THE IMPACT OF TRAFFIC NOISE POLLUTION ON THE POPULATION OF STRUBENSVALLEY IN ROODEPOORT

By

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ABSTRACT

The Strubensvalley area is an up market area with numerous shopping centres and trendy dwellings. A major road, namely Hendrik Potgieter Road (M47), feeding between Johannesburg and North West/Botswana, runs through the suburb. Residents of Strubensvalley are in their concern about this road: the noise pollution which impacts negatively on their lives.

This research investigates the traffic noise and the impact it has on the population of Strubensvalley. The selected study area was delimited by drawing a circle with a radius of four kilometers around the middle point, it being at the intersection of Hendrik Potgieter Road and Krugerrand Road. Clearwater Mall and Wilgeheuwel Retail Crossing shopping centre are the two large features on the circumference of the study area.

A calibrated sound level meter was used to measure the traffic noise at 18 different measuring points within the study area. Measurements were taken during the day (6am to 10pm) and at night (10pm-6am) in order to establish the noise impact caused by the peak flow and non-peak flow of traffic in the suburb.

A 30-item noise -health-related questionnaire was used to establish the impact of traffic noise on the respondents. A hundred randomly -chosen participants within the study area were interviewed on a door-to-door basis. On completion of this research, it was established that the people interviewed were generally annoyed by the traffic noise in Hendrik Potgieter Road. The majority of the participants complained about the annoyance and interference factor caused by traffic noise in that it affected them in activities (e.g. napping during the day).
It was established that the majority of people living close or alongside Hendrik Potgieter Road were mainly affected by traffic noise. The adverse effects associated with road traffic noise and irritability, general annoyance, interruptions in daytime relaxation hours, and sometimes disturbance of sleep during the night.
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Chapter 1: Introduction

1.1 Background

Industrial development through imported technology and the concentration of small locally based industries in the developing countries (e.g. South Africa), have led to the introduction of uncontrolled and unknown wastes into the environment in liquid, solid and gaseous forms. Besides such obvious forms of pollution, there are also the insidious forms, such as noise pollution, that have far reaching negative consequences. Countries in the Third World are facing the dilemma of whether to pursue economic development irrespective of environmental destruction in order to catch up with the more advanced industrialised countries, or to pursue ecologically sustainable industrial development that combines economics and ecology. It is now widely acknowledged that developing countries are experiencing severe environmental problems and destruction that were unknown 20 or 30 years ago. These environmental problems could include noise, air and water pollution (Van der Merwe, B. 2008; Personal Communication, Owner: dBAcoustics).

Of the three, noise pollution is the less obvious but rather a problem that has grown steadily worse with time. It can be defined as unwanted or offensive sounds that unreasonably intrude into the daily activities of people. A number of factors contribute high noise levels, such as an increase in population and an increase in the volume of traffic. (Department of Environment & Climate Change, 1995). However greater community awareness of environmental noise has increased and there are greater expectation now for state and local government to reduce noise levels (Singh & Rao, 2001).

In recent times, noise nuisance has escalated dramatically in both its severity and extent. Today the noise generated from traffic is a major source of environmental pollution. This is substantiated by results emanating from the continuous monitoring of equivalent noise levels (Leq) at a number of sensitive, residential, commercial and
industrial sites during the day and at night. Having developed as a cumbersome condition that has become unacceptable to society, noise pollution has manifested itself in the urban environment. Noise has in fact been a constant threat since the Industrial Revolution (Singh & Rao, 2001).

Urban noise pollution has rapidly grown to become a significant environmental problem (Bragdon, 1971). A threat to human kind’s physical and psychological well-being, the sounds of our technology accompany us through our working, leisure, and sleeping hours. Even though some research has been done on the effects of noise; there are a few national and private groups that are trying to reduce noise pollution. However this crisis has generally received modest attention in South Africa. This syndrome of modern society deserves further recognition as a serious environmental challenge for several reasons. Noise is insidious. The chance of gaining refuge from noise is disappearing fast. Noisy garbage trucks and early jet flights signal the beginning of each day (Bragdon, 1971).

Unfortunately, data and statistics on pollutants are scarce in developing countries. This is generally the case in South Africa. Moreover, there are limited sources, systematically revealing the contribution of noise to pollution. During this research, it was discovered that Strubensvalley in Roodepoort, South Africa, is largely characterised by noise pollution, which is having an adverse impact on the environment. Since this suburb is a rapidly developing urban area, its noise attributes are unfavourable to some of its residents. Health is also affected to some extent by noise pollution, since it tends to lead to stress related conditions (Burns, 2007).

1.2. Problem Statement

Noise pollution can be defined as unwanted or offensive sounds that unreasonably intrude into people’s daily activities. Noise has many sources, most of which are associated with urban development: road, air and rail transport; industrial neighbourhood and recreational noise (Wolf et al., 2002). A number of factors contribute to problems of high noise levels, including the following:
- A growing population, particularly in cases where it leads to increasing urbanisation and urban consolidation. Activities associated with urban living generally lead to increased noise levels.

- Increasing volumes of road, rail and air traffic (Wolf et al., 2002).

Community awareness of environmental noise has increased and there are greater expectations for developed and developing countries to reduce noise levels (Bragdon, 1971).

Noise is a natural consequence of whatever we do. It forms part of our everyday background and for the most part we just accept it or at least tolerate it. However, noise has the capacity to cause conflict between those who are generating it and those who are subjected to it but who do not wish to be (Saenz & Stephens, 1986).

Under most circumstances, unwanted noise will not cause people to complain, but there are clearly circumstances where the volume, duration, or repetition (or all three) will cause irritation and frustration. The recipient of the unwanted noise intrusion may take legal action, or in some instances resort to more dramatic measures (Saenz & Stephens, 1986).

1.3 Objectives

The main aim of this study is to investigate noise pollution and the effects it has on the community of Strubensvalley, Roodepoort (South Africa).

The objectives of this study are:
- to determine the effects of environmental noise pollution.
- to quantify the levels of noise pollution in Strubensvalley.
- to ascertain the impact of noise pollution on the surrounding neighbourhood.
1.4. Site Description and Study Area

Strubensvalley is a Roodepoort suburb situated on the western border of the City of Johannesburg’s Metropolitan Municipality. The access routes are Hendrik Potgieter Road (East/West)- from the N1 Western Bypass Motorway and the N14 Krugersdorp Highway; and Christian de Wet Road (North/ South) – from the Fourways area to Ontdekkers Road in Roodepoort. The study area is characterised by flat terrain in the south-western region and rocky terrain in the north-eastern region.

This is an urban area predominating with residential development, shopping complexes and office parks see to (See Figure 1). With this high density development, the natural vegetation is hardly visible. The Wilgespruit runs from east to west and the past the Retail Crossing Shopping Centre.

![Figure 1: The Strubensvalley area (high density residential developments, office parks and shopping centres)](image-url)
1.5 Study Framework

In the first place, this study ascertains the level of noise pollution and, secondly, discusses the impact of traffic noise on the residents of Strubensvalley area. Recent literature about noise pollution will be examined.

Chapter 1: Introduction is aimed at informing the reader about the context of the study. Furthermore this chapter provides a problem statement and lists the three objectives to be achieved throughout the study.

Chapter 2: Literature Review provides a brief explanation about noise/environmental noise pollution. It also includes past and current literature regarding noise pollution.

Chapter 3: Noise pollution in Strubensvalley is highlighted/ investigated. Also considered are the measuring techniques that were used during the noise survey that was conducted in Strubensvalley.

Chapter 4: The impact of noise pollution on the population of Strubensvalley examines the annoyance factor of noise pollution, as well as the negative effects resulting from exposure to road-traffic noise on people's well-being.

Chapter 5: Synthesis provides an insight into the key findings and limitations of the study. It also includes a conclusion presenting results of the study.
Chapter 2: Literature Review

2.1 Introduction

This chapter provides the reader with a brief introduction to environmental noise and noise pollution. The causes of traffic noise are looked at, as well as the impact noise has on humans.

2.2 Environmental Noise

*Noise is defined as unwanted sound* (Schmidt, 2005) Ambient noise or environmental noise is unwanted or harmful outdoor sounds created by human activities, including noise emitted through means of transport (e.g. road traffic, air traffic) and noise from sites of industrial activity (Goines & Hagler, 2007).

Environmental noise pollution is a threat to the health and well-being of human-kind. It is more severe and widespread than ever before, and it will continue to increase in magnitude and severity on account of present societal trends namely population growth and urbanisation. Its severity will intensify, in relation with the increase in the use of progressively more powerful, varied, and highly mobile sources of noise. Noise levels will also continue to rise with sustained growth in highway, rail, and air traffic, the major sources of environmental noise (Schell *et al*, 2006).

Environmental noise pollution is not an entirely new phenomenon, but rather a problem that has grown gradually with time. Although environmental noise is primarily an urban problem, the noise of machines that humankind insists on building is increasingly bringing noise pollution to the few remaining wild sanctuaries in the world. Environmental noise pollution may not pose the threat of immediate destruction that nuclear war does, but one should bear in mind that the effects are the same and just as lasting (Dooley, 2002).
Escape from human-induced sound is markedly more difficult today than a century ago, and within another half-century it may be all but impossible. One might well ask how human-kind arrived at the present state of affairs. Several causative factors would seem to be responsible (Schell et al, 2006). Perhaps most important has been the consistent submission to technology and the ever-increasing construction of high-density developments, the reason being that for each and every development:

1) there is an increase in the number of motor vehicles.
2) noise, unlike air and water pollution, cannot be visually determined and leaves no visible record of its presence.
3) noise is inherently a technical problem which the ordinary citizen has great difficulty in understanding. While humankind does not understand the complex make-up of noise pollution, it is nevertheless obvious that noise is a form of pollution that’s demands remedial action by government (Schell et al, 2006).

2.3 Noise Pollution

The words that are constantly heard in the media and academic circles are “climate change and global warming”. These words are associated with studies based on carbon dioxide emissions and excessive heat. According to manmade thinking, generally, humans do not believe that the noise impacts upon the total environment. They instead believe that fairly common atmospheric pollutants have more extreme consequences for the planet as opposed to noise. (Fyhri & Klaeboe, 2006).

Noise control has been presented as a significant challenge to people. As it is indeed a serious environmental problem. In ancient Rome, there were rules existed governing the noise emitted from the iron wheels of wagons, causing the inhabitants of the city to suffer disturbed sleep patterns and annoyance. In Medieval Europe, horse- drawn carriages and horseback riding were not allowed in certain cities at night to ensure that the city dwellers could enjoy a peaceful night's sleep. However, the noise problems of the past are incomparable to those of modern society. A massive number of motor cars
are constantly travelling through our cities and the countryside, while heavily-laden trucks with diesel engines, which have been ineffectually silenced for engine and exhaust noise, weave about in our cities day and night (Schwela & Zali, 1999).

In contrast to other pollution control measures, the control of environmental noise has been hampered by insufficient knowledge of its effects on humans. The effects of noise on people in developing countries are just as widespread as those in developed countries, and the long-term effects are the same. Even though noise pollution control is perceived as an extravagance, with the result that it has not been placed on the priority list of developed countries, exposure to harmful noise levels is often greater in developing countries, on account of ineffectual planning and the poor construction of buildings (Schmidt, 2005).

Hearing is vital for communication. It produces reflexes and emotions (Tripathi, 1994). Human behaviour is strongly influenced by sounds; the complete absence of sound can be a terrifying experience. Experiments in sound-proofed rooms have proved that complete silence can lead to serious psychological effects on individuals. In short, the human race needs noise (Tripathi, 1994). But what is the optimum noise level for humans? The type of sound is a very important factor and in addition it is important to know that the effect varies with individuals (Miyaya, 1997).

The most significant health problem caused by noise pollution is hearing loss. Loud noise deaffens quickly—extremely loud sounds, such as gunshots at close range, can cause immediate hearing loss. But even sound levels of only 85 decibels will cause some hearing loss after prolonged exposure (Hart, 1977). Most hearing loss occurs in the work-place, where workers may be unable to avoid unhealthy noise, and where exposure may continue for years. Factory workers, construction workers, farmers, military personnel, police officers, firefighters, and musicians all have reason to be concerned about their occupational exposure to noise (Hart, 1997).
Even at levels below those that cause hearing loss, noise pollution produces problems. Noise makes conversation difficult, interferes with some types of work, and disturbs sleep. As a source of stress, it can promote high blood pressure and other cardio-vascular problems, as well as nervous disorders. According to the National Institute of Health, 65 million people are exposed to noise levels that can hamper their work or disrupt their sleep, and 25 million risk health problems due to noise (Holmes, 1995).

The general noise level increases in towns and cities increases, mainly due to traffic. If a job entails concentration, the effect of noise on the worker will make the work much more tiring than if the job demands little thought concentration. The effect of noise on the health of individuals, especially over a period of years, is an area of research that needs to be explored (Schmidt, 2005).

People’s response to noise levels varies. From 0 to 10(dB) decibels, there is very little reaction with only sporadic complaints. Between 5 and 15dB the response is medium, with complaints becoming widespread. The response by people to noise levels between 10 and 20dB is strong with threats of community/group action. Any noise levels higher than 20dB have a very strong response and vigorous community action takes place (see Table 2.1)
Table 2.1: Categories of community/group response
(Source: SANS: 10103: 2004)

<table>
<thead>
<tr>
<th>Excess $L_{\text{Req,T}}$ dB</th>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>No observed reaction</td>
</tr>
<tr>
<td>0-10</td>
<td>Little</td>
<td>Sporadic complaints</td>
</tr>
<tr>
<td>5-15</td>
<td>Medium</td>
<td>Widespread complaints</td>
</tr>
<tr>
<td>10-20</td>
<td>Strong</td>
<td>Threats of community/group action</td>
</tr>
<tr>
<td>&gt;15</td>
<td>Very strong</td>
<td>Vigorous community/group action</td>
</tr>
</tbody>
</table>

The effects of noise have been a problem for decades and lately there has been growing concerns from government, health, industrial and community organisations to start addressing this problem. With the rest of the world South Africa is far behind with limited appreciation of the scope of the problem (Babisch, 2007).

Nevertheless, in spite of this lack of knowledge regarding the seriousness of noise pollution, an over-exposure to excessive noise is the major cause of hearing loss in the world today (Hatfield, 1969). In fact, it is estimated that 10 to 20 million people in the world have some degree of hearing impairment (Hatfield, 1969).

2.4 Causes of Traffic Noise

Noise comes from many sources; the most significant source is from transportation, particularly traffic noise. Highway noise emanates from three sources: (a) the engine, (b) the exhaust, and (c) the friction vehicle of the tyres on the road. Once typical highway speeds are reached, the predominant noise from light trucks and cars is from the tire/road interaction. Heavy trucks produce a high volume of noise from all three sources even at low speeds (Chepesiuk, 2005).
The level of road traffic noise depends on three factors:

1. The volume of traffic,
2. The speed at which the traffic moves, and
3. The number of trucks in the flow of traffic (Pelton, 1993). Generally, heavier traffic volumes, higher speeds, and greater numbers of trucks increase the loudness of traffic noise. Vehicle noise as a result of defective mufflers or other faulty equipment on the vehicle can also intensify increase the combination of the noises produced by the engine, exhaust, and tyres; resulting in the particular noise level of traffic (Pelton, 1993).

Any conditions (such as a steep incline) that cause the heavy labouring of a motor vehicle engine will also increase traffic noise levels. In addition, there are other more complicated factors that affect traffic noise levels. For example, the further a person moves away a main road, the more likely there will be a reduction in the traffic noise levels. In this case, the terrain, vegetation, and natural and human-made obstacles will dampen the noise effect from the road. Traffic noise is not usually a serious problem for people who live more than 160 m from heavily traveled freeways (Pelton, 1993).

2.5 Effects of Noise Pollution on humans

The following aspects will determine the impact and effects noise has on humankind in general:

2.5.1 Physical Effects of Noise

Noise of a high enough intensity will cause temporary or permanent damage to hearing. The mechanisms behind these injuries are well understood. High levels of noise giving rise to noise-induced hearing deficits can be experienced in various situations (e.g. in occupational situations, at motor sports events, at shooting ranges, and from loudspeakers or headphones within dwellings (Schwela & Zali, 1999). On account of significant variations
in human sensitivity to noisy environments and to the likelihood that they would cause of causing hearing impairment, the hazardous nature of a noisy environment is described in terms of “damage risk” (Schwela & Zali, 1999). This is defined as the probability, in a noise-exposed population, of suffering from noise-induced hearing loss. This risk is considered to be negligible at equivalent noise exposure levels below 75 dB (A) over an exposure period of eight hours (Schwela & Zali, 1999).

2.5.2 Physiological Effects

Noise can cause temporary stress reactions (e.g. increasing the heart rate and blood pressure), and produce negative effects on the digestive and respiratory systems. Based on observations of an increase in blood pressure after acute exposure to noise, it has been suggested that long-term exposure to noise could cause a persistent increase in blood pressure (Schwela & Zali, 1999). This hypothesis can be evaluated by examining experiences from epidemiological studies. A review of the cardio-vascular effects of noise reports that 55 studies have been performed on the relationship between noise and blood pressure and that about 80 percent of these reported some form of positive association (Tripathi, 1994). A few studies have also been made in the general population, comparing the physiological reactions of those living along noisy streets with those of people living along quiet streets. The results from some early studies show slightly higher blood pressure levels among people living along roads with heavy traffic as opposed to those living in quiet areas (Kryler, 1994).

2.5.3 Psychological Effects

Noise can be bothersome and can give rise to psychological and psychosomatic symptoms in the form of headaches, fatigue and irritability. Biochemical reactions indicating a general stress effect from noise have also been reported in human and animal studies (Holmes, 1995). In view of
the information available on sleep disturbance and on the stress reaction occurring after noise exposure, psychiatric symptoms or disorders have received particular attention. Psychiatric effects could occur in three different ways:

1) These symptoms could develop among previously normal persons;

2) Their development could be accelerated in predisposed persons; or

3) Symptoms could appear temporarily under particular conditions (Miyaya, 1997).

It could be hypothesised, according to previous studies on noise effects, that physical and psycho-social symptoms and reduced work capacity may occur as an effect of general annoyance and sleep disturbances caused by exposure to noise.

2.5.4. Sleep Disturbance

Exposure to noise can induce disturbances in sleep by causing difficulties in falling asleep, alterations in sleep rhythm or depth of sleep, and also through being woken up (Babisch, 2007). Long-term effects of noise-induced sleep interruption could be subjective fatigue, changes in performance and objective mood changes.

2.5.5 Annoyance

Exposure to environmental noise may interfere with ongoing activities and can be experienced as bothersome or annoying. Annoyance is generally defined as a feeling of displeasure concerning a source of pollution in the environment, which the individual knows or believes, will adversely affect his or her well-being (Manuel, 2005). The extent of annoyance is closely related to the noise levels from heavy vehicles. The noise levels from heavy
vehicles are clearly distinguishable from a background of lower levels produced by passenger cars (Hart, 1997).

2.6 Conclusion

Noise is considered to be unwanted sound, particularly when the sound causes annoyance. Noise comes from many sources. One of the most significant sources is from transportation, particularly traffic noise. Highway noise emanates from three sources: the engine, the exhaust, and the interaction between the tyres and the pavement. Once typical highway speeds are reached, the predominant noise from light trucks and cars is from the tyre/pavement interaction. Heavy trucks produce a higher volume of noise from all three sources, even at low speeds (Van der Merwe, 2008, Personal Communication., Owner: dB Acoustics).

Limiting transportation noise in the environment is important for the health and welfare of the surrounding community. Numerous studies have demonstrated the effect of noise on the health of those suffering under its impact. Effects ranging from hearing loss and even cardiac arrest have been linked to noise. Prolonged exposure to noise in excess of 75 dBA may initiate hearing loss. Noise may also negatively impact on the quality of life of those who must live with it. Loss of sleep and the inability to hold conversations are frequent complaints. Helping to alleviate these negative impacts is the objective of noise abatement programmes (Focus, 2002).

Environmental noise is recognised as a major health problem. The adverse health effects (i.e. general annoyance, interference in communication, and sleep disturbances) of transportation noise are well acknowledged. Unlike many other environmental problems, noise pollution is still intensifying (Fuggle & Rabie, 1992). Measures must be established with the purpose of encouraging productive and enjoyable harmony between humans and their environment. Such measures should, promote efforts to prevent or eliminate damage to the environment and to stimulate the health and welfare of people (Fuggle & Rabie, 1992).
Chapter 3: Noise Pollution in Strubensvalley

This chapter explains how the noise assessment in Strubensvalley was conducted. Illustrations of the instruments used during noise readings and the specific measuring points are also provided.

3.1 Measuring Instruments

The following noise equipment was used to obtain the data for this study:

1) A calibrated sound-level meter – Type 1 SLM Bruel & Kjaer 2238 (this was used to measure the noise levels)
2) A mediator, calibrated by De Beer Calibration Services.
3) A microphone- B & K 488 23721959 (to record the noise level and to shield against dust intrusion)
4) A wind-speed meter- Kerstel 1000 wind-speed meter (K338103), SABS MS/P 1075
5) A hand-held global positioning system (GPS) (to take co-ordinates)
6) A tripod (to place the sound level meter on)
7) Type 2260 Signal Cable (to capture/save the measured sound levels)

3.2 Measuring Points in the Study Area

The investigation was conducted at the intersections of Hendrik Potgieter Road and Krugerrand Street; Fredenharry Street and Hendrik Potgieter Road; Nic Diederichs Street and Hendrik Potgieter Road.

Measuring points were set up at distances of 30 metres, 60 metres and 90 metres distance away from Hendrik Potgieter Road (see Figure 3.1). Thus the existing ambient noise levels could be determined for 18 measurement positions along the existing road and within the residential area.
Figure 3.1: The 18 noise-measuring points in the study area
3.3 Noise Levels in the Study Area

The equipment that was used for the traffic noise survey was obtained from the City of Johannesburg Region C, as well as from Mr Barend van der Merwe of dBAcoustics cc.

A site visit was done on 6 February 2007 to identify the measuring points and to familiarize the researcher with the study area. The area was investigated and the measuring points were identified using a Geographical Point System (GPS), on which co-ordinates were recorded. Noise Control Regulations and the South African Bureau Standards specified the parameters to measure. In most cases they also described how to set up the measuring equipment and handle various factors such as meteorological conditions. The South African National Standards programme (SANS 10103:2008) specifies where measurements should be made, for example along property boundaries. Measurements also vary depending on the distance between the measurement point and facade/obstacles. These requirements must be noted and applied.

This means that measuring points must be set up:

- away from facades;
- away from obstacles;
- about 2.5 to 3.5m away from the boundary wall;
- in dry conditions, with a wind speed of less than 5 m/s;
- In line with the microphone, at 1.2 to 1.5 m above ground level (Van der Merwe, 2008).

The noise measurements were taken over a period of 15 -minute intervals. However, the Noise Control Regulations (Notice 5479 of 1999) specify a 10-minute interval. The 15 minute interval was chosen in order to obtain a more representative estimate of the ambient noise level. The sound level meter was calibrated by a calibration laboratory in
order to comply with the National Code of Practice (SANS 10103:2008) and with the specifications for accuracy of the National Code of Practice for Acoustics. The noise survey was undertaken to determine prevailing ambient noise (background noise in the area or environment) levels, which were measured on a number of days between 1 January 2008 and 8 February 2008 during the day and night-time periods. According to the SANS 10103:2008, the day-time period is between 06:00am and 22:00pm, and the night-time period is between 22:00pm and 06:00am. Measurements were made of the equivalent continuous A-weighted sound pressure levels. All equipment had valid calibration certificates, from the testing laboratories of De Beer Calibration Services. (If required calibration certificates are available for viewing).

The recommended noise levels in a suburban residential area are described in Table 3.1 and Table 3.2 of the SANS 10103:2008. These tables illustrate the ambient (background) noise level that is preferred by individuals. Table 3.1 shows the maximum noise levels in different districts. The required indoor and outdoor noise levels are given for different types of areas.

Leq (Equivalent continuous sound pressure level) is the indicator of how high the noise level is for a specific point. The Leq is the value representing the constant continuous sound pressure level, in decibels, that is representative of the instantaneous sound pressure level measured over a specified time interval. Lmax is the maximum sound level recorded for each event. Lmin is the minimum sound level recorded for each event (Van der Merwe, 2008).

The values in rural districts are lower than those for urban areas owing to the fact that there is less traffic and that rural areas are quieter. The sound levels range from 35dB in rural areas during the night to 45 dB during day (see Table 3.1).The rating level for noise in the suburban districts is higher than that for the rural districts, owing to the fact that there is more commotion (e.g convenient shops, restaurants) in suburban districts as opposed to rural areas. Suburban noise levels range from 40 dB during the night to 50 dB during the day.
In urban districts with workshops, business premises and main roads, the noise values are higher on account of the number of noisy activities in the area. They range from 50dB during the night to 60dB during day. In central business districts, the noise values are higher than those in other urban districts because there are more business operations (e.g. banks, retail stores, etc). The noise levels range from 55dB during the night to 65 dB during day.

**TABLE 3.1- Design and maximum rating levels for ambient noise for different areas of occupancy (Source: SANS:10103:2004)**

<table>
<thead>
<tr>
<th>Type of district</th>
<th>Equivalent continuous rating level $L_{R_{eq,,T}}$ for ambient noise</th>
<th>Outdoors</th>
<th>Indoors, with open windows</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$L_{R_{dn}}^{2),d}$</td>
<td>$L_{R_{d}}^{1),d}$</td>
<td>$L_{R_{n}}^{1),d}$</td>
</tr>
<tr>
<td>a) Rural districts</td>
<td>45</td>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td>b) Suburban districts with limited road traffic</td>
<td>50</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>c) Urban districts</td>
<td>55</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>d) Urban districts with some workshops, business premises and main roads</td>
<td>60</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>e) Central business district</td>
<td>65</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td>f) Industrial districts</td>
<td>70</td>
<td>70</td>
<td>60</td>
</tr>
</tbody>
</table>

Note: $L_{R_{eq,\,T}}$ This is a time-average level over time T (e.g if a noise level is stated as being 60 dB (A).

dBA (Decibels) This is a logarithmic unit used to measure the physical quantity (usually power or intensity) relative to a specified reference level.
\( L_{Aeq} \) A measure of the equivalent continuous day/night-time rating level.

The noise values in industrial districts are higher than those in central business districts because there are more sound sources, resulting in higher noise levels (e.g. motors involved in workshops, panel beating, machine tools, etc). They range from 60dB during the night to 70dB during day.

Environmental limits for noise are stipulated in the South African National Standard (SANS 10103:2008) and the Environmental Conservation Act (Act No. 73 of 1989). The SANS Rating Levels for noise were established to minimise effects such as the nuisance factor, disruption of sleep and concentration, and interference with normal daily activities such as speech and telephone communication (Van der Merwe, 2008).

Measurements were carried out in accordance with the South African National Standard Code of Practice (SANS 10103:2008), specifically *The measurement and rating of environmental noise with respect to land-use, health, annoyance and speech.* The publication Noise Control Regulations in terms of Section 25 of the Environmental Conservation Act, 1989 (Act No. 73 of 1989), was also consulted.

In terms of Section 24(5), read with Section 44 of the National Environmental Management Act (Act 107 of 1998), an Environmental Impact Assessment must be carried out on any new operation before building can commence or before major changes to the operation can be carried out. The purpose of the assessment is to determine any negative effect the development may have on the environment and to take corrective measures at the design stage. These assessments must be carried out by an independent person/company registered with the Department of Agriculture, Conservation and Environmental Affairs. In terms of this present study, no EIA (Environmental Impact Assessment) was conducted, due to the fact that The NEMA has not been promulgated at the time the developments were made.
The measuring points were differentiated into 18 points in order to achieve a non-biased outcome and, in addition, to obtain representative results. The measuring points 1 to 6 (see figure 3.2 below) were taken 30 m from the middle of Hendrik Potgieter Road.

Figure 3.2: Measuring points 1 to 6
Measuring point 1

Figure 3.2.1: Measuring point 1 during the day

Description

This measuring point was one metre lower than the road reserve on the boundary of a park. It was chosen because this is where study the area starts. This point was 30 metres away from the middle of the road. At this point, two measurements were taken, the first on 1 February 2008 at 09:30, the temperature was 25°C and the wind-speed at 0.5 m/s. The second measurement was taken on 6 February 2008 at 22:00; the temperature was 26°C and the wind-speed was 0.9m/s. (see Table 3.3.1). The number of vehicles was calculated during the noise measurement. The volume of traffic for measuring point 1 during the 15 minute of measurement period was 460. Reference will be made to this aspect.

Table 3.3.1: Data of measuring point 1

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/02/2008</td>
<td>09:30</td>
<td>25°C</td>
<td>26°7’5.16”S 27°53’52.67”E</td>
<td>0.5m/s</td>
</tr>
<tr>
<td>06/02/2008</td>
<td>22:00</td>
<td>26°C</td>
<td>26°7’5.16”S 27°53’52.67”E</td>
<td>0.9m/s</td>
</tr>
</tbody>
</table>
Measuring point 2

Figure 3.2.2: Measuring point 2 during the day

Description

Measuring point 2 is next to the Strubensvalley Veterinary Clinic, 30 metres from the middle of Hendrik Potgieter Road, 10 metres from the boundary wall and seven metres from Kruger Rand Street, at the intersection of Hendrik Potgieter Road and Kruger Rand Street. The measurements were taken on 1 February 2008 at 09:55; the temperature was 27°C and the wind-speed was 0.5 m/s.

The second measurement was taken on 6 February 2008 at 22:30; the temperature was 26°C and the wind-speed was 1.4m/s. (see Table 3.3.2). The number of vehicles was calculated during the noise measurement. The volume of traffic for measuring point 2 during the 15 minute measurement period was 437. Reference will be made to this aspect.
Table 3.3.2: Data of measuring point 2

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/02/2008</td>
<td>09:55</td>
<td>27°C</td>
<td>26º7´14.26&quot;S</td>
<td>27º54´12.62&quot;E</td>
</tr>
<tr>
<td>06/02/2008</td>
<td>22:30</td>
<td>26°C</td>
<td>26º7´14.26&quot;S</td>
<td>27º54´12.62&quot;E</td>
</tr>
</tbody>
</table>

Measuring point 3

Figure 3.2.3: Measuring point 3 during the day

Description
Measuring point 3 was taken two metres below road surface on the embankment, three metres away from the boundary wall and 30 m from Hendrik Potgieter Road. The measurements were taken on 1 February 2008 at 10:55; the temperature was 27°C and the wind-speed 0.6 m/s. The second measurement was taken on 6 February 2008 at 22:55, the temperature was 25°C and the wind-speed was 1.8 m/s. (see Table 3.3.3). The number of vehicles was calculated during the noise measurement. The volume of traffic for measuring point 3 during the 15 minute of measurement period was 642.
Table 3.3.3: Data of measuring point 3

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/02/2008</td>
<td>10:55</td>
<td>27°C</td>
<td>26°7’22.71”S 27°54’14.24”E</td>
<td>0.6 m/s</td>
</tr>
<tr>
<td>06/02/2008</td>
<td>22:55</td>
<td>25°C</td>
<td>26°7’22.71”S 27°54’14.24”E</td>
<td>1.8m/s</td>
</tr>
</tbody>
</table>

Measuring point 4

Figure 3.2.4: Measuring point 4 during the day

Description
Measuring point 4 was taken one metre below the road surface, along Hendrik Potgieter Road and behind a grove of Bluegum trees. The measurements were taken on 1 February 2008 at 10:25; the temperature was 27°C and the wind-speed 0.5 m/s. The second measurement was taken on the 6 February 2008 at 23:20, the temperature was 26°C and the wind-speed was 1.4m/s. (see Table 3.3.4). The number of vehicles was calculated during the noise measurement. The volume of traffic for measuring point 4 during the 15 minute of measurement period was 305.
Table 3.3.4: Data of measuring point 4

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Coordinates</th>
<th>Windspeed</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/02/2008</td>
<td>10:25</td>
<td>27°C</td>
<td>26°7’6.51&quot;S 27°53’51.76” E</td>
<td>0.5 m/s</td>
</tr>
<tr>
<td>06/02/2008</td>
<td>23:20</td>
<td>26°C</td>
<td>26°7’6.51&quot;S 27°53’51.76” E</td>
<td>1.4 m/s</td>
</tr>
</tbody>
</table>

Measuring point 5

Figure 3.2.5 Measuring point 5 during the day

Description

Measuring point 5 was taken level with Hendrik Potgieter road, 40 metres from business premises (Petra Place), and close to the intersection of Fredenharry Road and Hendrik Potgieter Road. The measurements were taken on 1 February 2008 at 11:10; the temperature was 27°C and the wind-speed 0.5 m/s. The second measurement was taken on the same area on the 6 February 2008 at 23:40, the temperature was 26°C and the wind-speed was 0.5 m/s. (see Table 3.3.5). The number of vehicles calculated during the noise measurement. The volume of traffic for measuring point 5 during the 15 minute measurement period was 555.
Table 3.3.5: Data of measuring point 5

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/02/2008</td>
<td>11:10</td>
<td>27°C</td>
<td>26°7′14.86″S 27°54′1.86″E</td>
<td>1m/s</td>
</tr>
<tr>
<td>06/02/2008</td>
<td>23:40</td>
<td>26°C</td>
<td>26°7′14.86″S 27°54′1.86″E</td>
<td>0.5m/s</td>
</tr>
</tbody>
</table>

Measuring point 6

Figure 3.2.6: Measuring point 6 during the day

Description

Measuring point 6 was taken five metres above the road reserve, and three metres from the boundary wall and a storm-water channel. The measurements were taken on 1 February 2008 at 11:40; the temperature was 28°C and the wind-speed 0.5 m/s. The second measurement was taken on the 6 February 2008 at 24:05, the temperature was 26°C and the wind-speed was 0.5m/s. (see Table 3.3.6). The number of vehicles was calculated during the noise measurement. The volume of traffic for measuring point 6 during the 15 minute of measurement period was 726.
Table 3.3.6: Data of measuring point 6

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/02/2008</td>
<td>11:40</td>
<td>28°C</td>
<td>26°7′24.22″S 27°54′12.62″E</td>
<td>1m/s</td>
</tr>
<tr>
<td>06/02/2008</td>
<td>24:05</td>
<td>26°C</td>
<td>26°7′24.22″S 27°54′12.62″E</td>
<td>0.5m/s</td>
</tr>
</tbody>
</table>
Measuring points 7 to 12 are indicated on figure 3.3 and are located within the neighbourhood and at approximately 60 metres from Hendrik Potgieter Road.

Figure 3.3: Measuring points 7-12
Measuring point 7

Figure 3.3.1: Measuring point 7 during the day

Description
Measuring point 7 was taken on the pavement about 4.27 m from the property boundary wall at the corner of Dragme Avenue and Dariek Street. The measurements were taken on 4 February 2008 at 10:00; the temperature was 25°C and the wind-speed 1.0 m/s. The second measurement was taken on the 7 February 2008 at 22:20, the temperature was 25°C and the wind-speed was 0.6m/s. (see Table 3.3.7).

Table 3.3.7: Data of measuring point 7

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/02/2008</td>
<td>10:00</td>
<td>25°C</td>
<td>26°7’4.12&quot;S 27°53’55.73E</td>
<td>1.0m/s</td>
</tr>
<tr>
<td>07/02/2008</td>
<td>22:20</td>
<td>25°C</td>
<td>26°7’4.12&quot;S 27°53’55.73E</td>
<td>0.6 m/s</td>
</tr>
</tbody>
</table>
Measuring point 8

Figure 3.3.2: Measuring point 8 during the day

Description
Measuring point 8 was taken on the pavement at the intersection of KrugerRand Street and Dragme Avenue and 60 metres from Hendrik Potgieter Road next to the Strubensvalley Veterinary clinic. The measurements were taken on 4 February 2008 at 10:25; the temperature was 28°C and the wind-speed 1.0 m/s. The second measurement was taken on the 7 February 2008 at 22:40; the temperature was 26°C and the wind-speed was 0.5m/s. (see Table 3.3.8).

Table 3.3.8: Data of measuring point 8

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/02/2008</td>
<td>10:25</td>
<td>28°C</td>
<td>26º7′12.28°S 27º54′5.79E</td>
<td>1.0m/s</td>
</tr>
<tr>
<td>07/02/2008</td>
<td>22:40</td>
<td>26°C</td>
<td>26º7′12.28°S 27º54′5.79E</td>
<td>0.5m/s</td>
</tr>
</tbody>
</table>
Measuring point 9

Figure 3.3.9: Measuring point 9 during the day

Description
Measuring point 9 was taken on the pavement of Veldpond Street, adjacent to the Valley Pride Complex. The measurements were taken on 1 February 2008 at 11:30; the temperature was 28°C and the wind-speed 1.0 m/s. The second measurement was taken on the 7 February 2008 at 23:55; the temperature was 26°C and the wind-speed was 0.5m/s. (see Table 3.3.9).

Table 3.3.9: Data of measuring point 9

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/02/2008</td>
<td>11:30</td>
<td>28°C</td>
<td>26°7′23.52&quot;S 27°54′20.13&quot;E</td>
<td>1.0m/s</td>
</tr>
<tr>
<td>07/02/2008</td>
<td>23:55</td>
<td>26°C</td>
<td>26°7′23.52&quot;S 27°54′20.13&quot;E</td>
<td>0.5m/s</td>
</tr>
</tbody>
</table>
Measuring point 10

Figure 3.3.4 Measuring point 10 the during the day

Description
Measuring point 10 was taken three metres from the boundary wall, along Lisbon Avenue and Cascades Road. The measurements were taken on 5 February 2008 at 10:00; the temperature was 28°C and the wind-speed 1.0 m/s (see Table 3.3.10). The second measurement was taken on the 8 February 2008 at 22:05; the temperature was 26°C and the wind-speed was 1.2 m/s. (see Table 3.3.10).

Table 3.3.10: Data of measuring point 10

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>05/02/2008</td>
<td>10:00</td>
<td>28°C</td>
<td>26°7′14.82″S</td>
<td>1m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>27°53′45.62E</td>
<td></td>
</tr>
<tr>
<td>08/02/2008</td>
<td>22:05</td>
<td>26°C</td>
<td>26°7′14.82″S</td>
<td>1.2m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>27°53′45.62E</td>
<td></td>
</tr>
</tbody>
</table>
Measuring point 11

Figure 3.3.5: Measuring point 11 during the day

Description
Measuring point 11 was taken in the park area (inside the townhouse complex). The measurements were taken on 5 February 2008 at 10:30; the temperature was 25°C and the wind-speed was 0.4 m/s. The second measurement was taken 8 February 2008 at 22:40; the temperature was 26°C and the wind-speed was 0.3 m/s (see Table 3.3.11).

Table 3.3.11: Data of measuring point 11

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T°</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>05/02/2008</td>
<td>10:30</td>
<td>25°C</td>
<td>26º7’10.28&quot;S 27º53’50.79&quot;E</td>
<td>0.8 m/s</td>
</tr>
<tr>
<td>08/02/2008</td>
<td>22:40</td>
<td>26°C</td>
<td>26º7’10.28&quot;S 27º53’50.74&quot;E</td>
<td>0.3 m/s</td>
</tr>
</tbody>
</table>
Measuring point 12

Figure 3.3.6: Measuring point 12 during the day

Description
Measuring point 12 was taken inside the Pennington Complex, Strubensvalley. It was taken eight metres from the inside boundary wall. The measurements were taken on 5 February 2008 at 11:05; the temperature was 25°C and the wind-speed 0.9 m/s. The second measurement was taken on 8 February 2008 at 23:30; the temperature was 22°C and the wind-speed was 0.7 m/s. (see Table 3.3.12).

Table 3.3.12: Data of measuring point 12

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T°C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>05/02/2008</td>
<td>11:05</td>
<td>25°C</td>
<td>26°7’33.64”S 27°54’7.45”E</td>
<td>0.9 m/s</td>
</tr>
<tr>
<td>08/02/2008</td>
<td>23:30</td>
<td>22°C</td>
<td>26°7’33.64”S 27°54’7.45”E</td>
<td>0.7 m/s</td>
</tr>
</tbody>
</table>
The measuring points 13 to 18 are indicated in figure 3.4 and are located approximately 90 metres from Hendrik Potgieter Road.

Figure 3.4: Measuring points 13 to 18
Measuring point 13

Figure 3.4.1: Measuring point 13 during the day

Description
Measuring point 13 was established on the pavement about 4.27 m from the property boundary wall and at the intersection between Dragme Avenue and Dariek Street. The measurements were taken on 1 February 2008 at 11:30; the temperature was 28°C and the wind-speed 0.9 m/s. The second measurement was taken on the 7 February 2008 at 24:20; the temperature was 26°C and the wind-speed was 0.3m/s (see Table 3.3.13).

Table 3.3.13: Data of measuring point 13

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/02/2008</td>
<td>11:30</td>
<td>28°C</td>
<td>26°6’59.56°S</td>
<td>1.0m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>27°54’13.49°E</td>
<td></td>
</tr>
<tr>
<td>07/02/2008</td>
<td>24:20</td>
<td>26°C</td>
<td>26°6’59.56°S</td>
<td>0.3m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>27°54’13.49°E</td>
<td></td>
</tr>
</tbody>
</table>
Measuring point 14

Figure 3.4.2: Measuring point 14 during the day

Description
Measuring point 14 was measured at the forefront of the house at 861 Fiver Street, three metres away from the house wall. The measurements were taken on 4 February 2008 at 12:20; the temperature was 28°C and the wind-speed 1.0 m/s. The second measurement was taken on 7 February 2008 at 24:45; the temperature was 26°C and the wind-speed was 0.5m/s. (see Table 3.3.14).

Table 3.3.14: Data of measuring point 14

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/02/2008</td>
<td>12:20</td>
<td>28°C</td>
<td>26°7’2.85&quot;S</td>
<td>1m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>27°54’8.70&quot;E</td>
<td></td>
</tr>
<tr>
<td>07/02/2008</td>
<td>24:45</td>
<td>26°C</td>
<td>26°7’2.85&quot;S</td>
<td>0.5m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>27°54’8.70&quot;E</td>
<td></td>
</tr>
</tbody>
</table>
Measuring point 15

Figure 3.4.3: Measuring point 15 during the day

Description
Measurement point 15 was taken in close proximity to Cul de Sac, adjacent to Talent Avenue and Tariff Avenue and at the forefront of 927 Tariff Avenue. The measurements were taken on 5 February 2008 at 11:15; the temperature was 28°C and the wind-speed 0.6 m/s (see Table 3.3.15). The second measurement was taken on 7 February 2008 at 01:00; the temperature was 25°C and the wind-speed was 1.5m/s.

Table 3.3.15: Data of measuring point 15

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>05/02/2008</td>
<td>11:15</td>
<td>28°C</td>
<td>26°7´14.72&quot;S 27°54´24.44&quot;E</td>
<td>0.6m/s</td>
</tr>
<tr>
<td>07/02/2008</td>
<td>01:00</td>
<td>25°C</td>
<td>26°7´14.72&quot;S 27°54´24.44&quot;E</td>
<td>1.5m/s</td>
</tr>
</tbody>
</table>
Measuring point 16

Description
Measuring point 16 was taken outside of the Lakes Townhouse complex gate, along Cascades Road and facing in the northerly direction. The measurements were taken on 4 February 2008 at 13:30; the temperature was 28°C and the wind-speed 0.6 m/s. The second measurement was taken on 7 February 2008 at 23:44; the temperature was 24°C and the wind-speed was 1.5m/s. (see Table 3.3.16).

Table 3.3.16: Data of measuring point 16

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T/C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/02/2008</td>
<td>13:30</td>
<td>28°C</td>
<td>26°7’17.67&quot;S 27°53´39.04&quot;E</td>
<td>0.6m/s</td>
</tr>
<tr>
<td>08/02/2008</td>
<td>23:44</td>
<td>24°C</td>
<td>26°7’17.67&quot;S 27°53´39.04&quot;E</td>
<td>1.5m/s</td>
</tr>
</tbody>
</table>
Measuring point 17 was taken in the park area (Park 362 Strubensvalley), nine metres from the boundary wall and close to the dam. The measurements were taken on 4 February 2008 at 14:00; the temperature was 25°C and the wind-speed 0.8 m/s. The second measurement was taken on 8 February 2008 at 24:05; the temperature was 23°C and the wind-speed was 0.3 m/s. (see Table 3.3.17).

Table 3.3.17: Data of measuring point 17

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T°C</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/02/2008</td>
<td>14:00</td>
<td>25°C</td>
<td>26º7’26.86”S 27º53’48.48E</td>
<td>0.8 m/s</td>
</tr>
<tr>
<td>08/02/2008</td>
<td>24:05</td>
<td>23°C</td>
<td>26º7’26.86”S 27º53’48.48E</td>
<td>0.3 m/s</td>
</tr>
</tbody>
</table>
Measuring point 18

Figure 3.4.6: Measuring point 18 during the day

Description
Measuring point 18 was taken in a Cul de Sac area, opposite 919 Almond Rock Avenue. The measurements were taken on 4 February 2008 at 14:30; the temperature was 25°C and the wind-speed 0.6m/s. The second measurement was taken on 8 February 2008 at 24:30; the temperature was 23°C and the wind-speed was 0.3m/s. (see Table 3.3.18).

Table 3.3.18: Data of measuring point 18

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>T°</th>
<th>Co-ordinates</th>
<th>Wind-speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/02/2008</td>
<td>14:30</td>
<td>25°C</td>
<td>26°7’42.02&quot;S</td>
<td>0.6 m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>27°54’3.78&quot;E</td>
<td></td>
</tr>
<tr>
<td>08/02/2008</td>
<td>24:30</td>
<td>23°C</td>
<td>26°7’42.02&quot;S</td>
<td>0.3 m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>27°54’3.78&quot;E</td>
<td></td>
</tr>
</tbody>
</table>
3.4 Daytime Readings

Noise levels were taken for the respective measuring points during the day and at night. Then the specification called South African National Standards (SANS) 10103:2008 was used for measuring and rating the level of environmental noise with respect to land-use, health, annoyance and speech communication.

Table 3.4: Day-time noise levels for measuring points 1 to 18

<table>
<thead>
<tr>
<th>Position</th>
<th>Distance (metres)</th>
<th>Day Date</th>
<th>Time</th>
<th>Leq</th>
<th>Lmax</th>
<th>Lmin</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>01/02/08</td>
<td>09:30</td>
<td>60.0dB(A)</td>
<td>75.5dB(A)</td>
<td>48.4dB(A)</td>
<td>27.1 dB (A)</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>01/02/08</td>
<td>09:55</td>
<td>60.3dB</td>
<td>71.2dB(A)</td>
<td>47.9dB(A)</td>
<td>23.3 dB (A)</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>01/02/08</td>
<td>10:55</td>
<td>59.5 dB (A)</td>
<td>77.2dB(A)</td>
<td>42.5dB(A)</td>
<td>34.7 dB (A)</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>01/02/08</td>
<td>10:25</td>
<td>59.8dB(A)</td>
<td>73.4dB(A)</td>
<td>33.8dB(A)</td>
<td>39.6dB (A)</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>01/02/08</td>
<td>11:10</td>
<td>63.3dB(A)</td>
<td>88.8dB(A)</td>
<td>45.7dB(A)</td>
<td>43.1 dB (A)</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
<td>01/02/08</td>
<td>11:40</td>
<td>60.4dB(A)</td>
<td>80.1dB(A)</td>
<td>47.2dB(A)</td>
<td>32.9 dB (A)</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>04/02/08</td>
<td>10:00</td>
<td>50.1dB(A)</td>
<td>68.9dB(A)</td>
<td>37.5dB(A)</td>
<td>31.4 dB (A)</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
<td>04/02/08</td>
<td>10:25</td>
<td>58.4dB(A)</td>
<td>73.8dB(A)</td>
<td>37.9dB(A)</td>
<td>35.9dB (A)</td>
</tr>
<tr>
<td>9</td>
<td>60</td>
<td>04/02/08</td>
<td>11:30</td>
<td>42.5 dB (A)</td>
<td>64.4dB(A)</td>
<td>33.5dB(A)</td>
<td>30.9 dB (A)</td>
</tr>
<tr>
<td>10</td>
<td>60</td>
<td>05/02/08</td>
<td>10:00</td>
<td>53.6dB(A)</td>
<td>75.8dB(A)</td>
<td>22.2dB(A)</td>
<td>24.8 dB (A)</td>
</tr>
<tr>
<td>11</td>
<td>60</td>
<td>05/02/08</td>
<td>10:30</td>
<td>47.6dB(A)</td>
<td>76.7dB(A)</td>
<td>29.1dB(A)</td>
<td>24.8 dB (A)</td>
</tr>
<tr>
<td>12</td>
<td>60</td>
<td>05/02/08</td>
<td>11:05</td>
<td>37.5 dB (A)</td>
<td>60.6dB(A)</td>
<td>32.1dB(A)</td>
<td>28.5dB (A)</td>
</tr>
<tr>
<td>13</td>
<td>90</td>
<td>04/02/08</td>
<td>11:40</td>
<td>49.0dB(A)</td>
<td>57.5dB(A)</td>
<td>38.0dB(A)</td>
<td>19.5 dB (A)</td>
</tr>
<tr>
<td>14</td>
<td>90</td>
<td>04/02/08</td>
<td>12:20</td>
<td>52.5dB(A)</td>
<td>67.1dB(A)</td>
<td>39.0dB(A)</td>
<td>28.1 dB (A)</td>
</tr>
<tr>
<td>15</td>
<td>90</td>
<td>04/02/08</td>
<td>13:00</td>
<td>46.1dB(A)</td>
<td>62.2dB(A)</td>
<td>35.2dB(A)</td>
<td>27.0 dB (A)</td>
</tr>
<tr>
<td>16</td>
<td>90</td>
<td>04/02/08</td>
<td>13:30</td>
<td>40.6dB(A)</td>
<td>57.9dB(A)</td>
<td>17.3dB(A)</td>
<td>23.3 dB (A)</td>
</tr>
<tr>
<td>17</td>
<td>90</td>
<td>04/02/08</td>
<td>14:00</td>
<td>49.9dB(A)</td>
<td>62.2dB(A)</td>
<td>35.2dB(A)</td>
<td>27dB (A)</td>
</tr>
<tr>
<td>18</td>
<td>90</td>
<td>04/02/08</td>
<td>14:30</td>
<td>56.9dB(A)</td>
<td>75.7dB(A)</td>
<td>33.8dB(A)</td>
<td>41.9 dB (A)</td>
</tr>
</tbody>
</table>

The measurements that were taken at the first six measuring points are given in Table 3.4. The Leq values range from 59.5 dB (A) at point 3 to 63.3dB (A) at point 5. The Lmax values range from 71.2dB (A) at point 2 to 88.8dB (A) at point 5. The Lmin values range from 33.8dB (A) at point 4 to 48.4dB (A) at point 1.
The average difference for the first six measuring points is 33.5 dB (A). This means that a person’s activities can be suddenly disrupted because any noise level higher than 3 dB (A) can be perceived by the human ear. The day-time readings were more than 5 dB (A) of the recommended noise level taken during the day.

Noise levels in locations within the residential area fell within the SANS 10103:2008 guidelines. However most existing noise levels within the Noise-sensitive area were higher than those stipulated in the Noise Control Regulations of 20 August 1999: Guidelines. The higher noise levels are due to the traffic coming from west of Hendrik Potgieter Road to converge on the major freeways. Another factor that is contributing to the increased noise levels is that most trucks use the road to travel to Botswana and Rustenburg.

With an annual urban growth rate of three percent, Strubensvalley is one of the youngest and most rapidly-expanding suburbs in Johannesburg. Strangely enough, even though a rapidly-growing suburb, it lacks the modern traffic conveniences of its modern counterparts.

### 3.5 Night-time readings

The night-time noise levels were higher than the recommended/ specified noise levels as prescribed by the South African National Standards (SANS 10103:2008). The SANS 10103:2008, recommend that the night-time noise level in an urban area should be 45dB (A). The higher noise levels are primarily due to the traffic in the local road network.

Table 3.5 shows the measured night-time noise levels from measuring point 1 to 18. The following units: Leq, Lmax and Lmin were used.
The average difference for the first six measuring points is 34.8 dB (A). This means that a person’s activities can be disrupted because any noise levels higher than 3dB (A) can be perceived by the human ear.

Measuring points 7 to 18 were located 60 to 90 metres from Hendrik Potgieter Road. They were taken away from the main road and fell well within the prescribed guidelines. Natural factors such as topography, vegetation, and temperature can reduce noise over distance. When there is an area of ground cover or normal unpacked earth between the source and the receptor, this area becomes absorptive to sound energy and is called a soft site (Van der Merwe, 2008).

Table 3.5: Night-time Measuring Noise levels for measuring point 1 to 18

<table>
<thead>
<tr>
<th>Position</th>
<th>Dist. Meters</th>
<th>Night Date</th>
<th>Time</th>
<th>Leq</th>
<th>Lmax</th>
<th>Lmin</th>
<th>The Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>06/02/08</td>
<td>22:00</td>
<td>56.4 dB(A)</td>
<td>65.5 dB(A)</td>
<td>40.7 dB(A)</td>
<td>24.8 dB(A)</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>06/02/08</td>
<td>22:30</td>
<td>52.4 dB(A)</td>
<td>62.7 dB(A)</td>
<td>33.2 dB(A)</td>
<td>29.5 dB(A)</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>06/02/08</td>
<td>22:55</td>
<td>60.7 dB(A)</td>
<td>73.5 dB(A)</td>
<td>41.7 dB(A)</td>
<td>31.8 dB(A)</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>06/02/08</td>
<td>23:20</td>
<td>64.4 dB(A)</td>
<td>87.6 dB(A)</td>
<td>39.7 dB(A)</td>
<td>47.9 dB(A)</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>06/02/08</td>
<td>23:40</td>
<td>62.7 dB(A)</td>
<td>81.2 dB(A)</td>
<td>41.7 dB(A)</td>
<td>39.5 dB(A)</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
<td>06/02/08</td>
<td>24:05</td>
<td>57.1 dB(A)</td>
<td>70.4 dB(A)</td>
<td>35.1 dB(A)</td>
<td>35.3 dB(A)</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>07/02/08</td>
<td>22:20</td>
<td>44.6 dB(A)</td>
<td>59.7 dB(A)</td>
<td>34.6 dB(A)</td>
<td>25.1 dB(A)</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
<td>07/02/08</td>
<td>22:40</td>
<td>55.7 dB(A)</td>
<td>74.5 dB(A)</td>
<td>33.2 dB(A)</td>
<td>41.3 dB(A)</td>
</tr>
<tr>
<td>9</td>
<td>60</td>
<td>07/02/08</td>
<td>23:55</td>
<td>38.9 dB(A)</td>
<td>51.9 dB(A)</td>
<td>32.3 dB(A)</td>
<td>19.6 dB(A)</td>
</tr>
<tr>
<td>10</td>
<td>60</td>
<td>08/02/08</td>
<td>22:00</td>
<td>51.4 dB(A)</td>
<td>74.5 dB(A)</td>
<td>49.7 dB(A)</td>
<td>24.8 dB(A)</td>
</tr>
<tr>
<td>11</td>
<td>60</td>
<td>08/02/08</td>
<td>22:40</td>
<td>64.0 dB(A)</td>
<td>84.6 dB(A)</td>
<td>33.2 dB(A)</td>
<td>51.4 dB(A)</td>
</tr>
<tr>
<td>12</td>
<td>60</td>
<td>08/02/08</td>
<td>23:20</td>
<td>44.6 dB(A)</td>
<td>67.6 dB(A)</td>
<td>33.0 dB(A)</td>
<td>34.6 dB(A)</td>
</tr>
<tr>
<td>13</td>
<td>90</td>
<td>07/02/08</td>
<td>24:20</td>
<td>47.7 dB(A)</td>
<td>59.5 dB</td>
<td>36.8 dB</td>
<td>22.7 dB</td>
</tr>
<tr>
<td>14</td>
<td>90</td>
<td>07/02/08</td>
<td>24:45</td>
<td>51.4 dB(A)</td>
<td>70.6 dB</td>
<td>32.4 dB</td>
<td>38.2 dB</td>
</tr>
<tr>
<td>15</td>
<td>90</td>
<td>07/02/08</td>
<td>01:00</td>
<td>45.8 dB(A)</td>
<td>71.5 dB</td>
<td>46.7 dB</td>
<td>24.8 dB</td>
</tr>
<tr>
<td>16</td>
<td>90</td>
<td>08/02/08</td>
<td>23:44</td>
<td>45.1 dB(A)</td>
<td>73.2 dB</td>
<td>31.6 dB</td>
<td>41.6 dB</td>
</tr>
<tr>
<td>17</td>
<td>90</td>
<td>08/02/08</td>
<td>24:05</td>
<td>43.2 dB(A)</td>
<td>63.2 dB</td>
<td>33.6 dB</td>
<td>29.6 dB</td>
</tr>
<tr>
<td>18</td>
<td>90</td>
<td>08/02/08</td>
<td>24:30</td>
<td>46.2 dB(A)</td>
<td>67.9 dB</td>
<td>33.4 dB</td>
<td>34.5 dB</td>
</tr>
</tbody>
</table>
Even during off-peak traffic Hendrik Potgieter Road can be very busy. This picture shows how hectic Hendrik Potgieter Road can be during an off-peak period. The road is shared by motor cars and many trucks travelling in both directions.

The traffic congestion on this road increased by 26 percent between 1999 and 2006 with the average travelling time for commuters being roughly 72 minutes. Add 13 000 additional cars on our roads every month and a few more years, and even the most mathematically-challenged can get an idea of the potential snarl-up on the horizon (Peska, 2006).

Statistics concerning traffic volumes for Hendrik Potgieter Road were obtained from the Johannesburg Road Agency. Strubensvalley in particular has expanded exponentially in the last few years, sending congestion in this area into a spiraling spin. And yet more
high-density residential developments are planned for these zones in the near future (Peska, P 2006: Personal Communication, Manager: Johannesburg Road Agency).

The following values for measuring points 1 to 6 are based on the scientific formulae recommended by the South African National Standard 10210 of 2004 in its publication *Calculating and predicting road traffic noise in order to assess and determine the correctness of measured noise levels*. The calculations were done after the measurements for all the measuring points had been taken.

The calculations were done in order to verify the correctness of the measured noise level of a specific point. Measuring points 1 to 6, of the measured noise levels were correct.

**The Calculated value for measuring point 1**

a) Basic noise model

\[
\text{Leq Basic} = 37 + 10 \log Q
\]

\[
Q = \text{Volume of traffic}
\]

\[
= 37 + 10 \log 459.5
\]

\[
= 63.3 \text{ dB A}
\]

b) Speed of traffic

\[
L_{p,v} = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A}
\]

\(L_{p,v}\) = correction of speed  \(p = \frac{\text{number of trucks}}{\text{Total vehicles}} \times 100\)

\[
= 418/919 \times 100
\]

\[
= 5.2
\]
\[ v = \text{mean traffic speed km/h (i.e. } 60 \text{ km/h)} \]
\[ p = \text{heavy vehicles } (\%) \]
\[ L_{p,v} = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A} \]
\[ = 33 \log (108.3) + 10 \log (1.4) - 68.8 \text{ dB A} \]
\[ = 68.6 \text{ dB A} - 68.8 \text{ dB A} \]
\[ = 0.195 \text{ dB A} \]

c) Correction for road surface texture
\[ L_t = 4 - 0.03p \]
\[ = 4 - 0.03 \times 5.2 \]
\[ = 4 - 0.156 \]
\[ = 3.844 \text{ dB A} \]

d) Ground conditions, distance of receiver from pavement
Using the graph, it is 30m from the road and the sound level meter is 3m from the ground surface. Due to the distance away from the source, the reduction level is (−7) dB A (see graph in Annexure A).

\[
\text{Actual measured value} = 60.0 \text{ dBA (Refer to Table 3.4)}
\]
\[
\text{Calculated value} = a + b + c + d
\]
\[ = 63.6 - 0.195 + 3.8 - 7 \]
\[ = 60.2 \text{ dB A} \]
This calculated value was done in order to compare the correctness of the measured value of measuring point 1. In this case, the measured value is correct and also very close to the calculated value. The same theory applies to measuring points 2-5.

The Calculated value for measuring point 2
a) Basic noise model
\[ L_{eq \text{ Basic}} = 37 + 10 \log Q \quad Q = \text{Volume of traffic} \]
\[ = 37 + 10 \log 437 \]
\[ = 63.4 \text{ dB A} \]
b) Speed of traffic

\[ L_{p,v} = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A} \]

\[ L_{p,v} = \text{correction of speed} \quad p = \text{number of trucks} \times 100 \]

\[ \text{Total vehicles} = \frac{17}{437} \times 100 = 3.9 \]

\[ v = \text{mean traffic speed (km/h)} \]
\[ p = \text{heavy vehicles (%)} \]

\[ L_{p,v} = 33 \log (108.3) + 10 \log (1.4) - 68.8 \text{ dB A} \]
\[ = 68.3 \text{ dB A} - 68.8 \text{ dB A} \]
\[ = 3.883 \text{ dB A} \]

c) Correction for road surface texture

\[ L_t = 4 - 0.03p \]
\[ = 4 - 0.03 \times 3.9 \]
\[ = 4 - 0.117 \]
\[ = 3.883 \text{ dB A} \]

d) Ground conditions, distance of receiver from pavement

Using the graph, it is 30m from the road and the sound level meter is 3m from the ground surface.

Actual measured value = 60.3 dBA (Refer to Table 3.4)

Calculated value = a + b + c + d
\[ = 63.4 - 0.435 + 3.8 - 7 \]
\[ = 59.7 \text{ dB A} \]
Calculated value for measuring point 3

a) Basic noise model

\[ \text{Leq Basic} = 37 + 10 \log Q \]

\[ Q = \text{Volume of traffic} \]

\[ = 37 + 10 \log 1283.5 \]

\[ = 37 + 31.0 \]

\[ = 68.0 \text{ dB A} \]

b) Speed of traffic

\[ \text{Lp}.v = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A} \]

\[ \text{Lp}.v = \text{correction of speed} \]

\[ p = \text{number of trucks} \times 100 \]

\[ \text{Total vehicles} \]

\[ = 17/437 \times 100 \]

\[ = 3.9 \]

\[ v = \text{mean traffic speed (km/h)} \]

\[ p = \text{heavy vehicles (}) \% \]

\[ \text{Lp}.v = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A} \]

\[ = 33 \log (108.3) + 10 \log (1.2) - 68.8 \text{ dB A} \]

\[ = 67.89 \text{ dB A} - 68.8 \text{ dB A} \]

\[ = -0.91 \text{ dB A} \]

c) Correction for road surface texture

\[ \text{Lt} = 4 - 0.03p \]

\[ = 4 - 0.03 \times 0.31 \]

\[ = 4 - 0.0093 \]

\[ = 3.99 \text{ dB A} \]
d) Ground conditions, distance of receiver from pavement

Using the graph, it is 30m from road and the sound level meter is 3m from the ground surface – 7 dB A

Actual measured value= 59.5 dBA (Refer to Table 3.4)

Calculated value = a + b + c+ d

= 68.0 -0.91+3.9
= 63.99 dB A

Calculated value for measuring point 4

a) Basic noise model

\[
\text{Leq Basic} = 37 + 10\log Q
\]

\[Q = \text{Volume of traffic}\]

\[= 37 + 10\log 305\]

\[= 37 + 24.8\]

\[= 61.8 \text{ dB A}\]

b) Speed of traffic

\[L_{p.v} = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A}\]

\[L_{p.v} = \text{correction of speed} \quad p = \text{number of trucks} \times 100\]

\[= \frac{13}{305} \times 100\]

\[= 4.2\]

\[v = \text{mean traffic speed (km/h)}\]

\[p = \text{heavy vehicles (％)}\]

\[L_{p.v} = 33\log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A}\]

\[= 33 \log (108.3) + 10 \log (1.35) - 68.8 \text{ dB A}\]

\[= 68.4 \text{ dB A} - 68.8 \text{ dB A}\]

\[= -0.4 \text{ dB A}\]
c) Correction for road surface texture

\[ L_t = 4 - 0.03p \]
\[ = 4 - 0.03 \times 4.2 \]
\[ = 4 - 0.126 \]
\[ = 3.87 \text{ dB A} \]

d) Ground conditions, distance of receiver from pavement

Using the graph, it is 30m from the road and the sound level meter is 3m from the ground surface – 7 dB A

Actual measured value = 59.8 dBA (Refer to Table 3.4)

Calculated value = a + b + c+ d
\[ = 61.8 - 0.4 + 3.86 - 7 \]
\[ = 58.26 \text{ dB A} \]

**Calculated value for measuring point 5**

a) Basic noise model

\[ L_{eq \text{ Basic}} = 37 + 10 \log Q \]
\[ Q = \text{Volume of traffic} \]
\[ = 37 + 10 \log 555 \]
\[ = 37 + 27.4 \]
\[ = 64.4 \text{ dB A} \]

b) Speed of traffic

\[ L_{p.v} = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A} \]

\[ L_{p.v} = \text{correction of speed} \]
\[ p = \text{number of trucks} \times 100 \]

Total vehicles
\[ = 13/305 \times 100 \]
\[ = 4.2 \]
\( v = \text{mean traffic speed (km/h)} \)
\( p = \text{heavy vehicles (%)} \)

\[
L_{p,v} = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A}
\]
\[
= 33 \log (108.3) + 10 \log (1.35) - 68.8 \text{ dB A}
\]
\[
= 69.4 \text{ dB A} - 68.8 \text{ dB A}
\]
\[
= 0.6 \text{ dB A}
\]

c) Correction for road surface texture

\[
L_t = 4 - 0.03p
\]
\[
= 4 - 0.03 \times 8.64
\]
\[
= 4 - 0.2592
\]
\[
= 3.74 \text{ dB A}
\]

d) Ground conditions, distance of receiver from pavement

Using the graph, it is 30m from the road and the sound level meter is 3m from the ground surface – 7 dB A

Calculated value = a + b + c + d
\[
= 64.4 + 0.068 + 3.74 - 7
\]
\[
= 61.82 \text{ dB A}
\]

**Calculated value for measuring point 6**

a) Basic noise model

\[
L_{eq \text{ Basic}} = 37 + 10 \log Q
\]
\[
Q = \text{Volume of traffic}
\]
\[
= 37 + 10 \log 726
\]
\[
= 37 + 28.6
\]
\[
= 65.6 \text{ dB A}
\]
b) Speed of traffic

\[ L_{p.v} = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A} \]

\[ L_{p.v} = \text{correction of speed} \quad p = \text{number of trucks} \times 100 \]

Total vehicles

\[ = \frac{13}{305} \times 100 \]

\[ = 4.2 \]

\[ v = \text{mean traffic speed (km/h)} \]

\[ p = \text{heavy vehicles (\%)} \]

\[ L_{p.v} = 33 \log (v + 40 + 500/v) + 10 \log (1 + 5p/v) - 68.8 \text{ dB A} \]

\[ = 33 \log (108.3) + 10 \log (1.35) - 68.8 \text{ dB A} \]

\[ = 68.1 \text{ dB A} - 68.8 \text{ dB A} \]

\[ = -0.69 \text{ dB A} \]

c) Correction for road surface texture

\[ L_t = 4 - 0.03p \]

\[ = 4 - 0.03 \times 3.16 \]

\[ = 4 - 0.0948 \]

\[ = 3.9052 \text{ dB A} \]

d) Ground conditions, distance of receiver from pavement

Using the graph, it is 30m from the road and the sound level meter is 3m from the ground surface – 7 dB A

Calculated value = a + b + c + d

\[ = 65.6 - 0.69 + 3.9 - 7 \]

\[ = 61.81 \text{ dB A} \]
Table 3.6: Comparison between the measured Leq and calculated values

<table>
<thead>
<tr>
<th>Position Value</th>
<th>Distance</th>
<th>Leq</th>
<th>Calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>30</td>
<td>60.0 dB A</td>
<td>60.2 dB A</td>
</tr>
<tr>
<td>2.</td>
<td>30</td>
<td>60.3 dB A</td>
<td>59.7 dB A</td>
</tr>
<tr>
<td>3.</td>
<td>30</td>
<td>59.5 dB A</td>
<td>63.9 dB A</td>
</tr>
<tr>
<td>4.</td>
<td>30</td>
<td>59.8 dB A</td>
<td>58.3 dB A</td>
</tr>
<tr>
<td>5.</td>
<td>30</td>
<td>63.3 dB A</td>
<td>61.8 dB A</td>
</tr>
<tr>
<td>6.</td>
<td>30</td>
<td>60.4 dB A</td>
<td>61.8 dB A</td>
</tr>
</tbody>
</table>

The above-mentioned comparison were done in order to mathematically determine if the measured values were correct. It is an indication that the measuring values were correct. Evaluation on these measuring points was done 30 m away from the Hendrik Potgieter because 30 m gives the person an unobstructed view of the road. There are no other aspects such as boundary walls, vertical structures, houses or trees that could affect the outcome of the survey.

International studies have indicated that traffic noise is considered to be a large-scale problem (Alam & Manzoor, 2005). By halving the traffic, a decrease of 3 dB (A) on noise levels could be achieved. Speed is also another factor to consider, as speed has the greatest influence on noise levels. A change in speed from 30 to 100 km/hour causes a 20dB (A) to 30 dB (A) increase in noise. By reducing speed on Hendrik Potgieter Road by half, it would be possible to cut the noise level by 4 to 5 dB (A).
3.6 Synthesis

During the course of the noise survey, it was discovered that noise levels in locations in residential areas within 60m and 90m of Hendrik Potgieter Road residential area fell within the SANS 10103:2008 Guidelines. However, most existing noise levels within 30m of Hendrik Potgieter Road were higher than those prescribed in the guidelines.

According to Table 2 of SANS 10103:2008, the study area can be classified as an urban district. It an area which attracts a lot of vehicles. The ambient noise level of this study area is made of traffic, which results in noise associated traffic.

It is therefore, in order for residential property to be situated in Hendrik Potgieter, care must be given for noise attenuation measures during the construction phase. This will assist future developments along busy roads. This should be done so that the people living in close proximity of frantic roads are not exposed to higher noise levels that could affect their health and well-being.
Chapter 4: The Impact of Noise Pollution on the Population of Strubensvalley

Chapter 4 deals with and the effects of traffic noise on the population of Strubensvalley. This chapter looks at the results of the noise survey questionnaire that was administered amongst the residents of Strubensvalley. The questionnaire covered issues such as gender, age, educational level and employment status. A sample size of 100 people was randomly selected. The selected population of 100 people received a door-to-door delivered on their reaction to environmental noise, their attitudes, their annoyance and the effect of noise on their daily activities. The houses were randomly selected, the choice being every fourth house from another.

4.1 Socio-Demographic Attributes of Interviewees

Sixty percent of the sampled population of 100 that were interviewed was females. Most of the females were widowed or housewives. A possible reason was that the surveys were conducted during the day, from 9am in the morning. The selected sample of interviewees comprises mostly of the age group 31 to 40 years, meaning that Strubensvalley is largely occupied by a middle-aged urban population. The study area accommodates numerous retail outlets which attract more working class people to reside closer to it.

More than 29 percent of the study population has Grade 12 with diploma qualifications. This shows that the interviewees are educated people. Seventy percent are employed full-time. The reason could be that that more of them have a good educational background and the necessary skills. More than 65 percent of the study population stay in freestanding houses. Seventy-two percent of them are the owners of the houses, the reason being that most of them are employed full-time, they middle-aged and family-oriented (See Table 4.1)
Table 4.1 Gender of interviewees

<table>
<thead>
<tr>
<th>Variables</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender:</strong> Male</td>
<td>40.0%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
</tr>
<tr>
<td><strong>Age:</strong> 21 years</td>
<td>8.5%</td>
</tr>
<tr>
<td>21-30</td>
<td>17.0%</td>
</tr>
<tr>
<td>31-40</td>
<td>35.1%</td>
</tr>
<tr>
<td>41-50</td>
<td>20.2%</td>
</tr>
<tr>
<td>51-60</td>
<td>13.8%</td>
</tr>
<tr>
<td>&gt; 60 years</td>
<td>5.3%</td>
</tr>
<tr>
<td><strong>Educational level</strong></td>
<td></td>
</tr>
<tr>
<td>Less than grade 12</td>
<td>16.9%</td>
</tr>
<tr>
<td>Grade 12</td>
<td>22.1%</td>
</tr>
<tr>
<td>Grade 12 with diploma</td>
<td>29.5%</td>
</tr>
<tr>
<td>Bachelor's degree or equivalent</td>
<td>18.9%</td>
</tr>
<tr>
<td>Honours degree or higher</td>
<td>12.6%</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
</tr>
<tr>
<td>Employed-part time</td>
<td>30.0%</td>
</tr>
<tr>
<td>Employed-full time</td>
<td>70.0%</td>
</tr>
<tr>
<td><strong>Residential preference</strong></td>
<td></td>
</tr>
<tr>
<td>Freestanding units (houses)</td>
<td>65.3%</td>
</tr>
<tr>
<td>Sectional title</td>
<td>34.7%</td>
</tr>
<tr>
<td><strong>Ownership</strong></td>
<td></td>
</tr>
<tr>
<td>Rent</td>
<td>27.8%</td>
</tr>
<tr>
<td>Own</td>
<td>72.2%</td>
</tr>
</tbody>
</table>

4.2 The Impact of Noise population on the population of Strubensvalley

The sample of the population that was interviewed was very much aware of the traffic noise in and around the neighbourhood.
4.2.1. The Effects of Noise on the Interviewees

From the sample of the 100 community members that were interviewed 35 percent described the traffic noise levels in the area as high. More than 55 percent of the surveyed population experienced high levels of noise during peak hours (that is between 6 and 7:30), while 51 percent of them experienced high levels of noise over weekends. Over weekend nights, more than 35 percent experienced high levels of noise. Almost 18 percent of the population experienced high levels of noise during week-days and week-nights.

The traffic noise category in Table 4.2 was rated fairly. This is due to the responses of people staying next to the Hendrik Potgieter Road, however as one proceeds further into Strubensvalley suburb and away from Hendrik Potgieter Road more people became less concerned about traffic noise.

Table 4.2. Perceptions about the level of noise in the residential area of Strubensvalley

<table>
<thead>
<tr>
<th>Noise Source</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic noise</td>
<td>32 (32%)</td>
<td>24 (24%)</td>
<td>35 (35%)</td>
<td>9 (9%)</td>
</tr>
<tr>
<td>Noise from dogs</td>
<td>48 (48%)</td>
<td>31 (31%)</td>
<td>11 (11%)</td>
<td>10 (10%)</td>
</tr>
<tr>
<td>Noise from shopping centres, office parks</td>
<td>54 (54%)</td>
<td>30 (30%)</td>
<td>3 (3%)</td>
<td>13 (13%)</td>
</tr>
<tr>
<td>Noise from building sites</td>
<td>61 (61%)</td>
<td>27 (27%)</td>
<td>2 (2%)</td>
<td>10 (10%)</td>
</tr>
<tr>
<td>Noise from playgrounds/recreational facilities</td>
<td>80 (80%)</td>
<td>6 (6%)</td>
<td>1 (1%)</td>
<td>13 (13%)</td>
</tr>
<tr>
<td>Noise from neighbours</td>
<td>63 (63%)</td>
<td>26 (26%)</td>
<td>3 (3%)</td>
<td>8 (8%)</td>
</tr>
<tr>
<td>Noise from children and the youth</td>
<td>63 (63%)</td>
<td>21 (21%)</td>
<td>5 (5%)</td>
<td>11 (11%)</td>
</tr>
</tbody>
</table>
The category for traffic noise from Hendrik Potgieter Road during peak hours was given a high score because of the volume of commuters entering and leaving their respective premises. The traffic noise is also high over the weekends because people are shopping doing some retail shopping and leaving the area to enjoy outdoor/recreational activities.

<table>
<thead>
<tr>
<th>Time of day when high noise levels are experienced in Strubensvalley</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>During peak hours</td>
<td>53(55.2%)</td>
</tr>
<tr>
<td>During week-days</td>
<td>17(17.7%)</td>
</tr>
<tr>
<td>Over weekends</td>
<td>49(51.0%)</td>
</tr>
<tr>
<td>During week-nights</td>
<td>17(17.7%)</td>
</tr>
<tr>
<td>During weekend nights</td>
<td>34(35.4%)</td>
</tr>
</tbody>
</table>

More than 51 percent of the interviewed population in Strubensvalley rarely suffers from headaches. The 30.1 percent who always suffer from headaches stay close to Hendrik Potgieter Road, which leads to the deduction that their headaches are due to the traffic noise. A relatively large proportion (40.4 percent) of the interviewed population always finds it difficult to fall asleep at night due to outside vehicle noise. Hendrik Potgieter Road seems to be noisier on account of the friction between the road surface and tyres increase at night. Often 42.7 percent of the surveyed population is awakened by outside noise. In most cases, the outside noise relates to traffic noise.
Table 4.4. The effects of noise on the interviewees

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headaches</td>
<td>18.3</td>
<td>51.6</td>
<td>30.1</td>
</tr>
<tr>
<td>Sense of hearing</td>
<td>85.1</td>
<td>13.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Difficulty falling asleep at night due to noise from outside</td>
<td>35.1</td>
<td>24.5</td>
<td>40.4</td>
</tr>
<tr>
<td>Sleep interruption by outside noise</td>
<td>23.6</td>
<td>33.7</td>
<td>42.7</td>
</tr>
</tbody>
</table>

4.3 Conclusion

This chapter looked at the impact of noise population on the population of Strubensvalley. According to the results of the questionnaires, it was established that the majority of the sample population are annoyed by traffic noise along Hendrik Potgieter Road.

The annoyance that humans feel when faced with noise is the most common outward symptom of stress building up inside. Therefore, annoyance and stress could be considered as symptoms of potentially more serious health problems.
Chapter 5: Synthesis

5.1 Key Findings of the Study

The noise survey was conducted in order to determine the impact of traffic noise pollution on the population of the Strubensvalley area of Roodepoort. It also set out to determine whether the current noise regime has an effect on the good health and well-being of the people residing in the vicinity. The purpose of this research was to assess the impact of traffic noise along Hendrik Potgieter Road from Christiaan de Wet Road to Nic Diederichs Road.

It was found that the majority of people are largely affected by traffic noise along Hendrik Potgieter Road. The majority of them are annoyed by traffic noise. It was established that the noise levels in this area were higher than the permitted noise levels. The most sensitive criteria for adverse effects induced by road-traffic noise are general annoyance, disturbance of day-time relaxation and disturbance of sleep with windows slightly open. It is suggested that these criteria should be used as indicators in assessing the health impact of road-traffic noise.

5.2 Limitations of the Study

At the point in time when this noise survey was conducted, it was difficult to go out and take measurements on certain days and nights as it was raining. Noise measurements should not to be taken when the weather is not fine, as poor weather conditions interfere. Most of the residents were not receptive to the questionnaires which were distributed in this door-to-door campaign. This made the questionnaire survey very difficult. Furthermore, some of the shortcomings relating to the accuracy of the completed questionnaires were perceptions that barking dogs, motorbikes are the main contribute to noise. Consecutively, some of the shortcomings were either barking dogs
or motorbikes revving or sirens from emergency vehicles were the main causes of the high noise levels rather than the traffic.

5.3 Conclusion

A good environment that promotes good health and well-being is one where sound levels from road-traffic noise in residential areas are below Leq 45 dB. Access to quiet indoor and outdoor sections of one’s dwelling supports health and results in a lesser degree and extent of annoyance, disturbed relaxation and sleep, and contributes to physiological and psychological well-being. To protect most people from experiencing annoyance and other adverse effects, the sound levels from road traffic should not exceed Leq 50 dB at the most.

Conclusions based on present knowledge and the results of this study are that road traffic noise has an impact on people’s well-being with special emphasis on annoyance. According to the World Health Organization, “health is a state of complete physical, mental and social well-being”. The City of Johannesburg has a responsibility for fostering the health of its people, which can be fulfilled only by providing adequate health and social measures to this end. Noise is, in this respect, more than just a nuisance, and it constitutes a danger that is real to people’s health in that it produces both physical and psychological stress. Although people seem to adjust to noise by ignoring it, the ear is, in fact, always operative as it transmits signals to the nervous system, which in turn stimulates reactions from the body. The fact that irritability is a very apparent reaction to noise has caused legislators to often consider public annoyance as a basic factor in noise control programmes. The annoyance that humans feel when faced with noise is the most common outward symptom of stress.
References


Fig. 13 - Soft Ground Correction, $L_{d,nr}$, in dB(A) as a Function of Horizontal Distance ($d$) of Receiver from Nearside Pavement Edge and Height ($h_r$) above Pavement Level, Valid for Distances Greater than 4 m.

$$L_{d,nr} = \left[ -10 \log \left( \frac{d}{d' + 3.5} \right) - 5.2 \log \left( \frac{h_r + 3.5}{d + 3.5} \right) \right] \text{ (dB(A))}$$

where

$$d' = \frac{(d - 3.5)^2}{h_r + 0.5} \sqrt{m}.$$