Stolthaven Bulk Liquids Fuel Storage Facility, Mayfield

Operational Noise Compliance Assessment

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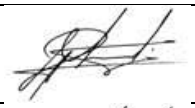
A	19-Dec-2016	Draft for client review	Patrick Martinez Associate Director	
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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been engaged by Stolthaven Australia Pty Ltd (Stolthaven) to carry out noise compliance measurements for operations at the Stolthaven Bulk Liquids Fuel Storage Facility (the Facility) operated by Stolthaven at the Port of Newcastle, Mayfield, NSW.

The Facility has three approval/license documents that control its operations, these documents are:

- State Significant Development (SSD) 6664 – 16 April 2015; and
  - Modification 1 – 28 September 2015.
- The NSW Environment Protection Authority (EPA) issued Environment Protection Licence No. 20193 (EPL 20193), License version date 27 August 2015; and
- Mayfield Concept Approval (MCP) (Application 09_0096) dated 16 July 2012 (latest modification 12 December 2014).

This acoustic assessment was conducted to determine compliance with the requirement in EPL 20193 and SSD 6664 MOD 1.

As the Facility lies within the MCP approval area, it requires noise emissions from the site to be consistent with the environmental assessment requirements of the MCP Approval. Consistency with the MCP Approval requirements has also been addressed in this report.

Section L5.6, L5.7 and M9 of the EPL 20193 outline the methods to determine compliance with the noise limits within the EPL 20193. Attended noise measurements were undertaken on 22/23 November 2016 at the closest nearby residential receiver locations in accordance with section L5.6.It was found that it was not possible to directly measure the noise arising from operations at the Facility due to the influence from extraneous noise sources, i.e. existing industrial noise from other industrial areas unrelated to the Facility and traffic noise on Industrial Drive. As such, an alternative method was employed to demonstrate the compliance noise levels. The compliance assessment was therefore carried out using SoundPLAN noise modelling software.

This method of noise compliance assessment is in accordance of the Chapter 11 of the EPA NSW Industrial Noise Policy (INP). In order to determine compliance of the Facility operational noise emissions with the required noise limits 'reasonable' worst case operational scenarios where determined from 2016 historical data provided by Stolthaven, and noise levels based upon the site attended and unattended noise measurements undertaken over the period of 2:00 pm 22 November 2016 to 9:00 am 23 November 2016 and detailed analysis of the Facility movement data provided by Stolthaven for this period.

This report presents the on-site attended and unattended noise measurements undertaken on 22/23 November 2016 to assist with development of a calibrated computer noise model of the operations at the Facility.

All measurements presented in this report were undertaken by Angus Leslie, Acoustic Engineer.

AECOM has been advised by Stolthaven that no noise complaints have been received to date in relation to noise from the operation of the Facility.

1.1 Stolthaven Bulk Liquid Storage Terminal description

1.1.1 Location

The Facility is located on the former BHP steelworks site in Mayfield North, adjacent to the Hunter River, approximately 5 km north-west of Newcastle CBD. The site location falls within the MCP area, which is currently being redeveloped as an industrial precinct.

During operations, haulage ships will dock at the Mayfield No. 4 Berth and pump fuel into storage tanks to be blended and held on site. Haulage trucks receive the blended fuels and transport it through an access road leading to the intersection of Industrial Drive and Ingall Street.

The nearest residential areas to the site are located to the south-west of the Facility at Mayfield, with the closest receivers in Crebert Street, approximately 900 m away. To the south east there are residential receivers located in Carrington, approximately 2 km away. To the south east there are the residential receivers located in Stockton, approximately 3 km away.

The Facility location and key sensitive receivers are shown in **Figure 1**.

1.1.2 Operational activities and facilities

Stolthaven has approval to operate the Facility to receive, store and dispatch diesel and biodiesel fuel. The Facility has been approved for an annual throughput of 1,300 ML of diesel and biodiesel.

The Facility makes use of an existing ship berthing facility to receive diesel fuel, which are transferred to site using an above-ground, dedicated pipeline approximately 1 km in length. Transportation of the fuel to customers is undertaken by B-Double road tankers. Transportation occurs 24 hours per day, 7 days per week.

1.1.3 Operational noise sources

Operations at the site consist of the following activities:

Internal private access Roads	• moving trucks, idling trucks.
Industrial noise sources	• fuel pumps; • haulage tanker trucks filling; • ships in berth filling/depositing (currently at Mayfield No. 4 Berth, as such these operations fall under Condition 5.11 of the Consent Condition DA-293-08-00 MOD 9, dated 29 August 2013)

Sound power levels of the different operations at the Facility were determined through on-site measurements on 22/23 November 2016.

1.1.4 Hours of operation

The operational hours for the Facility are Monday to Sunday 24 hours per day.

1.1.5 Nearby sensitive receiver locations

The locations of the Facility and nearby assessment receivers are shown in **Figure 1**. **Table 1** presents the assessment receiver locations including the land use classification in accordance with the INP.

Table 1 Assessment receiver locations

EPL receiver number / Mayfield Concept Plan receiver location	Address	Land use classification	Associated receiver area
R1/A	1 Arthur St, Mayfield	Residence - Urban	Mayfield
R2	52 Arthur St, Mayfield	Residence - Urban	Mayfield
R3	62 Arthur St, Mayfield	Residence - Urban	Mayfield
R4/B	2 Crebert St, Mayfield	Residence - Urban	Mayfield
R5	21 Crebert St, Mayfield	Residence - Urban	Mayfield
R6	30 Crebert St, Mayfield	Residence - Urban	Mayfield
R7	2 McNeil Cl, Mayfield	Residence - Urban	Mayfield
R8/C	32 Elizabeth St, Carrington	Residence - Urban	Carrington
R9/D	186 Fullerton Rd, Stockton	Residence - Suburban	Stockton
R10	Mayfield East Public School	School	-

Notes:

1. Letters designate the Mayfield Concept Plan assessment receiver locations.

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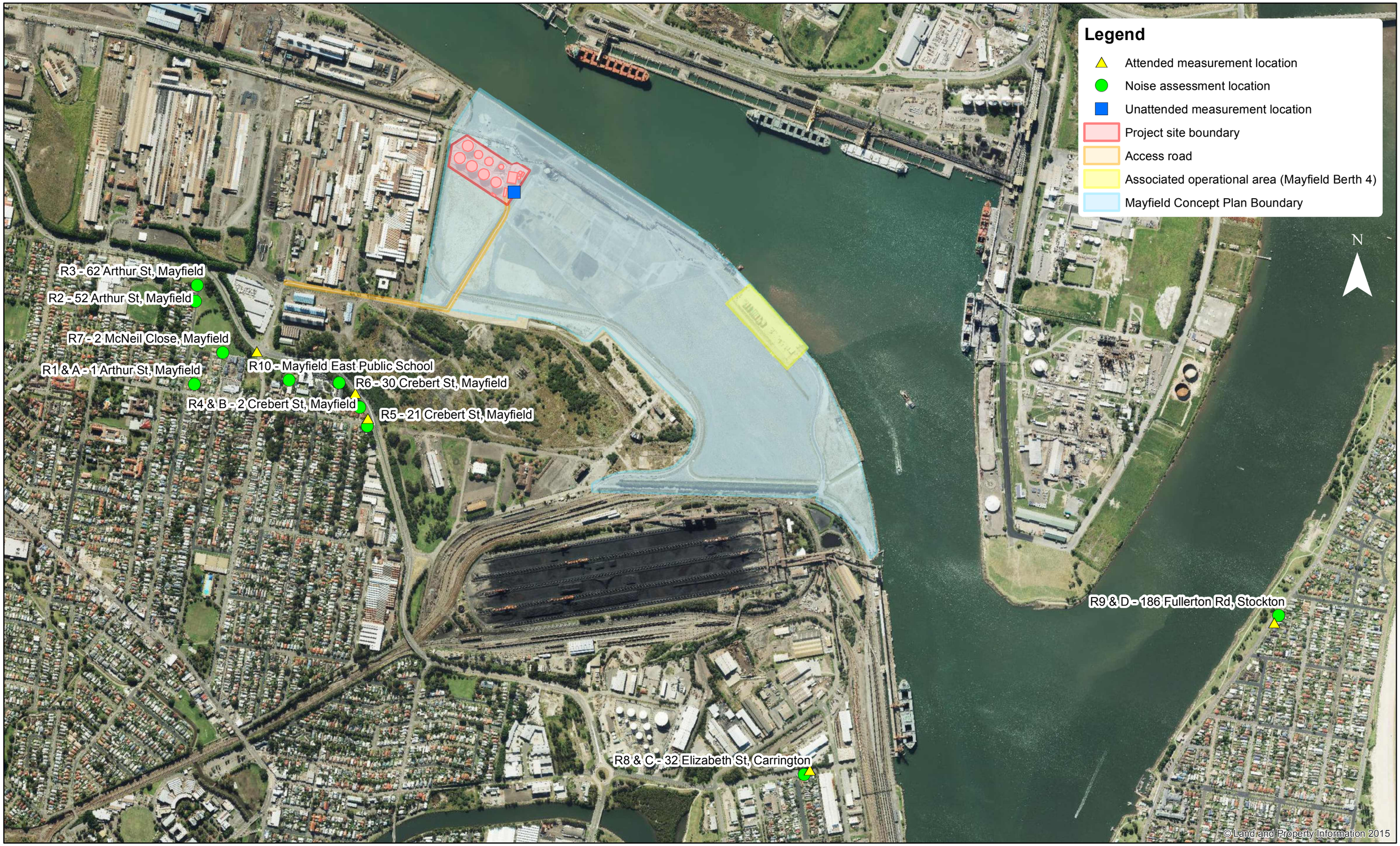

Stolthaven Bulk Fuel Liquids Fuel Storage Facility, Mayfield - Operational Noise Compliance Assessment

Project site location, noise assessment locations, and noise measurement locations

Dec 2016

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0 500 1,000 2,000 m

Figure 1

1.2 Compliance assessment criteria

1.2.1 Summary of monitoring requirements

1.2.1.1 Environment Protection Licence 20193

Section L5.1 of the EPL 20193, License version date 27 August 2015, presents the noise limits that apply to the site, and are reproduced in **Table 2**.

Table 2 Summary of site operational noise limits ($L_{Aeq(15minute)}$)

Receiver	Day	Evening	Night	
	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{A1(1min)}$
R1 - 1 Arthur St, Mayfield	48	43	42	52
R2 - 52 Arthur St, Mayfield	48	43	42	52
R3 - 62 Arthur St, Mayfield	48	43	42	52
R4 - 2 Crebert St, Mayfield	48	43	42	52
R5 - 21 Crebert St, Mayfield	48	43	42	54
R6 - 30 Crebert St, Mayfield	48	43	42	52
R7 - 2 McNeil Cl, Mayfield	48	43	42	52
R8 - 32 Elizabeth St, Carrington	49	48	44	54
R9 - 186 Fullerton Rd, Stockton	52	51	51	61
R10 - Mayfield East Public School	45	N/A	N/A	N/A

In addressing the requirement that "*Noise generated by the Project is to be measured in accordance with the procedures and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy*." these noise limits apply under all meteorological conditions except for any of the following:

a. Wind speeds greater than 3 metres/second at 10 metres above ground level; or

b. Stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or

c. Stability category G temperature inversion conditions;

1.2.1.2 Sleep disturbance requirements

Section L5.1 of the EPL 20193 presented sleep disturbance criteria which are reproduced in **Table 2**.

1.2.2 Conditions of Consent - State Significant Development (SSD) 6664 – 16 April 2015 (Modification dated 28 September 2015)

1.2.3 Amenity noise requirements – Mayfield Concept Plan (MCP)

A methodology to deal with cumulative noise from the entire MCP is currently in development and is yet to be finalised. As part of the most recent update, Minister for Planning's Project Approval (Application SSD 6664, dated 16 April 2015), two key sections are relevant to this noise compliance assessment, these include condition 22 and 27. These state:

22.

The Applicant shall, in consultation with the PON ensure that noise from operation of the Development:

a. Fits within the Site Noise Model developed for the Mayfield Concept Plan;

b. Does not exceed any noise quota provided by PON for the Development, in accordance with the Site Noise model for the Mayfield Concept Plan.

…

27.

The Applicant shall monitor noise from operation of the Development, to the satisfaction of the Secretary. The monitoring shall:

a. Be undertaken annually, or to address genuine noise complaints that are related to the Development as determined by the Department or the EPA.;

b. Be undertaken in accordance with the NSW Industrial Noise Policy; and

c. Demonstrate compliance with the relevant noise goals constrained in the Mayfield Concept Plan, or any noise quota established by the PON for the Development.

Note: The monitoring requirements could be satisfied by the monitoring network require for the Mayfield Concept Plan once it is established.

It is understood that a key part of the development of this cumulative noise management strategy is a focused upon the amenity (whole of period) noise levels. It is understood that, for any proposed development within the MCP area, the available noise criteria for the entire MCP area will be proportionally distributed amongst all future developments. When lodgement or notification of a new development is received by Port of Newcastle (PON), a noise allocation will be provided to the proposed development site that will become the cumulative amenity noise quota that they should meet. The overall MCP noise goals are presented in **Table 3.**

Table 3 MCP overall noise goals

Receiver	Project Specific Noise Goals, $L_{Aeq, period}$ dB(A)		
	Day (7.00 am to 6.00 pm)	Evening (6.00 pm to 10.00 pm)	Night (10.00 pm to 7.00 am)
A – 1 Arthur Street, Mayfield	60	49	43
B – 2 Crebert Street, Mayfield	60	50	43
C – 32 Elizabeth Street, Carrington	57	44	45
D - 186 Fullerton Rd, Stockton	55	37	37

PON's is using a Cumulative Environmental Noise Management Tool (CENMT) that has been developed for the MCP to manage individual site noise requirements for sites within the MCP. It is

noted that a site specific noise quota was not issued as part of the SSD 6664 MOD 1 approval as the methodology for assessing sites against these noise quotas is being finalised, and the Stolthaven Bulk Fuel Facility is the approved operational facility within the MCP.

As such for the purposes of assessing the sites noise emission against the requirements of the MCP; they have been assessed against the overall MCP amenity noise limits. This is appropriate for this compliance assessment as the Facility is the only approved operational facility within the MCP.

The Facility amenity noise emission levels were predicted and presented in **Section 2.4.2.** These noise levels include noise from traffic movements within the MCP area, but external of the Project site area.

2.0 Measurement Methodology and Results

2.1 Compliance measurements

2.1.1 Meteorological conditions

Meteorological results have been taken from the Stolthaven Terminal automatic meteorological station as required by EPL 20193 Condition M5.1.

Meteorological conditions during the representative assessment receiver attended measurement period have been reviewed for the noise monitoring period to determine the prevailing wind and temperature inversion conditions. The meteorological conditions experienced during noise compliance investigations is summarised as:

- During the night-time receiver measurement period at the Facility the equivalent average wind speed was a 1-4 m/s and generally from the NE, varying from NNE to E. The measurements were not impacted by the prevailing wind during the measurement periods;
- During the night period measurements, the temperature inversion conditions between the period of 10:30 pm 22 November 2016 until 2:00 am 23 November 2016 were generally Class D inversion with small periods of Class A-E, based upon calculations using he sigma-theta method referred to in Part E4 of Appendix E to the NSW INP;
- No rain occurred during any of the measurement periods; and
- The temperature during the night-time measurements it ranged between 21˚C - 22˚C, and the cloud conditions were generally clear skies with a few scattered clouds during all periods.

2.1.2 Instrumentation

Unattended and attended noise measurements were conducted using the equipment presented in **Table 4.**

Table 4 Measurement instruments

Equipment	Serial Number
Unattended noise measurements	
Cirrus Optimus CR:171C	G061710
Attended noise measurements	
Brüel and Kjaer Type 2250	3009330

All instruments presented in **Table 4** are designated as Class 1 instruments. Each sound level meter was calibrated before and after the measurements using a calibrator (Rion NC-74 Serial Number 34283660) with a drift in calibration not exceeding ±0.5 dB.

All the acoustic instrumentation employed during the noise measurements comply with the requirements of "*AS IEC 61672.1-2004 Electroacoustics - Sound level meters - Specifications*".

All equipment used for this report have valid calibration certificates.

2.1.3 Attended measurement results and discussion

Attended noise measurements of typical operations were undertaken at the Facility in order to develop the noise model used for this noise compliance assessment.

Attended noise measurements were undertaken at receiver locations R1, R4, R6, R7, R8 and R9, as presented in **Figure 1**. These receiver locations were selected as they are either key MCP receiver locations or all other receiver locations are further away. As such, by achieving compliance at these locations, compliance will be achieved at the other receiver locations.

At all the measurement locations, except R8 (32 Elizabeth Street, Carrington), exceedances of the noise limits were noted when only industrial noise was apparent at the measurement locations in the absence of traffic contribution from Industrial Drive or other adjacent roads.

Receiver attended measurements were undertaken, generally, following observation of trucks approaching the Facility. Correlation with data noted that a truck was in the Facility during all measurements, with the exception of 1 Arthur Street (R1/A). However, it should be noted that noise from site was not clearly distinguishable or quantifiable at the closer locations of R6 (30 Crebert Street, Mayfield) and R4/B (2 Crebert Street, Mayfield) when operations were taking place on-site. Additionally, where the measurements were undertaken with no activities within the Facility, the measured noise levels are significantly above the modelled noise levels.

It was not possible to quantify the noise contribution from the Facility during operation from the other industrial sources in the surrounding area at all receiver locations. Thus it was not possible to determine the noise contribution through direct measurement. The INP provides guidance in Chapter 11 as to how to review the noise emissions of a site where the existing noise levels are already high.

The results of the attended measurements conducted on 22/23 November 2016 are presented in **Table 5**.

Table 5 Attended measurements at assessment receiver locations on 22/23 November 2016

Location		Time of measurement	Monitored noise levels			Operators comments
			$L_{A1,}$ dB(A)	$L_{Aeq,}$ dB(A)	$L_{A90,}$ dB(A)	
-	Cnr of Industrial Drive and Ingall St (For R7 - 2 McNeil Cl, Mayfield)	11:58 pm 22 Nov	75	63	49	**INDUSTRIAL CONTRIBUTION:** Background constant broadband industrial hum at ~0-50 deg ~49/50 dB(A) (controls background). A few events which sound like banging of metal at ~340 deg. No distinguishable noise sources in the direction of the Stolthaven Facility (~47 deg). **TRAFFIC CONTRIBUTION:** Intermittent traffic on Industrial Drive was the main noise source other than the background industrial hum, with car passby's ~69-75 dB(A), truck passby's 66-80 dB(A). **OTHER:** Occasional crickets. *Average Wind – Calm, Clear Sky*
R4/B	2 Crebert St, Mayfield	11:01 pm 22 Nov	76	64	47	**INDUSTRIAL CONTRIBUTION:** Background constant broadband industrial hum at ~340-50ºdeg ~46/47 dB(A) (controls background). Occasional banging of metal to north. Faint but audible warning alarms to ~355 deg. No distinguishable noise sources in the direction of the Stolthaven Facility (~25ºdeg). **TRAFFIC CONTRIBUTION:** Intermittent traffic on Industrial Drive was the main noise source other than the background industrial hum, with car passby's ~67-73 dB(A), truck passby's 75-82 dB(A). **OTHER:** Occasional crickets. *Average Wind – Calm, Clear Sky*
R6	30 Crebert St, Mayfield	10:43 pm 22 Nov	80	68	46	**INDUSTRIAL CONTRIBUTION:** Background constant broadband industrial hum at ~340-50ºdeg ~46 dB(A) (controls background). Occasional banging of metal at 330 deg. Very faint but audible warning alarms to ~N. A truck accelerating was audible and a pump start-up wine on one occasion during the measurement (Just audible at ~45 dB(A)) in the direction of the Stolthaven Facility access road (~20ºdeg). **TRAFFIC CONTRIBUTION:** Intermittent traffic on Industrial Drive was the main noise source other than the background industrial hum, with car passby's ~71-74 dB(A). **OTHER:** Nearby bats (~55-59 dB(A)). *Average Wind – Calm, Clear Sky*

Location		Time of measurement	Monitored noise levels			Operators comments
			L_{A1}, dB(A)	L_{Aeq}, dB(A)	L_{A90}, dB(A)	
R1/A	1 Arthur St, Mayfield	12:20 am 23 Nov	55	50	48	**INDUSTRIAL CONTRIBUTION:** Background constant broadband industrial hum at ~10-40ºdeg ~48 dB(A) (controls background). Occasional banging of metal at to north (~51-54 dB(A)). Faint but audible warning alarms to north. No distinguishable noise sources in the direction of the Stolthaven Facility (~43ºdeg). **TRAFFIC CONTRIBUTION:** Intermittent traffic on Industrial Drive was the main noise source other than the background industrial hum, with truck passby's ~55/56 dB(A). **OTHER:** Crickets and occasional bats. *Average Wind –Calm to slight NNE ~0.5 m/s, Clear sky*
R9/D	186 Fullerton St, Stockton	1:24 am 23 Nov	49	46	45	**INDUSTRIAL CONTRIBUTION:** Strong constant broadband industrial hum from Kooragang Island ~45/46 dB(A (controls background), ranging over ~280-320 deg. No distinguishable sources in the direction of the Stolthaven Facility. **TRAFFIC CONTRIBUTION:** Local traffic on Fullerton Road excluded from measurement. **OTHER:** Nearby crickets, possums and bats. *Average Wind –Calm to slight NE ~0.5 m/s, Clear sky*
R8/C	32 Elizabeth St, Carrington	12:48 am 23 Nov	46	43	42	**INDUSTRIAL CONTRIBUTION:** Broadband industrial hum at ~10 deg, ~42-44 dB(A) (controls background), in addition to distant hum at ~120-150 deg, ~40 dB(A). Faint but audible warning alarms audible at ~10 deg. No distinguishable sources in the direction of the Stolthaven Facility. **TRAFFIC CONTRIBUTION:** Occasional tracks and car on nearby local roads. **OTHER:** Occasional nearby crickets and gulls. *Average Wind – Calm, Clear Sky*

Notes:

1. All bearings are with reference to magnetic north.

Section 11.1.2 Notes on noise monitoring of the INP states:

Where existing noise levels are high

"When compliance is being measured it may be found that, in many cases, existing noise levels are higher than noise level from the source, making it difficult to separate out the source noise level. When this happens, it may not be feasible to measure compliance at the specified location, and other methods will be needed. In these cases, measurements may be taken closer to the source and then calculated back to the specified location."

Accordingly, on-site measurements of individual plant items and typical operations were undertaken at the Facility between 2:00 pm 22 November 2016 until 9:00 am 23 November 2016.

It was noted during all measurements that the specific noise source being measured was the dominant noise source throughout the measurement period. Observations were made of the onsite operations, which have then been reviewed in conjunction with the Facility operational data to model 'reasonable' worst case operational scenarios over the assessment periods. These scenarios are described in **Section 2.2**. In addition, a noise logger was continuously measuring near the entrance of the site (see Figure 1), in order to assist with calibration of the predicted noise emission levels, correlate with Facility operational data, and determine operational source levels.

The noise model was validated using the unattended noise logger results and the attended measurements which measured continuously for the period from 2:00 pm 22 November 2016 to 5:30 am 23 November 2016, refer to **Section 2.3.2** for noise model calibration.

Key on-site attended measurement results are summarised in **Table 6**.

Table 6 On-site attended measurements at the Facility on 22/23 November 2016

Operation	Time of measurement	Monitored noise levels				Operator's comments
		$L_{A1(t)}$, dB(A)	$L_{A10(t)}$, dB(A)	$L_{Aeq(t)}$, dB(A)	$L_{A90(t)}$, dB(A)	
Background noise level at site with no site operations	11:23 pm	53	51	50	49	Background noise is dominated by ship loading activities and industrial activities (boiler to NE of site) to the north of the site.
Trucks pumping in Bays 1,2 & 3	2:51 pm	67	65	63	60	Trucks pumping in Bays 1,2 & 3 measured at the noise logger.
Truck pass-by	4:07 pm	70	70	68	64	Truck pass-by (accelerating down access road departing site) at logger location at 13 m from closest point of truck pass-by.
Truck pass-by	4:46 pm	75	75	72	66	Truck pass-by (accelerating down access road departing site) at logger location at 13 m from closest point of truck pass-by.
Truck pass-by	3:00 pm	72	72	69	64	Truck pass-by (accelerating down access road departing site) at logger location at 13 m from closest point of truck pass-by.

Operation	Time of measurement	Monitored noise levels				Operator's comments
		$L_{A1(t)}$, dB(A)	$L_{A10(t)}$, dB(A)	$L_{Aeq(t)}$, dB(A)	$L_{A90(t)}$, dB(A)	
Pump operations	3:11 pm	82	81	80	79	Measurement of pump/motor in operation@ 2m
Pump operations	3:57 pm	79	78	78	77	Measurement of pump/motor in operation@ 2m
Pump operations	3:56 pm	81	81	80	78	Measurement of pump/motor in operation@ 3m
Pump operations	3:59 pm	77	77	75	73	Measurement of pump/motor in operation@ 4m
Pump operations	2:20 pm	87	86	84	83	Measurement of pump/motor in operation@ 2m
Pump operations	2:23 pm	88	87	86	85	Measurement of pump/motor in operation@ 4m
Pump operations	2:24 pm	85	85	84	83	Measurement of pump/motor in operation@ 4m
Compressor	4:12 pm	71	71	70	70	Compressor at 4.5 m.

2.1.4 Unattended noise measurements

Unattended noise measurements were undertaken over the period of 2:00 pm 22 November 2016 to 5:30 am 23 November 2016 at a location adjacent to the site entrance. The location of the unattended noise logger is presented in **Figure 1.** The purpose of the noise logging at the selected location was for the following:

1. Determine the noise emissions from the Facility at a fixed location close enough to quantify on-site sources;
2. Determine the long term background noise levels when operations were not taking place at the site;
3. A source for analysis to determine duration and nature of the different onsite activities through correlation with the Facility activity data; and
4. Be a source of validation for the noise model.

2.2 Modelled operational scenarios

2.2.1 Observed operations for modelling

Based upon the attended measurements presented in **Table 6,** the movement logs for the Facility over the measurement period, and discussions with Stolthaven personnel, 'reasonable' worst case operational scenarios were established and modelled for the operations during the day, evening and night assessment periods, as required to satisfy the assessment periods under the following documents:

1. EPL 20193; and
2. the Minister for Planning's Project Approval (State Significant Development (SSD) 6664 – dated 16 April 2015) (Modification dated 28 September 2015).

2.2.2 Truck operations

The following data on truck operations was obtained from both site observations during the attended and unattended noise measurements, and from data provided by Stolthaven for the movements that took place over the measurements period of 2:00 pm 22 November 2016 to 5:30 am 23 November 2016.

- It was observed, and confirmed by movement data, that truck operations were typically B-Double trucks, and that a typical 'in-and-out' cycle time in the Facility was on median 30 minutes, with each tank filling cycle taking approximately 5-8 minutes;
- Based upon an analysis of the attended noise logger for a sample of truck movements from the site, it was observed that the average idling time for a truck from when it arrived to when it entered the Facility was approximately 1.5 minutes;
- There was typically on average 5-6 minute gap between the pumping operations when switching between tanks;
- The maximum number of trucks using the fuelling loading bays during the day was observed to be four simultaneously, which was confirmed for all periods through analysis of the movement data. As such the typical worst case would be four loading simultaneously;
- The pump source levels were based upon attended and unattended measurements, in order to take into consideration a full pump cycle, as the source level varies during the initial start-up and final filling phases of pumping, and the standard pumping rate. These have been included in the sound power levels presented in **Table 7**;
- It is noted that the measured pump noise levels were not all consistent with previous years. The pump levels linked to Bays 1 and 2 were consistent with previous years, however, the pumps linked to Bays 3 and 4 were up to 7 dB(A) higher than previous years. These elevated levels occurred as a result of a sloshing periodic noise that emerged during pumps that was not apparent during operation of the Bays 1 and 2 pumps. It is noted that compliance is achieved;
- Air-break releases would occur when the trucks arrived on-site and stopped prior to swiping in at the gate, and also when they stopped after moving into the bays. It should be noted that as a result of the design of the Facility, at no stage was it observed that trucks were required to reverse, and as such, no truck reversing beepers have been included in the assessment. It should be noted that it was observed that trucks typically did not use airbrakes when approaching the rear gate to leave the Facility;
- When the truck entered or exited the Facility a warning alarm at the gate would sound as the gate opened or closed;
- It was observed that when a truck was loading typically a single pump/motor set would be serving the truck during the loading operations, and motors would operate based upon the load required in the linked bays; and
- Based on discussions with personnel onsite, it was noted that a maximum of four pumps and full load would operate at the same time typically with all four bays in operations.

2.2.3 Compressor shed and office area operations

- It was observed the main compressor would run for durations of around 5 minutes;
- It was observed that an air-release vale that protruded from the southern façade of the compressor shed would operate rarely which is consistent with the previous year; and
- At the time the office plant was not in operation. The sound power level of some of the ventilation units was noted on the side of the units, and that unit types were also noted. As such, these were included in the modelling to take into account for periods where these are required for use.

2.2.4 Assessment noise source levels

The sound power level inputs presented in **Table 7** were used in the noise compliance modelling, and adjusted for duration and frequency of operations in accordance with the operations described in **Section 2.2.5** and **2.2.6**. The plant item sound power levels were determined from the attended noise measurements of typical operations made on site (**Table 6**) and the unattended noise logger. In order to determine compliance with the recommended noise limits, the predicted noise levels for each operational scenario were determined at each of the assessment locations. The results are presented in **Section 2.3**.

Modelling was undertaken using SoundPLAN noise modelling software. In total two intrusive (reasonable 'worst' 15-minute period) operational scenarios were modelled, in addition to day, evening and night amenity (whole of period) scenarios. The assessment of each scenario considers a 'reasonable' worst case operational period. The assumptions made for modelling purposes with regards to the equipment operating and the duration and frequency of operation are described in **Section 2.2.5** and **2.2.6**.

The predicted noise levels for both worst case wind or from worst case temperature inversion scenarios as required by the project approval conditions, in addition to the neutral scenarios are presented **Section 2.3**.

Table 7 The Facility plant items sound power levels

Plant item/operation	Sound power level, dB(A)
Trucks approaching/leaving site - Accelerating	88 dB(A)/m
Trucks approaching/leaving site – Using main access road	81 dB(A)/m
Trucks idling at site	94
Truck airbrake event	106[1]
Fuel Pump/Motor (Bay 1/2)	97
Fuel Pump/Motor (Bay 3/4)	105
Entrance gate/ exit gate alarm	96[2]
Office plant (individual item) – 5 items	68
Office plant (individual item) – 2 items	75
Compressor	91
Compressor shed air release valve	101[2]

Notes:

1. This has been based upon a 10 second measurement.
2. Based upon previous year

Table 8 The Facility plant items sound power levels for peak events

Plant item/operation	$L_{A1\ 1\ minute}$ Sound power level, dB(A)
Trucks approaching/leaving site - Accelerating	108
Truck airbrake event	115
Entrance gate/ exit gate alarm	101[1]
Compressor shed air release valve	101[1]

Notes:

1. Based upon previous year

2.2.5 Reasonable worst case intrusiveness scenarios (15 minute period)

The following are the modelled reasonable worst case intrusiveness scenarios (15 minute period). Two key sets of operations which generate noise emissions represent the sites worst case noise emissions, which are the worst case pumping operations, and then the worst case truck movements approaching or leaving the site. The make-up of these scenarios has been determined from an analysis of the movement data over the measurement period.

Both worst case periods occurred during the night-time measurement period, and so this has been used to assess against the day, evening and night periods. Noting the only difference will be the office noise contribution from the office based mechanical services, which generate negligible contribution to the overall noise impacts from the site operations.

Table 9 Worst case 15 minute intrusive assessment scenarios

Activity	Worst case on-site activities 15 minute assessment period (10:22 pm - 10:37 pm 22 November 2016)	Worst case truck movements 15 minute assessment period (4:11 am - 4:26 am 23 November 2016)
Leaving	Two trucks move down the approach road at approximately 40 km/h departing site. (Bays 1 & 4)	Two trucks move down the approach road at approximately 40 km/h departing site. (Bays 2 & 3).
Arriving	Two trucks move down the approach road at approximately 40 km/h and arrive at the site, stop with airbrake release, and idle for 1 minute at the entrance gate of the Facility (Bays 1 & 4).	Two trucks move down the approach road at approximately 40 km/h and arrive at the site, stop with airbrake release, and idle for 1 minute at the entrance gate of the Facility (Bays 1 & 4).
Pumping	Four B-Double trucks pumping in the facility. a. Bay 1 – One truck pumping for 9 minutes, then 2nd truck pumping for 2 minutes during period with 4 minute change over. b. Bay 2 – Pumping for 10 minutes c. Bay 3 – Pumping for 10 minutes each during period (Bay 3) with 3 minute tank switch break. d. Bay 4 – Pumping for 9 minutes with break.	Four B-Double trucks pumping in the facility. a. Bay 1 – Pumping for 10 minutes b. Bay 2 – Pumping for 6 minutes c. Bay 3 – Pumping for 6 minutes d. Bay 4 – Pumping for 6 minutes
	Consideration for the onsite speed and the usage of airbrakes at the Facility has been included in the modelling.	
	The operation of the entrance gate is associated with each truck movement through the Facility.	

Activity	Worst case on-site activities 15 minute assessment period (10:22 pm - 10:37 pm 22 November 2016)	Worst case truck movements 15 minute assessment period (4:11 am - 4:26 am 23 November 2016)
Other	Compressor shed operating with gas discharge during period.	
Office Plant	Office plant are not operating as the office building is not operating during the night period.	

2.2.6 Reasonable worst case amenity scenarios

The following are the modelled whole of period scenarios based upon on-site observations. All noise sources in the model were assumed to operate as per the points below.

1. Each truck using the Facility is a B-Double.
2. One motor/pumps combination is used to fill each tank.
3. Each B-Double tank takes 6 minutes to fill (i.e. 12 minutes per B-Double truck).
4. Each truck idles for a total of 1 minute on site at gate.
5. Air-break releases occur when the trucks arrived on-site and stopped prior to swiping in at the gate, and also when they stopped after moving into the bays.
6. Trucks move down the approach road at approximately 40 km/h and arrive at the site.
7. The operation of the entrance and exit gate is associated with each truck movement through the Facility.
8. Consideration for the onsite speed and the usage of airbrakes at the Facility has been included in the modelling.
9. Truck movements during the measurement day (22/23 November 2016) were supplied by Stolthaven and are presented in **Table 10**, these were included in the modelling considering the above assumptions.

Table 10 Trucks through the Facility on 22/23 November 2016

Trucks through the Facility on 22/23 November 2016	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)	Total
Trucks through the Facility in each period	32	7	26	65

Additionally, a review of the typical truck movement data provided by Stolthaven for 2016 has been used to determine the reasonable worst case movements through the facility over the year. The approach has been based upon the top 10% of movements through the facility during each of the day, evening or night assessment periods. The source noise levels have been based upon the on-site measured noise levels.

Presented in Table 11 are the truck numbers modelled to represent the reasonable worst case truck throughput during 2016.

Table 11 Reasonable worst case trucks through the Facility - 2016

Reasonable worst case trucks through the Facility - 2016	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
Truck movements (either to or from the facility)	**83**	**28**	**55**
Trucks in each period	41	14	28

10. Usage of the pump/motors is distributed throughout available pumps as per the operational usage.
11. Compressor shed operating with gas discharge operating throughout period.
12. Office plant are operating throughout the day and evening periods, 5 condenser units were noted on the south-western façade of the office building and are assumed the operation during the day and evening periods when the office could be occupied.

2.3 Modelling methodology

2.3.1 General modelling assumptions

Noise levels due to the operational activities shown in **Section 2.2** have been predicted to nearby noise sensitive receivers using SoundPLAN 7.3 (industry standard) noise modelling software. The base model has been based upon the current version of the *MCP Master SoundPlan model*.

The CONCAWE method was originally developed for predicting the long-distance propagation of noise from petrochemical complexes. It is especially suited to predicting noise propagation over large distances because it accounts for a range of atmospheric conditions that can significantly influence the propagation of noise over large distances.

Noting that the closest receptors in the vicinity of the proposed Facility are at least 500 m from the site, the CONCAWE environmental noise prediction method is an appropriate method for predicting the noise propagation. Whilst the General Prediction Method algorithm more accurately predicts at closer receiver locations, and was used for modelled receiver locations less than 100 m, as part of the model validation.

The modelling includes:

- Ground topography;
- Buildings and structures;
- All sources behave as point, or moving point sources;
- Ground Absorption; and
- Representative operational noise sources as required.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant equipment.

2.3.2 Model validation

The noise model outputs were compared with attended and long term unattended noise measurement results measured at the logger location. Measurements at locations further than this were not possible, as the existing industrial noise levels were in the region of 50 dB(A) during the night period and in the region of 55 dB(A) during the day from sources to the north, and at locations further away it was not possible to quantify noise directly from the Facility.

Validation of the worst case on-site pumping activities was undertaken, and is presented below in **Table 12.** Comparisons have been made against noise measurements for known operational activities (e.g. which pumps were operating, for how long, and which bays were occupied, and pumping was the dominate activity taking place).

Sources levels of truck operations have been based upon a series of truck pass-bys, from both the attended and unattended noise measurements. It is not possible to validate the model for the truck operations as a single truck source has been modelled, which is suitable for predicting to the assessment receiver locations, however, due to the close proximity of the truck movements to the logger location, it is not possible to correlate truck movements, with predicted noise levels so close the facility.

Table 12 Comparison between measured and modelled noise levels (22/23 November 2016)

Time period	Activity	Measured noise levels (L_{Aeq}, dB(A))	Predicted noise levels (L_{Aeq}, dB(A))	Difference, dB
2:20 am - 2:29 am 23 Nov	Pumping operations in Bay 1	58	58	0
12:57 am - 1:04 am 23 Nov	Pumping operations in Bay 3	65	64	1
9:30 pm - 9:37 pm 22 Nov	Pumping operations in Bay 3	62	64	2

The differences between the modelling and the measured results is as a result of the following:

1. Variation in the pump noise levels as a result of different fuel flow parameters.
2. Modelling is based upon a worst case average sound power level for the pumps, while during a pump cycle there were periods of highs and lows, and the pump was operating with either smooth constant flow, or initial start-up and ending phases.
3. Average corrections have been made for on and off times, based upon analysis of the unattended noise monitoring data, however, it was not always possible to determine which pumps were on/off.
4. Pump operation is based upon which bay is being used by a truck. The actual operating pump will vary depending upon which bay, and which tanks the fuel comes from. As such, it is difficult to know which are operating for comparison against the noise measurement results.

The results from the validation of the model show that the model is suitable for determining the compliance noise levels for this assessment.

2.4 Noise compliance assessment

Predicted operational noise levels **Table 13** to **Table 17** present the predicted noise levels at each of the assessment locations during each of the reasonable worst case operational scenarios and determine compliance with the noise limits presented in **Section 1.2.**

Observed meteorological conditions on the day of the measurements are presented in **Section 2.1.1**, however, as required by the EPL 20193 and the MCP noise verification requirements all applicable meteorological conditions have been assessed for each period.

It should be noted that in accordance with the INP:

"A development will be deemed to be in non-compliance with a noise consent or licence condition if the monitored noise level is more than 2 dB above the statutory noise limit specified in the consent or licence condition."

2.4.1 Reasonable worst case intrusiveness scenario (15 minute period)

The following are the modelled results for the reasonable worst case intrusiveness scenario (15 minute period). The modelling scenarios are presented in **Section 2.2.5.**

Table 13 Predicted noise levels, $L_{Aeq\ (15min)}$ dB(A) - Reasonable worst case intrusiveness scenario (15 minute period)

Receiver	Operational noise limits[1] $L_{Aeq\ (15min)}$, dB(A)	Neutral			3 m/s source to receiver wind			Temperature inversion (F-Class, 3˚C/100 m)[2]		
		Predicted noise level (Worst case site operations)	Predicted noise level (Worst case truck operations)	Compliance	Predicted noise level (Worst case site operations)	Predicted noise level (Worst case truck operations)	Compliance	Predicted noise level (Worst case site operations)	Predicted noise level (Worst case truck operations)	Compliance
R1	42	26	25	**Yes**	31	30	**Yes**	30	29	**Yes**
R2	42	27	27	**Yes**	32	31	**Yes**	31	30	**Yes**
R3	42	28	28	**Yes**	33	32	**Yes**	32	32	**Yes**
R4	42	36	34	**Yes**	41	39	**Yes**	40	39	**Yes**
R5	42	35	33	**Yes**	40	38	**Yes**	39	38	**Yes**
R6	42	36	35	**Yes**	40	39	**Yes**	39	38	**Yes**
R7	42	23	23	**Yes**	26	26	**Yes**	26	25	**Yes**
R8	44	17	16	**Yes**	22	21	**Yes**	22	21	**Yes**
R9	51	16	15	**Yes**	22	21	**Yes**	22	21	**Yes**
R10	45[3]	25	24	**Yes**	30	29	**Yes**	29	28	**Yes**

Notes:

1. Operational noise limits are based on the most stringent operational noise limits (i.e. night-time period).
2. Assessment of temperature inversion does not apply during the daytime period.
3. The school noise limit only applies during the daytime period when school is in use.

2.4.2 Reasonable worst case amenity (whole of day, evening or night period) scenarios

The following are the modelled results whole of period amenity operating scenarios. The modelling scenarios are presented in **Section 2.2.6**.

Table 14 Predicted noise levels, $L_{Aeq\ (Period)}$ dB(A) - Reasonable worst case amenity scenario (Whole of assessment period), Neutral meteorological condition

Period	Day			Evening			Night		
Receiver	Predicted noise level	MCP overall noise goals, $L_{Aeq\ (Period)}$	Compliance	Predicted noise level	MCP overall noise goals, $L_{Aeq\ (Period)}$	Compliance	Predicted noise level	MCP overall noise goals, $L_{Aeq\ (Period)}$	Compliance
Trucks through the Facility on 22/23 November 2016									
A	20	60	**Yes**	20	49	**Yes**	21	43	**Yes**
B	29	60	**Yes**	29	50	**Yes**	30	43	**Yes**
C	9	57	**Yes**	10	44	**Yes**	11	45	**Yes**
D	9	55	**Yes**	10	37	**Yes**	11	37	**Yes**
Reasonable worst case trucks through the Facility - 2016									
A	21	60	**Yes**	24	49	**Yes**	21	43	**Yes**
B	30	60	**Yes**	32	50	**Yes**	30	43	**Yes**
C	10	57	**Yes**	17	44	**Yes**	11	45	**Yes**
D	10	55	**Yes**	17	37	**Yes**	11	37	**Yes**

Table 15 Predicted noise levels, $L_{Aeq\ (Period)}$ dB(A) - Reasonable worst case amenity scenario (Whole of assessment period), Temperature inversion meteorological condition

Period	Day			Evening			Night		
Receiver	Predicted noise level	MCP overall noise goals, $L_{Aeq\ (Period)}$	Compliance	Predicted noise level	MCP overall noise goals, $L_{Aeq\ (Period)}$	Compliance	Predicted noise level	MCP overall noise goals, $L_{Aeq\ (Period)}$	Compliance
Trucks through the Facility on 22/23 November 2016									
A	N/A[1]	N/A[1]	N/A[1]	24	49	**Yes**	25	43	**Yes**
B	N/A[1]	N/A[1]	N/A[1]	33	50	**Yes**	34	43	**Yes**
C	N/A[1]	N/A[1]	N/A[1]	15	44	**Yes**	16	45	**Yes**
D	N/A[1]	N/A[1]	N/A[1]	16	37	**Yes**	17	37	**Yes**
Reasonable worst case trucks through the Facility - 2016									
A	N/A[1]	N/A[1]	N/A[1]	28	49	**Yes**	25	43	**Yes**
B	N/A[1]	N/A[1]	N/A[1]	36	50	**Yes**	34	43	**Yes**
C	N/A[1]	N/A[1]	N/A[1]	23	44	**Yes**	17	45	**Yes**
D	N/A[1]	N/A[1]	N/A[1]	23	37	**Yes**	17	37	**Yes**

Notes

1. Assessment of temperature inversion does not apply during the day-time period.

Table 16 Predicted noise levels, $L_{Aeq\ (Period)}$ dB(A) - Reasonable worst case amenity scenario (Whole of assessment period), 3 m/s source to receiver wind meteorological condition

Period	Day			Evening			Night		
Receiver	Predicted noise level	MCP overall noise goals, $L_{Aeq\ (Period)}$	Compliance	Predicted noise level	MCP overall noise goals, $L_{Aeq\ (Period)}$	Compliance	Predicted noise level	MCP overall noise goals, $L_{Aeq\ (Period)}$	Compliance
Trucks through the Facility on 22/23 November 2016									
A	25	60	**Yes**	25	49	**Yes**	26	43	**Yes**
B	34	60	**Yes**	34	50	**Yes**	35	43	**Yes**
C	15	57	**Yes**	16	44	**Yes**	17	45	**Yes**
D	15	55	**Yes**	16	37	**Yes**	17	37	**Yes**
Reasonable worst case trucks through the Facility - 2016									
A	26	60	**Yes**	29	49	**Yes**	26	43	**Yes**
B	34	60	**Yes**	37	50	**Yes**	35	43	**Yes**
C	16	57	**Yes**	23	44	**Yes**	17	45	**Yes**
D	16	55	**Yes**	23	37	**Yes**	17	37	**Yes**

2.4.3 Sleep disturbance assessment

The following are the modelled results to determine noise impacts with the potential to cause sleep disturbance against the required approval criteria. The sound power levels for the maximum noise events at the Facility are included in **Table 8.**

Table 17 Predicted noise levels - Sleep disturbance assessment, night-time period

Receiver	Criteria dB(A)	Neutral		3 m/s source to receiver wind		Temperature inversion (F-Class, 3˚C/100 m)	
		Predicted noise level, $L_{A1\ (1\ min)}$, dB(A)	Compliance	Predicted noise level, $L_{A1\ (1\ min)}$, dB(A)	Compliance	Predicted noise level, $L_{A1\ (1\ min)}$, dB(A)	Compliance
R1	52	40	Yes	43	Yes	44	Yes
R2	52	45	Yes	48	Yes	48	Yes
R3	52	46	Yes	48	Yes	49	Yes
R4	52	45	Yes	48	Yes	49	Yes
R5	54	43	Yes	46	Yes	47	Yes
R6	52	48	Yes	51	Yes	51	Yes
R7	52	45	Yes	47	Yes	48	Yes
R8	54	23	Yes	29	Yes	29	Yes
R9	61	23	Yes	30	Yes	30	Yes

3.0 Conclusion

AECOM Australia Pty Ltd (AECOM) was commissioned by Stolthaven Australia Pty Ltd (Stolthaven) to undertake a compliance noise assessment of operations at the Stolthaven Bulk Liquids Fuel Storage Facility (the Facility) operated by Stolthaven at the Port of Newcastle, Mayfield, NSW.

This acoustic assessment was conducted to determine compliance with the following site operational approvals and requirements -

1. State Significant Development (SSD) 6664 – 16 April 2015; and
    a. Modification – 28 September 2015
2. The NSW Environment Protection Authority (EPA) issued Environment Protection Licence No. 20193 (EPL 20193), License version date 27 August 2015; and
3. Mayfield Concept Approval (MCP) (Application 09_0096) dated 16 July 2012 (latest modification 12 December 2014).

As the Facility lies within the Mayfield Concept Plan approval area, it requires noise emissions from the site to be consistent with the environmental assessment requirements of the Mayfield Concept Plan Approval, as stated in the approval SSD 6664 MOD 1, which have been demonstrated in this report.

Attended noise measurements were undertaken on 22/23 November 2016 at the closest nearby residential receiver locations. It was found that it was not possible to directly quantify the impacts of noise arising from operations at the Facility due to the influence from extraneous noise sources, i.e. existing industrial noise from other industrial areas unrelated to the Facility and traffic noise on Industrial Drive, or the modelled noise impacts are significantly below the measured existing noise levels. As such, an alternative method was required in order to demonstrate the compliance noise levels.

The compliance assessment was therefore carried out using SoundPLAN noise modelling software, calibrated based upon on-site attended and unattended noise measurements undertaken on 22/23 November 2016 to determine noise impacts from the Facility at the assessment receiver locations.

This method of noise compliance assessment is in accordance of the Chapter 11 of the EPA NSW Industrial Noise Policy (INP). In order to determine compliance of the Facility operational noise emissions with the required noise limits, 'reasonable' worst case operational scenarios where determined from 2016 historical data provided by Stolthaven, and noise levels based upon the site attended and unattended noise measurements undertaken over the period of 2:00 pm 22 November 2016 to 9:00 am 23 November 2016 and detailed analysis of the Facility movement data provided by Stolthaven for this period.

Day, evening and night-time noise emissions were predicted to each of the required assessment locations and compared against the site noise limits for all scenarios. It is required that the noise emissions be assessed under worst case prevailing wind and temperature inversion conditions.\

Noise impacts were found to be consistent with operations in previous years.

Compliance has been found for all site approval requirements, at all receiver locations, during all assessment periods under all prevailing meteorological conditions.

Appendix A

Acoustic Terminology

Appendix A Acoustic Terminology

The following is a brief description of acoustic terminology that may have been used in this report.

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:
	0dB(A) Threshold of human hearing
	30dB(A) A quiet country park
	40dB(A) Whisper in a library
	50dB(A) Open office space
	70dB(A) Inside a car on a freeway
	80dB(A) Outboard motor
	90dB(A) Heavy truck pass-by
	100dB(A) Jackhammer/Subway train
	110 dB(A) Rock Concert
	115dB(A) Limit of sound permitted in industry
	120dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
L_{max}	The maximum sound pressure level measured over the measurement period
L_{min}	The minimum sound pressure level measured over the measurement period
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10}.

L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90}.
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Day	The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.
Evening	The period from 1800 to 2200 h Monday to Sunday and Public Holidays.
Night	The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.
Assessment background level [ABL]	The overall background level for each day, evening and night period for **each day** of the noise monitoring.
Rating background level [RBL]	The overall background level for each day, evening and night period for the **entire length** of noise monitoring.
Weighted sound reduction index [R_w]	A single figure representation of the air-borne sound insulation of a partition based upon the R values for each frequency measured in a laboratory environment.

*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 *"Acoustics – Glossary of terms and related symbols"*, the EPA's NSW Industrial Noise Policy and the EPA's Road Noise Policy.