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Effects of Noise Pollution on Residents Living in Birzebbuga and the Introduction of Effective Mitigation Measures

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ABSTRACT

There exists a direct influence of noise pollution on people's quality of life which can lead to several short and long-term health consequences. This paper presents the first phase of a mixed-method study conducted to understand the effects of noise pollution on residents living in Birzebbuga, Malta, followed by a second phase project completed in 2021. A questionnaire was completed by 477 inhabitants to obtain demographic information and data about noise pollution, its influence on residents' activities, and noise source discomfort. The study utilised the International Commission on the Biological Effects of Noise's five-scale technique to quantify noise irritation. The survey took place between February and May 2021. Data reported that in 98% of the participants noise pollution is a problem. 61.6% of respondents reported noise annoyance as the main category of pollution on health and well-being, followed by sleeping disorders and fatigue, stress, nervousness, loss of concentration, headaches and reduced ability to work. Given high levels of noise and the effects on the quality of life of residents, this study concludes that noise reduction regulations are a must, and a permanent sound monitoring network within the district of Birzebbuga is a crucial component for an effective low-noise implementation plan.

1. INTRODUCTION

Environmental noise, also known as noise pollution, is a major environmental health concern in Europe. It is caused by various sources including road, rail and airport traffic, industry and construction. Environmental noise can be substantially reduced by implementing cost-effective measures [1]. Environmental noise is the second biggest environmental cause of health problems after air pollution (the fine particulate matter in air), according to the World Health Organisation [2]. Prolonged exposure to noise can lead to serious illnesses including cardiovascular diseases, reduced cognitive performance in children, severe annoyance, which is a form of stress, sleep disturbance and tinnitus. The effects of noise exposure are also costly for our economy, as it leads to less productive working days, burdens healthcare systems and reduces the value of properties [1]. The EU noise strategy intends to monitor and address environmental noise in Europe in order to contribute to the zero-pollution target for 2050. EU regulations cover noise pollution from major sources, outdoor noise sources, and underwater noise that affects sea life [1]. The cumulative effect of repeated exposures to a variety of contaminants, particularly noise, has a substantial impact on inhabitants' quality of life, particularly in urban areas.

Cities' ports, such as Marsaxlokk in Malta, are instances of this. Furthermore, because the port is connected to the surrounding urban environment, such as Birżebbuġa, and because the same area is also near to the Malta International Airport, the potential negative impacts are amplified by the large number of exposed inhabitants in the immediate neighborhood. In the Maltese context, there is currently minimal research on the exposure- effect studies of community noise, with most reports only documenting noise levels within the area. Aside from that, noise pollution and its influence on human health are seen as a serious issue, causing concerned organisations such as the World Health Organization (WHO) and experts throughout the world to do more research on the assessment of its levels and harmful repercussions [3]. This study is warranted given the lack of research on the effects of noise pollution on residents of Malta's urban districts. Aside from that, no local research has been conducted to evaluate the level of environmental noise surrounding airports and marine ports. This research paper constitutes stage 2 to consolidate a previous.

2. LITERATURE REVIEW

2.1 Noise and impact on human beings

According to the European Environment Agency's (EEA) environmental noise pollution study, at least one in every five

Europeans is presently exposed to noise levels considered detrimental to their health. This figure is expected to rise in the coming years. According to the new EEA research 'Noise in Europe - 2020,' road traffic is the leading source of noise pollution in Europe, with noise levels expected to rise in both urban and rural locations over the next decade due to urban expansion and rising demand for mobility. Rail, aircraft and industry round up the other top sources of environmental noise pollution. The report provides an update of noise pollution trends over the 2012-2017 period, and it also provides an outlook of future noise projections as well as the associated health impacts in Europe, based on new World Health Organization (WHO) guidelines on the health effects from exposure to noise. Building on the previous EEA assessment of noise in Europe from 2014, the report also looks at actions being taken to manage and reduce noise exposure and reviews progress made to meet the EU objectives on noise pollution set by EU legislation, including the Environmental Noise Directive and the EU's 7th Environmental Action Programme (EAP). An estimated 113 million people are affected by long-term day-evening-night traffic noise levels of at least 55 decibels (dB(A)). In most European countries, more than 50% of inhabitants within urban areas are exposed to road noise levels of 55 dB or higher during the day-evening-night period. According to the World Health Organization, health consequences are expected at this level. Long-term exposure to noise levels above 55 dB is considered dangerous by the EU.

2.2 Significant health impacts

Long-term exposure to noise has significant health impacts [4]. On the basis of the new WHO information, the EEA estimates that such exposure causes 12,000 premature deaths and contributes to 48,000 new cases of ischemic heart disease (caused by a narrowing of heart arteries) per year across Europe. It is also estimated that 22 million people suffer chronic high annoyance and 6.5 million people suffer chronic high sleep disturbance. According to World Health Organization evidence, these health impacts start to occur below the reporting thresholds set by the EU Noise Directive and so are likely to be underestimated. In addition, the information provided by countries under the EU directive does not cover all urban areas, roads, railways and airports. Apart from affecting humans, noise pollution is also a growing threat to wildlife both on land and in water [5]. Noise can diminish reproductive success, increase mortality, and cause animals to escape to quieter locations. While some progress has been made by EU Member States in mapping and reporting more areas of high noise across Europe, overall, policy objectives on environmental noise have not yet been achieved. Notably, the objective set for 2020 by the 7th Environmental Action Programme of decreasing noise pollution and moving towards the WHO recommended levels for noise exposure will not be achieved. More than 30% of the data required under the EU directive is still not available after the legally set 2017 reporting deadline. Significant delays suggest that countries may not have taken the necessary steps to address noise pollution. The report adds that better implementation is also required — a point reinforcing the conclusions of a separate recent European Commission assessment on the implementation of the directive.

2.3 Actions to reduce noise levels

Countries are currently pursuing several measures to decrease and regulate noise levels, but it is difficult to assess their advantages in terms of beneficial health outcomes, according to the EEA report. Some of the most common noise-reduction strategies in cities include rebuilding older paved roads with smoother asphalt, improving traffic flow management, and lowering speed restrictions to 30 kilometres per hour. There are other initiatives focused at raising awareness and influencing people's behaviour to encourage them to choose less- noisy means of transportation such as cycling, walking, or electric automobiles. A substantial number of countries, towns, and regions have also established so-called quiet zones, the majority of which are parks and other natural spaces where people may escape city bustle noise. The report says more needs to be done to create and protect quiet areas outside of the city and improve accessibility of these areas in cities.

2.4 Background on the EU's environmental noise directive

People's exposure to noise is monitored under the Environmental Noise Directive (END) against two reporting thresholds; an indicator for the day, evening and night period (Lden) that measures exposure to noise levels associated with 'annoyance' and an indicator for night periods (Lnight) that is designed to assess sleep disturbance. These reporting thresholds are higher than the WHO recommended values and currently there is no mechanism in place for tracking progress against the latter lower values.

2.5 WHO environmental noise guidelines for the European region

In 1999 and 2009, WHO published guidelines to protect human health, specifically from night noise exposure and community noise. Over the years, there has been a substantial increase in quality studies on environmental noise exposure and health outcomes and several key developments. There have also been significant advancements in the understanding of health effects of noise during these last years. In 2018, considering this new evidence, the WHO Regional Office for Europe, which is one of six regional offices throughout the world, has developed Environmental Noise guidelines based on the growing understanding of the health impacts of exposure to environmental noise. These guidelines offer a valuable reference for establishing the links between noise pollution and public health. The current state of knowledge on noise sources and population exposure in Europe is largely based on data submitted by the European Union (EU) member countries on a five-year cycle to the EEA.

The WHO Regional Office for Europe comprises the 53 Member States covering a vast geographical region from the Atlantic to the Pacific oceans. These guidelines aim to provide recommendations for protecting human health from exposure to environmental noise originating from various sources such as leisure noise, transportation (aircraft, road traffic and railway) noise and wind turbine noise. In addition, they aim to support the legislation and policy-making process on local, national and international levels. The process of developing the European WHO guidelines followed a meticulous methodology that involved several groups of experts with separate roles and responsibilities. Specifically, the different steps in the development of the guidelines included the following:

- *The review of the applicable literature*

- *A systematic review of the evidence*
- *Identification of guideline exposure levels*
- *Formulation of the scope and key questions of the guidelines*
- *Assessment of certainty of the bodies of evidence resulting from systematic reviews*
- *The selection of priority health outcome measures*
- *The setting of the strength of recommendations*

The European Topic Centre on Air Pollution, Transport, Noise and Industrial Pollution (ETC/ATNI) is an international consortium working with the European Environment Agency under a framework partnership agreement for the period 2019-2021. The main tasks of the ETC are: Integrated activities in the areas of air pollution, noise, industry, energy and transport; air pollutant emissions monitoring, reporting and verification; Air pollutant mitigation assessments and indicators; Air quality and noise data; Air quality and noise assessments and indicators; ETC management and capacity building in EEA member and cooperating countries [6]. According to Eurostat data for 2016, more than a quarter of the Maltese population (26.25%) complained about noisy neighbourhoods and streets, the highest proportion across the EU. The figure was higher than the previous year of 24.8%. The EU average for 2016 was 17.9%. According to the data, the older population, mainly those aged 65 and over, were more likely to report experiencing such problems and even more so if the person making the report lived alone. Noise pollution has long been an in issue in Malta, with most complaints being in relation to traffic. Times of Malta reported in August 5th 2017, January 5th 2018 and June 18th 2018 that the European Commission was considering whether to open infringement proceedings against Malta over its failure to tackle excessive noise pollution from traffic.

3. METHODOLOGY

According to Proctor [7], the key basis and rationale for any research activity is consistency between the researcher's personal philosophy, the research questions, the purpose of a research study, and the methodology used. Quantitative research is a rigorous, objective, and systematic method that uses numerical data to learn about the world. The research technique in this study included a noise monitoring survey to investigate the noise climate of Birżebbuġa. The study's goal is to identify the noise sources in the hamlet of Birżebbuġa and combine this data to the first phase data collected (presented in an earlier research paper) which included information on residents' views about noise pollution and its influence on their activities. Both phases combined allowed for consolidated results and investigations. In this study, all electronically stored data was technologically secure. Security precautions were put in place, including the usage of keyword pins to meet data protection requirements.

3.1 Previous phase

In phase I of this study, it was deemed essential to collect data to understand the types of noise pollution and problems faced by residents, thus a questionnaire-based survey was deemed to be suited to collect this type of information. The data collated and built upon the 5-point verbal ICBEN scale was presented in a previous paper entitled 'Effects of noise pollution on residents in Birżebbuġa, Malta- Phase I. The introduction of effective mitigation measures.

3.2 Design parameters for noise recording

The World Health Organization's daytime and night-time recommended noise levels for outdoor noise were used to analyse the survey data. Based on the LAeq parameter (the equivalent continuous A-weighted sound pressure level recorded over the relevant time interval of interest), the WHO 2000 guidelines identify a day- time guideline value of 55 dBA outside and a night-time guideline value of 45 dBA outside. Noise levels measured using the 'A' weighting are denoted dB(A). The daytime and night-time measurement were performed at the selected monitoring points, 1.5 m above the ground level and a distance of at least 3.5m from any reflecting surface (other than the ground), in accordance with BS4142:1997. Noise measurements were made between December 2020 and August 2021. For each week, 2 measurements were taken at each monitoring point, one during daytime 07:00-23:00 (LAeq,[16h]) and another during night-time from 23:00- 07:00 (LAeq,[8h]). Measurements were randomly taken both on weekdays and weekends of the week at each of the selected monitoring point and over a range of different times. The measurements were made on a tripod at a height of 1.5 m from the ground level in dry weather conditions. Weekly daytime and night-time measurements were taken at each of the chosen monitoring locations, to establish the noise climate at the sensitive receptors during the day and at night.

3.3 Noise monitoring

The monitoring was performed using a Professional Sound Meter IEC651 type 2, ANSI SI.4 type 2. (Specifications: Measurement range 30-130dba. Accuracy: +1.5db (reference sound pressure standard, 94db@1KHz). Frequency weighting: A/C). Noise readings were compared on two occasions with a Kimo DB 200 Sound Level Meter Class:2.

Attention was made during the sampling period in order to identify dominant noise sources or activities that would influence results. Noise monitoring was not carried out during poor weather conditions (high wind speeds, rainy days) to avoid unreliable noise survey data. Wind speed did not exceed 5 m/s. To minimize the influence of reflections, the monitoring should be taken 3.5m from any reflecting surface or at 1 meter from the façade of a building. The noise climate at each of the Monitoring Points was established by undertaking daytime and night-time measurements based on a 10-minute sampling period.

3.4 Monitoring locations

Five monitoring points (coded as "MP" with letters accordingly from A to E) were selected based on the following criteria (Table 1):

- high density of residential population.
- high traffic volumes.
- same monitoring points locations, carried out between February 2014 to January 2015.
- operational noise impacts of the Malta Freeport Terminals on the residential population in Birżebbuġa.
- Being a combined dwelling area of houses,

maisonettes and apartments.

These monitoring locations established the noise climate at identified noise sensitive receptors located in the vicinity of Dawret il-Qalb Imqaddsa, Triq il-Gandoffla, Triq il-Qajjenza Triq San Patrizju and St Peter's Parish Church area. A high-resolution satellite image of the village of Birżebbuġa was captured from Google Earth software. The coordinates of these points were determined according to Google Earth (GE). GE uses geographical coordinate system (latitude and longitude) on the World Geodetic System of 1984 (WGS 84) reference ellipsoid, which is the same datum used by Global Positioning System (GPS).

Table 1. Monitoring point locations

Monitoring Point	Location	Coordinates
A	Triq il-Gandoffla	35°49`08`N 14°31`32`E
B	Triq San Patrizju	35°49`08`N 14°31`46`E
C	Dawret il- Qalb imqaddsa	35°49`33`N 14°31`54`E
D	Triq il-Qajjenza	35°49`56`N 14°32`05`E
E	St. Peter Parish Church	35°49`33`N 14°31`38`E

4. RESULTS

A total of 329 measurements were collected out throughout the 9 months of the survey (December 2020- August 2021). Overall, the majority of noise measurements were < 70 dBA, but levels varied by location, wind directions, traffic level, time of day and nearby conditions. The majority of the average daytime readings recorded at Triq il-Gandoffla (MP A), Triq San Patrizju (MP B), Dawret il-Qalb Imqaddsa (MP C), Triq il- Qajjenza (MP D) and St Peter's Parish Church (MP E) exceeded the Lden EU threshold of 55 dB (excess exposure defined in the Environmental Noise Directive). With regards to readings during night-time, all monitoring points, with the exception of Triq il-Gandoffla (MP A), exceeded the Lnight EU threshold of 50 dB (excess exposure defined in the Environmental Noise Directive). The survey identified that Triq San Patrizju (MP B) and Triq Dawret il-Qalb Imqaddsa were generally the noisiest locations during the day and night-time measurements while Triq il-Gandoffla (MP A) was generally the quietest night-time location.

Noise Levels Triq il-Gandoffla (Monitoring Point A)

Day Levels

Figure 1 shows that the average day time noise levels recorded at Triq il-Gandoffla (MP A) over the 9-month monitoring period ranged from 55 - 65 dBA LAeq(10 min).

Night Levels

Figure 2 shows that the average night-time noise levels recorded at Triq il-Gandoffla (MP A) over the 9-month monitoring period ranged from 43 - 48 dBA LAeq(10 min).

PREDOMINANT NOISE SOURCES OBSERVED

During the survey, the predominant noise sources in the vicinity of Triq il-Gandoffla (MP A) were mainly attributable to the following sources:

- The activity at the Malta Freeport Terminal (bangs/clanks from container handling, warning alarms, engines humming, landing of containers).
- Aircraft traffic (predominantly during the last three months of the Survey, i.e. June-August 2021).
- Vehicular traffic passing directly in front of the sound level meter.

OTHER SOURCES

- Nearby industrial facilities located on the edge of the Hal Far Industrial Estate.
- Gun Shots/Shooting range (mainly at weekends).
- Construction works.

Full names of authors are required. The middle name can be abbreviated.

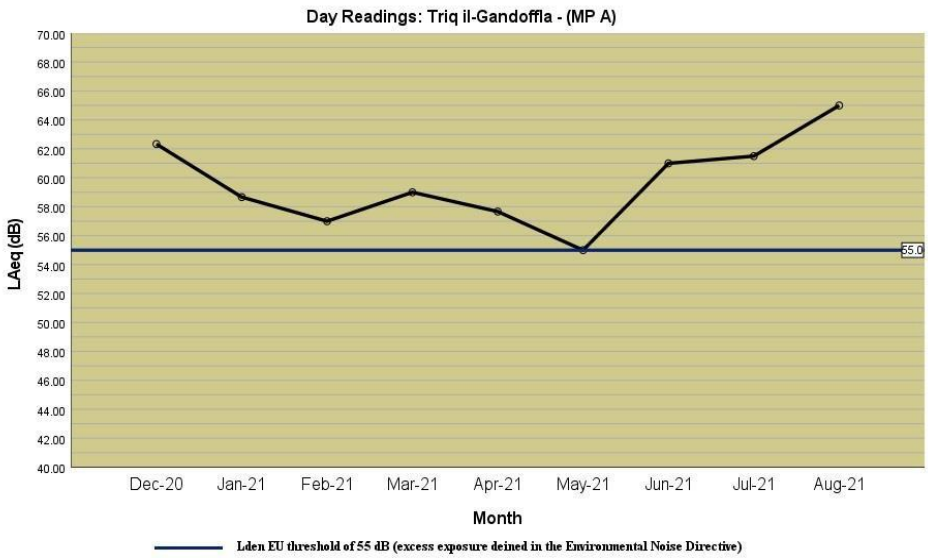

Figure 1. Average Day Time Noise Levels (LAeq dB) at MP A

Noise Levels at Triq San Patrizju (Monitoring Point B)

Day Levels

Figure 3 shows that the average day time noise levels recorded at Triq San Patrizju (MP B) over the 9-month monitoring period ranged from 61- 67 dBA LAeq(10 min).

NIGHT LEVELS

Figure 4 shows that the average night-time noise levels recorded at Triq San Patrizju (MP B) over the 9- month monitoring period ranged from 50 - 63 dBA *L*Aeq (10 min). Predominant Noise Sources Observed During the survey, the predominant noise sources in the vicinity of Triq San Patrizju (MP B) which were observed were mainly attributable to the following sources:

- The activity at the Malta Freeport Terminal (bangs/clanks from container handling, warning alarms, engines humming, landing of containers).
- High Vehicular traffic (in particular heavy vehicles).
- Commercial premises activities (particularly sound originating from Bocci Club Restaurant during summertime).
- Pedestrian activity.

OTHER SOURCES

- Construction works

Noise Levels: Dawret il-Qalb Imqaddsa (Monitoring Point C)

DAY EVELS

Figure 5 shows that the average day time noise levels recorded at Dawret il-Qalb Imqaddsa (MP C) over the 9-month monitoring period ranged from 58 - 66 dBA *L*Aeq(10 min).

NIGHT LEVELS

Figure 6 (on page 8) shows that the average night-time noise levels recorded at Dawret il-Qalb Imqaddsa (MP over the 9-month monitoring period ranged from 50 - 70 dBA *L*Aeq(10 min).

PREDOMINANT NOISE SOURCES OBSERVED

During the survey, the predominant noise sources in the vicinity of Dawret il- Qalb Imqaddsa (MP C), which were observed, were mainly attributable to the following sources:

- The activity at the Malta Freeport Terminal (bangs/clanks from container handling, warning alarms, engines humming, landing of containers).
- Enemalta refuelling point activities.
- Pedestrian activities.
- Vehicular traffic passing directly in front of the sound level meter (high noise level recorded in the June-August period can be partly attributed to higher traffic activity compared to other months).

OTHER SOURCES

- Construction works
- Commercial activity

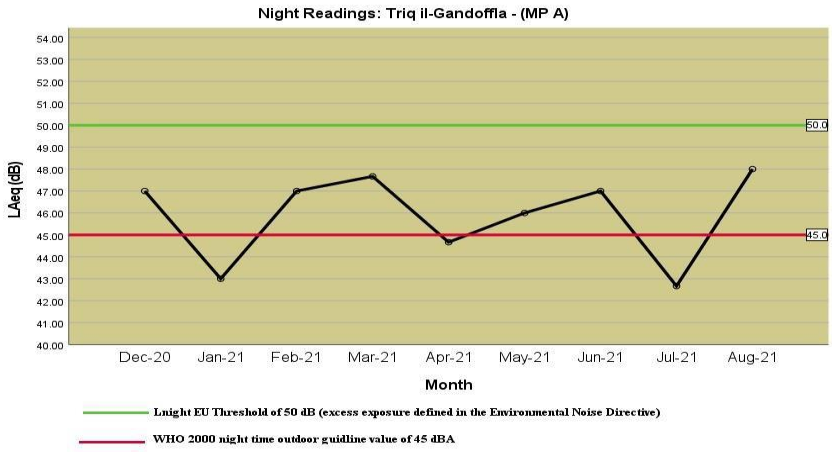

Figure 2. Average night-time noise levels recorded at Triq il-Gandoffla (MP A)

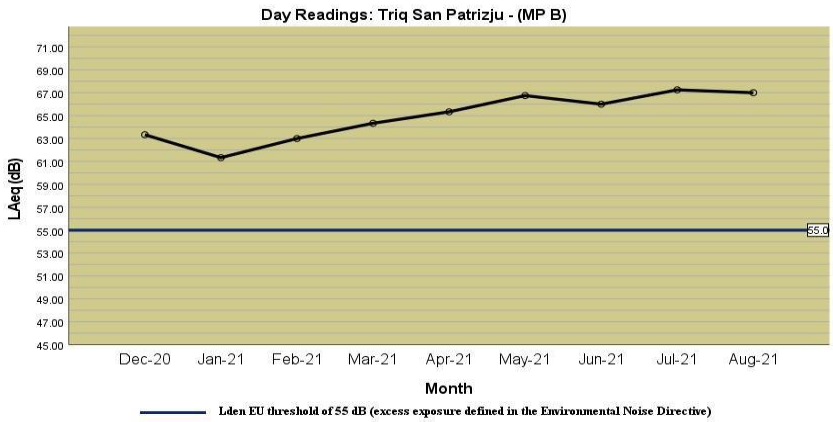

Figure 3. Day readings Triq San Patrizju

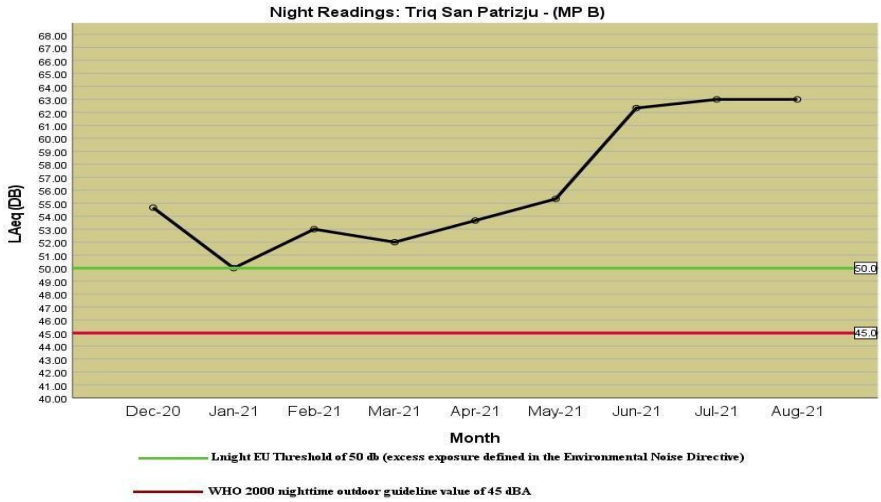

Figure 4. Night readings Triq San Patrizju

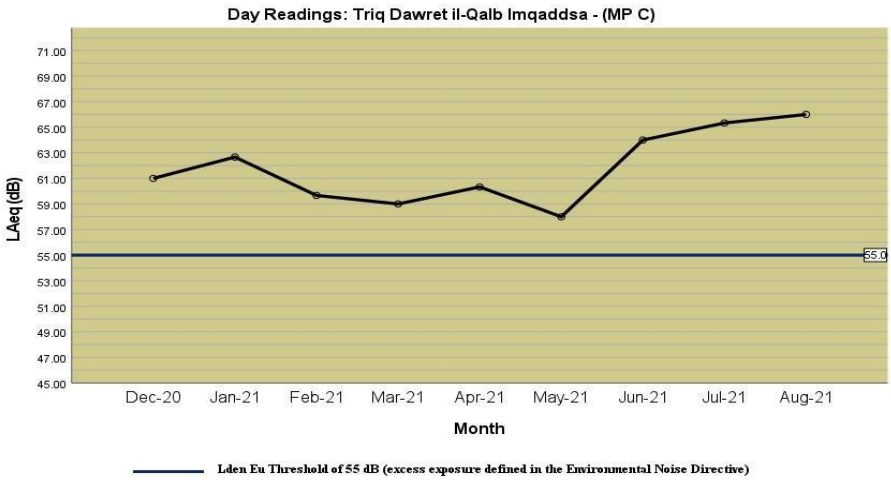

Figure 5. Day readings Dawret il-Qalb Mqaddsa

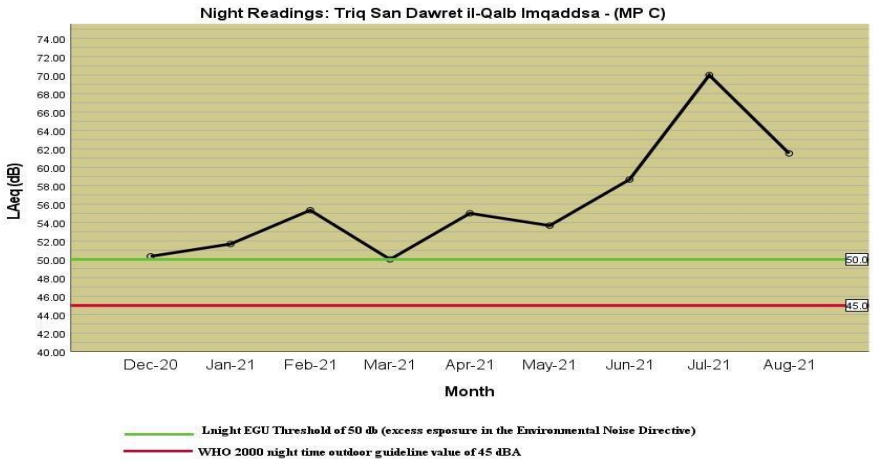

Figure 6. Night readings Triq Dawret il-Qalb Mqaddsa

Noise Levels: Triq il-Qajjenza (Monitoring Point D)

Day Levels

Figure 7 shows that the average day time noise levels recorded at Triq il-Qajjenza (MP D) over the 9-month monitoring period ranged from 57 - 64 dBA *L*Aeq (10 min).

NIGHT LEVELS

Figure 8 shows that the average night-time noise levels recorded at Triq il-Qajjenza (MP D) over the 9-month monitoring period ranged from 50 - 61 dBA *L*Aeq(10 min).

PREDOMINANT NOISE SOURCES OBSERVED

During the survey, the predominant noise sources in the vicinity of Triq il-Qajjenza (MP D) which were observed were mainly attributable to the following sources:

- The activity at the Malta Freeport Terminal (bangs/clanks from container handling, warning alarms, engines humming, landing of

containers).

- Pedestrian/Sunbathers activity especially June-August Period.
- Vehicular traffic passing directly in front of the sound level meter.

OTHER SOURCES

- Commercial activity (restaurants)

Noise Levels: St. Peter Parish Church Area (Monitoring Point E)

Day Levels

Figure 9 shows that the average day time noise levels recorded at St. Peter Parish Church Area (MP E) over the 9-month monitoring period ranged from 58 - 64 dBA *L*Aeq (10 min).

NIGHT LEVELS

Figure 10 shows that the average night-time noise levels recorded at St. Peter Parish Church Area (MP E) over the 9-month monitoring period ranged from 47 - 58 dBA *L*Aeq(10 min).

PREDOMINANT NOISE SOURCES OBSERVED:

During the survey, the predominant noise sources in the vicinity of St. Peter Parish Church Area (MP E) which were observed were mainly attributable to the following sources:

- Pedestrian activity.
- Church Bells.
- Vehicular traffic passing directly in front of the sound level meter.

OTHER SOURCES:

- Activity at the Band Club (June-August) and a Bar in the vicinity
- Open Market on every Thursday morning

The noise levels recorded during the 9 month long–term monitoring survey (December 2020-August 2021) provided a reasonable indication of the noise climate at the selected monitoring locations (Triq San Patrizju, Triq il-Gandoffla, Triq il-Qajjenza, Dawret il-Qalb Imqaddsa and St Peter's Parish Church parvis) within Birżebbuġa. The average daytime noise levels recorded over the nine months at all five monitoring locations ranged from 55 - 67 dBA, while those recorded during night-time ranged from 43 to 70 dBA.

Taking into account WHO European guidelines values [2] and the Environment Noise Directive relating to the assessment and management of environmental noise, the survey results achieved indicate that noise levels were generally high at all five monitoring locations over the nine months of the survey, both during the daytime and during the night-time with the exception of Triq Gandoffla (night-time). It should be noted that the WHO night-time noise guidelines are stricter than the Lnight threshold of 50 dB set under the Environmental Noise Directive (END), thus providing a higher level of protection for human health.

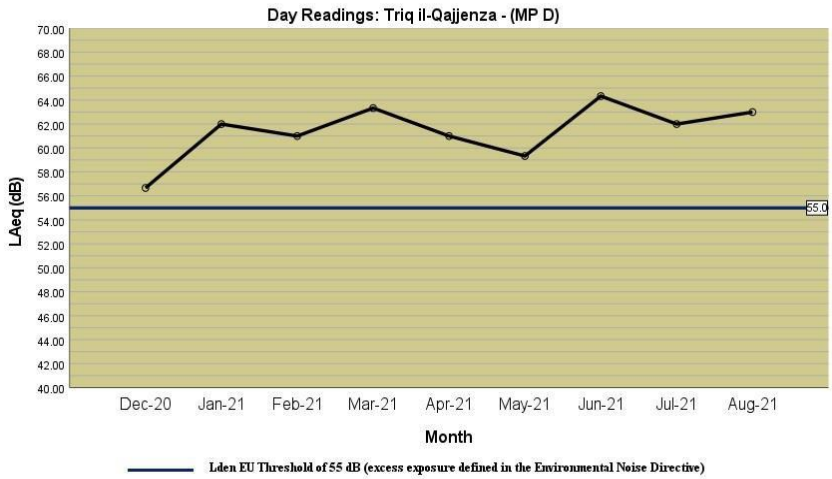

Figure 7. Day readings Triq il-Qajjenza

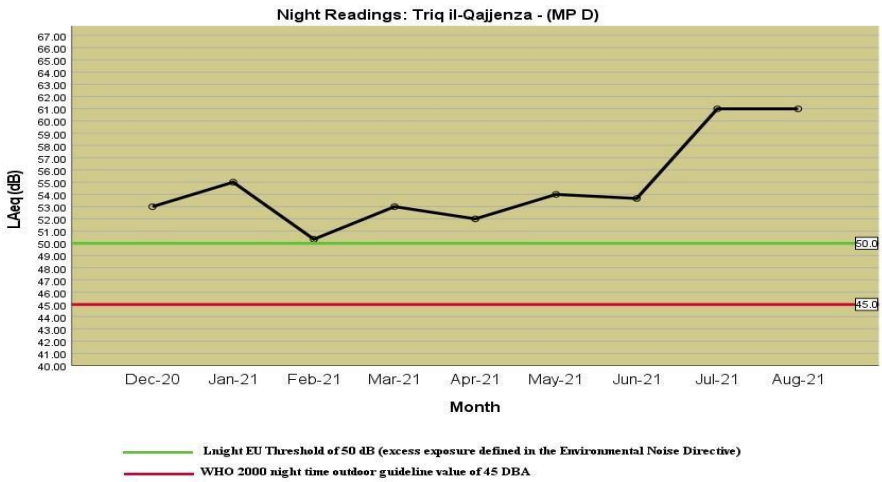

Figure 8. Night readings Triq il-Qajjenza

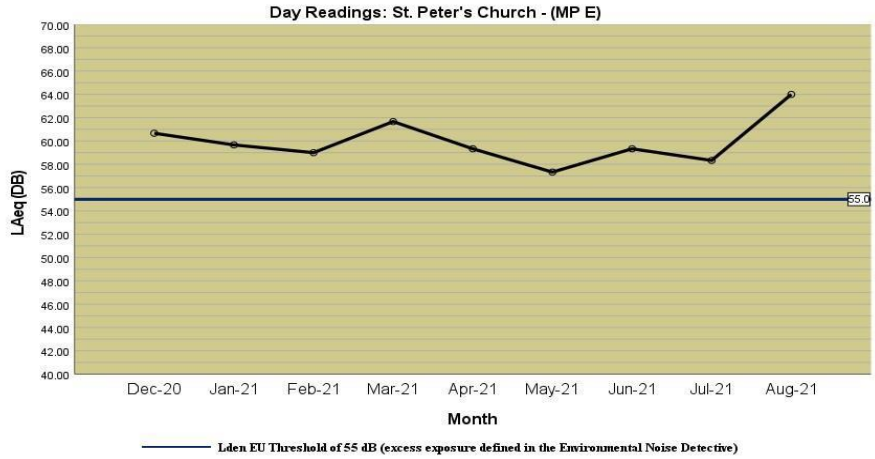

Figure 9. St. Peter Parish Church Area day readings

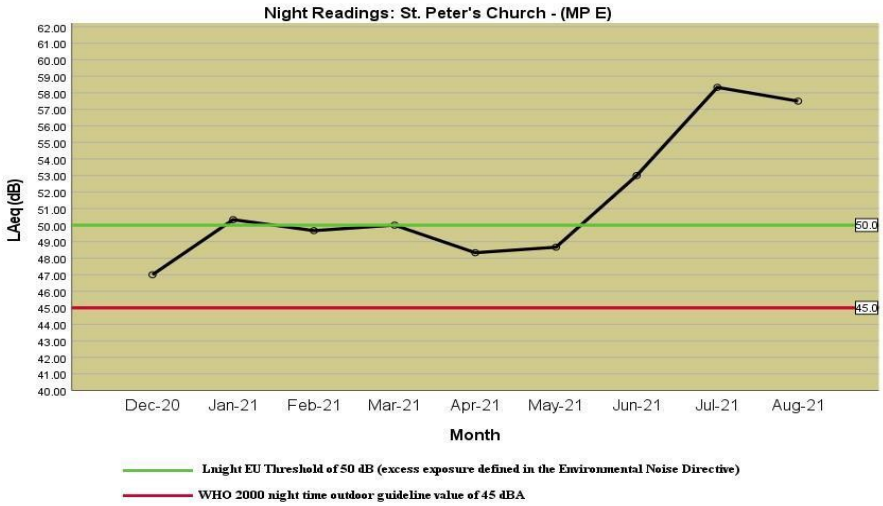

Figure 10. St. Peter Parish Church Area night readings

Higher noise levels were recorded during the period of May-August (2021) compared to the period from December 20202 to April 2021. People spending more time outside during the summer, enjoying the beach and wandering down the promenade of Birżebbuġa and Qajjenza, can explain this. Higher noise levels observed during this time can be ascribed in part to increased transportation activity when compared to other months. Another important factor was the relaxation of COVID-19 restrictions during these months, as the COVID-19 situation in Malta was slowly improving. As of 24th May 2021, groups of four people from different households were allowed to gather together in public, while snack bars and restaurants were allowed to open till midnight. Another contributing factor could be the reopening of tourism on 1st June 2020. As a result, passenger traffic at the Malta International Airport increased by 20 per cent compared to the previous month [8].

During the survey, various noise sources were audible, most notably the intermittent noises (such as the vehicular traffic passing directly in front of the sound meter (Figure 11), aircraft noise, alarms from an RTG crane originating from Malta Freeport Terminal, and the bangs/clanks from container handling). Noise attributable to Malta Freeport Terminal activities and vehicular traffic was particularly influential in the survey's ambient noise readings. Higher sound levels in Triq San Patrizju Monitoring Point (MP) B were recorded. These higher levels can be attributed to the fact that the monitoring area location is one of the busiest streets in Birżebbuġa and is also located close to the Malta Freeport Terminal. Two other monitoring points (Dawret il-Qalb Mqaddsa (MP C) and Triq l-Qajjenza (MP D) exhibiting higher sound levels are two other busy streets. Furthermore, Dawret il-Qalb Mqaddsa (MP C) and Triq l-Qajjenza (MP D) are adjacent to the promenade of Birżebbuġa and Qajjenza, respectively, where the waterbody contributes to higher sound levels. Meanwhile, the same street can be considered the busiest street in Birżebbuġa due to vehicular traffic is more prominent than other streets in Birżebbuġa.

Climatic conditions such as direction and wind speed had a considerable influence on the ambient noise levels at all five monitoring locations, especially Triq il-Gandoffla and Triq il-Qajjenza. Wind affects the propagation of sound by refracting its waves. Hence, monitoring locations standing downwind of a sound source experienced higher sound level, while other areas standing on the opposite end experienced lower sound levels. Daytime noise levels were also recorded on 1st May 2021 (Public Holiday) while the Malta Freeport Terminals was on shutdown. No onshore activity was supposed to be carried out during this day. However, it should be noted that a humming noise originating from the freeport terminal was audible. The average daytime noise level recorded during this day at the nearest monitoring location, ie. Triq San Patrizju

(MP B) was 58 dBA, which still exceeded the WHO daytime outdoor guideline value of 55 dBA. In the overall monitoring, sites noise daily average sound levels exceeded the 55 dB Lden daytime and 45 dB Lnight. The results achieved from the present study are in accordance with the results of another study carried out in Birżebbuġa between 2014 and 2015 and conducted by Adi Associates Environmental Consultants on behalf of Malta Freeport Terminal Co Ltd. The findings of this noise monitoring survey show that the mitigation measures that have been recommended by Adi Associates Environmental Consultants Ltd back in 2016 were not sufficient to reduce noise levels originating from the Malta Freeport and reaching the sensitive receptors in the vicinity of the terminal. The highest daytime and night-time noise level were recorded at Triq il-San Patrizju (MP B), which is the closest monitoring location to the Malta Freeport Terminal. All of the recorded average daytime noise levels at Triq San Patrizju (MP B) over the 9-month monitoring period year exceeded Lden levels above 55 dB.

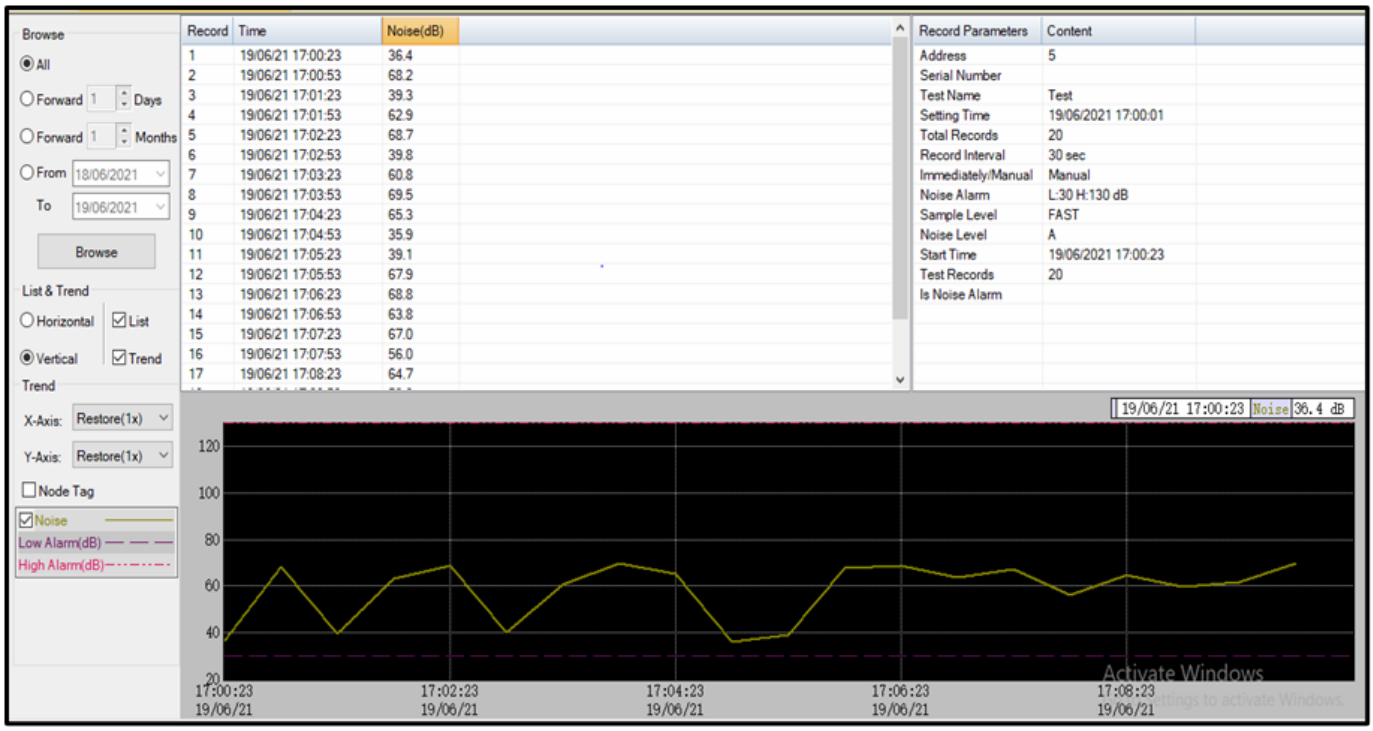

Figure 11. Sound meter data

5. CONCLUSIONS

As a result of data collated from both phases I and II, the following recommendations were presented:

Recommendation 1: Malta should join and contribute to The European Topic Centre on Air Pollution, Transport, Noise, and Industrial Pollution (ETC/ATNI) is a worldwide collaboration that has a framework cooperation agreement with the European Environment Agency for the period 2019-2021. The ETC's main tasks are: integrated activities in the areas of air pollution, noise, industry, energy, and transport; monitoring, reporting, and verification of air pollutant emissions; air pollutant mitigation assessments and indicators; air quality and noise data; air quality and noise assessments and indicators; ETC management and capacity building in EEA member and cooperating countries. This will enable Malta to serve as a model for other small islands and states in terms of data supply, monitoring, and control. **Recommendation 2:** Action on the fact that Malta, the noisiest country in the European Union, will require a specific law to deal with the problem, according to an Environment Ministry spokesperson. The spokesperson said the Commission for Noise Pollution, set up in 2016, would be presenting 'a comprehensive Bill' that would include proposals submitted by various entities [9]. **Recommendation 3**: Establish a solid framework for public dialogue. As Eurostat listed Malta's noise pollution concerns as the worst in the EU, the Times of Malta requested a list of the commission's ideas to solve the matter. No details were provided, but the representative asserted that the new Bill will eventually result in the establishment of a 'regulatory framework targeted at minimising noise nuisance'. Environment Minister Josè Herrera said that the main goal was to study prevailing problems and propose solutions. Confirming a draft Bill was in the pipeline, commission chairman Francis Debono insisted the issue was not an easy one to solve and that long-term solutions were needed. **Recommendation 4:** Education and mindset shift required together with a change in people's mentality, acknowledging it was no easy feat. People might not be ready to implement the changes being proposed so the challenge is on building the mentality itself. **Recommendation 5:** A single entity is required to be responsible. At present different entities are responsible for different aspects and that needs to change and while most of the difficulties are easy to pinpoint, finding solutions is not as straightforward as many assume. **Recommendation 6:** Establishing enforcement and compliance. Because different entities are responsible for different aspects, with a requirement to shift to a single entity in enforcement-related matters, the Environment Ministry, the police force, the Local Government Department, the Environment and Resources Authority, the Environmental Health Department, the Occupational Health and Safety

Authority, the Malta Tourism Authority, the Malta Competition and Consumer Affairs Authority, the Economy Ministry, and the Veterinary and Phytosanitary Regulation Department means that they will required to meet targets which can be audited by an external unit. In this way tackling an open infringement proceeding against Malta over its failure to tackle excessive noise pollution from traffic.

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