Traffic Noise Influence on Soundscape Quality At Campus Landscape Area

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Received: 26 October 2015   Final Version Received: 31st March 2017

Campuses located in urban areas are prone to issues such as high traffic and noise pollution which can affect both the indoor and outdoor learning environments. Environmental experiences involving the perception of positive and negative sounds relate to the study of *soundscape*. This paper presents a soundscape assessment using two physical approaches of site observation and sound measurement. Two landscape areas in University of Malaya (UM) campus were selected: the parcourse area (Site I) and the water feature area (Site II). The objectives are to investigate the level of sound quality and to identify the connection between the soundscape and the landscape elements. During site observation, the human sound of Site I, water sound of Site II and vehicular sounds characterize the selected sites. Both sites sound pressure level were at 50 dBA and above during low traffic conditions, and a critical level of over 60 dBA during high traffic conditions. This current sound level exceeded the permissible level for institutions of 50 dBA by the Department of Environment. Sounds generated by the water feature and from human activities do influence the soundscape during low traffic period but insignificant during high traffic period. It is important to take into consideration on the factor of location, surrounding context, landscape elements and vegetation when creating a landscape area for the community in the campus. It is hoped that the findings will provide fundamental data for future improvement and development of UM campus' landscape areas.

Keywords: *Soundscape, Traffic Noise, Landscape Elements, Campus Environment.*

1. INTRODUCTION

Densely populated urban cities are often associated with the increase in traffic that leads to noise pollution (Raimbault & Dubois, 2005; Goswami et al., 2011). One of the major contributions to noise emanates from the transportation sector (Goswami et al., 2011). A campus can be reflected as a small city that experiences the issues of traffic and noise. Nowadays there is a necessity of using private transportation as it eases one's mobility, especially within a large campus area. Traffic noises and quantity of car parks at a university campus indicates the ever growing use of vehicles by the campus community or outsiders is the main contribution to the excessive noise problem (Musa et al., 2012) within the campus (Kong et al., 2009;

Barata et al., 2011). The increased use of private vehicles, the location of the campus and the traffic movement influence the high sound level that could affect human health (El-Sharkawy & Alsubaie, 2014). Goswami et al. (2011) and Ozer et al. (2014) studied traffic noise within a campus, and the research showed that the sound level at certain locations exceeded the permissible sound level. Excessive exposure to traffic sound can accentuate the negative effect on human health. It is an environmental problem that can cause health hazard, environmental degradation, and influence the quality of life (Phukan & Kalita, 2013; Ozer et al., 2014). The usage of vehicles affected the indoor and outdoor environment and brings about negative impact on the quality of life in a campus (Kong et al., 2009). Green spaces are provided around a campus for students to enjoy outdoor activities where they can experience an environment that would be benefitting to their health. The quality of recreation spaces that aim to promote healthy lifestyle can be improved by the existence of soothing sounds of nature. However, it can easily deteriorated by acoustic disturbances (Yang and Kang, 2005).

Sound is one of the important elements that constitute an environment, and it relates exclusively with people's sense of hearing. Environmental sound differs with time, space and location (Raimbault & Dubois, 2005; Botteldooren et al., 2006). The environment naturally produces sounds, but over time, they are being toned down by human interventions with more distinct sound (Pijanowski et al., 2011). Sound is rarely being recognized as informative elements, but instead, they are being apprehended as noise and pollutant of the environment (Carles et al., 1999). Noise is referred to as undesired sound which implies a negative impression (Jennings & Cain, 2013) that can decrease the value of landscape in both urban and rural areas. Raymond Murray Schafer pioneered the term and study of soundscape to create a better quality of life by viewing sound from different dimensions other than the context of noise (Schafer, 1977). The term soundscape was derived from the word *sound*, which is the energy wave transmitted in the form of vibration (Kang, 2007); and *landscape*, which is an area with visible features that can be sensed (Eckbo et al., 1998). Other terms that can be defined as soundscape are 'sonic environment' (Schafer, 1977), 'environment of sound' (Truax, 1996), 'auditory or aural landscape' (Thompson, 2002), and 'acoustic environment' (Brown et al., 2011). The environment of sound is a holistic system that looked into a multi-dimensional entity of sound, environment, and people (Ozcevik & Can, 2012; Brown et al., 2011; Kang & Zhang, 2010; Davies et al., 2013).

Previous and recent studies acknowledged the changes in the soundscape, with a specific focus towards urban areas such as urban public open space (Yang & Kang, 2005; Kang & Zhang, 2010; Yu & Kang, 2011; Marry & Defrance, 2013), urban residential area (Skånberg & Öhrström, 2002; Yu & Kang, 2011), and underground shopping streets (Meng et al., 2013). Most acoustical studies done on campuses looked into the aspects of sound, environment, and people; but directed towards noise and annoyances influencing the learning environment (Jaff & Hossieni, 2012; Zannin et al., 2013; Ozer et al., 2014). People's experience of an outdoor environment relates closely with the existing sound in the area (Brown & Muhar, 2004). The sound of environment is a combination of natural sound from birds or water; human sound from people talking or laughing; and mechanical sound from vehicles or construction, among other things (Kawai & Yano, 2002; Yang & Kang, 2005; Kang & Zhang, 2010; Brown et al, 2011). This study focuses on the aspects of sound, landscape area, and people within a campus. The study would be concentrated on soundscape assessment through sound measurement and observation at two landscape areas in UM campus. The aim of this research is to assess the quality of soundscape and landscape in selected areas around UM campus. Based on this aim, the following objectives are formulated:

i. To investigate the level of sound quality at two selected landscape area.

ii. To identify the connection between the sounds and landscape elements.

2. LITERATURE REVIEW

Sound can be referred to various sound types and sources that can be perceived as positive or negative (Brown et al., 2011). Preferred sounds are sounds that offer positive feelings to the listener (Carles et al., 1999; Viollon et al., 2002; Yang & Kang, 2005; Davies et al., 2013). Undesired sounds are sound that evokes negative emotions or feelings such as annoyance, which interferes with activities or damage hearing (Brown et al., 2011). Planners or decision makers concerned with noise complaints and management often looked into reducing and eliminating negative sounds, rather than trying to enhance the value of positive sound (Raimbault & Dubois, 2005; Cain et al., 2013). They focus on controlling the negative sound which leads urban soundscape towards the 'less unpleasant' without being more 'pleasant' (Kawai & Yano 2002; Cain et al., 2013). Simply decreasing or eliminating negative sound can lead to anxiety and create other problems, besides being insufficient for the account of improving urban environment (Kang & Zhang 2010; Jennings & Cain, 2013; Cain et al., 2013).

The purpose and function of an area influence the type of sound created in it (Mastura et al., 2014). Depending on a space, sound may be described and valued differently (Brown et al., 2011). Consideration of individual sound is an important part of soundscape evaluation (Kang, 2007). Correspondence between sounds and the environmental context, which supports the activities undertaken by people, would result in quality soundscape (Kin-Che et al., 2010). Different places and context produce its own soundscape that is unique from one another (Brown et al., 2011). The context of the soundscape is an important yet challenging aspect that needs to be considered in the study of soundscape (Cain et al., 2013). It is due to sounds coming from different sources from within the area, and from the outside of the area. The site context relates behavior and activity whether or not it is compatible and meets the expectation of the users (Davies et al., 2013). The context of an area, including auditory information, is rarely perceived in isolation from other sensory such as the sense of vision and touch (Viollon et al., 2002). People's preferences for a particular landscape are determined by both the emotional attributes of sound, and the contextual elements it is perceived in (Carles et al., 1999).

Different components of the environment can be enhanced and emphasize through information provided by sounds that are beyond the context alone.

3. METHODOLOGY

Research on soundscape in urban areas is typically conducted at places such as public open spaces, where engagement between human and sounds existed (Yang & Kang, 2005; Kang & Zhang, 2010; Yu & Kang, 2011; Marry & Defrance, 2013). This research focuses on landscape areas within UM campus. The selected areas are the parcourse area (Site I) and the water feature area (Site II). The areas were selected based on the presence of landscape elements which are capable of contributing to either natural or human sound. Site I which contains parcourse equipment attract human interactions through physical activities which in turn create human sounds. Site II which comprises of water element generated the effect of waterfall sound when it is in operation. They are both located along the main road, which is accessible through Kuala Lumpur (KL) and Petaling Jaya (PJ) entrance gates, with high possibility of being influenced by traffic noise (Figure 1). Criteria for the selection of the sites were based on the provision of outdoor environment, availability of landscape element and its sound source, as well as its location and accessibility.

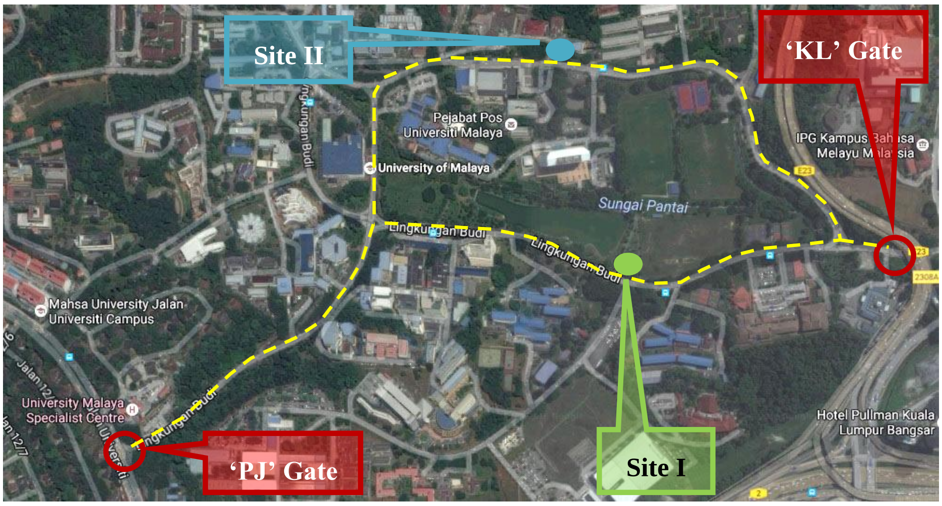

Figure 1: Satellite view of UM campus. (*Source: Google Earth*)

3.1 DATA COLLECTION

Research by Yang and Kang (2005), Kang and Zhang (2010), and Meng et al. (2013) include the assessment of sound pressure level (SPL) and sound environment questionnaire survey as part of their studies. In this study, physical assessment through site observation and sound measurement aims to identify and understand the current sound condition of the site. The measurement works were carried out according to the standard outlined in Planning Guidelines for Environmental Noise Limit and Control by the Department of Environment (D.o.E, 2007). The measurement of SPL was done using sound level meter 01dB SOLO Metravib. The measured SPL parameters are A-weighted sound pressure level (L_{Aeq}), minimum A-weighted sound pressure level (L_{Amin}), and maximum A-weighted sound pressure level (L_{Amax}). Following the standard drawn in Planning Guidelines for Environmental Noise Limits and Control 2007, the sound level meter was mounted on a tripod stand at a height of 1.2 to 1.5 meter above ground and at least 3.5 meters away from any walls, buildings, and other sound reflecting structures. The half inch microphone on the sound level meter was also secured with a wind protector. It is then located at one point of reference in each site during the measurement. The selected point of reference represents the main spot where people perceived sound at that particular landscape area (refer Figure 3 and Figure 6).

The data collection was conducted in the month of October and November in 2013. The sound level meter was set to run the measurements for two hours duration. The equipment was checked every half an hour to make sure that the measurement is recorded throughout the duration of the measurement. To ensure the safety of the equipment, a notice regarding the research purpose was placed on it to avoid any disturbances from the passerby, while still being monitored from a distance of about 10 to 20 meters. Observation on the site context and landscape elements was done one month earlier for identification purposes before conducting the sound measurement. A digital camera was used to capture the visual of the selected landscape areas. The layout plan of the sites was sketched to indicate the site context and landscape elements. Observation on the sound elements, human activity, and number of passing by vehicles was done during the sound measurement. The vehicle types are divided into four categories: car, motorcycle, lorry, and bus.

The time and day of the measurement were selected in order to achieve the preferred site conditions (Table 1). The different days selection were done to achieve the high and low traffic circumstances. The measurements for high traffic condition were conducted during the weekdays, while the measurements for low traffic conditions were conducted during holiday, weekend and weekday. The differences in timing schedule for all the measurement periods are due to the factor of human presence, as well as the operational time of the water feature.

Table 1: Schedule of measurements in Site I and Site II.

a) Site I				
Legend	High Traffic-Human Presence	High Traffic-No Human Presence	Low Traffic-Human Presence	Low Traffic-No Human Presence
	I_{H,w_H}	$I_{H,w/o\_H}$	I_{L,w_H}	$I_{L,w/o\_H}$
Day	Weekday (Thursday)	Weekday (Monday)	Holiday (Raya Haji)	Weekend (Sunday)
Time	1700-1900	0850-1050	0925-1125	1350-1550
b) Site II				

Legend	High Traffic-Water Feature (on)	High Traffic-Water Feature (off)	Low Traffic-Water Feature (on)	Low Traffic-Water Feature (off)
	II_{H,w_ON}	$II_{H,w/o\_OFF}$	II_{L,w_ON}	$II_{L,w/o\_OFF}$
Day	Weekday (Tuesday)	Weekday (Friday)	Holiday (Raya Haji)	*Weekday (Monday)
Time	0700-0900	0915-1115	0700-0900	0700-0900

*Weekday (Monday): in between weekend and public holiday (Raya Haji)

4. RESULTS

The results and discussions are based on both site observation and sound measurement. Analysis for each Site I and Site II are divided into three sections: site observation, sound measurement, and discussion.

4.1 SITE I (PARCOURSE AREA)

4.1.1 SITE OBSERVATION

Site I provided parcourse equipment for the campus community members to enjoy either active or passive activities such as exercising and socializing. It was observed that the site is usually crowded in the evenings. There is a gazebo nearby used as a place for waiting, sitting, and sight viewing. The site is located next to an open green space and lake area. It is surrounded by primary, secondary, and tertiary road. There are pines and trees planted along the primary road that is still immature in terms of heights and sizes. Therefore, the site is visually and audibly exposed to the sound of passing vehicles. Figure 2 shows the images of Site I and its context, and Figure 3 presents the layout plan and panoramic images of the site.

1 Primary Road

2 Secondary Road

3 Primary Road

4 Open Green Space

5 Parcourse

6 Tertiary Road

7 Gazebo 8 Lake

Figure 2: Images of Site I and its context.

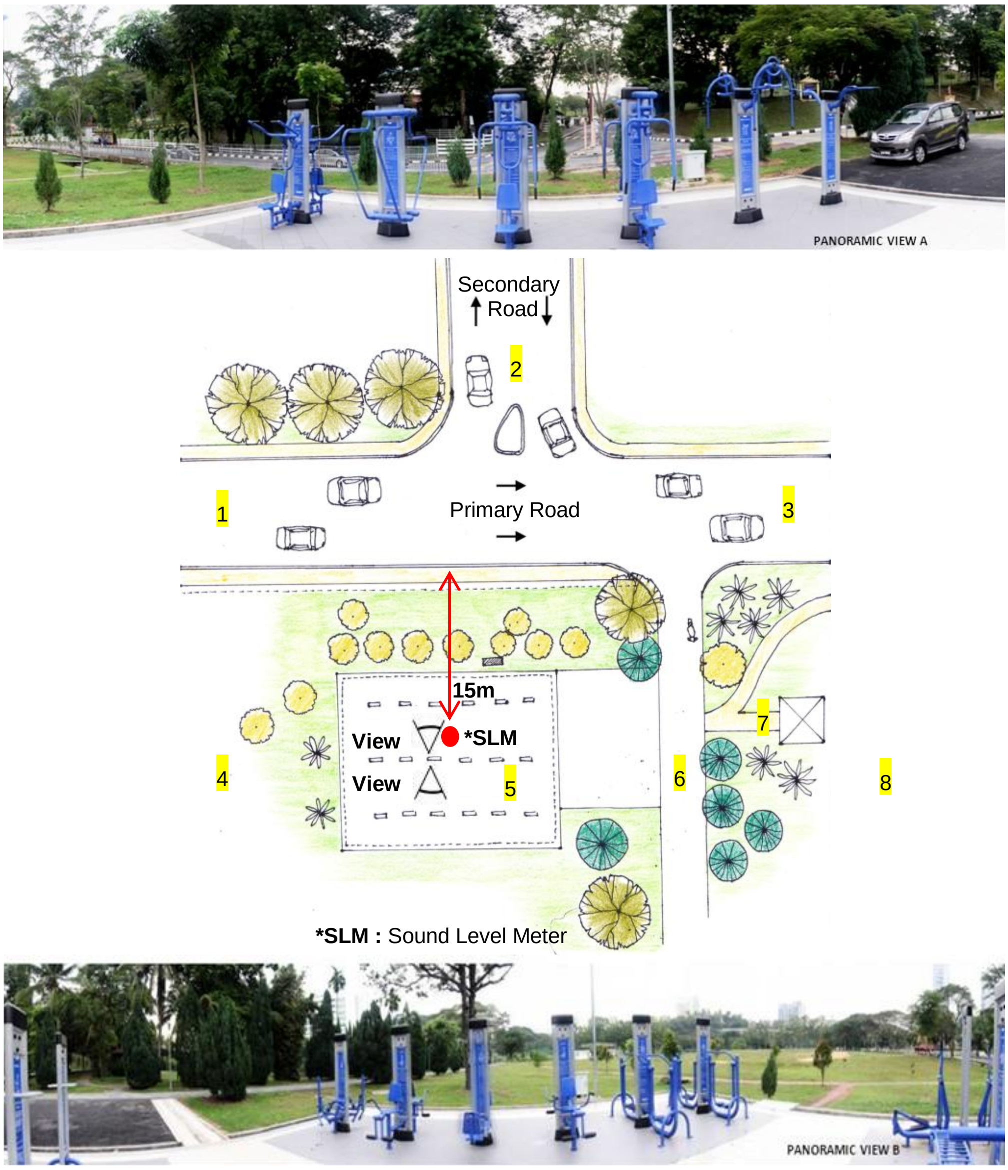

Figure 3: Layout plan and panoramic views of Site I.

Based on Table 2, the total number of vehicles passing by during *high traffic-human presence* (I_{H,w_H}) is 3,511 units. The total number consist of car (2,321 units), motorcycle (1,139 units), lorry (17 units), and bus (34 units). During *high traffic-no human presence* ($I_{H,w/o\_H}$), the total number of vehicles is 3,650 units. The total number comprise of car (2,540 units), motorcycle (1,048 units), lorry (19 units), and bus (43 units). The large total number of vehicles can be associated with the continuous movement of traffic along the primary road.

The total of 388 units of vehicles comprises of car (317 units), motorcycle (60 units), lorry (3 units) and bus (8 units) were recorded during *low traffic-human presence* (I_{L,w_H}). During *low traffic-no human presence* ($I_{L,w/o\_H}$), the total number of 239 units consist of car (163 units), motorcycle (73 units), and lorry (3 units) were logged.

Table 2: Number and types of vehicles recorded at Site I.

Type of Vehicles	**Site I**			
	I_{H,w_H}	$I_{H,w/o\_H}$	I_{L,w_H}	$I_{L,w/o\_H}$
Car	2321	2540	317	163
Motorcycle	1139	1048	60	73
Lorry	17	19	3	3
Bus	34	43	8	-
Total	3511	3650	388	239

4.1.2 SOUND MEASUREMENT

There were four measurement periods with different circumstances conducted at Site I. The four conditions were distinguished using four different colours. For high traffic conditions, the *high traffic-human presence* (I_{H,w_H}) is represented by the red line, while *high traffic-no human presence* ($I_{H,w/o\_H}$) is represented by the blue line. For low traffic conditions, the *low traffic-human presence* (I_{L,w_H}) is depicted using the green line, while the *low traffic-no human presence* ($I_{L,w/o\_H}$) is represented using the purple line. Referring to Figure 4, I_{H,w_H} (red line) and $I_{H,w/o\_H}$ (blue line) of the graph showed high sound level of 60 dBA and above, which was recorded during high traffic period. During low traffic period, I_{L,w_H} (green line) and $I_{L,w/o\_H}$ (purple line) of the graph basically recorded sound level of below 60 dBA. The fluctuations occurred in I_{L,w_H} (green line) and $I_{L,w/o\_H}$ (purple line) of the graph was due to the vehicles passing by every once in a while during low traffic period.

According to the sound measurement data collected, between low traffic period and high traffic period, there is an increase of 5 to 10 dBA. During high traffic period, both *high traffic-human presence* (I_{H,w_H}) and *high traffic-no human presence* ($I_{H,w/o\_H}$) recorded L_{Amin} of more than 50dBA and a similar L_{Amax} of 68 dBA. During low traffic conditions, the L_{Amin} recorded were below 50 dBA and the L_{Amax} recorded was 61 dBA for I_{L,w_H} and 55 dBA for $I_{L,w/o\_H}$ (Table 3). The presence of people may have influenced the increased of L_{Amin} during high traffic conditions and L_{Amax} during low traffic conditions. At the time of high traffic period, the presence of human has no significant influence on the L_{Amax}. However, the *no human presence* condition could lead to the lower L_{Amin} for both high and low traffic period.

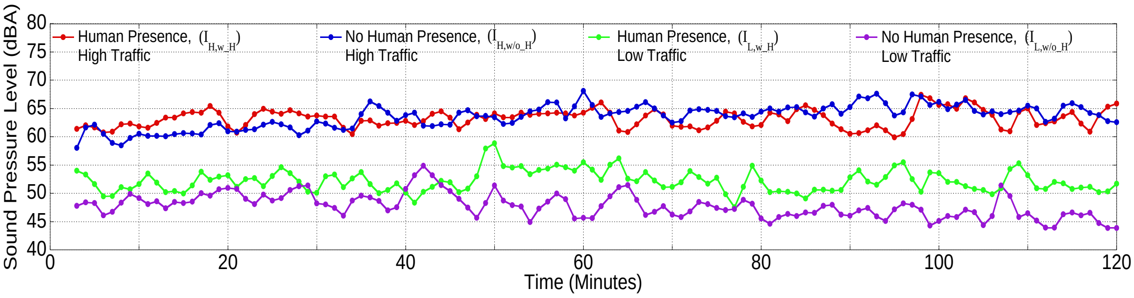

Figure 4: A-weighted sound pressure level (dBA) during high and low traffic period at Site I.

Table 3: Measured SPL parameters (L_{Amin}, L_{Amax}, Mean L_{Aeq}) in Site I.

Measured SPL Parameter	**Site I**			
	I_{H,w_H}, dBA	**$I_{H,w/o\_H}$, dBA**	**I_{L,w_H}, dBA**	**$I_{L,w/o\_H}$, dBA**
L_{Amin}	60	55	47	44
L_{Amax}	68	68	61	55
Mean L_{Aeq}	63	64	52	48

4.2 SITE II (WATER FEATURE AREA)

4.2.1 SITE OBSERVATION

Site II is clearly visible and easily accessible as it is located next to the primary road and main buildings of UM (Rumah Universiti KKUM Berhad and Tunku Canselor Hall). Site II is an open space terrace with built-in seating provided for passive activities. The site is mainly used as a meeting point for the campus community or as a stopping point. It is a focal point area, especially during convocation seasons. The water element is located slightly further along the walkway and the primary road. The man-made waterfall-like water element generated a mild sound of waterfall. Green patch areas at the side and rear of the site are planted with various types of immature and mature vegetation including groundcover, shrubs, trees, and palms. The surrounded greenery creates a natural ambience besides providing shades for the area. Figure 5 shows the images for Site II and its context while Figure 6 presents the layout plan and panoramic images of the site.

1 Terrace Area

2 Pedestrian Crossing

3 Green Area

4 Secondary Road

5 Water Feature

6 Primary Road

7 Parking Area

8 Open Space

9 Tunku Canselor Hall

Figure 5: Images of Site II and its context.

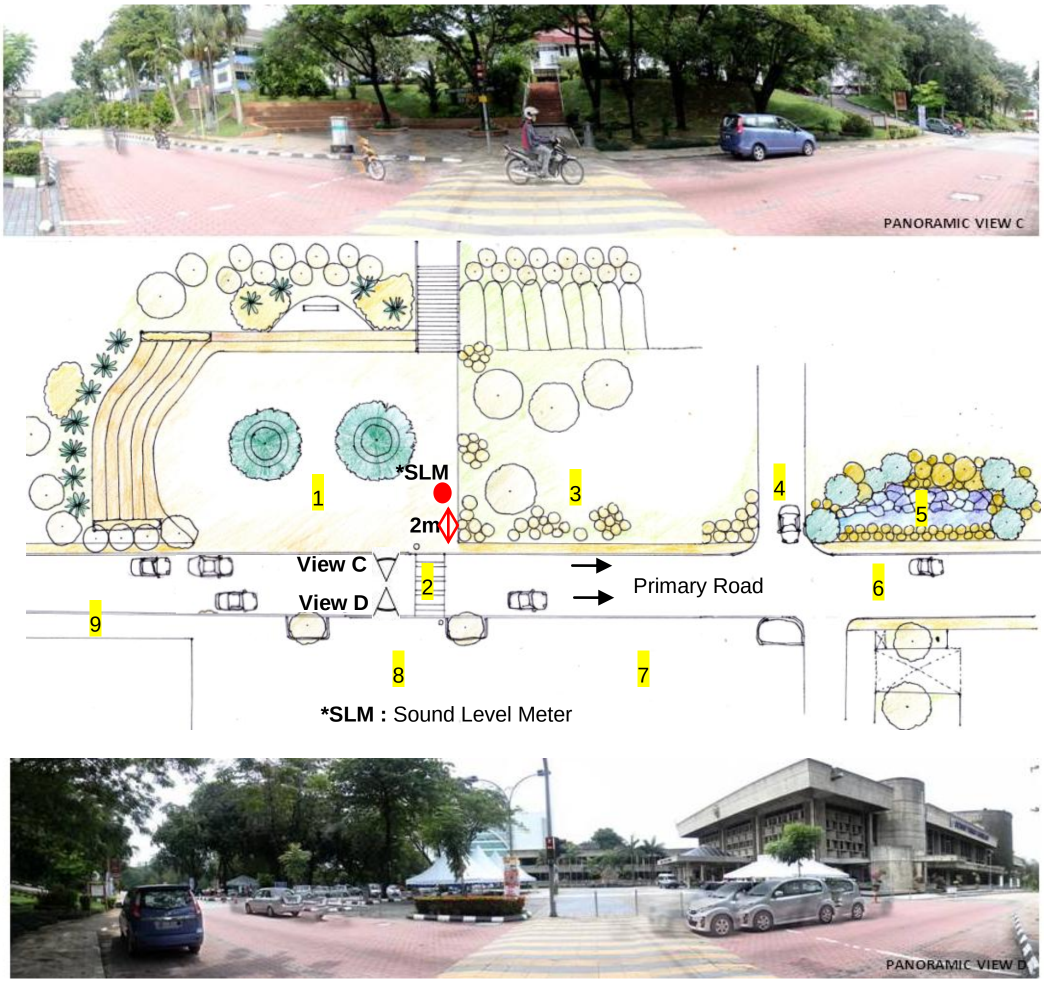

Figure 6: Layout plan and panoramic views of Site II.

Table 4 showed the total number of 2,491 units of vehicles during *high traffic-water feature on* (II_{H,w_ON}). The total number consists of car (1,927 units), motorcycle (518 units), lorry (13 units), and bus (33 units). The sound of the man-made waterfall can only be slightly heard as it was masked by the passing by vehicular sounds. The total number of 2,273 units of vehicles consists of car (1,693 units), motorcycle (492 units), lorry (50 units), and bus (38 units) was recorded during *high traffic-water feature off* ($II_{H,w/o\_OFF}$).

The total number of vehicles recorded during *low traffic-water feature on* (II_{L,w_ON}) comprises of car (122 units), motorcycle (34 units), and lorry (3 units); makes up a total of 159 units of vehicles. The total number of vehicles logged during *low traffic-water feature off* ($II_{L,w/o\_OFF}$) is 324 units, comprises of car (269 units), motorcycle (49 units), lorry (3 units), and bus (3 units).

Table 4: Number and types of vehicles recorded at Site II.

Type of Vehicles	Site II			
	II_{H,w_ON}	$II_{H,w/o\_OFF}$	II_{L,w_ON}	$II_{L,w/o\_OFF}$
Car	1927	1693	122	269
Motorcycle	518	492	34	49
Lorry	13	50	3	3
Bus	33	38	-	3
Total	2491	2273	159	324

4.2.2 SOUND MEASUREMENT

Figure 7 shows the recorded SPL at Site II. For easier understanding of the data, the four measurement conditions were distinguished using four different colours. For high traffic conditions, the *high traffic-water feature on* (II_{H,w_ON}) is represented by the red line, while *high traffic-water feature off* ($II_{H,w/o\_OFF}$) is represented by the blue line. For low traffic measurement condition, the *low traffic-water feature on* (II_{L,w_ON}) is represented by the green line while the *low traffic-water feature off* ($II_{L,w/o\_OFF}$) is represented by the purple line. It can be seen that the SPL recorded during high traffic conditions are high between the ranges of 60 to 65 dBA, which suggested that the sound produced by the passing by vehicles gives prominent influence to the sound level at the site. Meanwhile, SPL recorded during low traffic conditions is around 60 dBA and below. The gradual increase of *low traffic-water feature off* ($II_{L,w/o\_OFF}$) SPL is due to more regular presence of passing vehicles during the last half time of measurement. The difference in SPL fluctuations between the high traffic and low traffic conditions should also be noted. The dissimilarities are due to intermittent flow of traffic which occurred during low traffic period measurements. The gradual increase of *low traffic-water feature off* ($II_{L,w/o\_OFF}$)

During high traffic condition measurements, the L_{Amin} of recorded sound level is more than 50 dBA. Meanwhile, the L_{Amax} for both II_{H,w_ON} and $II_{H,w/o\_OFF}$ were recorded with minimal differences in sound level of 65 dBA and 67 dBA respectively. For measurement during low traffic conditions, the L_{Amin} for both II_{L,w_ON} and $II_{L,w/o\_OFF}$ did not exceed 50 dBA. Meanwhile, the L_{Amax} recorded for both condition logged a sound level with considerable differences with 60 dBA for II_{L,w_ON} and 66 dBA for $II_{L,w/o\_OFF}$ (refer Table 5).

The sound of the man-made waterfall influenced on the environment during low traffic conditions. Looking at the SPL data recorded, differences of an up to 10 dBA can be observed during II_{L,w_ON} and $II_{L,w/o\_OFF}$. Unsurprisingly, during high traffic conditions, sounds from the man-made waterfall recorded less significant masking effect as the sounds from the constant traffic flow was more outstanding.

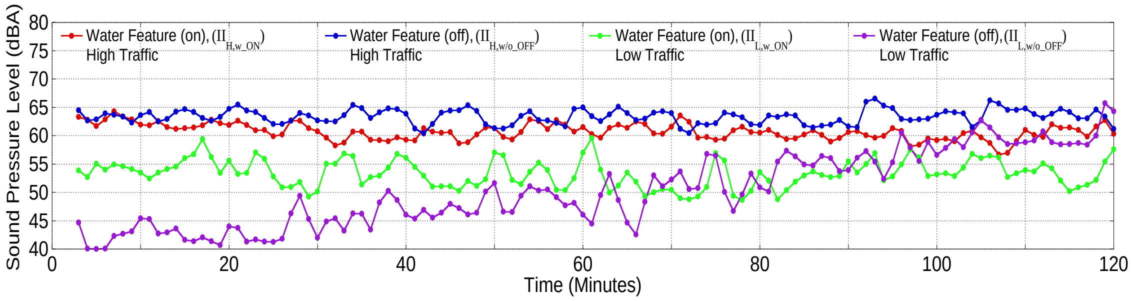

Figure 7: A-weighted sound pressure level (dBA) during high and low traffic conditions at Site II.

Table 5: Measured SPL parameters (L_{Amin}, L_{Amax}, Mean L_{Aeq}) in Site II.

Measured SPL Parameter	**Site II**			
	II_{H,w_ON}, dBA	**$II_{H,w/o\_OFF}$, dBA**	**II_{L,w_ON}, dBA**	**$II_{L,w/o\_OFF}$, dBA**
L_{Amin}	56	60	49	40
L_{Amax}	65	67	60	66
Mean L_{Aeq}	61	63	53	50

5. DISCUSSION

This section discussed on the results of site observation and sound measurement on both sites. Site I location and the lack of plantings made it clearly visible from the primary road, hence exposing the site to vehicular sounds. The placement of the parcourse next to open green space and lake lead to the expectation of natural sounds experience. The exposure of vehicular sound towards the site created a different kind of sound environment. Unwanted or negative sound may disturb or interfere with people activities such as having conversations or dealing with mental tasks (Moudon, 2009). Vehicles are the main sound source during high traffic condition that masked the sound produced by human activities. During low traffic condition, significant differences in measured sound pressure level can be observed. The infrequent passing by of vehicle during the measurement period enable one to easily experience sounds from other sources. The possibility of clearly hearing and experiencing human sound will provide information on the presence of people and consequently, trigger vibrant atmosphere at the site.

The location of Site II next to the primary road provided a significant impact on the measured sound pressure level. Plantings surrounding the area provided a decent shade for the site. However, it failed to work as a sound barrier from the sounds of passing vehicles. The site is an open space which is clearly noticeable and easily accessible from the primary road and adjacent buildings. The distance between the water feature, the terrace, and the pedestrian crossing decreases the supposed sound effect of the waterfall. Moreover, the water feature's visual aesthetic could hardly be appreciated from the distance as it is situated at the far back of the area. The purpose of the water feature sound during high traffic period was lacking as it was being toned down by vehicular sounds from the primary road. Based on the observation during low traffic period, the sound of man-made waterfall was essentially audible and it provided a different environmental experience for the site. At the events of low traffic period, the fluctuations of SPL in the graph were visibly noticeable. This is due to the fact that the low traffic conditions created a quieter environment and thus, a slight disturbance of sound produced by the passing vehicles made an obvious effect on the sound level. The sound of water at an appropriate location may evoke positive and pleasant feelings, and help in giving the environment a positive judgement (Gidlöf-Gunnarsson & Öhrström, 2007). Yang and Kang (2005) stated that high level of pleasant sound can act as masking sound that could considerably improve the soundscape quality of an area.

Based on the discussion of Site I and Site II, the provision of landscape elements at both sites such as parcourse and water feature as well as mix setting of nature and built environment are meant for the people to enjoy and experience. The different landscape elements produce different soundscape that accentuate the character of the sites (Brown et al., 2011). But due to the location that is along the primary road exposed both sites to traffic sound. The perceived sound that is undesired due to the purpose or expectation of an area affects activities, health (Brown et al., 2011) and the soundscape quality (Kin-Che et al., 2010).

6. CONCLUSION

Based on the research findings, connections can be observed between the soundscape, landscape elements, site context, and traffic flow. Vehicular sounds are the only visible sound that dominated the sites when there are no human activities or water element. Daytime is the time when the environment is highly exposed to traffic noise (Din et al., 2015). During high traffic period, vehicular sounds overshadow other sounds, hence, sound generated by human activities and water feature were barely audible to human hearing. During low traffic conditions, sounds generated from sources such as human, birds, and water can be heard; but the sound from occasional passing by vehicles affected the sound pressure level is more visible. This indicates the significant impact of vehicular sounds, especially when the environment's sound level recorded below 50 dBA. The mean L_{Aeq} for both sites during high traffic conditions are recorded over 60 dBA, which exceeded the D.o.E (2007) permissible sound level for institutional area, which supposed to be at 50 dBA. There is also a possibility that vehicle induced sound level was affected by the condition of the traffic flow, vehicle components (acceleration or brake), types of vehicles, and road condition.

In this case, landscape design modification can assist to enhance the quality of soundscape of the two sites. Vegetation offer functional, psychological, ecology and aesthetic advantages to an area and users (Adam et al., 2016). Vegetation would not only perform as visual attractions, but it is also a very economical way of providing sound buffering for the sites (Booth, 1983). The composition of trees or shrubs planted along the roadside, its arrangement; whether it is in a row or in groups; as well as the types and forms of the vegetation can influence the sound absorption and reflection. On the other hand, landscape elements such as parcourse and water feature should be strategically located. For instance, the parcourse should be placed further away from the roadside and placed within or surrounded by natural setting. Although the water feature is a visually attractive element to be located next to the roadside, for the sake of quality soundscape, it should be positioned closer to the landscape area focal point where the effect of the waterfall sound can be clearly experienced by people passing by the area.

All in all, the landscape area and the surrounding context influence the soundscape assessment. The sound that triggered and generated by the landscape elements are significantly influence by the traffic sound. The landscape and sound elements create an environment that is meant to be experienced and enjoyed by the campus community. This study focused on methods of physical observation and sound measurement only. The approach of site observation and sound measurement in assessing the environment is essential in order to understand the current situation of the site. It is hoped that psychological assessment on the users of the landscape areas can be pursued in order to look into the subjective matter regarding perception of the community towards the sound environment.

7. ACKNOWLEDGEMENT

A very special thanks to University of Malaya (UM) for funding this research under University of Malaya Research Grant (UMRG) project number RP009B-13SUS on “Landscape Identity of Cameron Highlands Hill Station: Cultural Landscape and Soundscape”.

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