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Vipac Engineers & Scientists

Animal Plant Mineral

Darwin Magnetite Processing Facility EIS Noise & Air - APM for TNG Ltd

Noise Impact Assessment

70Q-19-0071-TRP-8551327-4

3 February 2021

Report Title: Noise Impact Assessment **Job Title: Darwin Magnetite Processing Facility EIS Noise & Air - APM for TNG Ltd**	
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REVISION HISTORY

Revision No.	Date Issued	Reason/Comments
0	18/09/2019	Initial Issue
1	6/11/2019	Issue after comment
2	26/11/2019	Issue after further comment
3	03/11/2020	Updated Operation Issue
4	22/12/2020	Issue after further comment

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EXECUTIVE SUMMARY

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Enigma Mining Ltd (a wholly owned subsidiary of TNG Limited) to prepare a Noise Impact assessment for the proposed Darwin TIVAN® Processing Facility (the Project). A Notice of Intent was submitted to the Northern Territory Environment Protection Authority (NT EPA) in 2015; the NT EPA determined that an Environmental Impact Statement (EIS) level of assessment is required and released Terms of Reference for the EIS.

Potential noise and vibration impacts from the construction and operation of the Project were assessed against applicable criteria based on the Northern Territory EPA Noise Management Framework Guideline.

Future potential noise levels at the nearest noise sensitive receptors were predicted using the SoundPlan noise model from construction and operation of the project where the potential noise impacts are expected to be the greatest.

Operational noise emissions from fixed and mobile plant on the site, including rail siding operations and freight train movements are predicted to comply with the applicable criteria during all time periods and in both neutral and worst case weather conditions at all sensitive receivers surrounding the Project Site.

Construction noise emissions are predicted to comply during standard hours of construction at the majority of sensitive receivers surrounding the site. Construction noise levels are predicted to exceed at all receivers during non-standard hours in worst case climatic conditions. General noise mitigation measures have been recommended in Section 8 to reduce potential noise impacts from construction activities. It is recommended that a construction noise management plan is developed in consultation and engagement with potentially affected receptors to achieve alternative arrangements if required.

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1 INTRODUCTION

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Enigma Mining Ltd (a wholly owned subsidiary of TNG Limited) to prepare a Noise Impact assessment for the proposed Darwin TIVAN® Processing Facility (the Project). A Notice of Intent was submitted to the Northern Territory Environment Protection Authority (NT EPA) in 2015; the NT EPA determined that an Environmental Impact Statement (EIS) level of assessment is required and released Terms of Reference for the EIS.

The purpose of this assessment is to evaluate the potential impacts of noise generated from the construction and operational stages of the Project and to provide recommendations to mitigate any potential impacts that might have an effect on nearby sensitive receptors.

2 PROJECT DESCRIPTION

TNG Limited (TNG) proposes to develop the Project on Lot 1817 Middle Arm, Darwin Harbour, adjacent to the Elizabeth River Bridge. The Project, with associated access roads, supporting infrastructure and services comprises a development footprint of approximately 264 ha, which has partially been cleared by extractive industries. This location is shown in Figure 2-1. Construction of the Project is expected to take approximately 24 months.

The Project is located within the Litchfield Council area and is situated on relatively flat terrain with the occasional gentle undulation. The project is located approximately 5km south of the suburb of Bellamack.

2.1 PROPOSED OPERATIONS

The project will process magnetite concentrate to produce vanadium pentoxide, titanium dioxide pigment and iron. The three products will be exported through the Port of Darwin's East Arm Wharf. The magnetite concentrate will be railed from TNG's proposed Mount Peake Project, 235km northwest of Alice Springs. The proposed project life is expected to be 40 years, during which processing of magnetite concentrate would occur at a rate of 700,000 tonnes per annum.

On average three train loads of concentrate per week will be delivered to the refinery from Mount Peake. Unloading is expected to occur over a nine-hour period. Each train will have 90 to 95 PQGY hopper wagons with two 20 ft containers per wagon and a capacity of 26 tonnes of concentrate in each container (4,680 tonnes total). The products will be exported to the East Arm Wharf via rail in shipping containers or loaded into open rail cars (dependant on the product). The Project is expected to result in one ship movement per week.

The key components of the Project infrastructure include:

- Four-kilometre rail siding alongside the existing Adelaide-Darwin railway line to accommodate loading/unloading
- Processing plant
- Concentrate and coke stockpiles
- Conveyor tunnels
- Water tanks and ponds
- Filter cake stockpile area/hardstand
- Workshop and stores
- Ancillary buildings
- Oleum, Oxygen and acid regeneration plants.

The site location is shown in Figure 2-1 and the site layout is shown in Figure 2-2

Figure 2-1: Project Location

Figure 2-2 - Site Layout

2.2 TOPOGRAPHY

Site elevation varies between approximately 7m and 17m AHD, and topographical conditions extending to the nearest sensitive receivers ranging from 0m (water surface) to 25m. There are no significant changes in terrain between the site and the receivers, with the terrain gently undulating throughout the surrounding areas.

2.3 SENSITIVE RECEPTORS

The locations of the nearest confirmed noise sensitive receptors to the Project are shown in Figure 2-3 and detailed below. In total, 3 sensitive receptors are located within the locality of the proposed Project:

- R1: Residential Receivers located on Gerardine Crescent, Bellamack – approximately 2.7km from the nearest site boundary.
- R2: Residential Receivers located on Boyd Court, Virginia – approximately 4.8km from the nearest site boundary.
- R3: Bladin Village – Workers Accommodation for the Bladin Point LNG Facility – approximately 4.3km from the nearest site boundary

It is anticipated that the Project personnel during construction and operation will be accommodated locally.

Figure 2-3: Sensitive Receptor Locations Surrounding the Project Site

It is worth noting that the proposed 'Future Weddell urban/peri-urban area' is located approximately 2.3km south east of the site, however there are currently no plans to develop this area and therefore has not been considered as part of this assessment.

3 EXISTING ENVIRONMENT

This section describes the existing environment in terms of the environmental values of the surrounding area, existing noise sources which may be of concern and the noise monitoring details.

3.1 FIELDWORK

Noise monitoring was carried out by Vipac between 23rd and 30th August 2020 as part of a baseline assessment for this Project. Noise monitoring was carried out in accordance with Australian Standard AS1055:2018 Acoustics – *Description and Measurement of Environmental Noise*.

3.2 EXISTING SOURCES OF NOISE

The noise environment in the vicinity of the Project can be characterised as 'very rural', with only mild sources of activity noise, mostly light wind through vegetation, distant traffic noise and insect/bird noise. Channel Island Road and the Adelaide to Darwin Rail Line runs alongside the eastern boundary of the Project site, however traffic is intermittent on both road and rail. Vibration from existing rail movements was not detectable at the monitoring locations.

3.3 AMBIENT NOISE MONITORING

The existing noise environment at the nearest sensitive receivers has been determined through ambient noise monitoring between 23rd and 30th August 2020 at two locations in the vicinity of the Project site. The noise monitoring locations have been identified as:

- Monitoring Location 1 – 20 Gerardine Crescent, Bellamack
- Monitoring Location 2 – 21 Boyd Court, Virginia

The noise monitor locations are shown in Figure 3-1. Additional information relating to the monitoring locations are presented in Appendix C.

Weather observations during the monitoring period were obtained from the bureau of meteorology for the Darwin Airport (station ID: 014015). During the noise monitoring survey, the temperature ranged between 18 and 36 Degree Celsius, with no rainfall recorded. The weather observations are shown in Table 3-1.

Figure 3-1 Noise Monitoring Locations

Table 3-1: Weather Observations During the Monitoring Period (Source: BOM, 2020)

Date	Temps (°C)		Rain (mm)	9:00 AM			3:00 PM		
	Min	Max		Temp (°C)	Wind Direction	Wind Speed (km/h)	Temp (°C)	Wind Direction	Wind Speed (km/h)
23/08/2020	21.3	34.2	0	27.3	ENE	9	31.6	NNW	20
24/08/2020	19.9	35	0	26.8	SE	13	30.7	NNW	20
25/08/2020	18.3	35.3	0	25.9	E	13	34.6	SE	28
26/08/2020	17.9	34.9	0	25.6	SE	13	33.1	NNE	19
27/08/2020	19.7	36.4	0	27.8	ESE	20	35.6	E	30
28/08/2020	21.1	35.5	0	25.9	SE	15	34.9	SE	28
29/08/2020	20.3	33.9	0	24.7	SSE	17	33.3	NNE	9
30/08/2020	22	35	0	27.3	SE	15	34.9	NNW	20

A summary of the noise monitoring results is presented in Table 3-2. It can be clearly seen that the noise levels in the vicinity of the Project site are relatively quiet, especially during the night-time period, when the Rating Background Levels are 20-28 dB(A) during the full monitoring period. The noise monitoring results are representative of the Project site and the surrounding NSRs.

Table 3-2: Summary of Noise Monitoring Results 23rd to 30th August 2020

Noise Descriptor	Time Period for All Days	Overall Noise Levels dB(A) During Monitoring Period	
		ML1	ML2
$L_{Aeq, adj, 15 mins}$	Day (7am to 6pm)	51	44
	Evening (6pm to 10pm)	46	45
	Night (10pm to 7am)	43	37
$L_{A10, adj, 15 mins}$	Day (7am to 6pm)	51	47
	Evening (6pm to 10pm)	44	36
	Night (10pm to 7am)	43	38
$L_{A90, adj, 15 mins}$	Day (7am to 6pm)	42	37
	Evening (6pm to 10pm)	36	28
	Night (10pm to 7am)	35	27
Rating Background Level (RBL)	Day (7am to 6pm)	37	30
	Evening (6pm to 10pm)	32	24
	Night (10pm to 7am)	28	20

4 REGULATORY FRAMEWORK

This section outlines the criteria requirements for the Project for noise during construction and operation.

4.1 CONSTRUCTION NOISE

In accordance with the Northern Territory EPA *Northern Territory Noise Management Framework Guideline*, noise associated with the construction of the proposed Project is to be assessed in accordance with Section 3.3 of the guideline. Section 3.3 details the recommended standard hours of work for construction activities and is reproduced in Table 4-1 below.

Table 4-1 Recommended Standard Hours of Work

Work Type	Recommended Standard Hours of Work	Notes
Normal Construction	Monday to Saturday 7am-7pm and between 9am-6pm on Sundays or public holidays	Construction activities occurring before or after the recommended standard hours of work will incur a regulatory response in accordance with section 2.2.4 of the guideline
Blasting	Monday to Friday 9am-5pm Saturday 9am-1pm No blasting on Sundays or public holidays	

The assessment of the construction activities of the proposed Project will assume construction will occur during the recommended standard hours of work. No blasting is proposed as part of the construction of the Project and therefore is not discussed further.

Table 3.8 in Section 3.3 of the Guideline outlines the recommended assigned construction noise levels for airborne noise at residential receivers. This table is reproduced below:

Table 4-2 Recommended assigned construction noise levels for airborne noise at residential receivers

Descriptor	Recommended Assigned Construction Noise Level at residences $L_{Aeq\ (15min)}$	Notes
Monday to Saturday 7am to 7pm Sundays and public holidays 9am to 6pm	Recommended assigned noise affected level: RBL + 10 dB	The recommended assigned noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the recommended assigned noise affected level, proponents should apply all feasible and reasonable work practices to meet the recommended assigned noise affected level. Proponents should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
Outside recommended standard hours	Recommended assigned noise affected level: RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. Proponents should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the recommended assigned noise affected level, proponents should negotiate with the community. See Guidance Document Number One for guidance on community engagement.

Table 4-3 below presents the construction noise criteria specific to the site:

Table 4-3 Construction noise criteria at the nearest sensitive receivers

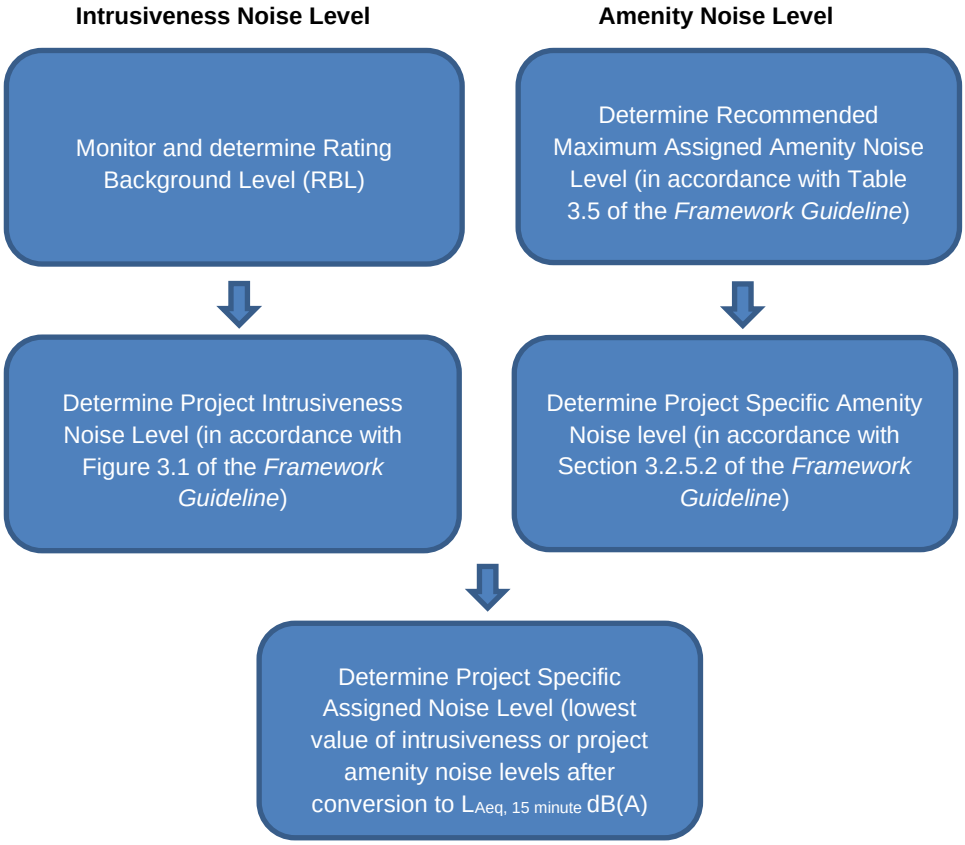
Receiver	Gerardine Crescent, Bellamack (R1)	Boyd Court, Virginia (R2-3)*
Standard Construction Hours (7am-7pm)	47	40
Non-standard Construction Hours (7pm-7am)	33	25

*The noise levels observed at Boyd Court are representative of those experienced at Receiver 3.

4.2 OPERATIONAL NOISE

In accordance with the Northern Territory EPA *Northern Territory Noise Management Framework Guideline*, noise associated with industrial/commercial premises is to be assessed in accordance with Section 3.2 of the guideline. The guideline refers to the NSW Industry Policy (INP) for Noise (2017) with a slight modification that introduces the concept of the 'project specific assigned noise level'. This replaces the 'project trigger noise level'.

The assessment criteria are established by applying the following process:



The project specific assigned noise level is a recommended mandatory limit and if exceeded will require noise management mitigation actions to be taken.

4.3 DERIVING PROJECT SPECIFIC NOISE CRITERIA

Based on the measured background noise levels outlined in Section 3.3), the applicable noise limits according to the criteria for the nearest sensitive receivers are presented in Table 4-4.

Table 4-4 Assessment Criteria

Criterion	Gerardine Crescent, Bellamack (R1)			Boyd Court, Virginia (R2-3)**		
	Day (7am – 6pm)	**Evening (6pm-10pm)**	**Night (10pm-7am)**	**Day (7am – 6pm)**	**Evening (6pm-10pm)**	**Night (10pm-7am)**
A: Rating Background Level*	37	32	28 (30*)	30	24 (30*)	20 (30*)
B: Intrusiveness criteria – (A + 5dB)	42	37	33 (35*)	35	29 (35*)	25 (35*)
C: Maximum assigned amenity noise levels – Suburban Residential	55	45	40	50	45	40
D: Project Specific Amenity Noise Level – (C - 5dB)	50	40	35	45	40	35
Project Specific Assigned Noise Level	**42**	**37**	**35**	**35**	**35**	**35**

*The NSW NPI states where the rating background level is found to be less than 30dB(A), then it is set to 30dB(A).
**The noise levels observed at Boyd Court are representative of those experienced at Receiver 3.

The operation of the Project will be 24 hours per day; therefore, the Project will be subject to the daytime, evening and night time criteria presented in Table 4-4. In this assessment, the impact of both construction and operation has been predicted and assessed using the criteria in Table 4-4.

5 NOISE ASSESSMENT METHODOLOGY

This section outlines the methodologies for the fieldwork, noise monitoring data analysis and noise prediction used for this assessment.

5.1 NOISE PREDICTION METHODOLOGY

5.1.1 MODELLING SOFTWARE

Noise level predictions have been assessed using the SoundPLAN noise modelling software and the CONCAWE algorithm (Manning, 1981) noise prediction methodology. The CONCAWE method was originally developed for predicting the long-distance propagation of noise from petrochemical complexes in the United Kingdom. It is especially suited to predicting noise propagation over large distances as it accounts for a range of atmospheric conditions that can significantly influence the propagation of noise over large distances.

The prediction of noise in the environment requires the definition of the noise sources and sensitive receptors. A number of environmental parameters affect noise propagation, including:

- Geometric spreading;
- Obstacles such as enclosures, barriers, and buildings;
- Meteorological conditions such as air absorption, wind effects, temperature gradient effects; and
- Ground effects.

The SoundPLAN software and calculation methodology allows the environmental parameters identified above to be modelled.

5.1.2 METEOROLOGICAL CONDITIONS

Noise propagation over long distances can be significantly affected by the weather conditions, mainly source-to-receiver winds and temperature inversions, as both these conditions can increase noise levels at sensitive receptors.

The CONCAWE methodology can predict to one of six meteorological categories (CAT). To determine which category is modelled, the Pasquill Stability Classes need to be determined for the Project. For this assessment the weather conditions, including stability class frequencies at the proposed Project have been obtained from The Air Pollution Model (TAPM). TAPM is a three-dimensional prognostic model developed and verified by Commonwealth Scientific and Industrial Research Organisation (CSIRO). TAPM-CALMET data generated for the air quality assessment has been used for uniformity. The wind parameters were compared for the Bureau of Meteorology (BOM) and TAPM data and were found to be similar.

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion of pollutants. The Pasquill-Turner assignment scheme identifies six Stability Classes (Stability Classes A to F) to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological conditions and are used in various air dispersion models. Temperature inversions are defined as Class F, these conditions only occur with clear and calm conditions during the evening and night time periods. The frequency of occurrence for each stability class for 2017 is detailed in Table 5-1. The 2017 meteorological data is representative of the long term conditions of the Project location.

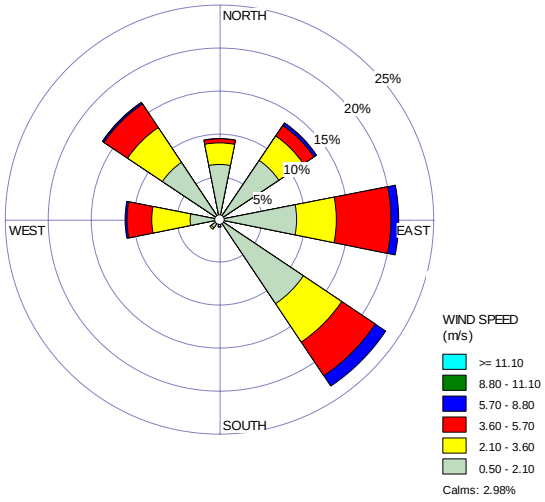
Table 5-1: Annual Stability Class Distribution Predicted [TAPM-CALMET, 2017]

Stability Class	Description	Frequency of Occurrence (%)	Average Wind Speed (m/s)
A	Very unstable low wind, clear skies, hot daytime conditions	3.8	1.6
B	Unstable clear skies, daytime conditions	16.4	2.6
C	Moderately unstable moderate wind, slightly overcast daytime	20.8	3.6
D	Neutral high winds or cloudy days and nights	9.6	4.1
E	Stable moderate wind, slightly overcast night-time conditions	3.5	3.5
F	Very stable low winds, clear skies, cold night-time conditions	45.9	1.5

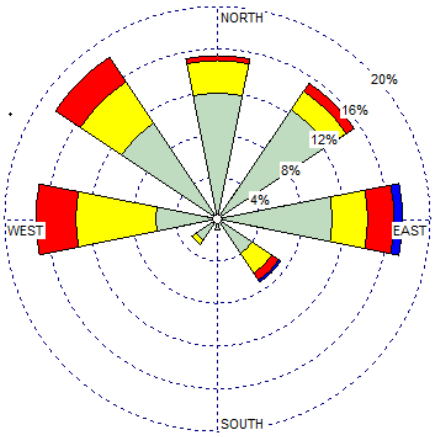
The wind roses are presented in Figure 5-1 and Figure 5-2 for the Project site. Figure 5-1 shows that the dominant wind direction is from Northwest and West during the summer months. In autumn and winter the winds are primarily from the South-easterly directions.

A comparison of the wind roses at 09:00 and 15:00 hours for the TAPM-CALMET derived dataset (Figure 5-2) at the Project site was also undertaken with the BOM long-term wind roses at Darwin Airport. The wind roses from BOM and TAPM-CALMET are similar. The BOM wind rose, based on approximately 25,700 observations, identifies Easterly and South-easterly winds as the prevailing winds at 9am, while TAPM-CALMET South-easterly winds as prevailing with some Easterlies. These differences in wind are influenced from the topography

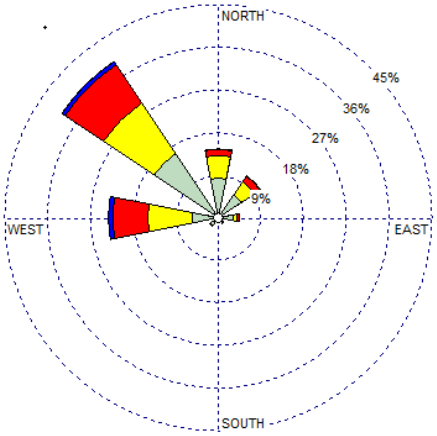
surrounding both the BOM monitoring station and the Project site. Overall, the meteorological data generated by TAPM-CALMET is representative of the site.



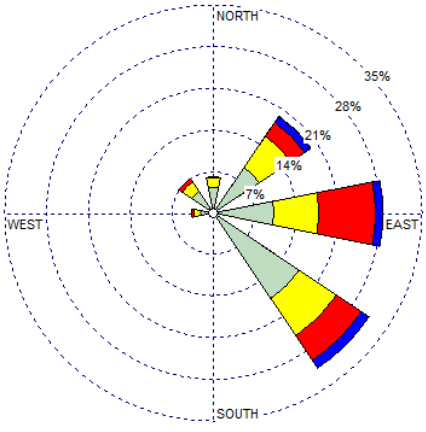
Annual



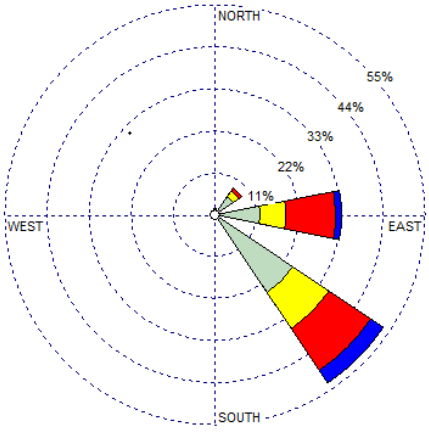
Spring



Summer



Autumn



Winter

Figure 5-1: Site-Specific Wind Roses by Season for 2017

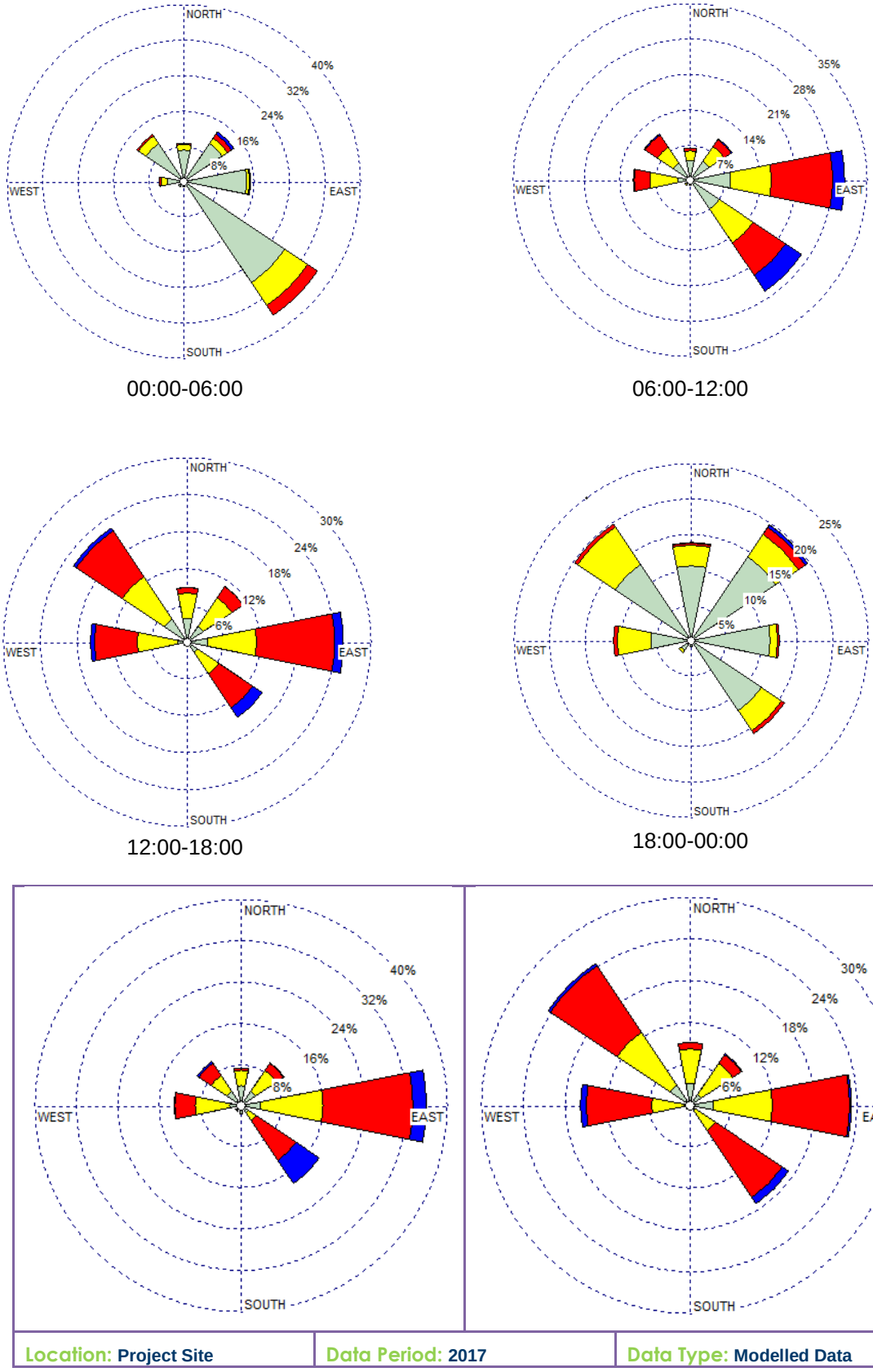


Figure 5-2: Annual Wind Roses for the TAPM-CALMET derived dataset at the Project site, 2017

5.1.3 MODELLED WEATHER SCENARIOS

The Northern Territory EPA *Northern Territory Noise Management Framework Guideline* again refers to the NSW Noise Policy for Industry for the requirements of prediction of noise 'accounting for noise-enhancing weather conditions (NSW NPI Fact Sheet D)'.

After reviewing the site specific wind speeds, wind direction and stability classes, it has been determined that the majority of sensitive receptors will be generally upwind of construction and operational noise sources. For the purposes of providing a worst case assessment; source to receptor winds have been applied to all receivers surrounding the Project site.

Stability classes A, B, and C are associated with an unstable atmosphere and are generally unfavourable for noise propagation. Condition D is a neutral condition for noise propagation while conditions E and F are unfavourable as stable conditions further facilitate noise propagation.

Taking into consideration the time of day the Project will be operating the following weather scenarios have been assessed:

Neutral Climatic Conditions:

- Class D (neutral) - Class D has been modelled for the average climatic condition scenarios for day, evening, and night, with 0m/s wind speeds.

Worst Case Climatic Conditions:

- Class F (stable) conditions occur for approximately 46% of the time at the Project area and are worst case climatic conditions that occur during the night time period. Class F has been used to assess worst case night time noise levels affected by temperature inversion. Temperature inversion only occurs during the night time period. Worst case source to receptor winds have been assessed, with wind speeds modelled at 2m/s.

6 NOISE MODELLING DETAILS

This section details the noise sources used in the prediction of the noise levels at the sensitive receptors, including the proposed equipment, location of the equipment and the associated sound power levels (SWL) for the construction and operational scenarios of the Project. All noise sources have been modelled operating for 100% of the time during standard and non-standard hours.

6.1 EQUIPMENT - CONSTRUCTION

Enigma Mining has provided the equipment list schedules for the construction of the Project. The equipment schedules for construction are presented in Table 6-1.

Table 6-1: Equipment Schedule for Construction

Equipment	Sound Power Levels (SWL) (dBA)	Quantity
Earthworks		
FRONT END LOADER	109	10
BACK HOE	101	32
BULL DOZER	115	16
ROLLER	105	8
SCRAPER	113	8
GRADER	113	8
TRUCK	105	32
PAVER	103	8*
Material Handling		
CONCRETE MIXER	109	5*
CONCRETE PUMP	109	5*
MOBILE CRANE	115	25
CHERRY PICKER/TELE HANDLER	104	50*
DERRICK	109	4*
Power Supply		
GENERATORS	108	10
COMPRESSORS	102	20
Impact		
PILE DRIVER (DIESEL)	115	6
PILE DRIVER (GRAVITY, BORED)	115	6
PNEUMATIC BREAKER	115	2
HYDRAULIC BREAKER	108	2
PNEUMATIC CHIPPER	112	4*
Other Equipment		
POKER VIBRATOR	94	8
COMPRESSED AIR BLOWER	108	10
POWER SAW	108	40*
ELECTRIC DRILL	105	40*
AIR TRACK DRILL	115	40*

*Quantities were not provided – The quantity used for the assessment are based on conservative assumptions made by Vipac.

6.2 EQUIPMENT - OPERATION

Enigma Mining has also provided the mobile and fixed plant equipment list schedules for the operation of the Project, presented in Table 6-2 and Table 6-3 below. All noise sources have been modelled operating for 100% of the time during the day evening and night period.

Table 6-2: Fixed Equipment Schedule for Operation

Equipment	Sound Power Levels (SWL) (dBA)	Quantity
AGITATOR	75	130
BULK BAG UNLOADER	75	2
DISINTEGRATOR / CRUSHER	105	1
HOIST	75	5*
COMBUSTION CHAMBER	95	5
CONVEYOR DISCHARGE CHUTE; SCREW FEEDERS	80	21
PNEUMATIC AIR COMPRESSOR	80	5
CYCLONES	60	32
COOLING WATER TOWERS	86	3
WATER COOLER	100	12
BUCKET ELEVATOR	65	1
DUST COLLECTOR	80	42
DRYER	80	7
VACUUM DRYER	85	5*
KILN AIR FAN	85	2
EXHAUST FAN	105	4
BOILER AIR FAN	105	2
FEEDERS	75	4
ROTARY FEEDER	75	3
ROM HOPPER SCREW FEEDERS	75	5
KILN FEEDER	75	1
ROM HOPPER WEIGH BELT FEEDER	80	2
LEACH RESIDUE FILTERS	75	2
FILTERS	75	24
ROM HOPPERS	90	2
ROTARY COOLER	70	10*
REDUCTION KILN	70	1
DRUM SCRUBBER	95	9
BACKMIXER	80	1
CONTAINER UNLOADER	85	2
BAGGING STATION	75	8
PELLETIZING & WRAPPING STATION	75	2
RECIRCULATION PUMP	80	10*
LEACH FEED PUMPS	80	6
SCRUBBER PUMPS	80	10
WATER PUMP	80	18
COOLING TOWER FEED PUMPS	85	12
SUMP PUMP	80	8
TRASH SCREEN	90	5*
SCREEN	90	1
KILN STACK	80	2
VENT STACK	80	2
AUTOMATIC BAG SPLITTER	75	1
AIR VIBRATOR	90	2
SEWAGE TREATMENT PLANT	70	1
OXYGEN PLANT	115	1

*Quantities were not provided – The quantity used for the assessment are based on conservative assumptions made by Vipac.

Table 6-3: Mobile Equipment Schedule for Operation

Equipment	Sound Power Levels (SWL)	Quantity
Plant Logistics		
DIESEL FREIGHT TRAIN (4,300Hp GT46CWM modified)	120	3*
FRONT END LOADER	109	3
TRUCK	105	3
REACH STACKER	110	3
FORK LIFTER (DIESEL DRIVEN)	85	4
STACKING PALLET TRUCK	75	2
Maintenance		
MOBILE CRANE	112	2
Power Supply		
GENERATORS	108	2
COMPRESSORS	102	2
Other Equipment		
MOBILE COMPRESSED AIR BLOWERS	108	2
POWER SAW	108	1
ELECTRIC DRILL	105	4
AIR TRACK DRILL	115	2

*Diesel locomotion quantity is based on 2 locomotives between Adnera and the Project site, and a single locomotive between the Project site and the East arm Wharf (detailed below).

6.3 LOCATION OF SOURCES – CONSTRUCTION

Construction noise sources have been conservatively assumed based on the site layout plans. Quantities of equipment have been split approximately 50/50 between the north and south areas of the site. As the construction noise sources are expected to vary in location on site during the construction process, this assessment has assumed a worst-case scenario where all sources are located toward the eastern boundary of both northern and southern site areas. The construction noise source locations are presented in Figure 6-1 and Figure 6-2.

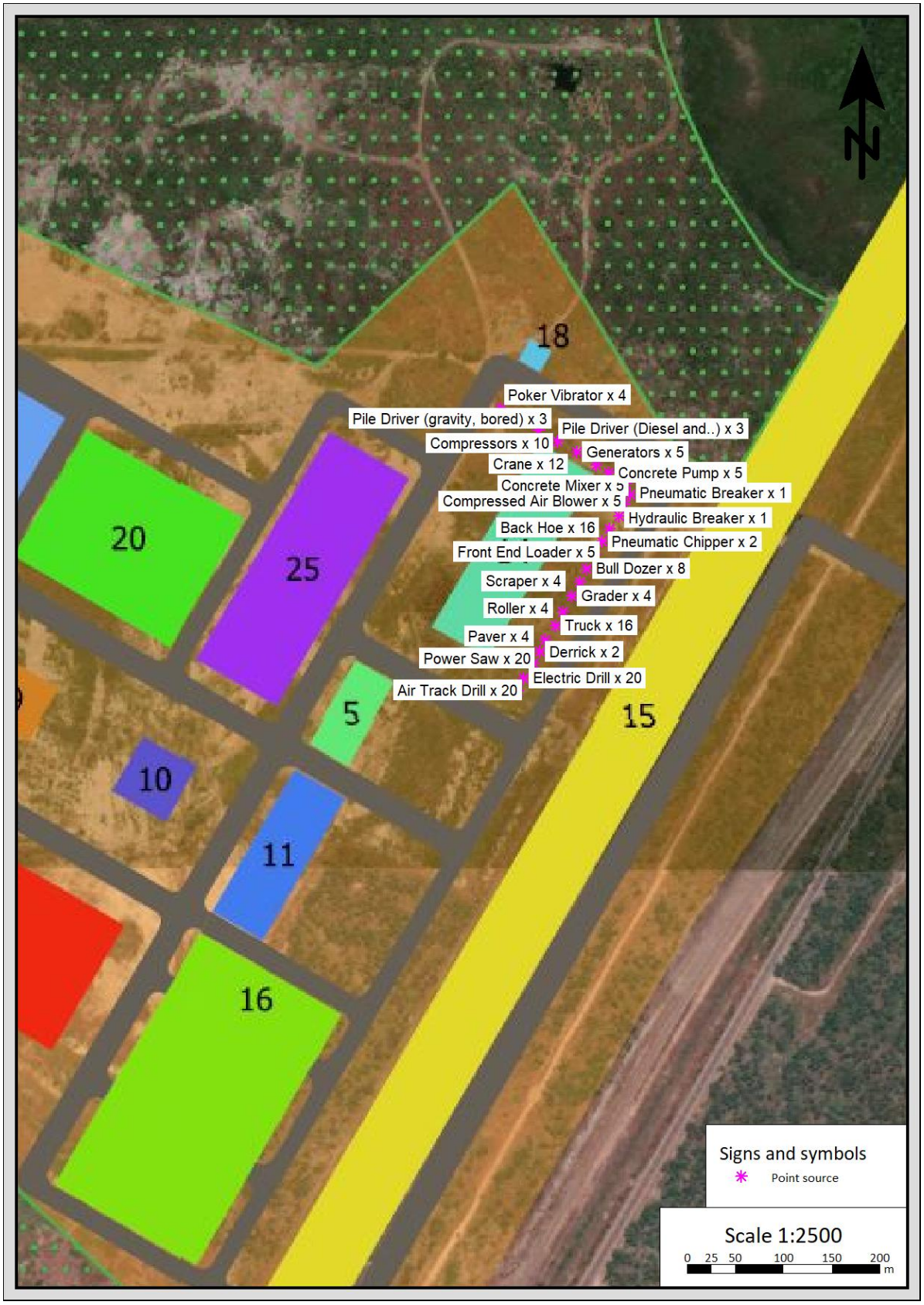


Figure 6-1: Location of Noise Sources – Construction - North

Figure 6-2: Location of Noise Sources – Construction – South

6.4 LOCATION OF SOURCES - OPERATION

Operational noise sources have been located on the southern half of the Project site as operation of the Processing Facility is expected to occur solely in this location; activities in the northern half of the site are predominantly laydown areas, administration/support buildings and water storage ponds. The current layout of plant/machinery is indicative only and subject to change, therefore this assessment has been based on a worst-case scenario where the majority of sources are located on the eastern half of the site. The operational noise source locations are presented in Figure 6-3.

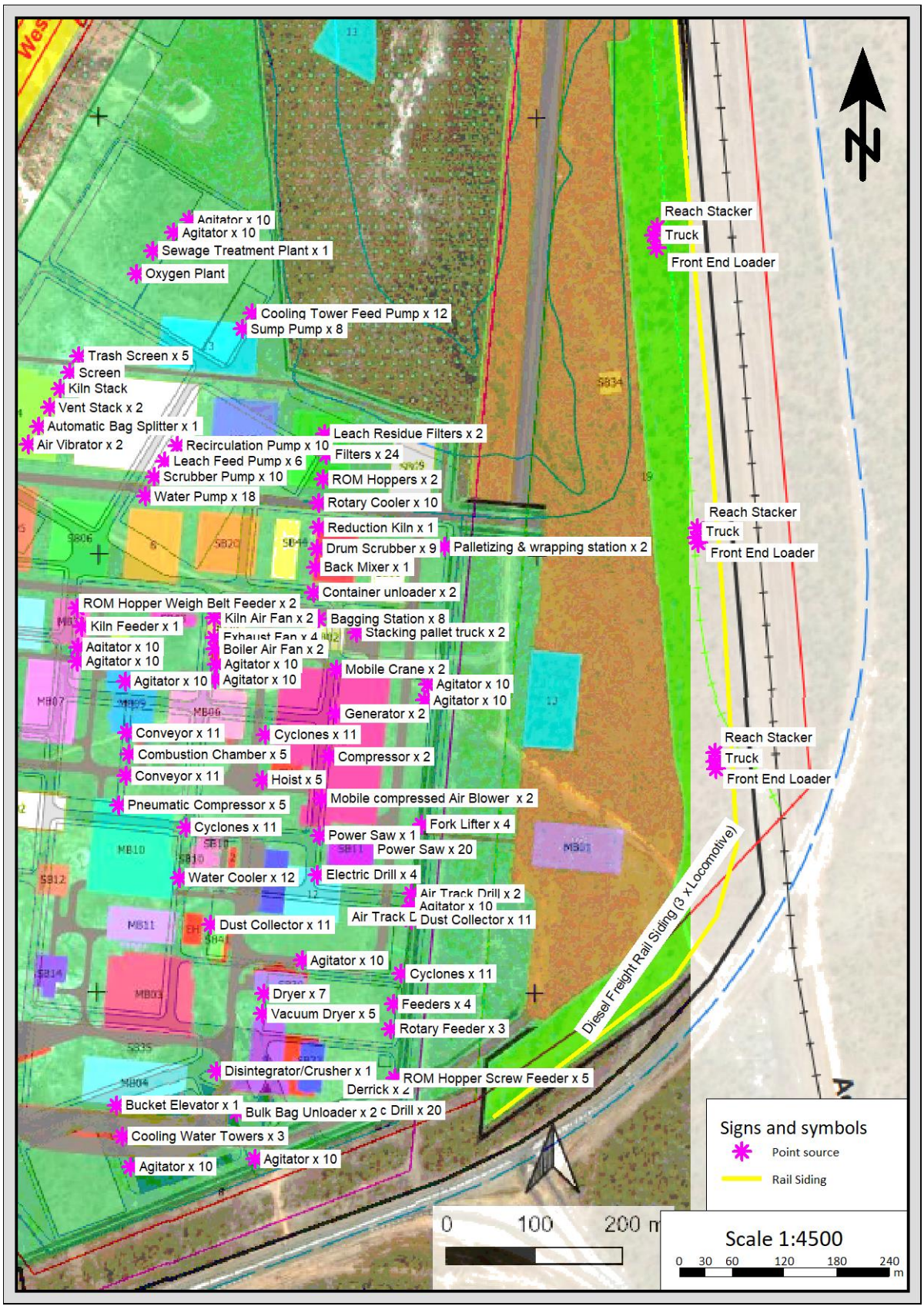


Figure 6-3 Location of Noise Sources – Operation

6.5 RAIL OPERATION

Rail siding operational information has been provided by the client (report ref: TNG Logistics Services Study Pricing Response) that details the likely diesel freight locomotive movements per week during the operational phase of the project. Indicative train pathing between Adnera and the Project Site has been provided and is detailed in Table 6-4. Indicative train pathing is also provided for movements between the project site and the East Arm Wharf to the north in Table 6-5.

Table 6-4 - Indicative Train Movements and Times – Adnera to Project Site

Indicative Train Pathing – Adnera to Darwin Processing Plant				
Day	Adnera		Darwin Processing Plant	
	Arrive	Depart	Arrive	Depart
Sunday				1200
Monday	0200	1100		
Tuesday			0630	1600
Wednesday	0600	1500		
Thursday			0830	2000
Friday	0930	1800		
Saturday			1200	

Table 6-5 - Indicative Train Movements and Times – Project Site to Wharf

Indicative Train Pathing – Darwin Processing Plant to Wharf					
	Darwin Processing Plant		EAW		
	Arrive	Depart	Arrive	Depart	Train Number
Sunday				2330	
Monday	0001	0430	0500	1500	Train 1
Monday	1530	1930	2000		Train 2
Tuesday					
Wednesday	0100	0530	0600	0030	Train 3
Thursday	0030	0530		0001	Train 4
Thursday	2200		0600	2130	
Friday		0200	0230	1500	Train 5
Friday	1530	1830	1900	0600	Train 6
Saturday	0630	1100	1130		Train 7

As can be summarised from the tables above, an average of three train loads of concentrate per week will be delivered to the refinery from Adnera. Unloading is expected to occur over a nine-hour period. Each train will have 90 to 95 PQGY hopper wagons with two 20 ft containers per wagon and a capacity of 26 tonnes of concentrate in each container (4,680 tonnes total). Trips between Adnera and the site will utilise two diesel locomotives.

Multiple movements are likely between the site and the East Arm wharf, with up to five arrivals and departures on Thursday, and an average of three per day over one week. Movements between the site and wharf is conducted by a single diesel locomotive.

Calculations were conducted to predict noise from diesel freight locomotives, reach stackers, front end loaders and haul trucks from the proposed rail siding of the Project. The following assumptions have been made to provide a conservative assessment of rail impacts onto the nearest sensitive receivers:

- The rail siding location has been based on the location detailed in drawing 'Plant Layout' (document number 1009237870) dated 12th June 2020.
- Acknowledging the train path information is still indicative at this stage, modelling has assumed the noise emissions from freight locomotives is continuous over a 24-hour period. This is considered a worst-case scenario, as it is anticipated that locomotives will switch off after parking, thus actual noise emissions from the diesel freight are expected to be much lower.
- Information detailed in the TNG report provided by the client indicates the rail interface will operate 24 hours a day, 7 days a week. Subsequently, noise emissions from reach stackers, front end loaders and haul trucks along the rail interface have been modelled as operating for 100% of the time (continuous).
- Indicative noise source levels for the proposed diesel locomotives have been provided by the client via email correspondence on 30th September 2020 (ref: Rail Information for TNG Darwin EIS) that details a maximum noise level of 88dB(A) for a 'GT46CWM, after modified Dynamic Brake Hatch Clyde Concept with acoustic louvres'.
- Based on the data provided, noise levels have been assumed to be at 10m from the locomotive. For the purposes of a conservative assessment the L_{Amax} has been used as an L_{Aeq} and calculated as a SWL of 120dBA for each locomotive.

7 NOISE IMPACT ASSESSMENT

This section details the results of the noise modelling and the impacts at nearby sensitive receptors. For both construction and operation, the following scenarios have been modelled:

Neutral Climatic Conditions

- Stability Class D – Day/Evening/Night: 0m/s winds;

Worst Climatic Conditions

- Stability Class F – Day/Evening/Night: 2m/s source to receiver wind.

It should be noted that actual noise levels may be lower than the predicted noise levels that are presented in the following sections. This is due to the conservative modelling assumption that all equipment listed in Table 6-1, Table 6-2 and Table 6-3 will be in operation simultaneously for 100% of the time in each time period, whereas this is unlikely to occur in actual operations.

7.1 PREDICTED NOISE LEVELS – CONSTRUCTION

Predicted construction activity noise level results for neutral and worst case climatic conditions are tabulated in Table 7-1 and Table 7-2. Noise contour maps for the Project's construction scenario under neutral and worst case climatic conditions are presented in Appendix B.

Table 7-1 Predicted Construction Noise Levels – Neutral Climatic Conditions

Receptor ID	Predicted Noise Levels L_{Aeq} dB(A)	Recommended Assigned Noise Affected Level L_{Aeq} dB(A)		Complies with Criteria?	
	Neutral Climatic	7am-7pm	7pm-7am	7am-7pm	7pm-7am
R1	30	**47**	**33**	✓	✓
R2	24	**40**	**25**	✓	✓
R3	24			✓	✓

Table 7-2 Predicted Construction Noise Levels – Worst Climatic Conditions

Receptor ID	Predicted Noise Levels L_{Aeq} dB(A)	Recommended Assigned Noise Affected Level L_{Aeq} dB(A)		Complies with Criteria?	
	Worst Climatic	7am-7pm	7pm-7am	7am-7pm	7pm-7am
R1	36	**47**	**33**	✓	+3
R2	30	**40**	**25**	✓	+5
R3	32			✓	+7

Construction noise is predicted to comply with the standard hours during both neutral and worst case climatic conditions, however, is predicted to exceed at all receivers during worst case climatic conditions in non-standard hours. Refer to Section 8 for noise mitigation and management measures.

7.2 PREDICTED NOISE LEVELS – OPERATION

Predicted operation activity noise level results for neutral and worst-case climatic conditions are tabulated in Table 7-3. Noise contour maps for the Project's operational scenario under neutral and worst-case climatic conditions are presented in Appendix B.

Table 7-3: Predicted Operational Noise Levels

Receptor ID	Predicted Noise Levels L_{Aeq} dB(A)		Project Specific Assigned Noise Levels L_{Aeq} dB(A)			Complies with Criteria?		
	Average Climatic	Worst Climatic	Day	Evening	Night	Day	Evening	Night
R1	16	21	42	37	35	✓	✓	✓
R2	15	20	35	35	35	✓	✓	✓
R3	15	23				✓	✓	✓

Operational noise from the Project site is predicted to comply with the day, evening and night time criteria at all receivers during neutral and worst case climatic conditions without the need for site specific noise mitigation.

8 NOISE MITIGATION AND MANAGEMENT MEASURES

The noise modelling results indicate that the noise levels from the Project are likely to exceed the Project criteria during non-standard construction hours in worst case climatic conditions at all receivers. Mitigation measures are proposed to address the impacts associated with construction to minimise the number of sensitive receptors impacted by the noise and to reduce the noise level.

8.1 MITIGATION FOR INITIAL CONSTRUCTION ACTIVITIES – NON-STANDARD HOURS

Noise modelling results for the construction phase indicates that exceedances may occur at all receivers during non-standard hours of construction. In the first instance, construction is recommended to occur during standard hours (7am-7pm) only. If out of hours construction is required, it is recommended to avoid operating particularly noisy machinery before 7am and after 7pm. If activities can only occur during the non-standard hours, then mitigation measures in accordance with the following are applicable:

- Provide an induction to construction personnel (including sub-contractors) addressing responsibilities regarding noise management outlined in a Construction Noise Management Plan (CNMP).
- Ensure truck drivers are informed of designated vehicle routes, parking locations, delivery hours, and minimising engine braking and idling.
- Provide education of supervisors, operators and sub-contractors on the need to minimise noise through toolbox meetings.
- Select appropriately sized equipment for the task, such as earthmoving/excavation equipment.
- Avoid noisy plant working simultaneously where possible.
- Ensure all equipment is equipped with appropriate noise control (e.g. mufflers, silenced exhausts, acoustic enclosures, flashing lights as an alternative to revising beepers), and equipment is shut down and not left idling when not in use.
- Ensure equipment is operated in the correct manner and adequately maintained - including replacement of engine covers, tightening of rattling components, repair of leakages in air lines and shutting down equipment not in use.
- Consider the use of temporary solid screens for noise mitigation of noisy stationary equipment.
- Use alternatives to ‘beeper’ style reversing alarms, such as broadband style alarms (or quacker alarms).

8.2 COMPLAINT MANAGEMENT

It is recommended the site operators develop a complaints procedure within its Standard Operating Procedures that will address issues raised by community members or stakeholders regarding noise during both construction and normal operation. Complaints will be further investigated, recorded and corrective actions will be implemented if required and where reasonable; actions taken will be communicated back to the complainant.

Where appropriate, noise monitoring will be undertaken at the affected location. Monitoring will be conducted to provide feedback into the success of mitigation measures, if any, to confirm modelling and determine if further corrective actions are required to protect sensitive receptors. Monitoring will be undertaken in accordance with the requirements of the NT EPA and AS1055:2018 – *Acoustics - Description and measurement of environmental noise.*

The complaints procedure will include:

- A site contact phone number will be established to allow a timely response to noise related complaints;
- A complaints register maintained;
- A written response will be made within seven days;

- Additional monitoring (if appropriate) following a complaint, provided it is not vexatious or frivolous. If additional noise monitoring is required, it will be conducted at the affected location;
- If the applicable criteria or the EA conditions are exceeded corrective actions will be implemented; and
- Corrective actions will be reported to the affected persons and recorded in the complaints register or as required in the EA conditions.

9 IMPACTS ON FAUNA

Section 4.8.3 of the Project's *EIS Terms of Reference* requires that a noise assessment "*should describe modelled levels of noise, vibration and lighting and the potential impacts on species protected under the EPBC Act and TPWC Act*".

There are no current government policies or other accepted guidelines that provide recommended noise level thresholds or limits in relation to noise impact on terrestrial fauna. In Australia, there are no noise studies presently available that deal with noise impacts on native species for long-term exposure, therefore a general literature review has been carried out for potential fauna impacts.

There is limited knowledge or understanding of the effects of noise on fauna given that the research and studies on animals to date has been limited to small, disconnected, anecdotal or correlational studies as opposed to coherent programs of controlled experiments (Manci et al (1988), Larkin, (1996), Radle, (1998), Wyle (2003), Warren et al, (2006), Dooling and Popper (2007) and (Dooling, Fay, and Popper (2000)). Noise may adversely affect wildlife by interfering with communication, masking the sounds of predators and prey and causing stress or avoidance reactions, and in some cases may lead to changes in reproductive or nesting behaviour. At sufficiently high levels, noise could cause temporary or permanent hearing damage.

In general, Radle (2007) states the consensus that terrestrial animals will avoid any industrial or plant or construction area where noise or vibration presents an annoyance to them. Additionally, Radle (2007) observed many animals react to new noise initially as a potential threat (potentially followed by startle/fright and avoidance), but quickly 'learn' that the noise is not associated with a threat. Most wildlife are generally mobile and will act to avoid noise and vibration if it is perceived to be annoying.

The response to noise by animals can depend on a wide variety of factors including noise level, noise spectrum (frequency distribution), noise characteristics (such as impulsiveness, rate of onset, tonality, modulation etc.), duration, temporal variation, number and type of events, level of ambient noise, time of day/season/year, and the animal's age, sex, type of activity at the time, breeding situation and past experience, and the type of animal species/genera, hearing thresholds, individual differences etc.

Studies have shown the reaction to noise can vary from species to species, including those that are known to have adapted to human activity. Environment Australia (1998) suggests that unusual noise, in combination with close proximity visual stimulation, is enough to disturb any animal, including humans. In addition, any sudden and unexpected intrusion, whether acoustic or of another nature, may also produce a startle or panic reaction.

Studies of the impact of the sonic boom on domestic and wild animals show that these species are unaffected by repeated booms and farmers have reported birds actually perching on scare guns after only a couple of days operation (Environment Australia, 1998). From a literature review, it has been considered that noise levels up to 60 dB(A) do not result in negative or adverse response to impacted animals or livestock. Noise levels up to 80 dB(A) can generate startle responses in birds and animals, and noise levels in excess of 90 dB(A) may cause negative impact such as behavioural responses.

The predicted noise levels from the Project operations are approximately 50-60 dB(A) at the site boundary and these noise levels are not expected to cause adverse response to animals or livestock. Typically, animals will avoid high noise areas and it is expected that animals will relocate away from such areas.

To summarise, the impacts of noise on animals is generally inconclusive. In general, there is no or little evidence of cause and effect regarding behavioural or physiological effects on domestic animals, and possibly slight evidence of some effects on some types of wild animals (especially for high or impulsive levels of noise). Finally, it is noted that animals tend to habituate to disturbances over time, particularly when it is steady and associated with non-threatening activity.

10 CONCLUSIONS

Potential noise impacts from the construction and operation of the Project were assessed against applicable criteria based on the Northern Territory EPA Noise Management Guideline.

Future potential noise levels at the nearest sensitive receptors were predicted using the SoundPlan noise model for both construction and operation of the project, where the potential noise impacts are expected to be the greatest.

Operational noise levels from the proposed Project are predicted to comply during all time periods and weather scenarios without the need for noise mitigation.

Noise levels are predicted to exceed the non-standard hour operation at the nearest receptors during construction of the Project and noise mitigation would be required if construction is to occur outside standard hours. Noise mitigation measures and management measures have been investigated in Section 8. It is recommended that a construction noise management plan is developed in consultation and engagement with potentially affected receptors to achieve alternative arrangements if required.

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Appendix A GLOSSARY

Ambient noise – the totally encompassing noise in a given situation at a given time; it is usually composed of noise from many sources, near and far.

Attenuation – a general term used to indicate the reduction of noise or vibration, by whatever method or for whatever reason, and the amount in decibels, by which it is reduced.

A-weighting – a frequency weighting devised to attempt to take into account the fact human response to sound is not equally sensitive to all frequencies.

Background noise level - The INP defines the background noise level as '*the underlying level of noise present in ambient noise when all unusual extraneous noise is removed'*. Additionally, the INP states that *'sound levels contributing to background levels can include sound from nearby traffic, birds, insects, animals, machinery and similar sources if these sounds are a normal feature of the location'*.

dB(A) – the A-weighted sound pressure level.

dB(Z) or dB(Lin) – the Z-weighted (linear) sound pressure level.

Decibel (dB) – the logarithmic-scaled unit used to report the level or magnitude of sound.

Hertz (Hz) - the unit of frequency.

L (Level) – the sound pressure level (SPL); it implies the use of decibels related to the ratio of powers or the power related quantities such as sound intensity or sound pressure.

Loudness – the measure of the subjective impression of the magnitude or strength of a sound.

Noise descriptors – A noise descriptor is a measure of noise used to define a specific characteristic of noise, e.g. average energy, variation (maximum and minimum) and annoyance. Noise descriptors are based on measurements of the sound pressure level. Common noise descriptors are provided below:

$L_{Aeq,T}$	Time–average A-weighted sound pressure level
$L_{A90,T}$	Background A-weighted sound pressure level. Corresponds to the level that is exceeded for 90% of the measured time interval
$L_{Amax,T}$	Maximum A-weighted sound pressure level, obtained by arithmetically averaging of the maximum levels of the noise under investigation
$L_{Amin,T}$	Minimum A-weighted sound pressure level, obtained by arithmetic averaging of the minimum levels of the noise under investigation
$L_{A10,T}$	Level that is exceeded for 10% of the measured time interval. The L_{10} is typically used to measure road traffic noise
$L_{A1,T}$	Level that is equal to or exceeded for 1% of the time interval considered in the absence of the noise under investigation

Noise criteria – a maximum or minimum value imposed on a noise index e.g. a legal purpose.

RBL – Rating Background Level: Statistical noise descriptor used to describe the lowest noise levels (background) on site.

Sound power – the sound energy radiated per unit time by a sound source, measured in watts.

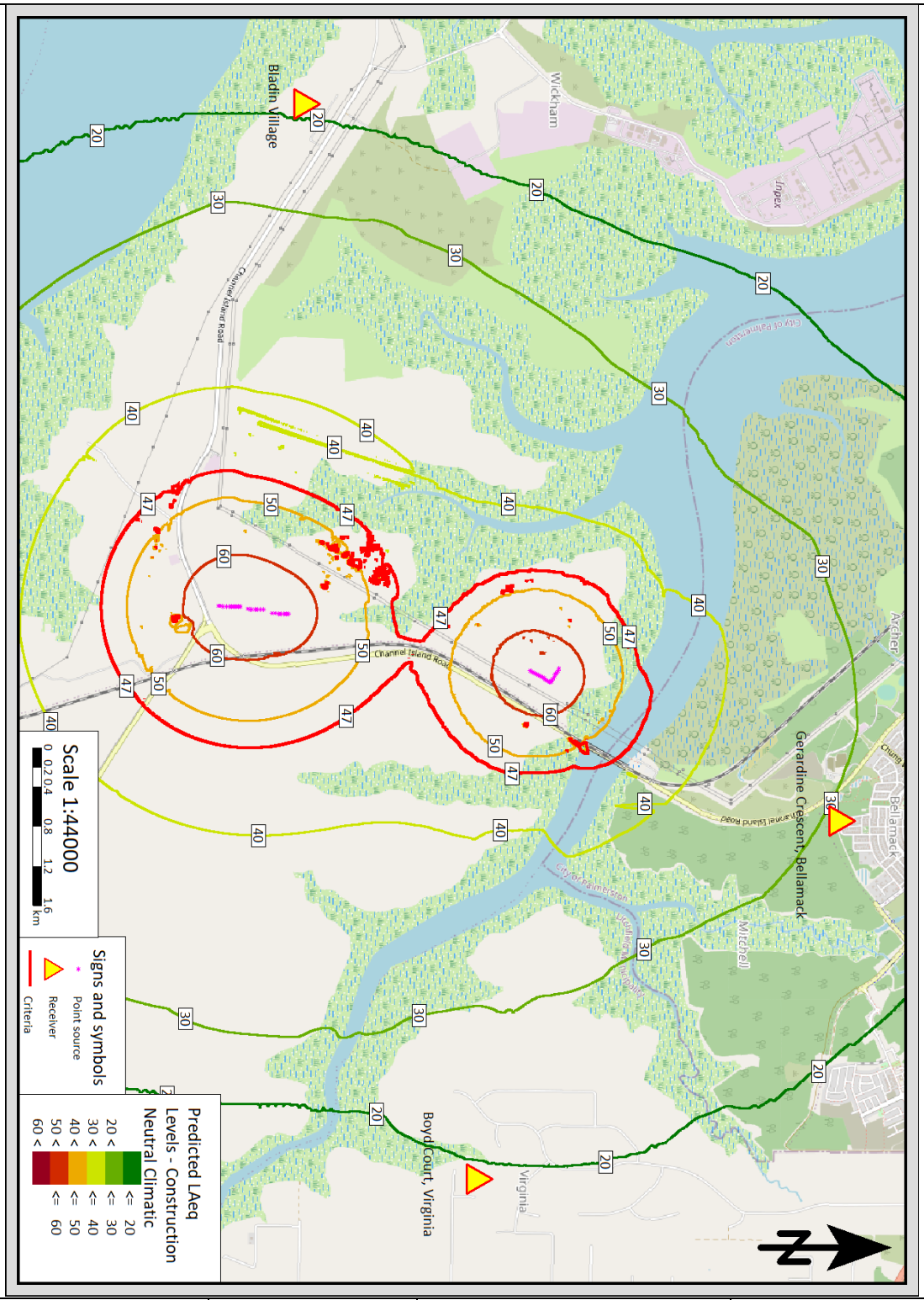
Sound propagation – the transfer of sound from one point to another.

Velocity – a vector quantity that specifies the time derivative of displacement.

Appendix B NOISE PREDICTION CONTOURS

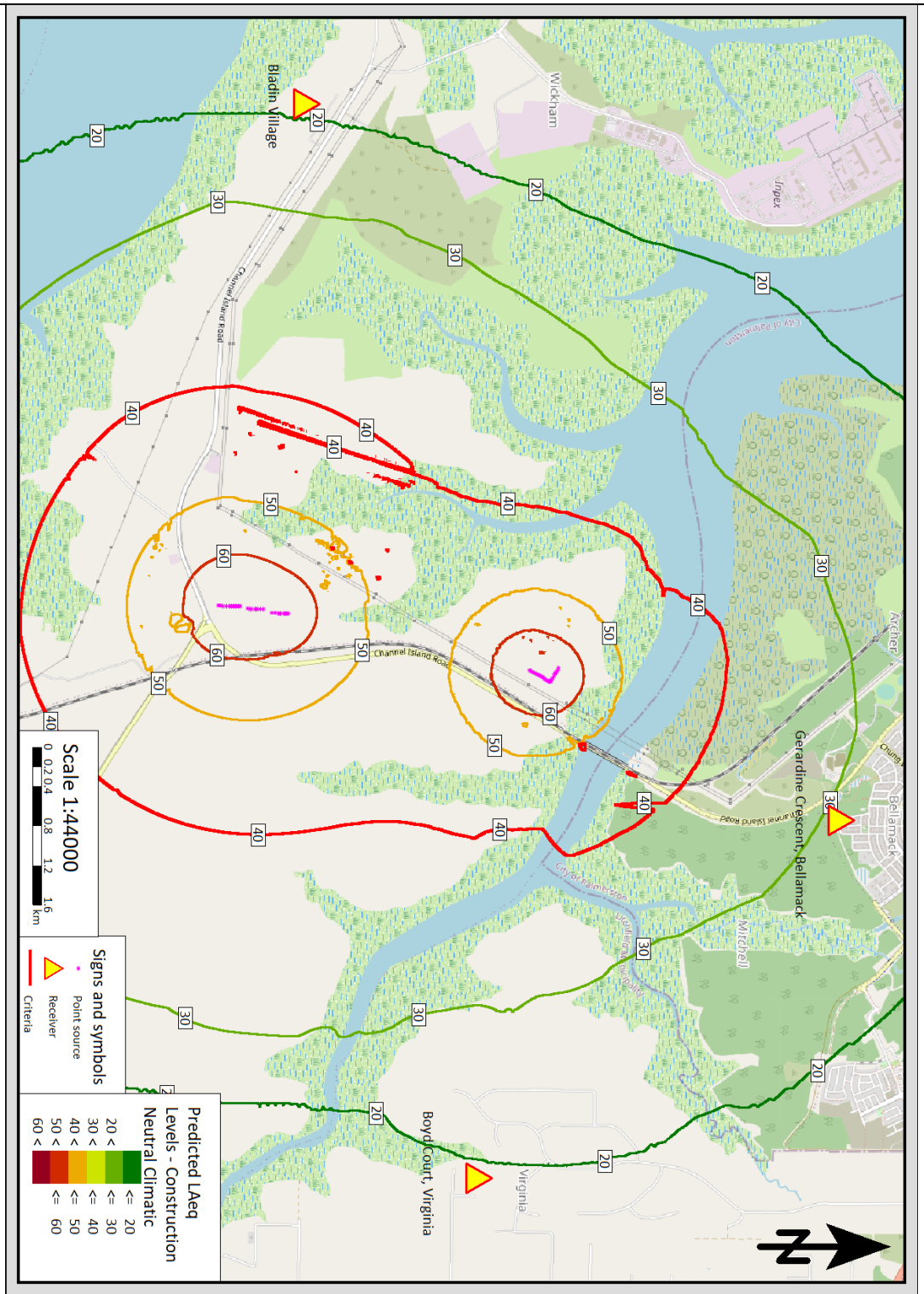
L_{Aeq} noise contour plots have been included for the following scenarios:

- Construction scenario, standard hours with neutral climatic conditions at Receiver 1,
- Construction scenario, standard hours with neutral climatic conditions at Receivers 2-3,
- Construction scenario, standard hours with worst case climatic conditions at Receiver 1,
- Construction scenario, standard hours with worst case climatic conditions at Receivers 2-3,
- Construction scenario, non-standard hours with neutral climatic conditions at Receiver 1,
- Construction scenario, non-standard hours with neutral climatic conditions at Receivers 2-3,
- Construction scenario, non-standard hours with worst case climatic conditions at Receiver 1,
- Construction scenario, non-standard hours with worst case climatic conditions at Receivers 2-3,
- Operational scenario during the night time period with neutral climatic conditions at Receivers 1-3,
- Operational scenario during the night time period with worst case climatic conditions at Receivers 1-3.



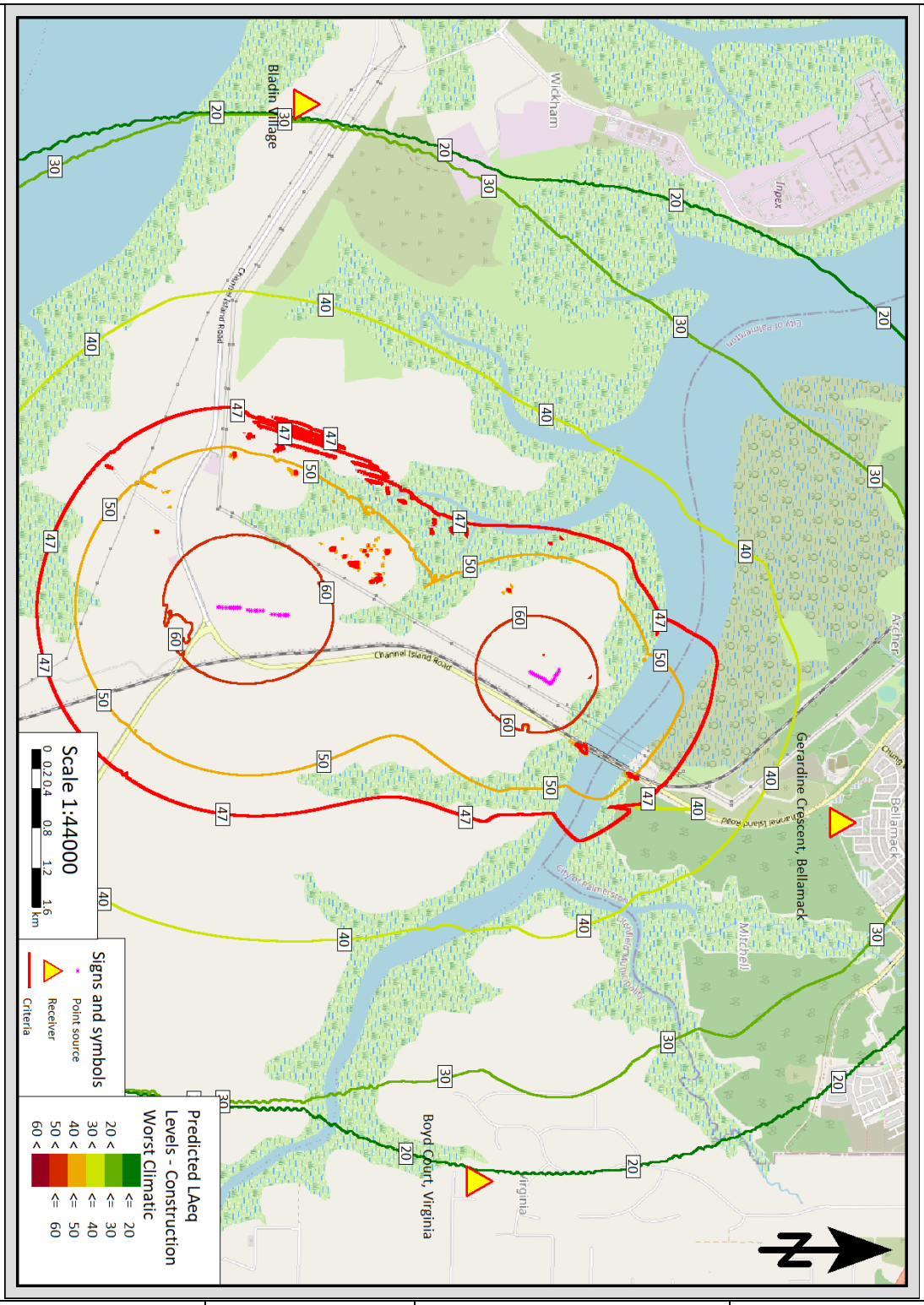
Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	7am-7pm	Neutral Climatic	47 dB(A)

Comment:
Construction Scenario in Neutral Conditions,
Standard Hours for Receiver 1



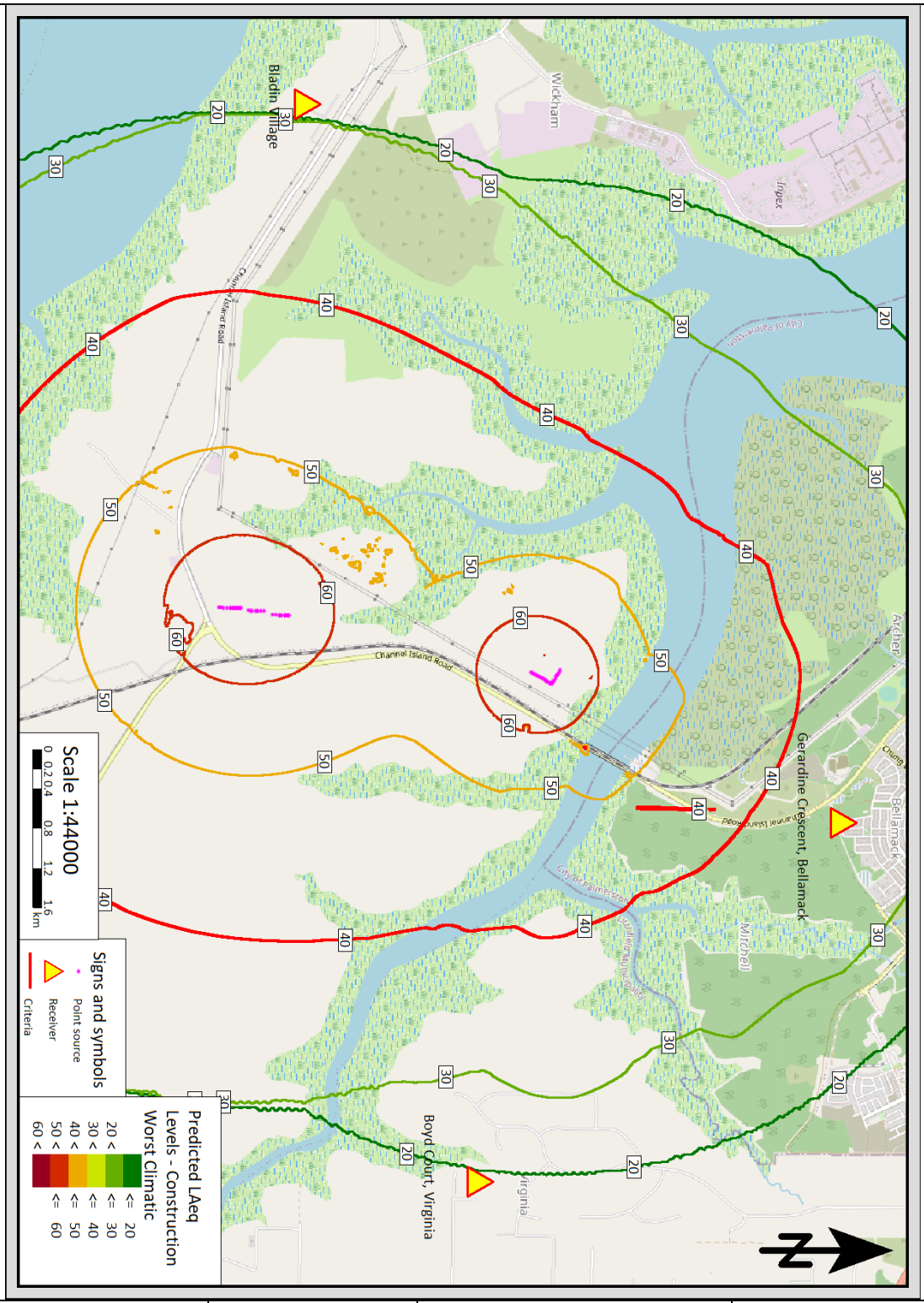
Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	7am-7pm	Neutral Climatic	40 dB(A)

Comment:
Construction Noise in neutral conditions during standard hours for receivers 2-3.



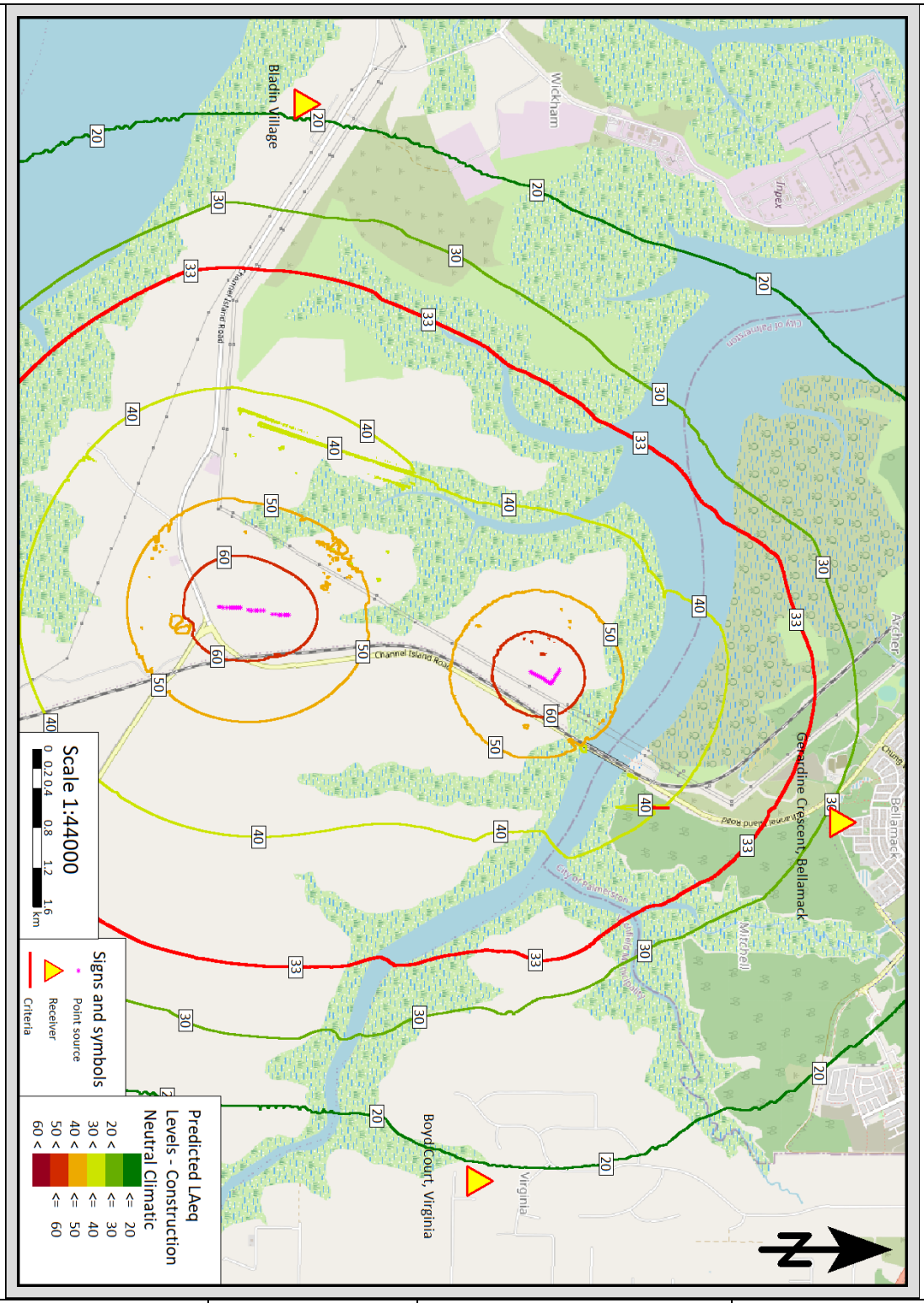
Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	7am-7pm	Worst Climatic	47 dB(A)

Comment:
Construction Scenario in Worst Climatic Conditions, Standard Hours for Receiver 1



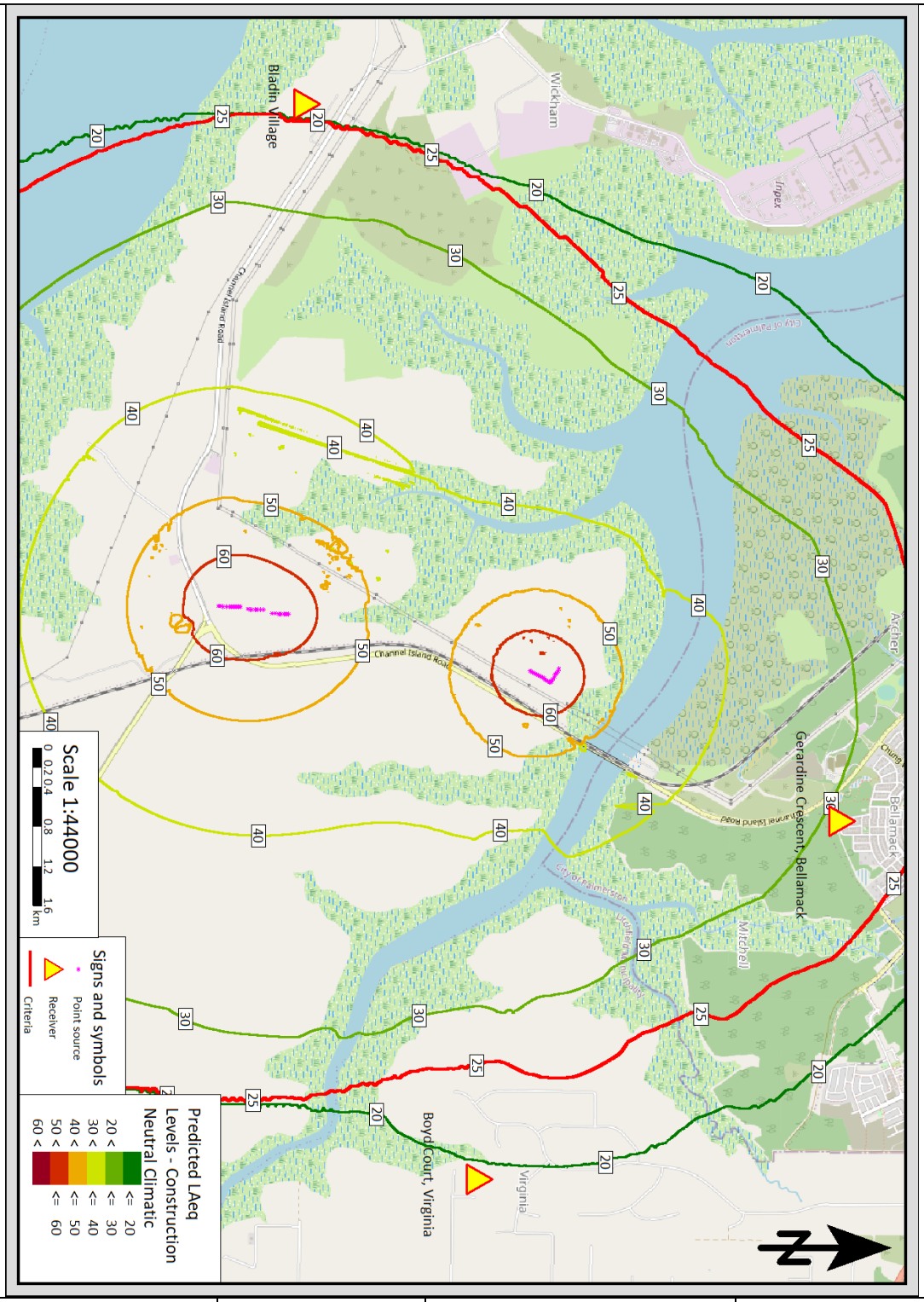
Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	7am-7pm	Worst Climatic	40 dB(A)

Comment:
Construction Noise during standard hours in worst climatic conditions for receivers 2-3.



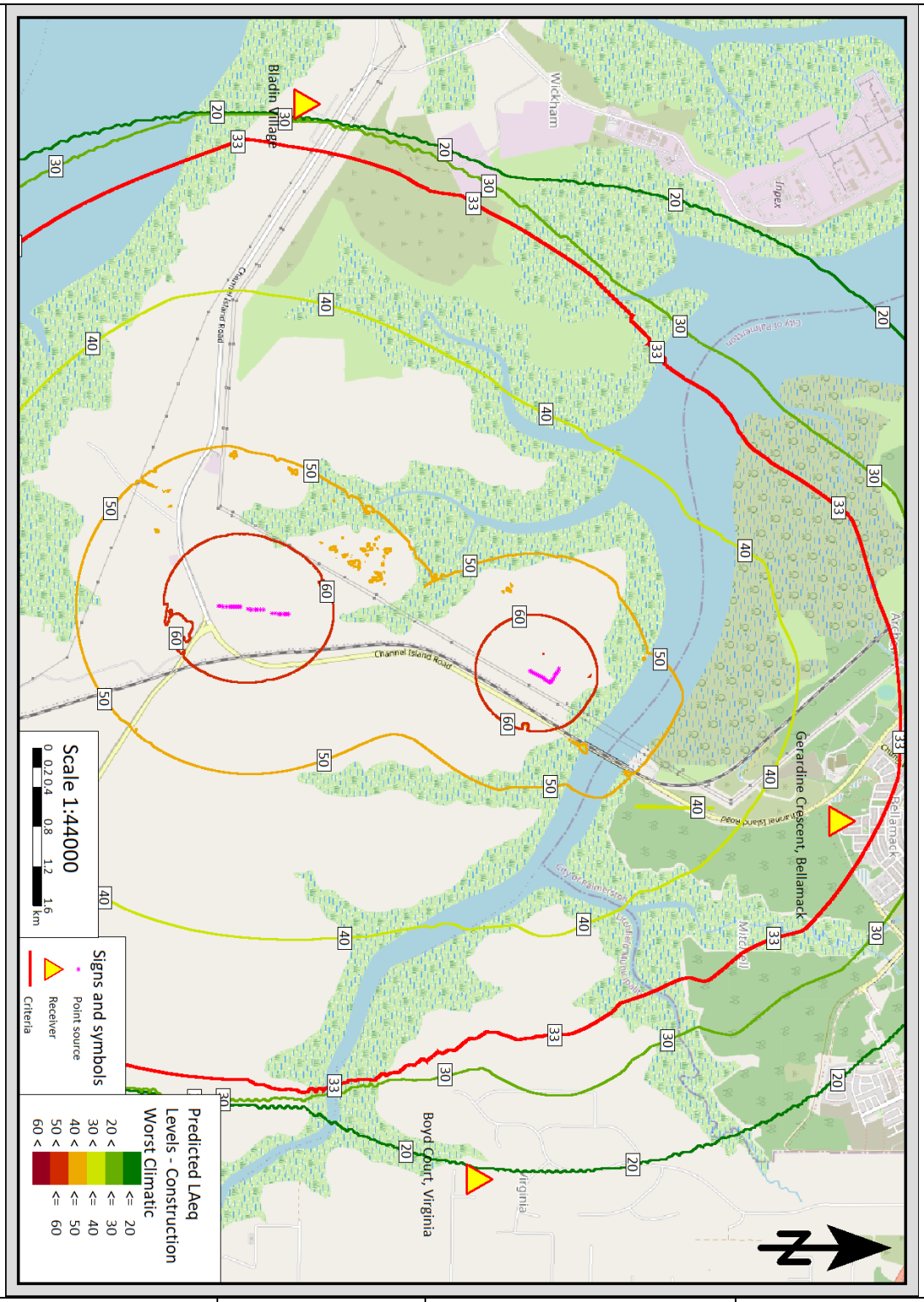
Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	7pm-7am	Neutral Climatic	33dB(A)

Comment:
Construction Noise during nonstandard hours in neutral climatic conditions for Receiver 1



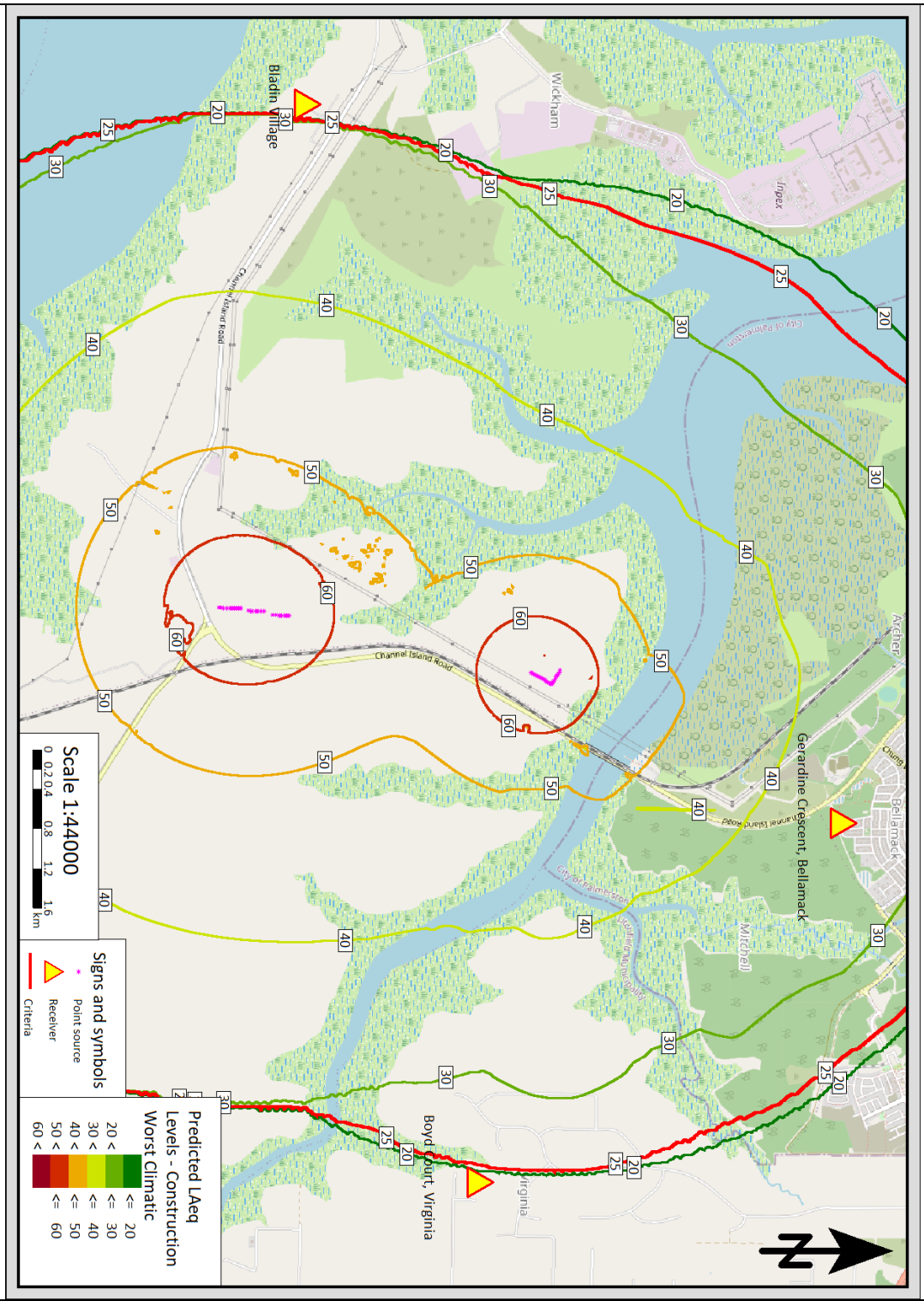
Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	7pm-7am	Neutral Climatic	25 dB(A)

Comment:
Construction Noise – Non-standard hours, neutral climatic conditions at receivers 2-3



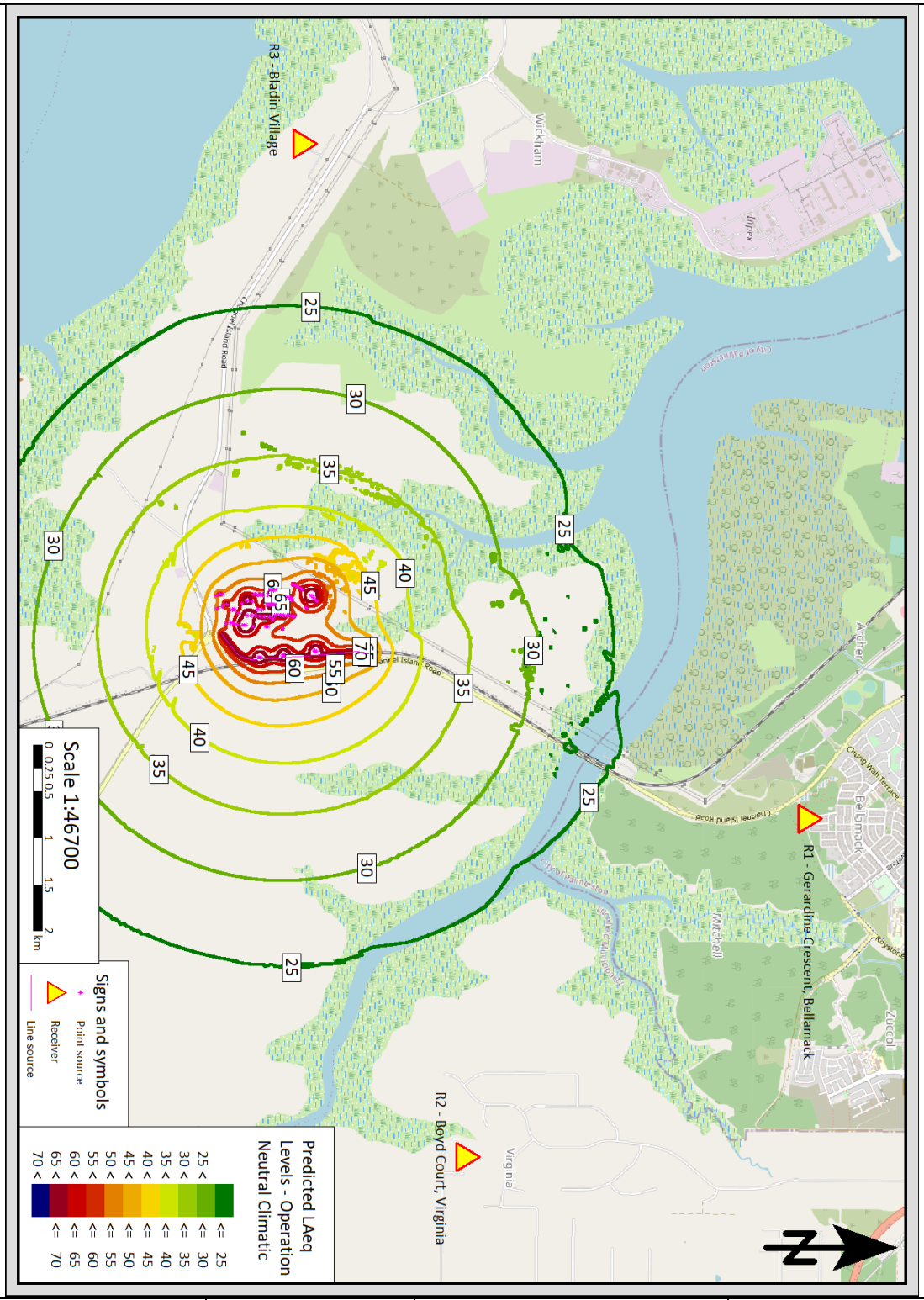
Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	7pm-7am	Worst Climatic	33 dB(A)

Comment:
Construction Noise – Non-standard hours,
worst climatic conditions at Receiver 1



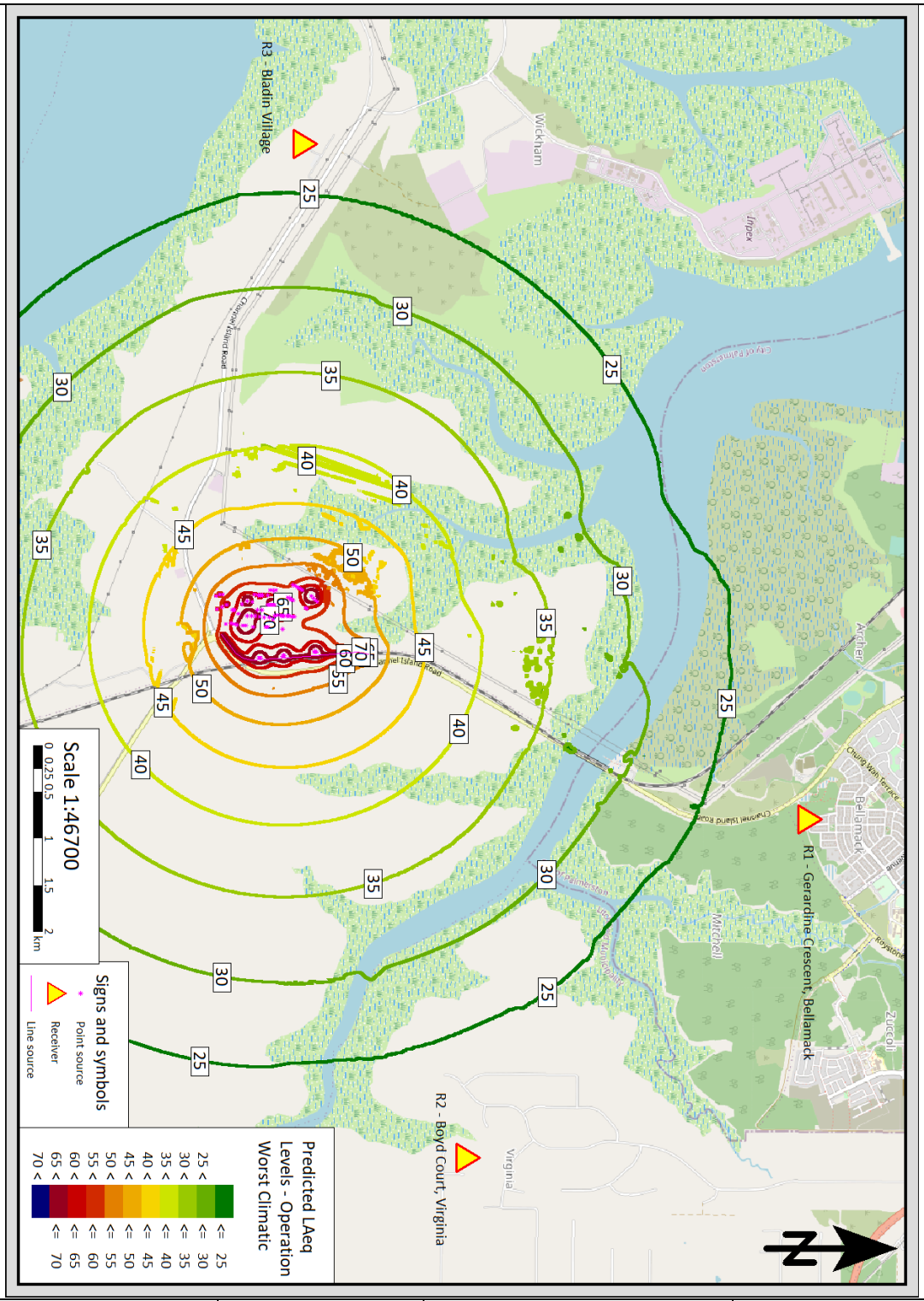
Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	7pm-7am	Worst Climatic	25 dB(A)

Comment:
Construction Noise – Non-standard hours, worst climatic conditions at Receivers 2-3



Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	Night	Neutral Climatic	35 dB(A)

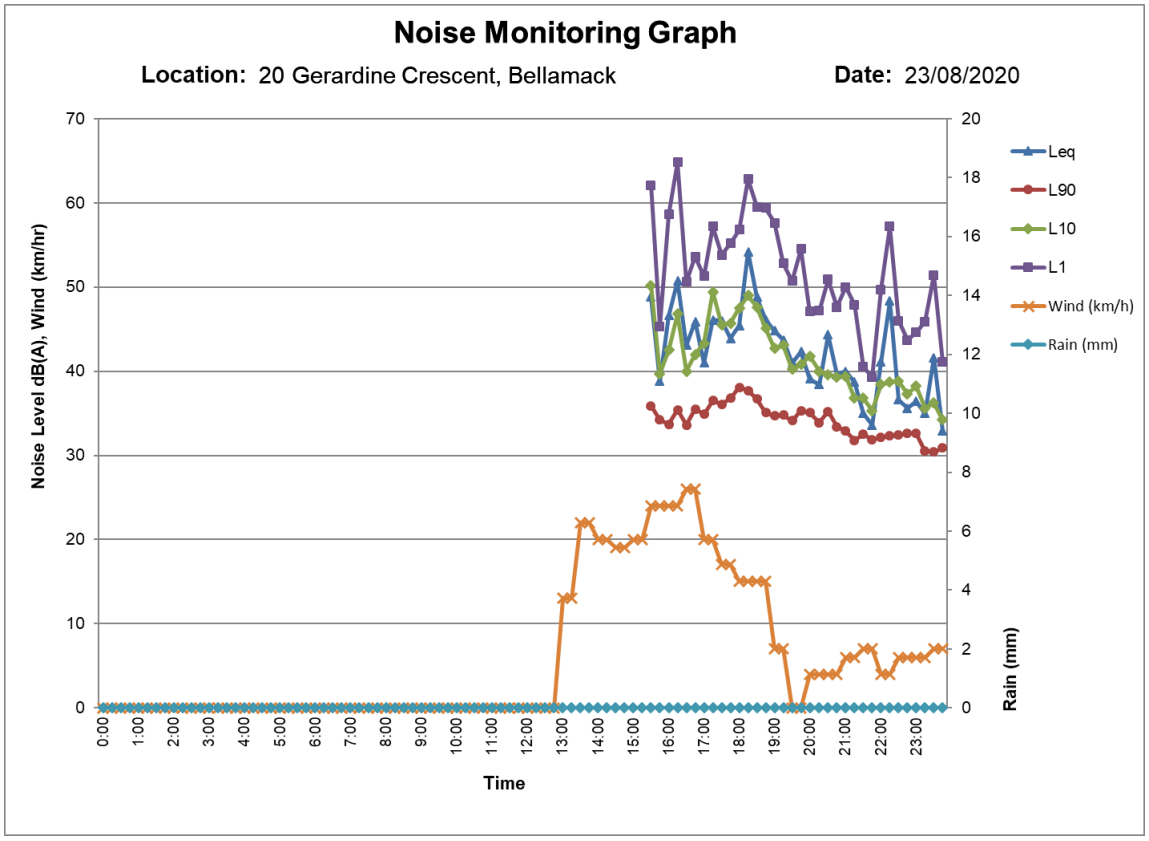
Comment:
Operational Scenario in Neutral Conditions –
All receivers

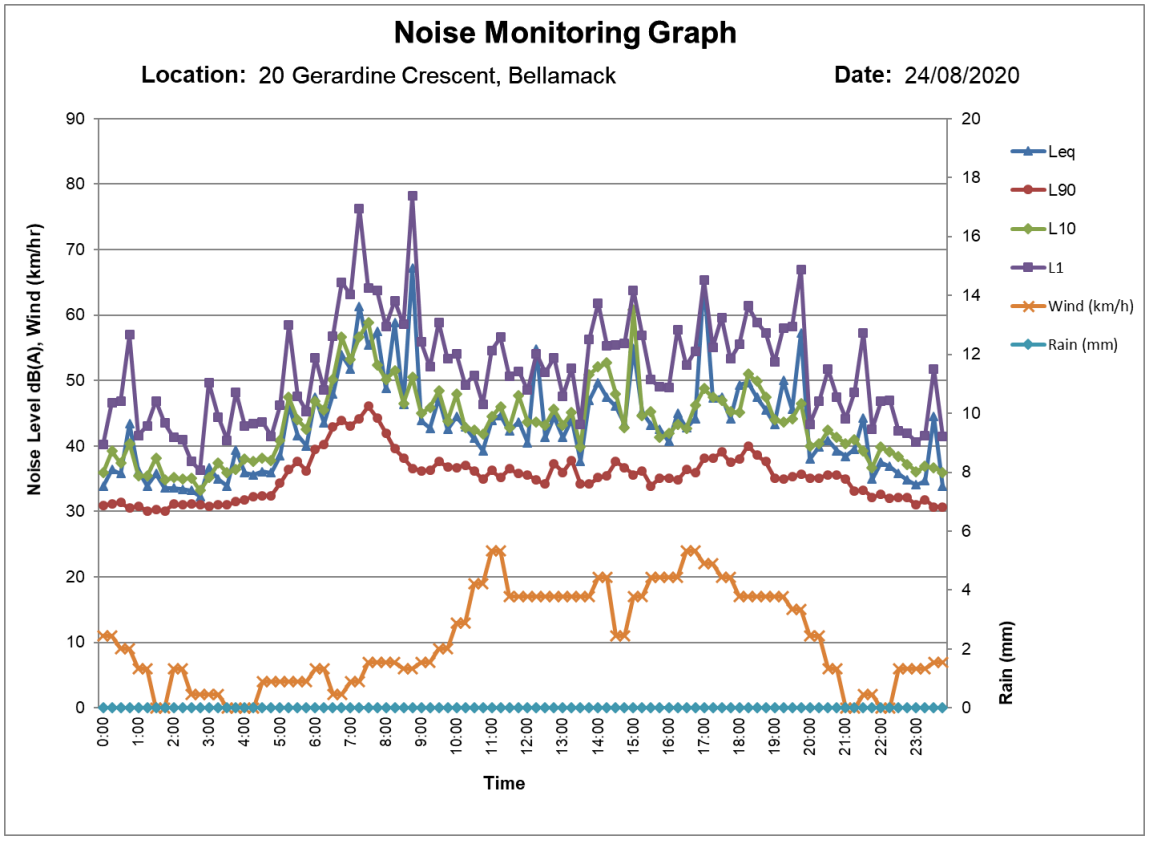


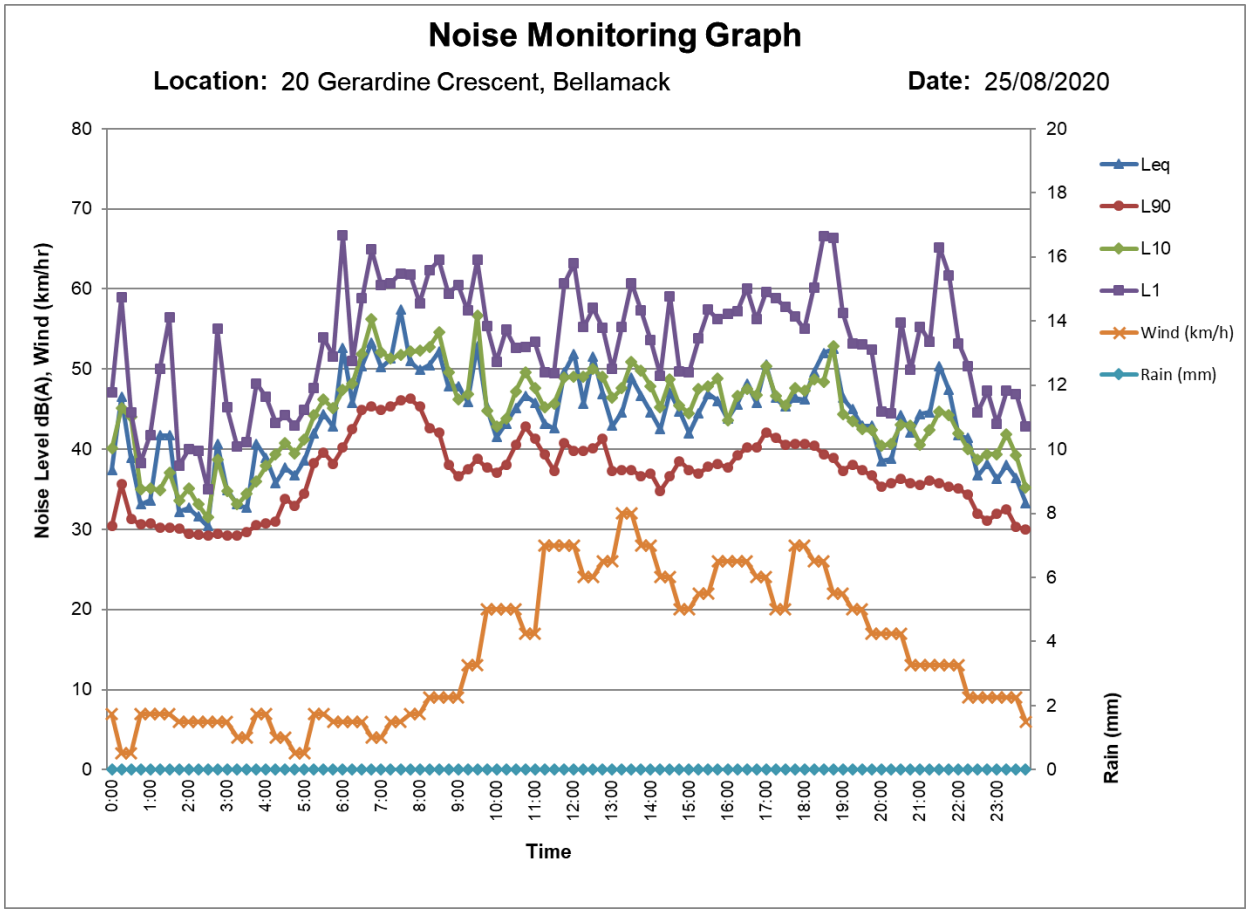
Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	Night	Worst Climatic	35 dB(A)

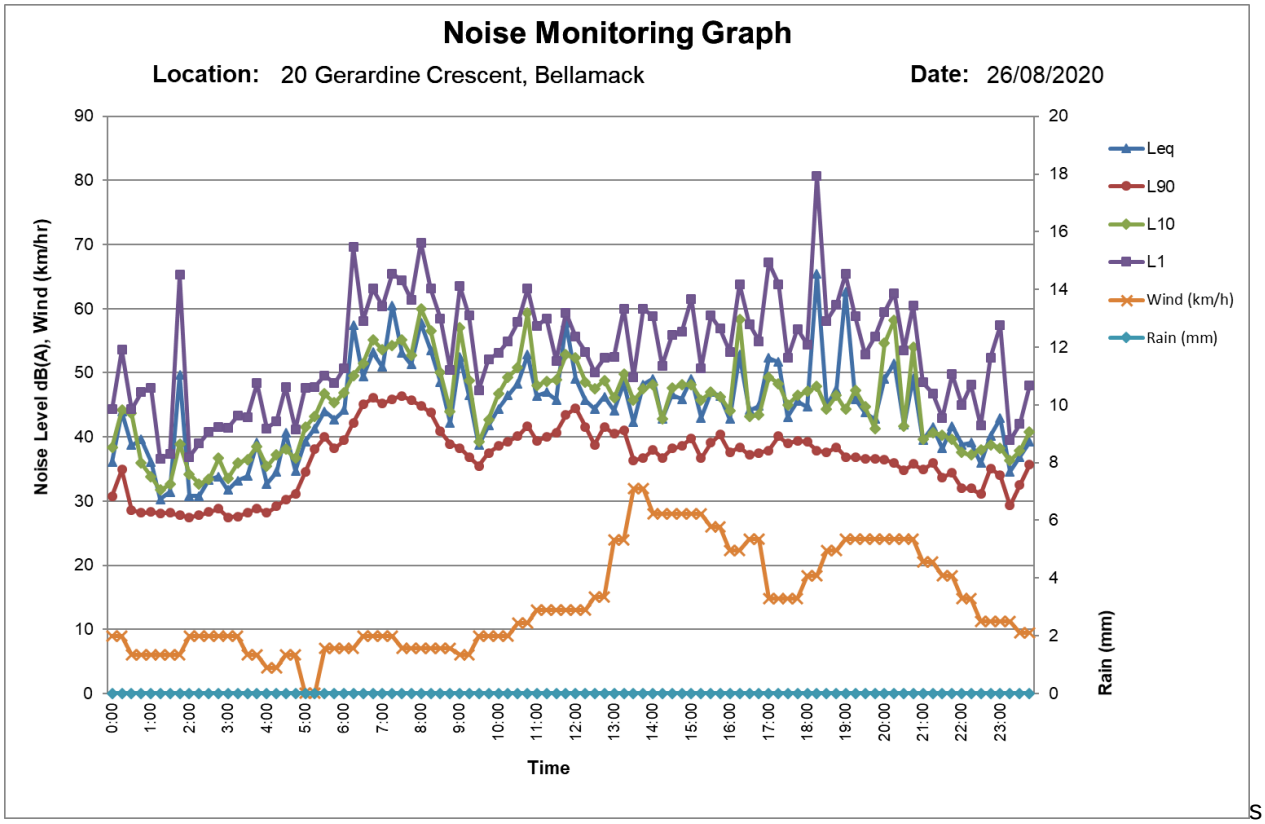
Comment:
Operational Scenario in Worst Climatic Conditions – All receivers

Appendix C NOISE MONITORING RESULTS

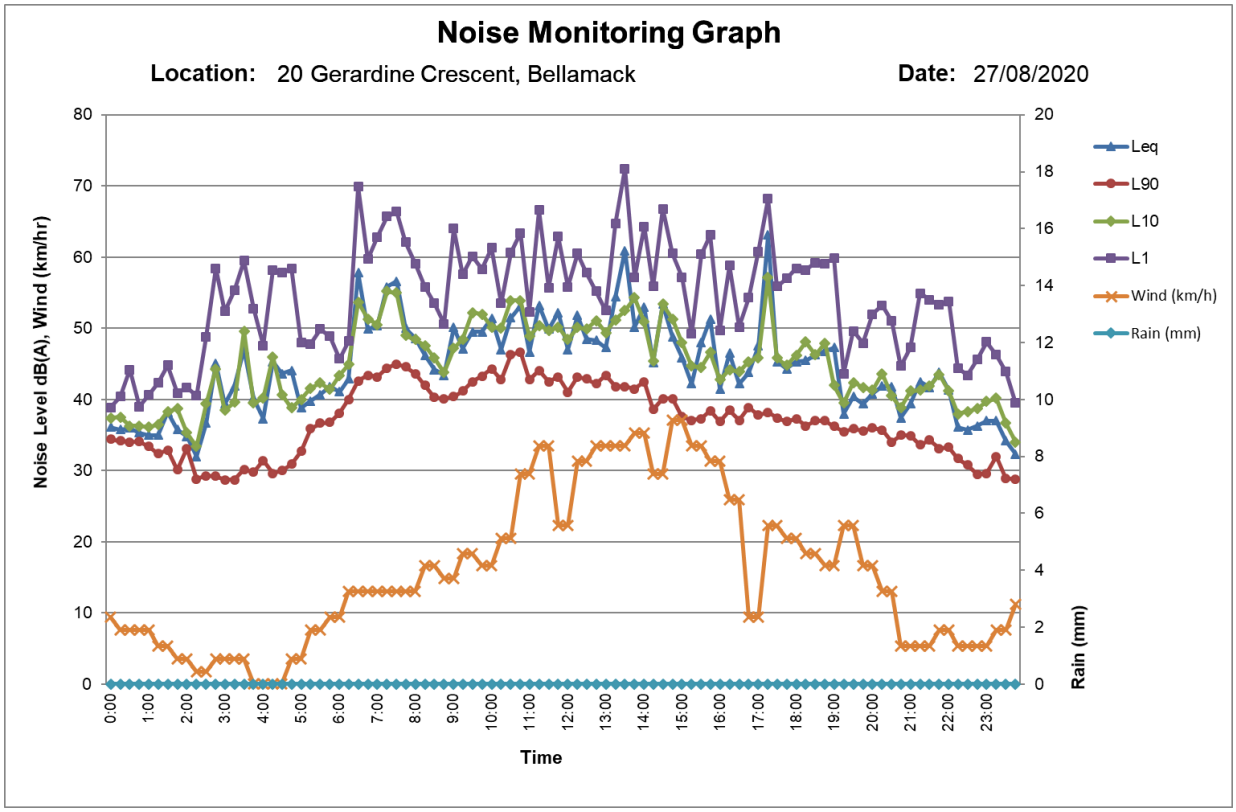


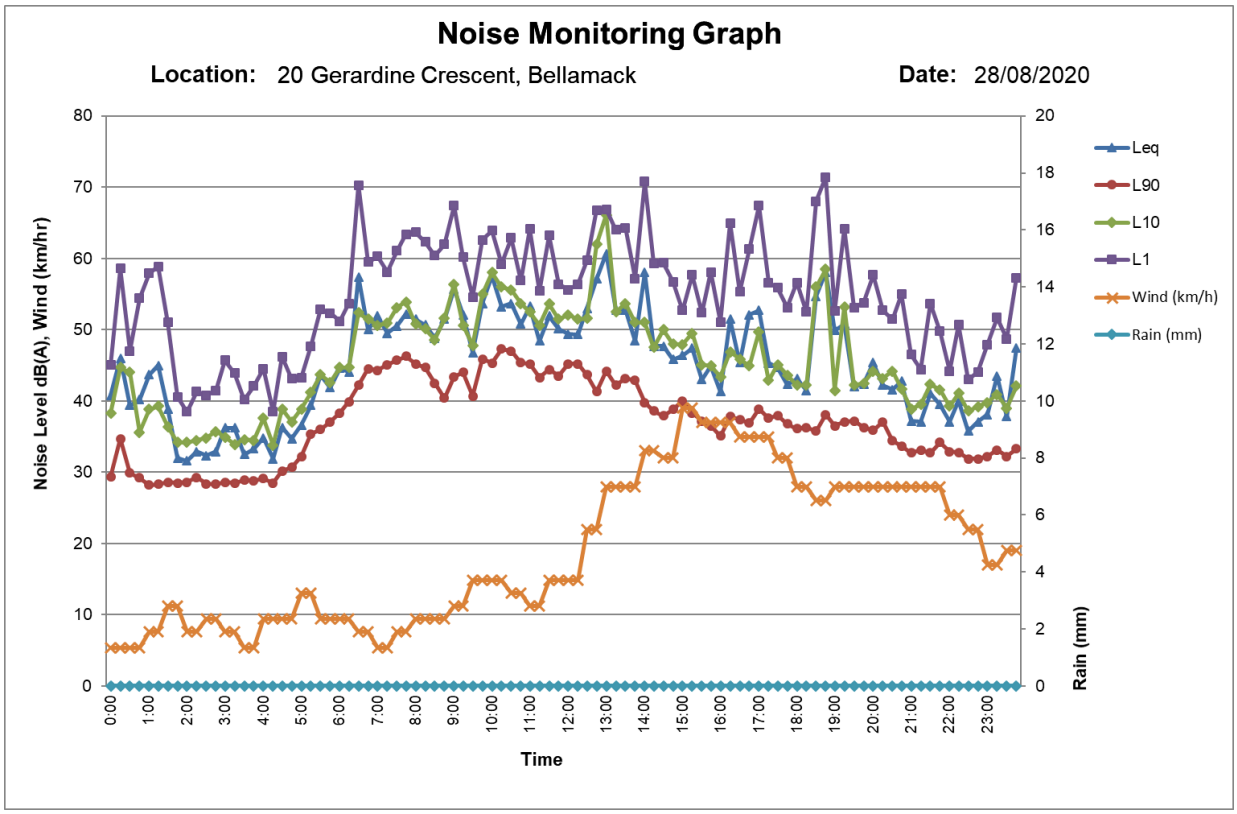


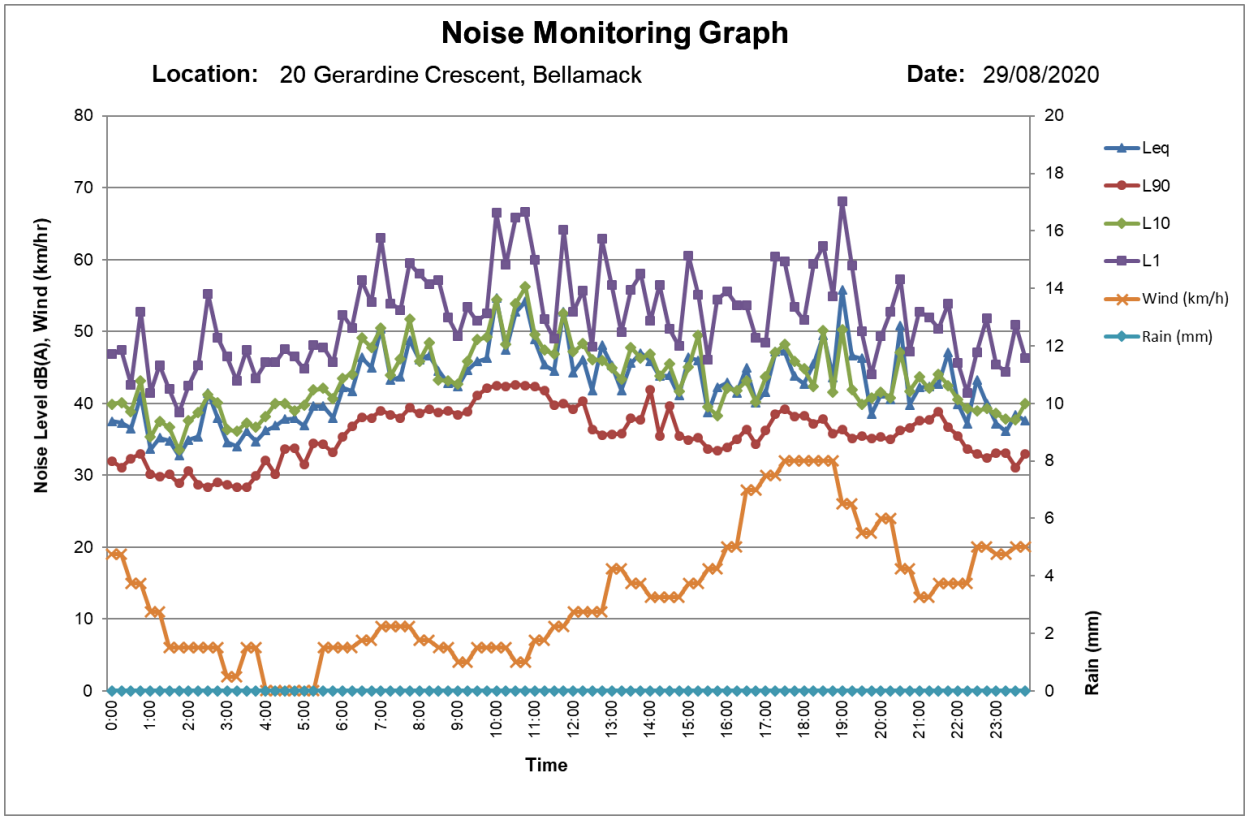

Noise Monitoring Graph
Location: 20 Gerardine Crescent, Bellamack
Date: 25/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)

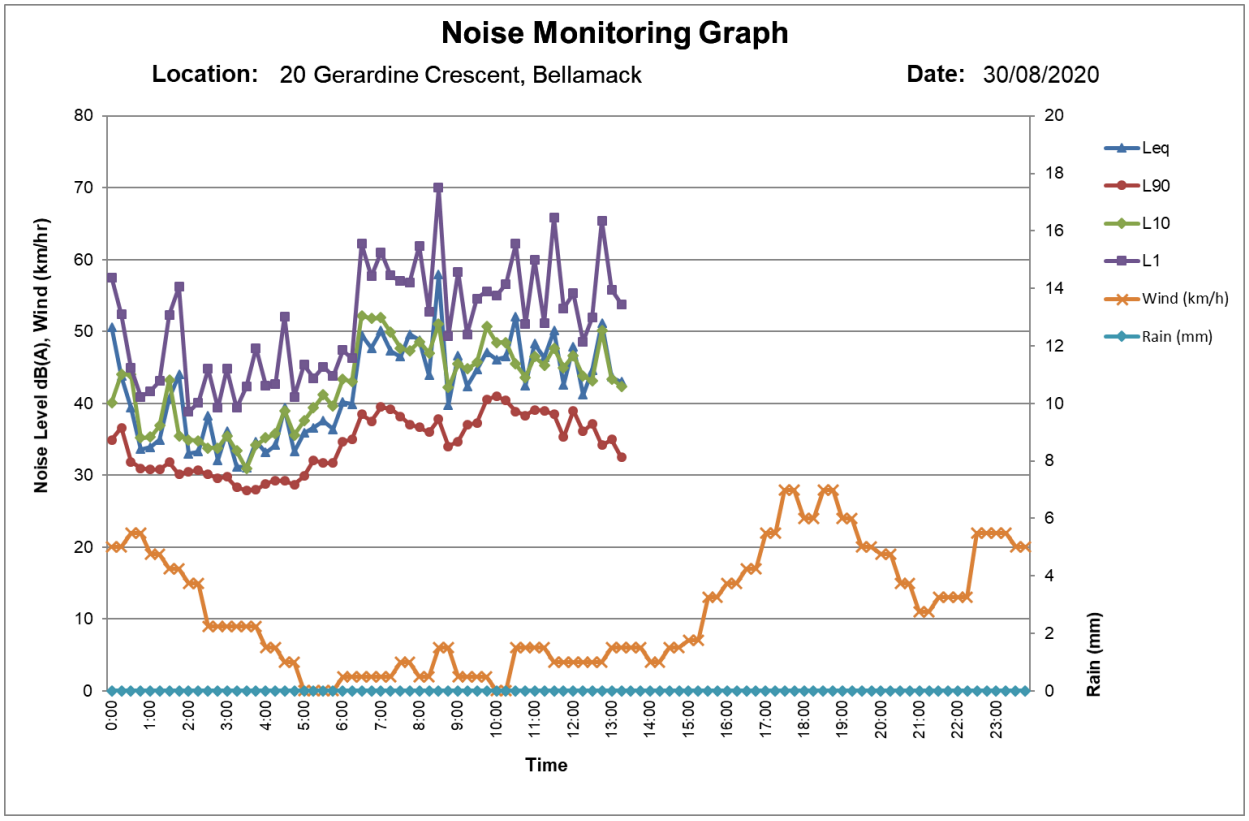

Noise Monitoring Graph
Location: 20 Gerardine Crescent, Bellamack
Date: 26/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)

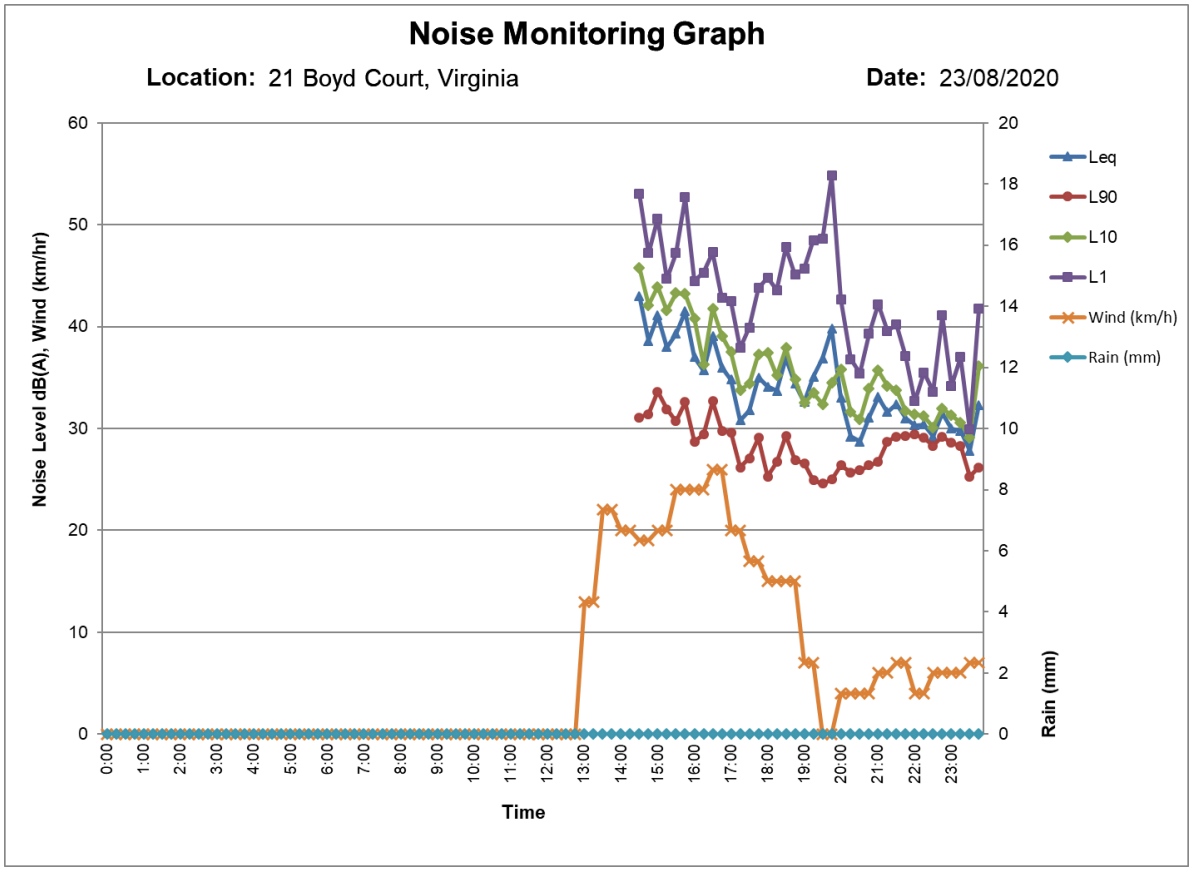
S

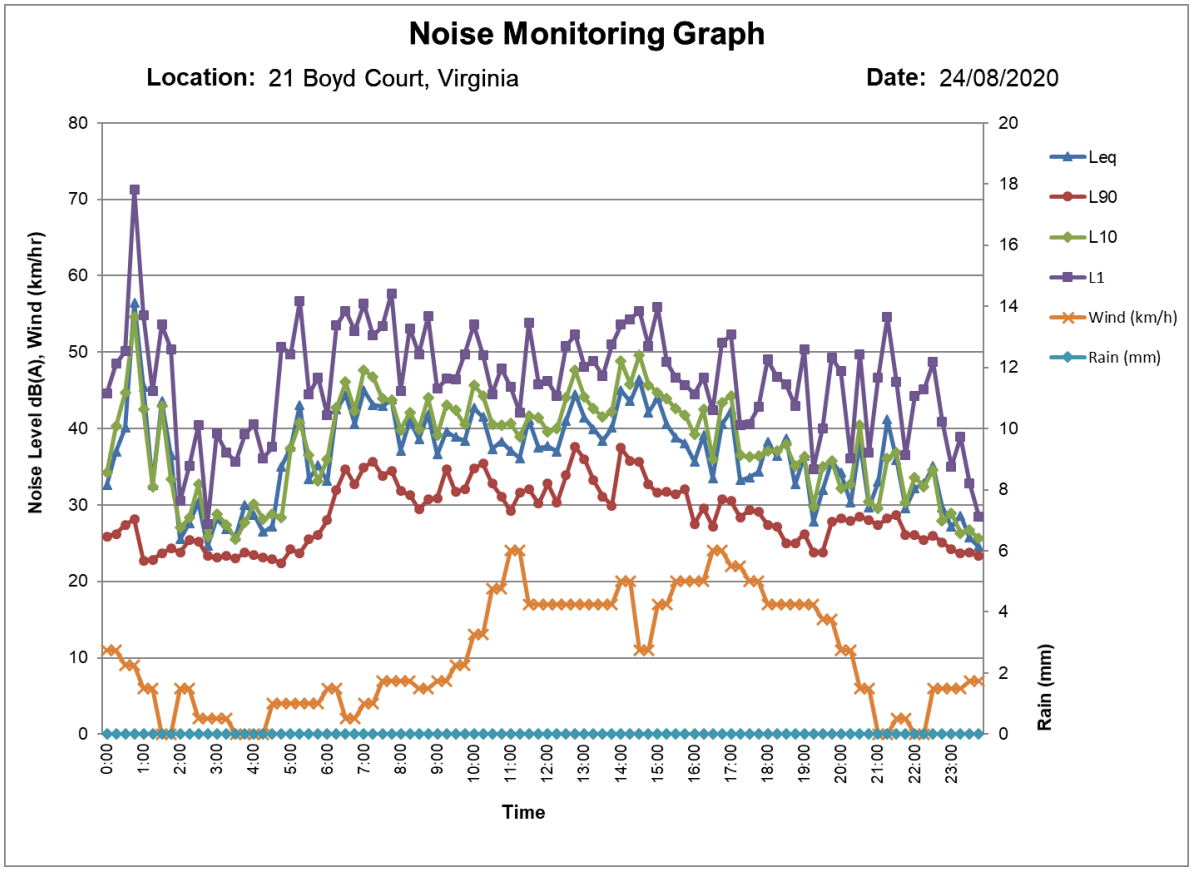

Noise Monitoring Graph
Location: 20 Gerardine Crescent, Bellamack
Date: 27/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)

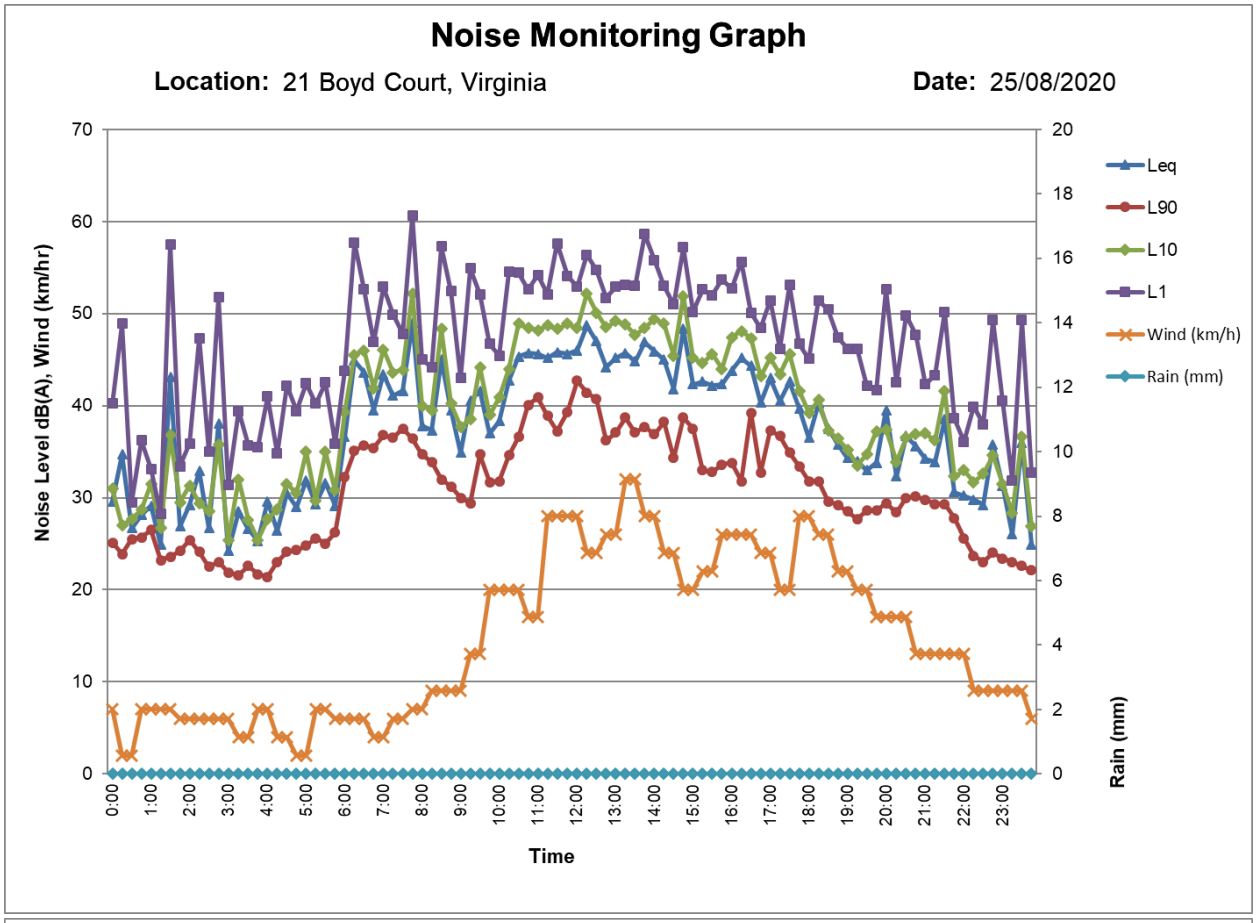

Noise Monitoring Graph
Location: 20 Gerardine Crescent, Bellamack
Date: 28/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)

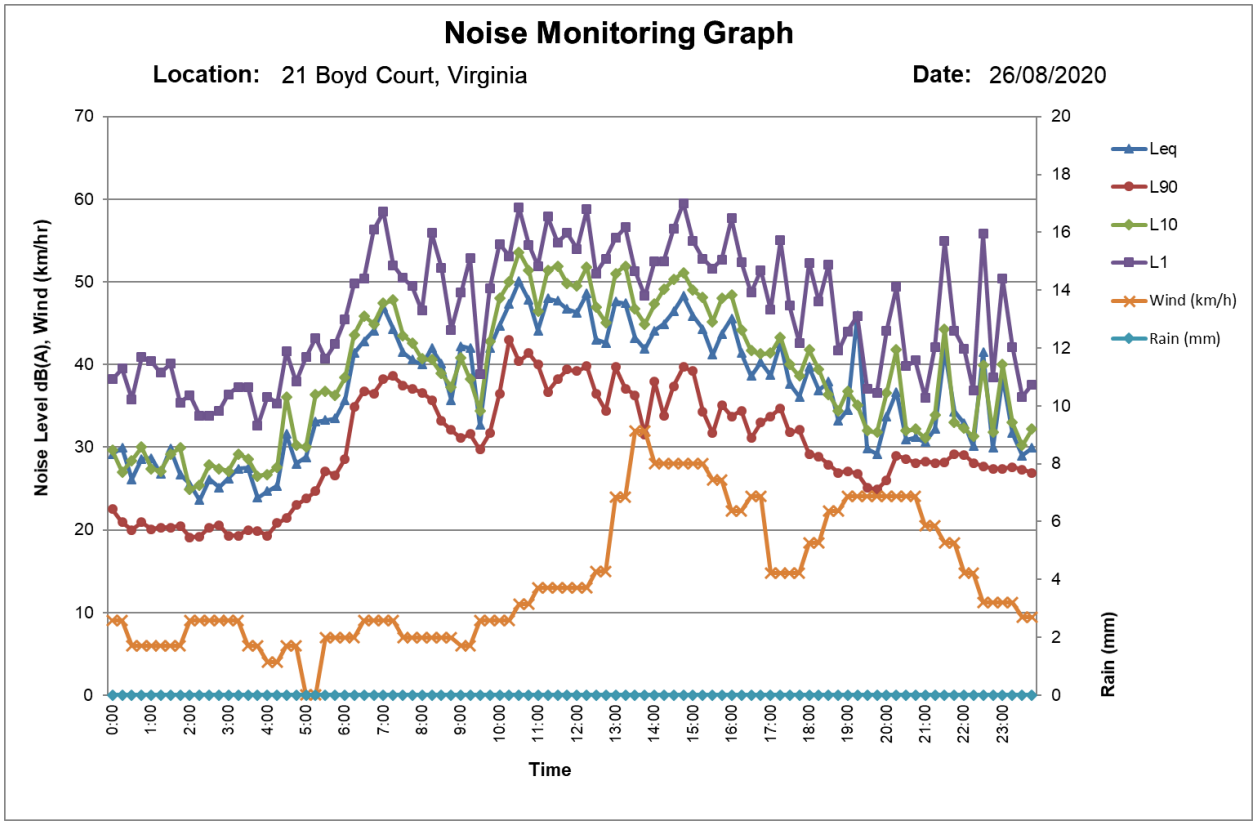

Noise Monitoring Graph
Location: 20 Gerardine Crescent, Bellamack
Date: 29/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)

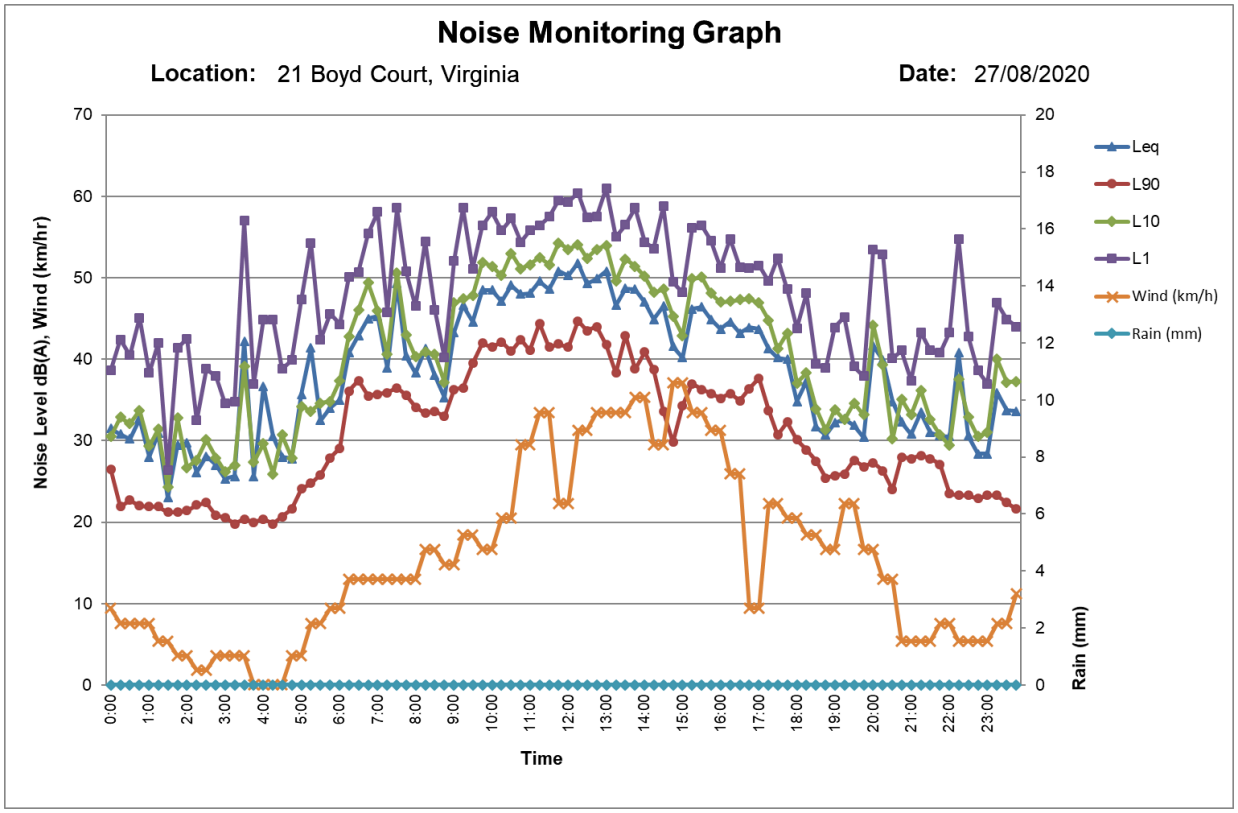

Noise Monitoring Graph
Location: 20 Gerardine Crescent, Bellamack
Date: 30/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)

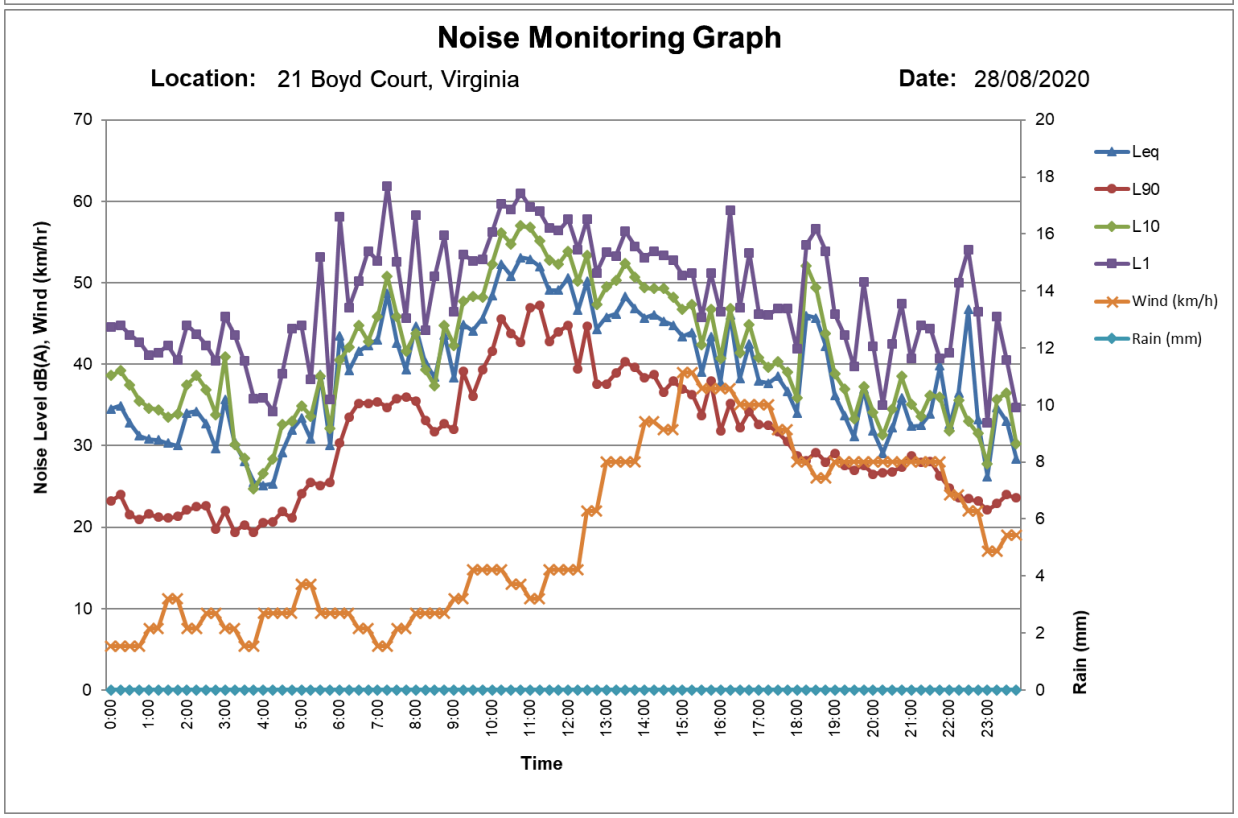

Noise Monitoring Graph
Location: 21 Boyd Court, Virginia
Date: 23/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)

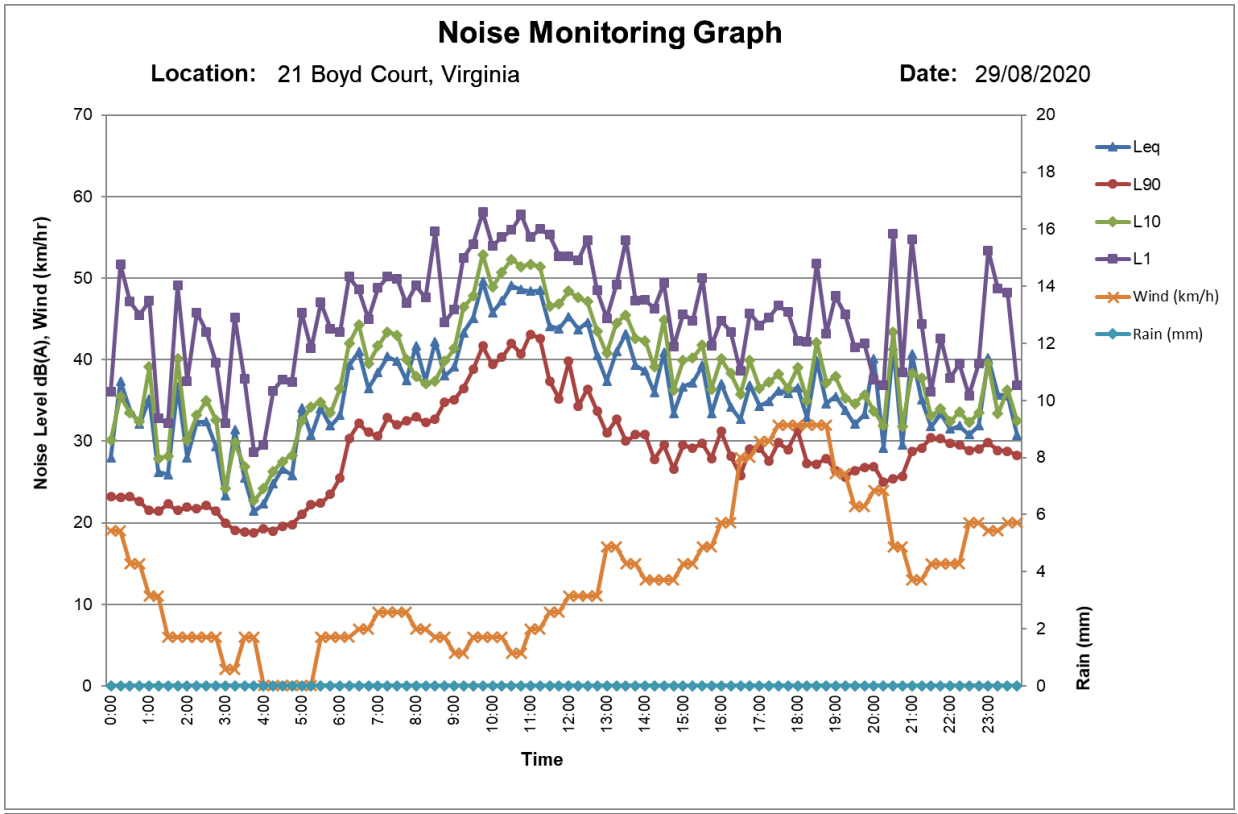

Noise Monitoring Graph
Location: 21 Boyd Court, Virginia
Date: 24/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)

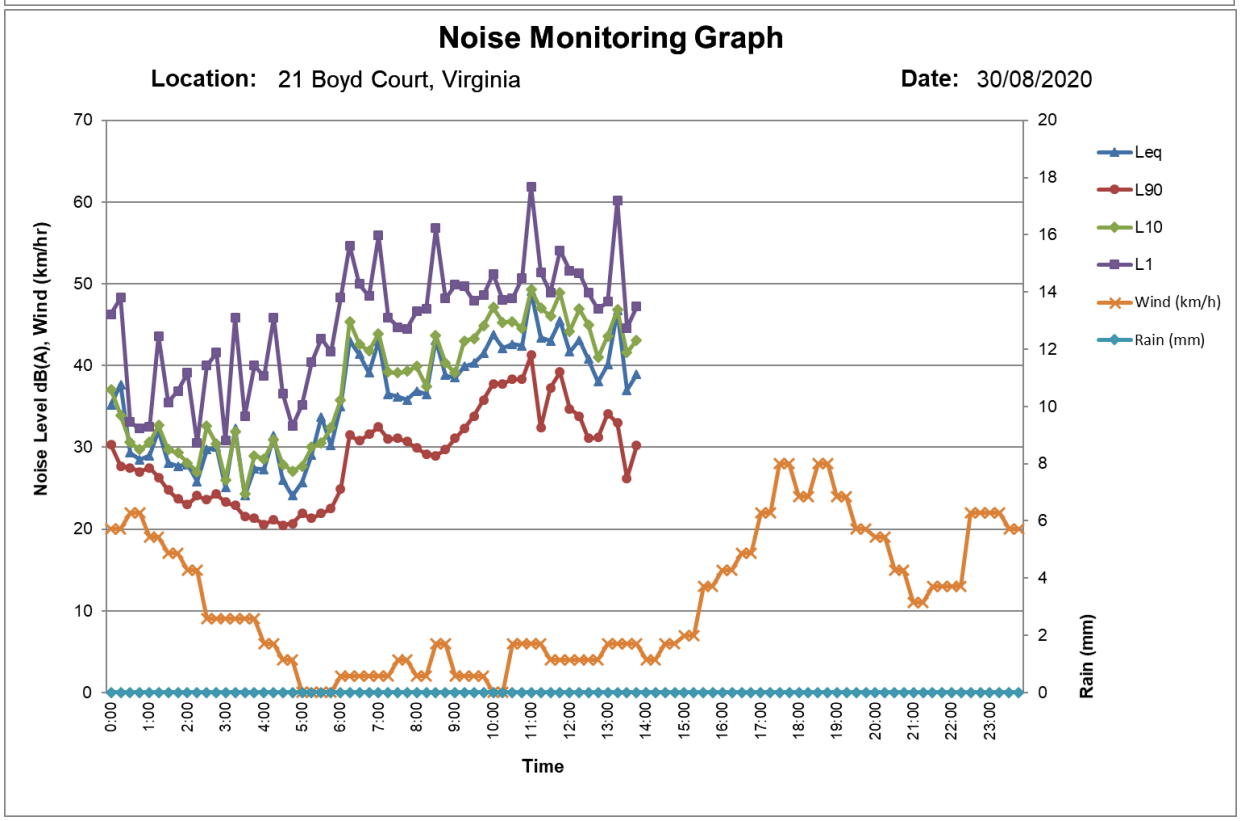

Noise Monitoring Graph
Location: 21 Boyd Court, Virginia
Date: 25/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)


Noise Monitoring Graph
Location: 21 Boyd Court, Virginia
Date: 26/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)


Noise Monitoring Graph
Location: 21 Boyd Court, Virginia
Date: 27/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)


Noise Monitoring Graph
Location: 21 Boyd Court, Virginia
Date: 28/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)


Noise Monitoring Graph
Location: 21 Boyd Court, Virginia
Date: 29/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)


Noise Monitoring Graph
Location: 21 Boyd Court, Virginia
Date: 30/08/2020
Noise Level dB(A), Wind (km/hr)
Rain (mm)
Time
Leq
L90
L10
L1
Wind (km/h)
Rain (mm)