

REPORT

**NOISE EVALUATION AT
JAMAICA PRIVATE POWER COMPANY FACILITY**

Submitted To:

**WEST KINGSTON POWER PARTNERS
Wikip Place, Marcus Garvey Drive
Kingston, Jamaica**



Taking Care of You and Your Environment.

OCTOBER 2020

REPORT

**NOISE EVALUATION AT
JAMAICA PRIVATE POWER COMPANY FACILITY**

Submitted To:

**WEST KINGSTON POWER PARTNERS
Wikip Place, Marcus Garvey Drive
Kingston, Jamaica**

Submitted by:

**C.L. ENVIRONMENTAL CO. LTD.
20 Windsor Avenue
Kingston 5**

OCTOBER 2020

EXECUTIVE SUMMARY

1.0 INTRODUCTION

This report represents the findings of the noise evaluation exercise conducted by C.L. Environmental Company Limited at the Jamaica Private Power Company facility from 12:00 am Friday 16th, to 12:00 am Saturday 17th of October, 2020.

2.0 NOISE LEVEL READINGS AND OCTAVE BAND ANALYSIS

The noise readings were compared with Natural Resources Conservation Authority (NRCA) guidelines, World Health Organization guidelines (50 and 55 dBA) and the World Bank guidelines (70 dBA).

3.0 RESULTS

.1 NOISE LEVEL READINGS

Table showing compliance of stations

STN	NRCA guidelines	WHO guidelines	WORLD BANK guidelines (dBA)
1	√	N/A	√
2	√ (day only)	N/A	X
3	√ (night only)	N/A	X
4	X	N/A	X
5	X	X	X
6	X	√ (55 dBA)	X
7	X	X	X

√ - Compliant X - Not compliant N/A - Not applicable

4.0 CONCLUSIONS

- Only industrial Stations 1 and 2 were compliant with NRCA guidelines for day and Stations 1 and 3 were compliant with NRCA guidelines for night. The off-site stations (Stations 5, 6 and 7) were non-compliant with the respective NRCA day and night guidelines with the exception of Station 7, which complied with NRCA night guidelines.
- Only Station 1 was compliant with the World Bank guidelines of 70 dBA in the industrial locations (at the property boundaries).
- The noise levels at Stations 5 was non-compliant with the World Bank guidelines for educational facilities for both day (55 dBA) and night (45 dBA). The noise levels at Station 6

and 7 were non-compliant with the World Bank guidelines for residential areas for both day (55 dBA) and night (45 dBA).

- Noise at the monitoring stations were in the low frequency range, mainly centered around the geometric means of 12.5 Hz, 20 Hz, 50 Hz and 200 Hz.
- There was not a general decrease in sound pressure levels (dBA) from the perimeter of the plant due to these off-site stations being possibly impacted by other anthropogenic noise sources.
- Meteorological conditions were within the levels for the optimum performance of the noise meters.
- Dominant wind direction on-site (southeast) would put Station 6 (D'Aguilar Rd.) downwind of the plant while Stations 5 and 7 would remain unaffected during the noise assessment period.

5.0 PROFESSIONAL STATEMENT

Noise measured at off-site stations were not influenced exclusively by noise emissions from the JPPC Power Plant. All of the noise measured at the JPPC perimeter stations were in the low frequency range. At this frequency and level (dBL) most of the noise will be below the hearing threshold of most persons.

However, plant noise was detected at the HEART Trust NTA monitoring location. There was correlation in the high noise levels detected between the plant and HEART Trust NTA, when plant generation/output was at its highest for the monitoring period. Even though there was correlation in this regard, there are other external factors contributing to elevated noise levels at HEART Trust NTA, such as motor vehicle traffic noise, truck engine brakes and noise from JPS Rockfort Diesel Barge.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	iii
TABLE OF CONTENTS	v
LIST OF TABLES	vi
LIST OF FIGURES	vi
LIST OF PLATES	vii
LIST OF APPENDICES	vii
1.0 INTRODUCTION	1
1.1 SCOPE OF WORKS	1
1.2 PROFESSIONAL TEAM	2
2.0 METHODOLOGY	3
2.1 NOISE LEVEL READINGS AND OCTAVE BAND ANALYSIS	3
2.2 METEOROLOGICAL CONDITIONS	5
3.0 RESULTS	7
3.1 STATION 1	7
3.1.1 Octave Band Analysis	8
3.1.2 Meteorological Data on plant	8
3.2 STATION 2	9
3.2.1 Octave Band Analysis	9
3.3 STATION 3	10
3.3.1 Octave Band Analysis	10
3.4 STATION 4	11
3.4.1 Octave Band Analysis	11
3.5 STATION 5	12
3.5.1 Octave Band Analysis	13
3.6 STATION 6	13
3.6.1 Octave Band Analysis	14
3.7 STATION 7	14
3.7.1 Octave Band Analysis	15
4.0 L10 and L90 NOISE STATISTICS	16
5.0 COMPARISON WITH NATURAL RESOURCES CONSERVATION AUTHORITY (NRCA) PROPOSED GUIDELINES	19
6.0 COMPARISON WITH WORLD BANK GUIDELINES	21
7.0 SIMPLE REGRESSION	23
8.0 CONCLUSIONS	24
9.0 PROFESSIONAL STATEMENT	25
APPENDICES	26

LIST OF TABLES

Table 1	Coordinates of noise monitoring stations and their distances from the plant powerhouse	4
Table 2	Instantaneous high and low dBA readings during the 24-hour noise evaluation.....	7
Table 3	L10 and L90 noise values	16
Table 4	L90 Noise Comparison between Stations 2 and 5.....	17
Table 5	Comparison of average noise levels at the Stations with NRCA proposed noise guidelines.....	20
Table 6	Comparison of Stations 1-4 with World Bank Guidelines	21

LIST OF FIGURES

Figure 1	Map depicting stations at which noise readings were taken	6
Figure 2	24-hour Average Noise Level plot at Station 1	7
Figure 3	Octave band spectrum of noise emitted at Station 1.....	8
Figure 4	24-hour Average Noise Level plot at Station 2	9
Figure 5	Octave band spectrum of noise emitted at Station 2.....	9
Figure 6	24-hour Average Noise Level plot at Station 3	10
Figure 7	Octave band spectrum of noise emitted at Station 3.....	10
Figure 8	24-hour Average Noise Level plot at Station 4	11
Figure 9	Octave band spectrum of noise emitted at Station 4.....	11
Figure 10	24-hour Average Noise Level plot at Station 5	12
Figure 11	Comparison of average noise levels (24 hrs) (dBA) for Stations 5, 6 and 7 with World Health Organization Standards.....	12
Figure 12	Octave band spectrum of noise emitted at Station 5.....	13
Figure 13	24-hour Average Noise Level plot at Station 6	13
Figure 14	Octave band spectrum of noise emitted at Station 6.....	14
Figure 15	24-hour Average Noise Level plot at Station 7	14
Figure 16	Octave band spectrum of noise emitted at Station 7.....	15
Figure 17	Comparison of noise emitted at Stations 1-4, to the World Bank Guidelines	21
Figure 18	Graph depicting average dBA readings for off-site locations during the day and night compared to World Bank Guidelines	22
Figure 19	Noise level of stations with increasing distance from the JPPC power plant perimeter fence	23

LIST OF PLATES

Plate 1 An example the Bruel and Kjaer outdoor noise kit setup on site, used for the 24-hour monitoring.....5

LIST OF APPENDICES

APPENDIX 1 NOISE CALIBRATION CERTIFICATES.....27
APPENDIX 2 PLANT GENERATION AND OUTPUT DATA (October 16, 2020).....30

1.0 INTRODUCTION

This report represents the findings of the noise evaluation exercise conducted by C.L. Environmental Company Limited at the Jamaica Private Power Company facility from 12:00 am Friday 16th, to 12:00 am Saturday 17th of October 2020 (Figure 1).

1.1 SCOPE OF WORKS

The following is the Scope of Works developed by the Client:

1. To carry out a noise assessment at the boundaries of the facility and within the surrounding communities mentioned in item 3 (below) over a 24-hour period.
2. The noise levels shall be measured in low, mid and high frequency bands in order to clearly define the noise attributable to the power plant.
3. A defined map of each survey location in relation to the plant shall be prepared and included in the report. The total number of data collection sites shall be seven (7), as laid out in the table below depicting the areas where noise levels are to be assessed.

LOCATION
Northern Boundary (on plant)
Western Boundary (on plant)
Southern Boundary (on plant)
Eastern Boundary (on plant)
HEART Trust NTA Rockfort Vocational Training Centre
D'Aguilar Road
17 ¾ Outlook Avenue

4. The report should contain the following information:

- (i) Dates, times and places of test.
- (ii) Test Method used.
- (iii) Copies of instrumentation calibration certificates.
- (iv) Noise level measurements
- (v) Any other relevant operating information.
- (vi) Evaluation of data, discussions and statement giving a professional opinion of the noise impact of the facility.

The report should be submitted to JPPC/JEP within two weeks after completion of testing.

1.2 PROFESSIONAL TEAM

Carlton Campbell, Ph.D. - Environmental Scientist

Matthew Lee, M.Sc. – Environmental Scientist

Glen Patrick - Technical Assistant

Patrick Litchmore - Technical Assistant

2.0 METHODOLOGY

The noise evaluation was conducted from 12:00 am Friday 16th, to 12:00 am Saturday 17th of October 2020. The measurements were taken continuously for twenty-four (24) hours at seven (7) locations. The locations are depicted in Figure 1 and listed in Table 1.

Plant generation and output over the noise assessment period can be seen in Appendix 2.

2.1 NOISE LEVEL READINGS AND OCTAVE BAND ANALYSIS

Noise level readings were taken by using seven (7) Brüel & Kjaer (B&K) Type 2250 noise meters with real time frequency analyser, connected to outdoor weatherproof kit. The octave band analysis was conducted at the concurrently with the noise level measurements. These were done in the third octave which provided thirty-three (33) octave bands from 12.5 Hz to 20 kHz.

Octave band analysis is used to characterize a noise. It is used to breakdown noise into its' respective frequency components or spectra in effect "fingerprinting" the noise. Each frequency is calculated as a percentage of the dBL reading. The frequency with the highest percentage is the characteristic frequency (centre) of the noise.

The noise meters were calibrated using a Brüel & Kjaer Type 4231 sound calibrator (Appendix 1). The meters were programmed using the Brüel & Kjaer BZ software to collect third octave, average sound level (Leq) over the period, Lmin (The lowest level measured during the assessment) and Lmax (The highest level measured during the assessment) every ten (10) seconds over the twenty four hour period.

Seven (7) meters were set up to run for the entire twenty-four (24) hour assessment period. An example of the outdoor monitoring kit is shown in Plate 1. Average sound level, Lmin and Lmax was set up on meter 2, which was set at slow, the weighting at A and an exchange rate of 3 (Leq). For octave band analysis, meter 1 was set at fast, the weighting at Z and an exchange rate of 3 (Leq).

A windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone. The microphones of the meters were at a height of approximately 1.5m above ground. Any abnormal activity, for example excessive barking of dogs or heavy traffic, was noted.

Average noise levels over the twenty-four hour time period was calculated using the formula:

$$\text{Average dBA} = 20 \log \frac{1}{N} \sum_{j=1}^N 10^{(L_j/20)}$$

where N = number of measurements, L_j = the j th sound level and $j = 1, 2, 3 \dots N$.

Table 1 **Coordinates of noise monitoring stations and their distances from the plant powerhouse**

STATIONS	LOCATIONS	Coordinates JAD 2001		Distance from Plant powerhouse (m)
		Northing	Easting	
	PROPERTY BOUNDARY			
1	Northern Boundary	646818.923	776243.719	96.30
2	Eastern Boundary	646722.594	776240.096	27.08
3	Southern Boundary	646634.208	776166.336	61.98
4	Western Boundary	646685.855	776124.778	34.72
	ENVIRONS			
5	HEART Trust NTA Rockfort VTC	646703.764	776395.837	183.95
6	D' Aguilar Road	647187.152	776225.345	458.27
7	17 ¾ Outlook Avenue	646669.086	775024.601	1132.99

The noise readings were compared with the Natural Resources Conservation Authority (NRCA) guidelines, World Health Organization guidelines (Berglund *et al.*, 1999) (50 and 55 dBA) and the World Bank guidelines (70 dBA – industrial, 55dBA – daytime residential and 45dBA – night time residential).

The NRCA proposed noise guidelines for environmental noise in Jamaica are dependent on zones and time. The zones are Industrial, Commercial, Residential and Silence and the time periods are

7 a.m. to 10 p.m. and 10 p.m. to 7 a.m. with each zone and time period having a distinct guideline level. NRCA also has a guideline for occupational noise.



Plate 1 An example the Bruel and Kjaer outdoor noise kit setup on site, used for the 24-hour monitoring

2.2 METEOROLOGICAL CONDITIONS

Meteorological data (Temperature, relative humidity, wind speed and direction and rainfall) was provided by JPPC.



Figure 1 Map depicting stations at which noise readings were taken

3.0 RESULTS

This section outlines the results of the noise evaluation exercise. There were fluctuations in the noise levels recorded at all stations, with off-site Stations 6 and 7 showing the greatest range (Table 2).

Plant generation and output over the noise assessment period can be seen in Appendix 2. The plant was off from 12:00am – 8:00am and was operational from 8am – 11:59pm on October 16th.

Table 2 Instantaneous high and low dBA readings during the 24-hour noise evaluation.

STN #	LOCATION	AVG (dBA)	HIGH (dBA)	LOW (dBA)	RANGE (dBA)	Centre Frequency (Hz)	Limits of Band (Hz)
1	Northern Boundary	61.7	92.3	52.9	39.4	50	45 - 56
2	Eastern Boundary	71.5	91.8	66.5	25.3	200	178 - 224
3	Southern Boundary	73.7	89.8	56.4	33.4	20	18 - 22
4	Western Boundary	75.8	98.5	52.6	45.9	20	18 - 22
5	HEART Trust NTA Rockfort VTC	65.7	95.8	57.3	38.5	50	45 - 56
6	D'Aguilar Road	54.4	90.7	42.6	48.1	50	45 - 56
7	17 ¾ Outlook Avenue	55.1	103.1	38.5	64.6	12.5	11 - 14

3.1 STATION 1

During the period, noise level at this station ranged from a low of 52.9 dBA to a high of 92.3 dBA. Average noise level L_{Aeq} for this period was 61.7 dBA (Figure 2).

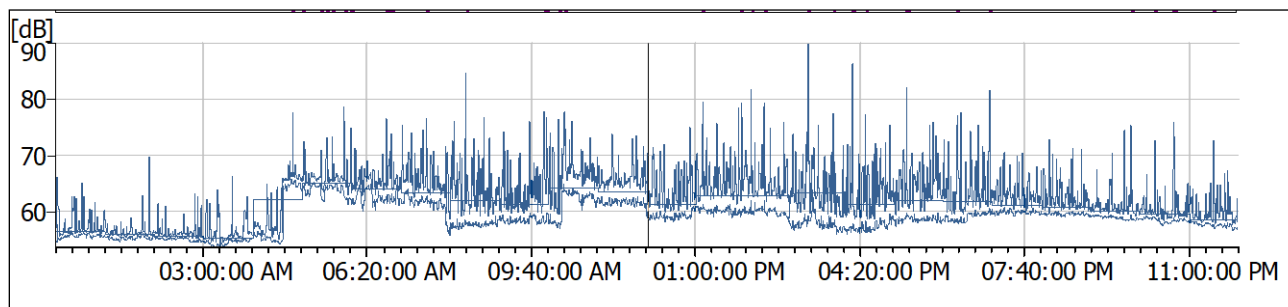


Figure 2 24-hour Average Noise Level plot at Station 1

3.1.1 Octave Band Analysis

The noise emitted at Station 1 was in the low frequency band centred around the geometric mean frequency of 50 Hz (octave frequency range 45 - 56 Hz) (Figure 3). There was also evidence of noise sources in the 25 Hz and 3.15 kHz frequency bands.

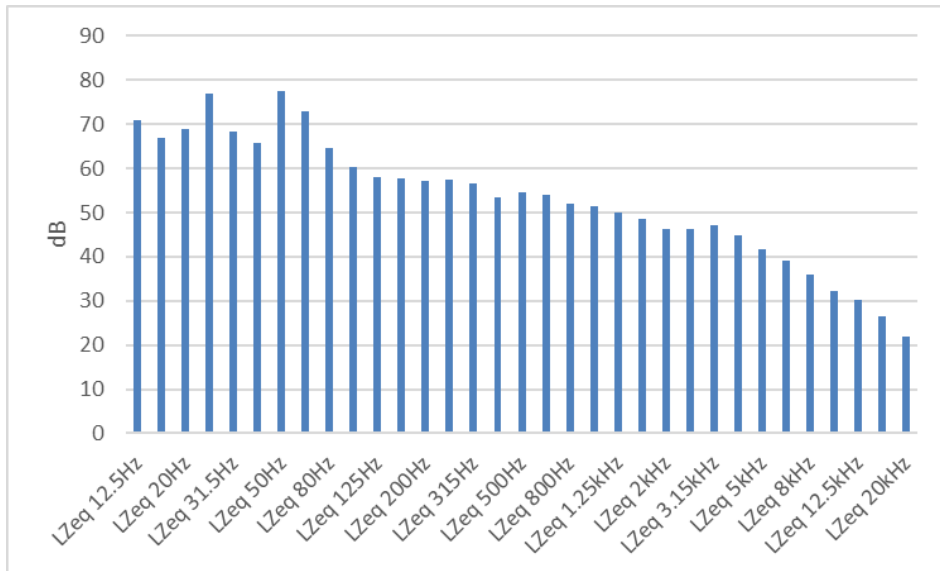


Figure 3 Octave band spectrum of noise emitted at Station 1.

3.1.2 Meteorological Data on plant

- Average temperature was 28.7 °C and ranged from a low of 25.8 °C to a high of 32.8°C.
- Average relative humidity was 69.7% and ranged from a low of 53.7% to a high of 78.6%.
- Average wind speed was 3.6 m/s and ranged from a low of 2.1 m/s to a high of 4.3 m/s.
- Dominant wind direction over the monitoring period was from the southeast.
- There was no measurable precipitation during the noise assessment.

Based on the meteorological data, this data was within the operating conditions for the noise meter of temperature of -10 – 50 °C and relative humidity 10 -90 %. The wind speeds were also within acceptable levels.

3.2 STATION 2

During the 24-hour period noise level at this station ranged from a low of 66.5 dBA to a high of 91.8.4 dBA. Average noise level L_{Aeq} (24h) for this period was 71.5.0 dBA (Figure 4).

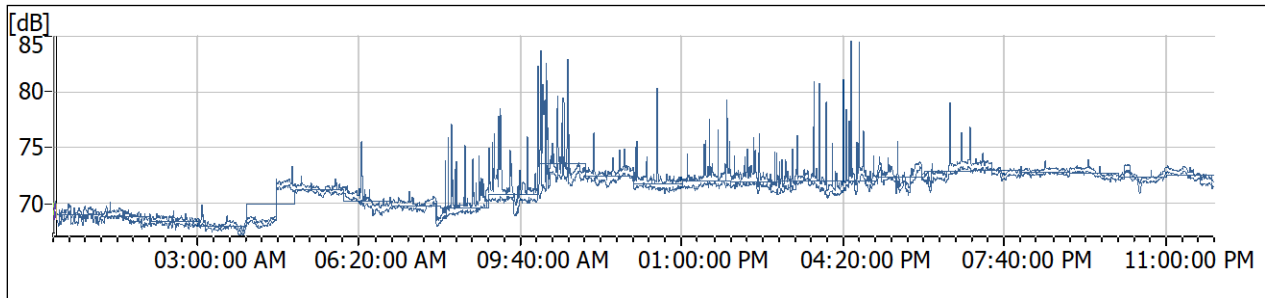


Figure 4 24-hour Average Noise Level plot at Station 2

3.2.1 Octave Band Analysis

The noise at Station 2 was in the low frequency band centred around the geometric mean frequency of 200 Hz (octave frequency range 178 – 224 Hz) (Figure 5). There was also evidence of noise sources in the 63 Hz frequency band.

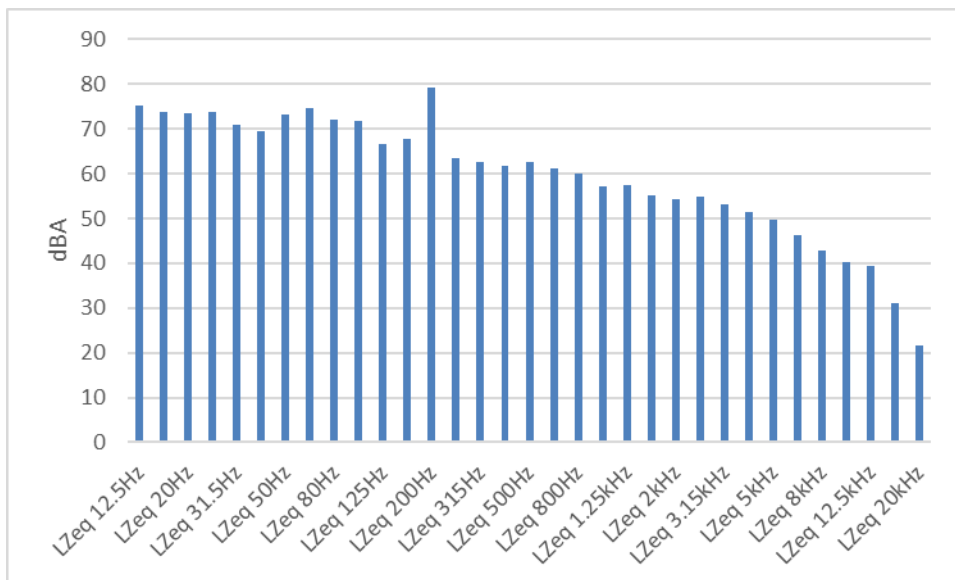


Figure 5 Octave band spectrum of noise emitted at Station 2

3.3 STATION 3

During the 24-hour period noise level at this station ranged from a low of 56.4 dBA to a high of 89.8 dBA. Average noise level L_{Aeq} (24h) for this period was 73.7 dBA (Figure 6).

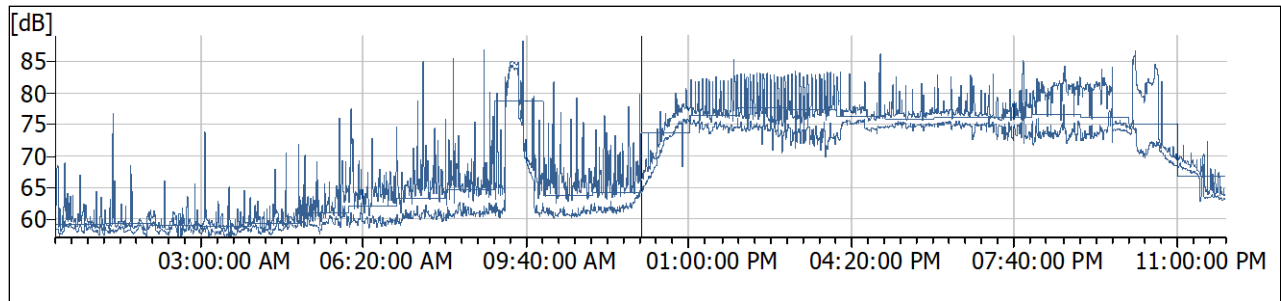


Figure 6 24-hour Average Noise Level plot at Station 3

3.3.1 Octave Band Analysis

The noise at Station 3 was in the low frequency band centred around the geometric mean frequency of 20 Hz (octave frequency range 18 – 22 Hz) (Figure 7). Although the noise is centred around the 20 Hz, there is evidence that there is some influence in the 50 Hz frequency band.

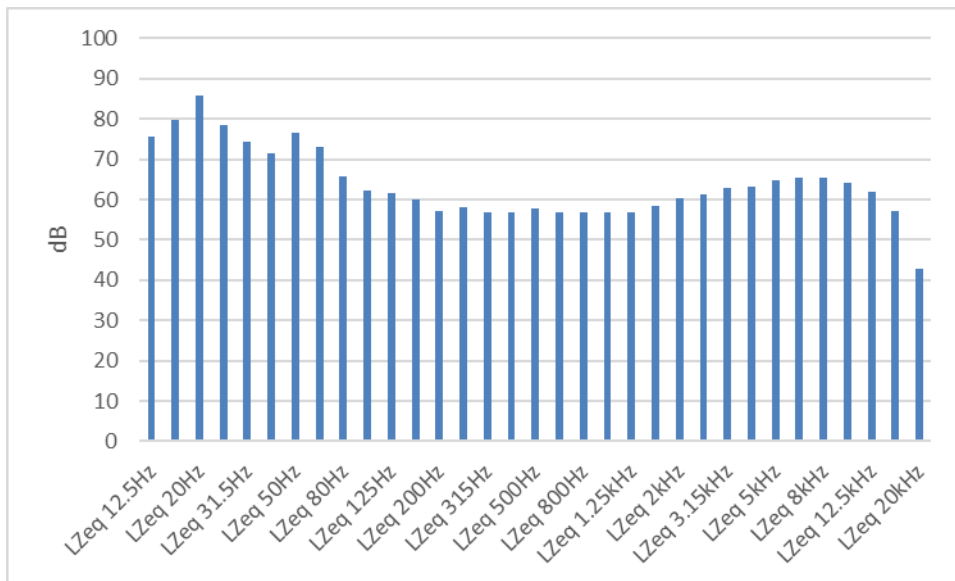


Figure 7 Octave band spectrum of noise emitted at Station 3

3.4 STATION 4

During the 24-hour period noise level at this station ranged from a low of 52.6 dBA to a high of 98.5 dBA. Average noise level L_{Aeq} (24h) for this period was 75.8 dBA (Figure 8).

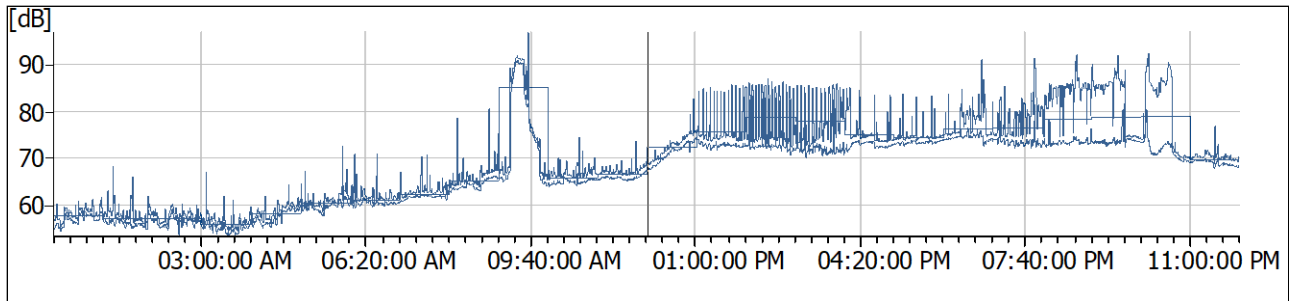


Figure 8 24-hour Average Noise Level plot at Station 4

3.4.1 Octave Band Analysis

The noise at Station 4 was in the low frequency band centred around the geometric mean frequency of 20 Hz (octave frequency range 18-22 Hz) (Figure 9). Although the noise is centred around 20 Hz, there is evidence that there is some influence in the 50 Hz and 63 Hz frequency bands.

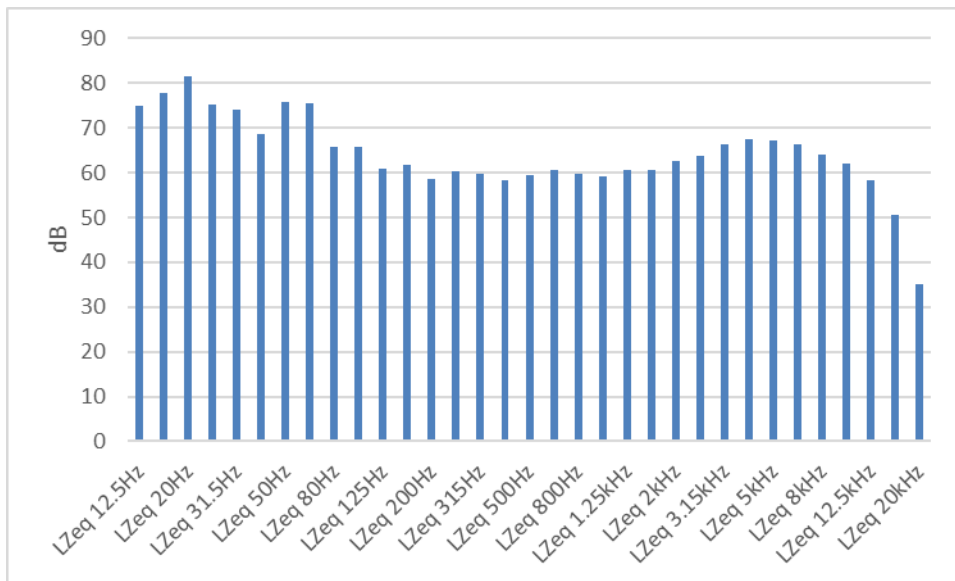


Figure 9 Octave band spectrum of noise emitted at Station 4

3.5 STATION 5

During the 24-hour period noise levels at this station ranged from a low of 57.3 dBA to a high of 95.8 dBA. Average noise level L_{Aeq} (24h) for this period was 65.7 dBA (Figure 10). The noise level at this station was non-compliant with the World Health Organization (WHO) guidelines of 50 dBA to prevent moderate annoyance and 55 dBA guideline to prevent serious annoyance.

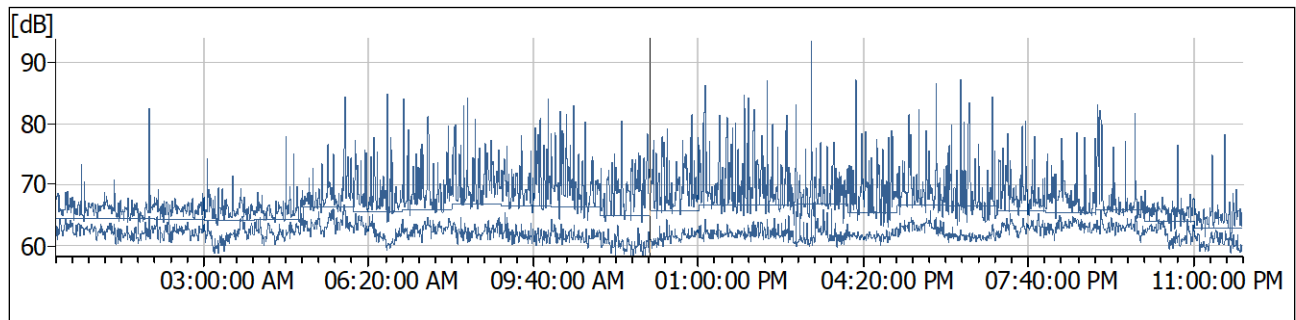


Figure 10 24-hour Average Noise Level plot at Station 5

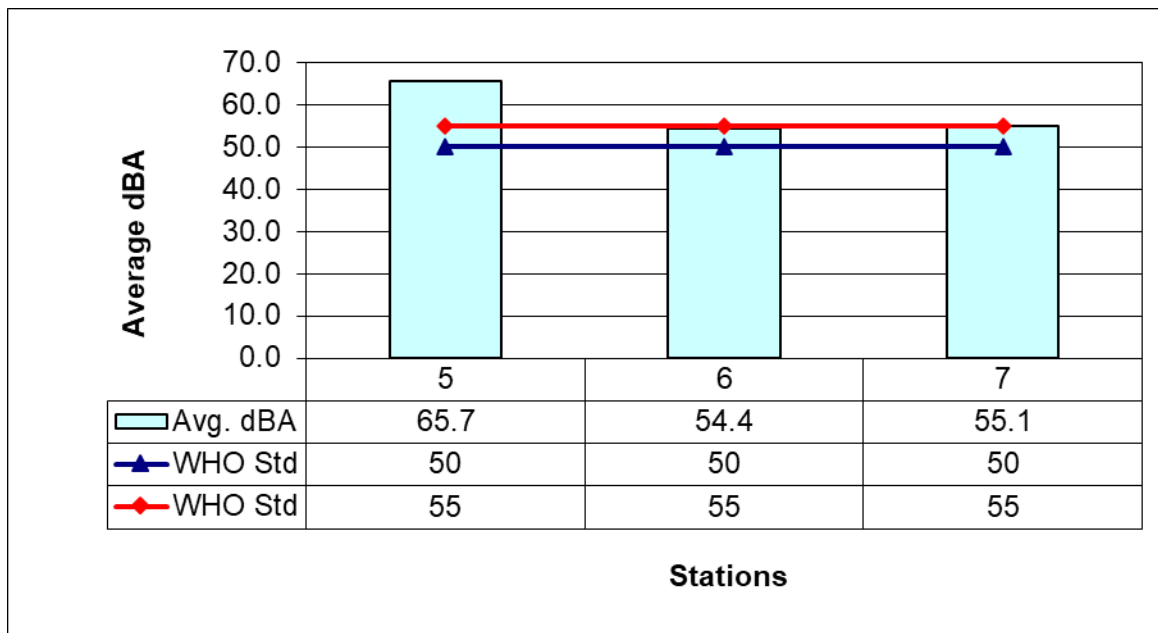


Figure 11 Comparison of average noise levels (24 hrs) (dBA) for Stations 5, 6 and 7 with World Health Organization Standards

3.5.1 Octave Band Analysis

The noise at Station 5 was in the low frequency band centred around the geometric mean frequency of 50 Hz (octave frequency range 45 - 56 Hz) (Figure 12). There was also evidence of noise sources in the 63 Hz and 1.25 kHz frequency bands.

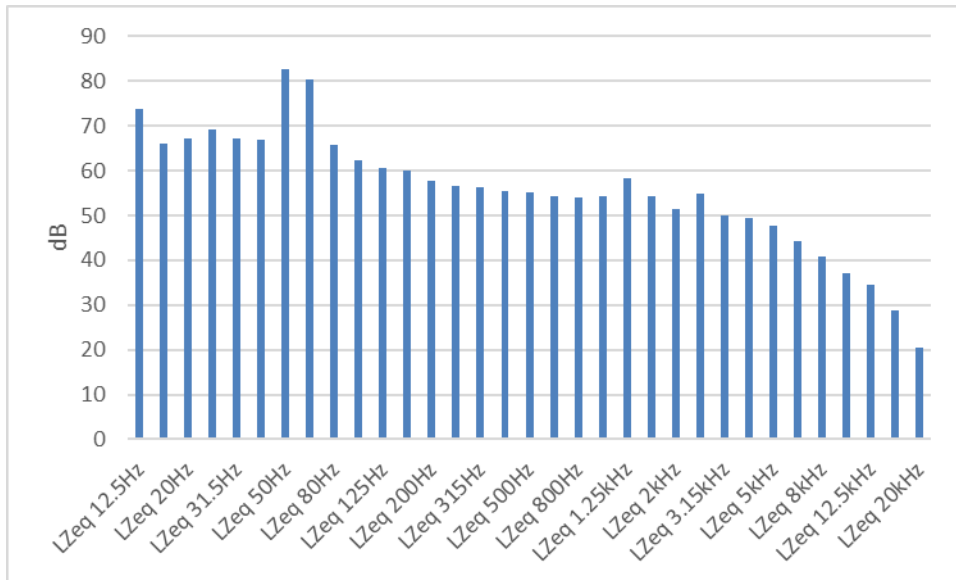


Figure 12 Octave band spectrum of noise emitted at Station 5

3.6 STATION 6

During the 24-hour period noise level at this station ranged from a low of 42.6 dBA to a high of 90.7 dBA. Average noise level L_{Aeq} (24h) for this period was 54.4 dBA (Figure 13). The noise level at this station was non-compliant with the World Health Organization (WHO) guidelines of 50 dBA to prevent moderate annoyance but compliant with the 55 dBA guideline to prevent serious annoyance.

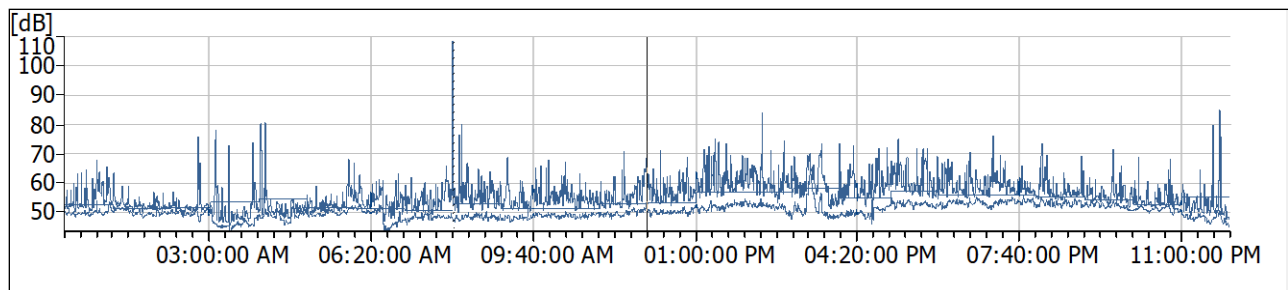


Figure 13 24-hour Average Noise Level plot at Station 6

3.6.1 Octave Band Analysis

The noise at Station 6 was in the low frequency band centred around the geometric mean frequency of 50 Hz (octave frequency range 45-56 Hz) (Figure 14). Although the noise is centred around the 50 Hz, there is evidence that there is some influence in the 63 Hz and 6.3 kHz frequency bands.

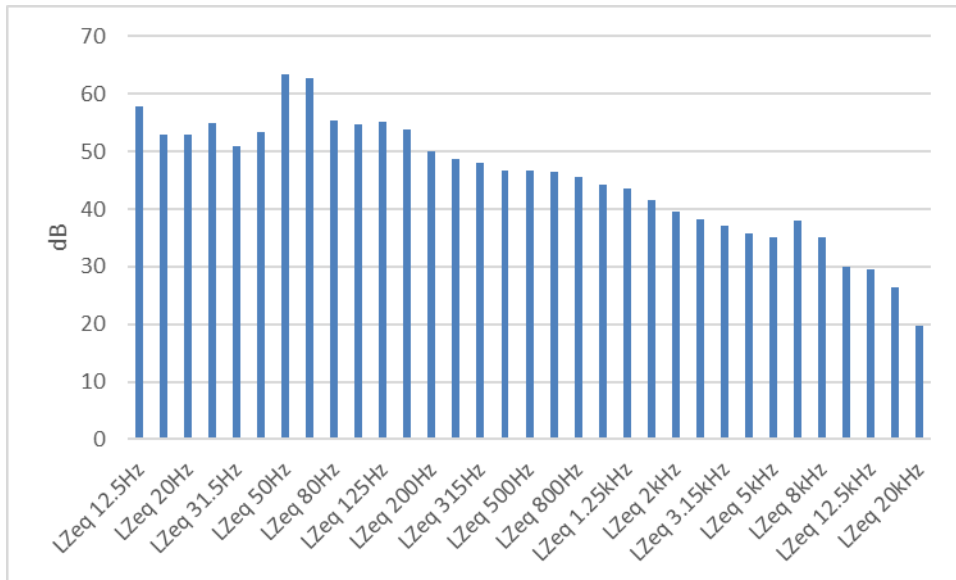


Figure 14 Octave band spectrum of noise emitted at Station 6

3.7 STATION 7

During the 24-hour period noise level at this station ranged from a low of 38.5 dBA to a high of 103.1 dBA. Average noise level $L_{Aeq}(24h)$ for this period was 55.1 dBA (Figure 15). The noise level at this station was non-compliant with the World Health Organization (WHO) guidelines of 50 dBA to prevent moderate annoyance and also slightly above the 55 dBA guideline to prevent serious annoyance.

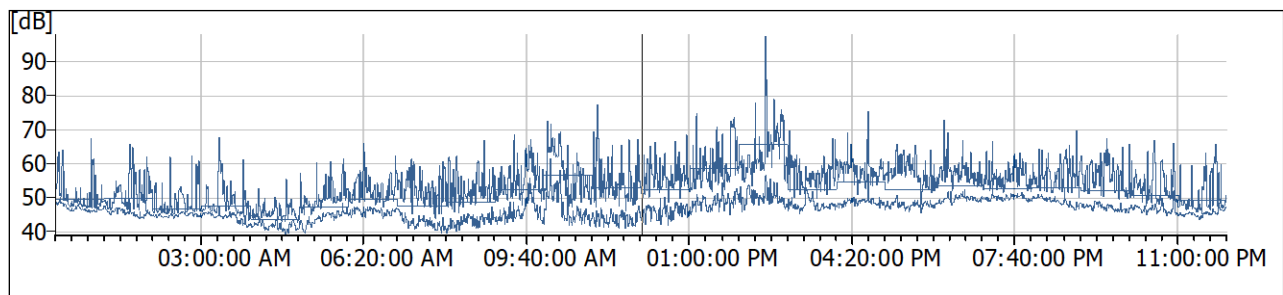


Figure 15 24-hour Average Noise Level plot at Station 7

3.7.1 Octave Band Analysis

The noise at Station 7 was in the low frequency band centred around the geometric mean frequency of 12.5 Hz (octave frequency range 11-14 Hz) (Figure 16). Although the noise is centred around the 12.5 Hz, there is evidence that there is some influence in the 50 Hz, 63 Hz, 500 Hz and 8 kHz frequency bands.

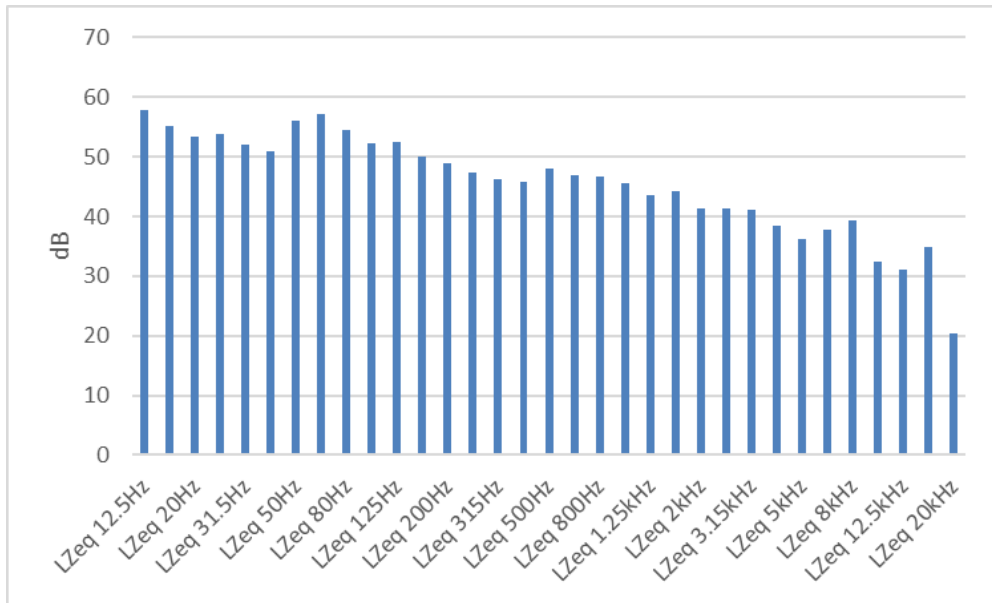


Figure 16 Octave band spectrum of noise emitted at Station 7

4.0 L10 and L90 NOISE STATISTICS

The two most common Ln values used are L10 and L90 and these are sometimes called the 'annoyance level' and 'background level' respectively. L10 is the sound level exceeded 10 percent of the time. This is a measure of the louder sound levels during the measurement period. It tends to represent the sporadic or intermittent noise events (high fluctuations). L90 denotes the sound level exceeded 90 percent of the time. It is a measure of the nominal background level. It represents what is considered the ambient noise at a location.

Table 3 below shows the L10 and L90 values for each station, as well as the 24-hour average noise level for comparative purposes. The L90 value (background noise level) for each station is lower than the corresponding 24-hour average noise level, which is expected. It is interesting to note that the three highest 24-hour average noise levels were attained at on-site Stations 4, 3 and 2 (in order from highest to lowest). However, when using the L90 value, which is a better indicator of nominal background noise level, the three highest noise levels were at Stations 2, 5 and 3 (in order from highest to lowest).

This L90 analysis shows that even though a location may have a high average noise level throughout a measurement period, it does not necessarily mean that this high noise level is maintained consistently throughout said measurement period. Sporadic spikes in noise levels (L10 value), will contribute to overstating the 24-hour average noise level.

Table 3 L10 and L90 noise values

STN #	LOCATION	L10 (dBA)	L90 (dBA)	24 hr AVG (dBA)
1	Northern Boundary	64.5	55.6	61.7
2	Eastern Boundary	72.9	68.4	71.5
3	Southern Boundary	76.4	58.7	73.7
4	Western Boundary	75.6	56.8	75.8
5	HEART Trust NTA Rockfort VTC	67.1	62.1	65.7
6	D'Aguilar Road	55.7	48.6	54.4
7	17 ¾ Outlook Avenue	55.0	44.7	55.1

It is interesting to note that Station 5 (HEART Trust NTA) had one of the highest L90 background noise levels, even higher than some stations on the plant. It is also interesting to note that the Station with the highest L90 value was Station 2 (eastern boundary), which is the station located closest to Station 5 (HEART Trust NTA). An analysis was therefore conducted to determine if noise from the plant may be impacting the HEART Trust NTA.

Hourly L90 noise levels were compared at Stations 2 and 5 based on plant output/generation every hour (Table 4). Noise levels at Station 2 were on average higher by 2.5 dB when the plant was on compared to when the plant was off. Noise levels at Station 5 were on average lower by 0.3 dB when the plant was on compared to when the plant was off. However, it is important to note than when the plant was at its highest generation capacity for the day (60% of total generation attained at 8:00pm), there was correlation in the L90 noise levels, in that both Stations 2 and 5 displayed their highest L90 noise levels at this time (8:00pm) (disregarding the Stn. 5 value of 63.58 dBA obtained at 5:00am). The noise meter at Station 5 also detected noise from the JPPC plant, as displayed by the noise signature. Even though there was correlation in this regard, there are other external factors contributing to elevated noise levels at Station 5 (HEART Trust NTA), such as anthropogenic noise sources detected (motor vehicle traffic noise, truck engine brakes and noise from JPS Rockfort Diesel Barge). The JPS Rockfort Diesel Barge is located approximately 220 metres south south west of Station 5 (HEART Trust NTA) and approximately 175 metres south south east of JPPC.

Table 4 L90 Noise Comparison between Stations 2 and 5

	DATE/TIME	Plant Output (Megawatt)	Hourly L90 (dBA)	
			STN 2 (Eastern Boundary of Plant)	STN 5 (HEART Trust)
PLANT OFF	16/10/2020 0:01	0	68.41	62.84
	16/10/2020 1:01	0	68.28	62.1
	16/10/2020 2:01	0	68.01	62.42
	16/10/2020 3:01	0	67.49	61.56
	16/10/2020 4:01	0	68.06	62.19
	16/10/2020 5:01	0	70.84	63.58
	16/10/2020 6:01	0	69.38	61.89
	16/10/2020 7:01	0	69.24	62.96
PLANT ON	16/10/2020 8:01	1.8	68.93	62.77
	16/10/2020 9:01	16.9	70.03	62.14

	DATE/TIME	Plant Output (Megawatt)	Hourly L90 (dBA)	
			STN 2 (Eastern Boundary of Plant)	STN 5 (HEART Trust)
	16/10/2020 10:01	22.8	71.6	62.03
	16/10/2020 11:01	23.4	71.94	60.67
	16/10/2020 12:01	25.5	71.33	61.83
	16/10/2020 13:01	30.5	71.55	62.31
	16/10/2020 14:01	33.2	71.26	62.05
	16/10/2020 15:01	34	71.24	61.5
	16/10/2020 16:01	34	71.03	61.61
	16/10/2020 17:01	34.2	71.35	63.23
	16/10/2020 18:01	36.9	72.1	61.61
	16/10/2020 19:01	40	72.42	63.1
	16/10/2020 20:01	41.3	72.53	63.26
	16/10/2020 21:01	38.3	72.24	63.02
	16/10/2020 22:01	34.2	71.87	61.72
	16/10/2020 23:01	27.3	71.84	60.56

5.0 COMPARISON WITH NATURAL RESOURCES CONSERVATION AUTHORITY (NRCA) PROPOSED GUIDELINES

The NRCA has two guidelines as it relates to noise levels. The first is designated occupational and the second environmental noise. Stations 1 to 4 were within the industrial zone. The environmental guideline is broken-down into zones and time periods (10 pm to 7 am and 7 am to 10 pm) for environmental noise (Table 5). Environmental noise guidelines include industrial, commercial, silence and residential noise.

For the purposes of this study, Station 5 is considered a silence zone (due to the presence of a school) and Stations 6 and 7 are considered residential areas.

During the daytime (7am – 10pm) industrial Stations 1 and 2 complied with NRCA guidelines of 75 dBA, however Stations 3 and 4 were non-compliant. During the night-time (10pm – 7am), industrial Stations 1 and 3 complied with the NRCA night guidelines of 70 dBA while Stations 2 and 4 were non-compliant.

The other off-site stations (Stations 5, 6 and 7) were non-compliant with the corresponding NRCA daytime and night-time guidelines except for Station 7, which was compliant with the corresponding night-time guideline of 50 dBA (Table 5).

While the majority of noise detected at the plant boundaries were attributed to plant operations, there was a lot of motor vehicle traffic noise detected at Station 3 and less so at Station 4. These included noises from trucks, motorcycles as well as truck engine brakes.

At the off-plant locations, noise detected which were above the NRCA daytime guideline included: persons talking, dogs barking, motor vehicle noises, power saw noises, sweeping, music from radio/television and noises from goats. Noise detected which were above the NRCA night time guideline included: crickets chirping, birds chirping, dogs barking, motor vehicle noises and music/sounds from television/radio.

Table 5 Comparison of average noise levels at the Stations with NRCA proposed noise guidelines.

STN #	ZONE	ACTUAL AVG. LEVELS (dBA) (7 am - 10 pm)	NRCA DAY STD. (dBA) (7 am - 10 pm)	ACTUAL AVG. LEVELS (dBA) (10 pm - 7 am)	NRCA NIGHT STD. (dBA) (10 pm - 7 am)
1	Industrial	62.2	75	60.8	70
2	Industrial	72.1	75	70.3	70
3	Industrial	75.3	75	66.9	70
4	Industrial	77.4	75	70.1	70
5	Silence	66.2	45	64.6	40
6	Residential	62.7	55	52.8	50
7	Residential	56.7	55	48.8	50

N/A – Not applicable

Values in red show non-compliance with NRCA day and/or night standards

6.0 COMPARISON WITH WORLD BANK GUIDELINES

Only Station 1 was compliant with the World Bank guidelines (property boundary) of 70 dBA. Stations 2, 3 and 4 were non-compliant. (Table 6 and Figure 17).

Table 6 Comparison of Stations 1-4 with World Bank Guidelines

STATION NUMBER	AVERAGE NOISE LEVEL (dBA)	WORLD BANK STD (dBA)
1	61.7	70
2	71.5	70
3	73.7	70
4	75.8	70

Values in red show non-compliance with World Bank Guideline

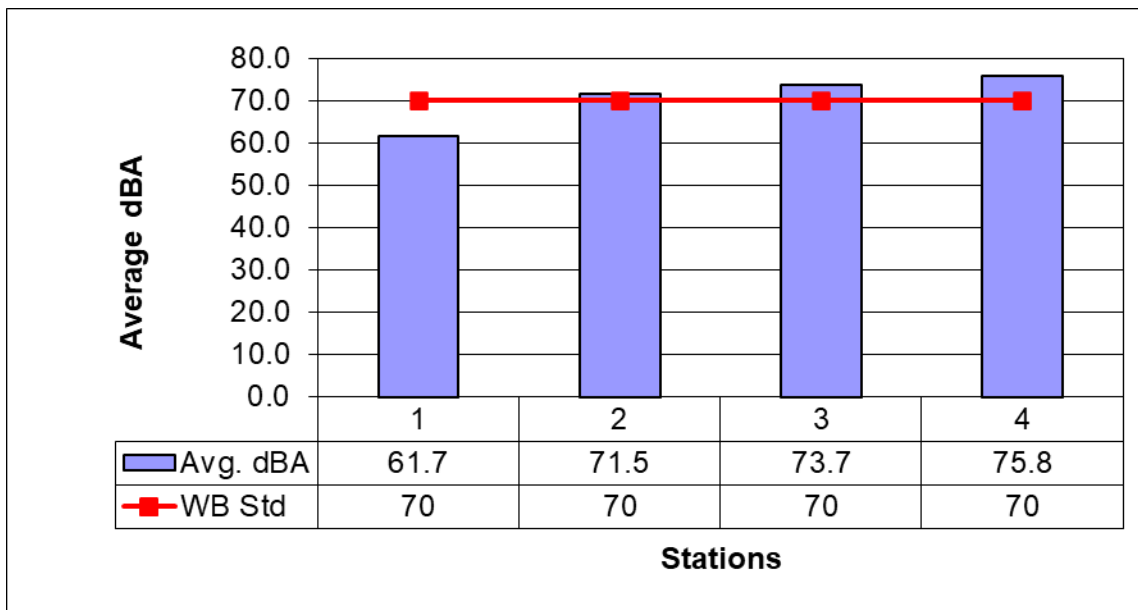


Figure 17 Comparison of noise emitted at Stations 1-4, to the World Bank Guidelines

The noise levels at Station 5 (66.2 dBA day, 64.6 dBA night) was non-compliant with the World Bank guidelines for educational facilities for both day (55 dBA) and night (45 dBA) respectively (Figure 18).

The noise levels at Station 6 (62.7 dBA day, 52.8 dBA night) and Station 7 (56.7 dBA day, 48.8 dBA night) were non-compliant with the World Bank guidelines for residential areas for both day (55 dBA) and night (45 dBA) (Figure 18).

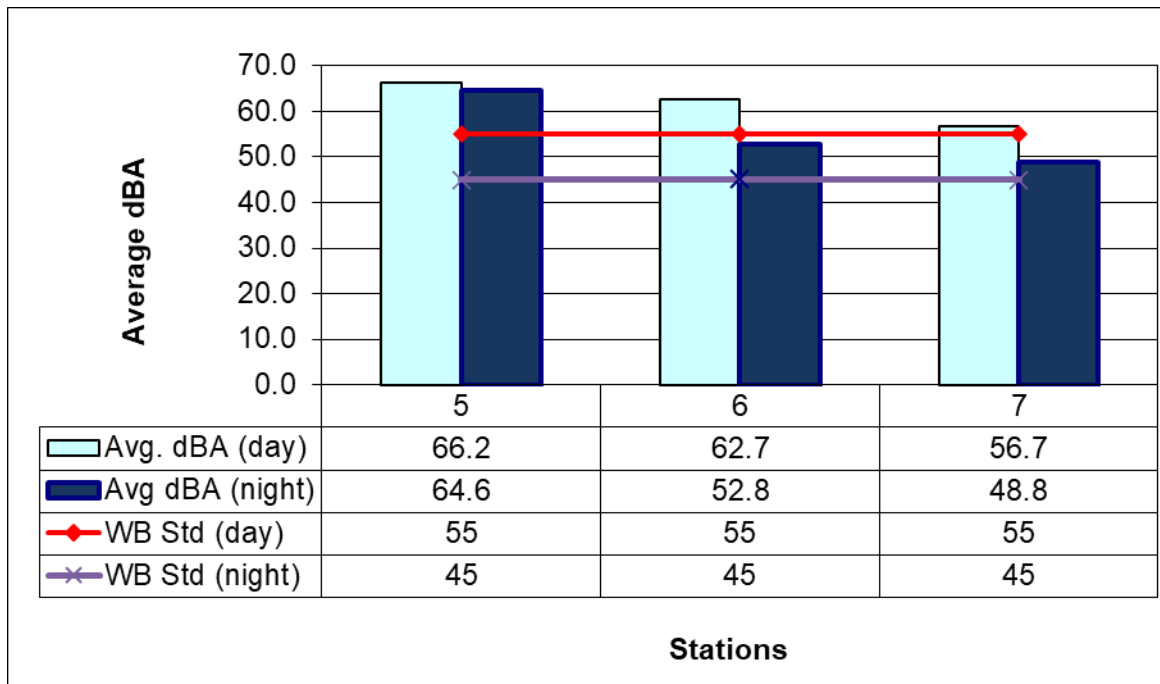


Figure 18 Graph depicting average dBA readings for off-site locations during the day and night compared to World Bank Guidelines

7.0 SIMPLE REGRESSION

There is an inverse relationship between sound level and distance. Using this fact, a graph was plotted showing stations with increasing distance from the perimeter fence of the JPPC power plant (Figure 19). The stations did not exhibit this relationship possibly due to anthropogenic noise sources at each of these off-plant noise monitoring locations. Noise detected at these off-plant locations, which were above the NRCA daytime guideline included: persons talking, dogs barking, motor vehicle noises, power saw noises, sweeping, music from radio/television and noises from goats. Noise detected which were above the NRCA night-time guideline included: crickets chirping, birds chirping, dogs barking, motor vehicle noises and music/sounds from television/radio.

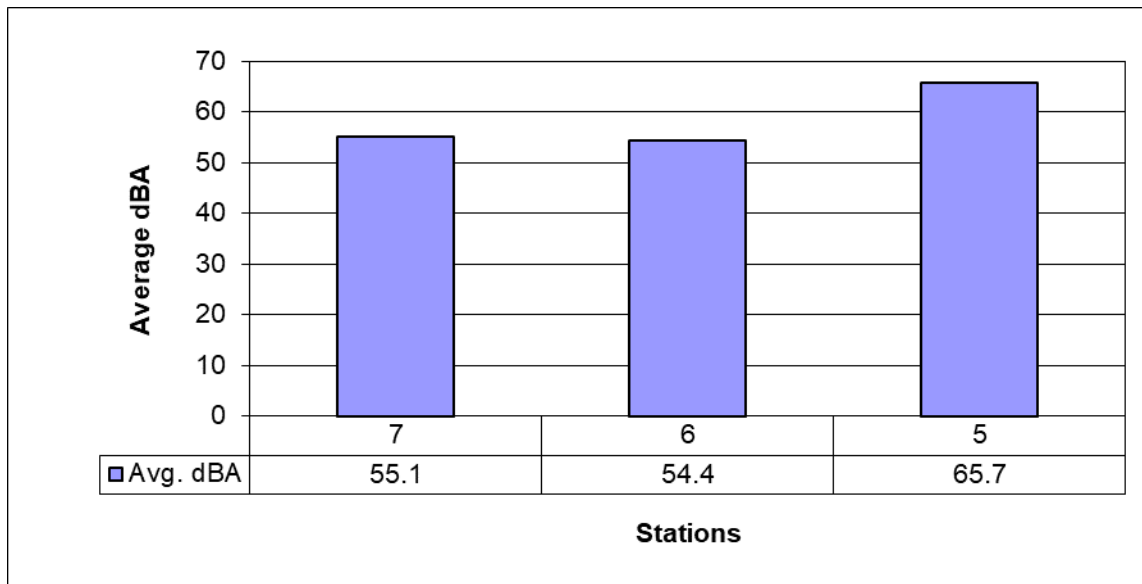


Figure 19 Noise level of stations with increasing distance from the JPPC power plant perimeter fence

8.0 CONCLUSIONS

The following conclusions were arrived at from the results of the noise evaluation at the JPPC power plant perimeter fence and environs.

- Only industrial Stations 1 and 2 were compliant with NRCA guidelines for day and Stations 1 and 3 were compliant with NRCA guidelines for night. The off-site stations (Stations 5, 6 and 7) were non-compliant with the respective NRCA day and night guidelines with the exception of Station 7, which complied with NRCA night guidelines.
- Only Station 1 was compliant with the World Bank guidelines of 70 dBA in the industrial locations (at the property boundaries).
- The noise levels at Stations 5 was non-compliant with the World Bank guidelines for educational facilities for both day (55 dBA) and night (45 dBA). The noise levels at Station 6 and 7 were non-compliant with the World Bank guidelines for residential areas for both day (55 dBA) and night (45 dBA).
- Noise at the monitoring stations were in the low frequency range, mainly centered around the geometric means of 12.5 Hz, 20 Hz, 50 Hz and 200 Hz.
- There wasn't a general decrease in sound pressure levels (dBA) from the perimeter of the plant due to these off-site stations being possibly impacted by other anthropogenic noise sources.
- Meteorological conditions were within the levels for the optimum performance of the noise meters.
- Dominant wind direction on-site (southeast) would put Station 6 (D'Aguilar Rd.) downwind of the plant while Stations 5 and 7 would remain unaffected during the noise assessment period.

9.0 PROFESSIONAL STATEMENT

Noise measured at off-site stations were not influenced exclusively by noise emissions from the JPPC Power Plant. All of the noise measured at the JPPC perimeter stations were in the low frequency range. At this frequency and level (dBL) most of the noise will be below the hearing threshold of most persons.

However, plant noise was detected at the HEART Trust NTA monitoring location. There was correlation in the high noise levels detected between the plant and HEART Trust NTA, when plant generation/output was at its highest for the monitoring period. Even though there was correlation in this regard, there are other external factors contributing to elevated noise levels at HEART Trust NTA, such as motor vehicle traffic noise, truck engine brakes and noise from JPS Rockfort Diesel Barge.

APPENDICES

APPENDIX 1 NOISE CALIBRATION CERTIFICATES

The Bruel and Kjaer Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: <http://www.bksv.com>



Calibration
Certificate
1568.01

CERTIFICATE OF CALIBRATION

No.: CAS-416103-L3Y8P3-403

Page 1 of 2

CALIBRATION OF:

Calibrator: Brüel & Kjær Type 4231 Serial No.: 3018640
IEC Class: 1

CUSTOMER:

CL Environmental
20 Windsor Avenue
5 Kingston Jamaica

CALIBRATION CONDITIONS:

Environment conditions: Air temperature: 23.4 °C
Air pressure: 98.698 kPa
Relative Humidity: 32 %RH

SPECIFICATIONS:

This document certifies that the acoustic calibrator as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Bruel and Kjaer Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants. The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær acoustic calibrator calibration application Software version 2.3.4 Type 7794 using calibration procedure 4231 Complete

RESULTS:

- "As Received" Data: Within Acceptance Criteria "As Received" Data: Outside Acceptance Criteria
 "Final" Data : Within Acceptance Criteria "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration: November 4, 2019

Certificate issued: November 4, 2019

Meshaun Hobbs

Calibration Technician

Quality Representative

Sound Pressure Levels

All stated values are valid at environmental reference conditions

Nominal Level [dB]	Accept Limit Lower [dB]	Accept Limit Upper [dB]	Measured Level [dB]	Measurement Uncertainty [dB]
94	93.80	94.20	93.98	0.12
114	113.80	114.20	113.97	0.12

Frequency

Nominal Frequency [Hz]	Accept Limit Lower [Hz]	Accept Limit Upper [Hz]	Measured Frequency [Hz]	Measurement Uncertainty [Hz]
1000	999.00	1001.00	999.97	0.10

Total Distortion*

Distortion mode: TD* THD*

Calibration Level [dB]*	Accept Limit [%]*	Measured Distortion [%]*	Measurement Uncertainty [%]*
94	1.00	0.55	0.13
114	1.00	0.33	0.13

Environmental Reference Conditions:

Pressure: 101.3 kPa, Temperature: 23 °C, Relative Humidity: 50%

Instrument List

Type	Description	Serial no	Cal. date	Due date	Calibrated by	Trace number
3560	PULSE Analyzer	2723320	2019-10-17	2020-10-31	JCA	CAS-413598-Q8W9Z2-101
9545	Transfer Microphone	3	2019-10-16	2020-10-31	MH	CAS-413598-Q8W9Z2-401
4228	Reference Sound Source	1610502	2019-04-05	2021-04-30	W.Shipman	CAS-375162-C8J4Z3-705

During the calibration the calibrator has been loaded by the load volume of the Transfer Microphone. The load volumes for a number of different types of Transfer Microphones are listed in the table below.
For Brüel & Kjær Pistonphones types 4220 and 4228 the result of the SPL calibration has been corrected to be valid for a load volume of 1333 mm³. For all other types the result is valid with the actual load volume.

Transfer Microphone Type	Fulfils standard IEC 61094-1 LS	Fulfils standard IEC 61094-4 WS	Load Volume 1" (1/2" mic including DP-0776)	Load Volume 1/2"
4180	yes	yes	1126 mm ³	43 mm ³
4192	-	yes	1273 mm ³	190 mm ³
9545	-	-	1333 mm ³	-

Condition "As Received":

Good

Comments

APPENDIX 2 PLANT GENERATION AND OUTPUT DATA (October 16, 2020)

Date	Hour	Dispatch	Engine#1	Engine#2	STG	SUT#1	SUT#2	Plant Load	Plant Output (MegaWatt)
16-Oct	0:00	0	0	0	0	0	0	0	0
16-Oct	1:00	0	0	0	0	0	0	0	0
16-Oct	2:00	0	0	0	0	0	0	0	0
16-Oct	3:00	0	0	0	0	0	0	0	0
16-Oct	4:00	0	0	0	0	0	0	0	0
16-Oct	5:00	0	0	0	0	0	0	0	0
16-Oct	6:00	0	0	0	0	0	0	0	0
16-Oct	7:00	0	0	0	0	0	0	0	0
16-Oct	8:00	1.8	2.61	0	0	1.8	0	0.81	1.8
16-Oct	9:00	26.02	17.86	0	0	16.9	0	0.96	16.9
16-Oct	10:00	52.04	23.92	0	0	22.8	0	1.12	22.8
16-Oct	11:00	52.04	24.42	0	0	23.4	0	1.02	23.4
16-Oct	12:00	52.04	24.33	2.02	0	25.5	0	0.85	25.5
16-Oct	13:00	52.04	24.17	7.87	0	30.5	0	1.54	30.5
16-Oct	14:00	52.04	24	10.89	0	33.2	0	1.69	33.2
16-Oct	15:00	52.04	23.17	12.65	0	34	0	1.82	34
16-Oct	16:00	52.04	20.71	15.08	0	34	0	1.79	34
16-Oct	17:00	52.04	18.07	17.88	0	34.2	0	1.75	34.2
16-Oct	18:00	52.04	18.02	20.57	0	36.9	0	1.69	36.9
16-Oct	19:00	52.04	18.46	23.43	0	40	0	1.89	40
16-Oct	20:00	52.04	19.44	23.78	0	41.3	0	1.92	41.3
16-Oct	21:00	52.04	18.03	22.11	0	38.3	0	1.84	38.3
16-Oct	22:00	34.2	16.69	19.27	0	34.2	0	1.76	34.2
16-Oct	23:00	26	14.86	14.06	0	27.3	0	1.62	27.3