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Greenbox Architecture

Lane Cove West Data Centre

SSDA Air Quality Assessment

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Job number 259234

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Appendices

1 Introduction

The proposed Sirius Road datacentre at 1 Sirius Road, Lane Cove West (Lot 1/DP 1151370) is anticipated to incorporate 51 standby generators within the site boundary to support the buildings' power requirement for critical IT systems and other site infrastructure in the event of mains power loss or damage of electrical infrastructure on site.

The majority of the generators are located along the roof of the building, with the remaining located at grade along the north-western area of the site. Appendix A identifies the design drawings that present the distinct locations of the standby generators. At this stage, the locations of the generators are indicative only, however their current locations are expected to be largely consistent with the final developed design.

A qualitative based desktop assessment of the potential air quality impacts from the on-site standby generators has been completed to accompany the State Significant Development Application (SSDA) Submission.

2 Standby Generator Use

Data centre components do not easily tolerate power spikes due to switching from a normal to emergency power supply. When these components lose power (if only for a fraction of a second), various IT systems critical to the facility and the service it provides will be interrupted. The proposed site infrastructure includes uninterruptible power supplies (UPS) with battery back-up for power conditioning and short-term interruptions. However, standby generators are needed to ensure ongoing operation if power is interrupted for more than a few minutes. As a result, supplying uninterrupted power to data centres 100% of the time is a critical aspect for their operation. Fundamentally, the function of the standby generators at the site would be to provide power when there is an unexpected interruption of main power.

Given the unlikely event of an interruption of main power, the standby generators would switch on to provide power to each of the buildings. It is likely any loss of main power would be resolved quickly, within a few hours and therefore even when required the generators would only operate for a short time. It is not possible to estimate the likelihood of power outage/damage over a year which would require the standby generators to be in operation, however it is anticipated that the generators would only be required for around 50 hours per year (approximately 0.6% of the time).

The standby generators would be tested on a monthly basis (approximately one hour of operation per month) to ensure they can continue to provide an uninterrupted power supply when required. Each generator would be tested independent of each other (i.e. not be operating concurrently) and be completed during the daytime period when wind conditions are favourable for dispersion.

A photograph of a standby diesel generator similar to the proposed is shown in Figure 1.

Figure 1: Proposed standby diesel generator

3 Air Quality Assessment

3.1 Generator Emissions

While in use, the standby generators would produce total unburned hydrocarbons (HC), nitrogen oxide (NO_x), carbon monoxide (CO), particulate matter (PM), sulfur dioxide (SO_2) and smoke.

At present however, there are no regulations in place in Australia that limit emissions from non-road diesel engines and equipment. Therefore, to determine the likelihood for air quality impacts, a review of the US EPA emission standards (where the generator was developed) and the NSW Protection of the Environment (POEO) Regulation 2010 emission limits against the Cummins QSK95-G4 generator specification sheet (see Appendix B) has been completed. The outcomes of the assessment are summarised in Table 1.

The comparison indicates that for all pollutants (with the exception of NO_x) emission rates will be below the respective US EPA and POEO emission limits. It should be noted that Clause 57A of the POEO (Clean Air) Regulation 2010 states that standby generators are exempt from the air impurity standards for nitrogen dioxide and nitric oxide listed in Schedule 4 of the POEO (Clean Air) regulation 2010 if they are used no more than 200 hours per year, which as detailed previously in section 2 is the case for this proposal.

Table 1: Emission rate assessment

Pollutant	**Cummins QSK95-G4[1]**		**US EPA[3]**	**POEO Regulation 2010**
	g/kWh[2]	**mg/m³**	**g/kWh**	**mg/m³**
HC	0.14	81	0.19	*no limit detailed*
NOx	6.79	3990	0.67	500
CO	0.22	150	3.5	*no limit detailed*
PM	0.04	18	0.03	50
SO_2	0.004	1.8	*no limit detailed*	*no limit detailed*

[1] The worst case ¼ Standby performance data has been applied for the Cummins QSK95-G4.

[2] A conversion from g/BHP-hr to kWh has been applied.

[3] Nonroad Compression-Ignition Engines: Exhaust Emission Standards (2016), https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100OA05.pdf

3.2 Sensitive Receptors

The closest sensitive receptors are south-west of the site within the existing commercial precinct at Lane Cove, located approximately 50 metres from the proposed generators. The more sensitive receptors (residential and schools) are located over 400 metres from the site.

Potential air quality impacts from the generators upon staff at the data centre are based on occupational criteria for air quality metrics. These are typically several orders of magnitude greater than those provided for the evaluation of environmental impact, this is since environmental criteria are designed to protect the full spectrum of society, including the frail, very young and very old.

Conversely, those who are exposed occupationally are assumed to be fit and healthy individuals. For these reasons, no further assessment of potential occupational air quality impacts has been assessed in this memorandum.

3.3 Potential impacts

Given the distance of sensitive receivers (residential properties or schools), it is unlikely that local air quality at these locations would be significantly affected even when the standby generators are in operation.

However, operation of the generators has the potential to impact local air quality immediately adjacent to the site, particularly concentrations of NOx/NO_2, if in operation over a long period of time. While emissions of NOx are exempt from regulatory standards, these emissions can convert to NO_2 in the atmosphere and impact on human and ecological health. Therefore, operation of the generators during a power outage or damage event should be minimised as far as possible. This is included in the maintenance strategy for the site and therefore it is expected that this would be achieved under typical circumstances.

4 Conclusion

Given that the standby generators will operate within relevant emissions limits, are a considerable distance from sensitive receptors (residential/schools) and are only expected to be used for short, intermittent periods, the air quality impact from them is anticipated to be minor and transient.

Therefore, no further air quality assessment (e.g. dispersion modelling) for the proposal has been recommended.

Appendix A

Reference Drawings

This air quality assessment, and in particular the standby generator locations are presented in the following drawings:

Drawing Title	**Drawing Number**
BASEMENT FLOOR PLAN _ RL 6.5	ATSYD2_SSD_DRG_ARC_010
GROUND FLOOR PLAN _ RL11.0	ATSYD2_SSD_DRG_ARC_0101
FIRST FLOOR PLAN _ RL17.5	ATSYD2_SSD_DRG_ARC_0102
SECOND FLOOR PLAN _ RL24.0	ATSYD2_SSD_DRG_ARC_0103
ROOF PLAN _RL 30.5	ATSYD2_SSD_DRG_ARC_0104
SECTIONS 1	ATSYD2_SSD_DRG_ARC_0200
SECTIONS 2	ATSYD2_SSD_DRG_ARC_0201
LONG SECTIONS	ATSYD2_SSD_DRG_ARC_0202
MASTER PLAN - EGRESS DIAGRAM	ATSYD2_SSD_DRG_ARC_0900
MASTER PLAN - HYDRANT POINT	ATSYD2_SSD_DRG_ARC_090

Appendix B

Generator Specification

This air quality study has been undertaken using the attached manufacturer information. This equipment is still to be competitively tendered – an equivalent unit from another manufacturer may be used. We expect the equipment to be similar in performance and to meet all relevant Australian Standards.

Generator set data sheet

Model: C3750 D5
Frequency: 50 Hz
Fuel type: Diesel
kVA rating: 3750 Standby
3350 Prime
3000 Continuous
Emissions level: Unregulated

Fuel consumption

	Standby				Prime				Continuous			
	kVA (kW)				kVA (kW)				kVA (kW)			
Ratings	3750 (3000)				3350 (2680)				3000 (2400)			
Ratings without fan[1]	3844 (3075)				3445 (2756)				3095 (2476)			
Load	1/4	1/2	3/4	Full	1/4	1/2	3/4	Full	1/4	1/2	3/4	Full
US gph	57	100	143	186	52	90	128	166	48	82	116	150
L/hr	216	379	541	704	197	341	484	628	182	310	439	568

[1]Ratings for reference with the optional remote radiator cooling configuration. See note 1 under “Alternator data” section.

Engine

	Standby rating	Prime rating	Continuous rating
Engine model	QSK95-G4		
Configuration	Cast iron, vee, 16 cylinder		
Aspiration	Turbocharged and after-cooled		
Gross engine power output, kWm (bhp)	3213 (4307)	2851 (3822)	2562 (3434)
BMEP at set rated load, kPa (psi)	2696 (391)	2392 (347)	2151 (312)
Bore, mm (in)	190.0 (7.48)		
Stroke, mm (in)	210.1 (8.27)		
Rated speed, rpm	1500		
Piston speed, m/s (ft/min)	10.5 (2067)		
Compression ratio	15.5:1		
Lube oil capacity, L (qt)	647 (684)		
Overspeed limit, rpm	2070		
Regenerative power, kW	230		

Fuel flow

Maximum fuel flow, L/hr (US gph)	1392.9 (368)
Maximum fuel inlet restriction with clean filter, kPa (in Hg)	13.5 (4)
Maximum fuel return line restriction kPa (in Hg)	34 (10)
Maximum fuel inlet temperature, °C (°F)	71.1 (160)
Maximum fuel outlet temperature, °C (°F)	92.2 (198)

Air

Combustion air, m^3/min (scfm)	245 (8640)	228 (8050)	215 (7590)
Maximum air cleaner restriction with clean filter, mm H_2O (in H_2O)	457 (18)		
Alternator cooling air, m^3/min (cfm)	240 (8476)		

Exhaust	Standby rating	Prime rating	Continuous rating
Exhaust flow at set rated load, m^3/min (cfm)	546 (19290)	505 (17840)	473 (16690)
Exhaust temperature at set rated load, °C (°F)	404 (760)	392 (737)	381 (718)
Maximum back pressure, kPa (in H_2O)	7 (28)		

Standard set-mounted radiator cooling

Ambient design, °C (°F)	43 (109)
Fan load, kW_m (HP)	78 (105)
Coolant capacity (with radiator), L (US gal)	1120 (296)
Cooling system air flow, m^3/min (scfm)	3135 (110700)
Maximum cooling air flow static restriction, kPa (in H_2O)	0.12 (0.5)

Optional set-mounted radiator cooling

Ambient design, °C (°F)	52 (126)
Fan load, kW_m (HP)	78 (105)
Coolant capacity (with radiator), L (US gal)	1120 (296)
Cooling system air flow, m^3/min (scfm)	3135 (110700)
Maximum cooling air flow static restriction, kPa (in H_2O)	0.12 (0.5)

Optional remote radiator cooling

Engine coolant capacity, L (US gal)	379 (100)		
Max flow rate at max friction head, jacket water circuit, L/min (US gal/min)	2559 (676)		
Max flow rate at max friction head, aftercooler circuit, L/min (US gal/min)	538 (142)		
Heat rejected, jacket water circuit, MJ/min (Btu/min)	78.80 (74730)	70.70 (67050)	64.20 (60900)
Heat rejected, aftercooler circuit, MJ/min (Btu/min)	19.60 (18560)	16.90 (15990)	14.70 (13940)
Heat rejected, fuel circuit, MJ/min (Btu/min)	0.24 (231)	0.21 (203)	0.19 (180)
Total heat radiated to room, MJ/min (Btu/min)	23.30 (22070)	20.70 (19660)	18.70 (17690)
Maximum friction head, jacket water circuit, kPa (psi)	59 (8.5)		
Maximum friction head, aftercooler circuit, kPa (psi)	59 (8.5)		
Maximum static head above engine crank centerline, jacket water circuit, m (ft)	18 (60)		
Maximum static head above engine crank centerline, aftercooler circuit, m (ft)	18 (60)		
Maximum jacket water outlet temp, °C (°F)	104.4 (220)	100 (212)	100 (212)
Maximum aftercooler inlet temp, °C (°F)	71.1 (160)	68 (155)	68 (155)
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)	46.1 (115)		

Note: For non-standard remote installations contact your local Cummins representative.

Weights

Unit dry weight kgs (lbs)	29500 (65100)
Unit wet weight kgs (lbs)	31200 (68771)

Note: Weights represent a set with standard features and alternator frame P80X. See outline drawing for weights of other configurations.

Derating factors

Standby	Full genset power available up to 809 m (2654 ft) at ambient temperatures up to 40 °C (104 °F) and 702 m (2303 ft) at ambient temperatures up to 50 °C (122 °F). Above these conditions, derate at 3.3% per 305 m (1000 ft) and 2% per 10 °C (18 °F).
Prime	Full genset power available up to 1451 m (4760 ft) at ambient temperatures up to 40 °C (104 °F) and 1023 m (3356 ft) at ambient temperatures up to 50 °C (122 °F). Above these conditions, derate at 3.4% per 305 m (1000 ft) and 8% per 10 °C (18 °F).
Continuous	Full genset power available up to 2333 m (7654 ft) at ambient temperatures up to 40 °C (104 °F) and 1680 m (5512 ft) at ambient temperatures up to 50 °C (122 °F). Above these conditions, derate at 3.7% per 305 m (1000 ft) and 8% per 10 °C (18 °F).

Ratings definitions

Emergency Standby Power (ESP):	Limited-Time Running Power (LTP):	Prime Power (PRP):	Base Load (Continuous) Power (COP):
Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power to a constant electrical load for limited hours. Limited-Time Running Power (LTP) is in accordance with ISO 8528.	Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) is in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.

Alternator data[1]

Voltage	Connection	Temp rise ºC	Duty[2]	Max surge kVA	Winding No.	Alternator	Feature code
380	Wye, 3-phase	150/125/105	S/P/C	11145	12	ADS-532	B595-2
380-440	Wye, 3-phase	150/125	S/P	11146	12	ADS-532	B667-2
380	Wye, 3-phase	105	P	11145	12	ADS-532	B630-2
400	Wye, 3-phase	125	S	11146	12	ADS-532	BA63-2
400	Wye, 3-phase	105	P	11146	12	ADS-532	BA62-2
400-415	Wye, 3-phase	125	P	10132	12	ADS-531	B635-2
400	Wye, 3-phase	105	C	11146	12	ADS-532	BA61-2
415	Wye, 3-phase	125	S	11146	12	ADS-532	BA68-2
415	Wye, 3-phase	105	P	11146	12	ADS-532	BA66-2
415	Wye, 3-phase	105	C	11146	12	ADS-532	BA65-2
440	Wye, 3-phase	105	C	11025	12	ADS-532	BA71-2
440	Wye, 3-phase	105	P	11025	12	ADS-532	B658-2
690	Wye, 3-phase	125	S	11970	65	ADS-586	BA77-2
690	Wye, 3-phase	150	S	11970	65	ADS-586	BA78-2
690	Wye, 3-phase	105	P	11970	65	ADS-586	BA74-2
690	Wye, 3-phase	125	P	9960	65	ADS-531	BA76-2
690	Wye, 3-phase	80	C	11970	65	ADS-586	BA72-2
690	Wye, 3-phase	105	C	11970	65	ADS-586	BA73-2
3300	Wye, 3-phase	80	S	14880	8003	ADS-592	B620-2
3300	Wye, 3-phase	105	S	10845	51	ADS-587	BA80-2
3300	Wye, 3-phase	125/105/80	S/P/C	10845	51	ADS-587	B470-2
3300	Wye, 3-phase	150	S	9481	51	ADS-545	BB78-2
3300	Wye, 3-phase	80	P	10845	51	ADS-587	BA79-2
3300	Wye, 3-phase	105	P	9481	51	ADS-545	B372-2
3300	Wye, 3-phase	125	P	9481	51	ADS-545	BB79-2
3300	Wye, 3-phase	105	C	10845	51	ADS-587	B471-2
6000	Wye, 3-phase	80	S	14170	8010	ADS-591	BA83-2
6000	Wye, 3-phase	105	S	12728	8008	ADS-589	BA86-2
6000	Wye, 3-phase	125	S	10463	71	ADS-534	BB80-2
6000	Wye, 3-phase	80	P	10463	71	ADS-534	BA82-2
6000	Wye, 3-phase	105	P	8866	71	ADS-533	BA85-2
6000	Wye, 3-phase	80	C	10463	71	ADS-534	BA81-2
6000	Wye, 3-phase	105	C	8866	71	ADS-533	BA84-2
6300/6600	Wye, 3-phase	80	S	14685	8009	ADS-590	B642-2
6300	Wye, 3-phase	105	S	13160	8007	ADS-588	B497-2
6300	Wye, 3-phase	125	S	10727	61	ADS-534	BA88-2
6300	Wye, 3-phase	80	P	13770	8008	ADS-589	B645-2
6300	Wye, 3-phase	105	P	10727	61	ADS-534	B498-2
6300	Wye, 3-phase	80	C	10727	61	ADS-534	BA87-2
6300	Wye, 3-phase	105	C	10727	61	ADS-534	B482-2

Alternator data[1] (continued)

Voltage	Connection	Temp rise ºC	Duty[2]	Max surge kVA	Winding No.	Alternator	Feature code
6600	Wye, 3-phase	105	S	10656	61	ADS-534	B679-2
6600	Wye, 3-phase	125	S	10656	61	ADS-534	BA91-2
6600	Wye, 3-phase	80	P	14175	8008	ADS-589	BA89-2
6600	Wye, 3-phase	105	P	9378	61	ADS-533	BA90-2
6600	Wye, 3-phase	80	C	10656	61	ADS-534	B828-2
6600	Wye, 3-phase	105	C	9378	61	ADS-533	B793-2
10k	Wye, 3-phase	80	S	14399	8024	ADS-591	BA93-2
10k	Wye, 3-phase	105	S	13500	8022	ADS-589	BA94-2
10k	Wye, 3-phase	125	S	10427	81	ADS-534	BA95-2
10k	Wye, 3-phase	80	P	13500	8022	ADS-589	BA92-2
10k	Wye, 3-phase	105	P	10427	81	ADS-534	B494-2
10k	Wye, 3-phase	80	C	10427	81	ADS-534	B794-2
10k	Wye, 3-phase	105	C	9125	81	ADS-533	B474-2
10.5k	Wye, 3-phase	80	S	14240	8023	ADS-590	BA98-2
10.5k	Wye, 3-phase	105	S	12784	8021	ADS-588	BB01-2
10.5k	Wye, 3-phase	125	S	12784	8021	ADS-588	BB02-2
10.5k	Wye, 3-phase	80	P	13770	8022	ADS-589	BA97-2
10.5k	Wye, 3-phase	105	P	10665	83	ADS-534	BA99-2
10.5k	Wye, 3-phase	80	C	12784	8021	ADS-588	BA96-2
10.5k	Wye, 3-phase	105	C	9333	83	ADS-533	B475-2
11k	Wye, 3-phase	80	S	14685	8023	ADS-590	B624-2
11k	Wye, 3-phase	105	S	11656	8021	ADS-588	B477-2
11k	Wye, 3-phase	125/105/80	S/P/C	10613	83	ADS-534	B648-2
11k	Wye, 3-phase	80	P	13770	8022	ADS-589	B985-2
11k	Wye, 3-phase	105	C	9288	83	ADS-533	B478-2

Notes:

[1] Alternator data is configured for a set with ratings including engine cooling fan losses and standard features at 40 °C ambient temperature. For non-standard configurations, including remote radiator applications, check appropriate alternator data sheets or contact your local Cummins representative.

[2] Standby (S), Prime (P) and Continuous ratings (C).

[3] Maximum rated starting kVA that results in a minimum of 90% of rated sustained voltage during starting.

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

For more information contact your local Cummins distributor or visit power.cummins.com

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NAD-5916-EN (10/17)

Exhaust emission data sheet
C3750 D5
50 Hz Diesel generator set

Engine Information:

Model:	Cummins Inc. QSK95-G4	Bore:	7.48 in. (190 mm)
Type:	4 Cycle, VEE, 16 cylinder diesel	Stroke:	8.27 in. (210 mm)
Aspiration:	Turbocharged and Aftercooled	Displacement:	5816 cu. in. (95.3 liters)
Compression Ratio:	15.5:1		
Emission Control Device:	Turbocharged and Aftercooled		
Emission Level:	Stationary emergency		

Performance Data	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby	Full Prime	Full Continuous
Engine BHP @ 1500 RPM (50 Hz)	1145	2185	3225	4308	3822	3433
Fuel Consumption L/Hr (US Gal/Hr)	216 (57)	371 (98)	537 (142)	723 (191)	636 (168)	575 (152)
Exhaust Gas Flow m^3/min (CFM)	205 (7251)	317 (11195)	443 (15664)	560 (19765)	510 (18022)	473 (16705)
Exhaust Gas Temperature °C (°F)	331 (627)	378 (713)	383 (722)	413 (776)	391 (763)	384 (723)
Exhaust Emission Data						
HC (Total Unburned Hydrocarbons)	0.19 (81)	0.09 (46)	0.08 (40)	0.06 (31)	0.06 (33)	0.08 (41)
NOx (Oxides of Nitrogen as NO_2)	9.1 (3990)	9.3 (4540)	7.6 (3800)	7.4 (3700)	7.3 (3670)	7 (3500)
CO (Carbon Monoxide)	0.3 (150)	0.2 (110)	0.1 (30)	0.1 (40)	0.1 (30)	0.1 (30)
PM (Particulate Matter)	0.05 (18)	0.01 (6)	0.01 (3)	0.01 (4)	0.01 (3)	0.01 (3)
SO_2 (Sulfur Dioxide)	0.005 (1.8)	0.004 (1.8)	0.004 (1.8)	0.004 (1.7)	0.004 (1.7)	0.004 (1.8)
Smoke (FSN)	0.35	0.16	0.08	0.11	0.08	0.08

All values (except smoke) are cited: g/BHP-hr (mg/Nm^3 @ 5% O_2)

Test Conditions

Steady-state emissions recorded per ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rates stabilized.

Fuel Specification:	40-48 Cetane Number, 0.0015 Wt.% Sulfur; Reference ISO8178-5, 40 CFR 86, 1313—98 Type 2-D and ASTM D975 No. 2-D. Fuel Density at 0.85 Kg/L (7.1 lbs/US Gal)
Air Inlet Temperature	25 °C (77 °F)
Fuel Inlet Temperature:	40 °C (104 °F)
Barometric Pressure:	100 kPa (29.53 in Hg)
Humidity:	NOx measurement corrected to 10.7 g/kg (75 grains H_2O/lb) of dry air
Intake Restriction:	Set to 18 in of H_2O as measured from compressor inlet
Exhaust Back Pressure:	Set to 1.5 in Hg
Note:	mg/m^3 values are measured dry, corrected to 5% O_2 and normalized to standard temperature and pressure (0°C, 101.325 kPa)

The NOx, HC, CO and PM emission data tabulated here are representative of test data taken from a single engine under the test conditions shown above. Data for the other components are estimated. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures and instrumentation. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.