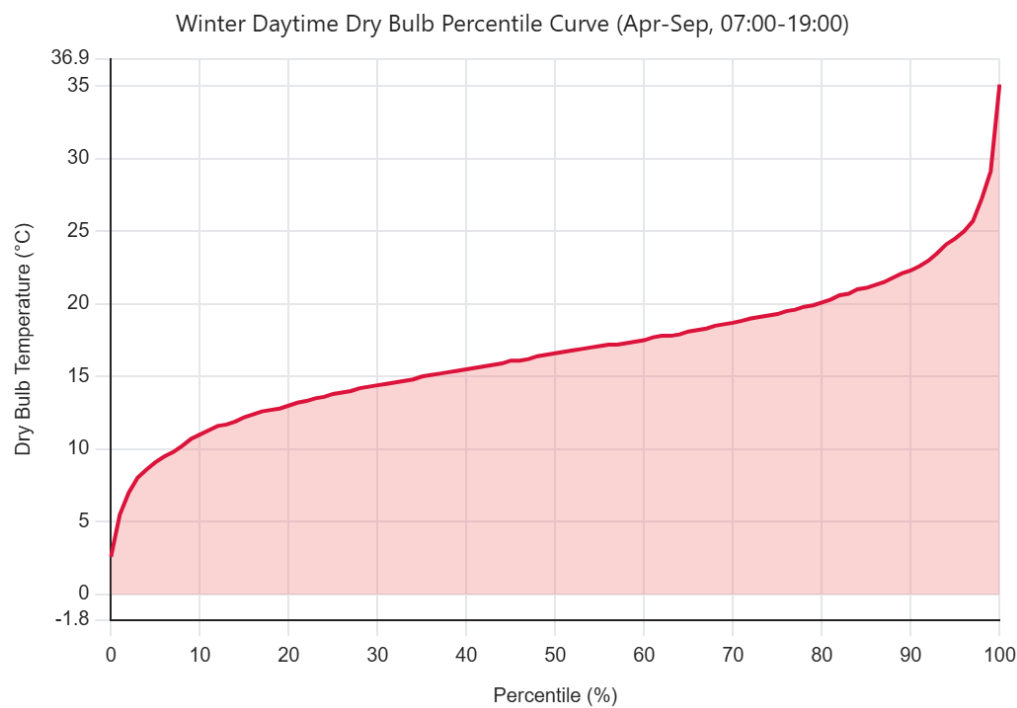


Figure 13: Perth Cooler Months (Apr – Sep) Daytime Temperature Data (07:00 to 19:00)



C.2 EVENING PERIOD DATA

Figure 14: Perth Warmer Months (Oct – Mar) Evening Temperature Data (19:00 to 22:00)

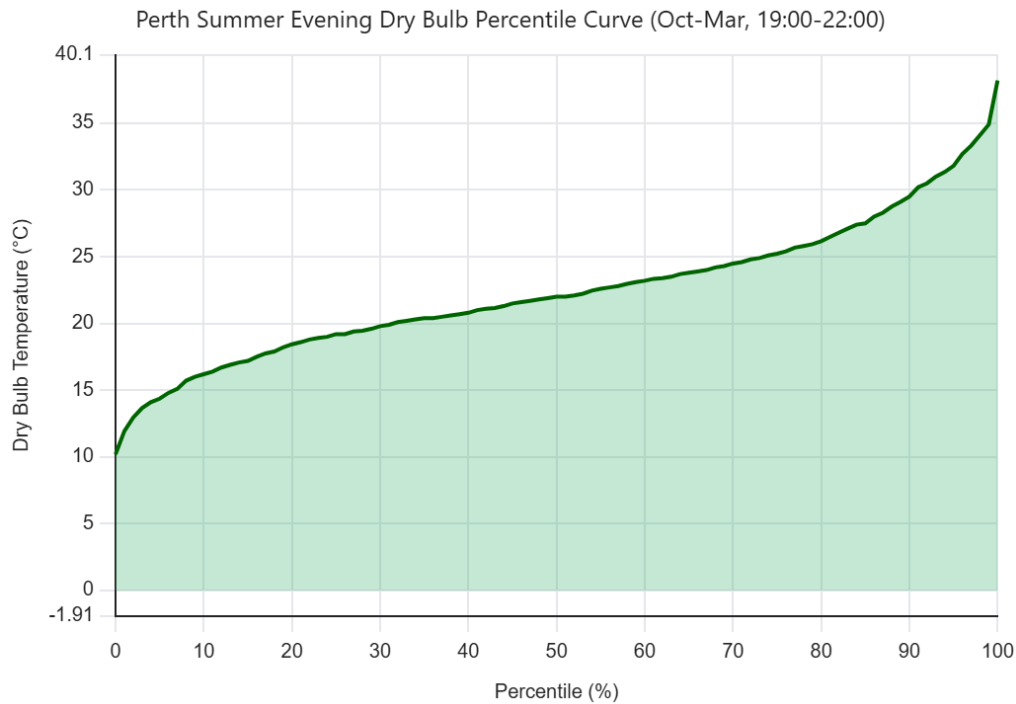
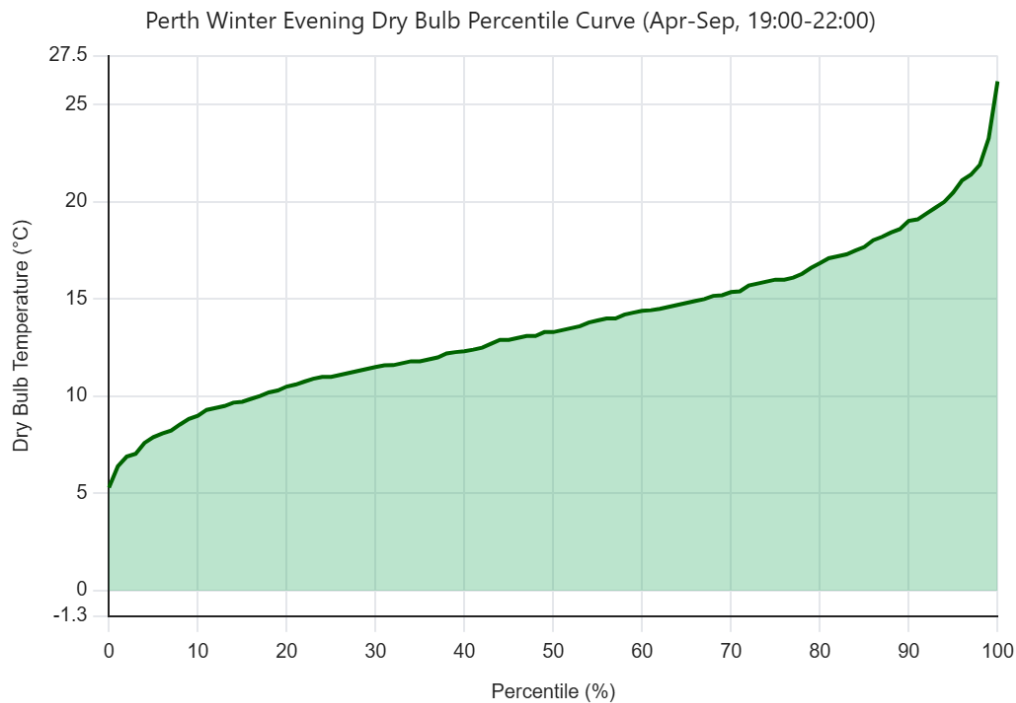


Figure 15: Perth Cooler Months (Apr – Sep) Evening Temperature Data (19:00 to 22:00)



C.3 NIGHT PERIOD DATA

Figure 16: Perth Warmer Months (Oct – Mar) Night Temperature Data (22:00 to 07:00)

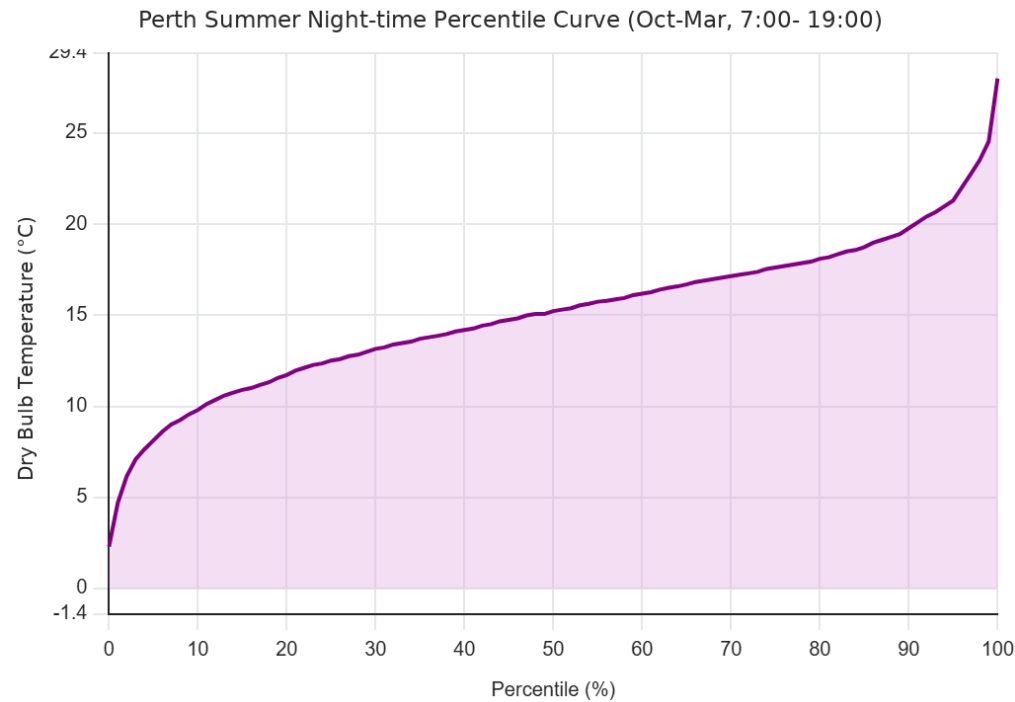
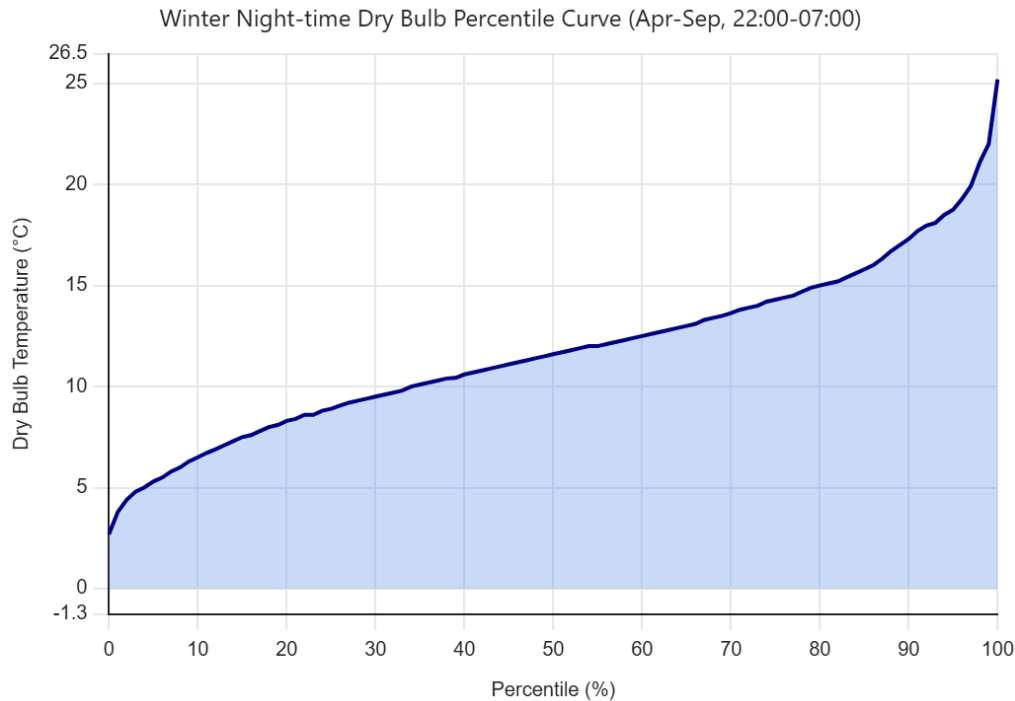
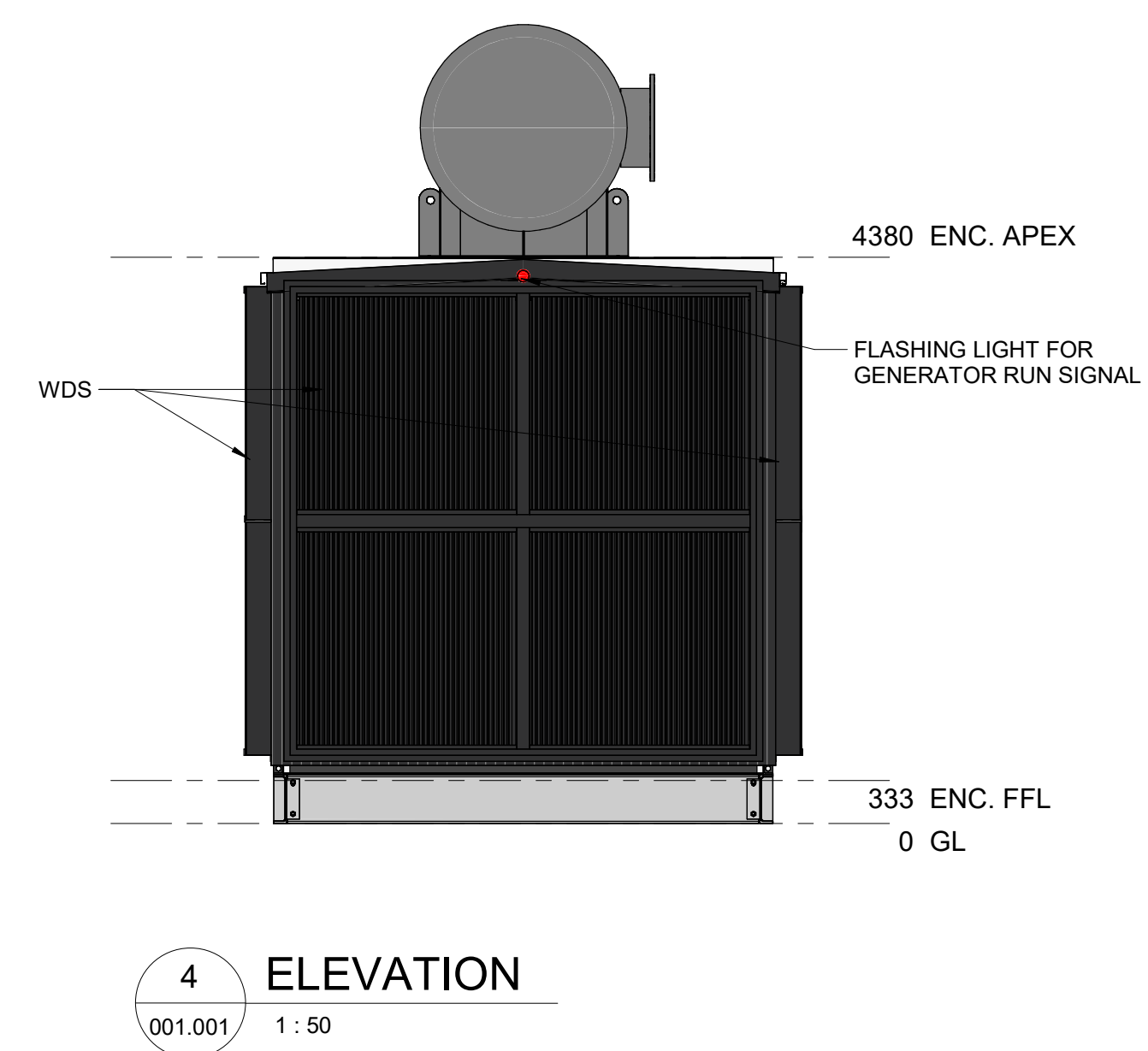
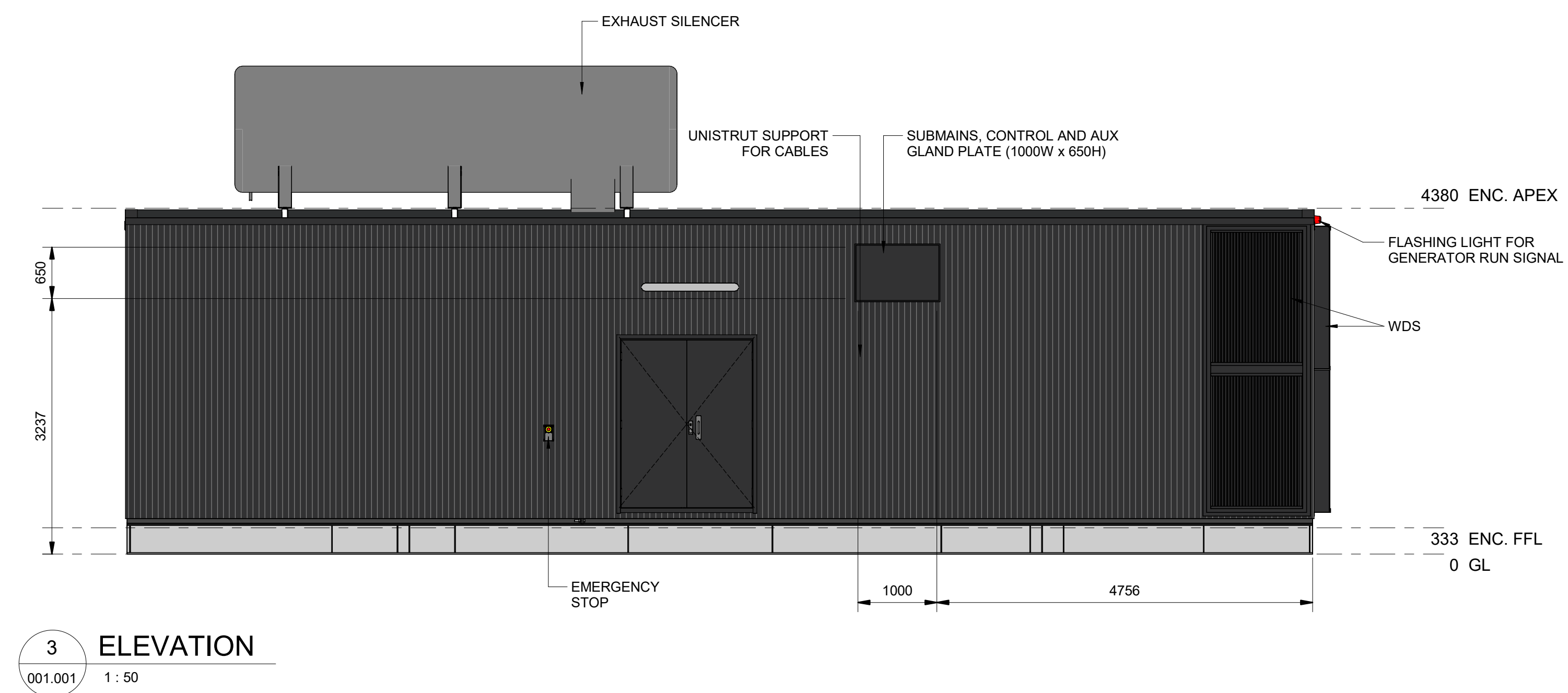
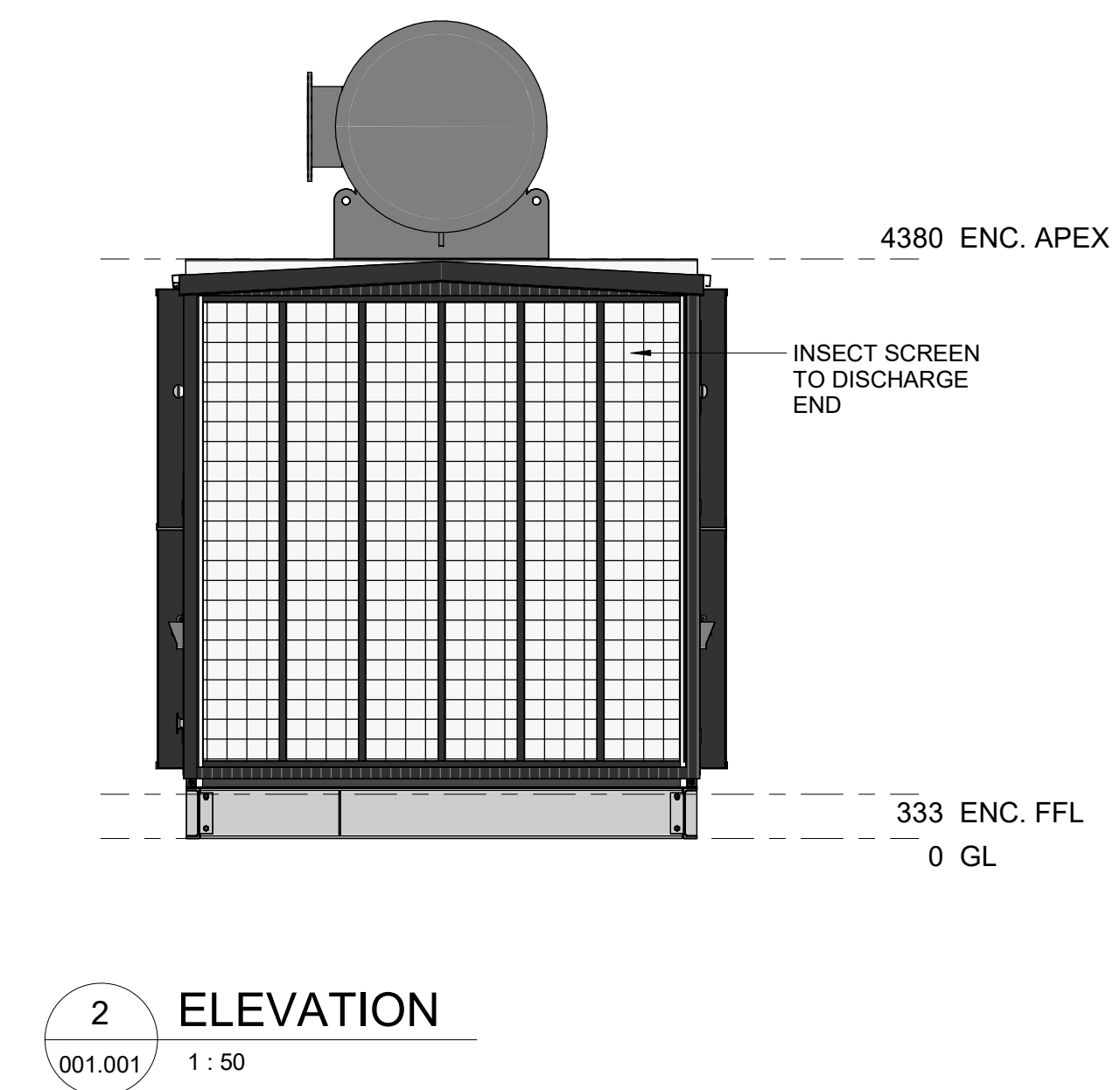
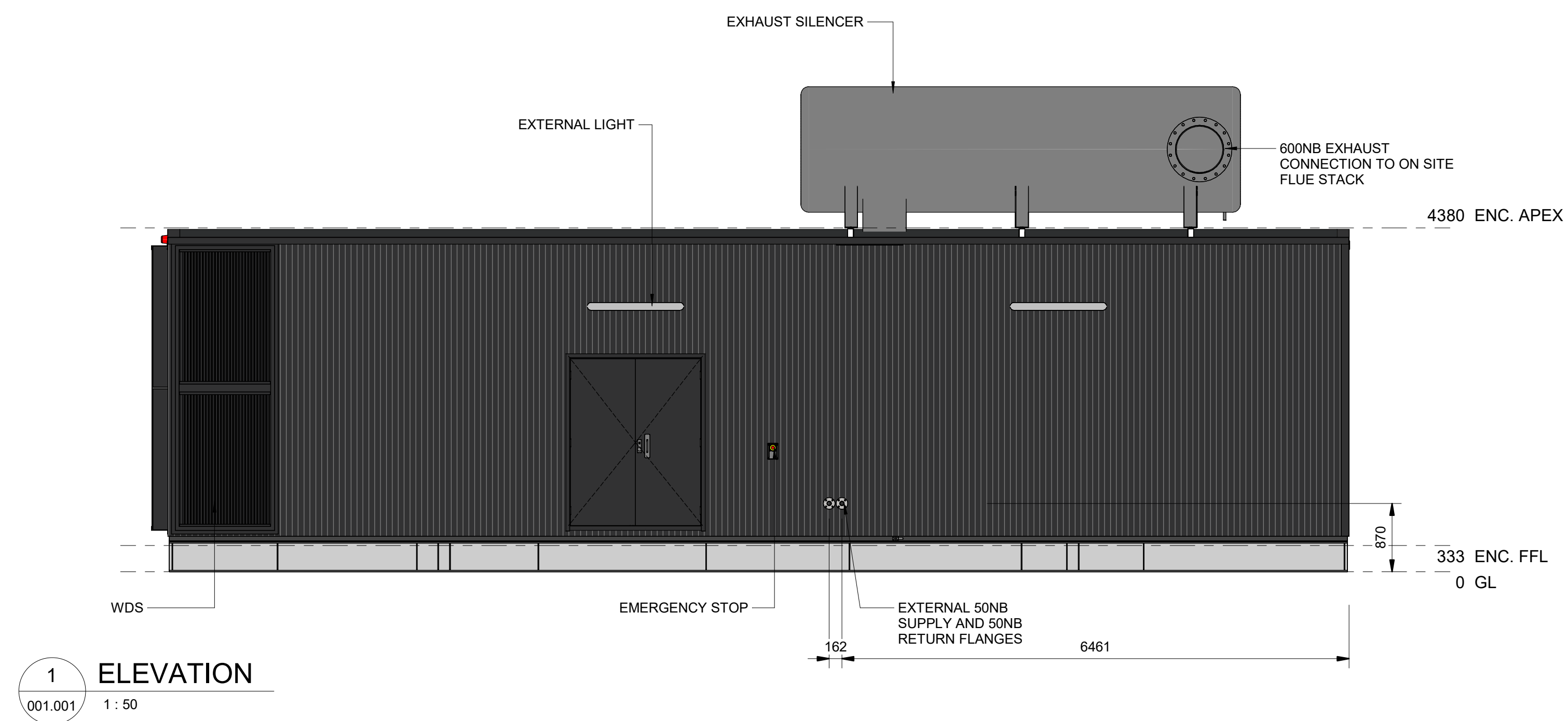


Figure 17: Perth Cooler Months (Apr – Sep) Night Temperature Data (22:00 to 07:00)





NOTES:

CLIENT:

PENSKE



1 ANZAC ST, CHULLORA
NSW 2190 AUSTRALIA
t: 02 9890 4425
f: 02 9890 9743
e: info@parratech.com.au
w: www.parratech.com.au

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