DETERMINATION OF DISTURBANCE LEVEL USING NOISE MONITORING DEVICE AT RESIDENTIALS AREAS IN THE VICINITY OF SULTAN ISMAIL PETRA AIRPORT, PENGKALAN CHEPA

by

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DECLARATION

I declare that this thesis entitled "Determination of Disturbance Level using Noise Monitoring Device at Residential Areas in the Vicinity of Sultan Ismail Petra Airport, Pengkalan Chepa" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ________________________

Name : ________________________

Date : ________________________

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LIST OF ABBREVIATIONS

dB(A)	Decibel
DOE	Department of Environmental, Malaysia
EQA	Environmental Quality Act
GPS	Geographical Point System
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
L_{eq}	Equivalent Continuous Sound Level
WHO	World Health Organization

LIST OF SYMBOLS

L_{min}	Minimum peak noise level
L_{max}	Maximum peak noise level
km	Kilometre
m	Meter

Determination of Disturbance Level Using Noise Monitoring Device at Residential Areas in The Vicinity of Sultan Ismail Petra Airport, Pengkalan Chepa

ABSTRACT

The noise generated by aircraft during departure and arrival flight operations continues to be significant problem at most major airports. This study aimed to determine the noise level at residential areas in the vicinity of Sultan Ismail Petra Airport, Pengkalan Chepa, Kota Bharu, Kelantan. Aircraft noise had given adverse effects of community noise, including interference with communication, noise induced hearing loss, annoyance responses and effects on sleep, the cardiovascular and psychophysiological systems, performance, productivity, and social behavior. Sound levels were recorded once at three various locations within airport compound and its surrounding areas, up to 1 km radius from the center of airport. Every readings of noise level were recorded in decibel, dB(A) for two hours at five minutes interval during day time and night time which is morning, evening and night. Findings put the average noise level in the study was the highest at Institut Perguruan Kota Bharu in the evening with 68.91 dB(A) in May compared to the other two stations. Taman Sri Pengakalan Chepa recorded the lowest reading of noise level in the evening with 45.50 dB(A) in June during night time. Overall, the noise level recorded at the three stations had exceeded the standard level stated by the Department of Environment (DOE) Malaysia standards which was 50 dB(A) in day time and 40 dB(A) in night time. The result of the one-way ANOVA test carried out on the dependent variable average noise revealed a statistically significant with the value of $F(2,24) = 19.70$, $p = 0.000$. These finding are very useful to be used as reference and guideline for future regulations on noise limit to be implemented for areas in Malaysia.

Penentuan Tahap Gangguan Menggunakan Alat Kawalan Bunyi di Kawasan Perumahan di Sekitar Lapangan Terbang Sultan Ismail Petra, Pengkalan Chepa

ABSTRAK

Bunyi yang dihasilkan oleh pesawat semasa berlepas dan mendarat terus menjadi masalah yang ketara di kebanyakan lapangan terbang utama. Kajian ini bertujuan untuk menentukan tahap bunyi di kawasan perumahan di sekitar Lapangan Terbang Sultan Ismail Petra, Pengkalan Chepa, Kota Bharu, Kelantan. Bunyi bising pesawat telah memberikan kesan buruk bunyi kepada masyarakat, termasuk gangguan komunikasi, bunyi bising sememangnya, jawapan kegusaran dan kesan ke atas tidur, kardiovaskular dan sistem psychophysiological, prestasi, produktiviti, dan tingkah laku sosial. tahap bunyi direkodkan sekali pada tiga pelbagai lokasi di dalam kawasan lapangan terbang dan kawasan-kawasan sekitarnya, sehingga 1 km radius dari pusat ke lapangan terbang. Setiap bacaan paras bunyi yang telah direkodkan dalam desibel, dB(A) selama dua jam pada lima minit selang pada waktu siang dan malam yang pagi, petang dan malam. Hasil kajian menunjukkan tahap bunyi purata dalam kajian ini adalah yang tertinggi di Institut Perguruan Kota Bharu pada waktu malam dengan 68.91 dB(A) pada bulan Mei berbanding dengan kedua-dua stesen lain. Taman Sri Pengkalan Chepa mencatatkan bacaan terendah bunyi bising pada waktu petang dengan 45.50 dB(A) pada bulan Jun pada waktu malam. Secara keseluruhan, tahap bunyi yang dirakam di tiga stesen telah melebihi tahap standard yang dinyatakan oleh Jabatan Alam Sekitar standard (JAS) Malaysia yang merupakan 50 dB(A) pada siang hari dan 40 dB(A) di waktu malam. Hasil ujian ANOVA sehala yang dijalankan ke atas bunyi purata pembolehubah bersandar mendedahkan statistik yang signifikan dengan nilai $F(2,24) = 19.70$, $p = 0.000$. Penemuan ini adalah sangat berguna untuk digunakan sebagai garis panduan dan rujukan bagi peraturan-peraturan masa depan pada had bunyi yang akan dilaksanakan bagi kawasan di Malaysia.

CHAPTER 1

INTRODUCTION

1.1 Background of study

Environmental pollution is generally concerned in terms of its effects on land, air and water as these are the major constituents of our environment. However, an attention has been focused on another type of pollution called noise pollution but differs from water and air pollution which disappears fast and fortunately does not remain in the environment for extended periods of time (Kumar, 2003). According to Environmental Quality Act 127, any change or disturbance in terms of chemical, physical and biological that contribute to imbalance of environment can be considered as pollution (EQA, 1974). In other words, pollution is the introduction of contaminants into an environment that cause instability, disorder, harm or discomfort to the physical systems or living organisms (Wahab, 2008).

Noise has become part of our environment. With progress in industrial growth and urbanization, the level of noise has been increasing continuously. In ancient Rome, rules existed as to the noise emitted from the ironed wheels of wagons which battered the stones on the pavement, causing disruption of sleep and annoyance to the citizenry (Ansensio *et al*., 2011). In Medieval Europe, horse carriages and horseback riding were not allowed during night time in certain cities to ensure peaceful sleep for inhabitants (Putnoky, 2009). However, the noise problems of the past are incomparable with those of the modern society. An immense number of cars, motorcycles, trucks and other motorized vehicles crises-crosses developing cities, day and night (Munsi, 2015).

Among the complex environmental effects of airport operation, the problem of noise caused by aircraft is of particular significance as it interferes directly with the living conditions of many people who live near the airport. Because sound can be subjective, individuals have different perceptions, sensitivities and reactions to noise (Phun *et al.*, 2015). The most widespread form of noise is that which arises from transportation sources such as road traffic, railways and aircraft. Noise pollution is the less obvious but rather a problem that has grown steadily worse with time (Moela, 2010).

People who live in highly polluted urban areas tend to report sleep disturbances due to noise especially people living in the vicinity of highways, airports and other major noise sources (Vallet, 2001). Aircraft noise continues to be an issue at many airports, especially where capacity expansions are underway or being considered (Nelson, 2004). In one study, children who were exposed to noise levels above 55 dB had decreased attention, difficulty with social adaptation, and increased oppositional behavior to others compared to children not exposed to these noise levels (Ritovska *et.al.*, 2004). Besides children, noise can affect adults and communities in many ways through physical, psychology and social. The effects of aircraft noise on human being different depend on the time of day (Hoeger, 2004). Previous study on aircraft noise revealed that people felt more harassed at night than during the day by the same noise level (Amra, 2015).

1.2 Problem Statement

A comfortable environment is one in which there is little or no annoyance and distraction so that working or leisure tasks can be carried out unhindered either physically or mentally. However, aircrafts do influence the environment. The most important effect is the noise produced by them. Nowadays, the management of noise pollution of inhabited neighborhoods has become a significant issue for many airports (Brechet & Picard, 2012).

Noise pollution also occurred in Malaysia without any exception. The growth in noise pollution problem among community is unpredictable because it involves direct as well as cumulative adverse health effect. It also adversely affects future generations, and has socio-cultural, aesthetic and economic effects (WHO, 2000). The problem of aircraft noise disturbance involves a complex interaction of a number of physical, biological, physiological and sociological processes (Wahab, 2008). Communities near airport are becoming more sensitive to noise disturbance issues and have increasing expectations in regard to the quality of life. It is important to monitor the noise level at the vicinity of the Sultan Ismail Petra Airport to make sure that the noise level do not exceed the standards and do not cause disturbance towards community nearby.

1.3 Objectives

The objectives of this study are identified as follows:

1. To determine the noise level at residential areas in the vicinity of the Sultan Ismail Petra Airport by using sound level meter.
2. To compare the noise level at selected areas in vicinity of airport with Department of Environment (DOE) Malaysia standards.

CHAPTER 2

LITERATURE REVIEW

2.1 Background of Study Area

Sultan Ismail Petra Airport is an airport that operates in Pengkalan Chepa, Kota Bharu which is a city in the state of Kelantan in Malaysia. It is labeled as KBR according to International Air Transport Association (IATA) airport code while known as WMKC according to International Civil Aviation Organization (ICAO) airport code. With runway length of 2128 m x 46 m, the airport offers flight between a total of seven domestic destinations from Malaysia Airlines, AirAsia, Firefly and Malindo Air.

Sultan Ismail Petra Airport is surrounded by residential areas, institutional areas as well as golf course and hotel as shown in Figure 2.1. It becomes the busiest airport in the East Coast in 2012 and 9th by passenger traffic and 3rd in Malaysia by terms of total aircraft movements (take-off and landing) in 2012 (Mohamad, 2015). This may include commercial, private, training and military aircraft. The airport handled 1,132,000 passengers with 64,114 total aircraft movements (Mohamad, 2015).

Figure 2.1: Map of the Sultan Ismail Petra Airport

2.2 Noise Pollution

Noise pollution had less attention from the public or the authorities. This happened because of noise only occurred for a short time (for a few minutes or several hours) compared to air and water pollution, applied to long term and ongoing (Amra, 2015). Plus, not everyone consider noise as a disturbance. Generally, humans do not believe that noise impacted the total environment. Instead, they believe that the fairly common atmospheric pollutants have more extreme consequences for the planet as opposed to noise (Fyhri & Klaeboe, 2006). Noise pollution is indeed a serious environmental problem as it has been presented as a significant challenge to people (Moela, 2010).

Noise can be defined as unwanted sound or offensive sounds that bother daily activities of the community (Schmidt *et al*., 2005). People responded to sound differently and subjectively and described as loudness, noisiness, annoyance and speech interference (Wahab, 2008). Therefore, noise depends on the vicinity of the area. The common noise sources from variety of sources such as jet plane, road traffic, garbage trucks, construction equipment, manufacturing processes and lawn mowers (Ismail, 2008).

Human is the main creature that will feel the impact of noise. However it depends on the sensitivity of a person, the more sensitive they are the earlier responds will they get from the noise. A person may lose their hearing in some period of time without noticing it when it exposed too long to the noise. Normally, once they realize when they get symptoms like hearing disability (Amra, 2015). At this stage, this situation has become quite serious and may cause deafness disease.

2.3 Noise Level Measurement

Noise is measured in units called decibels dB(A). A decibel dB(A) is a logarithmic unit that indicates the ratio of a physical quantity relative to a specified reference level. Since it expresses a ratio of two quantities with the same unit, it is a dimensionless unit (Patrick & Babatope, 2013). The decibel system is based on human hearing possibilities. The dB(A) value is an indicator of the relative power (pressure) of a sound by reference to the lowest sound audible to human ears. The normal range of human hearing varies between 0 and 12-120 dB(A) (painful levels) (Fausti *et al.*,1981). The A-weighted decibel scale dB(A) performs this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. In the A-weighted decibel, everyday sounds normally range from 30 dB(A) which was very quiet to 100 dB(A) which was very loud (Haines *et al.*, 2001).

2.4 Source of Noise Pollution

The main source of noise pollution is from transportation systems, motor vehicle noise, aircraft noise and also rail noise (Stansfeld & Matheson, 2003). Other sources are from car alarms, office equipment, factory machinery, construction work, grounds keeping equipment, barking dogs, appliances, power tools, lighting hum, audio entertainment systems, loudspeakers and noisy people. Noises recorded as point features were described as fans, vents, bicycle stations, construction machinery, fountains, maintenance equipment, gardening saw, and high pitched sound (Job & Sakashita, 2007).

2.5 Aircraft Noise

This noise occurred during various phases of a flight, on the ground while parked such as auxiliary power units, while taxiing, on run-up from propeller and jet exhaust, during take-off, underneath and lateral to departure and arrival paths, over flying while on route or during landing (Heidelinde, 2016). Aircraft noise mainly refers to the noise radiation during taking off, landing, taxiing, sliding and running engine, which has the characteristics of sudden intermittent, high sound pressure level, a wide affecting range and long-time influence (Jiao & Cai, 2008). Aircraft noise is highly recommended by DOE Malaysia standards within 50 dB(A) at day time and 40 dB(A) in the night time. The noise may affect sleep, attentiveness, problem solving, memory, conversation, academic work in terms of reading and learning, and cause annoyance as well as affect task performance (Otutu, 2011). Gradually, the noise pollution can influence towards human reaction. This reaction depends on the individual hearing sensitivity.

Previously, a study carried out on people living close to London's Heathrow Airport showed that many people suffered from mental illnesses due to excessive exposure to noise compared to a similar group of people living in a quieter area some distance away from the airport (Jones *et al*., 1972). A study of residential communities around Heathrow airport found a significantly increased risk of heart disease and stroke in people that were exposed to regular aircraft noise (Hansel *et al*., 2013). Similarly, Swiss researchers found that aircraft noise was associated with increased mortality from heart attacks (Huss *et al*., 2010). In Malaysia, a study conducted by the DOE in 1981 to 1982 showed that the noise levels in 96% of the residential areas in Kuala Lumpur, Ipoh, and Pulau Penang failed to meet the WHO recommendation (Ahmed *et al*., 2014).

2.6 Aircraft Noise Impact

Noise is something that is negative and should be avoided because it can threaten health and comfort of residents in the affected areas. Threats can occur in two forms, it is physical and psychological (Amra, 2015). Although the noise impact cannot be seen with the naked eye but it will cause problems if prolonged in a long time. The variation among individuals in response to effects of aircraft is often conceptualized as noise sensitivity (Smith, 2003). Exposure to aircraft noise can lead to short-term responses such as sleep disturbances, annoyance and learning impairment in children and long term exposure is associated with increased risk of high blood pressure, heart disease, heart attack, stroke and dementia (Lee *et al*., 2016). The most common human effects on aircraft noise are annoyance, speech and learning interference and sleep disturbance as well as disruption towards normal daily activities like conversation, outdoor recreation, living and also family activities (Nelson, 2004).

The following aspects determined the impact and effects of interruption due to aircraft noise on human health. Table 4.5 showed the classification of the effect of aircraft noise on human health.

Table 2.1: Effect of Aircraft Noise on Human Health (Johari, 2008)

Physiological	Psychological
Rise of blood pressure (5-10 mmHg)	Tinnitus
Hearing loss	Annoyance & Aggression
Coronary artery disease – heart disease	Hypertension
Immune deficiencies	High stress level
Neorodermatitis	Speech interference
Asthma	Sleep interferences & awakening

2.6.1 Sleep Disturbance

People who live in highly populated urban areas tend to report sleep disturbance due to noise. Usually, these people live in the vicinity of highways, airport and other major noise sources (Vallet, 2001). A recent review identified a range of sleep outcomes which have been examined for aircraft noise exposure including interference with ability to fall asleep, shortened sleep duration, awakenings, increased bodily movements and perceived quality of sleep (Michaud *et al.*, 2007). There may also be after-effect during the day following disturbed sleep such as perceived sleep quality, mood and performance in terms of reaction time all decreased following sleep disturbed by aircraft noise (Stephen & Mark, 2003).

Noise can make it difficult to fall asleep, create momentary disturbances of natural sleep patterns by causing shifts from deep to lighter stages and cause awakening (Basner *et al.*, 2010). Therefore, noise may even cause awakening that a person may or may not be able to recall. Circadian changes related to disrupted sleep may also adversely affect the immune system (Schmidt *et al.*, 2013). Any time that our normal 25 hour circadian rhythm is altered or interrupted, it will have physiological and behavioural impacts. Normal circadian a was naturally altered as one ages including changes in sleep pattern with respect to earlier onset of sleepiness, early morning awakenings and increased need for daytime napping (Antal, 1975).

Noise can cause temporary stress reactions such as increasing the heart rate and blood pressure as well as produce negative effects on the digestive and respiratory systems (Moela, 2010). Several studies on people living near airports have found a link between increased exposure to aircraft noise and the risk of having high blood pressure (Munzel *et al.*, 2014). Sleep studies show the noise not only has an immediate effect on the quality of sleep but also can have long term effects on mental and physical health (Crowther, 2013).

2.6.2 Annoyance

Annoyance can interfere with daily activities leading to stress-related symptoms, with severe effects on well-being and health (Lee *et al*, 2016). Annoyance is defined as a feeling of displeasure associated with any agent or condition believed by an individual to adversely affect him or her (Savale, 2014). Annoyance is a multifaceted psychological concept including both evaluative and behavioural components used to describe negative reactions to noise such as disturbance, dissatisfaction, displeasure, irritation and nuisance (Clark & Stansfeld, 2011). Annoyance is the most widespread, subjective response to noise. Some individuals are intensely annoyed at very low sound levels, while others remain calm even when exposed to higher noise levels (Phun *et al.*, 2015).

Aircraft noise was more annoying than road traffic and railway noise less annoying than road traffic noise (Wolfgang *et al.*, 2009). Annoyance response can also increase in relation to a change in airport operations. A study around Zurich airport found that residents who experienced a significant increase in aircraft noise exposure due to an increase in early morning and late evening flight operations had a pronounced over reaction of annoyance (Brink *et al.*, 2008).

2.6.3 Memory and Learning

Excessive noise exposure can pose a threat to health. Therefore, noise can cause physical and psychological stress, especially among children and the elderly (Waie, 2003). Noise can impose negative effect towards children as they are particularly vulnerable to the effects and because noise has the potential to interfere with learning abilities at a critical development stage (Haines *et al*, 2001). They have less cognitive capacity to understand and anticipate stressors and lack well developed coping strategies (Clark & Stansfeld, 2011). As the children are still developing both physically and cognitively, there is possible risk that exposure to an environmental stressor such as noise may have irreversible negative consequences for this group (Stansfeld *et al*., 2010).

Aircraft noise negatively impacts a child's ability to learn (Seabi *et al*., 2005). Chronic aircraft noise exposure impaired reading comprehension and recognition memory in children aged 9 to 10 years. Furthermore, there was some studied of two school aged children populations (Hygge *et al*., 2002). One group consisted of children attending school in an area of a new airport development (aircraft noise) and the other consisted of children attending school in the vicinity of a recently closed airport (quiet). The researchers discovered that after the opening of the new airport, the children's long-term memory and reading comprehension were impaired. Thus, it is quite possible external traffic noise may play a role in impairing cognition in school aged children (Stansfeld *et al*., 2005).

2.6.4 Cardiovascular Impact

Noise triggers the body to release stress hormones that increase blood pressure and heart rate. This can happen not only in loud occupational environment but also in quiet settings when sleep or concentration is disturbed (Munzel *et al*., 2014). A recent review, suggested that risk for cardiovascular outcomes such as high blood pressure (hypertension), heart attack and stroke, increase by 7 to 17% for a 10 dB(A) increase in aircraft or road traffic noise exposure (Basner *et al*., 2014). A review of the evidences for children concluded that there were associations between aircraft noise and high blood pressure (Paunovic *et al*., 2011). A recent study around London Heathrow airport examined risks for hospital admission and mortality for stroke, coronary heart disease and cardiovascular disease for around 3.6 million people living near London Heathrow airport (Hansell *et al*., 2013).

2.6.5 Hearing Loss

Human is the main creature that will feel the impact of noise. However it depends on the sensitivity of a person, the more sensitivity they are the earlier responds they will get from the noise (Amra, 2015). A person may lose their hearing in some period of time without noticing it when it exposed too long to the noise. Normally, since they realize when they get symptoms like hearing disability. At this stage, this situation has become quite serious and may cause deafness disease. People will suffer from deafness problem immediately when exposed to loud sound that over 150 dB(A).

2.6.6 Speech Interference

Noise can be bothersome and can give rise to psychological and psychosomatic symptoms in the form of headaches, fatigue and irritability (Moela, 2008). Most of the occurrence of aircraft may contributed to the noise level that exceeded more than 65 dB(A). This definitely will interrupt normal conversation between people especially at the outside of building (Ismail *et al.,* 2010).

CHAPTER 3

MATERIALS & METHODS

3.1 Study Area

This study was carried out at the vicinity of Sultan Ismail Petra Airport areas, Pengkalan Chepa, Kelantan. Sultan Ismail Petra Airport is surrounded by residential areas, rubber and oil palm plantations as well as sensitive areas. The nearest land uses within 1 km radius are Kampung Tok Kaya (N $6°10'16.30$ E102°17'59.31"), Kampung Parang Puting ($N6°10'80$ $E102°17'.81$") and Kampung Teluk Reba (N$6°10'.52$ E102°17'44.97"). Therefore, the locations that were involved include sensitive areas such as residential and institutional areas nearby the airport. Sensitive area is where there is a high density of buildings and people which includes schools, offices and many other noise sensitive gathering places. The larger and more complex a community is, the higher the number of noise sources and the more difficult it is to act for noise reduction purposes (Coelho, 2007). According to that, the noise limit is higher than in low populated areas when the population number in this area is high.

Three sampling locations were selected within 1 km radius from center of airport. The particular problem of these sampling locations faced were located under the pathway or flight tracks of aircraft landing and taking off as shown in Figure 3.1. The factor of selecting those locations were based on accessibility and away from any obstacles such as large building and large tree in order to make sure the recorded of reading were accurate (Wahab, 2008).

Station 1 was located within residential area in Taman Sri Pengkalan Chepa (N6°10′. 31 E102°17'38.86) approximately 200 m to the north of the airport. Meanwhile, Station 2 was located nearby Institut Pengajian Guru Kota Bharu (N6°09′45.28 E102°17'39.07) that was situated at Jalan Maktab approximately 500m from the center of airport. Along the road Station 3 was located also within residential areas at Kampung Parang Puting (N6°16′92.30" E102°30'22.92) approximately 900 m to the west of the airport as shown in Figure 3.1.

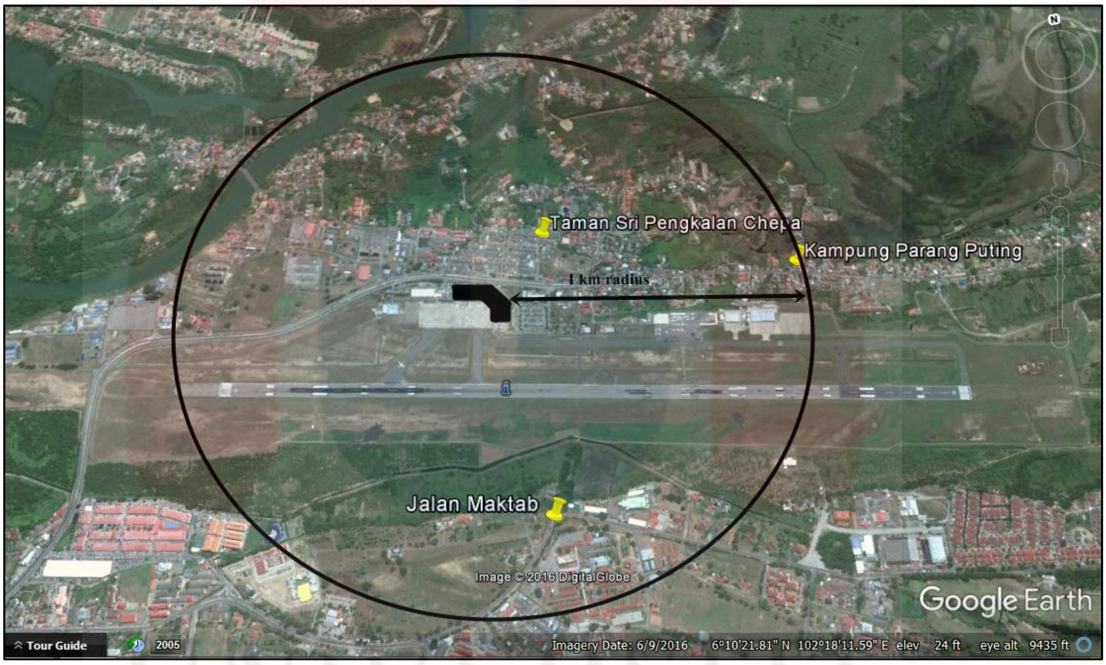

Figure 3.1: Location of residential areas

3.2 Materials

In this study, the data was collected using Model TM 102 Sound Level Meter Auto Ranging as shown in Figure 3.2. This sound level meter was provided by Environmental Laboratory, Faculty of Earth Science of Universiti Malaysia Kelantan. This material is completed with international standards quality. Furthermore, the coordinates of measurement stations where noise measurements were carried out will be determined with Geographical Point System (GPS) as shown in Figure 3.3. It was crucial to get the exact reading of coordinates of the sampling areas.

Figure 3.2: The set-up of TENMARS-102 sound level meter

Figure 3.3: Geographical Point System (Islam & Kim, 2014)

3.3 Methodology

The study was carried out from May 2016 until July 2016. Three sampling days in a month were allocated for each station. The data was collected in three months. Data sampling at the selected locations was carried out in three phases which were from morning until afternoon, from afternoon until evening and from evening until night. For the first phase, the data sampling was carried out at about 9.00 am until 11.00 am. Meanwhile, the second phase at about 2.00 pm until 4.00 pm and the third phase from 8.00 pm until 10.00 pm. Readings of noise level were recorded in decibel, dB(A) for 2 hours each phase at 5 minutes interval (Department of Environmental Malaysia, 2014). The reading was repeated for another one hour for each phase. All noise estimates was calculated as A-weighted average continuous equivalent sound pressure levels (L_{eq}). The average data was analyzed to determine the peak hours. Community noise exposure often varies significantly between day, evening and night-time periods. For obvious reasons, community sensitivity often varies considerably at these different times. Therefore, it was often desirable to set different criteria for acceptable noise exposure for each of these different time periods (Berglund & Lindvall, 1995).

3.4 Measurement Method

3.4.1 Microphone Placement

Difficulties can arise in the measurement of noise due to the placement of sound level meter and tripod. For example, if a microphone is located too close to a reflective surface, the noise level will show up higher than the actual noise level. Also, if the tripod is placed on a rigid surface then vibration through the legs of the tripod may affect the measured level (Ali, 2005). Noise levels can vary from place to place because of shielding by buildings as any hard surface will reflect sound.

Due to this, the measuring points must be setup away from facades, away from obstacles, about 2.5 to 3.5 m away from boundary wall, in dry conditions, with a wind speed of less than 5 m/s and also in line with the microphone at 1.2 to 1.5 m above ground level (Zannin *et al*., 2013)

3.4.2 Location of Sampling

According to the Planning Guidelines for Environmental Noise Limits and Control of Malaysia (2007), the measurements for noise emission as propagated to the environment by a sound source should be made at locations along or adjacent to the real property boundary of the sound source and at the receiver location. Besides, the measurements also made at all strategic locations representatives of the entire real property boundary and at all locations affecting the community. Different land used contributed to different explanation and condition of noise level acceptance to community. Different location of runway condition contributes to explanation on how noise level varies in terms of runway condition (Wahab, 2008).

3.5 Data Collection

Data obtained from each station had recorded and collected for analysis purpose. Data reading had been analyzed by using computer software, namely *Microsoft Excel* for ease of analysis. Environmental noise was measured with reference to the A-weighted decibel scale, dB(A). This reflected the fact that the human ear does not detect all frequencies of sound equally efficiently. To quantify sound levels which vary with time equivalent continuous sound level or L_{eq} was calculated. The descriptors Equivalent Continuous Sound Level $\left(L_{eq}\right)$, minimum noise level ($L_{\min}$) and maximum noise level(L_{max}) measured to assist in assessing the existing noise levels at the selected areas (Ahmed *et al.*, 2014). Frequency distribution tables and other descriptive statistics such as numbers and percentages were used to summarize study data in both tabular and graphical formats. Then, an assessment of the quality of the resulting noise will be compared based on standard proposed by the DOE (Ismail, 2008). The data of flight schedule also had been collected which include time, takeoff or landing and also type of aircraft. Therefore, at a specific location near an airport, the noise exposure on a particular day was likely to be higher or lower than the annual average exposure, depending on the specific operations at the airport on that day (Phun *et al*., 2015).

Aircraft noise limit and vicinity of airport noise limit in Malaysia are referred to the international standard (Fadhil *et al.*, 2012). Table 3.1 showed the maximum permissible sound level for development, which varies based on the population density in residential.

Table 3.1: The Maximum Permissible Sound Level (L_{eq}) by Receving Land Use for Planning and New Development

Receiving Land Use Category	**Day Time** **7.00am to 10.00pm**	**Night Time** **10.00pm to7.00am**
Noise sensitive areas, low density residential, institutional (school, hospital), worship areas.	50 dB(A)	40 dB(A)
Suburban residential (medium density) areas, public spaces, parks, recreational areas.	55 d(BA)	45 dB(A)
Urban residential (high density) areas, designated mixed development areas (residential-commercial).	60 dB(A)	50 dB(A)
Commercial business zones.	65 dB(A)	55 dB(A)
Designated industrial zones.	70 dB(A)	60 dB(A)

(Source: Schedule 1 of Department of Environment 2007)

3.6 Statistical Analysis

The data recorded were originally imported into Microsoft Excel where the date, times, location and L_{eq} were extracted. The data then transferred to SPSS statistical analysis software for review and analysis. Analysis of variance (ANOVA) is a collection of statistical method used to analyze the differences between group means and their associated procedures such as variation among and between groups (Sahoo, 2014). The one-way analysis of variance (ANOVA) was used to determine whether there were any significance differences between the means of two or more independent group.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

Noise level was observed at some selected areas in Pengkalan Chepa in different period of time which was morning, evening and night respectively. The data obtained from the data collection process will be analyzed in this chapter. All the data will be analyzed using Window Microsoft Excel. The obtained and calculated data on Equivalent Continuous Noise Level (L_{eq}) are analyzed to get the average and compared to the standard classification of noise exposure level. Readings recorded using Sound Level Meter is summarized in Appendix A. Results are compared to Maximum Permissible Sound Level for Development by the Department of Environment (DOE) Malaysia.

4.2 Data Analysis

4.2.1 Institut Perguruan Kota Bharu

As described in Chapter 3, the data observation was carried out over three days in a month at each station for three months. The first station was at institutional area nearby Institut Perguruan Kota Bharu (Station 1), residential area at Taman Sri Pengkalan Chepa (Station 2) and residential area at Kampung Parang Puting (Station 3).

Figure 4.1 showed three lines have been plotted for the reading of average noise level, the maximum noise level reading and minimum reading of noise level in

3 months. The noise level in form of dB(A) recorded at institutional area nearby Institut Perguruan Kota Bharu (Station 1).

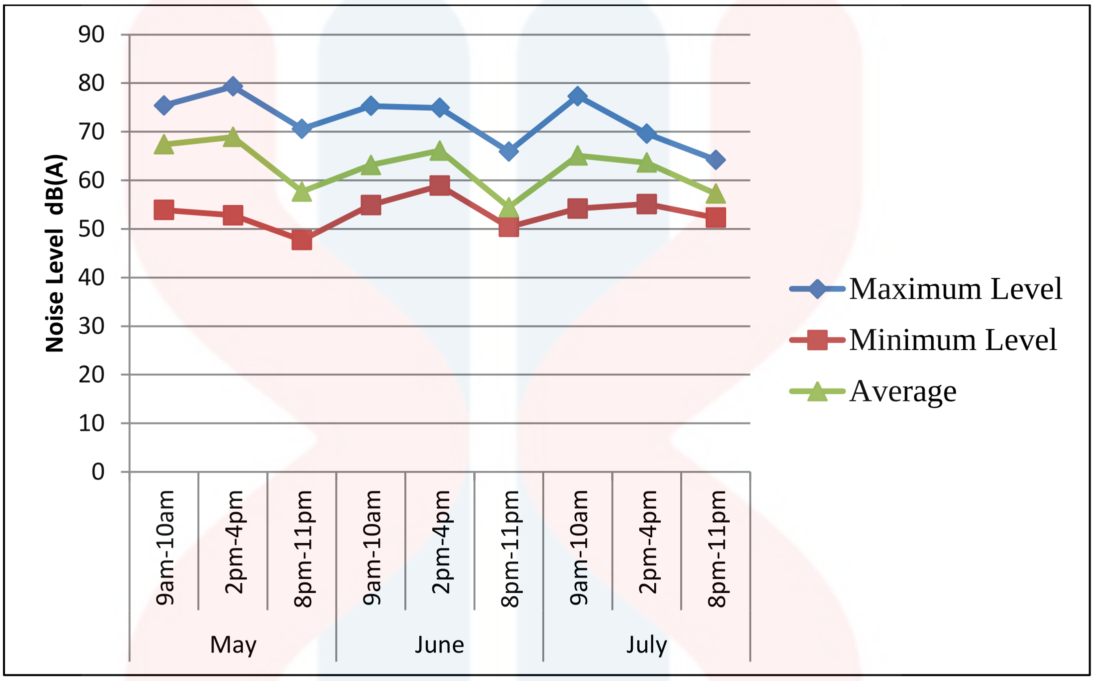

Figure 4.1: Noise level recorded near Institut Perguruan Kota Bharu (Station 1)

As mentioned before, the scope study area is up to 1 kilometer radius from the center of the airport. Based on Figure 4.1, the average noise level recorded on May at Station 1 was 67.41 dB(A) in the morning. The highest average was recorded on the evening which was 68.91 dB(A) meanwhile at night was 57.68 dB(A). The maximum noise level at Station 1 in the morning was 75.40 dB(A). During the evening, the noise level increase to 79.30 dB(A) while the noise reading at night was 70.6 dB(A). The minimum level recorded in the morning was 53.9 dB(A) and slightly decrease in the evening to 52.8 dB(A) and continue to decrease at night which was 47.7 dB(A).

From the observation, the normal operating hours of Sultan Ismail Petra Airport are active between 6.00 am until 12.00 am. There is no flight between 12.00 am to 6.00 am as the flights at these hours rerouted to Kuala Lumpur International

Airport. The flight schedule was obtained at Sultan Ismail Petra Airport as shown in Figure 4.2.

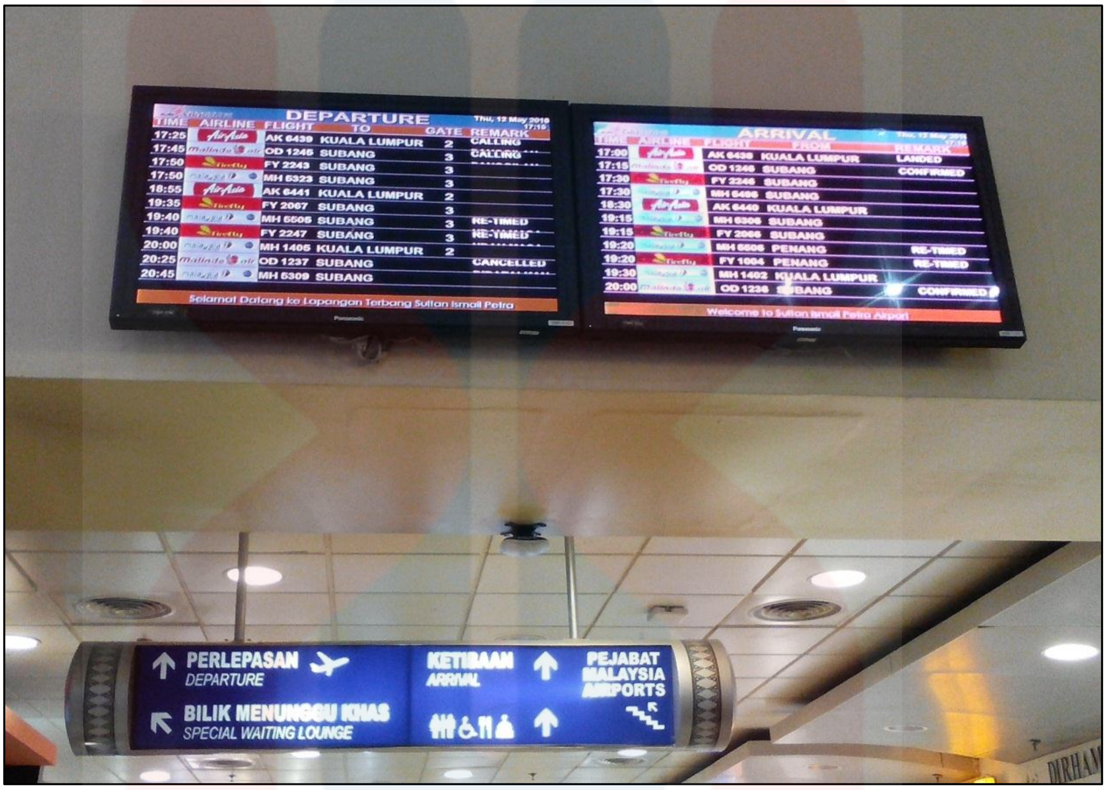

Figure 4.2: The flight schedule on 12 May 2016

From the observation, Station 1 was the noisiest among all the station with the highest noise level reading followed by Station 3 and Station 2. The highest noise level was recorded on May in the evening at Station 1. One of the factors that influence the reading might from the number of aircraft was the highest in May as the percentage number of aircraft was 35.07% as showed in Figure 4.3. Meanwhile, the percentage number of aircraft in June was the lowest which was only 30.10%and the percentage number of aircraft increased in July which was 34.87%. The noise level showed the lowest in June as the operation of flights were less than the number of flight operations in May and July. The impact of aircraft noise on community depended upon several factors including the number of operations, which the higher the number of aircraft the higher the noise level recorded (Horonjeff & Mckelvey, 1994). In general, the frequency of aircraft operations during period of time influenced the frequency reading of noise level.

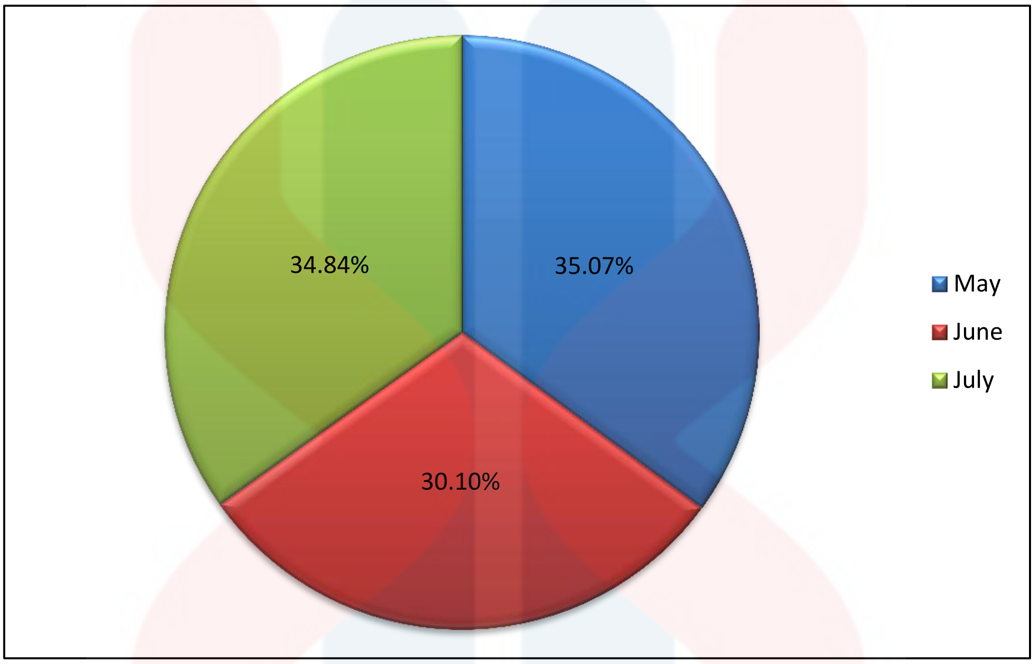

Figure 4.3: Percentage Number of Aircrafts Operations

It is clearly indicated in Figure 4.1 that many peak noise occurred during the measurement. This particular scenario indicated that the increasing noise level can be respectively associated with some aircraft activities. The reading of noise level increased in the evening. This may be due to busy work of airport activity. Based on flight schedule and observation, this was the times when aircrafts arrived at airport from other destinations. When the aircrafts arrived, they had a quick check up by maintenance department and depart to next destination or parked there waiting for the next scheduled flight. The noise level produced during the night in three months showed the decreasing as there was less operation of aircraft in night time as the operational hours off at 12.00am.

Data was collected on June at Station 1 which was located at latitude 6º16´24.95N and longitude 102º29´35.08´´E. The average of noise level produced was 63.16 dB(A) in the morning and up to 66.10 dB(A) in the evening. At night, the average of noise level was 54.46 dB(A). The maximum level of aircraft noise showed the highest reading for this month in Station 1 which was 75.3 dB(A) and slowly to decreasing until 74.9 dB(A) in the evening. During night time, the maximum level showed the reading was 50.4 dB(A). The minimum of noise level produced was in the ranged between 50 dB(A) and 59 dB(A) during both day and night which was 54.9 dB(A) in the morning, 58.9 dB(A) in the evening and 50.4(A) dB(A) at night.

The other factor that may contribute to the high level of noise was from traffic volume. A high traffic flow in peak working hours during day time had caused noise level recorded was maximum during day time compared to night time. Station 1 recorded the highest of noise level due to major roads that pass through this location especially during daytime. Furthermore, this location also quite near with educational area whereby traffic noise had contributed as a source of environmental noise. Moreover, this station was surrounded by offices and clinic. This had increased the volume of traffic.

From the observation, Station 1 showed the highest of noise level compared to Station 2 and Station 3 in May, June and July. This scenario occurred may be caused by additional noise disturbance from surface transportation. The reading increased in the morning and decrease in the night. The reading of noise level increased slightly in the evening compared in the morning as it was peak hour. From the observation, there were some buses that had engines, which produced a loud noise followed by the sound emission through the exhaust of the bus in May.

The data collected at Station 1 on July showed that the average of noise level at this area was the range 57 dB(A) to 66 dB(A). The reading of average aircraft noise showed the highest reading at Station 1 compared to the other two stations which was 65.1 dB(A) in the morning on this month. The average of noise level produced was 63.64 dB(A) in the evening and 57.25 dB(A) at night. The maximum level of noise produced the highest at Station 1 which was 77.3 dB(A) in the morning. The noise level recorded during the evening was 69.6 dB(A) and 64.2 dB(A) at night. The minimum of noise level was 54.2 dB(A) in the morning and up to 55.1 dB(A) in the evening. At night, the minimum of noise level recorded was 52.3 dB(A).

In the study, three sampling locations were selected within 1 km radius from the center of airport. Station 1 is located within airport compound, adjacent to airport terminal, about 200 m from center of runway nearby Institut Perguruan Kota Bharu. Station 2 is located within residential area, namely Taman Sri Pengkalan Chepa about 500 m from the center of airport. Meanwhile Station 3 is located within the residential area about 900m from the center of airport in the north of the runway strips which one of the routes of flight take-off and landing operation as showed in Table 4.1.

Table 4.1: The Distance of Selected Areas from the Airport

Station	Distance
Station 1	Approximately 200m from the runway of airport
Station 2	Approximately 500m from the center airport
Station 3	Approximately 900m from the center of airport

The highest noise level was recorded at Station 1 as it was surrounded by educational area and near the runway of airport. Educational areas were the place where parents sending their children to the school and became focus area to the academician. Therefore, the population number of people around this area was high. This area was the pathway of the public transport as there were many educational areas in this area such as Sekolah Menengah Sains Tengku Muhammad Faris Petra and Sekolah Kebangsaan Pengkalan Chepa. Station 1 was closer to airport terminal and more exposed to a long duration of noise annoyance which exposed to aircraft noise arriving and departing to destinations in Peninsular Malaysia, such as Kuala Lumpur and Langkawi. The high level of the noise maybe influenced by the machinery work and influenced by the noise produced from the existing activity of landing and arriving of aircraft. An area with environmental noise level less than 55 dB(A) is usually considered as a comfortable environment with little or no annoyance so that no negative physical and mental influence will be caused to essential activities such as working leisure and sleeping (Kadiri *et al.*, 2006).

4.2.2 Taman Sri Pengkalan Chepa

Noise level recorded on May at Station 2 showed that the average of noise level was 51.15 dB(A) in the morning as showed in Figure 4.4. Meanwhile, the reading showed 48.1 dB(A) in the evening. At night, the average of noise level at this area was 45.52 dB(A) which was the lowest. The maximum reading for presented 57.9 dB(A) in the morning meanwhile for the night the reading was 58.5 dB(A). The highest decibel on that day was 61.6 dB(A) in the evening. The minimum noise level showed 41 dB(A) in the morning. The decibel of noise level showed a bit different in the evening and at night which were 38.8 dB(A) and 38.6 dB(A) at the same station.

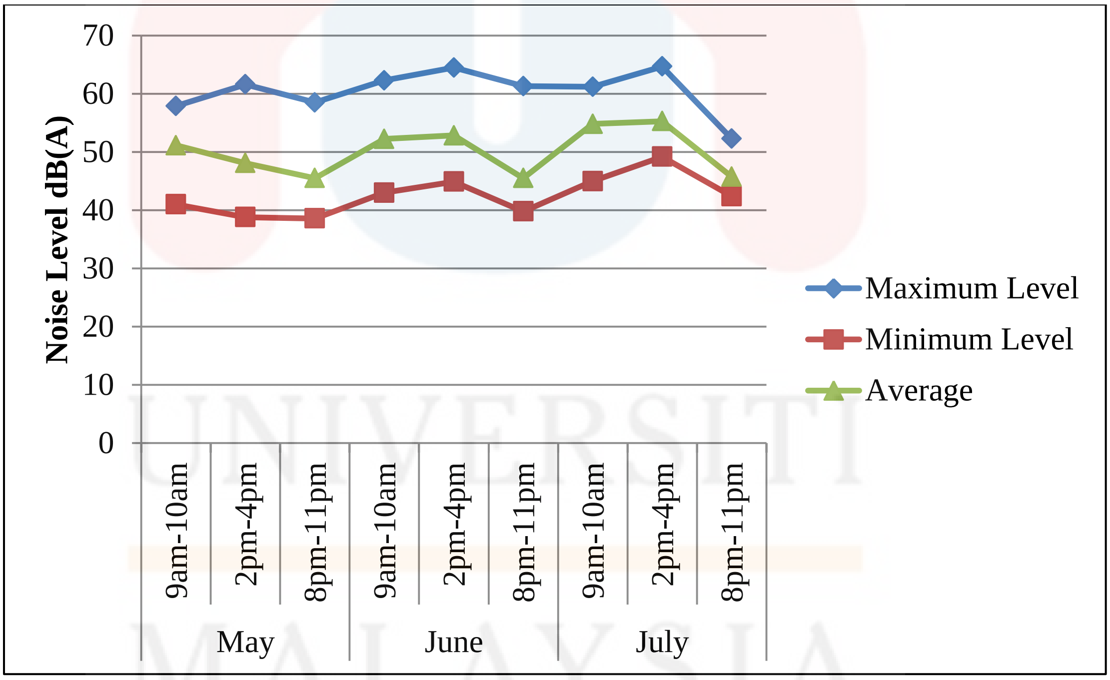

Figure 4.4: Noise level recorded at Taman Sri Pengkalan Chepa (Station 2)

From the observation, the noise level fluctuated in May, June and July at Station 2. The high level of noise produced in the morning and decrease during night time. Figure 4.4 clearly showed that the minimum level of noise was below 50 dB(A) in May and June during day time. This may be caused by a little number of flight schedules.

The average of noise level recorded on June at Station 2 was similar during day time within the range 52.25 dB(A) in the morning to 52.86 dB(A) in the evening. Meanwhile, the average noise level was 45.50 dB(A) at night. Station 2 showed the maximum level quite similar within the range 61 dB(A) to 65 dB(A) for both day and night which indicated the high reading recorded was 64.5 dB(A) during the evening meanwhile 62.3 dB(A) in the morning and 61.2 dB(A) at night. The noise level recorded the minimum level was below 50 dB(A) which was in range 43.0 dB(A) in the morning, 44.9dB(A) in the evening and decrease to 39.8 dB(A) at night.

In this study, Station 2 was the lowest the reading of noise level. Station 2 had smaller roads compared to Station 1. Therefore, there were less vehicles passing through this area as most of the people went for their work station and be out from home. Therefore, the reading of noise level decreased. Compared the noise level reading in July, the noise level was increased as the number of residents increase especially in the evening due to festival day. However, the noise level has exceeded from the standard noise allowed by the DOE Malaysia Standards level for the residential area which was 50 dB(A) during day time.

The noise level was recorded on July 2016. The average of noise level at Station 2 was similar during day time within the range 54.83 dB(A) in the morning to 55.29 dB(A) in the evening. Meanwhile, the average noise level was 45.74 dB(A) at night which slightly increased compared to the data recorded in June. Station 2 indicated the maximum level within the range 61 dB(A) to 65 dB(A) during day time. Meanwhile, the noise level recorded at night was 52.3 dB(A). The minimum level of noise recorded did not exceed 50 dB(A) which was in range 42 dB(A) to 50 dB(A) during day and night time. The highest reading was 49.2 dB(A) which was noted in the evening.

4.2.3 Kampung Parang Putting

The noise level recorded on May at Station 3 showed that the average is the highest in the morning which was 58.38 dB(A) while the lowest average was at night 52.48 dB(A) as shown in Figure 4.5. The average noise level recorded in the evening was 56.80 dB(A). The maximum noise level was the highest in the morning which was 71.5 dB(A). Meanwhile the noise level produced in the evening was 64.6 dB(A) and decreased to 60.4 dB(A) at night time. During day time, the minimum noise level at this area was the range of 51 dB(A) (in the evening) to 52 dB(A) (in the morning). At night the noise level at this area was 45.5 dB(A).

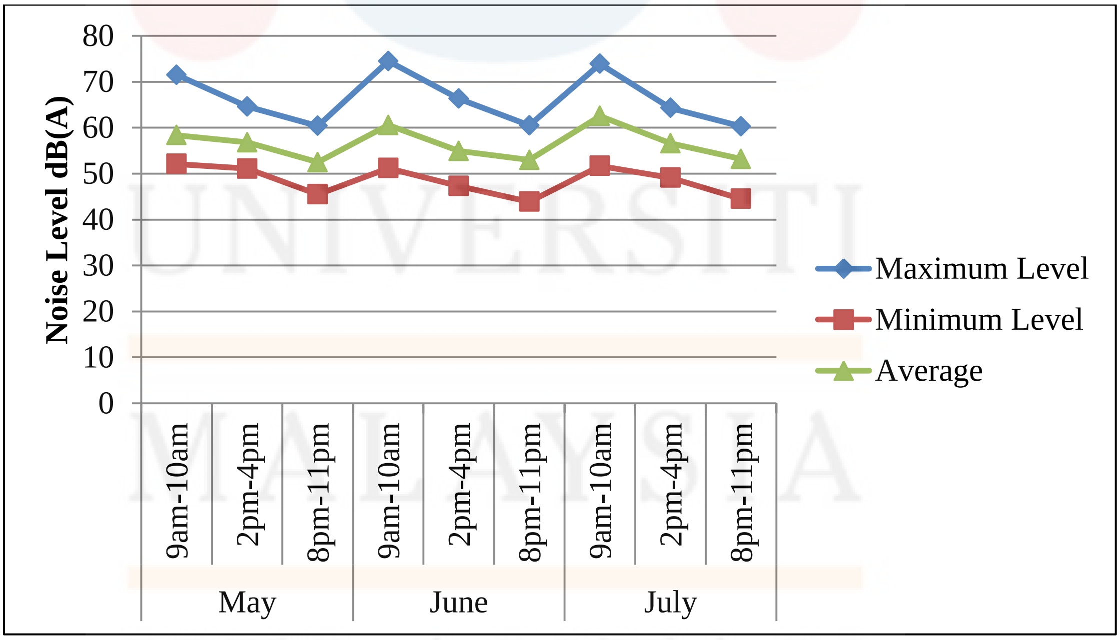

Figure 4.5: Noise level recorded at Kampung Parang Putting (Station 3)

Based on observation, the highest noise level was found during the morning hours in May, June and July at Station 3 which was the peak hours. Most of the noise peak took place due to the excessive noise level from the aircraft (Ismail *et al.*, 2010). Different vehicle types produced different levels of noise (Olayinka, 2013). From the observation, the volume number of vehicles increases more than usually due to festivals celebration in July that also influences the reading of noise level. The lowest noise level recorded at Station 2 also due to its surrounding as this area is a totally residential area whereas most of the times it became calm and quite.

Station 3 showed the average of noise level recorded on June was 60.55 dB(A) which was the highest compared to average of noise produced in the evening and at night which was 54.91 dB(A) and 52.99 dB(A). The maximum aircraft noise level in this station produced the high reading in the morning which was 74.5 dB(A) while there were a little differences reading during the evening and night time which was 66.3 dB(A) in the evening and decrease to 60.6 dB(A) during night time. The noise produced at minimum level was 51.2 dB(A) in the morning while there was 47.3 dB(A) and 43.9 dB(A) in the evening and at night.

The noise level was recorded on July. Station 3 showed the average of noise level was 62.54 dB(A) which was the highest compared to average of noise produced in the evening and at night which was 56.58 dB(A) and 53.19 dB(A). The maximum level of noise was 73.9 dB(A) in the morning. The maximum level reading recorded in the evening and at night had a small different which was 64.3 dB(A) and 60.3 dB(A). The minimum of noise level recorded in this area was in range 44 dB(A) to 51 dB(A) during day and night time. The reading showed the highest in the morning which was 51.7 dB(A) while 49.1 dB(A) in the evening and 44.5 dB(A) at night.

The other factor that might contribute to the highest level of noise due to distance of populated areas to airport. Station 3 consisted of housing area and also educational nearby which is Sekolah Kebangsaan Parang Puting. Different land uses contribute to different condition of noise level acceptance to community (Wahab, 2008). Based on Table 4.1, it showed that the greater the distance from the noise source, the noise levels generated also reduced. These locations were residential areas which were located closest to the runway and directly received noise exposure as well as gave impact for residents. This area supposedly gave high reading of noise level as it was located at the end of the runway strip in the north and was exposed to aircraft noise caused by take-off, approach and flyover operation of flight flying to and from destinations in East Malaysia. From the observation, the distance of Station 3 to the airport not influenced the noise level reading of aircraft. The ambient noise had no effect in community because intrusive noise level was high enough to be annoying even by high ambient noise level from the human activities. Station 3 located nearby Sekolah Kebangsaan Parang Puting. Factors that influence the noise level readings were from the parents sent their children to the school, the vehicles passing by and school activities.

The high maximum noise levels from aircraft flying over communities cause a number of impacts, including disruption to normal conversation, interference with television viewing and disturbance to sleep (Stansfeld & Matheson, 2003). The noise produced in May, June and July decreased during night time due to students return home from the school. Noise could also have an impact on reading performance by negatively affecting health status (Stansfeld *et al*., 2010). Children attending schools near airports may also return to homes located in aircraft flight-paths of noise, which might interfere with sleep patterns and consequently impair learning (Haines *et al.*, 2001).

As a conclusion from the study, the highest noise level was recorded at Station 1 in the evening on May. Meanwhile, Station 2 recorded the lowest noise level during night time on June and the highest noise level recorded at Station 3 was in the morning on July. Compared to the three stations, Station 1 showed the highest noise level recorded while Station 3 was the second highest noise level recorded followed by Station 2.

4.3 Comparison of Noise Level with DOE Standards Level

Compared to Maximum Permissible Sound Level by Department of Environment (DOE) Malaysia, the maximum noise limit in residential areas for day time was 50 dB(A) and 40 dB(A) for night time. Figure 4.5 clearly showed that the noise condition most of the selected areas were higher than the acceptable limit.

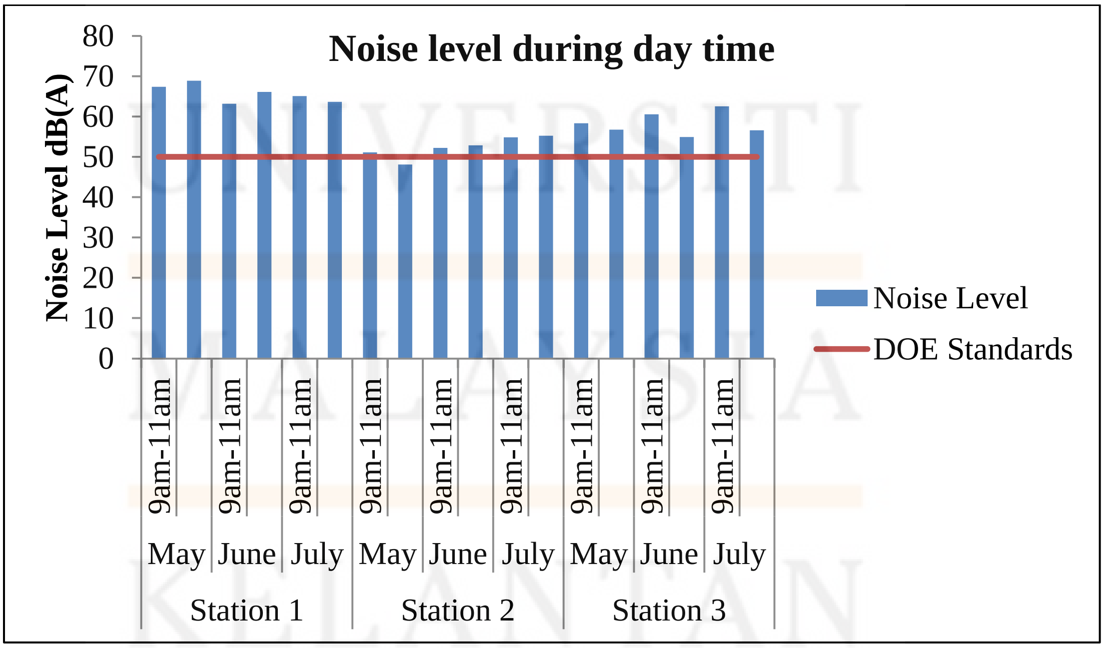

Figure 4.6: Comparison of noise level with DOE Standards Level during day time

Figure 4.6 showed the data recorded at Station 1, Station 2 and Station 3 during day time. Compared to the DOE Malaysia Standards Level, the noise level produced in Station 1 was exceeding above 50 dB(A) in May, June and July. The high level of noise produced maybe because of the activity of landing and departing of the aircraft. The reading of noise level was above to the noise standard. Based on the observation, Station 1 showed the highest level of noise in May in the evening due to several factors stated. Thus, the surrounding will be affected when the noise level is exceeded.

The noise level at Station 2 still below than the standards noise 50 dB(A) in May. The factor that contributed this as the number of flight reduced in this month. Even though the reading is below the standard, this area still needs to be observed. This is to make sure that there will be no harm to the surrounding in future. Meanwhile, the noise level was exceeded standard noise level in June and July.

Station 3 showed the noise level at this area in May, June and July severely exceeded the standard noise level which was 50 dB(A) for residential area in day time. The levels of aircraft noise within this area was exceeded the limit due to by location factor as all 3 stations are located within 1 km radius. The level of noise should be observed all the times to avoid any adversely impacts.

Figure 4.7 showed the comparison of noise level during night time with DOE standards level in 3 months. The data recorded showed decreasing trend at each station due to the operational hours of flight occurred only 6.00 am until 12.00am. However, according to DOE Malaysia Standards level, the noise level should not be more than 40 dB(A) for night time. The high level of noise may affected by the nearby traffic. Meanwhile Station 1 showed the highest noise level compared to the Station 2 and Station 3. The noise aircraft should below the standards which should protect the public as well as vulnerable groups such as the elderly, children and the chronically ill from the effects of night time noise exposure on health (Van & Davies, 2013). Overall, the noise level decline during night time in each station. During night time, the activity in airport became less than day time. This may lead toward a critical situation for the people on these areas because of such noisy condition.

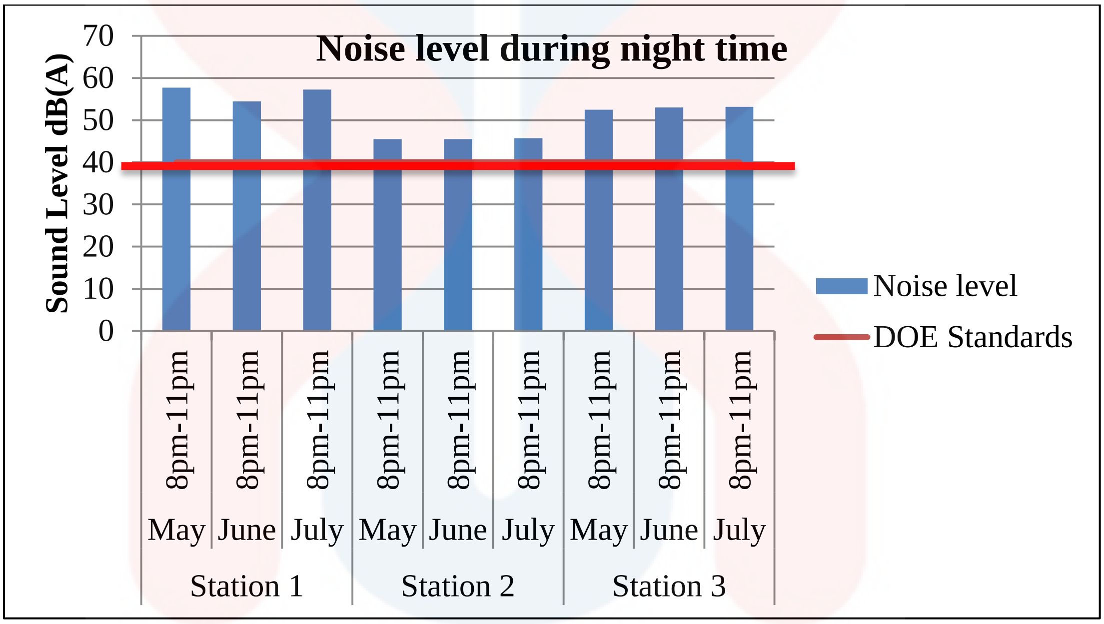

Figure 4.7: Comparison of noise level with DOE Standards Level during night time

4.4 Statistical Analysis

4.4.1 One-Way ANOVA

To evaluate the effect of aircraft noise, a one-way analysis of variance (ANOVA) was conducted with the independent variable was stations while average of noise was the dependent variable. The results of the ANOVA test shown in Table 4.3 above revealed a statistically significant different relationship F (2,24) = 19.70, *p* = 0.000.

Table 4.2: Analysis of Variance of Noise Level

ANOVA					
	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	702.565	2	351.282	19.697	0
Within Groups	428.013	24	17.834		
Total	1130.578	26			

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The study was focused on the effects of aircraft noise on residents particularly on the areas lying under and adjacent to the probable arrival and departure route, since it is in these regions that the aircrafts are too close to the ground and therefore have the greatest noise impact. Overall, the study plots and direct observation that has been carried out has achieved the first objective that has been stated which is to determine the noise level in the vicinity of the Sultan Ismail Petra Airport. Meanwhile, the second objective also has been achieved which to identify the sources of aircraft noise. The third objective which is to compare the noise level in vicinity of airport with Department of Environment (DOE) Malaysia standards also has been achieved. The noise level at Station 1, Station 2 and Station 3 have exceeded the noise standard during day time and night time which is 40 dB(A) and 50 dB(A). Station 1 has the highest noise level compared the other two stations.

Noise as an environmental pollutant can logically be considered a public health hazard whenever it produces harmful physiological effects, interferes with normal activities such as sleep, speech, watching or listening to television, learning, performance of task which need concentration, radio broadcasts, relaxation, telephone communication, teaching, listening to music, or causes annoyance and general mental distress.

5.2 Recommendation

This study had achieved the objective which was to determine the noise level in the vicinity of the Sultan Ismail Petra Airport, Pengkalan Chepa, Kelantan. There are some suggestions that can be applied to ensure that the noise level can minimize the rate of adoption that could impact on the population around this area.

Equipment availability factor is seen the major constraint and obstacle. Equipment only can be used once at a time due to a long sampling duration at each station thus, it cannot be at different places at the same time or used simultaneously. This problem may give inaccurate results in the study. On the other hand, there was only two set of sound level meter provided by Environmental Laboratory. Therefore, data sampling for this study needed to be conducted with rotation between the partners.

In order to improve this study in the future, it is suggested that frequency of data sampling, number of sampling station and scope of study need to be increased and widened. Data sampling should be conducted at least twice and at least 10 sampling station should be selected. Study area should cover the whole town of Pengkalan Chepa in order to get more accurate and convincing results. In order to reduce the noise pollution, permissible noise limit in airport and its surrounding area should be included in DOE Malaysia guidelines as noise pollution is a significant problem in airport.

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APPENDIX A

Raw Data of Noise Level at Station 1

Location : Institut Perguruan Kota Bharu

Latitude / Longitude: 6º16´24.95N / 102º29´35.08´´E

Date: May 2016

9.00 am- 11.00	2.00pm-4.00pm	8.00pm-10.00pm
61.7	69.7	53.2
63.7	70.3	62.7
69.2	74.4	54.2
75.4	72.7	53.9
64.7	58.1	50.3
71.6	66.1	65
63.9	64.9	50.4
73.1	76.8	50.6
71.3	67.7	55.8
71.8	71.4	61.5
77.6	70.3	52.2
64.6	79.3	60.2
66.6	70.9	70.6
70.5	72	59.5
68.7	69.8	69.4
68.2	52.8	58.2
74.6	74.7	53.5
73.6	66.8	52
53.9	68.5	56.4
63	71.6	54.1
56.8	60	47.7
67.5	67.2	61.6
69.2	64.9	62.5
56.7	72.9	68.9

Raw Data of Noise Level at Station 1

Location : Institut Perguruan Kota Bharu

Latitude / Longitude: 6º16´24.95N / 102º29´35.08´´E

Date : June 2016

9.00am-11.00am	2.00pm-4.00pm	8.00pm-10.00pm
59.3	66.4	52.7
54.9	65	52
60.3	62	50.7
61.4	70.9	64.5
66.9	74.9	53.2
65.1	67.9	59.8
66.6	66.2	58.2
55.8	63.3	65.9
62.7	64	51.8
58.3	59.9	56.6
70.1	65.8	51.4
62.5	71.9	62.3
60.4	64.7	68
61.2	65.1	52.2
66.2	64.4	53.8
57.8	58.9	61.1
69.2	64.3	50.4
68.6	67.9	52.6
57.5	62.4	56.7
70.1	68.1	53.6
61.6	72	64.4
61.8	66.4	58.7
62.2	60.9	53.9
75.3	72.3	55.2

Raw Data of Noise Level at Station 1

Location : Institut Perguruan Kota Bharu

Latitude / Longitude: 6º16´24.95N / 102º29´35.08´´E

Date : July 2016

8.00am-10.00am	2.00pm-4.00pm	8.00pm-10.00pm
59.5	64	59
57.1	63.4	60.1
68.4	64.7	58.2
67.6	62.4	55.5
73.3	63.9	59.2
60	63.3	52.3
65.4	62.9	63.8
78.5	58.9	54.3
66.9	55.1	55
58.9	67.1	56.2
60.7	64.2	55.9
67.5	69.2	63.4
77.3	66.4	54.4
68.9	63.4	52.4
60.1	59	53.9
56.9	60.1	53.3
62.7	68.2	62.9
61.5	65.5	55.1
70.5	69.6	58.9
73.5	63.2	57.1
54.2	63.8	64.2
58.1	64.4	59.2
68.1	65	56.4
66.7	59.7	53.4

Raw Data of Noise Level at Station 2

Location : Residential Areas at Taman Sri Pengkalan Chepa

Latitude / Longitude: 6 º 17´08.20N, 102 º29´38.56´´E

Date: May 2016

8.00am-10.00pm	2.00pm-4.00pm	8.00pm-10.00pm
55	49.3	39.4
52.4	42.3	41.9
55.6	46.6	53.7
47.6	49.9	54
55.1	50	44.5
57.9	52.1	49.3
62.5	54.9	42.9
50.2	43.7	45.4
46.2	44.5	58.5
56.7	48.7	43.7
48.7	47.8	41.9
47	39.5	47
45.2	52.6	46.7
53	45.1	43.1
48.6	55.1	39.8
50.3	39.2	42.7
44.3	40.8	47.5
41	58.8	40.9
55	60.6	38.6
55.3	61.6	53.3
48	40.6	51.2
47.9	38.8	42.6
46.5	40.3	41.6
57.7	51.5	42.3

Raw Data of Noise Level at Station 2

Location : Residential Areas at Taman Sri Pengkalan Chepa

Latitude / Longitude: 6 º 17´08.20N, 102 º29´38.56´´E

Date: June 2016

8.00am-10.00am	2.00pm-4.00pm	8.00pm-10.00pm
54.9	49	39.9
54.2	57.8	42
49.1	44.9	45.9
52.7	52.5	41.8
47.4	47.3	43.9
52.3	56.4	41.4
44.6	54.9	46.7
51.2	48.1	44.1
49.1	62	43.1
57.6	55.3	44.3
48.7	49.2	43.7
54.9	57.7	39.8
59.6	45.3	56.8
44.9	54.8	47.7
55.3	63.7	42.7
43	48.6	43.5
52	52.1	44
45.8	46.6	46
62.3	53.8	43.3
56	50.4	61.3
60.4	56.2	51
56.6	49	39.9
45.7	57.8	42
55.8	44.9	45.9

Raw Data of Noise Level at Station 2

Location : Residential Areas at Taman Sri Pengkalan Chepa

Latitude / Longitude: 6 º 17´08.20N, 102 º29´38.56´´E

Date : July 2016

8.00am-10.00	2.00pm-4.00pm	8.00pm-10.00pm
59	50.7	43.4
47.7	54.5	44.7
54.5	53.2	42.4
56.9	59.8	43.9
55.8	58.2	43.2
52.8	55.2	42.9
45	51.8	45.1
59.2	56.6	48.9
59.9	58	47.1
48.6	61.4	44.2
55.3	52.3	49.2
50	52.2	46.4
60.4	53.8	43.4
58.1	51.1	49
51.2	60.4	50.1
55.6	52.6	48.2
57.4	53.6	45.5
54.4	54.3	52.3
56.4	54.4	43.2
52.3	56.7	43.8
61.2	58.7	44.3
54.3	64.7	45
51.9	49.2	46.2
57.9	53.5	45.9

Raw Data of Noise Level at Station 3

Location: Kampung Parang Puting

Latitude/ Longitude: 6 º10´ 80N 102º 17´. 81´´E

Date : May 2016

8.00am-10.00am	2.00pm-4.00pm	8.00pm-10.00pm
54.3	55	45.5
54.6	58.2	53
64.9	58.3	54.5
57.9	55.9	60.4
48.9	62	52.1
71.5	62.7	54.6
71.1	56.3	49.1
55	51.7	55.9
55.9	56.7	52.3
63.2	57.4	50.4
57.4	55.8	46.3
56.2	53.6	53.6
53	60.4	53.7
57.1	56.2	57
64.1	57.3	47.2
64.8	55	52.4
55.8	54.9	51.8
56.6	58.4	58.2
59.5	64.6	54.5
60.4	54.3	48.2
55.9	59.1	53.7
56.6	57.9	52.6
52.1	50.3	49.9
54.3	51.1	52.7

Raw Data of Noise Level at Station 3

Location: Kampung Parang Puting

Latitude/ Longitude: 6 º10´ 80N 102º 17´. 81´´E

Date : June 2016

9.00am-11.00am	2.00pm-4.00pm	8.00pm-10.00pm
55.5	52.1	43.9
56.9	53.7	58.7
70	59.6	53.3
63.6	55	47.2
57	52.4	54.5
59	66.3	44.3
66.2	54.9	55.9
58.2	47.3	51.8
61	50.4	60.5
51.2	49.3	52.3
53	53.7	58
56.7	63.1	52.2
74.5	58.6	46.5
65.5	51.9	59.9
69.1	53.3	53.8
62	54.6	50.1
57.6	62.4	45.6
55.2	54	53.5
59.4	48.7	54.2
67.6	52.2	58.7
59.9	54.3	53.9
53.1	61.9	48
67.9	56.4	55.2
53.2	51.8	59.8

Raw Data of Noise Level at Station 3

Location: Kampung Parang Puting

Latitude/ Longitude: 6 º10´ 80N 102º 17´. 81´´E

Date : July 2016

9.00am-11.00am	2.00pm-4.00pm	8.00pm-10.00pm
68.8	49.1	44.5
54.9	53.2	54.3
66.3	59.2	55.5
66.3	64.3	46.2
65.9	52.3	45.9
56.9	56.6	57.1
52.4	50	54.7
68.3	62.3	48.2
63.7	52.1	59.6
73.9	54.1	57.8
58.6	53.7	60.3
51.7	60.7	55.4
55.9	54.5	51.5
63.9	58.7	47.1
70.1	59.5	52.4
60.3	55.1	54.5
55.5	62.8	57
55.4	59.2	53.3
60.4	53.7	56.5
66.2	59.6	46.6
59.2	63.4	52.3
71.6	54.6	57.7
64.8	56.7	49
69.9	52.6	59.1

Station (S)	Date	Number of flight	Total
S1	12 May 2016	103	
S2	20 May 2016	93	289
S3	27 May 2016	93	
S1	25 June 2016	93	
S2	12 June 2016	81	248
S3	26 June 2016	74	
S1	10 July 2016	103	
S2	11 July 2016	96	287
S3	25 July 2016	88	

Raw Data Number Operations of Aircrafts

APPENDIX B

Sampling data at Station 1

Sampling data at Station 2


Sampling data at Station 3

The Flight Schedule at Sultan Ismail Petra Airport