



SPEIGHTSTOWN NOISE CHARACTERIZATION STUDY



PROJECT REPORT

Environmental Protection Department







ENVIRONMENTAL PROTECTION DEPARTMENT

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1.0 Glossary

- Decibel (dB): a unit of sound level
- L_{A10} : The sound level that was exceeded during 10% of the measuring time in dB(A).
- L_{A90} : The sound level that was exceeded during 90% of the measuring time in dB(A).
- L_{Aeq} : The continuous equivalent sound level which is the single sound pressure level (SPL) that, if constant over the stated measurement period, would contain the same sound energy as the actual monitored fluctuating sound level over the measurement period in dB(A).
- L_{Aday} – the L_{Aeq} during the day i.e. from 7am -7pm in dB(A).
- $L_{Aevening}$ - the L_{Aeq} during the evening i.e. from 7pm-11pm in dB(A).
- L_{Anight} - the L_{Aeq} during the night i.e. from 11pm to 7am in dB(A).
- L_{Amax} : The maximum sound pressure level (SPL) value measured during the duration of monitoring in dB(A).
- L_{Amin} : The minimum sound pressure level (SPL) value measured during the duration of monitoring in dB(A).
- Sound pressure level (SPL): A logarithmic measure of the effective sound pressure of a sound relative to a reference value. It is measured in decibels (dB) above a standard reference level.
- WHO: Acronym for World Health Organization.

2.0 Executive Summary

Speightstown, previously known as Little Bristol, was one of Barbados' major towns and is located along the north-west coast of Barbados. Within Speightstown was a central core or mixed use corridor where typical commercial facilities were located such as banking, shopping, restaurants, fish market, hotels/guest accommodation, doctors' offices, lawyers offices, pharmacies, gas station and mass transit/ bus terminals along with a police station, schools, and an array of cultural and natural heritage assets. Outside of the central core but within wider Speightstown were mostly residential/ hotel areas. Speightstown is approximately 1.5km² with a central core of about 0.19 km²¹. Traffic counts provided by the Ministry of Transport and Works indicated that 618 to 8875 vehicles passed through Speightstown's central core daily. The housing stock in and around Speightstown ranged from chattel houses to multi storey concrete houses.

The Environmental Protection Department (EPD) designed and implemented the Speightstown Noise Characterization Study in order to gather baseline data and characterize the sound levels which persons were exposed to while in/near Speightstown. This project focused on Speightstown's central core as this area would have the highest people counts and activity levels and should therefore provide the highest ambient sound levels for Speightstown as well as be the area where the highest number of persons that would be affected. Currently there is limited noise data on Barbados with most of the focus being on noise levels due to complaints and not the general noise climate. Similar studies have been done for Bridgetown (2012/2013) and Oistins (2017). The project involved surveillance of the activities carried out in the area, monitoring of sound levels, traffic counts, weather data collection, analysis of the data, writing of a final report and close out of project. The noise descriptors collected were on the A-scale, fast response: L_{A10} , L_{A90} , L_{Aeq} , L_{Amax} , L_{Aday} , $L_{Aevening}$ and L_{Anight} .

The monitoring locations used were Speightstown Fish Market, Pizza Man Doc, District E Police Station, Eddies Trading Co. Ltd., Northern Business Centre, and Port St. Charles.

¹Estimated using the National Physical Development Plan (Amended 2003) and Google Earth Pro

Some of the important findings and conclusions of the study were:

- In general the noise levels persons were exposed to while in Speightstown, at the sites monitored, were within World Health Organization (WHO) guidelines for community noise for industrial, commercial shopping and traffic areas. The WHO sets the noise limits for commercial areas such as Speightstown at $L_{Aeq} 70\text{dBA}$ over 24hrs and $L_{Amax} 110\text{dBA}$. For the six sites the L_{Aeq} ranged from 55 to 66 dBA and the L_{Amax} from 87 to 107dBA.
- The recorded sound levels however exceeded the guideline values for residential areas. For residential areas, WHO sets limits at L_{Aday} and $L_{Aevening}$ at 55dBA during the day/evening and L_{Anight} 45dBA during the night (World Health Organization:, 1999). Barbados' Cabinet adopted the WHO Guidelines for Community Noise as policy in 2007. For the sites close to residential areas- Pizza Man Doc, District E Police Station and Port St. Charles - the L_{Aday} and $L_{Aevening}$ values ranged from 53-65dBA and L_{Anight} from 48-57dBA. This was especially instructive as these locations were on the outskirts of residential areas. The lack of a buffer area between incompatible land uses could present a problem when comparing it to many international standards including the World Health Organization's Community Guidelines as they often do not account for mixed use areas but provide noise limits for individual zones/areas e.g. strictly residential or strictly commercial. It would therefore be prudent to manage the sound levels within Speightstown to prevent the WHO commercial noise limits from being exceeded as well as to prevent any further possible noise increases on residential areas that were nearby.
- The results indicated that the sites located along the main street, Queen's Street, namely the Speightstown Fish Market, Northern Business Centre and Pizza Man Doc had the highest sound levels and sites further away from the main street- Port St. Charles and District E Police Station- as expected had comparatively lower sound levels. This trend was expected as activity level and/or surrounding noise sources affect the sound levels. Visual inspection of the graphs in Appendix 2 revealed that the sound levels generally rose around 5-6 am and dipped between 8:30-10:00 pm depending on the location. The exception was Speightstown Fish Market where the sound levels were generally constant during the day or

night. This was likely due to the wave action as it was located near the sea.

- In Barbados Sundays are typically quiet and while this trend was generally noted at all the sites, the exceptions were the Speightstown Fish Market and Northern Business Centre. This suggests that the noise source(s)/activity levels near these sites were consistently present irrespective of the day or that if a noise source(s) are removed/reduced another source(s) with similar sound levels replaced them. For example the sea waves near Speightstown Fish Market would be a consistent source of noise irrespective of the day, thus resulting in the sound levels on Sundays being no different to any other day.
- Traffic noise was the main observed activity near the monitoring sites followed by people (talking, liming).
- The relationship between L_{Aeq} and traffic counts was investigated using Spearman's rank order correlation. At the Speightstown Fish Market there was weak to moderate, positive correlation between the two variables. At all the other locations- Pizza man Doc, District E Police Station, Eddies Trading, Northern Business Centre and Port St. Charles- there was strong, positive correlation between the two variables. The results from the Speightstown Fish Market site indicated that traffic was not the only significant contributor to the sound levels in that area. At the other locations there was a strong, positive correlation with traffic indicating that as traffic increased at those locations so did the sound levels. It should be noted that the above results only indicated if high traffic counts and high sound levels (or vice versa) tend to occur together. Whether this link was a direct link or indirect link was not investigated. For example, increased traffic counts could mean an increase in other sources of noise e.g. person related sounds and general business activity which could instead be the direct factor(s) for increased sound levels.

The following recommendations and critical assessment were made:

- *There should be an increased focus on gathering sound level data across Barbados as well as educating the public on the effects of noise.*
- *In order to maintain the sound levels in Speightstown at acceptable levels, future projects or programmes planned for Speightstown should take sound levels into*

consideration. Not only should existing receptors be considered but also the possible locations of future surrounding receptors. While it is difficult to give exact suggestions as it depends on factors such as the noise source, proximity of sensitive receptors, time of day that the high sound levels occur, some general noise management options are setting a minimum sound transmission class of building materials in Speightstown, restricting the number of dwellings and density in some areas, noise barriers/buildings, setting buffer areas, enforced cut off times for loud activities and setting up permanent monitoring stations .

- *Continuous control/ management of the traffic related sound levels within the town:* Currently the traffic counts in Speightstown were not overwhelming for the current road traffic arrangements. However as this can change with a new large scale development in the town or in the surrounding areas it was important to consider road network, parking space availability, location of mass transit routes and other issues which can affect traffic volumes or congestion. Other measures that can help control or manage road traffic noise are paving roads with noise dampening asphalt, maintaining the road surface, encouraging the use of quieter vehicles (e.g. with tax deductions, reduce importation taxes), discouraging the unnecessary use of vehicle horns and the use of electric powered buses.
- *Similar baseline data should be collected for other areas in Barbados.*
- *Depending on the purpose of the study/investigation, only areas where short-term sampling during the busiest/noisiest periods exceeds desired limits may require further long-term monitoring.* This could be part of the criteria for site selection, as it would increase the efficiency with which resources are used.
- *Further training and resources should be obtained for capacity building of the Environmental Protection Department and by extension Barbados.*

3.0 Introduction

Speightstown, previously known as Little Bristol, is one of Barbados' major towns and is located along the north-west coast of Barbados. According to the National Physical Development Plan (Amended 2003) Speightstown extended from the sea adjoining the north boundary of Cobblers Cove Hotel eastwards along the existing water course to the escarpment at approximately 30 metres elevation, then northwards along the escarpment to Retreat Hill Road, turning westwards along Retreat Road to its junction with Highway 1, then westwards to the sea (See Figure 1) (Government of Barbados, 2003).

Within Speightstown is a central core or mixed use corridor where typical commercial facilities were located such as banking, shopping, restaurants, fish market, hotels/guest accommodation, doctors' offices, lawyers offices, pharmacies, gas station and mass transit/ bus terminals along with a police station, schools, and an array of cultural and natural heritage assets. At the time of writing Speightstown could be characterized as a quiet northern town and it was noted in the National Physical Development Plan (Amended 2003) that "the growth of public transportation and highway improvements has reduced the dependence of northern parishes on Speightstown as a service centre" (Government of Barbados, 2003), the result being that persons opted to conduct their business elsewhere. Outside of the central core but within wider Speightstown were mostly residential areas/ hotel areas.

Speightstown is approximately 1.5km² with a central core of about 0.19 km²². Traffic counts provided by the Ministry of Transport and Works in 2018 indicated that 618 to 8875 vehicles passed through Speightstown's central core daily. The housing stock in and around Speightstown ranged from chattel houses to multi storey concrete houses.

The Environmental Protection Department (EPD) designed and implemented this Speightstown Noise Characterization Study in order to gather baseline data and characterize the sound levels which persons were exposed to while in/near Speightstown. Currently there is limited noise data on Barbados with most of the focus being on noise levels due to complaints and not the general noise climate. Similar studies had been done for Bridgetown (2012/2013)

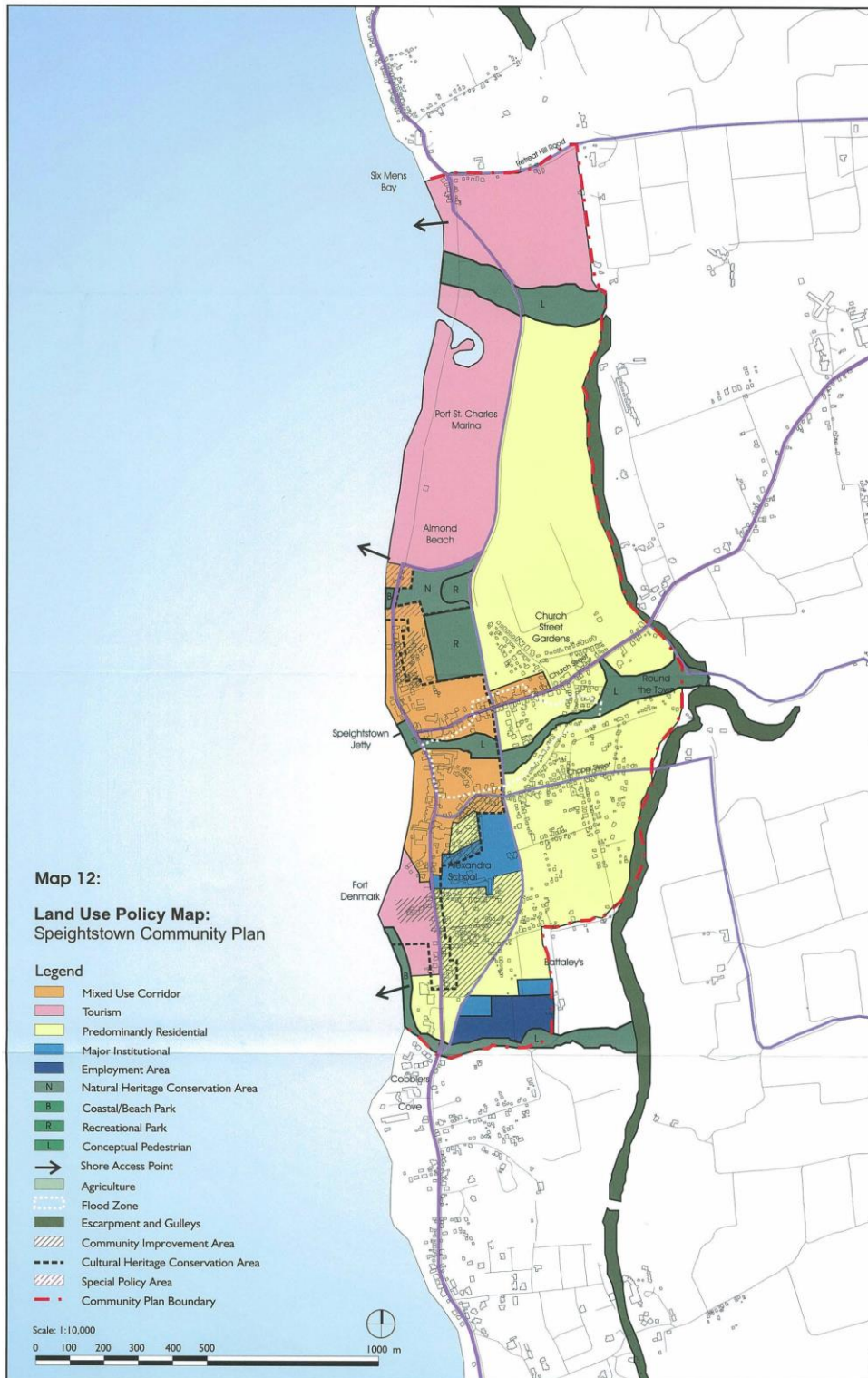
²Estimated using the National Physical Development Plan (Amended 2003) and Google Earth Pro

and Oistins (2017).

It is true that noise is subjective and often defined as “unwanted sound” (Cowan, 1994) resulting in it being difficult to set noise limits. According to the World Health Organization (WHO) Guidelines for Community Noise, exposure to high noise levels could lead to various health effects including temporary or permanent hearing loss, interference with speech communication, sleep disturbance as well as annoyance. WHO set the noise limits for commercial areas at $L_{Aeq} 70\text{dBA}$ over 24hrs and $L_{Amax} 110\text{dBA}$. For residential areas WHO sets limits L_{Aday} and $L_{Aevening}$ at 55dBA during the day and evening (16hrs) and $L_{Aeq} 45\text{dBA}$ during the night (8hrs). Further WHO advised that in order to avoid hearing impairment, noise exposures should never exceed 140dB for adults and 120dB for children (World Health Organization, 1999). Barbados’ Cabinet adopted the WHO Guidelines for Community Noise as policy in 2007.

This project focused on Speightstown’s mixed use area shown in Figure 1 below, since this area would have the highest people counts and activity levels and should provide the highest ambient sound levels for Speightstown as well as the highest number of persons that should be affected. The central core encompassed the commercial entities. The wider Speightstown area encompassed all the coloured areas on the map.

Figure 1: Map of Speightstown



Source: National Physical Development Plan (Amended 2003) *(not to scale)

The monitoring locations used were Speightstown Fish Market, Pizza Man Doc, District E Police Station, Eddies Trading Co. Ltd., Northern Business Centre, and Port St. Charles. The project involved surveillance of the activities carried out in the area, monitoring of sound levels, traffic counts and weather conditions, analysis of the data, writing of a final report and close out of project. This document was the final report for the project.

Goal and Objectives

The goal of this project was to characterize the sound environment of Speightstown's central core.

This goal was broken down into the following research questions:

1. What were the noise descriptors at the monitoring sites during 24hr monitoring?
($L_{Aeq,15min}$, $L_{A10,15min}$, $L_{A90,15min}$, $L_{Amax,15min}$)
2. What were the major sources of noise identified?
3. How did the recorded noise levels compare with WHO guidelines?
4. Were the twenty-four (24hr) sound levels on Sundays statistically different to those recorded on other days of the week?
5. Was there a correlation between the traffic counts and the noise levels recorded?

Scope

The assessment focused on:

- Recording, analysing and reporting the sound levels (A-scale: L_{A10} , L_{A90} , L_{Aeq} , L_{Amax} ,) at the monitoring sites within Speightstown during the period 7th Feb to 12 April, 2018. L_{Aday} , $L_{Aevening}$, L_{Anight} were also recorded though not part of the original project scope.

The assessment did **not** focus on:

- Other sections of Speightstown that were outside of the core
- Other possible noise descriptors
- Other time periods
- Workplace noise, as it was not under the purview of the Environmental Protection Department
- Indoor noise e.g. inside the receptors house/building

Limitations, Assumptions and Risks

The following limitations, assumptions and risks were inherent to the project:

Assumptions

- The period of monitoring produced data that was representative of typical sound levels in Speightstown.

Limitations

- The staff assigned to conduct the project had other substantive tasks and this led to time constraints due to increased workload in those areas. This could result in delays or rescheduling the monitoring period for a site.
- Any unusual, noisy events or activities occurring near the monitoring site would skew the results. Random visits during the monitoring period to each site were conducted in an effort to identify any such occurrences and make any necessary changes to the monitoring (e.g. monitor on another day).

- Noise readings should not be taken during heavy rain or high winds above 5m/s. Additional contingency days were added to the schedule as rain can prevent monitoring. Wind speeds and humidity were noted.
- The availability of suitable, secure locations with flat roofs was a challenge as typical Barbadian residential homes and most buildings were not built with flat roofs. As a result, 24hr monitoring within a residential area was not conducted as a suitable location was not identified.

Risks

- Insufficient resources to conduct all the activities of the project. This did not occur but had it occurred the scope would have been adjusted appropriately.
- Damage to equipment e.g. lightning or rain, vandalization or malfunction. The equipment was insured and the Royal Barbados Police Force was notified of the project. If damage occurred the scope of the project would be adjusted and/or the option of sourcing alternative equipment considered.

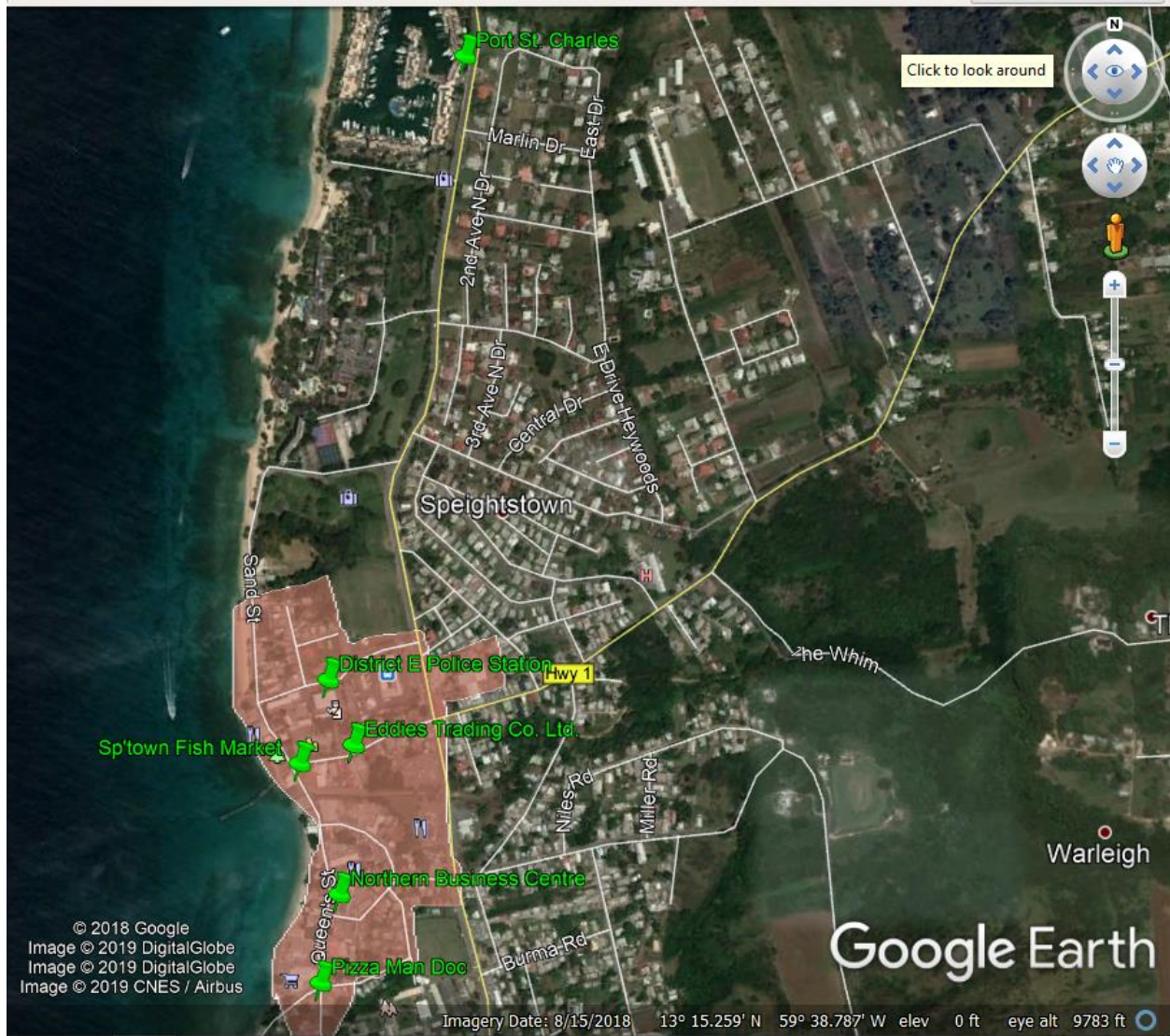
4.0 Study Area

Speightstown is one of Barbados' major towns and was located along the north-west coast of Barbados and is approximately 1.5km² with a central core of about 0.19 km² ³. Within Speightstown was a central core or mixed use corridor where typical commercial facilities were located such as banking, shopping, restaurants, fish market, hotels/guest accommodation, doctors' offices, lawyers offices, pharmacies, gas station and mass transit/ bus terminals along with a police station, schools, and an array of cultural and natural heritage assets. At the time of writing Speightstown could be characterized as a quiet northern town. Outside of the central core but within wider Speightstown were mostly residential areas/ hotel areas. The housing stock in and around Speightstown ranged from chattel houses to multi storey concrete houses. Traffic counts provided by the Ministry of Transport and Works indicated that 618 to 8875 vehicles passed through Speightstown's central core daily.

The six monitoring locations selected for twenty-four hour (24hr) monitoring were Speightstown Fish Market, Pizza Man Doc, District E Police Station, Eddies Trading Co. Ltd., Northern Business Centre, and Port St. Charles (See Figure 2). The list of the contact persons and contact information for the sites was in Appendix 3. The description and pictures of the monitoring locations are provided below.

³Estimated using the National Physical Development Plan (Amended 2003) and Google Earth Pro

Figure 2: Aerial Map Showing Monitoring Sites and the Speightstown Core Area*



Legend Speightstown central core area

*sketch of Speightstown core area as delineated in Barbados' Physical Development Plan (2003)

Speightstown Fish Market

The Speightstown Fish Market is a typical fish market where processing and sale of fish occurred. It is located on the seaward side of Queen's Street and an esplanade is also near the establishment. Formally the Physical Development Plan of Barbados (2003) zoned the area as a Recreational Park. The daily traffic counts on the nearby road, Sand Street, ranged from 2362 to 3190. The GPS coordinates were N 13 15.029, W 59 38.639. Monitoring occurred at this site

from 7th to 13th February, 2018.

The microphone was placed in the corner of a large, uncovered, upper level deck to the front of the property. The deck was 4.7m above ground level and the microphone was 1.4 m above the floor of the deck which was accessible by interior stairs. The nearest reflecting surface (wall of the building) was 2m away from the microphone. Pictures of the building as well as the monitoring equipment on the deck of the building were shown in Figure 3.

Figure 3: Speightstown Fish Market



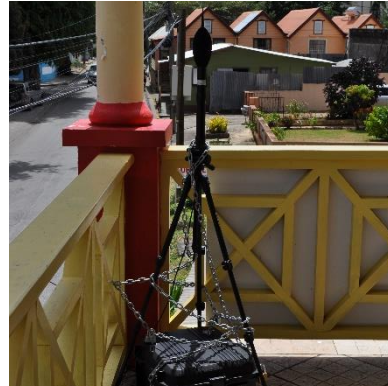
Pizza Man Doc

Pizza Man Doc is a commercial building along Queen's Street which housed a pizza restaurant as well as a few other shops. Surrounding this site is Alexandra Secondary School, a supermarket, a mall, other stores and houses. It is located towards the southern end of the mixed use corridor. And as it is next to a major institutional zone as well as a tourism/residential area it could give an idea of the sound levels experienced in those areas. The traffic counts on the nearby road, Queen's Street, ranged from 2321 to 3699. The GPS coordinates are N 13 14.836, W59 38.617. Monitoring occurred at the site from 16th – 21st February, 2018.

The microphone was placed in the corner of a large, covered, upper level patio to the front of the property. The patio was 3.8m above ground level and the microphone was 1.4 m above the floor of the patio which was accessible by exterior stairs. The nearest reflecting surface (wall of the building) was 2m away from the microphone. Pictures of the building as well as the monitoring equipment on the deck of the building are shown in

Figure 4.

Figure 4: Pizza Man Doc



District E Police Station

District E Police Station is a typical satellite police station located within the Speightstown mixed use corridor and is surrounded by a bus terminal, residences, the defunct Alma Parris Memorial Secondary School and a recreational area/pasture. The traffic counts on the nearby road, Major Walk, ranged from 618 to 1309. The GPS coordinates are N 13 15.114 W 59 38.624. This location was monitored from 24th February- 3rd March 2018.

The sound level meter was set up on the green area at the front of the police station. The microphone was at a height of 1.25 m above the ground level and 12.7m away from the nearest reflective surface. Pictures of the building as well as the monitoring equipment are shown in Figure 5.

Figure 5: District E Police Station

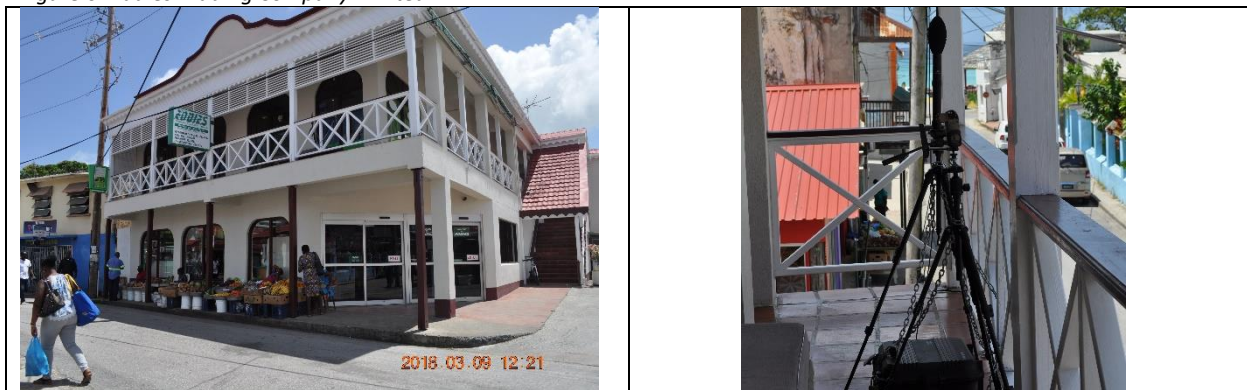


Eddies Trading Co. Ltd

Eddies Trading Co. Ltd is mainly a supermarket but there were also offices and a hairdresser housed in the same building. It is located on Church Street and is approximately in the middle of Speightstown’s mixed use corridor, surrounded by commercial shops and street vendors. The traffic counts on the nearby road, Church Street, ranged from 1292 to 2327. The GPS coordinates are N 13 15.050, W59 38.591.

The building has a narrow, upper level patio which was accessible via an external staircase. The patio was approximately 9m above the ground and the microphone was placed 1.5m above the floor and 1m from the nearest reflective surface. This site was monitored from 6th -12th March 2018. Pictures of the building as well as the monitoring equipment on the roof of the building were shown in Figure 6.

Figure 6: Eddies Trading Company Limited



Northern Business Centre

Northern Business Centre is a commercial building along Queen’s Street that housed an art gallery, stores and offices. This area is an active area of Speightstown. Surrounding Northern Business Centre was a bank, post office, street side vendors and stores. It is situated towards the mid to southern end of the Speightstown mixed use corridor. The traffic counts on the nearby road, Queen’s Street, ranged from 2528 to 4610. The GPS coordinates were N 13 14.916, W 59 38.611. Monitoring occurred at the site from 17th – 24th March, 2018.

The microphone was placed in the corner of a small, covered, upper level patio to the front of the property. The deck was 3.9m above ground level and the microphone was 1.7 m above the floor of the deck which was accessible by interior stairs. The nearest reflecting surface (wall of the building) was 0.65m away from the microphone. It was true that this site was less than optimum in terms of the proximity of the microphone to nearest reflecting surfaces, however it was the best possible site identified within this active area of Speightstown. Pictures of the building as well as the monitoring equipment on the deck of the building are shown in Figure 7.

Figure 7: Northern Business Centre



Port St. Charles

Port St. Charles is a multi-acre, luxury villa/marina resort where sea vessels docked and persons lived. The resort is located on the seaward side of Highway 1B and is within wider Speightstown but just outside of the mixed use corridor. The area was zoned “Tourism” according to the Physical Development Plan of Barbados (2003). Though not within the residential area as it is a villa/marina where persons lived it was deemed a suitable residential area surrogate for Speightstown. Surrounding the resort are the sea, Highway 1B and residences. It is situated towards to the north of Speightstown and the traffic counts on the nearby road, Highway 1B, ranged from 6780 to 8875. The GPS coordinates are N 13 15.665, W59 38.491. Monitoring occurred at the site from 27th March- 11th April, 2018.

The microphone was placed on an uncovered, upper level deck to the front of the property. The deck was approximately 9.7m above ground level and the microphone was 1.5 m above the floor of the deck which was accessible by interior stairs. The nearest reflecting surface (wall of the building) was over 5m away from the microphone. Pictures of the building as well as the monitoring equipment on the deck of the building are shown in Figure 8

Figure 8: Port St. Charles



Summary of monitoring sites

Table 1 below summarizes the characteristics of the monitoring sites used in this study.

Table 1: Summarized characteristics of the monitoring sites

Monitoring site	Brief description	Monitoring period	Physical Development Plan of Barbados (2003) Zone
Speightstown Fish Market GPS coordinates: N 13 15.029 W 59 38.639	A typical fish market where processing and sale of fish occurred.	7 th to 13 th February, 2018	Mixed use corridor
Pizza Man Doc GPS coordinates: N 13 14.836 W59 38.617	A building which housed a pizza restaurant as well as a few other stores.	16 th – 21 st February, 2018.	Mixed use corridor (and adjacent to a major institutional area and tourism/residential area)
District E Police Station GPS coordinates: N 13 15.114 W 59 38.624	Typical satellite police station with a secure, ground level area at the front of the building.	24 th February-3 rd March 2018.	Mixed use corridor
Eddies Trading Co. Ltd. GPS coordinates: N 13 15.050 W59 38.591	A complex which was largely occupied by a supermarket and associated activities (e.g. the office and storage). There was also a hairdresser in the building.	6 th -12 th March 2018.	Mixed use corridor
Northern Business Centre GPS coordinates: N 13 14.916 W 59 38.611	A mall which housed stores as well as an art gallery and offices.	17 th – 24 th March, 2018.	Mixed use corridor
Port St. Charles GPS coordinates: N 13 15.665 W59 38.491	A luxury villa/marina where sea vessels docked and person lived.	27 th , 28 th Mar 6 th -9 th , 12 th April, 2018	Tourism

5.0 Methodology

Monitoring of the general noise climate of Speightstown involved unattended monitoring at

six receptor sites – District E Police Station, Eddies Trading Co. Ltd., Speightstown Fish Market, Northern Business Centre, Pizza Man Doc and Port St. Charles. In addition to gathering sound level data, meteorological data, traffic counts and activity surveillance data were collected. Bruel & Kjaer 2270 sound level meters (Type 1) and Kestrel 5500 weather meter were used during monitoring. Further details on the equipment used were in Appendix 5.

Project planning included identification of potential locations, preliminary talks with prospective owners, final selection of locations, preparation of lists (checklists, contact lists, schedules), preparation for monitoring, equipment test runs and engaging other stakeholders as required (e.g. Ministry of Transport and Work, Royal Barbados Police Force).

The measurement methodology was based primarily on ISO 1996-2: 2007 Acoustics – Description and measurement of environmental noise. The sites were selected using the following criteria:

- Representation of different zones: It was desired to have at least one of each type of major zone represented (e.g. mixed use corridor, tourism, residential and major institutional).
- The activity within the mixed corridor was generally homogenous.
- The suitability of a site taking into account factors such as security, accessibility, roof type and roof height.
- Expected degree of stakeholder interest: Noise levels in some areas such as Queen’s Street and Church Street were anticipated to be of interest to stakeholders as these were areas many persons traversed and hence would be impacted by the sound levels in those areas.

The monitoring techniques employed during monitoring were as follows:

- In general the microphone was positioned 3m-11m above the ground, 1.2m-1.5m above the floor level and at least 3.5m away from any reflecting structure other than the ground. It was noted that the optimal microphone position was not achieved at all sites.
- A windscreen was used during monitoring.

- The fast weighting was used when taking the measurements.
- It was preferred that the wind speed was between 1 and 5m/s, measured at a height of 3m to 11m above the ground and there was no heavy precipitation.
- In-field calibration was done twice weekly.

The noise descriptors collected were on the A-scale, fast response: L_{A10} , L_{A90} , L_{Aeq} , L_{Amax} , L_{Amin} , L_{Aday} , $L_{Aevening}$, L_{Anight} . L_{Aday} , $L_{Aevening}$ and L_{Anight} , three metrics outside the original scope of the project, were collected during monitoring and were the L_{Aeq} for the periods 7:00 -19:00 (day), 19:00-23:00 (evening) and 23:00-7:00 (night) respectively. These values would be particularly important for residential areas as there are different sound level limits for different times of the day in such areas. As no suitable residential sites were identified during the project these metrics were not in the original project scope. However as it was noted that Pizza Man Doc, District E Police Station and Port St. Charles were near to residences these metrics were reported.

An external power supply (12V) was used as the primary power supply with the sound level meter's internal batteries as a backup. The portable noise monitoring option –Type 3571 outdoor monitoring kit was used as this was an enclosure designed to facilitate outdoor monitoring over long periods.

Surveillance of the activities occurring at each site was done from June 2017 to April 2018 in order to identify the potential sources of noise. Each day of the week was assessed during the day and at night at each site.

The meteorological data was obtained using a Kestrel 5500 weather meter set up next to the microphone. The meteorological data collected were temperature, wind direction, wind speed, relative humidity, barometric pressure and cloud cover. Other data collected during the project included the type of instrumentation used, start and stop times, GPS location,

description of any source(s) of noise and the type of area or zone. The survey form used to record the data is shown in Appendix 4.

At EPD's request, the Ministry of Public Works and Transport placed traffic counters on the roads near to the monitoring sites. The schedule outlining when the traffic counters were deployed at the various locations is shown in Appendix 6. The Royal Barbados Police Force (RBPF) was informed of the project, monitoring locations and their assistance in security surveillance was requested.

The collected data was analyzed using SPSS Statistics and Microsoft Excel. The aerial maps were produced using Google Earth.

6.0 Results

What were the weather conditions during monitoring?

“The data collected indicated that in general the wind speeds varied from 0 to 7.6 m/s, the temperature ranged from 21 to 35.3°C, relative humidity from 46.4% to 100% and atmospheric pressure from 1032.5 to 1006.5mbar during monitoring “

Localized meteorological data was collected using the Kestrel 5500 weather monitor. This was in accordance with ISO-1996: 2007, which required that wind speed, temperature, relative humidity and atmospheric pressure be recorded during monitoring.

The standard indicated that the wind speed should be between 1 to 5 m/s during monitoring. For all sites, the wind speed ranged from 0 to 7.6 m/s with the average daily wind speed ranging from 0.3 to 2.3 m/s. As wind speed cannot be controlled a windscreen was used during monitoring to reduce the effect on the sound level due to the wind. The standard also indicated that there should be no heavy rainfall during monitoring. EPD did not have a rain gauge so reports from persons at the sites were used. If there were reports of a significant volume of rain the data from those days were not used. As a contingency extra monitoring days had been included at each site to accommodate heavy rainfall. The meteorological conditions for each site are in Appendix 1.

What were the noise descriptors for the monitoring sites during 24hr monitoring?

“For the six sites the L_{Aeq} ranged from 55 to 66 dBA, the L_{A10} from 56 to 69dBA, the L_{A90} ranged from 34 to 55dBA, the L_{Amin} from 29 to 47dBA, and the L_{Amax} from 87 to 107dBA.”

The daily noise descriptors for the six sites used (Speightstown Fish Market, Pizza Man Doc, District E Police Station, Eddies Trading Co. Ltd., Northern Business Centre, Port St. Charles) for twenty-four hour (24hr) monitoring were summarized graphically (Figure 9 to Figure 13) and in tabular form below (Table 2). Graphs of the raw fifteen (15) minute data are in Appendix 2.

For the six sites the L_{Aeq} ranged from 55 to 66 dBA, the L_{A10} from 56 to 69dBA, the L_{A90} ranged

from 34 to 55dBA, the L_{Amin} from 29 to 47dBA, and the L_{Amax} from 87 to 107dBA. It was noted that the sound levels were generally highest at the Speightstown Fish Market and Northern Business Centre with lowest levels observed at the District E Police Station.

Figure 9: Daily L_{Aeq} values at each site

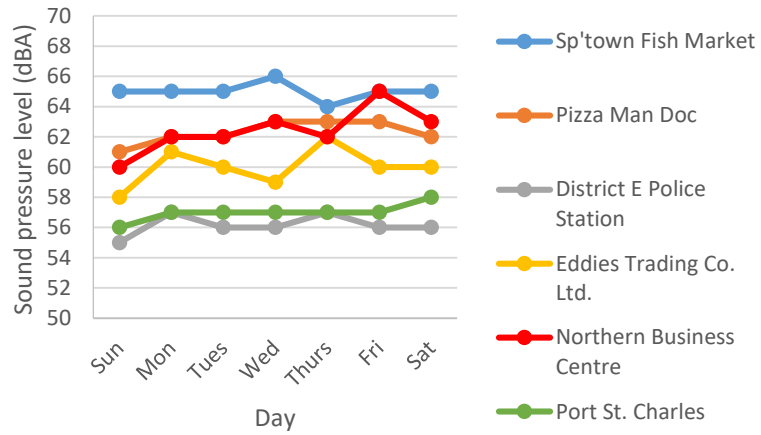


Figure 10: Daily L_{A10} values at each site

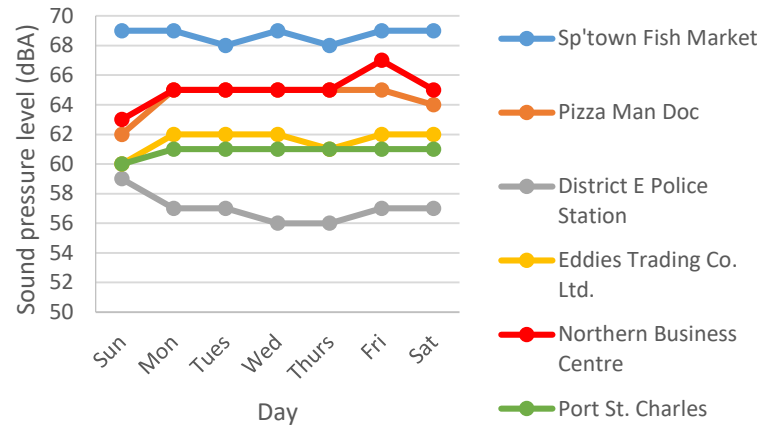


Figure 11: Daily L_{A90} values at each site

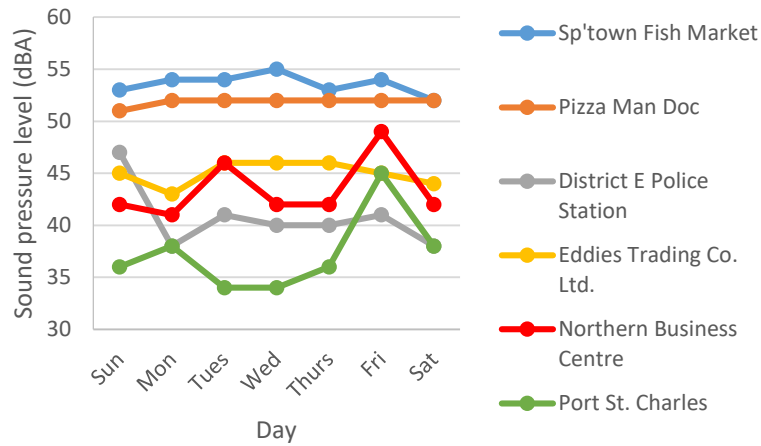


Figure 12: Daily L_{Amin} values at each site

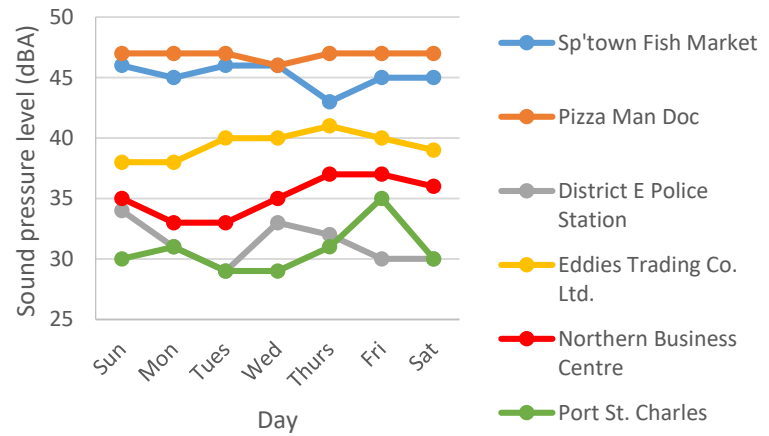


Figure 13:: Daily L_{Amax} values at each site

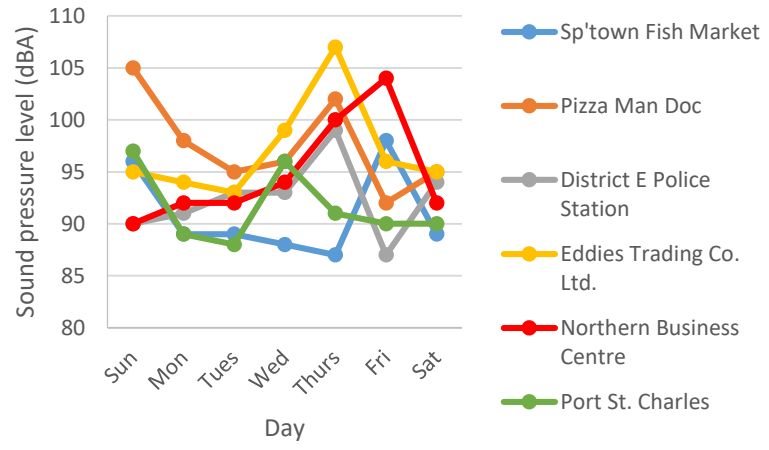


Table 2: Noise descriptor results

	Sp'town Market	Fish	Pizza Man Doc	District E Police Station	Eddies Trading Co. Ltd.	Northern Business Centre	Port St. Charles
Sunday	LAeq: 65	LAeq: 61	LAeq: 55	LAeq: 58	LAeq: 60	LAeq: 56	
	LA10: 69	LA10: 62	LA10: 59	LA10: 60	LA10: 63	LA10: 60	
	LA90: 53	LA90: 51	LA90: 47	LA90: 45	LA90: 42	LA90: 36	
	LAmin: 46	LAmin: 47	LAmin: 34	LAmin: 38	LAmin: 35	LAmin: 30	
	LAmax: 96	LAmax: 105	LAmax: 90	LAmax: 95	LAmax: 90	LAmax: 97	
	LAday: 65.6	LAday: 64	LAday: 57	LAday: 60	LAday: 61	LAday: 57	
	LAevening: 65.9	LAevening: 62	LAevening: 55	LAevening: 58	LAevening: 61	LAevening: 56	
	LANight: 63.6	LANight: 56	LANight: 48	LANight: 55	LANight: 55	LANight: 53	
Monday	LAeq: 65	LAeq: 62	LAeq: 57	LAeq: 61	LAeq: 62	LAeq: 57	
	LA10: 69	LA10: 65	LA10: 57	LA10: 62	LA10: 65	LA10: 61	
	LA90: 54	LA90: 52	LA90: 38	LA90: 43	LA90: 41	LA90: 38	
	LAmin: 45	LAmin: 47	LAmin: 31	LAmin: 38	LAmin: 33	LAmin: 31	
	LAmax: 89	LAmax: 98	LAmax: 91	LAmax: 94	LAmax: 92	LAmax: 89	
	LAday: 65.2-65.8	LAday: 64-65	LAday: 59	LAday: 61	LAday: 64	LAday: 59	
	LAevening: 65.4	LAevening: 60	LAevening: 57	LAevening: 59	LAevening: 60	LAevening: 56	
	LANight: 62.6-64.4	LANight: 56-57	LANight: 52	LANight: 61	LANight: 53	LANight: 53	
Tuesday	LAeq: 65	LAeq: 62	LAeq: 56	LAeq: 60	LAeq: 62	LAeq: 57	
	LA10: 68	LA10: 65	LA10: 57	LA10: 62	LA10: 65	LA10: 61	
	LA90: 54	LA90: 52	LA90: 41	LA90: 46	LA90: 46	LA90: 34	
	LAmin: 46	LAmin: 47	LAmin: 29	LAmin: 40	LAmin: 33	LAmin: 29	
	LAmax: 89	LAmax: 95	LAmax: 93	LAmax: 93	LAmax: 92	LAmax: 88	
	LAday: 65.3	LAday: 64	LAday: 57-59	LAday: 62	LAday: 64-65	LAday: 59	
	LAevening: 64.6	LAevening: 62	LAevening: 57	LAevening: 58	LAevening: 61	LAevening: 56	
	LANight: 63.2	LANight: 56	LANight: 50-51	LANight: 52	LANight: 57	LANight: 53	
Wednesday	LAeq: 66	LAeq: 63	LAeq: 56	LAeq: 59	LAeq: 63	LAeq: 57	
	LA10: 69	LA10: 65	LA10: 56	LA10: 62	LA10: 65	LA10: 61	
	LA90: 55	LA90: 52	LA90: 40	LA90: 46	LA90: 42	LA90: 34	
	LAmin: 46	LAmin: 46	LAmin: 33	LAmin: 40	LAmin: 35	LAmin: 29	
	LAmax: 88	LAmax: 96	LAmax: 93	LAmax: 99	LAmax: 94	LAmax: 96	
	LAday: 65	LAday: 65	LAday: 58	LAday: 61	LAday: 65	LAday: 59	
	LAevening: 64	LAevening: 62	LAevening: 54	LAevening: 58	LAevening: 64	LAevening: 57	
	LANight: 63	LANight: 57	LANight: 51	LANight: 53	LANight: 50	LANight: 53	
Thursday	LAeq: 64	LAeq: 63	LAeq: 57	LAeq: 62	LAeq: 62	LAeq: 57	
	LA10: 68	LA10: 65	LA10: 56	LA10: 61	LA10: 65	LA10: 61	
	LA90: 53	LA90: 52	LA90: 40	LA90: 46	LA90: 42	LA90: 36	
	LAmin: 43	LAmin: 43	LAmin: 32	LAmin: 41	LAmin: 37	LAmin: 31	
	LAmax: 87	LAmax: 102	LAmax: 99	LAmax: 107	LAmax: 100	LAmax: 91	
	LAday: 64	LAday: 65	LAday: 59	LAday: 65	LAday: 65	LAday: 59	
	LAevening: 64	LAevening: 61	LAevening: 53	LAevening: 56	LAevening: 61	LAevening: 57	
	LANight: 63	LANight: 55	LANight: 50	LANight: 50	LANight: 52	LANight: 53	

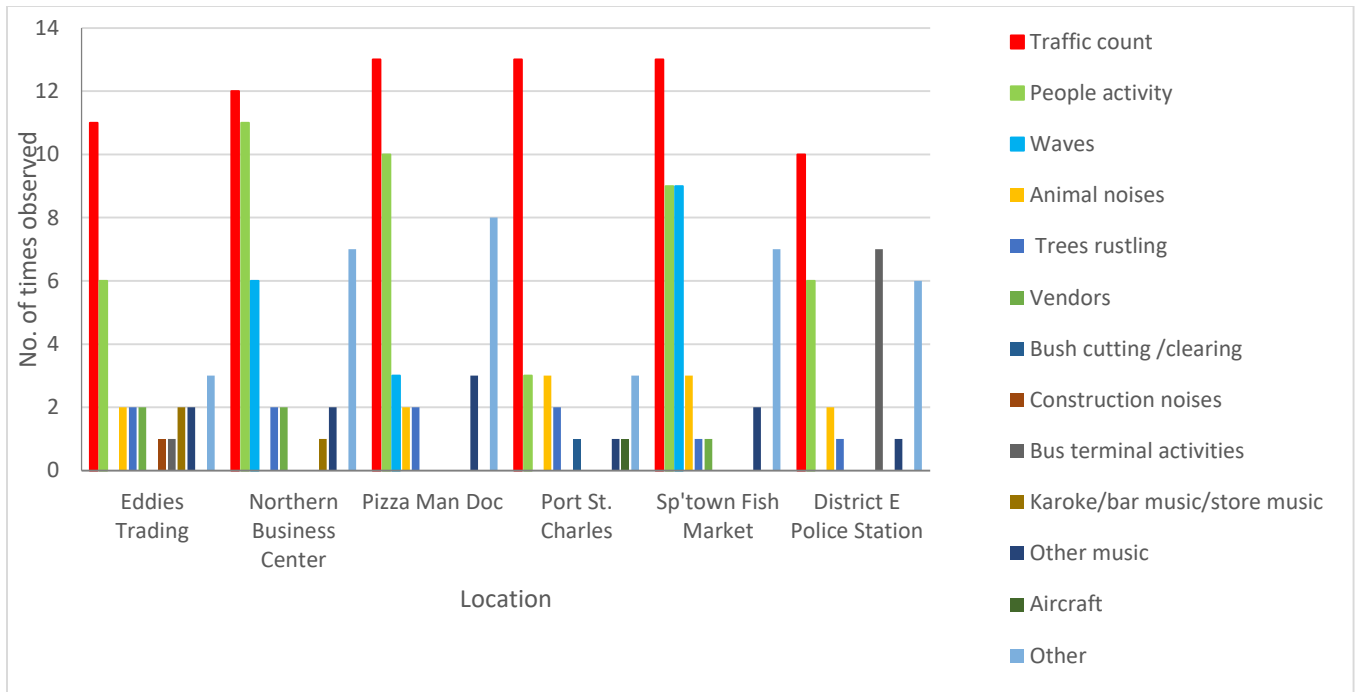
	Sp'town Market	Fish	Pizza Man Doc	District E Police Station	Eddies Trading Co. Ltd.	Northern Business Centre	Port St. Charles
Friday	LAeq: 65		LAeq: 63	LAeq: 56	LAeq: 60	LAeq: 65	LAeq: 57
	LA10: 69		LA10: 65	LA10: 57	LA10: 62	LA10: 67	LA10: 61
	LA90: 54		LA90: 52	LA90: 41	LA90: 45	LA90: 49	LA90: 45
	LAmin: 45		LAmin: 45	LAmin: 30	LAmin: 40	LAmin: 37	LAmin: 35
	LAmax: 98		LAmax: 92	LAmax: 87	LAmax: 96	LAmax: 104	LAmax: 90
	LAday: 64-66		LAday: 64	LAday: 58	LAday: 62-63	LAday: 65-68	LAday: 58-59
	LAevening: 64		LAevening: 62	LAevening: 54	LAevening: 57	LAevening: 65	LAevening: 58
	LANight: 63		LANight: 56	LANight: 52	LANight: 49-52	LANight: 57- 61	LANight: 56
Saturday	LAeq: 65		LAeq: 62	LAeq: 56	LAeq: 60	LAeq: 63	LAeq: 58
	LA10: 69		LA10: 64	LA10: 57	LA10: 62	LA10: 65	LA10: 61
	LA90: 52		LA90: 52	LA90: 38	LA90: 44	LA90: 42	LA90: 38
	LAmin: 45		LAmin: 45	LAmin: 30	LAmin: 39	LAmin: 36	LAmin: 30
	LAmax: 89		LAmax: 95	LAmax: 94	LAmax: 95	LAmax: 92	LAmax: 90
	LAday: 66		LAday: 64	LAday: 59	LAday: 63	LAday: 64	LAday: 60
	LAevening: 65		LAevening: 61	LAevening: 54	LAevening: 59	LAevening: 63	LAevening: 57
	LANight: 63		LANight: 55	LANight: 49	LANight: 50	LANight: 53	LANight: 51

What were the major sources of noise identified?

“Traffic was the most frequent source of noise identified followed by people (e.g. talking, liming)”

The activities observed during surveillance conducted June 2017 to April 2018 at the monitoring sites are shown in Figure 14 below. The types of activities observed as well as the frequency with which they were observed are shown. The sources of noise observed included traffic, sea waves, people related activities such as talking or playing, animal noises, music and bus terminal activities. As expected, the most frequent sources of noise observed were traffic and people related noises. Sources that were observed infrequently or at relatively few sites were placed in the “Other” category for example sirens.

Figure 14: Activities observed at each location



	Traffic count	People activity	Waves	Animal noises	Trees rustling	Vendors	Bush cutting/clearing	Construction noises	Bus terminal activities	Karaoke/bar music/store music	Other music	Aircraft	Other
Eddies Trading	11	6	2	2	2	2	1	1	2	2	3		
Northern Business Center	12	11	6		2	2				1	2		7
Pizza Man Doc	13	10	3	2	2						3		8
Port St. Charles	13	3		3	2		1				1	1	3
Sp'town Fish Market	13	9	9	3	1	1					2		7
District E Police Station	10	6		2	1				7		1		6

How did the recorded noise levels compare with WHO guidelines?

“The sound levels at all the sites monitored were within the WHO guidelines values for commercial areas however exceeded the guideline values for residential areas.”

The World Health Organization’s guideline value for industrial, commercial shopping and traffic areas; indoors and outdoors, is an L_{Aeq} of 70dB with a L_{Amax} of 110dB over a 24hr period. The $L_{Aeq,24hr}$ varied from 55 to 66dBA and the L_{Amax} varied from 87 to 107dBA. Therefore, all the areas monitored were within the WHO guidelines for industrial, commercial shopping and traffic areas. (See Table 3). The areas of Speightstown monitored were largely commercial. It was desired to set up a monitor within the residential area within wider Speightstown but finding a suitable secure house that would allow permission proved difficult.

Table 3: Range of 24hr L_{Aeq} and L_{Amax} values at the monitoring sites

	Sp'town Market	Fish	Pizza Man Doc	District E Police Station	Eddies Trading Co. Ltd.	Northern Business Centre	Port St. Charles
L_{Aeq} /dBA	64-66		61-63	55-57	58-62	60-65	56-58
L_{Amax} /dBA	87-98		92-105	87-99	93-107	90-104	88-97

L_{Aday} , $L_{Aevening}$ and L_{Anight} , three metrics outside the original scope of the project, were collected during monitoring. The separation of the L_{Aeq} into day, evening and night values was important for comparison with the WHO guidelines for residential areas as WHO guidelines gave different noise limits for day and night. The WHO guidelines for residential areas was L_{Aday} / $L_{Aevening}$ of 55dBA (16hrs, 7:00-23:00) and an L_{Anight} of 45Dba (8hrs, 23:00-7:00). As no residential sites were identified these metrics were not within the original scope. However as it was recognized that some of the sites – Pizza Man Doc, District E Police Station and Port St. Charles- were close to residential areas, the values were also reported (See Table 4). All the sites near to residential areas exceeded the WHO guidelines for residential areas while being acceptable for a commercial/industrial area.

Table 4: Range of 24hr L_{Aday} and L_{Anight} values at the monitoring sites

	Pizza Man Doc	District E Police Station	Port St. Charles
L_{Aday} /dBA	60-65	53-59	56-60
L_{Anight} /dBA	55-57	48-52	51-56

Were the 24hr sound levels (L_{Aeq}) on Sundays statistically different to those recorded on other days of the week?

“The L_{Aeq} values recorded on Sundays were statistically different to the other days of the week at Pizza Man Doc, Eddies Trading and Port St. Charles. District E Police Station had mixed results with Sundays being quieter than most days of the week. At the Speightstown Fish Market and Northern Business Centre there was no statistical difference between Sundays and the other days of the week.”

For the analysis the 24hr Sunday data for each site was compared to each weekday’s data for that particular site. The data was first tested for normality using histograms, Kurtosis and Skewness and the Kolmogorov–Smirnov (KS) statistic. Based on the tests conducted, in general the data was not found to be normally distributed and the non-parametric Wilcoxon Signed Rank Test was used for the comparison analysis. If the difference between the sound levels (Sunday vs. weekday) was statically significant the significance level (Asymp. Sig. (2-tailed)) would be below 0.05.

Culturally or historically Sundays are quiet days in Barbados. In Speightstown, however Sundays were not always statistically different to other days of the week at Speightstown Fish Market or Northern Business Centre. This suggested that the noise source(s)/activity levels near these sites was consistently present irrespective of the day or that if a noise source(s) were removed/reduced another source(s) with similar sound levels replaced them.

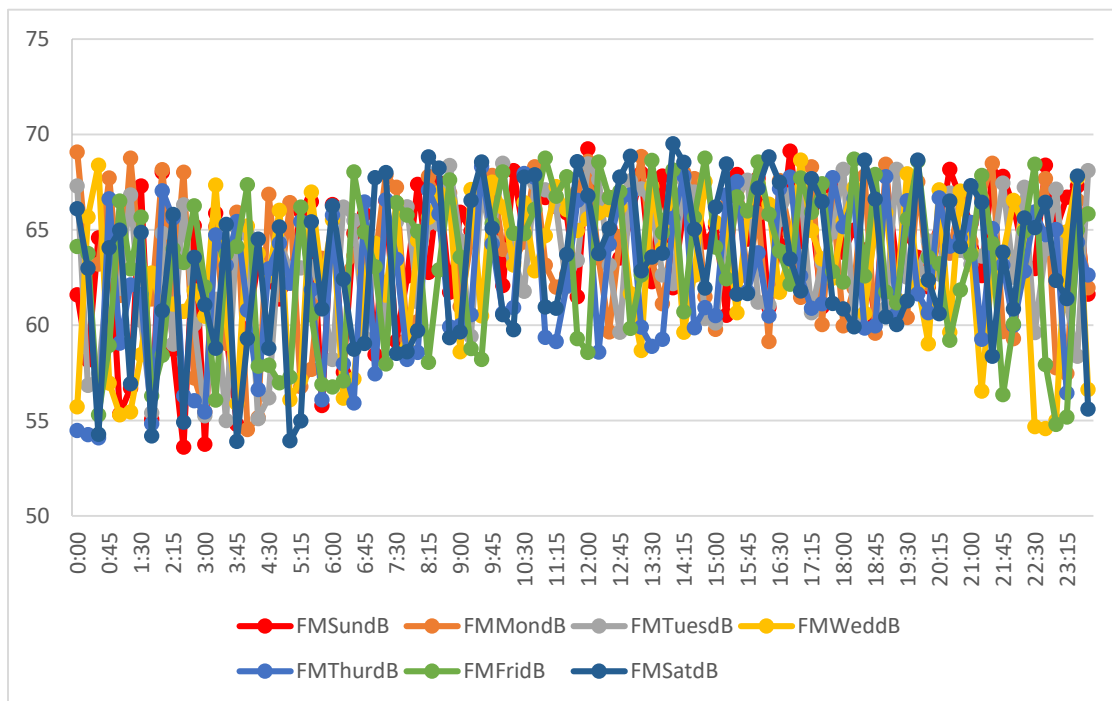
The Wilcoxon Signed Rank Test showed that at the Speightstown Fish Market, Sundays were generally not statistically different to the weekdays except Thursday (See Table 5). Thursday was slightly quieter than Sunday. The data therefore suggests that the noise levels at this location were generally consistent no matter the day. A graph showing the L_{Aeq} over the

week is also provided in Figure 15. It was noted that this site was very close to the sea and the waves contributed to the sound levels. This may be a possible reason for the consistency in sound levels irrespective of the day.

Table 5: Results of Wilcoxon Signed Rank Test for Speightstown Fish Market comparing Sunday's L_{Aeq} values with other weekday L_{Aeq} values

Test Statistics ^a						
	FMMondB - FMSundB	FMTuesdB - FMSundB	FMWeddB - FMSundB	FMThurdB - FMSundB	FMFridB - FMSundB	FMSatdB - FMSundB
Z	-.692 ^b	-1.367 ^b	-1.639 ^b	-3.238 ^b	-1.045 ^b	-1.467 ^b
Asymp. Sig. (2-tailed)	.489	.172	.101	.001	.296	.142
a. Wilcoxon Signed Ranks Test						
b. Based on positive ranks.						
FM- Speightstown Fish Market, dB- decibels. Asymptotic significances are displayed. The significance level is 0.05						

Figure 15: Variation of L_{Aeq} values over the week at Speightstown Fish Market

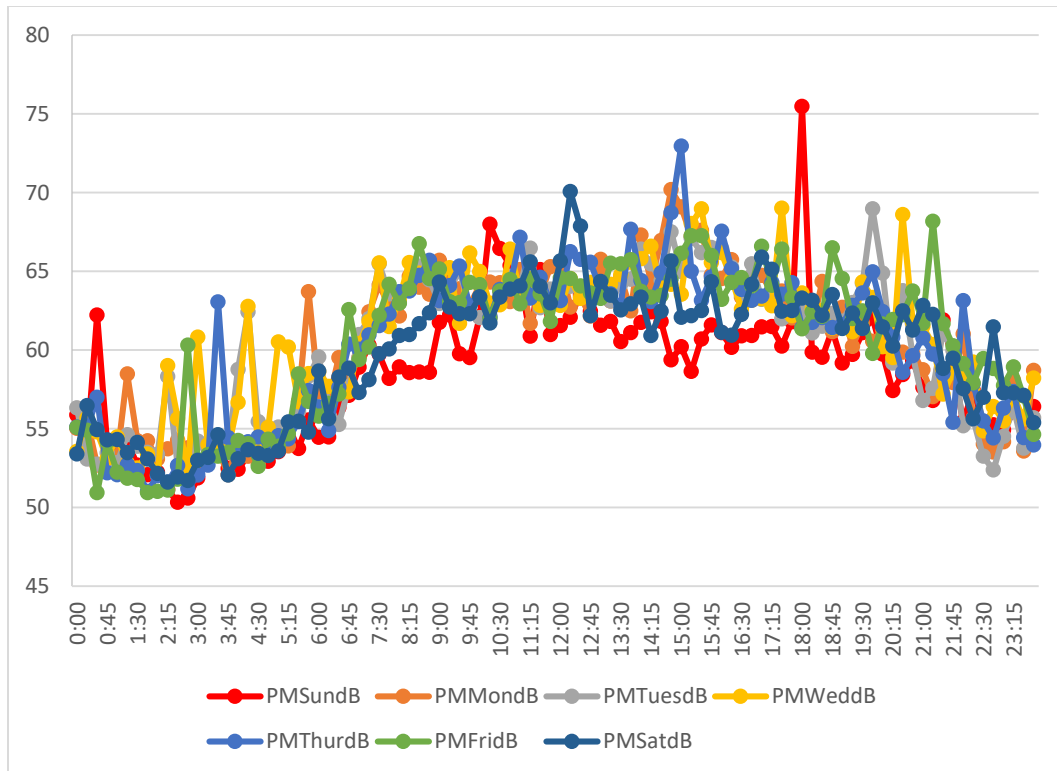


The Wilcoxon Signed Rank Test showed that at Pizza Man Doc, Sundays were statistically different to every other day of the week with Sunday being generally quieter. A graph showing the L_{Aeq} over the week is also provided in Figure 16. This was the norm in other parts of the island where Sunday is typically the quietest day of the week.

Table 6: Results of Wilcoxon Signed Rank Test for Pizza Man Doc comparing Sunday's L_{Aeq} values with other weekday L_{Aeq} values

Test Statistics ^a						
	PMMondB - PMSundB	PMTuesdB - PMSundB	PMWeddB - PMSundB	PMThurdB - PMSundB	PMFridB - PMSundB	PMSatdB - PMSundB
Z	-5.412 ^b	-5.679 ^b	-6.308 ^b	-5.545 ^b	-5.889 ^b	-5.266 ^b
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
a. Wilcoxon Signed Ranks Test						
b. Based on negative ranks.						
PM- Pizza Man Doc, dB- decibels. Asymptotic significances are displayed. The significance level is 0.05						

Figure 16: Variation of L_{Aeq} values over the week at Pizza Man Doc comparing Sunday's L_{Aeq} values with other weekday L_{Aeq} values

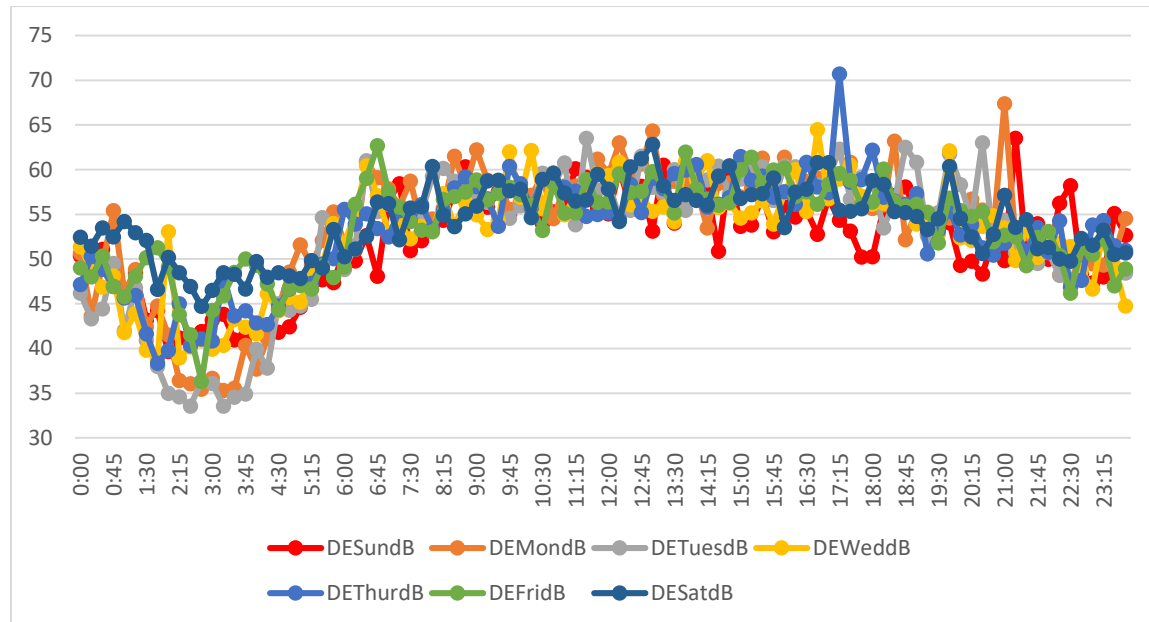


The Wilcoxon Signed Rank Test showed that at the District E Police Station, Sundays were statistically different to Monday, Thursday, Friday and Saturday but were not statistically different to Tuesday and Wednesday (See Table 7:). This trend was close to the cultural norm as basically Sunday is usually the same or quieter than the other days of the week. A graph showing the L_{Aeq} over the week is also provided in Figure 17.

Table 7:: Results of Wilcoxon Signed Rank Test for District E Police Station comparing Sunday's L_{Aeq} values with other weekday L_{Aeq} values

Test Statistics ^a						
	DEMondB - DESundB	DETuesdB - DESundB	DEWeddB - DESundB	DEThurdB - DESundB	DEFridB - DESundB	DESatdB - DESundB
Z	-3.234 ^b	-1.155 ^b	-1.526 ^b	-2.867 ^b	-3.932 ^b	-4.774 ^b
Asymp. Sig. (2-tailed)	.001	.248	.127	.004	.000	.000
a. Wilcoxon Signed Ranks Test						
b. Based on negative ranks.						
DE- District E Police Station, dB- decibels. Asymptotic significances are displayed. The significance level is 0.05						

Figure 17: Variation of L_{Aeq} values over the week at District E Police Station



The Wilcoxon Signed Rank Test showed that at Eddies Trading, Sundays were statistically different to every other day of the week (See Table 8). This trend was similar to the cultural norm as basically Sunday was either the same or quieter than the other days of the week. A graph showing the L_{Aeq} over the week is also provided in Figure 18.

Table 8: Results of Wilcoxon Signed Rank Test for Eddies Trading comparing Sunday's Leq values with other weekday Leq values

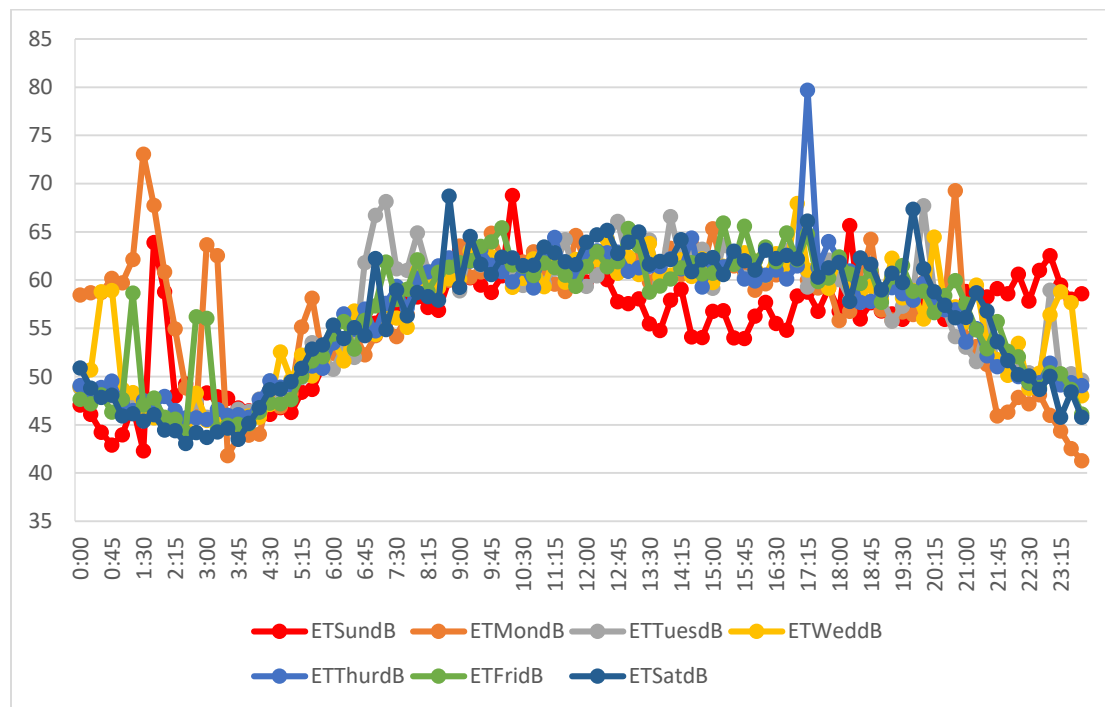
Test Statistics ^a						
	ETMondB - ETSundB	ETTuesdB - ETSundB	ETWeddB - ETSundB	ETThurdB - ETSundB	ETFridB - ETSundB	ETSatdB - ETSundB
Z	-2.465 ^b	-2.295 ^b	-2.434 ^b	-2.317 ^b	-2.699 ^b	-2.408 ^b
Asymp. Sig. (2-tailed)	.014	.022	.015	.021	.007	.016

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

ET- Eddies Trading, dB- decibels. Asymptotic significances are displayed. The significance level is 0.05

Figure 18: Variation of L_{Aeq} values over the week at Eddies Trading

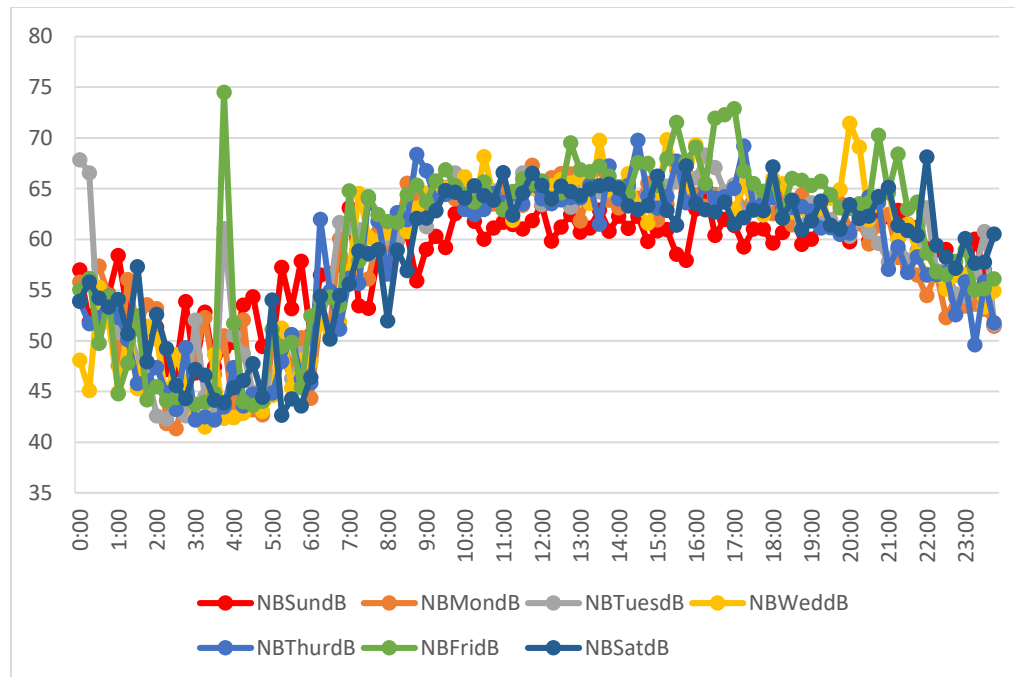


The Wilcoxon Signed Rank Test showed that at the Northern Business Centre, Sunday was not statistically different to any day of the week except Friday (See Table 9:). This finding is unlike the cultural norm where Sunday was either the same or quieter than the other days of the week. A graph showing the L_{Aeq} over the week is also provided in Figure 19.

Table 9: Results of Wilcoxon Signed Rank Test for Northern Business Centre comparing Sunday's L_{Aeq} values with other weekday L_{Aeq} values

Test Statistics ^a						
	NBMondB - NBSundB	NBTuesdB - NBSundB	NBWeddB - NBSundB	NBThurdB - NBSundB	NBFridB - NBSundB	NBSatdB - NBSundB
Z	-1.328 ^b	-1.884 ^b	-1.182 ^b	-.090 ^b	-3.603 ^b	-1.878 ^b
Asymp. Sig. (2-tailed)	.184	.060	.237	.929	.000	.060
a. Wilcoxon Signed Ranks Test						
b. Based on negative ranks.						
NB- Northern Business Centre, dB- decibels. Asymptotic significances are displayed. The significance level is 0.05						

Figure 19: Variation of L_{Aeq} values over the week at Northern Business Centre



The Wilcoxon Signed Rank Test showed that at the Port St. Charles, Sundays were statistically different to every other day of the week (See Table 10). This trend was close to the cultural norm as Sundays were usually quieter than the other days of the week. A graph showing the L_{Aeq} over the week is also provided in Figure 20.

Table 10: Results of Wilcoxon Signed Rank Test for Port St. Charles comparing Sunday's Leq values with other weekday Leq values

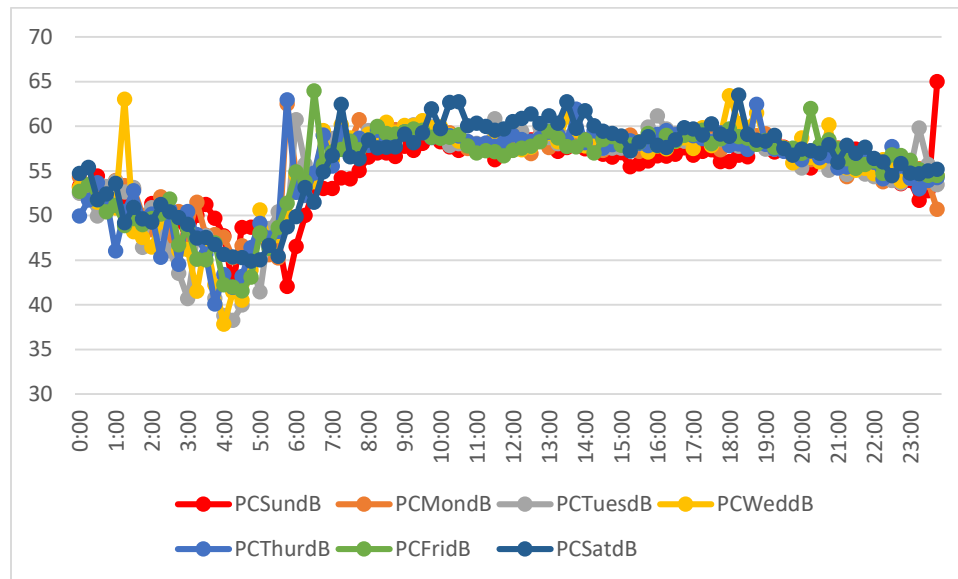
Test Statistics ^a						
	PCMondB - PCSundB	PCTuesdB - PCSundB	PCWeddB - PCSundB	PCThurdB - PCSundB	PCFridB - PCSundB	PCSatdB - PCSundB
Z	-4.729 ^b	-2.860 ^b	-3.662 ^b	-3.863 ^b	-3.537 ^b	-5.277 ^b
Asymp. Sig. (2-tailed)	.000	.004	.000	.000	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

PC- Port St. Charles, dB- decibels. Asymptotic significances are displayed. The significance level is 0.05

Figure 20: Variation of L_{Aeq} values over the week at Port St. Charles



In Barbados Sundays were typically quiet and while this trend was generally noted at all the sites, the exceptions were the Speightstown Fish Market and Northern Business Centre. This suggests that there was a noise source(s)/activity levels near these sites were consistently present irrespective of the day or that if a noise source(s) are removed/reduced another source(s) with similar sound levels replaced them.

Was there a correlation between the traffic counts and the noise levels recorded?

“The relationship between L_{Aeq} and traffic counts was investigated using Spearman’s rank order correlation. At the Speightstown Fish Market there was weak to moderate, positive correlation between the two variables. At all the other locations- Pizza man Doc, District E Police Station, Eddies Trading, Northern Business Centre and Port St. Charles- there was strong, positive correlation between the two variables.”

The correlation between traffic counts and noise levels was investigated using the Spearman’s rank order correlation for each site. Spearman’s rank order correlation was used to determine the strength and direction of the relationship between the two variables. The sign (positive or negative) indicated the direction of the relationship. A positive correlation coefficient would indicate that as traffic increased the noise levels increased while a negative correlation coefficient would indicate that as traffic decreased the noise levels increased. The value of the coefficient indicated the strength of the relationship. The ranges provided in Table 11 were used to describe the strength of the relationship (Cohen, 1988). The traffic count data is provided in Appendix 7 .

Table 11 : Ranges used in description of the strength of the relationship

Range of r values	Interpretation
$r=.10$ to $.29$ or $r=-.10$ to $-.29$	Small
$r=.30$ to $.49$ or $r=-.30$ to $-.49$	Medium
$r=.50$ to 1.0 or $r=-.50$ to -1.0	Large

At the Speightstown Fish Market there was a weak to moderate, positive correlation between the fifteen (15) minute L_{Aeqs} and the fifteen (15) minute traffic counts. These results suggest that traffic was not the only significant contributor to noise at this location. It was noted that this location was located near the sea and the waves were most likely the more dominant and consistent contributor to sound at this site during the monitoring period. Additionally the survey of noise sources at each site revealed that traffic, people and sea waves were the three most observed activities at the Speightstown Fish Market. The results of the statistical analysis are below:

Table 12: Correlation analysis of 15 minute L_{Aeqs} with 15 minute traffic counts at the Speightstown Fish Market

Day	Spearman Rank Order Correlation Coefficient**	Correlation Description
Sunday	0.29	Weak positive correlation
Monday	0.199	Weak positive correlation
Tuesday	0.321	Medium positive correlation
Wednesday	0.379	Medium positive correlation
Thursday	0.190	Weak positive correlation
Friday	0.353	Medium positive correlation
Saturday	0.361	Medium positive correlation

** Correlation is significant at the .01 level (2-tailed).

At all of the other locations- Pizza man Doc, District E Police Station, Eddies Trading, Northern Business Centre and Port St. Charles- there was strong, positive correlation between the 15 minute L_{Aeqs} and the 15 minute traffic counts. Therefore, as traffic counts increased so did the L_{Aeqs} . The results of the analysis of the data from each monitoring location are below:

Table 13: Correlation analysis of 15 minute L_{Aeqs} with 15 minute traffic counts at Pizza Man Doc

Day	Spearman Rank Order Correlation Coefficient**	Correlation Description
Sunday	0.828	Strong positive correlation
Monday	0.867	Strong positive correlation
Tuesday	0.819	Strong positive correlation
Wednesday	0.815	Strong positive correlation
Thursday	0.887	Strong positive correlation
Friday	0.849	Strong positive correlation
Saturday	0.890	Strong positive correlation

** Correlation is significant at the .01 level (2-tailed).

Table 14: Correlation analysis of 15 minute L_{Aeqs} with 15 minute traffic counts at District E Police Station

Day	Spearman Rank Order Correlation Coefficient**	Correlation Description
Sunday	0.525	Strong positive correlation
Monday	0.694	Strong positive correlation
Tuesday	0.780	Strong positive correlation
Wednesday	0.765	Strong positive correlation
Thursday	0.742	Strong positive correlation
Friday	0.741	Strong positive correlation
Saturday	0.687	Strong positive correlation

** Correlation is significant at the .01 level (2-tailed).

Table 15: Correlation analysis of 15 minute L_{Aeqs} with 15 minute traffic counts at Eddies Trading

Day	Spearman Rank Order Correlation Coefficient**	Correlation Description
Sunday	0.666	Strong positive correlation
Monday	0.585	Strong positive correlation
Tuesday	0.787	Strong positive correlation
Wednesday	0.835	Strong positive correlation
Thursday	0.924	Strong positive correlation
Friday	0.892	Strong positive correlation
Saturday	0.914	Strong positive correlation

** Correlation is significant at the .01 level (2-tailed).

Table 16: Correlation analysis of 15 minute L_{Aeqs} with 15 minute traffic counts at Northern Business Centre

Day	Spearman Rank Order Correlation Coefficient**	Correlation Description
Sunday	0.742	Strong positive correlation
Monday	0.873	Strong positive correlation
Tuesday	0.781	Strong positive correlation
Wednesday	0.799	Strong positive correlation
Thursday	0.888	Strong positive correlation
Friday	0.790	Strong positive correlation
Saturday	0.865	Strong positive correlation

** Correlation is significant at the .01 level (2-tailed).

Table 17: Correlation analysis of 15 minute L_{Aeqs} with 15 minute traffic counts at Port St. Charles

Day	Spearman Rank Order Correlation Coefficient**	Correlation Description
Sunday	0.805	Strong positive correlation
Monday	0.825	Strong positive correlation
Tuesday	0.794	Strong positive correlation
Wednesday	0.765	Strong positive correlation
Thursday	0.750	Strong positive correlation
Friday	0.803	Strong positive correlation
Saturday	0.864	Strong positive correlation

** Correlation is significant at the .01 level (2-tailed).

It should be noted that the above results only indicated if high traffic counts and high sound levels (or vice versa) tend to occur together. Whether this link was a direct link or indirect link was not investigated. For example, increased traffic counts could mean an increase in other sources of noise e.g., person related sounds and general business activity which could instead be the direct factor(s) for increased sound levels.

In summary, the study found that an increase of traffic volume was associated with an increase in noise levels at all the sites except the Speightstown Fish Market where there was low to moderate, positive correlation.

7.0 Discussion

Speightstown, one of Barbados' major towns, located along the north-west coast of Barbados was the focus of this noise characterization project. The project involved surveillance of the activities carried out in the area, monitoring of sound levels, collecting data on traffic counts and weather conditions, analysis of the data, writing of a final report and close out of project.

The monitoring locations used were Speightstown Fish Market, Pizza Man Doc, District E Police Station, Eddies Trading Co. Ltd., Northern Business Centre, and Port St. Charles. The results indicated that the sites located along the main street, Queen's Street, namely the Speightstown Fish Market, Northern Business Centre and Pizza Man Doc had the highest sound levels and sites further away from the main street- Port St. Charles and District E Police Station- as expected had comparatively lower sound levels. This trend was expected as activity level and/or surrounding noise sources affect the sound levels. Visual inspection of the graphs in Appendix 2 revealed that the sound levels generally rose around 5:00-6:00 am and dipped between 8:30-10:00 pm depending on the location. The exception was at Speightstown Fish Market where the sound levels were generally constant during the day or night. This was likely due to the wave action as it was located near the sea.

In Barbados Sundays were typically quiet and while this trend was generally noted at all the sites, the exceptions were the Speightstown Fish Market and Northern Business Centre. This suggests that there was a noise source(s)/activity levels near these sites that were consistently present irrespective of the day or that if a noise source(s) was removed/reduced another source(s) with similar sound levels replaced them. Again the sea waves near Speightstown Fish Market would be a consistent source of noise irrespective of the day, thus resulting in the sound levels on Sundays being no different to any other day.

The sound levels in all the areas monitored met the WHO guidelines for industrial, commercial shopping and traffic areas (i.e. L_{Aeq} of 70dB and a L_{Amax} of 110dB over a 24hr period) as the (L_{Aeq}) for the three sites ranged from 55 to 66dBA and the L_{Amax} from 87 to 107dBA. The areas of Speightstown monitored were largely commercial. It was desired to set up a monitor

within the residential area within wider Speightstown but finding a suitable secure house that would allow permission proved difficult. However it was noted that three of the sites were in close proximity to residences- Pizza Man Doc, District E Police Station and Port St. Charles. The sound levels at these locations exceeded the WHO guidelines for residential areas, i.e. L_{Aday} of 55dBA and L_{Anight} of 45dBA, as at the Pizza Man Doc the L_{Aday} varied from 60-65dBA, the L_{Anight} varied from 55-57dBA while at District E Police Station the L_{Aday} varied from 53-59dBA, the L_{Anight} varied from 48-52 dBA and at Port St. Charles the L_{Aday} varied from 56-60 dBA, the L_{Anight} varied from 51-56dBA. Therefore, all the sites monitored exceeded the WHO guidelines for residential areas while being acceptable for a commercial/industrial area. This was especially instructive as Pizza Man Doc, District E Police Station and Port St. Charles were on the outskirts of residential areas. The lack of a buffer area between incompatible land uses could present a problem when comparing it to many international standards including the World Health Organization's Community Guidelines as they often do not account for mixed use areas but provide noise limits for individual zones/areas e.g. strictly residential or strictly commercial. It is therefore prudent to manage the sound levels within Speightstown to prevent the WHO commercial noise limits from being exceeded as well as to not cause any further possible noise increases on residential areas that are nearby. Suggested ways of managing the sound levels in Speightstown are provided in Section 8.0 Conclusions, Recommendations and Critical Assessment.

As in any typical town, the most observed sources of noise was traffic followed by people (e.g. talking or soliciting of customers). The relationship between L_{Aeq} and traffic counts was investigated using Spearman's rank order correlation. At the Speightstown Fish Market there was weak to moderate, positive correlation between the two variables. At all the other locations- Pizza man Doc, District E Police Station, Eddies Trading, Northern Business Centre and Port St. Charles- there was strong, positive correlation between the two variables. The results from the Speightstown Fish Market site again point to traffic not being the only significant contributor to the sound levels in that area. At the other locations there was a strong, positive correlation with traffic indicating that as traffic increased at those locations so did the sound levels.

8.0 Conclusions, Recommendations and Critical Assessment

The following conclusions were made:

- In general the noise levels persons were exposed to while in Speightstown, at the sites monitored, were within W.H.O. guidelines for community noise for industrial, commercial shopping and traffic areas. However, the values exceeded the guideline values for residential areas. For the six sites the L_{Aeq} ranged from 55 to 66 dBA, the L_{A10} from 56 to 69dBA, the L_{A90} ranged from 34 to 55dBA, the L_{Amin} from 29 to 47dBA and the L_{Amax} from 87 to 107dBA. For the sites close to residential areas- Pizza Man Doc, District E Police Station and Port St. Charles - the L_{Aday} values ranged from 53-65dBA and L_{Anight} from 48-57dBA. This was especially instructive as Pizza Man Doc, District E Police Station and Port St. Charles are on the outskirts of residential areas. The lack of a buffer area between incompatible land uses could present a problem when comparing it to many international standards including the World Health Organization's Community Guidelines as they often do not account for mixed use areas but provide noise limits for individual zones/areas e.g. strictly residential or strictly commercial.
- Traffic noise was the main observed activity near the monitoring sites followed by people (talking, liming).
- The relationship between L_{Aeq} and traffic counts was investigated using Spearman's rank order correlation. At the Speightstown Fish Market there was weak to moderate, positive correlation between the two variables. At all the other locations- Pizza Man Doc, District E Police Station, Eddies Trading, Northern Business Centre and Port St. Charles- there was strong, positive correlation between the two variables. The results from the Speightstown Fish Market site imply that traffic was not the only significant contributor to the sound levels in that area. Based on the surveillance of activities at the site, sea wave sound was most likely a significant contributor also. At the other locations there was a strong, positive correlation with traffic indicating that as traffic increased at those locations so did the sound levels. It should be noted that the above results only indicated if high traffic counts and high sound levels (or vice versa) tend to

occur together. Whether this link was a direct link or indirect link was not investigated. For example, increased traffic counts could mean an increase in other sources of noise e.g. person related sounds and general business activity which could instead be the direct factor(s) for increased sound levels.

- The L_{Aeq} values recorded on Sundays were quieter than any other day of the week at all the sites except the Speightstown Fish Market and Northern Business Centre. This suggests that there was a noise source(s)/activity levels near these sites that were consistently present irrespective of the day or that if a noise source(s) are removed/reduced another source(s) with similar sound levels replaced them. For example, the sea waves near Speightstown Fish Market would be a consistent source of noise irrespective of the day, thus resulting in the sound levels on Sundays being no different to any other day.

The following recommendations and critical assessment are made:

- *There should be an increased focus on gathering sound level data across Barbados as well as educating the public on the effects of noise.*
- *In order to maintain the sound levels in Speightstown at acceptable levels, future projects or programmes planned for Oistins should take sound levels into consideration.* Not only should existing receptors be considered but also the possible locations of future surrounding receptors. While it is difficult to give exact suggestions as it depends on the noise source, proximity of sensitive receptors, time of day that the high sound levels occur etc. some possible general noise management options are setting a minimum sound transmission class of building materials in Speightstown, restricting the number of dwellings and density in some areas, noise barriers/buildings, setting buffer areas, enforced cut off times for loud activities, setting up of permanent monitoring stations .
- *Continuous control/ management of the traffic related sound levels within the town:* Currently the traffic counts in Speightstown were not overwhelming for

the current road traffic arrangements. However as this can change with a new large scale development in the town or in the surrounding areas it was important to consider road network, parking space availability, location of mass transit routes and other issues which can increase/decrease traffic volumes or congestion. Other areas that can help control or manage road traffic noise were paving roads with noise dampening asphalt, maintaining the road surface, encouraging the use of quieter vehicles (e.g. with tax deductions, reduce importation taxes), discouraging the unnecessary use of vehicle horns, use of electric powered buses.

- *Similar baseline data should be collected for other areas in Barbados.*
- *A more rigorous method of determining the amount of rainfall (e.g. using a rain gauge) would be better for future projects.*
- *Depending on the purpose of the study/investigation, only areas where short-term sampling during the busiest/noisiest periods exceeds desired limits may require further long-term monitoring.* This could be part of the criteria for site selection, as it would increase the efficiency with which resources are used.
- *Further training and resources should be obtained for capacity building of the Environmental Protection Department and by extension Barbados.*

9.0 References

- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed.)*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Cowan, J. P. (1994). *Handbook of Environmental Acoustics*. . New York: John Wiley & Sons Inc.
- Government of Barbados. (2003). *Physical Development Plan, Amended (2003)*. Government of Barbados.
- World Health Organization:. (1999). *Guidelines for Community Noise*. Retrieved August 3, 2017, from <http://www.who.int/docstore/peh/noise/Comnoise-4.pdf>

Appendix 1: Meteorological Data

Meteorological data during monitoring at District E Police Station (24th February- 3rd March 2018)

Date	Temperature (°C)			Windspeed (m/s)			Relative Humidity (%)			Barometric Pressure (mb)		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
2/24/2018	25.9	23.9	29.5	2.3	0.0	6.2	65.4	53.4	75.0	1015.6	1014.2	1017.4
2/25/2018	25.3	23.2	28.9	1.6	0.0	5.0	70.3	55.1	92.0	1015.7	1014.5	1017.0
2/26/2018	25.0	21.6	29.9	1.7	0.0	5.2	77.4	53.5	100.0	1014.5	1012.4	1028.5
2/27/2018	25.3	21.3	32.5	1.3	0.0	4.9	74.2	53.0	88.4	1013.8	1012.2	1015.5
2/28/2018	24.9	22.4	29.4	1.1	0.0	3.4	88.6	66.3	100.0	1014.8	1013.7	1016.5
3/1/2018	25.1	22.9	30.0	0.8	0.0	4.9	89.6	61.7	100.0	1015.0	1013.0	1024.6
3/2/2018	26.5	21.0	35.2	0.8	0.0	3.4	76.5	48.8	96.7	1012.2	1010.2	1014.4
3/3/2018	26.5	23.3	31.5	0.6	0.0	3.0	85.4	66.7	99.8	1010.8	1009.2	1012.5

Meteorological data during monitoring at Eddies Trading Co. Ltd. (6th - 11th March 2018)

Date	Temperature (°C)			Windspeed (m/s)			Relative Humidity (%)			Barometric Pressure (mb)		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
3/6/2018	27.3	25.7	31.2	0.8	0.0	2.2	78.4	64.2	88.6	1015.5	1013.5	1017.7
3/7/2018	27.3	25.6	30.7	1.0	0.0	3.8	75.0	62.9	82.2	1015.8	1014.2	1017.5
3/8/2018	26.9	25.6	30.4	1.0	0.0	2.3	75.6	61.5	81.6	1016.9	1015.7	1018.4
3/10/2018	27.4	25.4	31.3	1.3	0.0	3.3	69.9	59.6	78.5	1016.5	1014.7	1018.4
3/11/2018	27.0	24.5	30.3	1.1	0.0	3.1	71.3	58.0	86.2	1016.3	1015.0	1018.2

Meteorological data during monitoring at Northern Business Centre (17th - 24th March 2018)

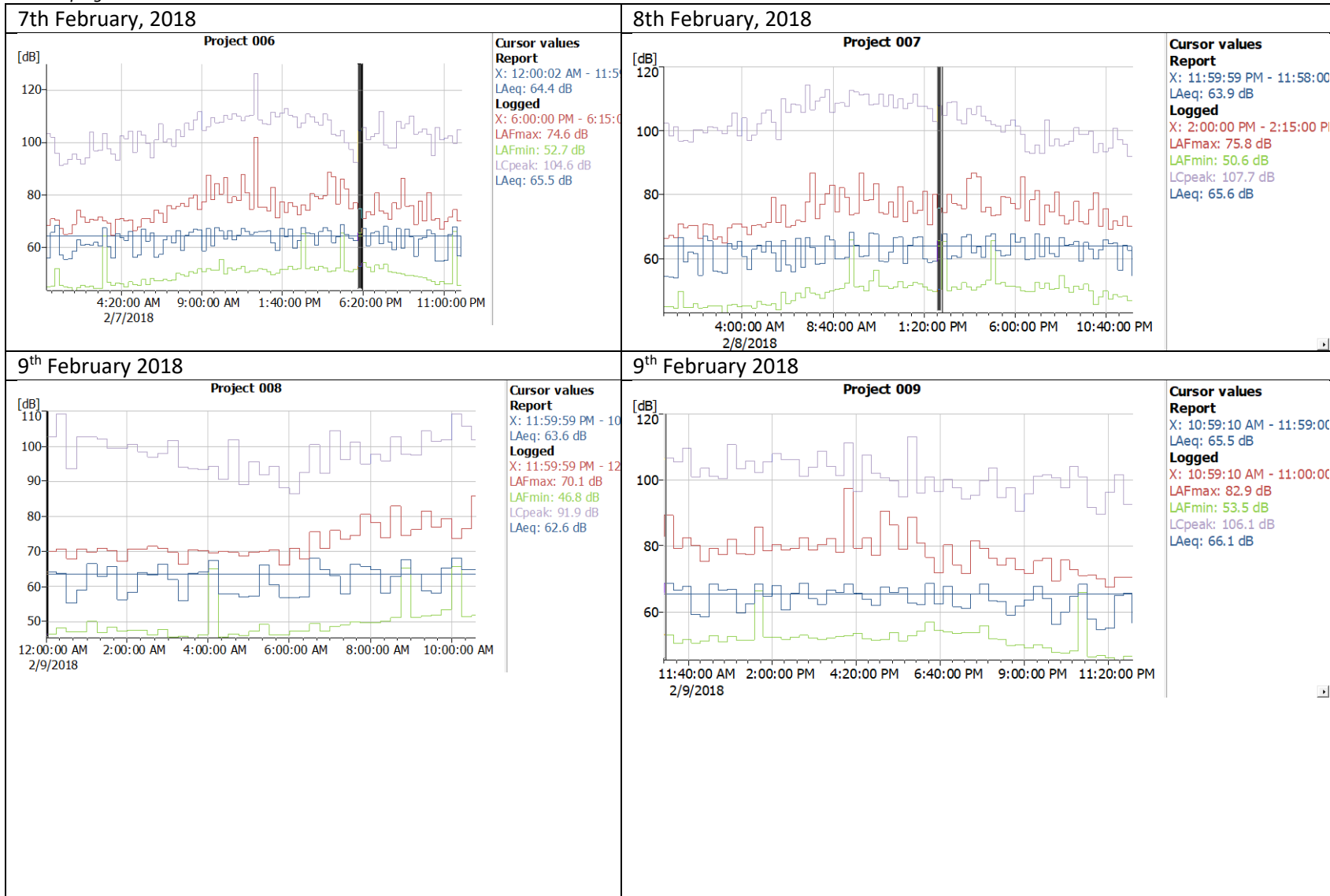
Date	Temperature (°C)			Windspeed (m/s)			Relative Humidity (%)			Barometric Pressure (mb)		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
3/17/2018	27.4	24.8	31.8	1.1	0.0	3.9	68.3	52.8	80.7	1014.6	1012.9	1016.7
3/18/2018	27.0	24.0	32.7	1.0	0.0	4.7	66.7	47.0	81.3	1012.9	1011.2	1015.0
3/19/2018	27.3	23.6	33.4	0.8	0.0	3.8	63.2	46.5	76.3	1011.9	1010.5	1013.5
3/20/2018	27.2	23.9	30.9	1.6	0.0	6.7	73.0	59.0	88.2	1012.9	1011.5	1014.5
3/21/2018	27.4	25.8	31.3	1.2	0.0	4.1	72.3	59.8	84.9	1014.7	1012.5	1016.5
3/22/2018	28	22	31.9	0.9	0.0	4.3	69.4	56.9	81.9	1015.3	1014.0	1016.7
3/23/2018	27	22	28.1	1.1	0.0	4.7	68	51.3	78.1	1014.3	1012.9	1016.2
3/24/2018	27	25	31.2	0.8	0.0	4.7	67	52.9	81.3	1013.5	1011.7	1014.7

Meteorological data during monitoring at Port St. Charles (27th March-11th April 2018)

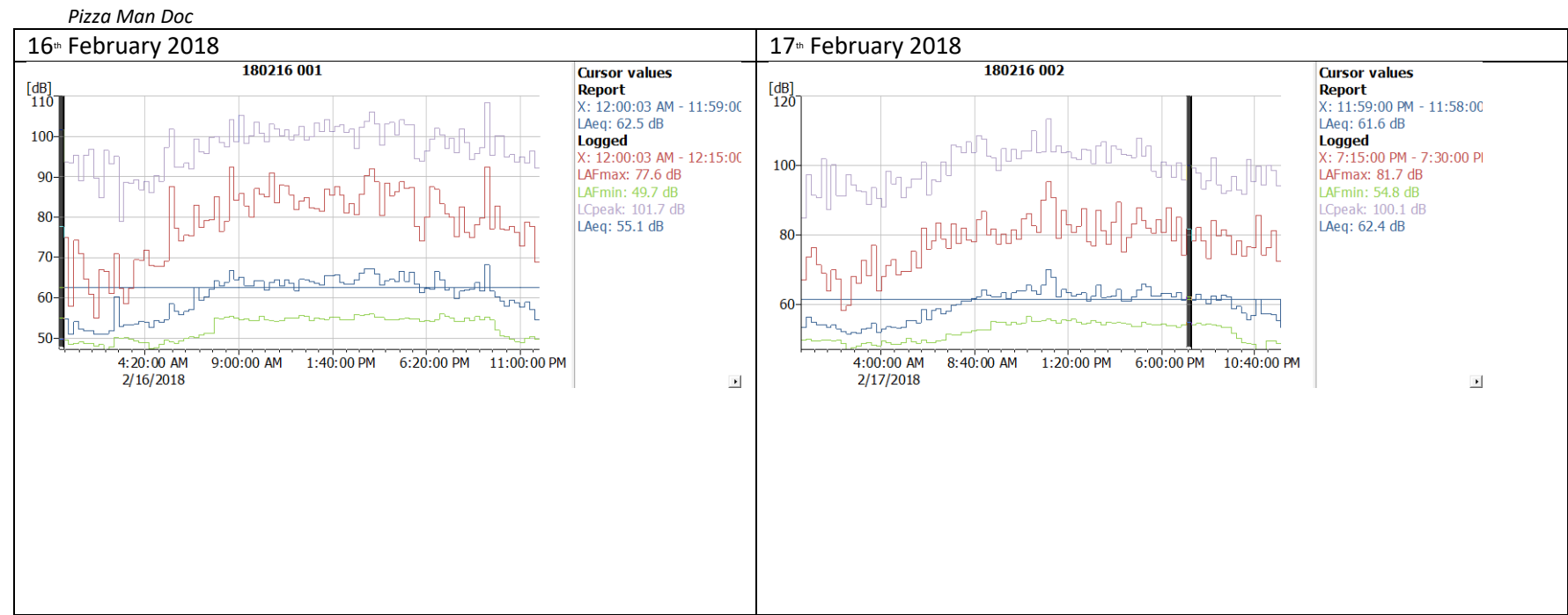
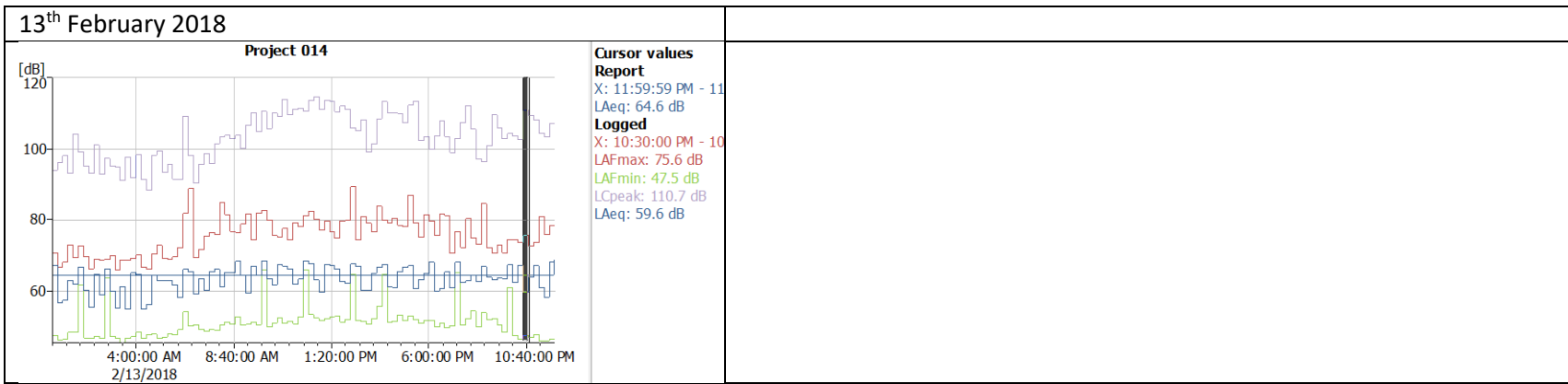
Date	Temperature (°C)			Windspeed (m/s)			Relative Humidity (%)			Barometric Pressure (mb)		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
3/27/2018	27.6	24.2	33.3	1.1	0.0	7.2	70.5	46.9	87.6	1012.1	1010.2	1013.9
3/28/2018	28.1	23.9	34.2	0.5	0.0	4.4	70.4	47.6	86.7	1012.1	1010.5	1013.4
4/2/2018	28	25	32.8	1.3	0.0	4.9	69	48.1	89.9	1012.0	1010.2	1013.4
4/6/2018	28	24	32.6	1.7	0	5.3	67	50.7	95.8	1014	1012.4	1015.7
4/7/2018	28	24	33.4	1.6	0	5.3	76	52	100	1014.4	1012.2	1016
4/8/2018	27	23	34.4	1.9	0	7.5	80	52.7	100	1014.3	1010.5	1016.2
4/10/2018	27	25	33.4	1.5	0	7.6	66	47.9	89.6	1013.9	1012	1016.7

Appendix 2: Graphs of raw noise data

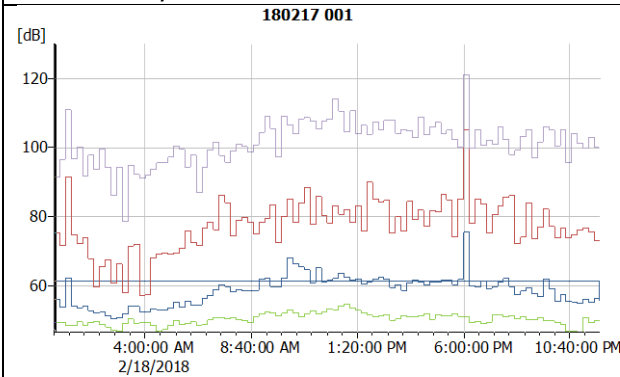
Speightstown Fish Market





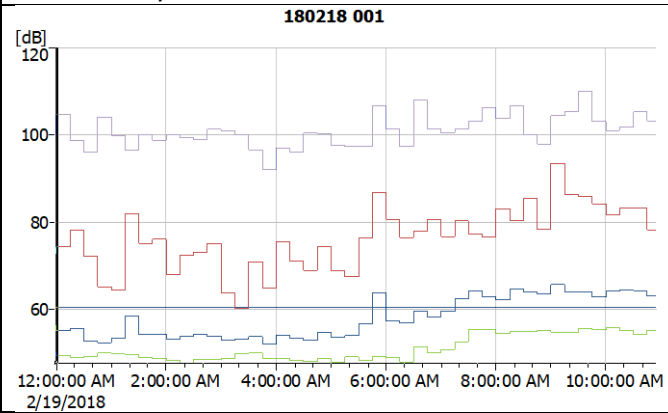


18th February 2018



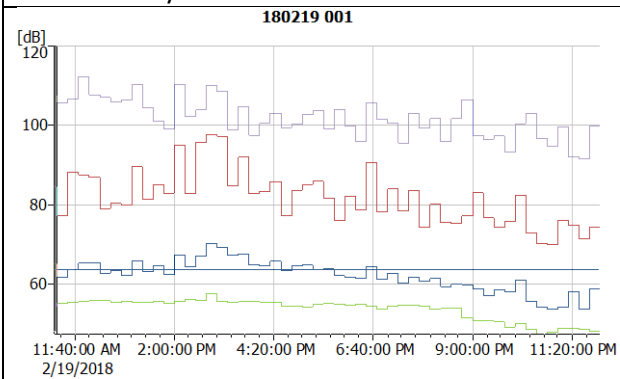
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LAeq: 61.3 dB
Logged
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LAFmax: 72.5 dB
LAFmin: 48.8 dB
LCpeak: 94.3 dB
LAeq: 55.5 dB

19th February 2018



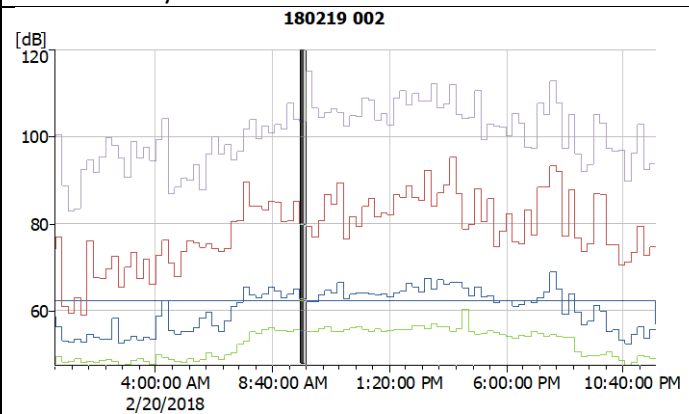
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LAeq: 60.4 dB
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LAFmax: 73.0 dB
LAFmin: 50.0 dB
LCpeak: 100.2 dB
LAeq: 56.3 dB

19th February 2018



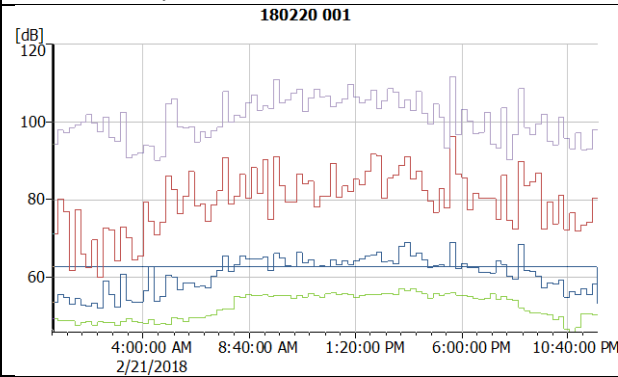
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LAeq: 63.6 dB
Logged
X: 11:10:02 AM - 11:15:00
LAFmax: 84.4 dB
LAFmin: 54.4 dB
LCpeak: 107.3 dB
LAeq: 65.1 dB

20th February 2018



Cursor values
Report
X: 11:59:00 PM - 11:58:00
LAeq: 62.4 dB
Logged
X: 9:45:00 AM - 10:00:00
LAFmax: 80.0 dB
LAFmin: 55.6 dB
LCpeak: 103.6 dB
LAeq: 62.7 dB

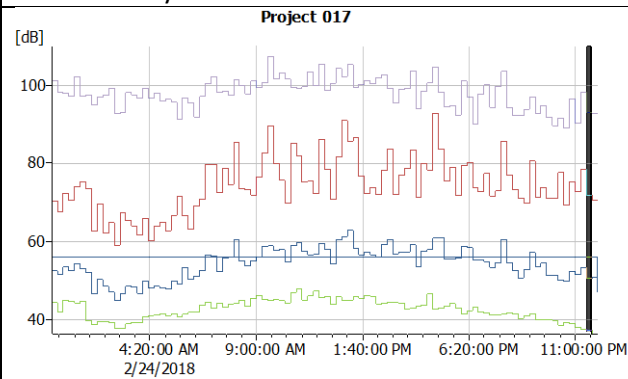
21st February 2018



Cursor values
Report
X: 11:59:00 PM - 11:57:00
LAeq: 62.7 dB
Logged
X: 11:59:00 PM - 12:00:00
LAFmax: 74.7 dB
LAFmin: 49.1 dB
LCpeak: 93.9 dB
LAeq: 55.7 dB

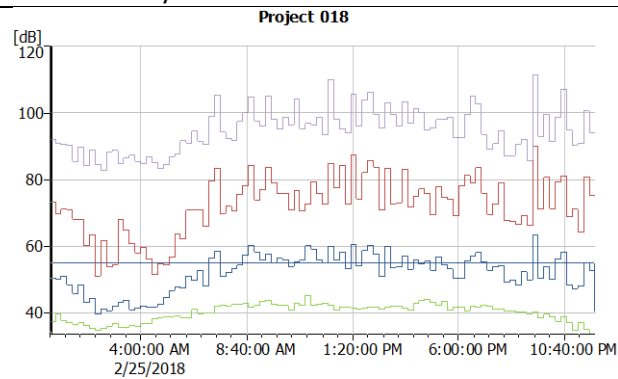
District E Police Station

24th February 2018



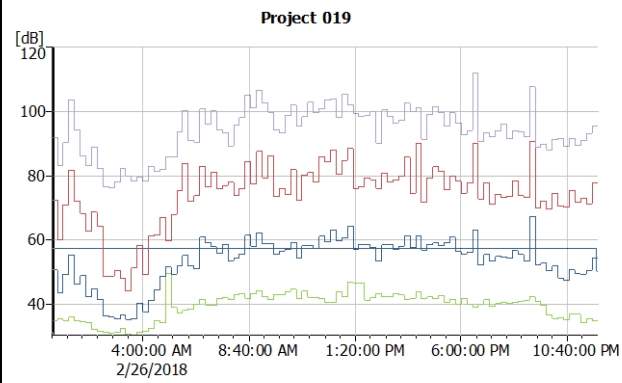
Cursor values
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LAeq: 56.0 dB
Logged
X: 11:30:00 PM - 11:45:00
LAFmax: 71.8 dB
LAFmin: 37.3 dB
LCpeak: 92.9 dB
LAeq: 50.5 dB

25th February 2018



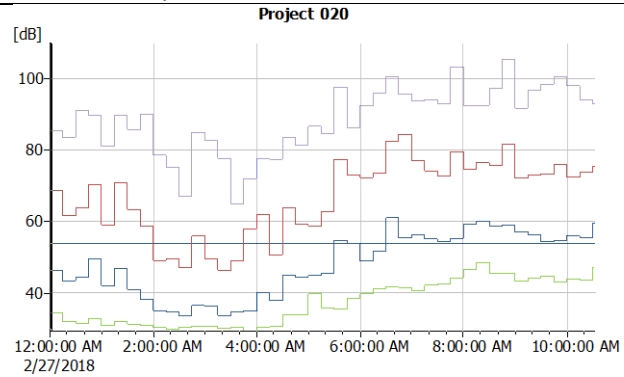
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LAeq: 54.9 dB
Logged
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LAFmax: 70.5 dB
LAFmin: 36.3 dB
LCpeak: 92.7 dB
LAeq: 50.7 dB

26th February 2018



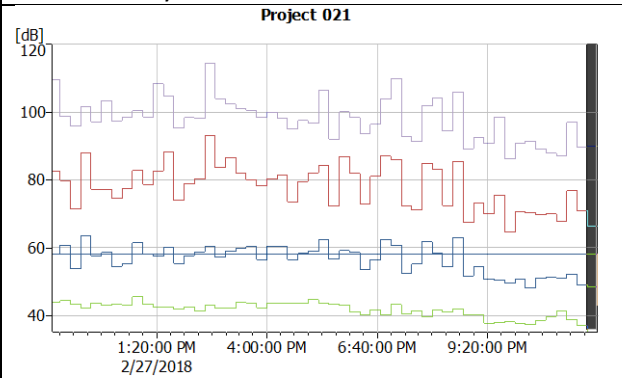
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LAeq: 57.3 dB
Logged
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LAFmax: 75.3 dB
LAFmin: 33.7 dB
LCpeak: 94.0 dB
LAeq: 52.7 dB

27th February 2018



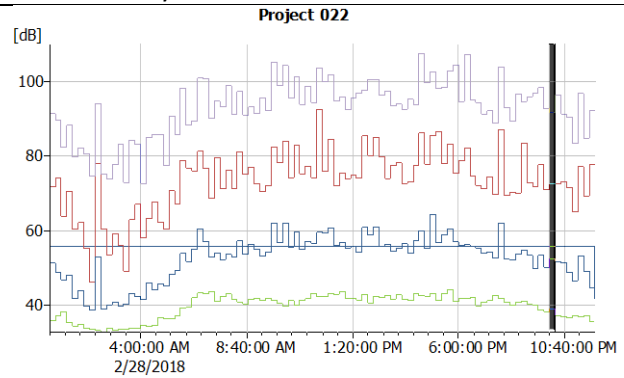
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LAeq: 53.7 dB
Logged
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LAFmax: 77.9 dB
LAFmin: 34.8 dB
LCpeak: 95.5 dB
LAeq: 54.5 dB

27th February 2018



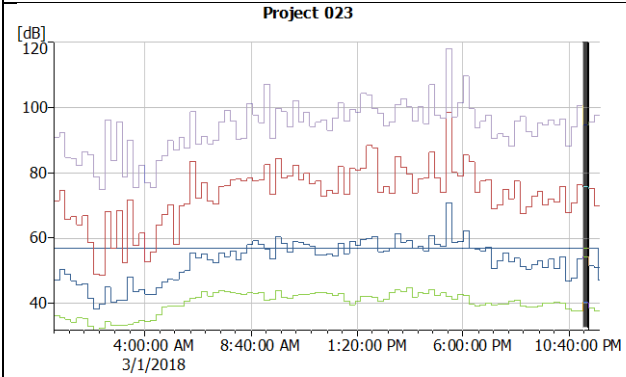
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LAeq: 58.2 dB
Logged
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LAFmax: 66.3 dB
LAFmin: 35.2 dB
LCpeak: 89.9 dB
LAeq: 48.5 dB

28th February 2018

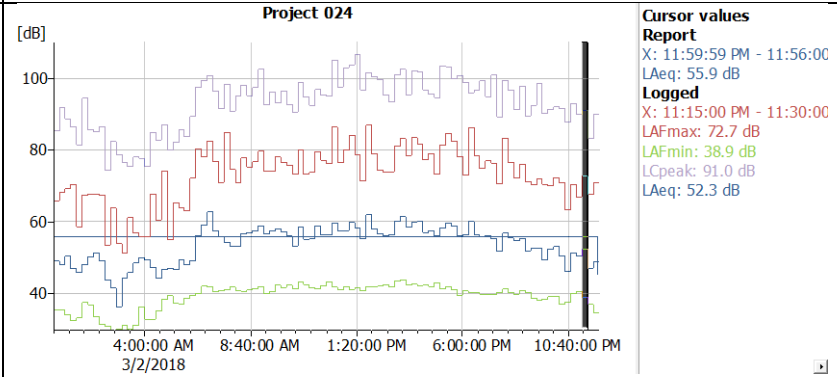


Cursor values Report
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LAeq: 55.8 dB
Logged
X: 10:00:00 PM - 10:15:00
LAFmax: 72.5 dB
LAFmin: 39.1 dB
LCpeak: 91.7 dB
LAeq: 52.6 dB

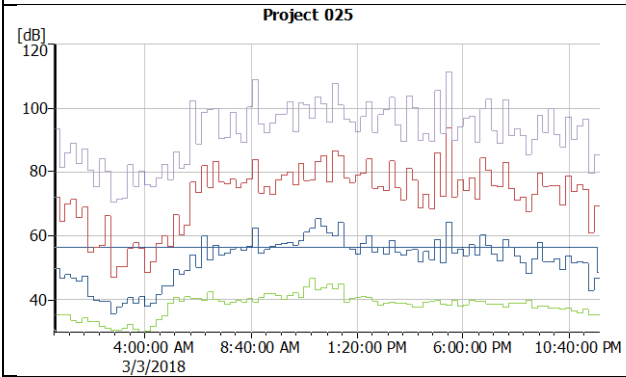
1st March 2018

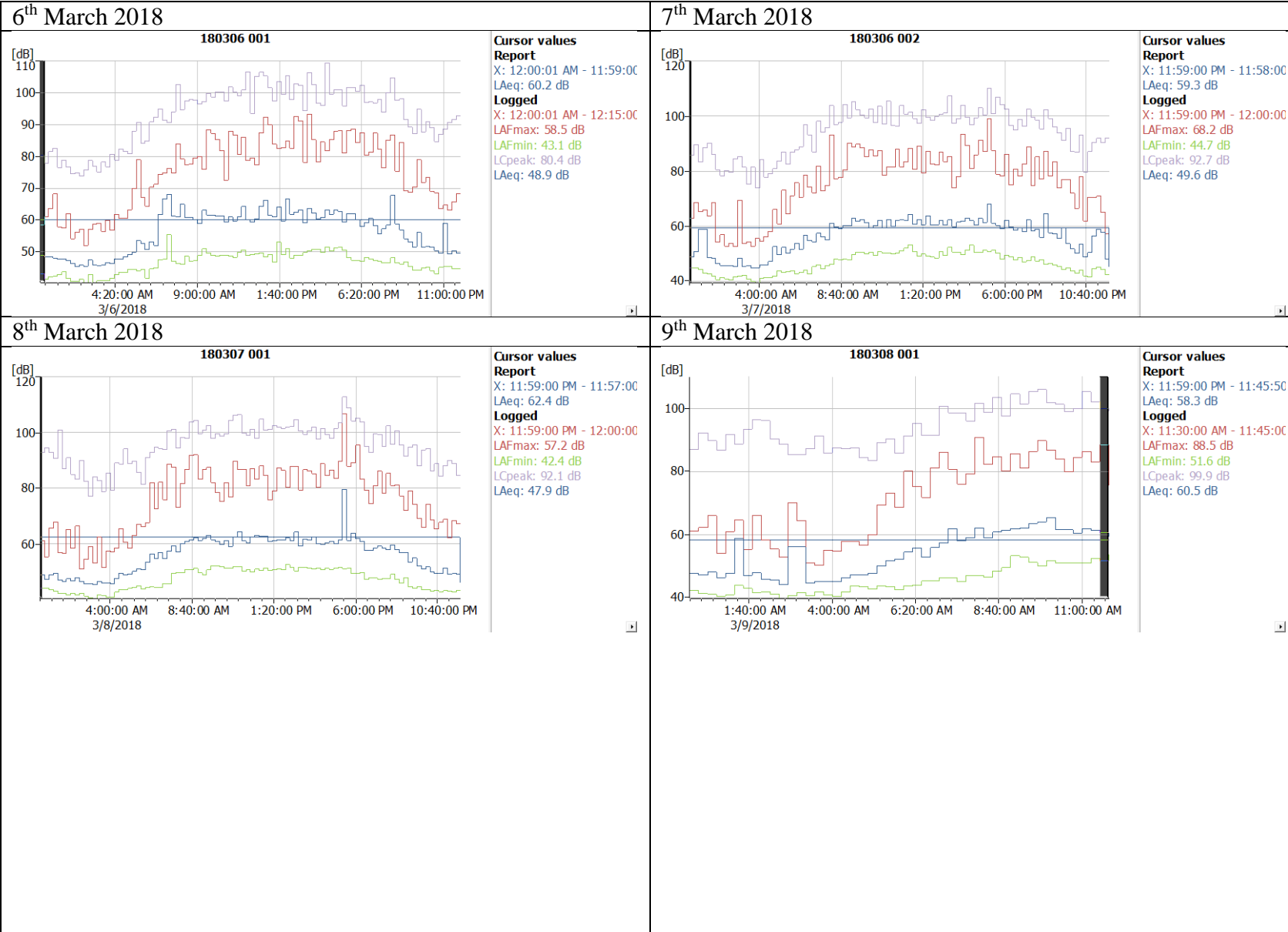


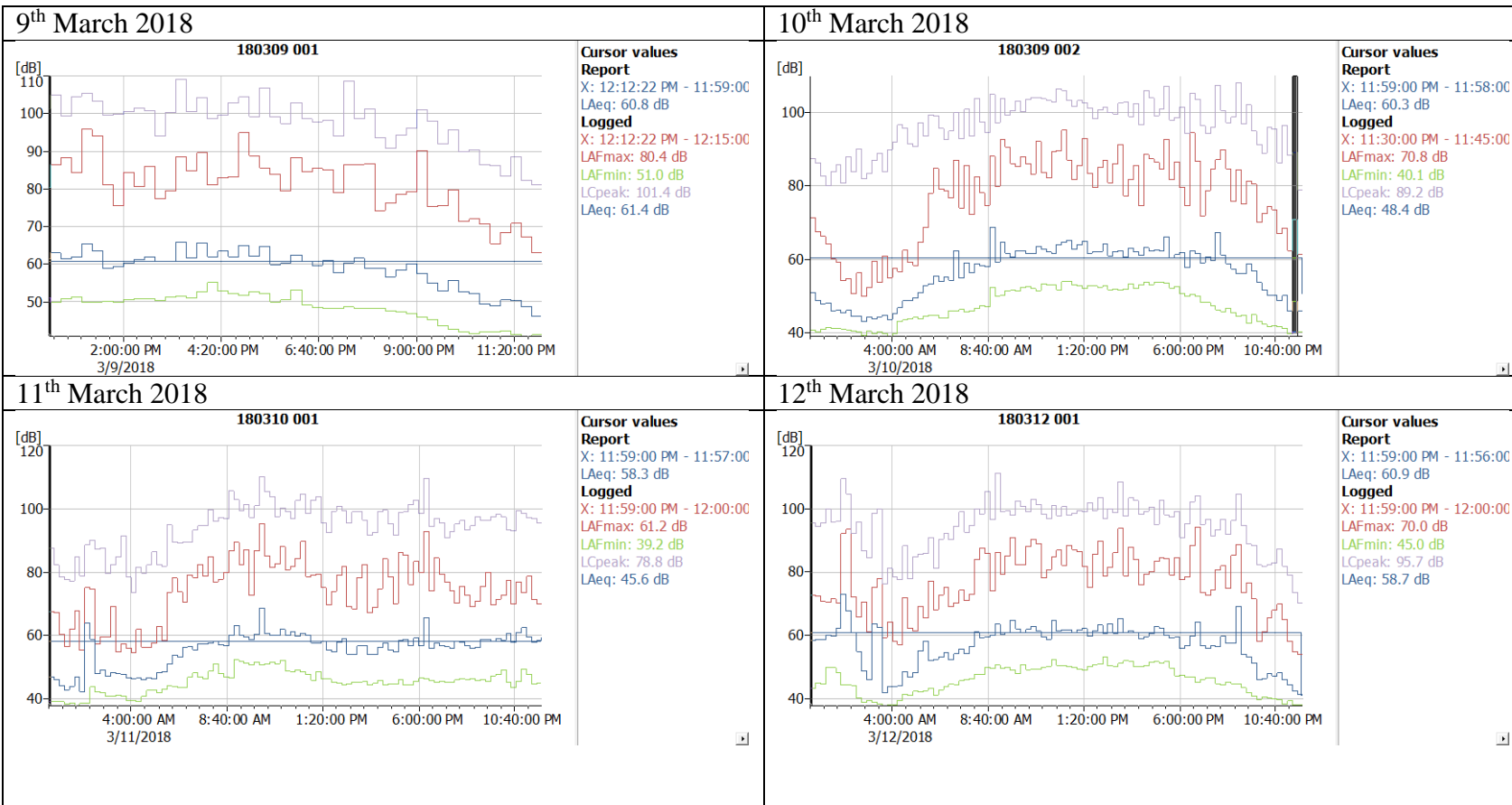
2nd March 2018



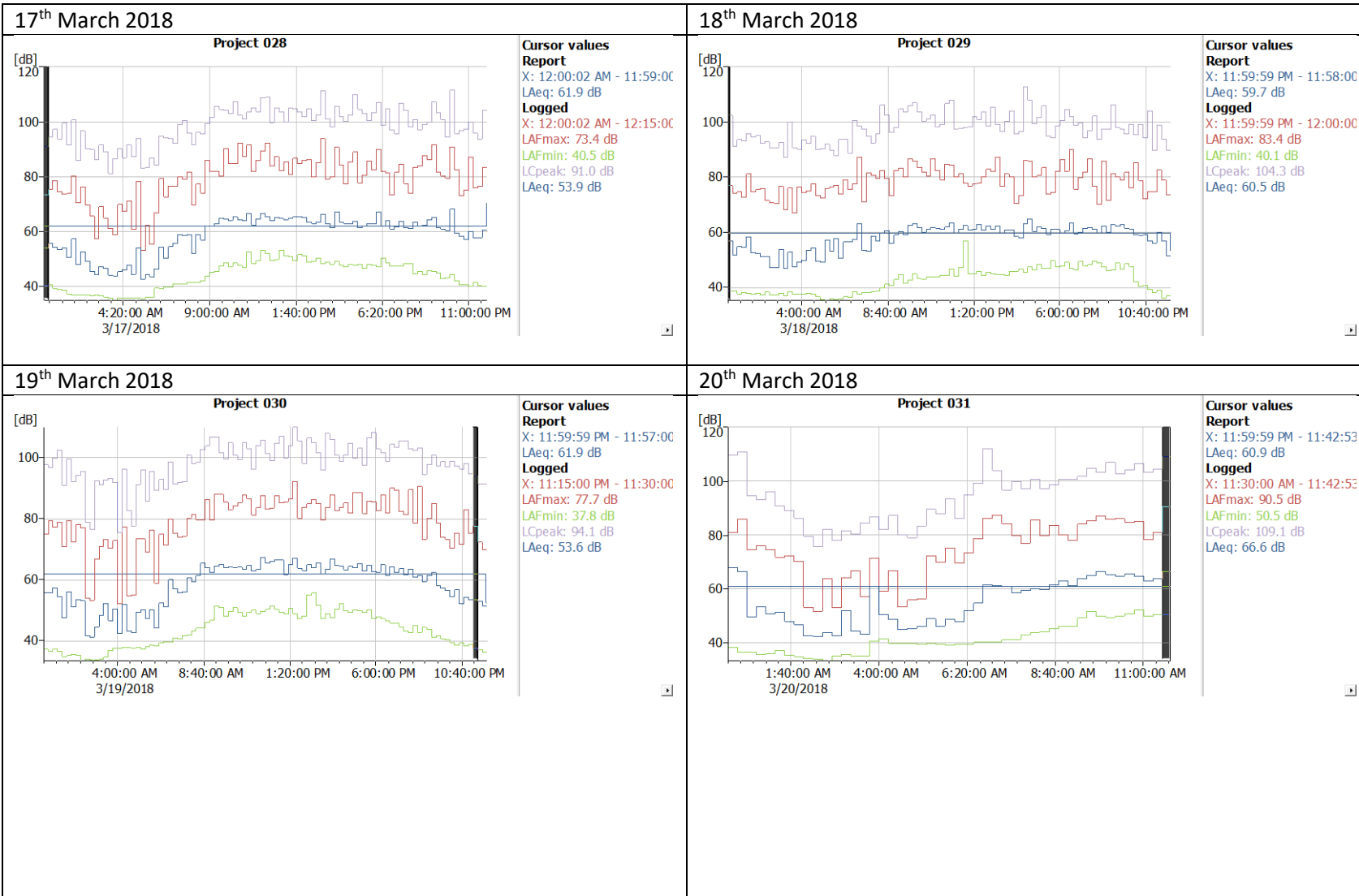
3rd March 2018



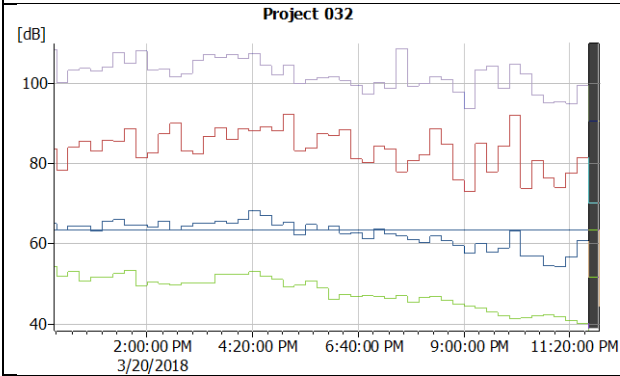




Northern Business Centre

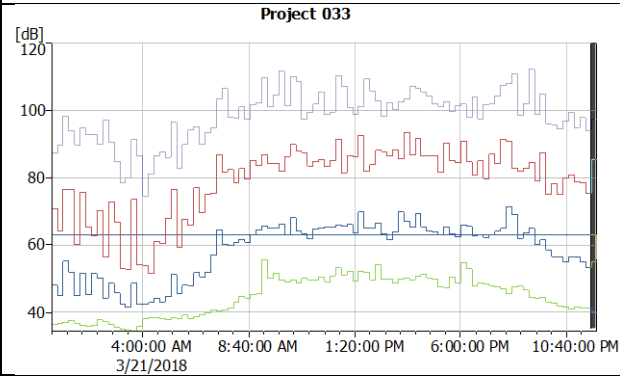


20th March 2018



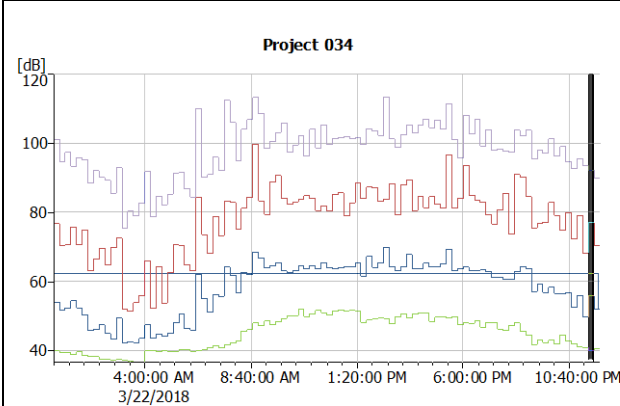
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Logged
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 LAFmin: 38.3 dB
 LCpeak: 90.7 dB
 LAeq: 51.6 dB

21st March 2018



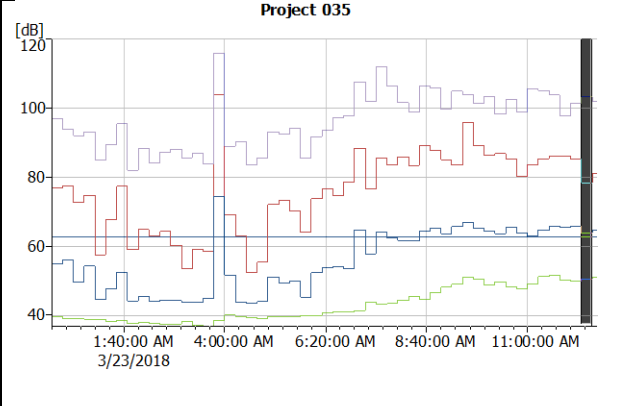
Cursor values Report
 X: 11:59:59 PM - 11:58:00
 LAeq: 63.2 dB
Logged
 X: 11:45:00 PM - 11:59:59
 LAFmax: 85.3 dB
 LAFmin: 40.0 dB
 LCpeak: 97.6 dB
 LAeq: 54.9 dB

22nd March 2018



Cursor values Report
 X: 11:59:59 PM - 11:57:00
 LAeq: 62.2 dB
Logged
 X: 11:30:00 PM - 11:45:00
 LAFmax: 77.1 dB
 LAFmin: 39.9 dB
 LCpeak: 92.2 dB
 LAeq: 55.8 dB

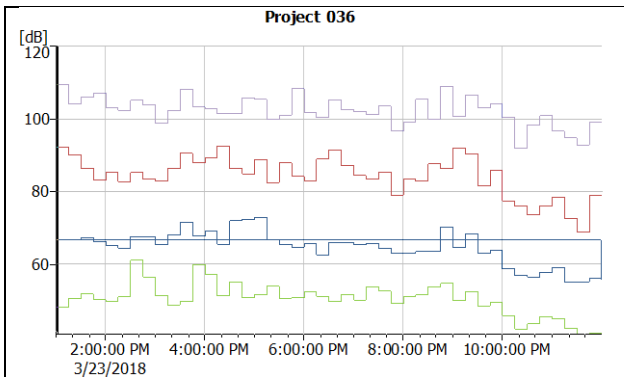
23rd March 2018



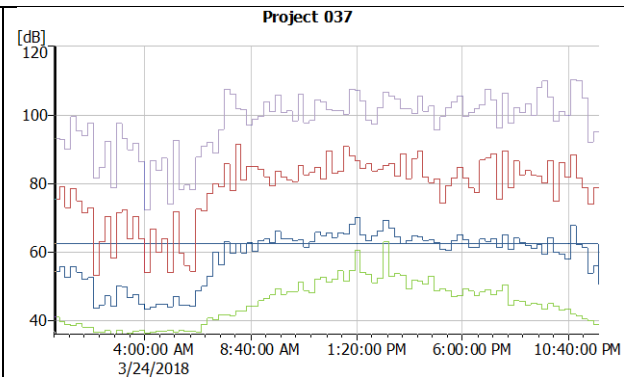
Cursor values Report
 X: 11:59:59 PM - 12:36:34
 LAeq: 62.7 dB
Logged
 X: 12:15:00 PM - 12:30:00
 LAFmax: 78.4 dB
 LAFmin: 50.6 dB
 LCpeak: 103.3 dB
 LAeq: 63.9 dB

23rd March 2018

24th March 2018

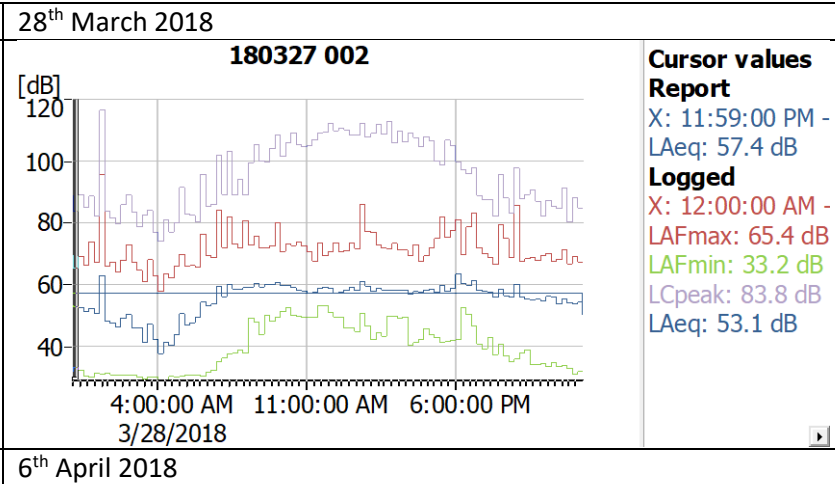
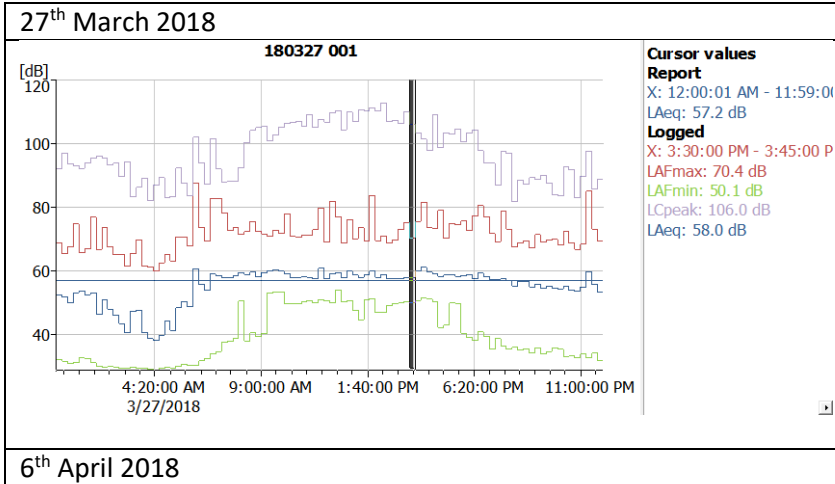


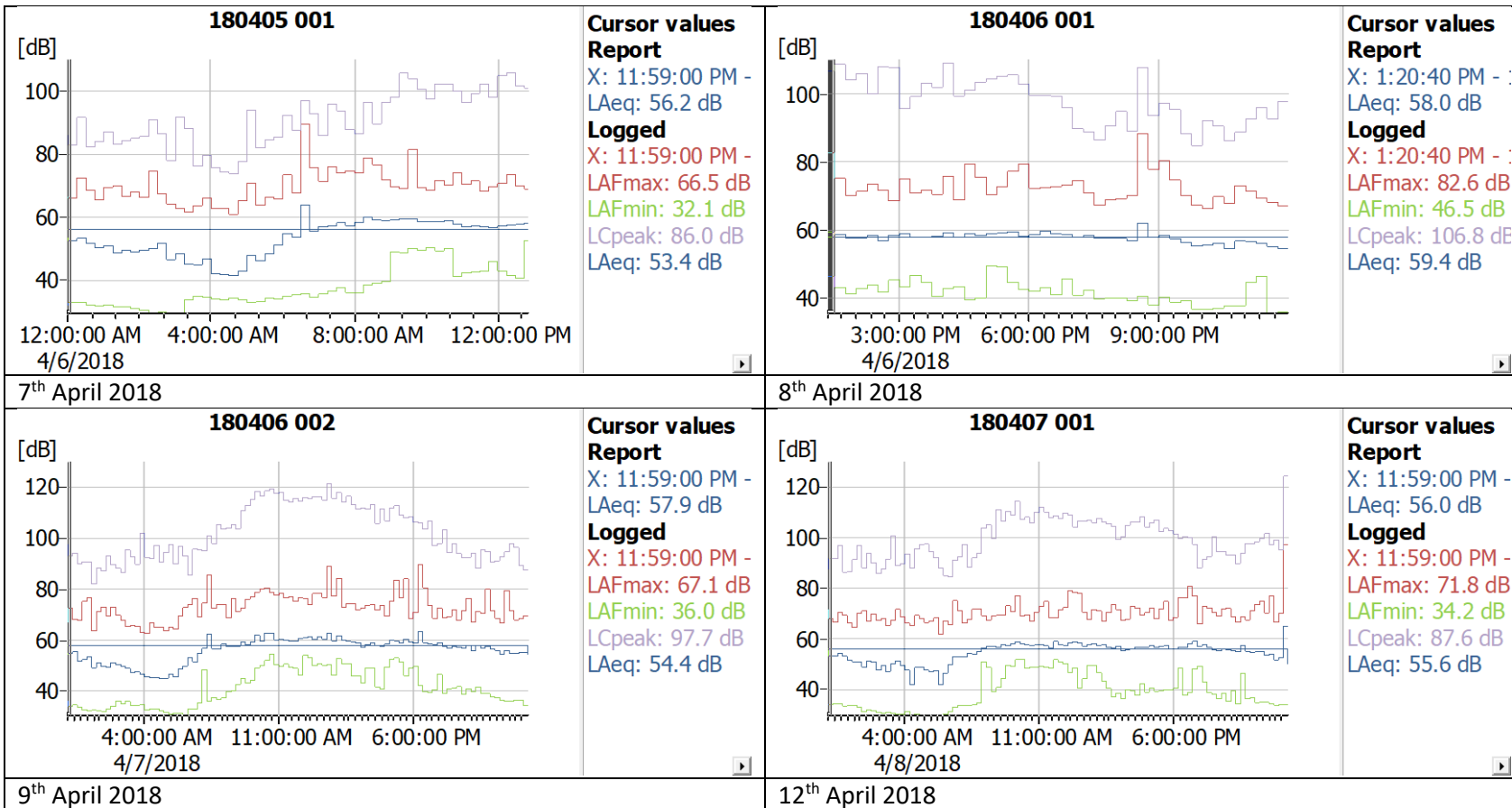
Cursor values Report
 X: 12:59:28 PM - 11:59:00
 LAeq: 66.6 dB
Logged
 X: 12:59:28 PM - 1:00:00 I
 LAFmax: 89.5 dB
 LAFmin: 55.4 dB
 LCpeak: 113.0 dB
 LAeq: 69.5 dB

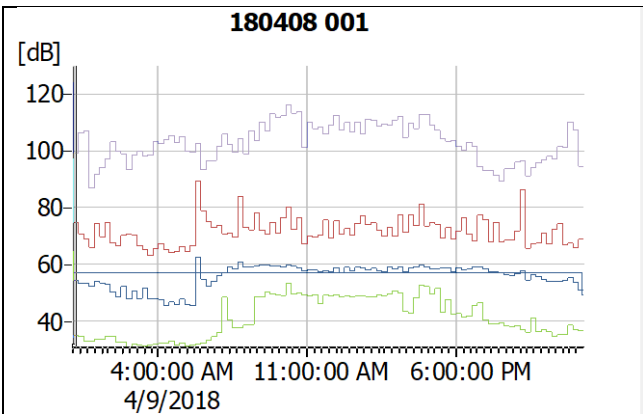


Cursor values Report
 X: 11:59:59 PM - 11:58:00
 LAeq: 62.5 dB
Logged
 X: 11:59:59 PM - 12:00:00
 LAFmax: 78.8 dB
 LAFmin: 41.0 dB
 LCpeak: 99.0 dB
 LAeq: 56.1 dB

Port St. Charles

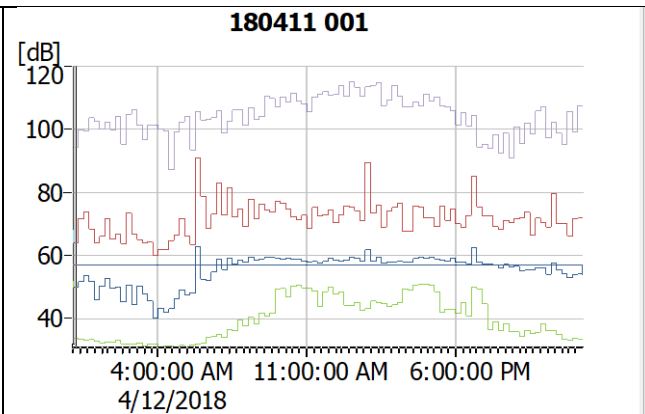






Cursor values Report
 X: 11:59:00 PM -
 LAeq: 57.0 dB

Logged
 X: 11:59:00 PM -
 LAFmax: 97.3 dB
 LAFmin: 34.1 dB
 LCpeak: 124.3 dB
 LAeq: 64.7 dB



Cursor values Report
 X: 11:59:00 PM -
 LAeq: 57.2 dB

Logged
 X: 11:59:00 PM -
 LAFmax: 68.1 dB
 LAFmin: 33.8 dB
 LCpeak: 94.4 dB
 LAeq: 51.8 dB

Appendix 3: Stakeholder Contact List

Name	Title/Position	Address	Contact numbers
<p>Mr. Gray Broome</p> <p>Contact person: Ms. Lopez</p>	<p>Director/ Owner</p>	<p>Pizza Man Doc Cnr Bx and Passage Road St. Michael</p>	<p>[Redacted]</p> <p>[Redacted]</p> <p>[Redacted]</p> <p>[Redacted]</p>
<p>Mr. Major Batson</p> <p>Contact person: Ms. Rosan Innis</p>	<p>Owner</p>	<p>Northern Business Centre Queen's Street Speightstown St. Peter</p>	<p>[Redacted]</p> <p>[Redacted]</p>
<p>Mr. Sherlock King</p> <p>Contact persons: Mr. Horace Hinds and Ms. Webster</p>	<p>Manager of Markets</p>	<p>Manager of Markets Ministry of Agriculture Graeme Hall Christ Church</p>	<p>[Redacted]</p> <p>[Redacted]</p> <p>[Redacted]</p>
<p>Commissioner of Police Royal Barbados Police Force</p>		<p>Commissioner of Police Royal Barbados Police Force</p>	<p>[Redacted]</p>
<p>Inspector Leacock (Holetown)</p>	<p>Inspector</p>	<p>District E Police Station</p>	<p>[Redacted]</p>
<p>Mr. Anthony Edwards</p>	<p>Owner</p>	<p>Eddies Trading Church Street Speightstown St. Peter</p>	<p>[Redacted]</p>
<p>Mr. Jarood Skeete</p> <p>Contact person: Ms. Andrea Jackman</p>	<p>Manager</p>	<p>CEO Common Services Ltd. Port St. Charles Heywoods St. Peter</p>	<p>[Redacted]</p>
<p>Ms. Cadougan Mr. Jason Hurley Ms. Angela Springer</p>	<p>MTW Traffic Section</p>		<p>[Redacted]</p>

**SPEIGHTSTOWN NOISE CHARACTERIZATION STUDY 2018
NOISE MEASUREMENT FORM**

Location Name: _____ GPS Coordinates: N 13 _____ W 59

Address/ Location: _____

Contact person & number:

Site Description: Description of location (Type of area/zone, activities conducted, topography, nature of ground):

Land Use Designation:

Activities:

Topography:

Nature of ground:

Sound Environment Description: Description and location of (major) sources of ambient noise: (cars, amplified music, steady tone, impulsive, etc.):

Sources:

Instruments & Accessories used:

Brüel&Kjær 2270 SLM S/N:.....

Brüel&Kjær 4952 microphone S/N:

Brüel&Kjær 4231 calibrator S/N:

Internal Battery supply: S/N-

External Batteries: Two (2) PC680 (12V) S/N- 0574 4D140520659 & 0769-2016 0314

Windscreen Kestrel Weather monitor Outdoor noise monitoring kit

Other(s): Camera, tripod

General Weather Description

DAY	CLOUDS (/8)	WIND DIRECTION (Degree direction)	WIND SPEED (knots)	DRY BULB (°C)	RH (%)	StN PRESSURE (mbar)	MSL (mbar)	24 HR Rainfall (mm)

Equipment Calibration

Equipment	Calibration Date & Time	Current Sensitivity	Comments
			dB deviation from last
			dB deviation from last
			dB deviation from last
			dB deviation from last
			dB deviation from last

REMEMBER TO:

- Install the SLMs internal battery
- Switch external battery
- Take pictures
- Calibrate SLM
- Re-start meter

Comments

DATE & TIME	COMMENTS

Appendix 5: Instrumentation specifications

Equipment (brand and model)	IEC compliance	Date of last factory calibration
Bruel & Kjaer 2270 SLM* S/N: 3009267	IEC 61672-1:2002 Class 1 IEC 612:1995 w. Am. 1, 1/1 and 1/3 Oct Band Class 0 IEC 60804:200 Type 1 IEC 60651:1979 w. Am.1&2 Type 1	31 st Oct 2017
Bruel & Kjaer 2270 SLM* S/N: 3009263	IEC 61672-1:2002 Class 1 IEC 612:1995 w. Am. 1, 1/1 and 1/3 Oct Band Class 0 IEC 60804:200 Type 1 IEC 60651:1979 w. Am.1&2 Type 1	1 st Nov 2017
Bruel & Kjaer 4952 microphone S/N: 3052521	IEC 61672 Class 1 ANSI S 1.40 -1984	25 th Oct 2017
Bruel & Kjaer 4952 microphone S/N: 3080409	IEC 61672 Class 1 ANSI S 1.40 -1984	25 th Oct 2017
Bruel & Kjaer 4231 calibrator S/N: 2085222	IEC 942 ,1988 Class 1 ANSI S 1.40 -1984	23 rd Oct 2017
Bruel & Kjaer 4231 calibrator S/N: 2528279	IEC 942 ,1988 Class 1 ANSI S 1.40 -1984	21 st March 2018

*SLM- sound level meter,

Appendix 6: Dates traffic counters were deployed

Location	Traffic Counts
Fish Market	6-12 th April 2018
Pizza Man Doc	7 th -13 th March 2018
District E Police Station	20 th – 26 th June 2018
Eddies Trading	8 th -14 th March 2018
Northern Business Centre	14 th -20 th March 2018
Port St. Charles	15 th -21 st March 2018

Appendix 7: Traffic Counts

Start Time	Speightstown Fish Market							Pizza Man Doc							District E Police Station						
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
0:00	11	17	2	6	1	4	3	6	4	5	3	3	3	11	18	7	5	1	0	2	5
0:15	5	16	3	5	0	3	2	3	2	3	2	1	2	3	18	6	2	1	3	2	3
0:30	3	13	2	2	0	0	2	1	0	0	1	2	3	4	11	5	3	0	2	1	5
0:45	6	5	2	0	0	0	1	2	2	0	1	5	2	5	13	5	2	3	1	0	6
1:00	2	3	0	0	2	0	3	1	1	1	0	0	1	2	6	5	0	0	1	0	0
1:15	4	2	1	1	1	0	1	2	1	1	1	1	1	7	8	1	1	0	0	1	1
1:30	2	4	1	1	0	1	1	0	0	0	1	1	1	1	7	5	1	0	0	2	3
1:45	3	10	0	2	2	0	2	0	1	0	0	2	1	0	2	2	1	0	0	0	1
2:00	16	6	0	0	3	1	2	0	1	0	0	1	0	0	5	10	1	0	0	0	2
2:15	6	1	0	1	1	0	0	1	2	2	0	0	0	0	1	5	0	0	0	0	1
2:30	0	5	0	0	0	0	0	0	1	0	1	0	0	1	1	1	0	1	0	1	0
2:45	2	2	1	0	1	0	0	0	0	2	1	1	0	1	2	2	0	0	0	0	0
3:00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	11	0	0	0	0	1
3:15	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0
3:30	0	1	0	1	0	1	1	0	0	0	1	1	1	2	2	3	0	0	0	1	0
3:45	1	1	0	0	2	0	0	1	0	1	1	0	1	0	0	3	0	0	1	0	1
4:00	1	1	0	1	1	1	0	1	1	1	2	1	1	2	2	0	0	0	0	0	0
4:15	0	1	0	0	1	1	0	0	0	0	0	1	1	0	0	3	0	0	0	1	0
4:30	1	1	0	1	1	0	2	1	1	2	2	1	0	0	1	0	0	2	1	0	0
4:45	1	2	1	2	1	0	0	3	1	0	2	0	2	0	0	0	0	1	2	0	0
5:00	1	1	3	2	0	0	0	0	1	1	1	0	1	0	1	3	1	1	2	0	0
5:15	1	3	1	2	4	5	1	2	2	1	2	0	1	3	3	1	1	2	3	2	1
5:30	0	3	1	1	4	3	1	1	9	2	1	2	3	4	2	3	3	2	0	0	0
5:45	4	1	1	5	6	6	3	5	3	1	3	2	2	2	1	4	2	3	4	3	1
6:00	8	10	4	12	6	15	5	5	9	6	9	5	7	2	1	5	4	4	2	5	3

Start Time	Speightstown Fish Market							Pizza Man Doc							District E Police Station						
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
6:15	3	9	8	5	10	6	7	4	7	6	9	4	5	8	2	7	3	3	2	4	2
6:30	12	10	14	14	12	11	5	7	10	13	11	10	14	3	5	7	5	9	6	7	9
6:45	6	10	12	11	5	21	8	10	11	18	12	13	22	5	4	6	3	9	3	9	7
7:00	17	20	16	22	15	14	8	10	20	25	23	20	25	11	9	12	8	10	8	10	4
7:15	25	11	12	17	21	17	11	26	22	26	17	28	27	7	6	14	11	8	3	12	3
7:30	10	30	21	19	15	34	21	18	26	39	23	23	20	15	6	13	11	7	7	8	8
7:45	15	31	36	22	27	33	22	10	42	39	37	29	40	23	12	10	11	8	5	13	5
8:00	16	30	37	24	37	19	21	16	68	64	75	58	50	37	6	12	14	11	10	13	16
8:15	19	38	39	23	30	36	40	13	84	72	97	87	70	58	9	17	20	12	15	26	7
8:30	23	47	33	30	32	36	30	18	99	101	104	82	98	35	5	23	18	19	11	30	10
8:45	25	40	42	37	39	41	29	23	76	87	79	88	76	48	10	20	14	12	10	25	9
9:00	60	29	41	42	36	52	50	45	59	45	60	74	54	39	32	20	20	15	10	35	13
9:15	43	38	40	51	33	64	74	42	54	71	66	47	63	47	31	24	21	6	9	20	10
9:30	40	53	48	31	48	60	57	41	66	56	46	48	68	47	17	15	10	10	7	20	26
9:45	30	43	49	40	41	50	48	59	59	62	46	68	44	64	14	9	14	7	8	18	17
10:00	46	61	40	32	52	58	52	45	56	58	69	58	65	55	12	22	23	7	5	17	17
10:15	43	49	55	43	48	55	52	53	46	72	55	55	57	56	6	10	21	10	5	16	23
10:30	48	54	37	41	43	44	54	53	58	68	57	59	75	60	23	18	19	5	8	22	20
10:45	39	60	69	38	52	41	67	46	57	70	70	57	81	67	14	15	26	4	14	18	28
11:00	29	42	57	42	57	54	66	58	55	70	52	80	78	61	20	18	17	6	10	20	23
11:15	67	55	41	40	51	64	70	53	57	61	62	63	70	77	16	11	20	9	18	16	13
11:30	47	49	35	49	56	41	48	63	76	75	71	77	83	75	21	17	21	5	13	20	12
11:45	62	45	53	44	44	46	62	50	59	51	75	63	74	68	11	12	24	5	19	25	18
12:00	43	31	64	55	68	67	63	49	62	61	60	63	71	75	19	15	21	9	18	21	20
12:15	66	40	39	57	65	61	86	39	83	62	70	62	58	78	14	14	19	13	10	15	25
12:30	40	38	52	55	46	70	69	42	47	69	69	69	70	62	13	17	15	5	11	25	16
12:45	38	28	56	57	47	69	89	44	70	51	68	76	56	69	11	12	17	8	10	14	29
13:00	36	39	54	43	52	56	84	42	40	53	59	71	55	61	16	12	18	11	16	24	17

Start Time	Speightstown Fish Market							Pizza Man Doc							District E Police Station						
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
13:15	31	60	47	47	49	75	70	47	50	53	56	70	60	77	10	21	12	11	22	19	22
13:30	35	64	51	53	49	46	62	44	61	47	48	59	64	63	9	9	23	6	11	19	29
13:45	22	48	42	57	48	66	40	37	48	75	58	62	55	58	8	16	17	11	22	11	33
14:00	31	43	42	61	34	57	65	21	57	55	83	74	55	60	14	13	16	8	13	21	30
14:15	27	46	46	65	49	61	58	27	53	63	70	55	57	52	14	20	17	15	20	29	27
14:30	33	44	38	55	55	57	48	24	63	64	72	68	68	56	5	14	13	6	18	16	25
14:45	32	49	41	60	56	45	64	48	66	67	61	80	80	55	4	20	16	10	18	15	19
15:00	37	46	43	55	56	53	48	31	88	63	67	79	75	57	10	20	10	11	15	20	16
15:15	49	44	48	57	40	62	62	34	95	59	72	63	91	64	8	23	21	14	13	21	15
15:30	51	40	77	52	48	64	40	40	68	63	55	78	71	74	16	25	19	10	19	26	17
15:45	42	59	60	55	51	87	47	36	68	66	49	62	69	122	14	17	14	10	9	23	24
16:00	44	53	58	63	46	80	49	36	79	58	64	58	79	54	15	17	24	13	14	39	18
16:15	48	61	52	54	70	73	47	50	48	70	57	60	97	57	16	14	20	14	19	20	21
16:30	42	57	62	57	56	65	55	40	56	67	60	85	95	59	12	26	25	12	16	16	13
16:45	47	61	63	71	66	73	49	43	75	65	70	74	65	70	9	24	21	16	15	31	11
17:00	51	81	56	56	82	47	61	39	74	64	66	60	80	71	13	30	22	19	23	19	17
17:15	27	73	60	67	89	63	48	58	75	59	68	77	69	56	12	21	15	6	21	31	12
17:30	46	44	67	36	74	75	60	45	44	59	54	57	62	41	17	14	19	21	17	31	25
17:45	60	51	43	58	71	58	59	49	50	58	56	51	71	47	23	18	16	11	12	26	24
18:00	50	53	47	60	51	75	71	51	58	57	46	46	61	58	13	32	23	10	22	31	33
18:15	46	41	56	45	43	51	58	48	53	50	61	54	61	63	30	19	24	10	29	15	14
18:30	45	48	54	46	67	46	56	37	70	33	44	50	65	52	18	14	20	5	17	27	20
18:45	66	36	38	51	50	55	47	49	36	50	47	40	54	44	16	11	17	9	16	25	14
19:00	38	37	49	38	44	56	71	37	42	28	54	55	49	49	16	15	17	4	17	18	27
19:15	40	40	35	27	32	45	57	45	48	40	29	30	43	46	23	14	14	9	15	21	22
19:30	35	43	43	44	49	45	31	29	42	27	44	36	33	39	14	10	20	7	19	21	14
19:45	34	32	48	40	51	54	41	19	47	35	40	47	31	46	18	14	20	9	6	14	25
20:00	23	25	40	22	36	37	47	23	34	27	41	29	40	41	22	20	17	9	14	14	23

Start Time	Speightstown Fish Market							Pizza Man Doc							District E Police Station						
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
20:15	21	23	30	20	23	42	34	27	25	17	22	36	43	48	7	19	11	3	14	18	15
20:30	23	19	29	25	32	22	65	17	10	20	22	26	41	34	12	12	17	2	13	19	13
20:45	11	14	21	10	38	20	38	11	20	20	14	24	35	22	8	7	17	15	26	20	18
21:00	17	17	9	11	13	15	36	13	14	15	29	26	33	26	7	4	8	3	7	15	25
21:15	9	13	12	9	11	28	21	19	9	18	26	20	20	24	5	6	5	8	7	12	21
21:30	14	13	11	6	16	17	15	14	14	18	20	18	19	25	17	4	7	3	4	4	27
21:45	9	7	10	10	11	21	10	13	5	17	12	13	25	19	10	6	9	4	4	7	18
22:00	9	8	10	8	11	13	15	24	3	11	16	15	16	16	5	4	9	2	3	14	19
22:15	19	7	3	6	9	12	11	30	8	7	11	12	14	20	9	3	5	4	4	12	11
22:30	11	3	5	5	10	16	6	14	6	14	7	4	10	6	2	5	2	6	4	6	12
22:45	12	4	5	10	5	16	10	15	5	8	8	9	10	10	11	2	1	2	6	8	14
23:00	19	5	3	11	4	9	15	7	4	6	8	7	11	11	2	7	1	1	1	5	8
23:15	7	3	5	3	10	11	6	7	4	0	6	4	4	11	11	4	4	0	3	10	15
23:30	15	4	1	5	4	9	9	6	1	1	0	5	7	7	10	1	2	4	1	10	8
23:45	8	1	4	2	0	7	15	3	3	3	4	5	7	8	6	3	2	1	0	5	13

Start Time	Eddies Trading							Northern Business Centre							Port St. Charles					
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri
0:00	3	0	0	1	1	3	12	1	3	0	2	4	4	26	33	16	22	18	32	34
0:15	2	0	2	0	0	4	8	3	4	2	1	3	6	31	16	10	13	10	18	19
0:30	2	0	1	0	1	1	8	6	2	1	3	0	6	23	17	12	16	15	13	31
0:45	2	0	0	0	0	1	3	2	1	0	3	0	3	21	11	10	7	12	17	16
1:00	1	0	1	0	0	0	2	4	0	2	5	1	6	20	18	6	10	9	10	26
1:15	0	0	0	0	0	1	1	0	0	0	2	0	4	11	15	4	7	18	7	18
1:30	0	0	1	1	0	0	1	1	1	4	2	2	1	10	8	2	7	12	10	16
1:45	0	0	0	0	1	0	2	0	0	0	1	0	1	10	3	5	4	5	4	14
2:00	0	0	0	2	1	0	2	4	0	1	0	0	1	8	7	4	7	4	5	10
2:15	1	0	0	0	0	0	2	2	0	0	0	1	0	9	2	5	3	5	6	14
2:30	0	0	0	0	0	0	1	2	0	0	1	0	0	2	3	5	2	7	2	11
2:45	1	0	0	0	1	0	3	1	0	0	0	0	1	5	8	2	1	2	3	7
3:00	0	0	0	0	0	0	1	0	0	0	0	0	1	6	7	4	3	2	4	7
3:15	0	0	0	0	0	0	8	2	0	2	0	0	1	10	4	0	1	1	3	5
3:30	0	0	0	0	0	0	4	0	0	0	0	1	2	2	8	2	3	1	5	7
3:45	1	0	1	0	0	0	3	0	0	1	0	0	0	5	2	2	0	4	2	6
4:00	0	0	0	0	0	0	3	1	0	1	0	1	2	3	6	6	4	4	4	8
4:15	0	0	0	0	0	0	3	3	1	1	1	0	0	3	5	6	3	6	4	5
4:30	0	0	0	1	0	0	1	0	0	0	2	0	0	7	7	8	8	7	8	8
4:45	0	0	0	0	0	0	0	1	0	2	1	1	0	7	15	10	16	7	10	5
5:00	0	0	0	0	0	0	2	0	0	2	0	1	1	7	14	18	14	15	17	9
5:15	2	1	0	0	2	0	2	7	5	1	5	5	4	12	19	15	14	14	13	16
5:30	0	0	0	1	1	2	2	3	4	5	1	3	1	21	26	26	23	25	30	26
5:45	0	1	0	0	1	2	5	6	6	7	8	5	1	22	26	27	32	29	35	23
6:00	1	0	1	2	1	2	6	12	6	13	7	11	8	39	57	45	48	47	45	40
6:15	1	2	7	5	8	5	6	9	16	9	13	9	8	41	78	85	77	70	79	46
6:30	6	4	2	4	2	4	4	10	12	13	19	27	8	40	99	80	92	115	97	55
6:45	3	7	4	9	5	5	10	18	16	18	14	23	8	47	104	124	125	104	121	55

Start Time	Eddies Trading							Northern Business Centre							Port St. Charles						
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	
7:00	9	8	7	4	8	8	21	18	28	18	18	21	3	51	165	136	118	127	135	53	
7:15	9	16	9	8	15	4	20	24	21	25	26	18	16	70	121	131	138	118	124	78	
7:30	8	16	13	11	14	10	11	35	33	36	35	32	18	60	120	127	120	128	125	74	
7:45	20	16	13	18	20	18	11	38	44	29	45	37	36	77	146	150	147	124	148	107	
8:00	29	21	25	29	30	28	24	44	46	44	45	62	41	86	158	135	136	141	145	94	
8:15	34	27	44	39	37	36	26	68	82	70	61	69	42	92	171	155	172	132	147	94	
8:30	43	37	35	46	37	27	25	79	79	68	70	60	45	83	169	156	158	120	148	100	
8:45	45	44	48	43	51	49	42	73	86	70	68	74	60	105	143	129	166	129	155	122	
9:00	46	35	35	44	35	35	67	98	68	69	79	76	75	105	142	146	132	121	136	134	
9:15	41	48	41	47	44	41	66	65	67	72	70	84	88	103	133	109	117	120	134	122	
9:30	36	34	39	33	36	31	46	74	69	75	59	79	69	97	112	111	95	113	123	106	
9:45	29	37	34	34	45	36	53	64	76	62	62	82	73	100	108	107	104	107	92	126	
10:00	44	38	36	35	39	43	45	74	63	67	53	68	76	111	121	94	108	86	100	125	
10:15	32	28	21	32	45	53	53	61	74	53	65	92	84	109	116	93	98	107	111	123	
10:30	33	28	34	33	39	40	56	69	55	87	53	69	86	94	98	86	103	113	118	140	
10:45	33	32	32	35	45	51	64	65	58	81	78	80	87	130	115	95	122	111	117	148	
11:00	32	28	33	30	45	49	46	83	73	85	75	88	111	103	87	88	93	93	122	134	
11:15	26	27	38	39	40	47	53	72	87	74	82	63	81	106	93	123	122	120	116	127	
11:30	37	33	32	39	43	45	52	75	67	61	81	90	89	103	111	103	126	123	99	156	
11:45	28	36	28	32	34	55	71	88	91	77	86	89	103	116	105	119	105	113	132	152	
12:00	41	35	40	40	38	49	58	66	93	70	78	104	87	122	116	135	115	126	119	147	
12:15	35	41	49	55	32	58	65	74	93	81	88	102	92	126	120	122	115	146	130	137	
12:30	41	34	39	54	45	61	60	70	83	73	68	104	105	104	103	109	105	96	130	146	
12:45	24	35	37	50	35	49	44	72	84	76	71	96	106	126	101	109	109	107	122	155	
13:00	36	36	36	34	52	52	43	70	80	72	74	95	76	126	115	99	114	103	138	157	
13:15	30	29	44	36	36	61	54	75	53	73	73	89	103	101	98	104	120	120	135	140	
13:30	28	23	31	38	32	63	52	85	58	70	75	84	94	97	113	109	111	106	132	147	
13:45	28	37	24	34	31	73	44	80	74	78	70	70	88	102	96	130	104	96	110	147	

Start Time	Eddies Trading							Northern Business Centre							Port St. Charles						
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	
14:00	36	27	40	46	26	52	39	66	82	73	68	83	71	100	100	105	118	101	119	143	
14:15	33	35	27	39	34	51	32	81	79	53	55	96	81	93	123	107	122	102	106	133	
14:30	44	31	35	32	36	39	38	63	60	87	80	74	61	66	94	136	100	103	112	124	
14:45	38	30	24	37	41	43	34	81	74	79	71	76	84	92	144	129	105	115	143	138	
15:00	46	38	22	33	31	40	36	82	61	90	61	74	68	119	174	116	150	141	124	127	
15:15	48	42	35	38	50	44	42	75	81	72	63	98	78	98	141	165	142	126	170	119	
15:30	29	37	33	43	42	42	42	76	71	77	74	110	81	105	136	128	142	134	154	136	
15:45	36	27	33	29	51	38	38	67	69	66	62	80	95	111	121	142	124	141	130	141	
16:00	28	38	28	37	54	44	41	72	77	93	67	86	79	109	134	125	117	106	173	150	
16:15	24	34	33	37	37	40	43	81	74	68	60	77	72	104	129	119	141	116	139	134	
16:30	51	38	43	42	58	43	37	87	80	79	71	101	69	105	140	146	147	138	159	141	
16:45	37	41	45	38	57	44	44	88	83	98	89	92	73	116	145	152	142	157	152	129	
17:00	47	48	38	42	44	45	52	91	73	86	81	89	88	116	172	146	171	133	153	138	
17:15	33	51	33	39	54	45	38	79	66	79	93	97	74	103	139	150	140	144	173	134	
17:30	30	37	30	22	30	31	46	72	69	63	73	85	95	117	148	138	142	154	167	122	
17:45	20	31	35	46	37	35	43	73	67	79	76	98	77	135	139	155	139	159	152	124	
18:00	31	28	34	28	48	35	41	53	53	71	61	91	74	126	146	150	142	142	163	133	
18:15	24	32	34	40	42	27	32	47	71	59	59	103	65	140	129	142	141	137	166	145	
18:30	35	28	30	22	49	41	51	62	67	61	52	89	61	115	144	136	158	130	142	145	
18:45	23	20	27	18	39	29	39	72	44	47	66	78	66	120	119	107	129	130	150	146	
19:00	28	19	31	30	26	36	35	49	56	66	60	69	62	112	111	103	117	117	143	146	
19:15	23	27	21	23	33	37	33	49	62	65	58	62	60	96	112	105	123	128	150	139	
19:30	20	29	22	17	23	40	26	51	40	61	55	59	69	91	93	89	93	115	131	142	
19:45	18	17	24	22	28	28	20	62	46	61	40	49	62	109	78	88	85	93	114	132	
20:00	19	21	19	33	23	26	29	30	35	46	23	54	43	87	97	81	84	93	135	114	
20:15	22	19	16	14	25	30	25	31	19	36	32	54	56	97	75	73	71	96	108	98	
20:30	10	15	20	14	22	23	13	26	25	27	29	41	50	84	90	92	75	83	109	128	
20:45	18	14	20	13	24	26	18	22	24	30	23	53	55	72	64	81	80	77	108	111	

Start Time	Eddies Trading							Northern Business Centre							Port St. Charles						
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	
21:00	7	6	11	12	20	19	16	16	8	28	17	43	33	83	63	76	74	65	112	122	
21:15	9	2	5	9	13	15	15	16	17	16	26	35	34	63	79	73	87	83	105	123	
21:30	6	7	8	6	13	9	12	12	15	22	10	25	34	62	51	59	51	76	81	66	
21:45	2	5	4	3	16	11	19	9	7	9	15	22	26	54	69	59	64	60	72	79	
22:00	0	2	5	4	9	3	11	10	9	15	19	22	27	54	59	60	50	71	75	100	
22:15	3	0	5	1	4	3	11	8	14	10	16	9	19	70	54	56	56	51	74	79	
22:30	1	0	2	4	5	2	13	8	10	3	5	9	16	40	31	38	34	49	59	67	
22:45	2	1	1	2	5	1	7	7	5	9	12	15	15	43	45	39	43	46	55	53	
23:00	0	1	3	3	3	3	15	5	1	9	6	11	13	43	41	33	34	28	51	56	
23:15	1	1	0	0	2	1	8	3	0	3	5	9	6	32	33	29	28	37	39	56	
23:30	0	0	0	2	5	2	11	3	6	2	4	10	15	30	28	12	29	26	31	39	
23:45	0	1	0	3	2	2	6	6	3	4	9	7	7	15	22	21	24	27	29	40	