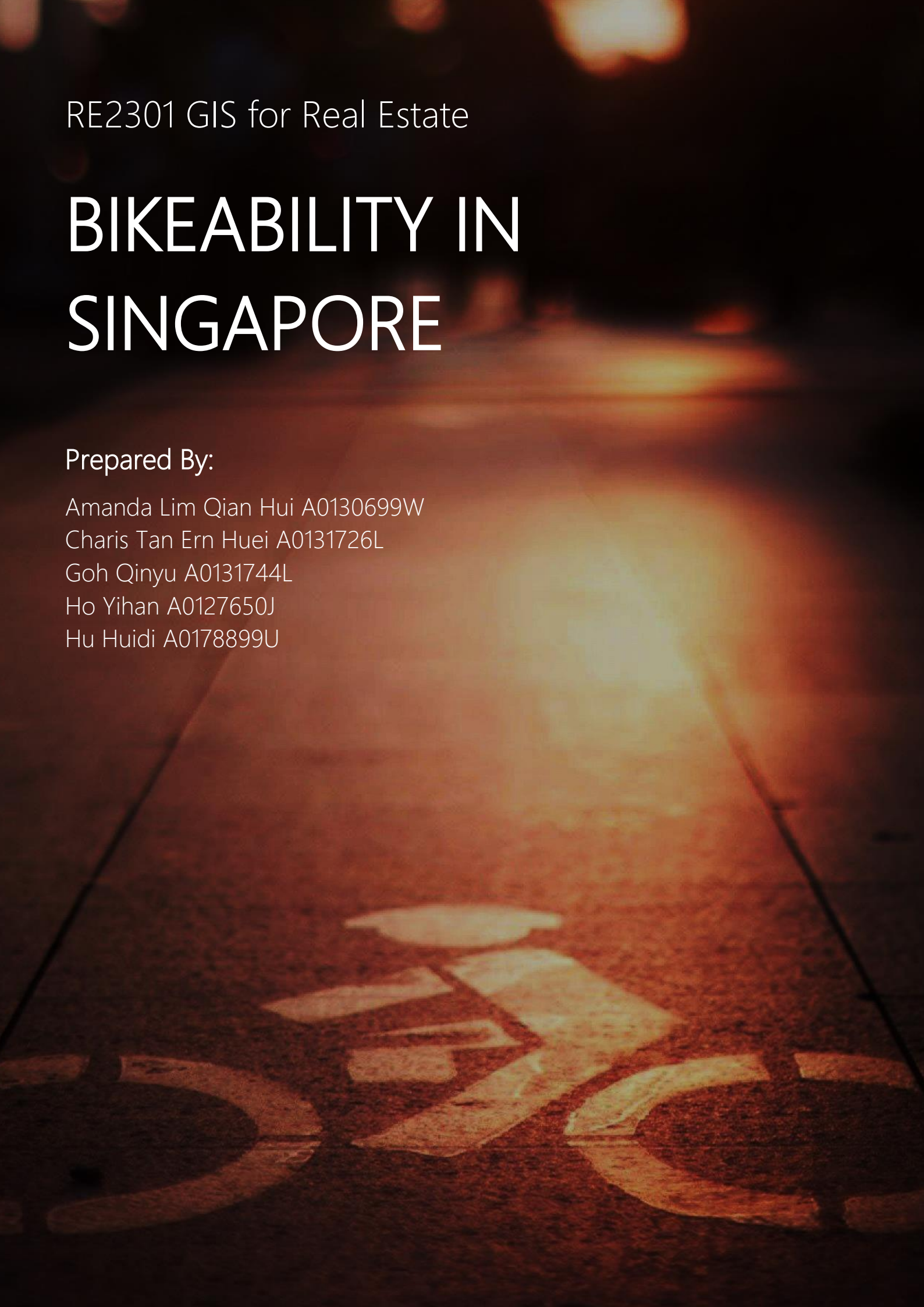

RE2301 GIS for Real Estate

BIKEABILITY IN SINGAPORE

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EXECUTIVE SUMMARY

Cycling is increasingly promoted as an alternative form of transportation in Singapore in conjunction with the nation's vision to be a car-lite city. While the government has already invested sizeable capital into building bicycle friendly structures such as bicycle paths, cycling ramps and bicycle parking facilities around the country and transformed many places in Singapore into Cycling Towns, are all towns in Singapore necessarily suitable for cycling?

This research will focus on the formulation of a Bikeability Index to evaluate the relative bikeability of bicycle towns and non-bicycle towns in Singapore. It will be the first local research that evaluates bikeability throughout Singapore. GIS will be extensively utilised for data collection, cleaning and processing, as data such as slope, temperature and bicycle paths will be evaluated for each planning subzone in Singapore.

Where applicable, case studies on "bicycle nations" such as the Netherlands and Denmark will be used to provide further insights, as well as to provide suggestions to improve bikeability in Singapore.

Tags: Transportation Infrastructure Planning, cycling, last mile travel, bikeability, bicycle town, GIS

CONTENT PAGE

CHAPTER ONE: INTRODUCTION

While cycling has been increasingly promoted as a suitable form of last mile transportation with the government ramping up heavy investment in transforming many towns into cycling towns, are the towns actually ideal for cycling? This chapter will introduce the research problem as well as the hypotheses and objectives of this paper.

1.1 Background Study

Singapore is a small 720km^2 city-state, where strategic city planning is crucial so as to cater to the needs of its growing population. New Housing Development Board (HDB) town developments as well as regional town centers throughout the island call for a greater focus on transport connectivity. The state has taken great strides in reducing the distance between home and work location to major transport nodes. This is evident in the latest Land Transport Master Plan 2013, where the state aims to have 8 out of 10 homes within a 10-minute walk from an MRT station by 2030. (LTA, 2013)

Furthermore, cycling is also the most environmentally friendly way to get to places, especially for short distances, generating no carbon footprint compared to other modes of transportation, as seen in Figure 1.1 below.

Figure 1.1: Comparison of carbon footprint across different transport modes

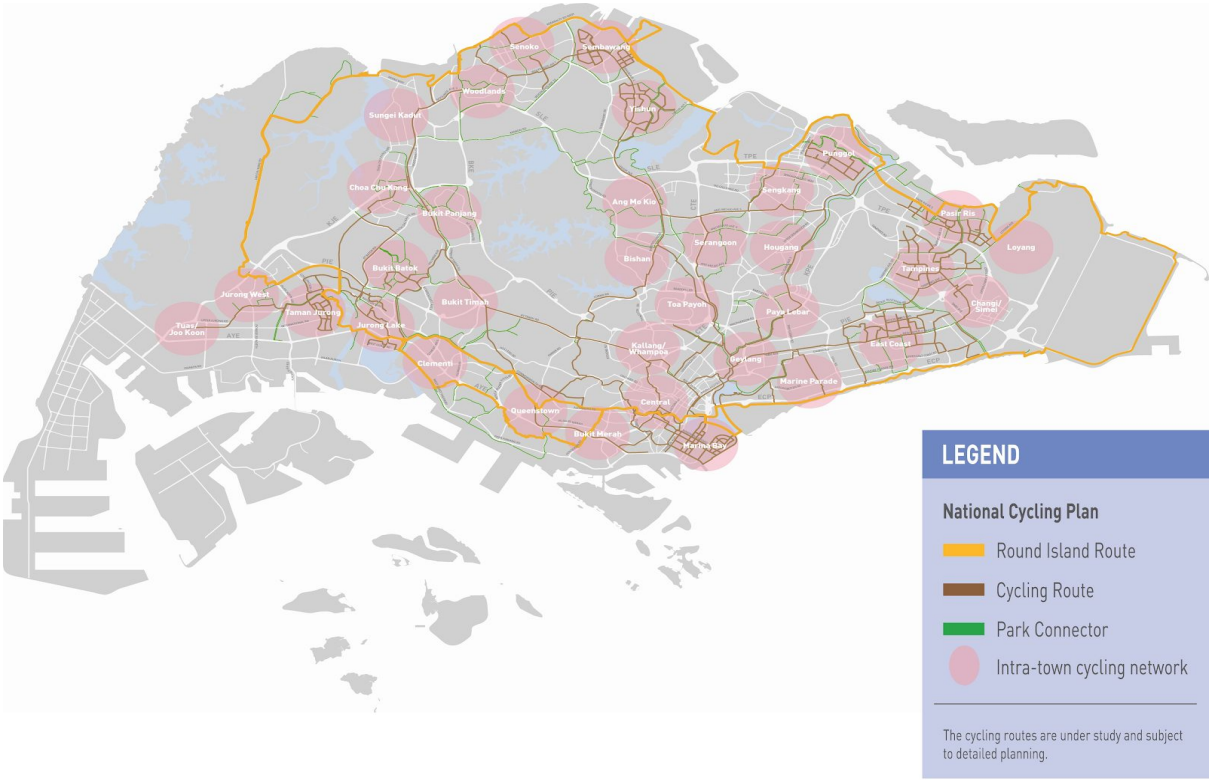
Transport Mode	Average Carbon Footprint (CO^2 per 10 km)
Walking	0
Cycling	0
Taking the bus	0.19kg*
Taking the MRT	0.13kg*
Driving	1.87kg

**Note: Assuming an average loading of 80 passengers per bus and 1,100 per train.*
Source: LTA, 2018.

With Singapore aspiring to be a nation championing sustainability, the state exhibited increasing openness and receptivity towards cycling friendly initiatives and private public partnership, as well as ramped up investment in various cycling infrastructure in recent years.

For one, the National Cycling Plan (NCP), rolled out in 2013 by several government agencies such as Land Transport Authority (LTA), Urban Redevelopment Authority (URA), Sport Singapore (SportSG), National Parks Board (NParks) and Housing Development Board (HDB) aims to make cycling a good alternative transportation option for Singapore residents, regardless of distance travelled.

Figure 1.2: Singapore's National Cycling Plan



Source: URA, 2018.

For short distance travel, more specifically intra-town cycling, LTA is in the process of building a 190 km cycling path network within HDB towns by 2020 to facilitate convenient and safe cycle from homes to MRT stations as well as neighbourhood centres (Ministry of Transport, 2017). Other than a dedicated cycling path network, MRT Stations are increasingly linked to park connectors to make cycling a viable option to Singaporeans for leisure purposes as well.

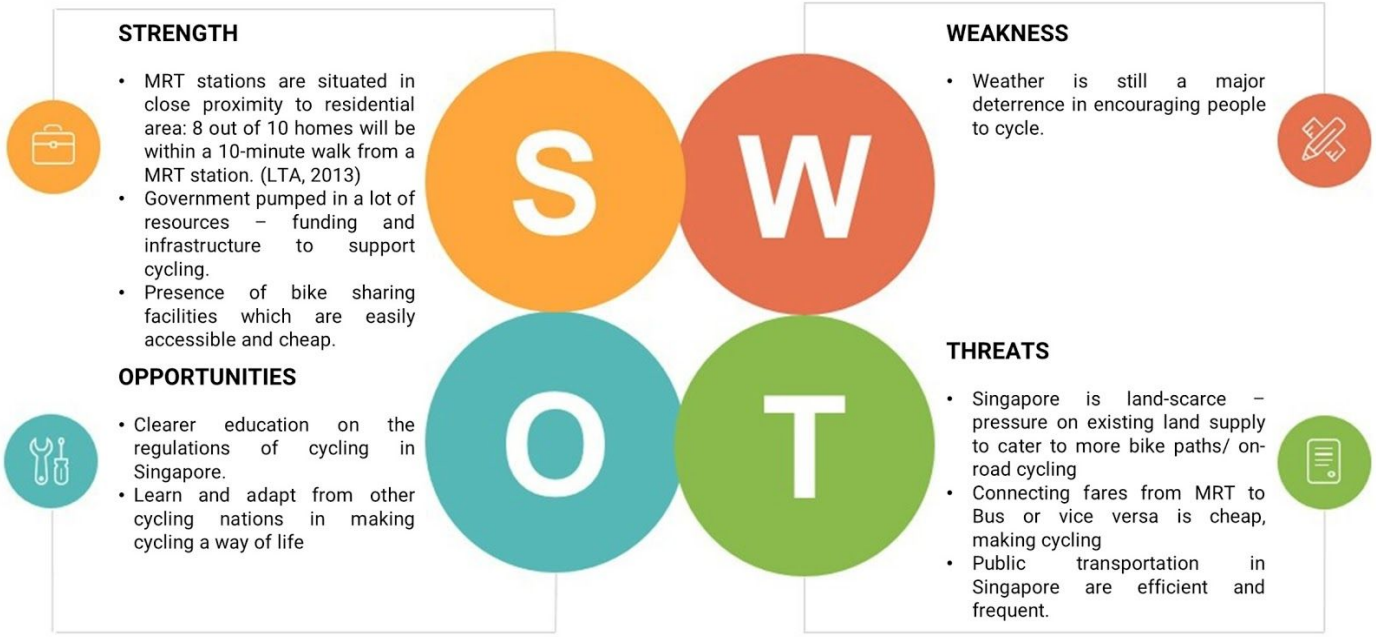
On the other hand, long distance cycle, more specifically inter-town cycling is encouraged through the integration of HDB towns' cycling paths to NParks' Park Connector Network (PCN). By 2030, Singapore's National Cycling Plan aims to have 700 km of cycling network linked up, constituting both inter and intra-town routes, the Park Connector Network and round-island routes (Figure 1.2). This integrated cycling network plan aims to provide Singapore residents with the means to cycle easier and safely within and between towns.

Besides the additional cycling paths, supporting cycling infrastructure and programmes have been rolled out to facilitate cycling. Bicycle parking facilities are readily available at MRT stations as well as new HDB public housing developments. LTA is also working actively with Town Councils and other agencies to provide sufficient bicycle parking within existing HDB estates and at community spaces such as hawker centres, libraries and near bus interchanges. Other supporting cycling infrastructure, such as bicycle crossings, road marking and traffic signs have been introduced as well to facilitate easy and safe cycling. Cycling education programmes were also rolled out, such as the Code of Conduct for Cycling required and programmes targeting road safety.

LTA has also facilitated the entrance of private shared bicycle operators such as oBike, ofo and Mobike into Singapore market and worked closely with them to promote cycling in Singapore. Currently, the number of dockless shared bicycles in Singapore collectively is estimated to be around 100,000. (Lim, 2018).

An assessment of cycling as a form of last-mile transportation is presented below.

Figure 1.3: SWOT in promoting cycling as last mile



1.2 What is Bikeability?

Bikeability refers to how viable cycling is as a last mile transportation that commuters are willing to switch from alternative transportation. The viability of cycling is measured using the various determinants listed in Figure 1.4..

Figure 1.4: Determinants of bikeability of a place

Bikeability of a place can be measured using the 4 determinants - Connectivity, Convenience, Comfort/ Ease of Travel as well as Safety. Firstly, the more places a person can reach through cycling in a city, the more people would be willing to cycle. To illustrate, the lack of cycling paths may result in the cyclist having to travel a longer distance to get to a place. It would also be more difficult for people to navigate to reach their destination, for example having to cycle on grass or road, hence thereby making other modes of transportation a more attractive option. Secondly, cycling has to be convenient for people to be willing to cycle. The access to bicycles and bicycle racks both at point of origin and destination can be measures of convenience to measure bikeability of a place. Thirdly, a place is more bikeable if it is easy to travel and more comfortable for a cyclist. For example, if the weather is comfortable to be outdoors and the terrain of the place is relatively flat, cycling can be a great substitute against other modes of transportation. Lastly, safety of cyclists is a crucial determinant affecting bikeability and people's willingness to cycle. Cycling can be dangerous especially when there is a lack of cycling-friendly infrastructure, support by the government and social acceptance. Hence, these 4 determinants will be considered thoroughly when measuring the bikeability of Singapore.

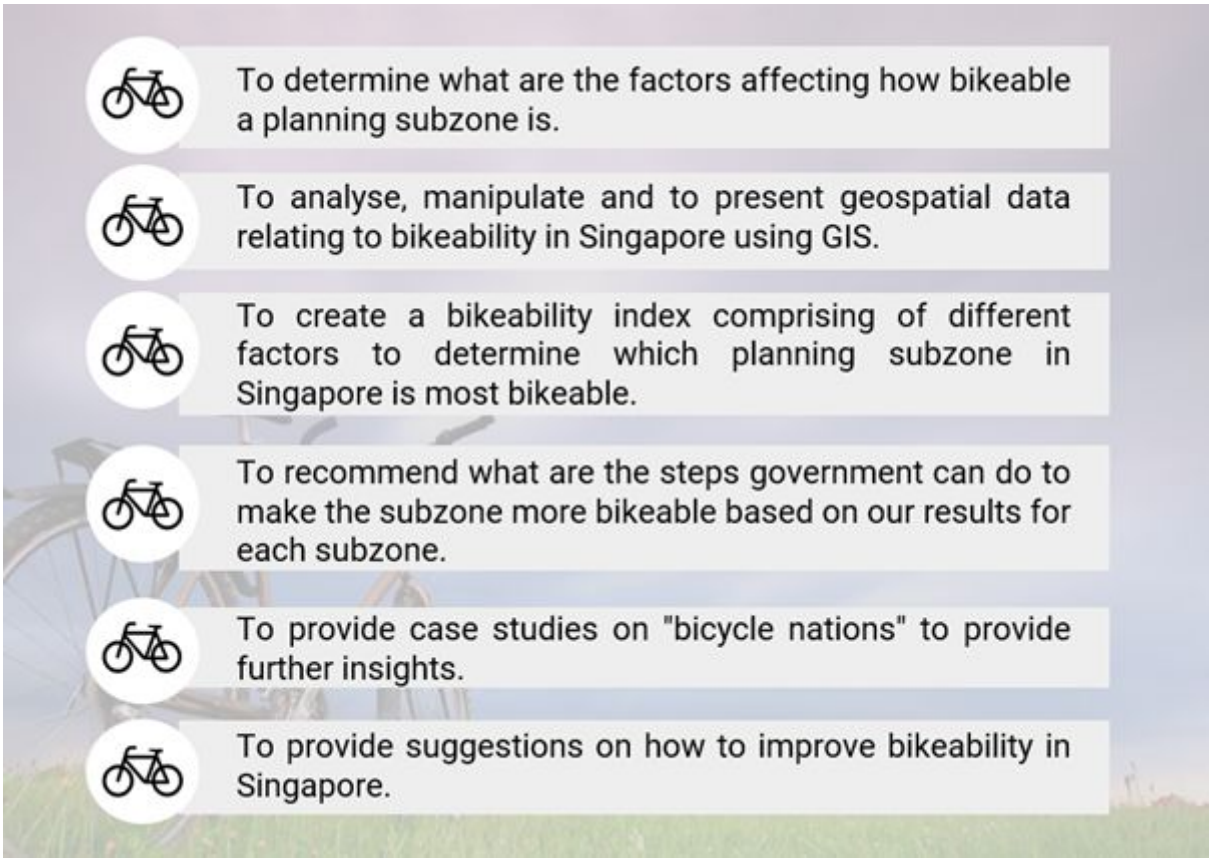
1.3 Research Problem

While the state has put in sizeable investment into building cycling infrastructure and facilitating the development of Singapore as a conducive city for cycling as mentioned in Section 1.1, it is only logical that such efforts are being evaluated closely to assess on their effectiveness. This calls for our research to determine the bikeability of Singapore on a more micro scale and not just on the national scale level. This will then provide an indication as to whether the government should be spending so much resources turning different planning subzones into bicycle towns, and whether they are indeed ideal places to promote cycling in the first place.

1.4 Research Objectives

The research objectives of this study is listed below:

Figure 1.5: Research Objectives



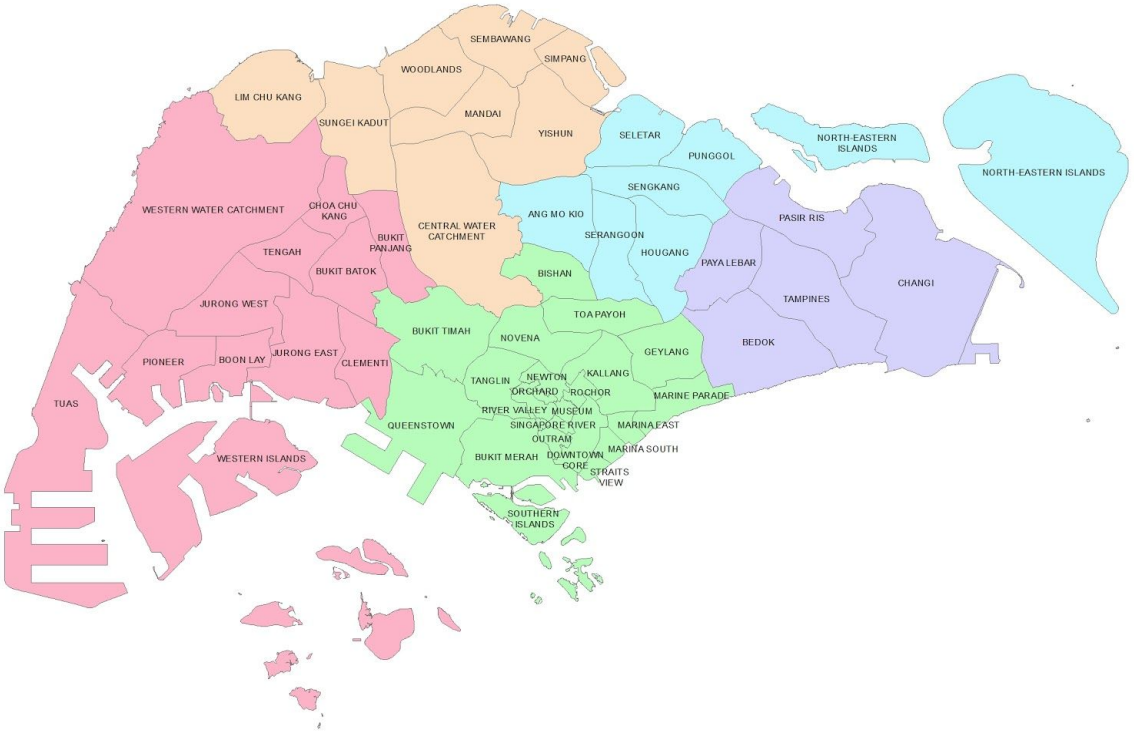
1.5 Research Significance

This paper is significant in three ways. Firstly, this study will serve as the first local research that provides a comprehensive study on bikeability throughout Singapore, as currently there are no published literature which measures bikeability. Secondly, this research will be useful for relevant government statutory boards such as Land Transport Authority in planning for cycling or alternative transportation infrastructure. Lastly, the Bikeability Index results will indicate the effectiveness of government investment in establishing cycling towns. For example, the results of the Bikeability Index will show which towns are more bikeable and ideal to promote cycling as a last mile alternative, and hence should have more resources dedicated to make it a cycling town. On the other hand, for towns which are less bikeable, expending resources on bicycles and cycling-friendly infrastructure will not be as feasible, and instead other alternatives like e-scooter, walking; or innovative measures will fare better.

1.6 Scope of Research

For this bikeability study, the entire Singapore will be examined to determine which towns in Singapore are more bikeable. This research will utilize two scales for analysis. A more macro scale dividing Singapore into the 55 Planning Areas according the 2008 Master Plan (Figure 1.6) will be analysed for the Bikeability Index.

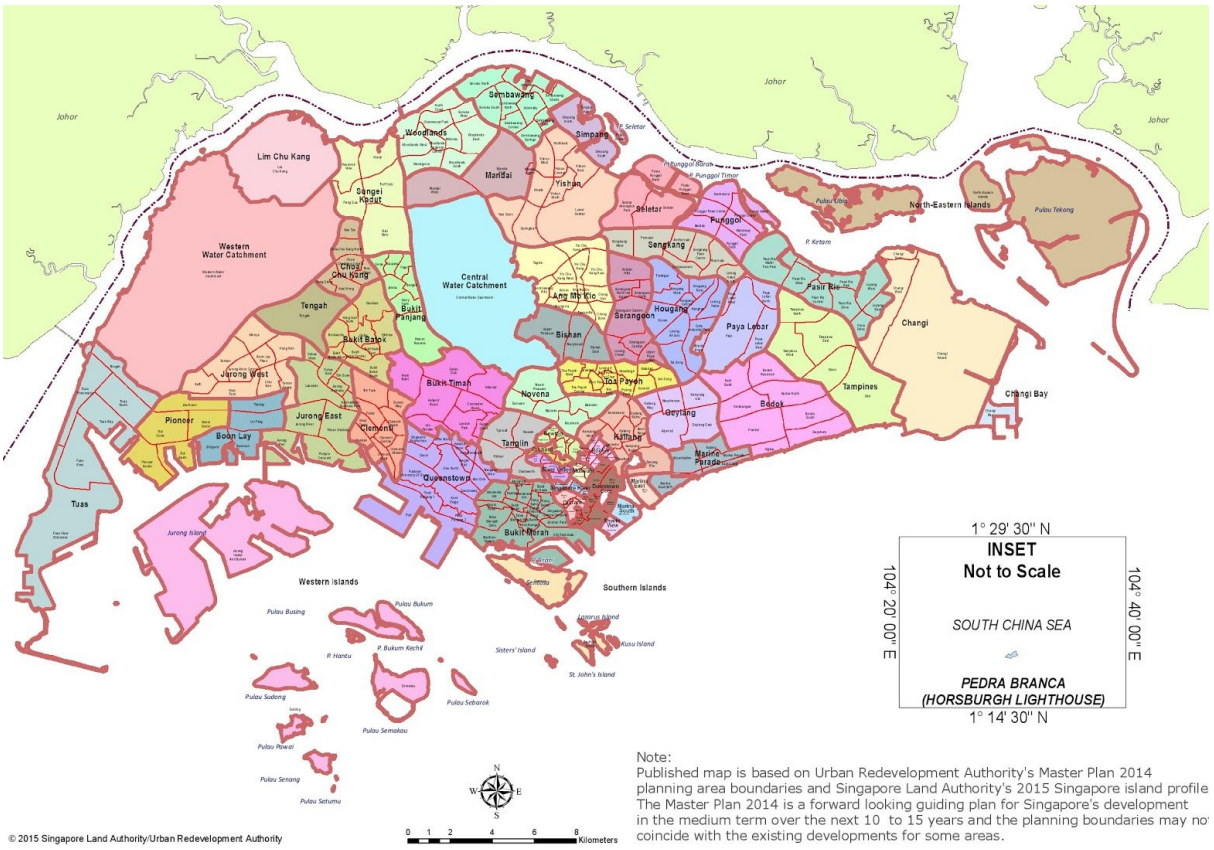
Figure 1.6: Singapore Planning Areas in 2008 Master Plan



Source: Author

However, as a Planning Area still covers a relatively wide area, a more micro scale using the 323 Subzones in Singapore according to the 2008 Master Plan categorisation (Figure 1.7) will also be analysed in terms of its bikeability to generate a more conclusive results for analysis. This more micro scale employed will permit more targeted measures to understand and improve bikeability of the area.

Figure 1.7: Singapore Subzones in 2008 Master Plan



Note:
Published map is based on Urban Redevelopment Authority's Master Plan 2014 planning area boundaries and Singapore Land Authority's 2015 Singapore island profile. The Master Plan 2014 is a forward looking guiding plan for Singapore's development in the medium term over the next 10 to 15 years and the planning boundaries may not coincide with the existing developments for some areas.

Source: URA

CHAPTER TWO: LITERATURE REVIEW

2.1 Bikeability Index

Research has been conducted and various indices have been developed to evaluate the level of bikeability of a city. To create comparable index values for different cities, various components that support or hinder cycling activities have been factored and weighed.

There are mainly 2 broad methodology to quantify the components which make up existing bikeability indices. The first type of indices is based on questionnaires and audits, while the other make use of GIS-data. Eddy (1996) and Harkey et al. (1998) adopt the former method of index formulation where complex formulas are used on components measured by audits. Eddy (1996) factored 27 different components, comprising of categories such as "street condition" and "street facilities" for the purpose of quantifying the cycling friendliness of a street segment. In a recent study by Van Dyck et al. (2012), a "Bikeability Index" was formulated using questionnaires from adult samples. The index was based on perceived built environmental characteristics that were associated with transport-related cycling. The components includes proximity to destinations, availability of cycling facilities, level of difficulty in parking near local shopping malls, etc.

The use of GIS data allows semi-automatic calculation of indices which adds efficiency, especially to the analysis of large areas. One of such bikeability index employs GIS to quantify its components is developed by Winters et al. (2012). The index comprises of 5 components, which can be grouped into positive factors and negative factors. The positive factors include bike route density and separation, connectivity, and destination density, while the negative factor is composed of the topography. The study was conducted in the city of Vancouver to identify areas which are bicycle-friendly and areas where further improvements can be applied. However, as the urban street network conditions are different from those in North America, there is a need for an adjustment of the index of Winters et al.

The method of formulation of indices using Eddy (1996)'s method involves acquiring measurements from manual sources, thereby rendering it time consuming. As such, our group has adopted the latter methodology of employing GIS data to allow us to draw insights within a shorter period of time.

2.2 Bicycle Friendly Cities

The correlation between built environment and cycling behaviours has been well discussed in the literatures. There have been surveys conducted to find out cyclists' opinions on the factors which may motivate and deter their cycling activities. Some of the factors highlighted includes issues of safety, infrastructure, and the physical environment (Winters et al, 2011). Bicycle friendly cities are towns which displayed exemplary efforts to promote and encourage cycle activities.

Highly-dense urban development with safe and comfortable transport networks are constructs that contribute towards the realisation of the concept of Bicycle Friendly Cities (BFCs). In a high-density city, many destinations are typically located within small catchment area which implies that trip distances between any 2 places are typically short. The density of a city's urban development affects the distance taken for residents to travel from a location to the next. The main attributes of a city with safe transport routes are paths with physical separation from the motorized traffic and a gently graded topography. In addition, some geo-environmental characteristics such as temperature and precipitation also significantly affect bikeability of a city.

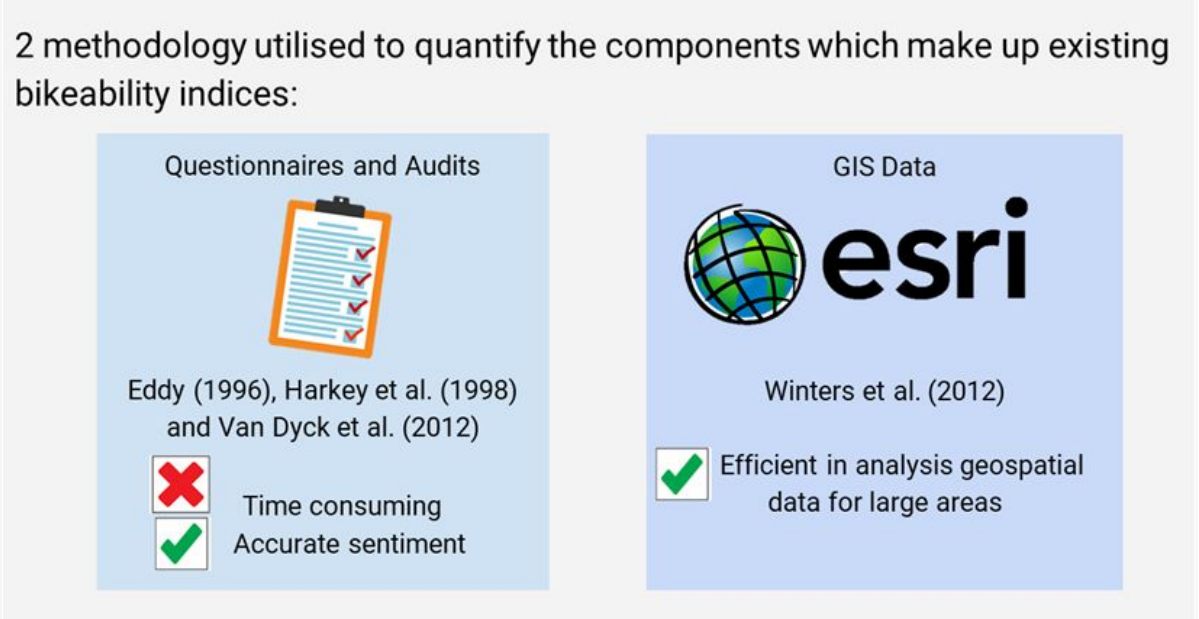
The characteristics of BFCs can be categorized into 2 distinct groups; passive versus active. Macro-scale characteristics such as general urban and environmental attributes of a city will fall into the former group, while micro-scale characteristics such as bicycle facilities are part of the latter. Marco-scale characteristics are dependent on the government's commitment towards the development of infrastructures and facilities towards improving bikeability, while micro-scale characteristics are dependent on the socio-economic and cultural aspects of the local community. Passive characteristics provides an indication to the city's readiness to adopt cycling in terms of the physical realm aspect. Active characteristics measures psychological aspects that are essential to meet the necessary requirements of providing safe, comfortable and efficient utilitarian cycling. The study and understanding of BFCs will allow the team to better evaluate and conduct meaningful suggestions to existing towns.

CHAPTER THREE: BIKEABILITY INDEX FORMULATION

3.1 Methodology of Study

Various methodologies in constructing the Bikeability Index have been explored in the Literature Review section of the report. A summary and analysis of the 2 common methodology used to construct bikeability indices is shown in Figure 3.1 below.

Figure 3.1: Summary and analysis of methodologies employed for various Bikeability Indices



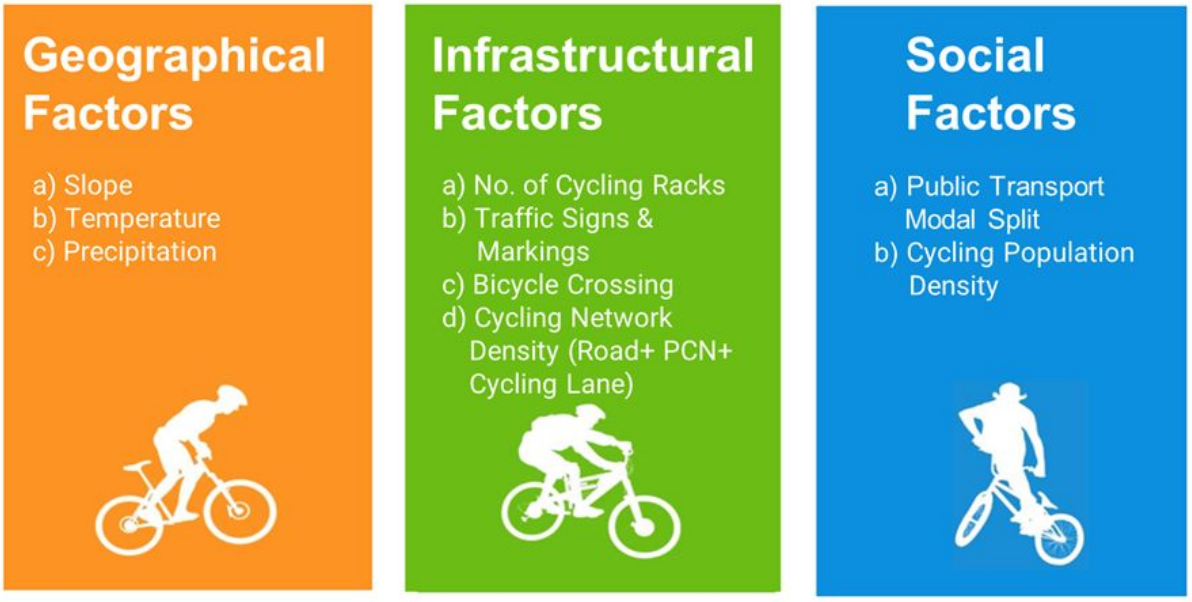
The usage of questionnaires and audits is advantageous to quantify components making up bikeability indices due to its ability to capture on-the-ground sentiment of factors affecting people's decision to cycle. However, collecting accurate data from respondents of different age groups, social economic status and planning areas can prove to be time consuming and resource intensive. On the other hand, using GIS data to construct the index will serve as a useful indicator for measuring and analysing the bicycle-friendliness based on the conditions of built environment conditions in various subzones of Singapore. The generated index using geo-spatial data, will provide a visual mean to analyse how individual factors affecting bikeability and provide insights to possible improvement which can be made to the built environment in attempt to promote higher level of cycling in Singapore.

Due to the benefits both methodologies carry, this paper will employ both methodologies to select and analyse factors which constitute the Bikeability Index. An online survey was carried out, surveying 150 respondents in Singapore on factors affecting their willingness to cycle as a form of last mile transportation. The survey results will be addressed in this report where applicable. A copy of the survey questions and results can be found in Appendix A.

3.2 Components Making Up the Bikeability Index

Upon careful considerations of common factors employed in bikeability indices of past literature while considering the context of Singapore as well as survey feedback, the following indicators seen in Figure 3.2 were selected for the Bikeability Index of this study.

Figure 3.2: Selected factors constituting the Bikeability Index



The factors are split into 3 categories, which will be elaborated further below.

Firstly, geographical factors, such as slope, temperature and precipitation are unique to each planning area/ subzone and are crucial factors affecting the population's willingness to cycle. Comfort is an essential indicator in selecting between different modes of transportation, ceteris paribus. When the journey between origin and destination is hilly, or the weather is scorching hot or raining, people tend to opt for a more comfortable substitute, such as public transportation or taxis and ride sharing services. With Singapore's planning areas and subzones having different terrain and different weather conditions, albeit marginally, these factors are identified to be crucial in affecting people's willingness to cycle and are hence included in the Bikeability Index.

Secondly, the presence of cycling infrastructure is identified to affect the bikeability of a place. The cycling network in the place itself has to be well-connected and far-reaching to encourage cyclists to travel from point A to point B. The more connected the cycling network is, the more people would be willing to cycle as a form of transportation. The cycling network is measured using road (substitute for footpaths), Park Connector Network (PCN) as well as designated cycling lanes. Besides an excellent cycling network, the supply of proper bicycle parking facilities located near origin and destination introduces convenience to cyclists and would in turn encourage them to take up cycling as a form of transportation. Other supporting cycling infrastructure such as proper road marking and traffic signs targeting cyclists as well as bicycle crossings make cycling safer, as the road users are more aware of

cyclists' presence on roads/ pavements as well as road crossings. The presence or therelackof these infrastructural factors in planning areas or subzones, hence affect the bikeability of a place.

Lastly, people make up a place. An analysis of bikeability of a place is only complete if the population/ users within the place is regarded. As such, social factors such as Public Transport Modal Split and the cycling population density is essential to understand what is the cycling catchment group within the place itself and the specific behavioural traits they exemplify with regards to cycling. The inclusion of these factors will hence make the Bikeability Index more holistic and useful for policy making with regards to planning for alternative transportation in a planning area or subzone level.

3.3 Bikeability Index Formulation

To construct the Bikeability Index, a multi factor analysis will be carried out. Specific weights and scores will be assigned to the different factors seen earlier in Figure 3.2. Following which, the final Bikeability Index of each subzone will be tabulated based on the sum of weight and score of each indicator, as shown in the equation below.

Bikeability Score *= (W_1 x Slope) + (W_2 x Cycling Path Density) + (W_3 x Availability of Bicycle Friendly Facilities) + (W_4 x Public Transport Modal Split) + (W_5 x Cycling Population Density) + (W_6 x Precipitation) + (W_7 x Temperature), where W_1 – W_7 are the weights applied to each layer of data.*

CHAPTER FOUR: DATA COLLECTION AND GIS DESIGN

This chapter discusses the GIS design for data collection, cleaning and preparation process. For detailed breakdown of the raw data name, type, sources and weblinks, please refer to Appendix E. The discussion will be segmented according to the three main types of factors analyzed in this project- Geographical, Social and Infrastructural.

4.1 Geographical Factors

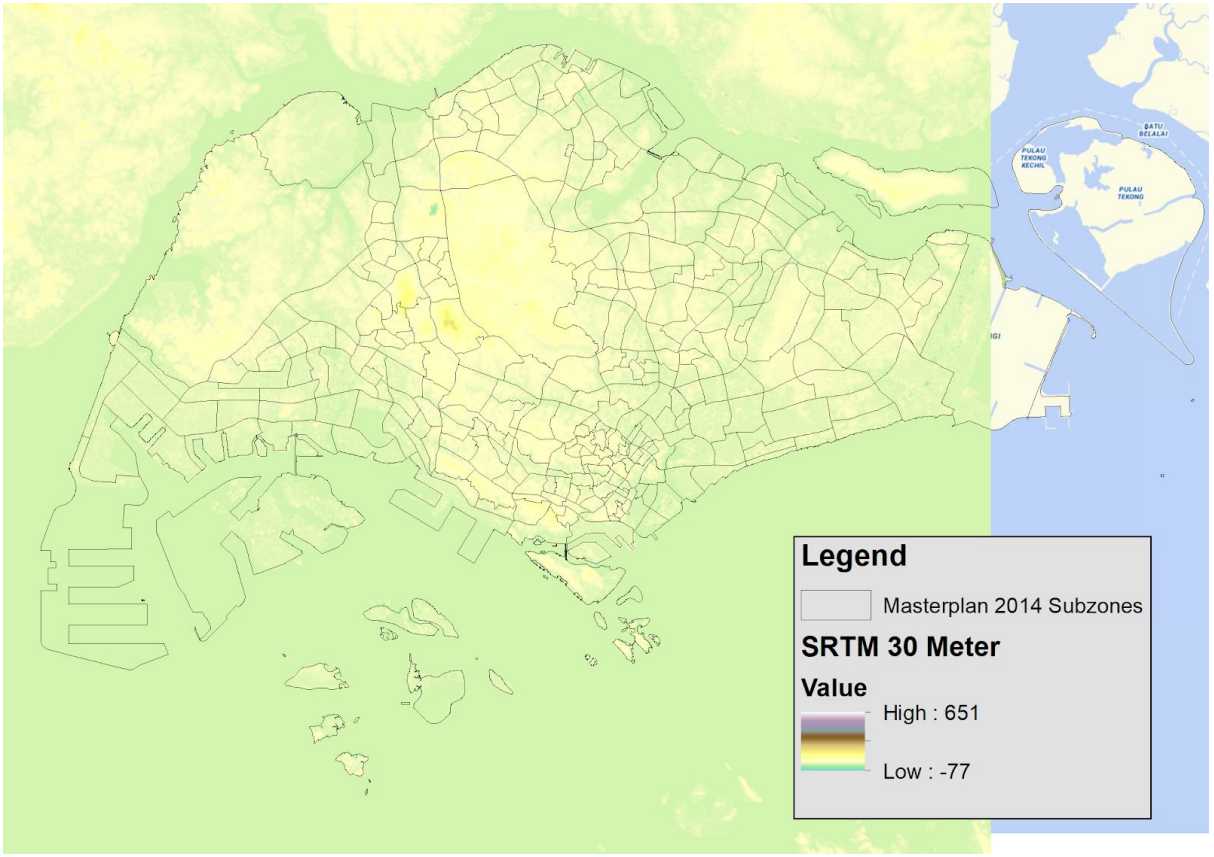
Slope is an important determinant of bikeability as too steep a slope would inhibit cycling altogether. Similarly, the presence of precipitation or high temperature will discourage cycling too.

4.1.1 Slope

Raw data, known as the Space Shuttle Radar Topography Mission (SRTM) 30 meter, is obtained from US Geological Survey (USGS) in the form of a raster dataset. The dataset is a Digital Elevation Terrain Elevation data (DTED), where elevation values is captured and stored in the cell values of the raster dataset.

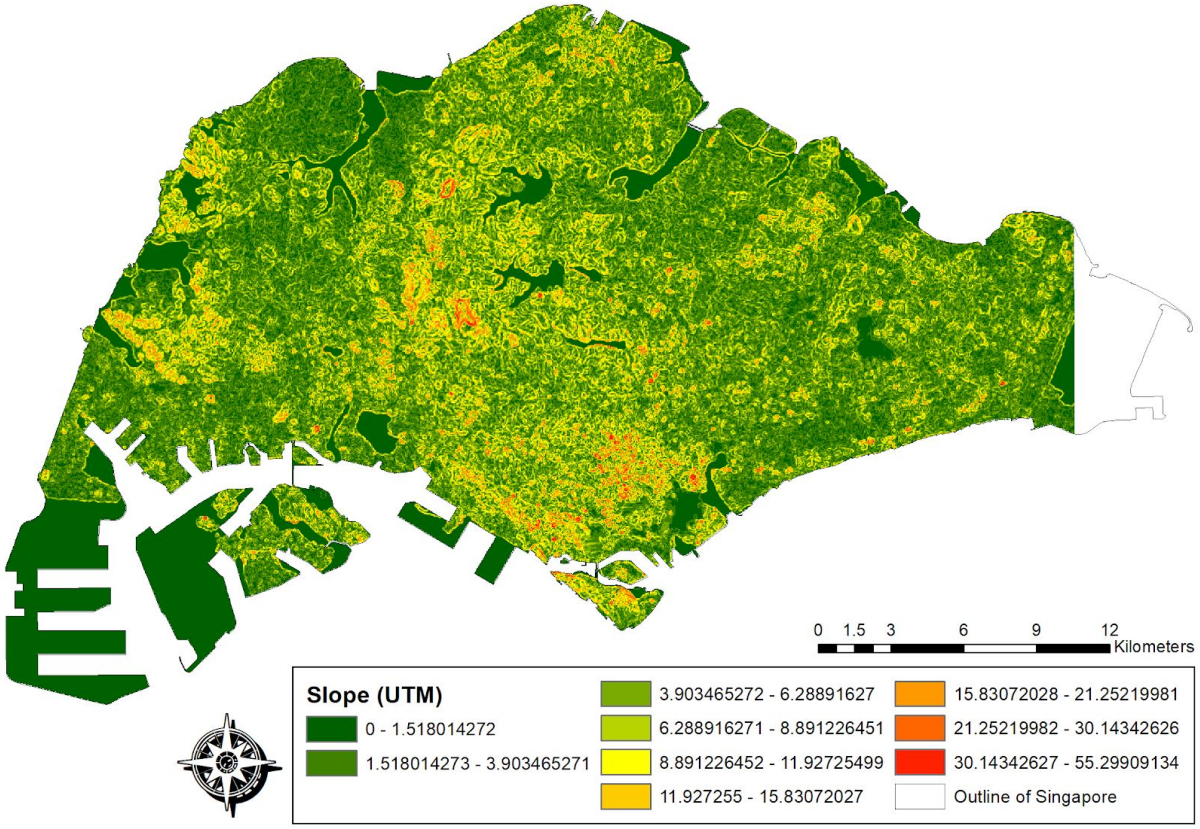
Although the SRTM 30 meter is a dated dataset captured back in February 2000, the fact that topography is rather stable across time periods makes it the best dataset that can be utilized for the purpose of this research. This is due to the fact that SRTM 30 meter is available for free and that its spatial resolution of 30 meters is actually much higher than the next best alternative- the ASTER Global Digital Elevation Model, which offers a lower 90 meters resolution for areas outside America.

Figure 4.1: SRTM 30 meters for Singapore



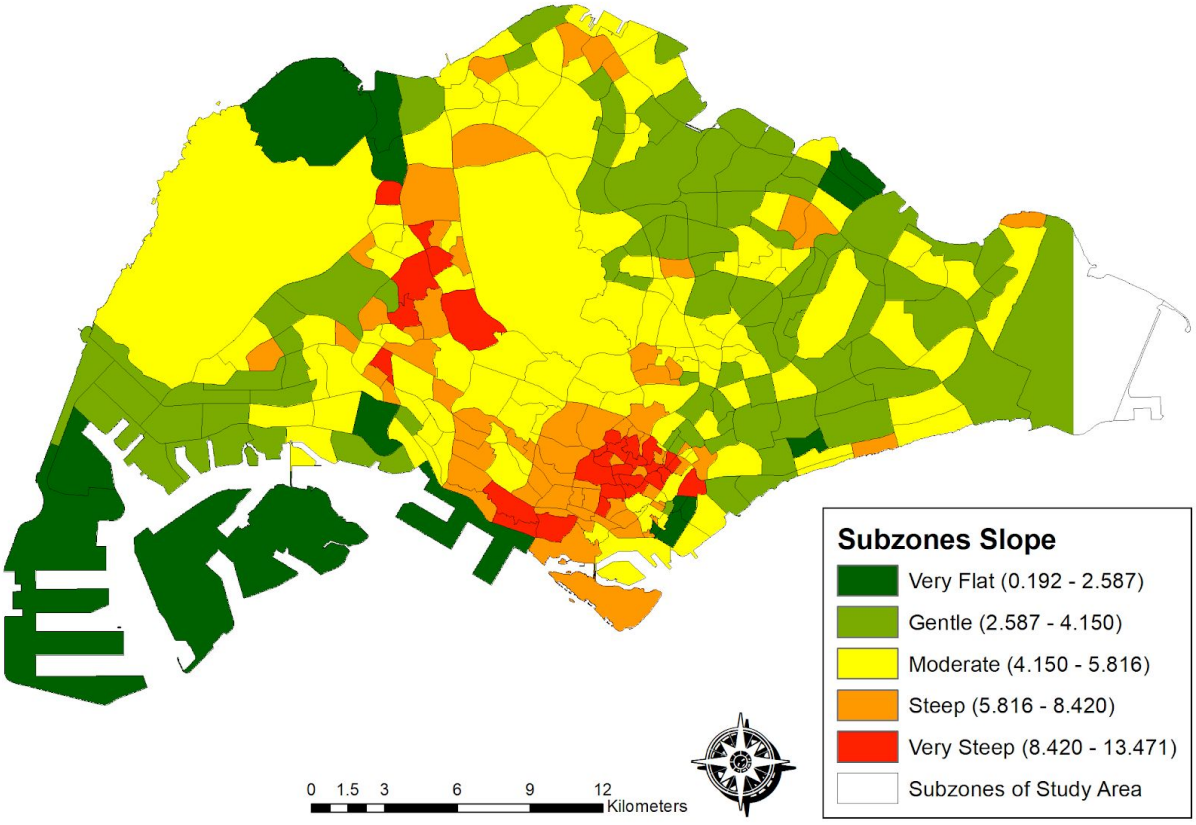
The downloaded SRTM 30 meters does not cover the whole Singapore, and cuts off at Changi Airport (Figure 4.1). However, this omission of elevation data for Changi Airport and Pulau Tekong is not critical as it is unlikely that the general public will be allowed access to cycle in such areas. Before slope can be calculated from this dataset, reprojection must be conducted. This is a key GIS design as the original WGS1984 Geographical Coordinate System of the dataset is degree based, hence unable to calculate slope in metric units. Reprojection to a projected coordinate system such as UTM will enable such metric based calculations. The resulting calculated slope map for Singapore is seen in Figure 4.2 below.

Figure 4.2: Calculated slope map for Singapore after utilizing slope tool in ArcMap



Another key GIS design is the utilization of the Zonal Statistic Tool in ArcMap to calculate the mean slope (rasterized data) for each subzone (vector), resulting in the final map shown in Figure 4.3 below.

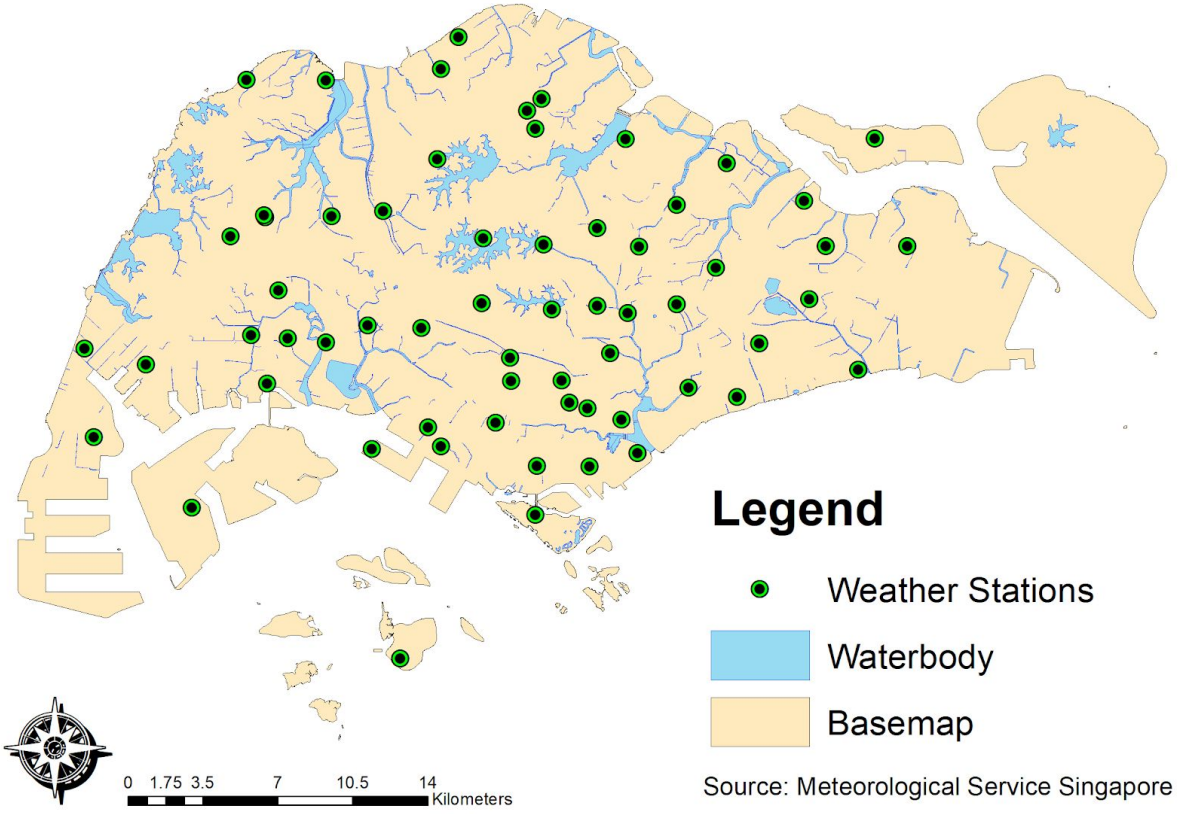
Figure 4.3: Final subzone slope map after utilizing the Zonal Statistics Tool in ArcMap



4.1.2 Precipitation and Temperature

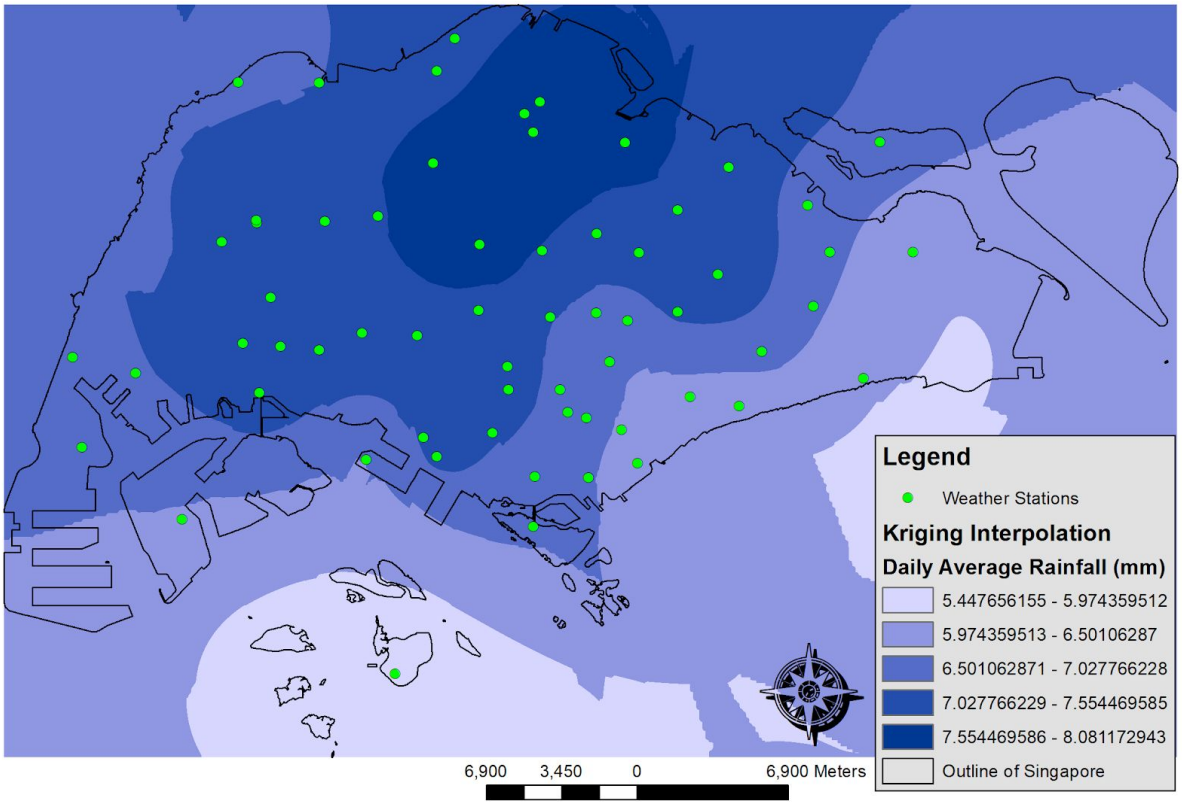
Meteorological Service Singapore (MSS) provides free downloads of daily historical records of rainfall and temperature measurements captured by each weather station in Singapore. However, there is no readily available dataset on the location of the weather stations in Singapore, except for the official image found in MSS. Therefore, the first step of data collection involves manually digitizing the relative locations of all 62 weather stations in Singapore (Figure 4.4).

Figure 4.4: Manually digitized weather stations in Singapore



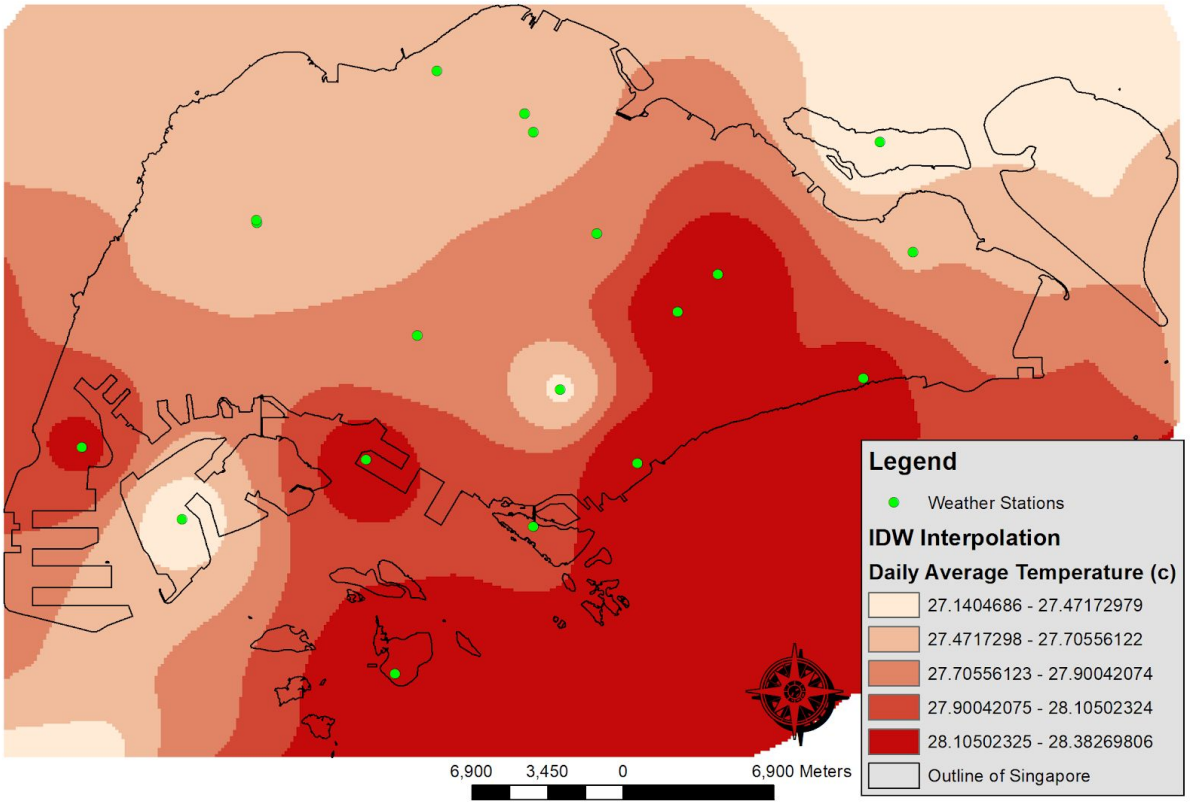
A key GIS design consideration involves the determination of interpolation methods for precipitation and temperature. All 62 weather station measures rainfall but only 18 records temperature readings daily. As a result of this difference in number of data points available for interpolation, different interpolation methods was chosen.

Figure 4.5: Kriging interpolation for Precipitation



The kriging method of interpolation was utilized for precipitation interpolation as this is a statistical model that can predict unknown values in between known data points better when there is more data points (Figure 4.5).

Figure 4.6: IDW interpolation for Temperature



Meanwhile, Inverse Distance Weighting (IDW) was chosen as the interpolation method for temperature as it is a non statistical model that provides more accurate interpolation as compared to Kriging when less data points is available (Figure 4.6).

Finally, Zonal Statistic Tool was again utilized to calculate the mean of the rasterized precipitation and temperature data for each vector subzones, and the final map is shown in Figure 4.7 and 4.8 below.

Figure 4.7: Final subzone temperature map after utilizing the Zonal Statistic Tool in ArcMap

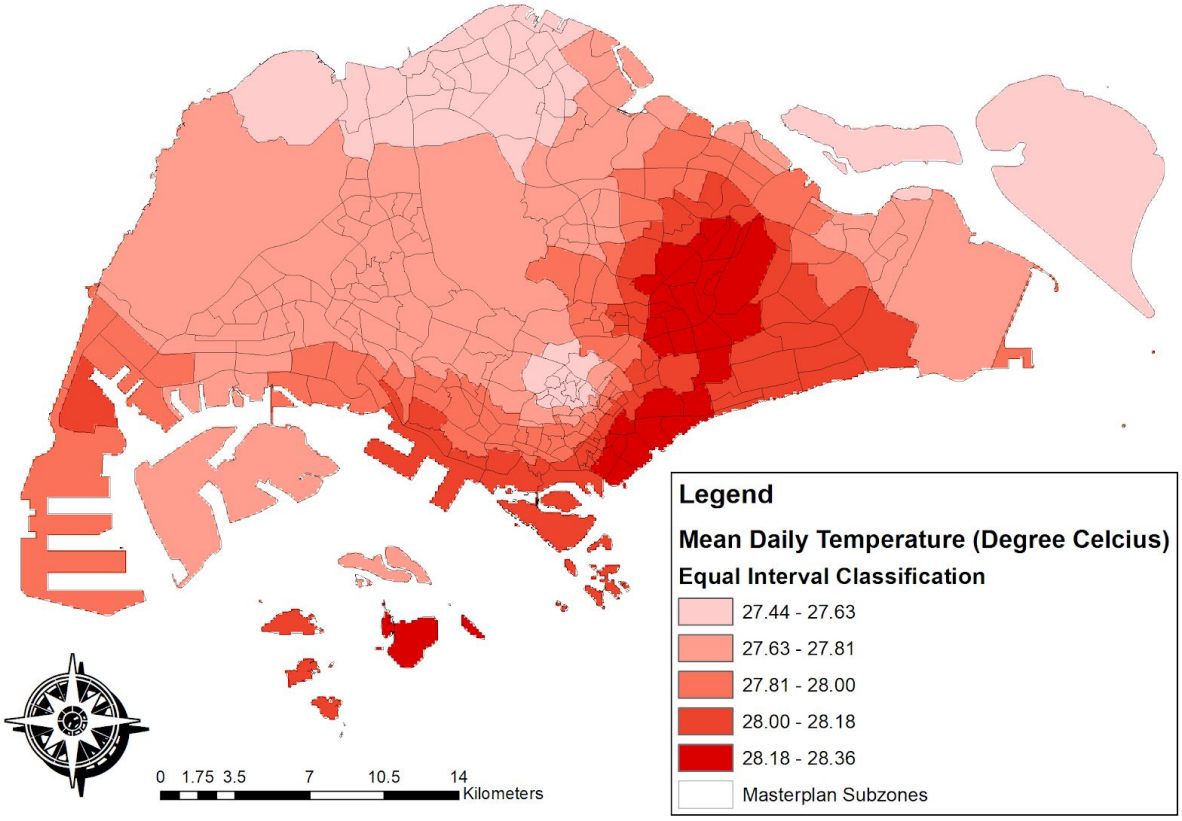
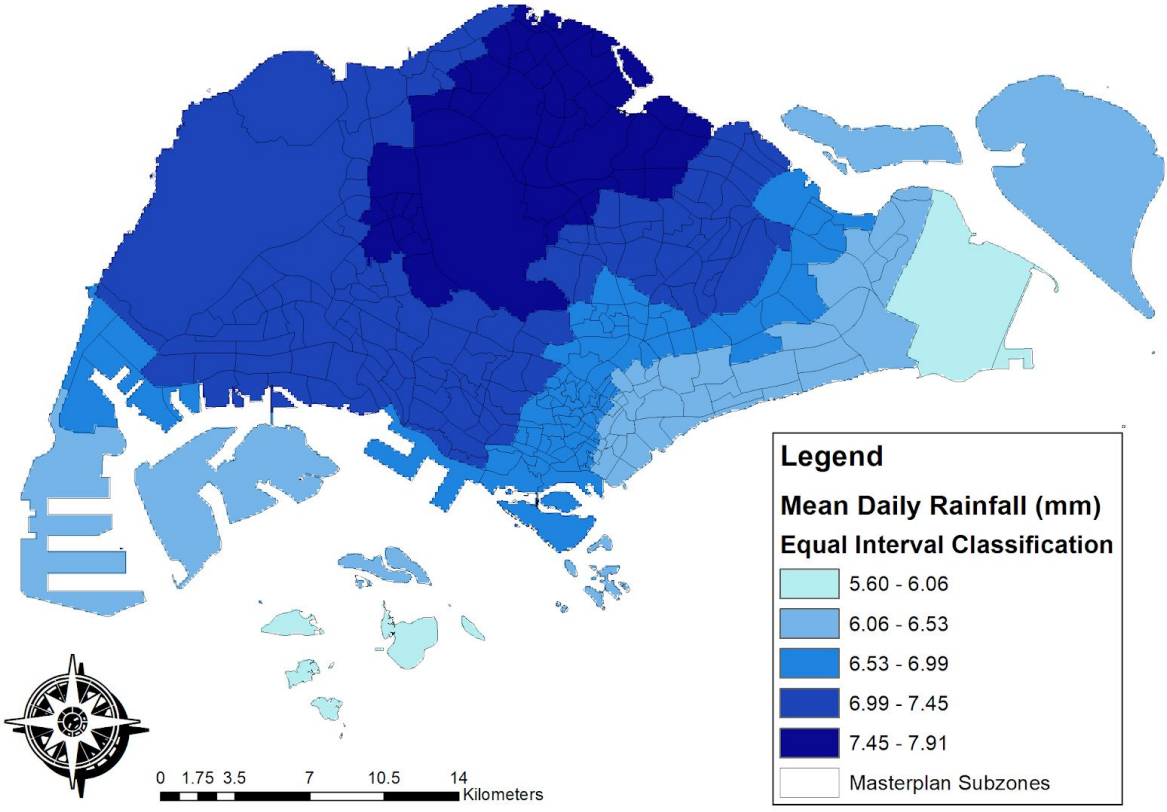


Figure 4.8: Final subzone precipitation map after utilizing the Zonal Statistic Tool in ArcMap



4.2 Social Factors

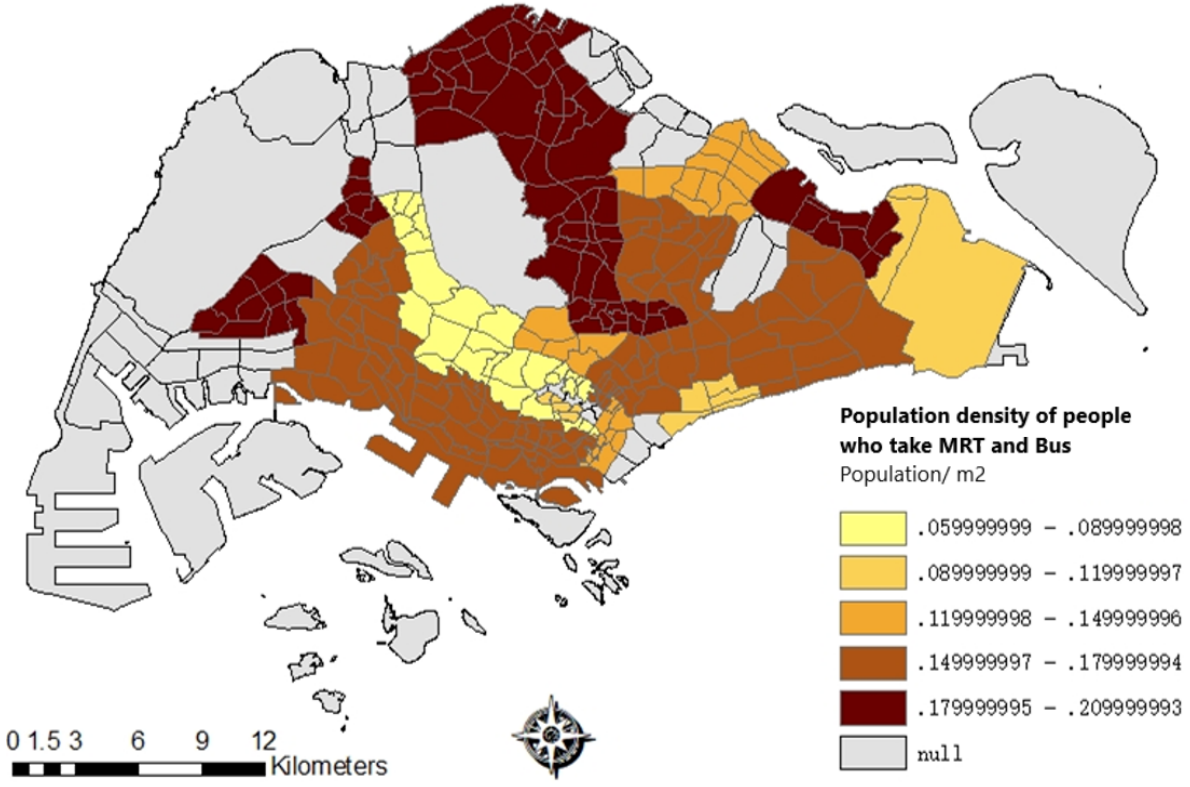
Bikeability of an area is affected by the number of people who are willing and able to cycle too. The public transport modal split measures the proportion of population that is currently not cycling but where cycling is the strongest substitute of public transport for last mile travel. Meanwhile, cycling demographics measures the proportion of demographics in each subzone that is currently engaging in cycling activities.

4.2.1 Public Transport Modal Split

Public Transport Modal Split measures residents' usual mode of transport to work in each subzone. The factor adopted for bikeability index is the number of residents whose common mode of transport is a combination of both MRT and bus. This category of residents' transport mode is specially selected as cycling is deemed to be a good substitute as a last mile transportation in replacement of short distance bus travel.

Data on residential transport modal split is obtained from the Singapore Population Census 2010. Population density of MRT and bus as the main public transport mode to work is calculated by divided the number of people over the subzone land area. The resulting population density map is shown in Figure 4.9.

Figure 4.9: Population density of people who take MRT and Bus as the main mode of transport



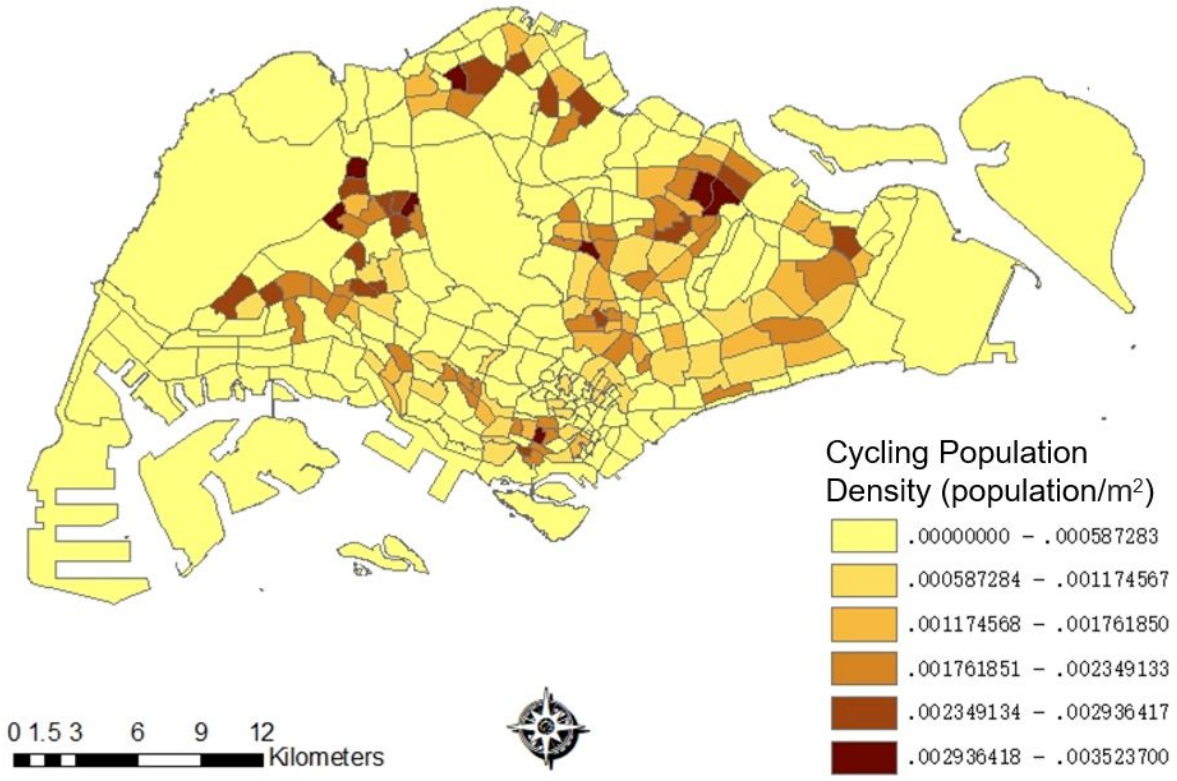
4.2.1 Cycling Demographics

Figure 4.10: Cycling statistics according to age group

Age Group	Percentage
13 - 14 years	3.4
15 - 19 years	9.4
20 - 24 years	8.1
25 - 29 years	10.5
30 - 34 years	9.6
35 - 39 years	12.7
40 - 44 years	12.0
45 - 49 years	12.4
50 - 54 years	7.2
55 - 59 years	3.9
60 - 64 years	4.9
65 years & above	5.8
Total	**100%**

Singapore Sports Council's 2011 National Sports Participation Survey compiled percentage of population per age group that cycles (Figure 4.10). Coupled with the demographics obtained from Singapore Population Census 2017, the percentage of cycling population per age group is calculated. This is further normalized by the subzone land area to obtain the population density of cycling demography per subzone (Figure 4.11).

Figure 4.11: Cycling Population Density



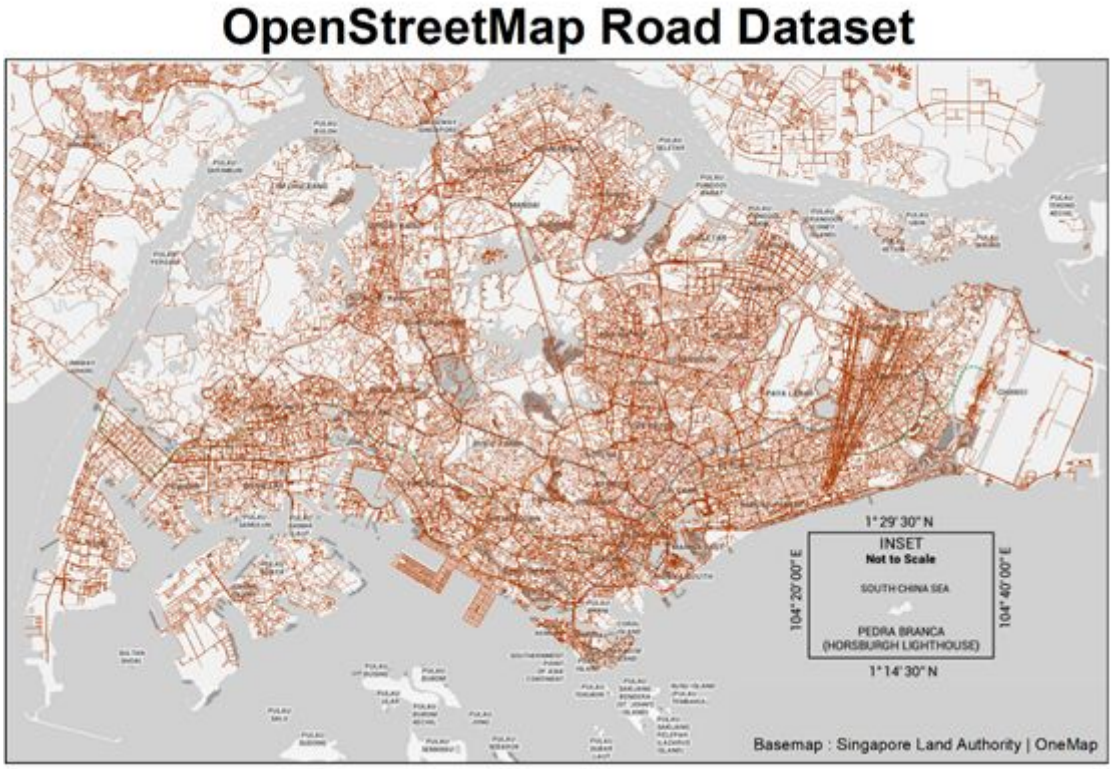
4.3 Infrastructural Factors

Infrastructural factors include road and cycling network density, which measures the road area available for cyclists to cycle on for each subzone. The availability of cycling infrastructure such as road signs affects the overall bikeability of an area too, thus cycling infrastructure density is calculated for the bikeability index too.

4.3.1 Road Density

It is legal for cyclist to travel on vehicular roads in Singapore. Therefore, there is a need to calculate road density for each subzone as part of the bikeability measure of an area. The road dataset is obtained from OpenStreetMap (OSM), an international open source geospatial data provider (Figure 4.12).

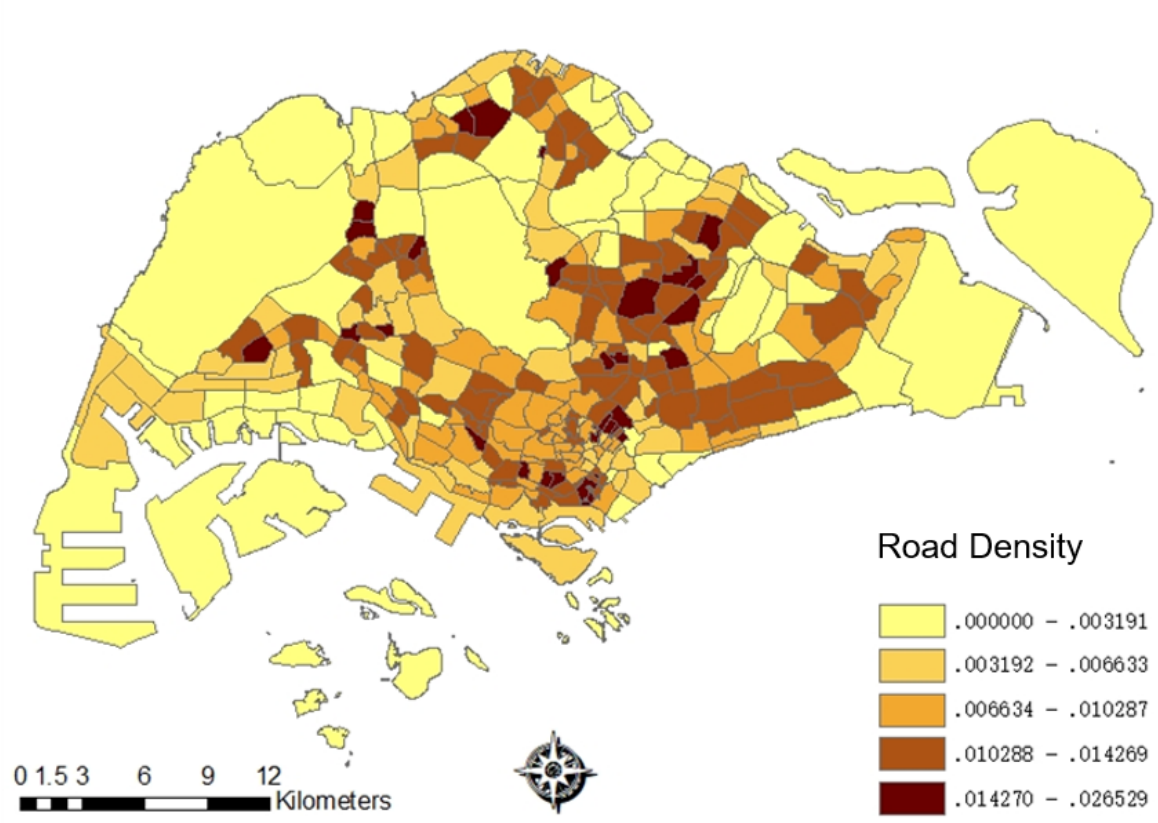
Figure 4.12: Road Network downloaded from OpenStreetMap



The OSM road dataset is not the most accurate as evident from the many straight-lines cutting through large areas of Singapore in Figure 4.1. This is because the dataset is a piece of Volunteered Geographic Information (VGI) that is created via crowdsourcing. To improve the accuracy of the OSM road dataset, access to SLA OneMap- currently the most updated, maintained and detailed map of Singapore (Singapore Land Authority, 2017) - was obtained by connecting to the application programming interface. OneMap was thus used as the base map for subsequent checking, editing and addition of roads in Singapore.

A key GIS design consideration lies in determining which categories of road to include in the calculation of road density. Expressways and major arterial roads are excluded from the calculation of road density as it was hypothesized that the high volume of fast moving traffic would deter most cyclists from travelling through these routes. The final road density map is shown in Figure 4.13 below.

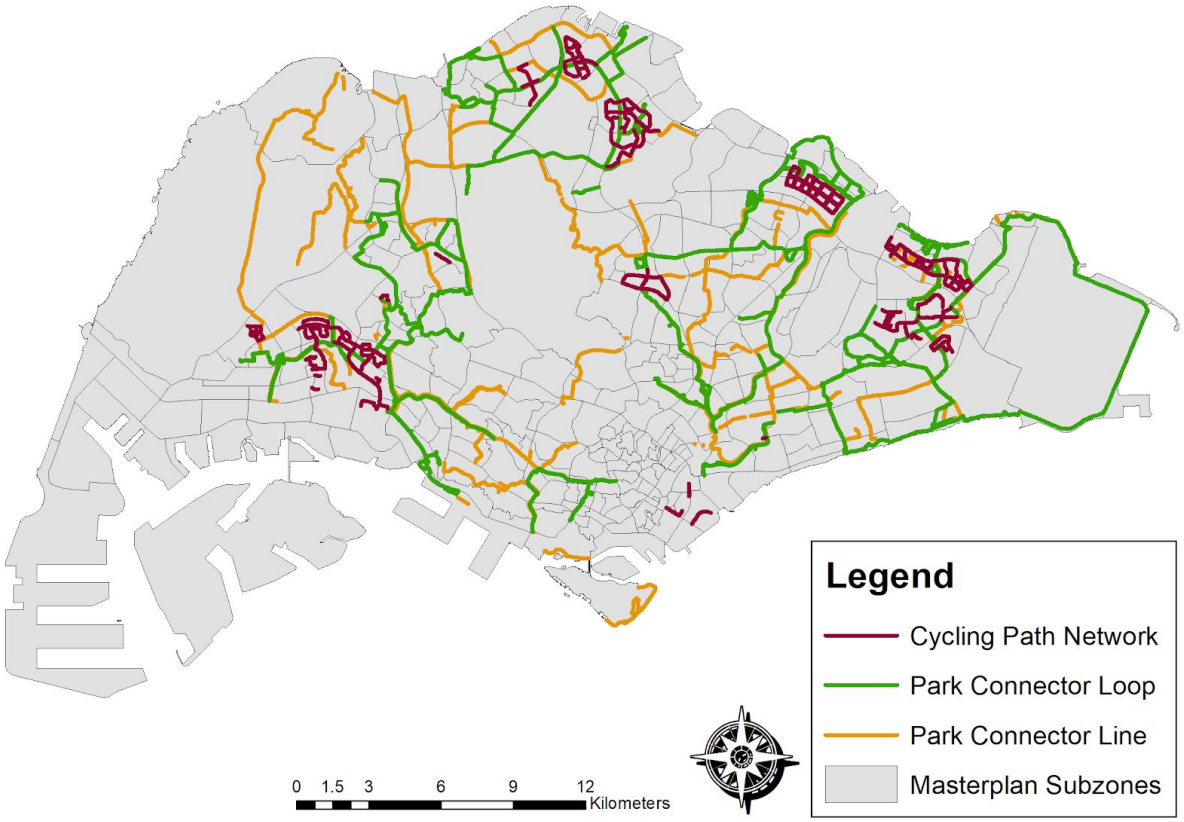
Figure 4.13: Road Density at subzone level



4.3.2 Cycling Path Density

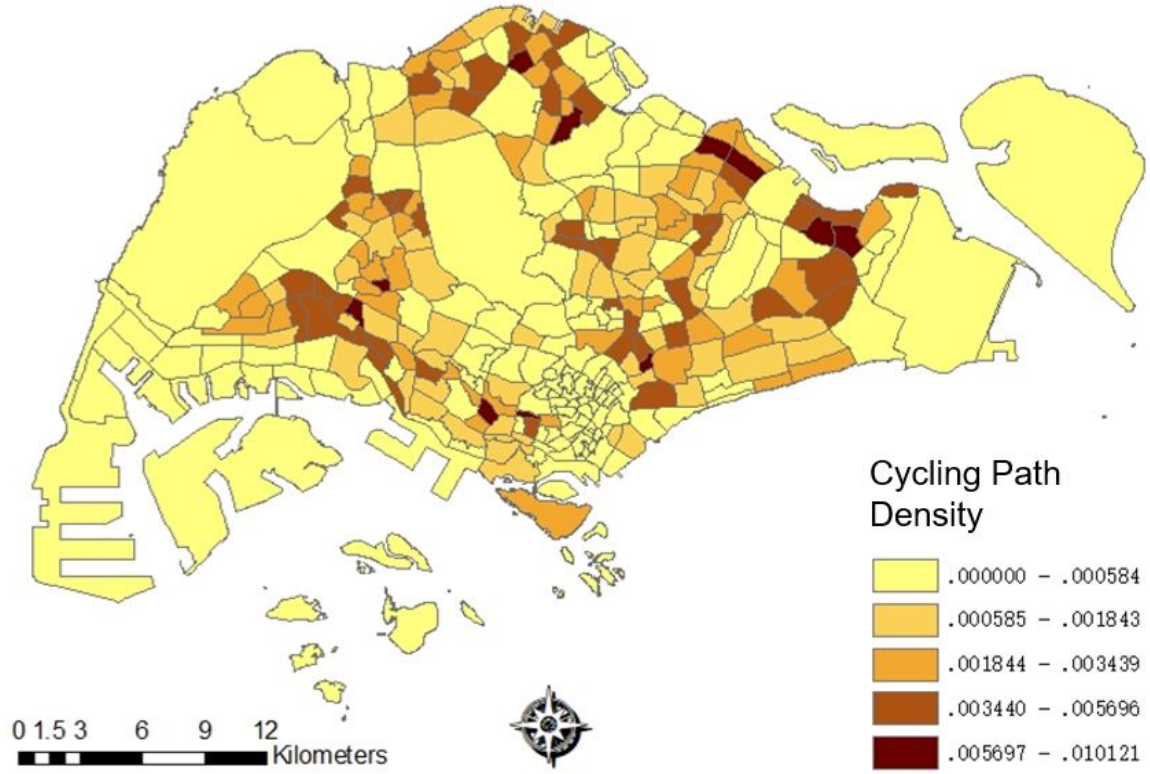
In addition to vehicular roads, cyclists can also cycle on three types of special footpaths designated for cycling (Figure 4.14). Namely the cycling path network, park connector loop and park connector line, they are obtained from data.gov.sg and merged into a single feature class.

Figure 4.14: Three types of cycling path in Singapore



The cycling path density per subzone is calculated by normalizing the total length of the cycling paths with the area of the subzones (Figure 4.15).

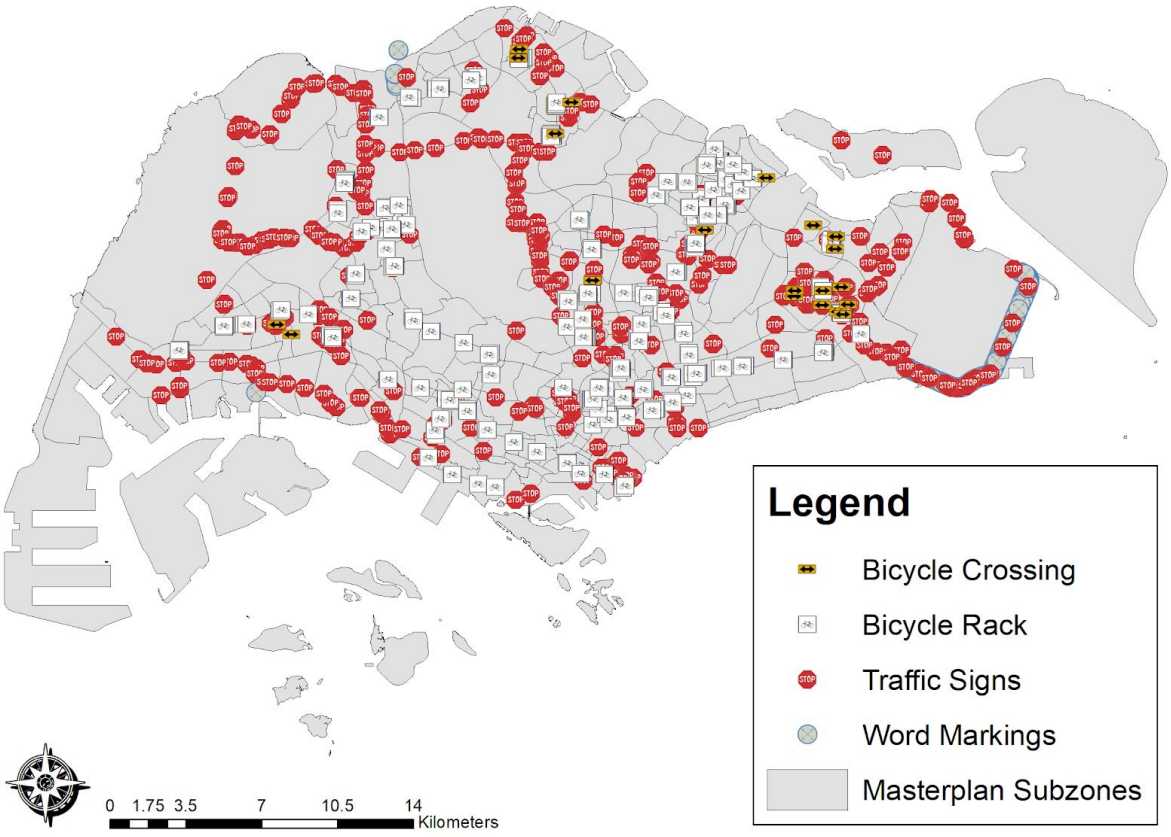
Figure 4.15: Cycling Path Density at subzone level



4.3.3 Cycling Infrastructure Density

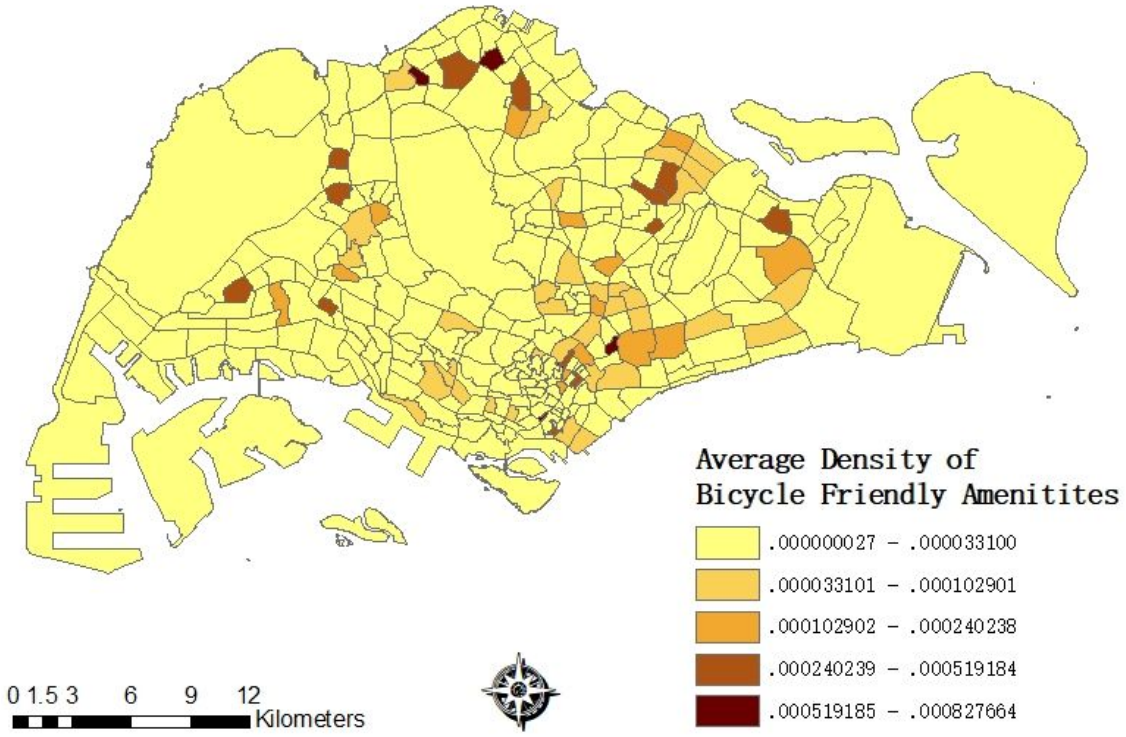
Cycling infrastructure refers to the designated bicycle racks, bicycle crossings, traffic signs and word markings (Figure 4.16). The presence of such amenities makes an area more bikeable.

Figure 4.16: Four categories of cycling infrastructure in Singapore



The bicycle crossing data points were manually digitized based on LTA's published locations while the rest of the datasets were downloaded from LTA datamall as well as data.gov.sg. To calculate the density of such infrastructure, all the data points are merged into a single feature class and normalized with the subzone's area. The final output is seen in Figure 4.17 below.

Figure 4.17: Cycling Infrastructure Density at subzone level



CHAPTER FIVE: FINAL BIKEABILITY INDEX

5.1 Bikeability Scores

In the determination of the bikeability of a planning area or subzone, scores ranging from 1 to 5 are assigned to each individual bikeability factor. A higher score indicates that the particular planning area or subzone is more bicycle friendly relative to other areas respectively. Equal interval classification for the collected dataset are adopted and are visualised in the individual factor maps as shown in Chapter Four. A breakdown on how the scores are assigned to each bikeability factors for planning areas and subzones are set out in Figure 5.2 and 5.3 respectively.

On the other hand, the weightage allocated to each indicator is decided based on the results from our survey. The survey aims to provide insight to public's perception of the importance of each indicator in affecting their cycling and transport behaviour. An overview of the survey conducted is attached in Appendix A. From the 150 respondents that were surveyed, slope steepness is observed to be the greatest consideration. This is followed by the cycling path density, availability of bicycle friendly facilities, precipitation and temperature. Hence, factor that matters most to the residents are allocated greatest weightage. Moreover, social factors based on demographic data as discussed in Chapter Three are assigned greater weightage as compared to other geographical factors (Precipitation and Temperature) since weather conditions are natural factors which cannot be modified. The weightage allocations for each bikeability factors are observed in Figure 5.1.

Figure 5.1: Weightage of Bikeability Factor

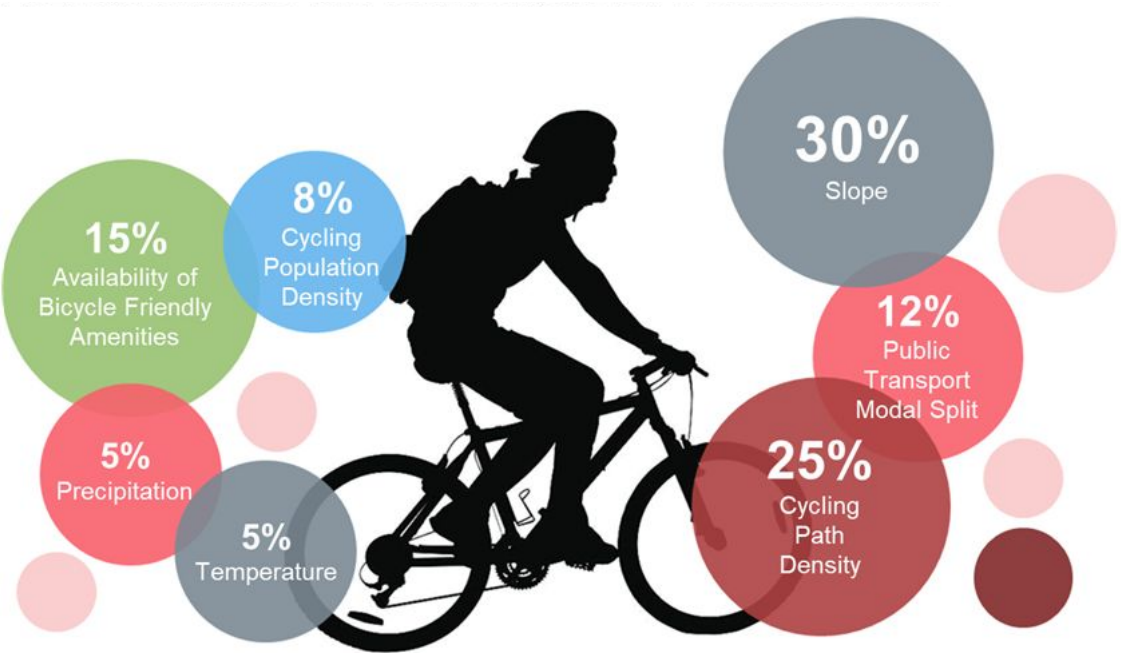


Figure 5.2: Scores assigned to each bikeability indicator (Planning Area)

SCORES	Slope	Cycling Path Density			Availability of Bicycle Friendly Amenities	Public Transport Modal Split	Cycling Population Density	Precipitation (mm)	Temperature (°C)
		Major Road Density	Minor Road Density	Dedicated Cycling Path Density					
1 *(Low bikeability)*	> 8.42	< 0.0191	< 0.0262	< 4.37E-04	< 2.62E-05	< 9.2%	< 4.64E-04	> 7.45	> 28.18
2	5.82 – 8.42	0.0191 – 0.0383	0.0262 – 0.0505	4.37E-04 – 8.74E-04	2.62E-05 – 5.24E-05	9.2% - 12.2%	4.64E-04 – 9.28E-04	6.99 – 7.45	28.00 – 28.18
3	4.15 – 5.82	0.0383 – 0.0574	0.0505 – 0.0748	8.74E-04 – 1.31E-03	5.24E-05 – 7.86E-05	12.2% - 15.2%	9.28E-04 – 1.39E-03	6.53 – 6.99	27.81 – 28.00
4	2.59 – 4.15	0.0574 – 0.0765	0.0748 – 0.0991	1.31E-03 – 1.75E-03	7.86E-05 – 1.05E-04	15.2% - 18.2%	1.39E-03 – 1.86E-03	6.06 – 6.53	27.63 – 27.81
5 *(High bikeability)*	< 2.59	> 0.0765	> 0.0991	> 1.75 E-03	> 1.05E-04	> 18.2%	> 1.86E-03	< 6.06	< 27.63

Figure 5.3: Scores assigned to each bikeability indicator (Subzones)

SCORES	Slope	Cycling Path Density			Availability of Bicycle Friendly Amenities	Public Transport Modal Split	Cycling Population Density	Precipitation (mm)	Temperature (°C)
		Major Road Density	Minor Road Density	Dedicated Cycling Path Density					
1 *(Low bikeability)*	> 8.42	< 0.0048	< 0.00531	< 0.00202	< 1.66E-04	< 9.2%	< 7.05E-04	> 7.45	> 28.18
2	5.82 – 8.42	0.0048 – 0.00961	0.00531 – 0.0106	0.00202 – 0.00405	1.66E-04 – 3.31E-04	9.2% - 12.2%	7.05E-04 – 1.41E-03	6.99 – 7.45	28.00 – 28.18
3	4.15 – 5.82	0.00961 – 0.0144	0.0106 – 0.0159	0.00405 – 0.00607	3.31E-04 – 4.97E-04	12.2% - 15.2%	1.41E-03 – 2.11E-03	6.53 – 6.99	27.81 – 28.00
4	2.59 – 4.15	0.0144 – 0.0192	0.0159 – 0.0212	0.00607 – 0.0081	4.97E-04 – 6.62E-04	15.2% - 18.2%	2.11E-03 – 2.82E-03	6.06 – 6.53	27.63 – 27.81
5 *(High bikeability)*	< 2.59	> 0.0192	> 0.0212	> 0.0081	> 6.62E-04	> 18.2%	> 2.82E-03	< 6.06	< 27.63

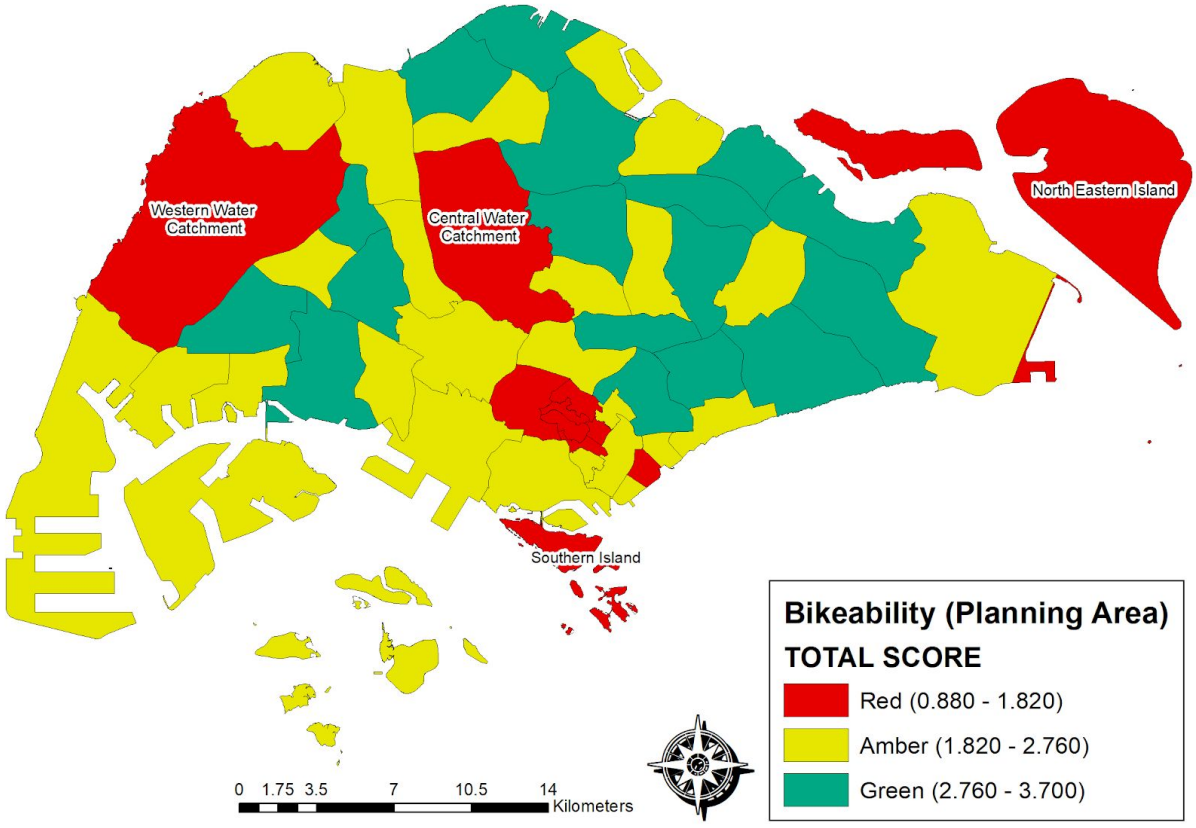
Subsequently, the total bikeability score is computed based on the multi-factor equation as presented in Chapter Three, where the sum of the weighted scores for each bikeability factor is obtained. From the total bikeability score of each planning area and subzone, the planning areas and subzone are grouped into three categories (Green, Amber and Red) using equal interval classification. Green represents the subzone is very bicycle friendly, while red represents subzone is not as not conducive for cycling. A complete summary of the bikeability score and index for each planning areas and subzones are set out in Appendix B to D.

Based on the total bikeability scores distributions, an overall bikeability score maps for planning areas and subzones are illustrated.

5.2 Bikeability Scores of Planning Areas

The overall bikeability score for all planning areas is depicted in Figure 5.4. A planning area is considered to be low on bikeability if its score falls below 1.82 (red), moderate when the score is between 1.82 to 2.76 (amber) and good when the score is above 2.76 (green).

Figure 5.4: Bikeability scores of each planning area in Singapore



Generally, it can be observed that most planning areas in Singapore are at least moderately bikeable, with the exception of the water catchment areas as well as the Northeastern and Southern islands. In fact, a sizeable proportion of planning area is deemed to have a good

bikeable score as can be seen by the numerous patches of green in Figure 5.4 above. The bikeability of the 55 planning towns in Singapore are summarized in Figure 5.5.

Figure 5.5: Bikeability Index of planning areas in Singapore

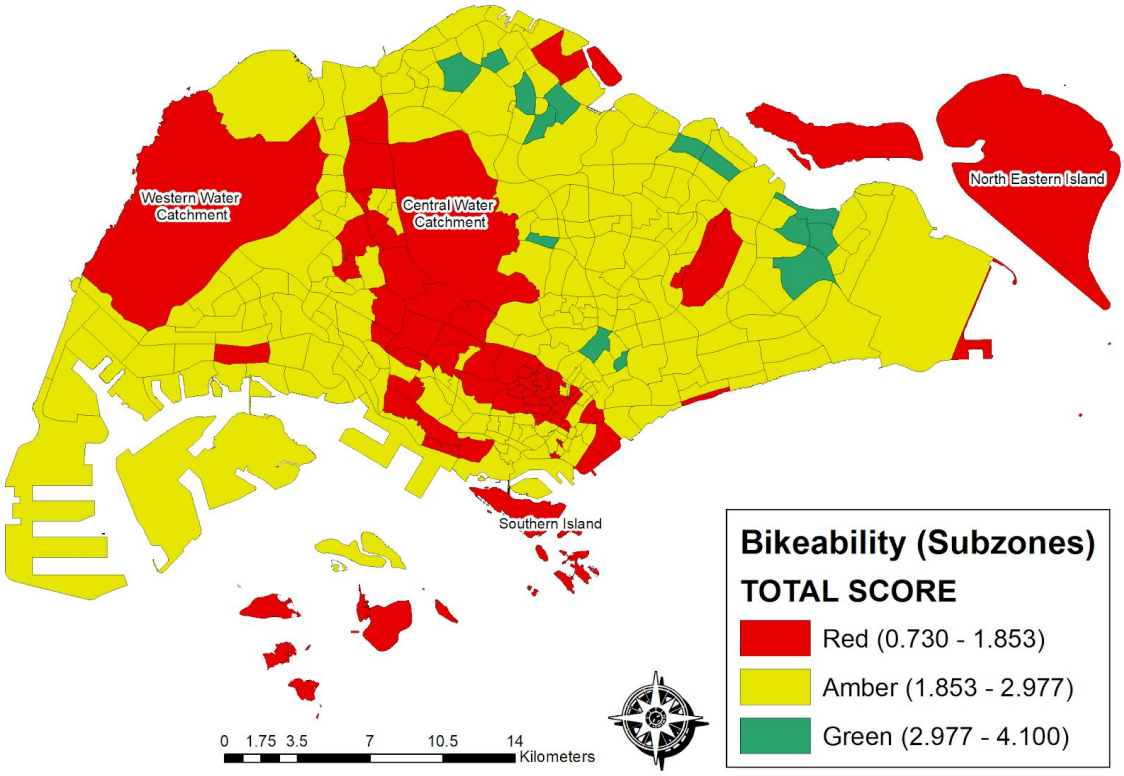
** Note: Completed Cycling Networks in Singapore*

5.3 Bikeability Scores of Subzones

The overall bikeability score of all subzones is depicted in Figure 5.6 below. A subzone is considered to be low on bikeability if its score falls below 1.853 (red), moderate when the score is between 1.853 to 2.977 (amber) and high when the score is above 2.977 (green).

The reason for the different bikeability score for subzones as compared to that of planning areas is primarily due to Modifiable Areal Unit Problem (MAUP). MAUP is defined as " a challenge that occurs during the spatial analysis of aggregated data in which the results differ when the same analysis is applied to the same data, but different aggregation schemes are used" (Esri GIS Dictionary, 2018). MAUP is a common problem associated with spatial data analysis. In this study where different geographical scales of study area are analysed, the scale effect of MAUP has resulted in different outcomes despite applying the same methodology. However, the difference in results would not render either score invalid.

Figure 5.6: Bikeability scores of each subzone in Singapore



The subzone map findings of bikeability is consistent with that of planning area. This is exemplified by the fact that subzones with low bikeability are generally concentrated in and around previously identified water catchment areas. However, the subzone findings also revealed more areas that are low in bikeability as well as the fact that on a subzone basis, there are lesser areas that is considered have good bikeability scores. The bikeability of the selected subzones in Singapore are summarized in Figure 5.7.

Figure 5.7: Bikeability Index of selected subzones in Singapore

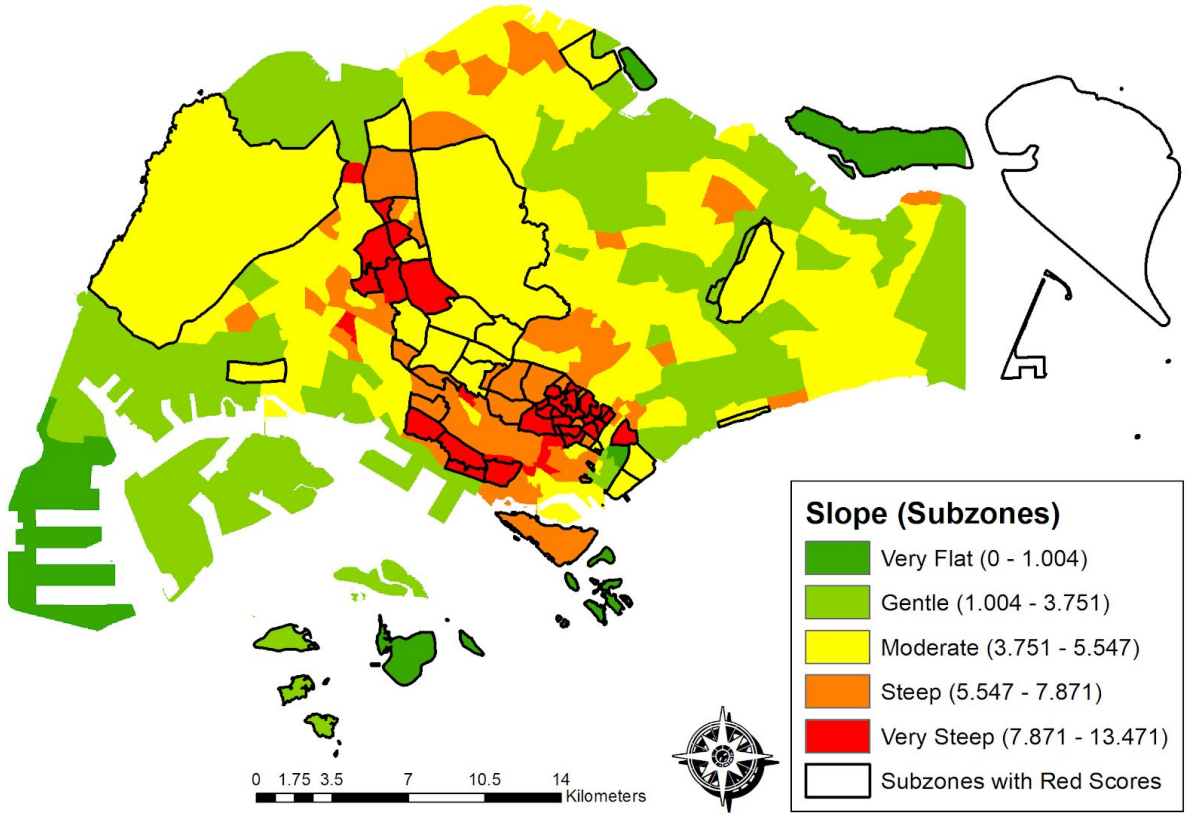
MOST BIKEABLE SUBZONE		MODERATE		LEAST BIKEABLE SUBZONE	
BOON KENG	PASIR RIS	WOODLANDS	KHATIB*	GUILIN	BENCOOLEN
SEMBAWANG*	CENTRAL*	REGIONAL	ALJUNIED	DOVER	SUNSET WAY
CENTRAL*	WOODLANDS	CENTRE	BEDOK	AIRPORT ROAD	NEWTON CIRCUS
YISHUN WEST*	EAST	TANJONG	RESERVOIR*	PAYA LEBAR WEST	TURF CLUB
WATERWAY	YISHUN SOUTH*	PAGAR	PUNGGOL	ANAK BUKIT	PHILLIP
EAST*	SHANGRI-LA*	HONG KAH	CANAL*	EAST COAST	LIU FANG
TAMPINES EAST*	BENDEMEER	NORTH	FLORA DRIVE*	HILLCREST	WESTERN WATER
PASIR RIS DRIVE*	YISHUN EAST*	KANGKAR	HONG KAH	HOLLAND ROAD	CATCHMENT
PUNGGOL TOWN	PASIR RIS PARK*	CHOA CHU	YUHUA EAST*	SWISS CLUB	GOODWOOD PARK
CENTRE*		KANG NORTH	POTONG PASIR	ANSON	MONK'S HILL
		GEYLANG	SEMBAWANG	SENJA	PATERSON
		BAHRU	SPRINGS*	NATIONAL	TELOK BLANGAH
		FARRER PARK	MEI CHIN	UNIVERSITY OF	DRIVE
		MACKENZIE	MACPHERSON	S'PORE	CENTRAL WATER
		LOYANG WEST*	KIM KEAT	DAIRY FARM	CATCHMENT

** Note: Completed Cycling Networks in Singapore*

CHAPTER SIX: ANALYSIS OF RESULTS

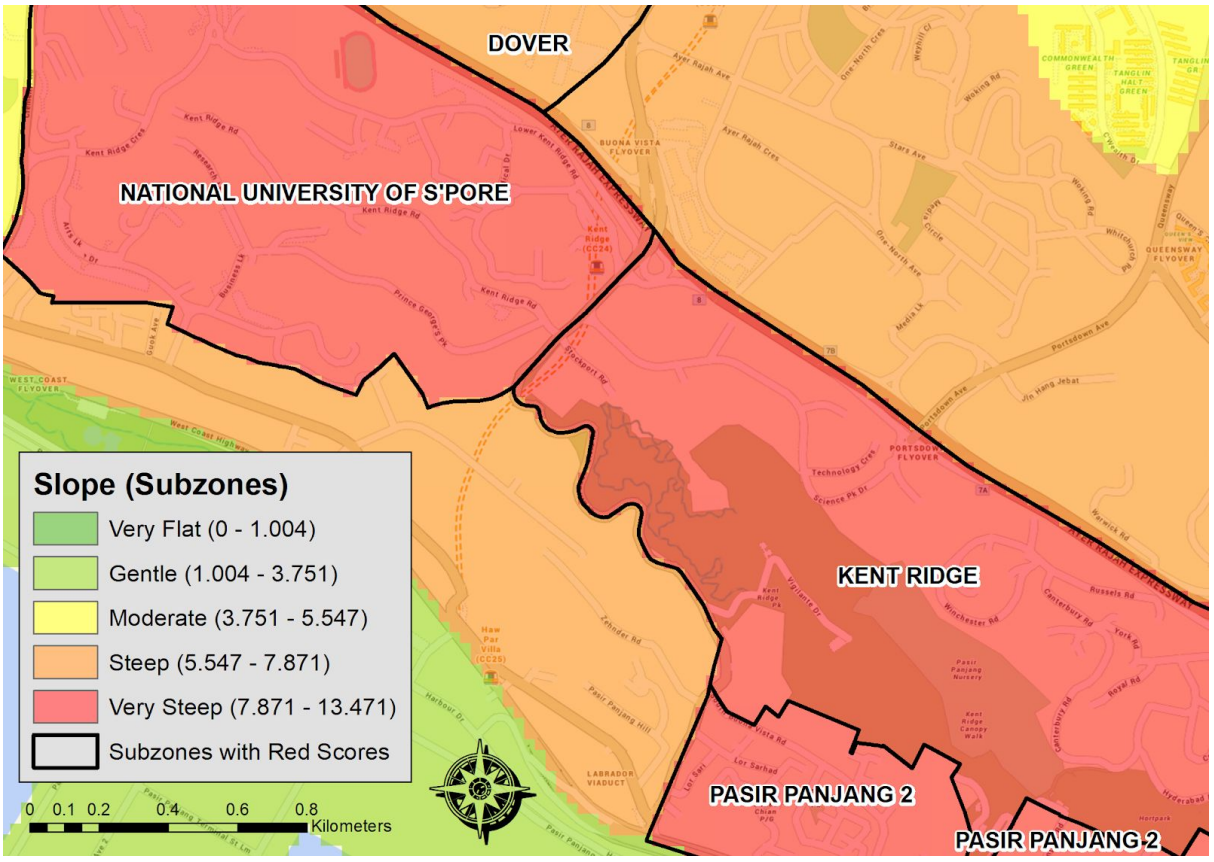
6.1 Slope and Relative Bikeability

Figure 6.1: Slope of subzones with low bikeability



From the subzone map findings of bikeability in Chapter 5, it is observed that 68 subzones had low bikeability scores. After analysing the scores of each bikeability factor, it is observed that 41 subzones with low bikeability scores can be attributed to their topography. These 60.8% of the low bikeability subzones have moderate to very steep slopes as reflected in Figure 6.1.

Figure 6.2: Example of steep slope and low bikeability in Queenstown planning area



For instance, National University of Singapore, Kent Ridge and Pasir Panjang are subzone within the Queenstown planning area with very low bikeability scores. Despite having relatively high scores assigned to the public transport modal split for these three subzones, their bikeability scores are still relatively low which make cycling to be rather unsuitable and discourages public to adopt cycling in these subzones. These subzones are examples of steep slopes, as observed in Figure 6.2, attributing to the low bikeability score.

6.2 Bikeability of Current and Future "Cycling Towns"

In addition to the overall bikeability of Singapore, analysis of the current and future cycling towns are carried out to evaluate if government's initiatives are well-implemented.

A comparison of Figure 6.3 and 6.4 reveals that while all current cycling towns have relatively high bikeability scores on the planning area (larger) scale, this is not necessary the case in the subzone (smaller) level. In fact, this analysis shows that planning areas such as Bedok and Jurong East are not bikeable as it was originally purported to be in the planning area level analysis, as there is not a single subzone in these planning areas that are deemed to be in the high bikeability category (green).

Figure 6.3: Analysis of the bikeability of designated cycling towns as per planning area

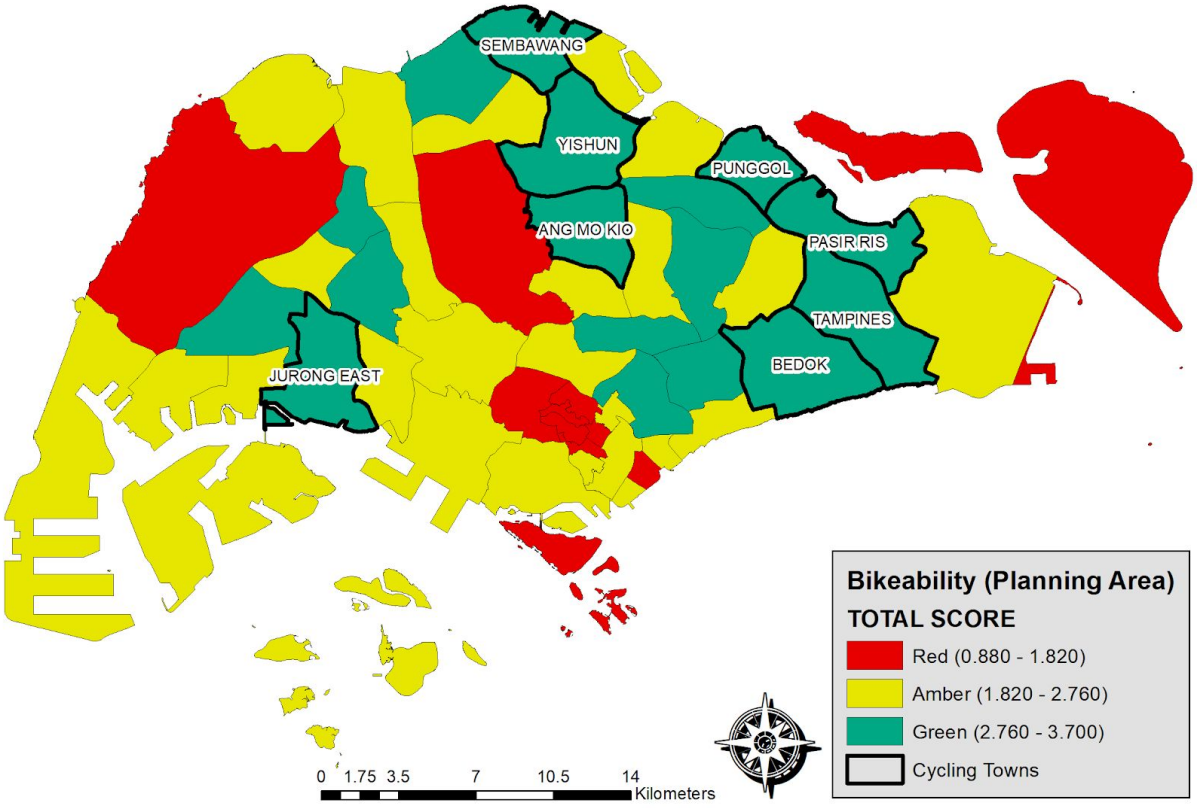
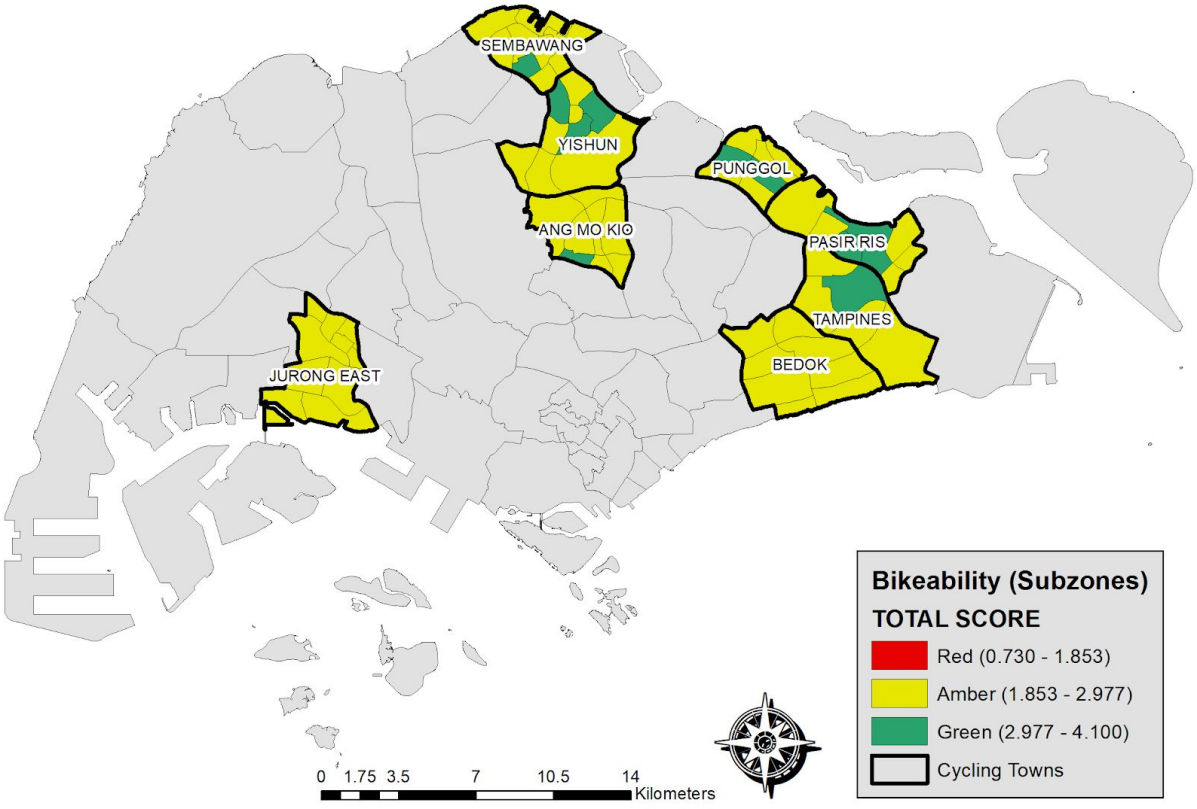
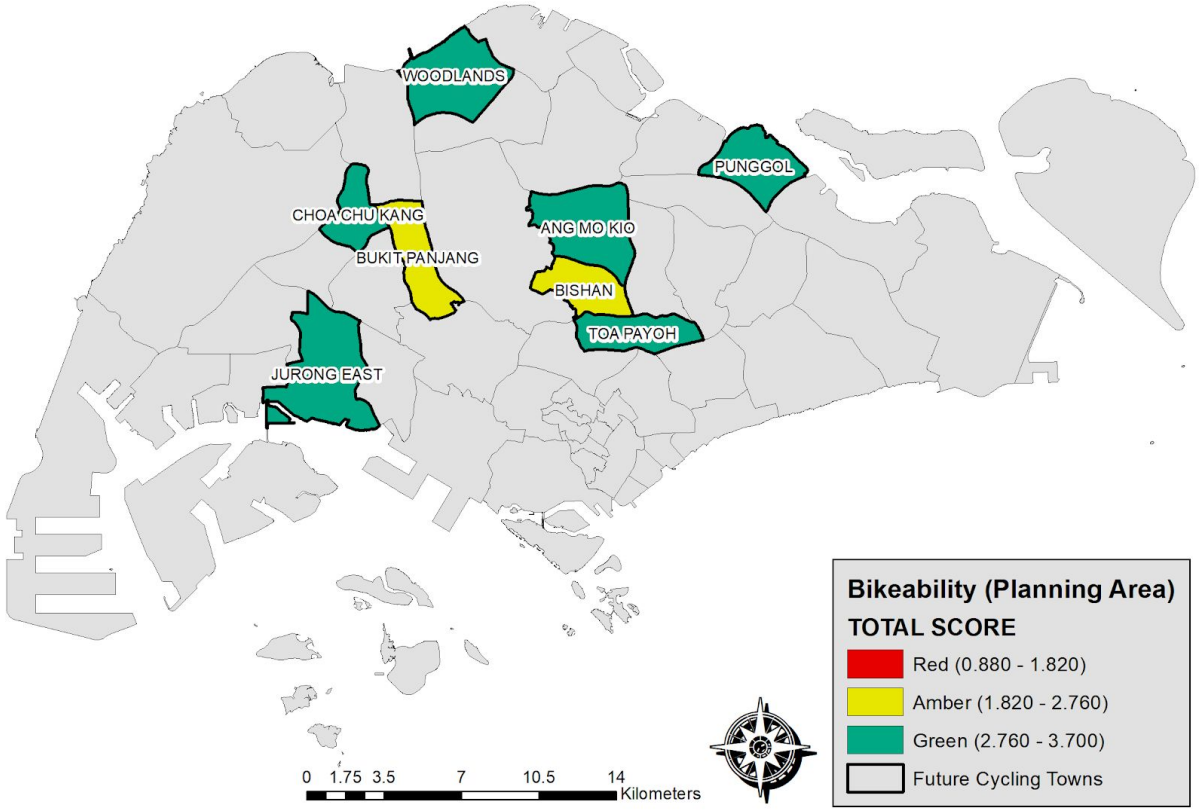


Figure 6.4: Analysis of the bikeability of designated cycling towns as per subzone



This is an exemplification of the MAUP scale effect, and a testament that bikeability analysis on the subzone level is more accurate than in the planning area scale. However, planning area level analysis is still integral as the first step analysis of bikeability. The macro planning area scale analysis helps identify obvious issues that is critical at the larger scale, which might be harder to sieve out in a more micro subzone analysis. One example of such an useful analysis in the planning area scale is the evaluation of the suitability of future planned cycling towns (Figure 6.5 below).

Figure 6.5: Analysis of the bikeability of future cycling towns



As can be seen in Figure 6.5, both Bishan and Bukit Panjang planning areas are the only planned cycling towns that do not have a good bikeability score out of all the 8 future designated cycling towns. Should the government continue with the initial physical infrastructure investment plans given that these areas have been identified with moderate bikeability?

Figure 6.6: Key factors affecting bikeability in Bishan and Bukit Panjang planning area

Factors	Bishan	Bukit Panjang
Slope	3	2
Dedicated Cycling Path	1	5
Availability of Bicycle Friendly Amenities	1	2
Public Transport Modal Split	4	1
Precipitation	2	1

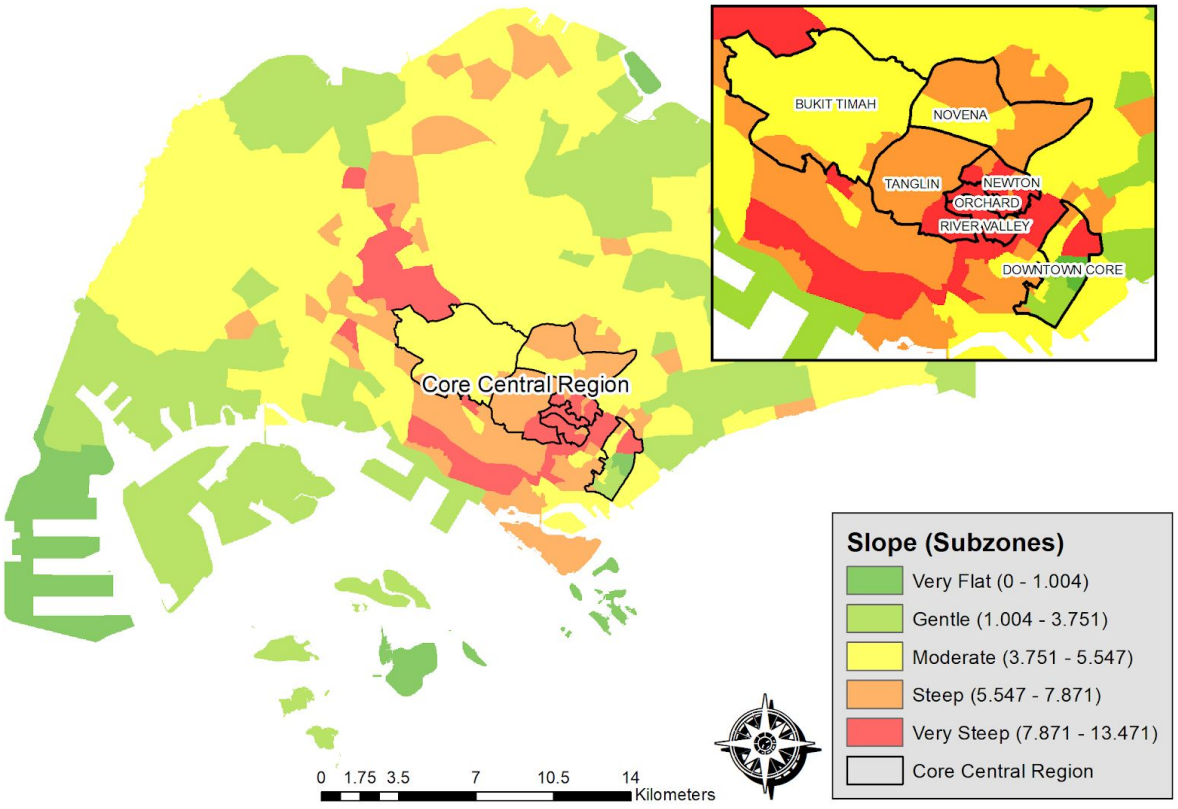
An analysis of the key factors affecting bikeability in Bishan and Bukit Panjang in Figure 6.6 revealed that low bikeability in the former is caused by a lack of dedicated cycling path and bicycle friendly amenities, while the latter is due to steep slope. This in turn informs the recommendation that the relevant authorities should focus on the provision of dedicated cycling path and bicycle friendly amenities in Bishan and reconsider making Bukit Panjang a cycling town. If the government choose to proceed with the idea of Bukit Panjang as a cycling town, more has to be done to overcome the slopes if not Bukit Panjang will risk being a white elephant cycling town where cycling amenities are built but not utilized by the public.

6.3 Car-Lite Singapore and Cycling

Singapore today is still pretty much a monocentric city centered at CBD in Raffles Place despite efforts to create polycentric nodes in areas such as Tampines (Zhong, Huang, Müller Arisona and Schmitt, 2013). Cycling has been prominently featured by planning authorities to be a complementary solution to a car-lite Singapore, as exemplified in LTA's Walk Cycle Ride SG Scheme (LTA, 2016). Coupled with recent slew of bike-to-work initiatives by interest groups such as LoveCyclingSG (Ang, 2016), it would be apt to analyze how viable is cycling as a form of transport for people to work.

As slope has been found to be the most influential factor in determining people's willingness to cycle in our survey, an analysis featuring slope and the core central region of singapore would help shed light on the viability of cycling as a form of transport to work.

Figure 6.7: Steep Core Central Region



It is evident from Figure 6.7 that the areas surrounding the downtown core, where the CBD is located, is very hilly. Only residents residing in the west of Singapore can cycle to the downtown core for work without passing through any steep areas. Therefore, it can be concluded that while cycling to work is a great initiative ideologically, its practical feasibility is limited due to the fact that the downtown core is surrounded by hilly areas.

CHAPTER SEVEN: RECOMMENDATIONS

In this section, we will based our recommendation on a set of considerations: research study results, current development efforts, feasibility and effectiveness. These considerations help us to guide our thinking process and develop solutions which are efficient and effective.

7.1 Factors Affecting Bikeability and Study of Introducing Changes

7.1.1 Topography

The topography of the town is allocated with the highest weightage in our index. The factor was ranked most important by 64% of the total respondents which affect their willingness to cycle. However, it is inevitable that some planning areas will have a higher relief which makes it not ideal for cycling. For instance, as mentioned in previous chapters, CCR in Singapore is especially Some methods which can be introduced to tackle the problem includes the flattening of land and the construction of elevated, gently-graded cycling path network. Such solutions would require the participation of multiple agencies, including the Urban Redevelopment Authority (URA), Land Transport Authority (LTA) and National Environment Agency (NEA). In addition, it would be an expensive investment as the opportunity costs are high considering that the returns are non-tangible. Hence, they have been ruled out by our team due to their infeasibility in terms of costs and efficiency. Alternatives must be explored for residents in these towns to adopt other sustainable forms of transportation for their last-mile journey. One possible idea is to explore the use of electronic scooters in towns where slope steepness pose as a challenge to cycling activities. In fact, we see companies rolling out more e-scooter sharing service which proved that having e-scooter as a form of transport is not a far future.

7.1.2 Availability of bicycle friendly amenities

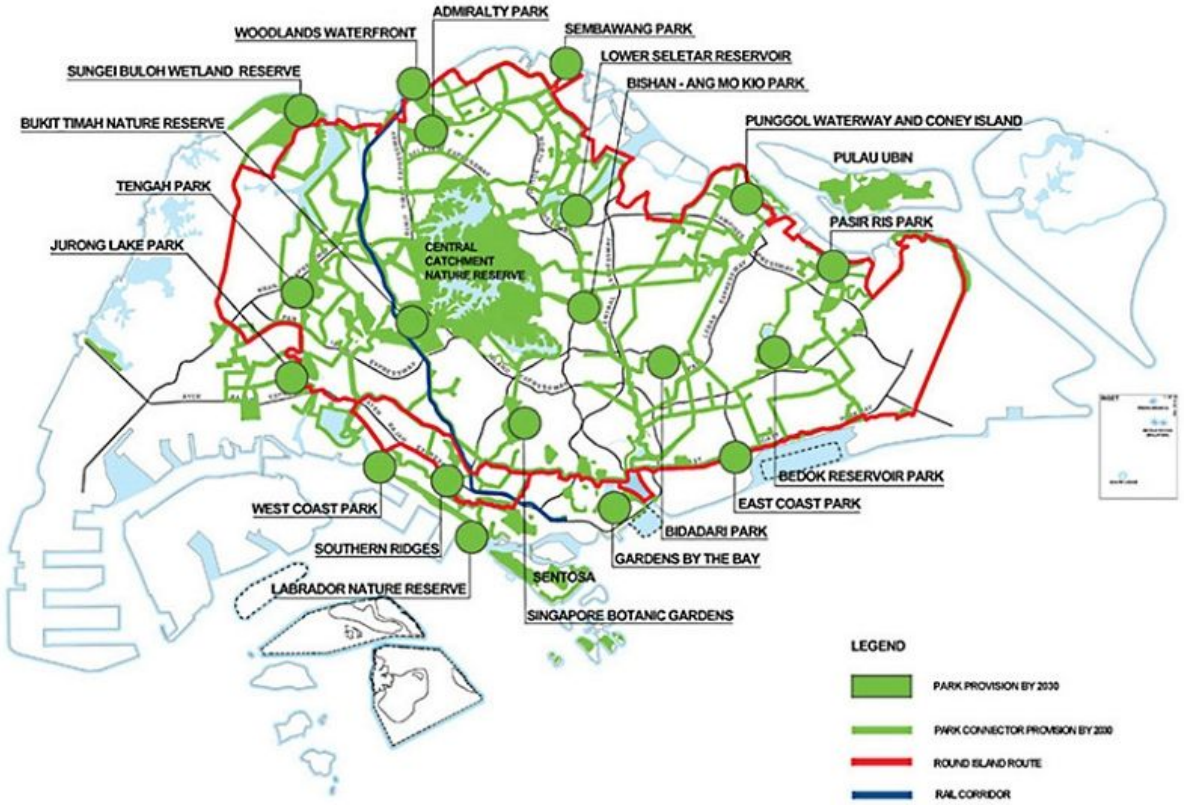
From our survey results, it has been reflected that the availability of bicycle friendly amenities has positively contributed to the cycling activity of a town. Interestingly, however, it has been noted from the index that less than 30% of the planning areas provide sufficient bicycle friendly amenities such as bicycle parking racks. Our team has attempted to improve both the quantity and quality of bicycle amenities in Singapore. In our survey, some respondents feedbacked that the current amenities may not have the most user-friendly design. For instance, female uses may find it challenging to utilize the two-layered bicycle racks distributed across Singapore. As such, we often find cyclists cluttering their bikes on the ground deck, causing these areas to be unsightly and messy. Our team has decided to introduce an innovative solution, i.e. the fully automated underground bicycle parking system. There are many advantages to this system. Firstly, by shifting parking spaces underground, the addition of such bicycle amenities will not further pressure our already scarce land resources. Secondly, the system is user-friendly, it only requires cyclists to push the bikes into the slot and the rest will be automated by the machine.

Figure 7.1: Fully automated bicycle parking system

7.1.3 Dedicated cycling path

With safety being a major motivating factor for bicycle commuters' consideration, the presence of dedicated cycling path will likely be able to encourage more cycling activity. The government has recognised the need to extend the existing supply as seen by the works and plans developed across the years. URA is committed towards improving the bicycle commuting within Singapore and has since published the National Cycling Plan (Urban Redevelopment Authority, 2018) in 2013 (Ministry of Transport, 2017), which aims to develop cycling routes for recreational and short commuting purposes. With URA 's plan to extend the park connector by 200 km by year 2020 (Urban Redevelopment Authority, 2018), it will form part of the ultimate 700 kilometres long extensive network of walking and cycling paths envisioned. The Bikeability Index of the towns should increase for the towns with lower Bikeability Index.

Figure 7.2: Envisioned extensive network of cycling path



7.1.4 Rainfall and Temperature

The other factors for weather and temperature are factors that are conditions that are beyond human control. Alternatively, one of the possible ways to deal with inclement weather and temperature is to introduce sheltered cycling paths. Sheltered paths can shelter commuters from rain or direct sun during warm days, thereby making it more bearable to travel on bikes. In recent years, the government has been introducing sheltered walkways in Singapore. The fact that cyclists are also able to utilise such paths provides them with the ability to cycle regardless of the geo-environmental factors.

7.1.5 Social Factors

Up to now, the factors that we have been covering pertains to the built environment of an area. Our team has decided to adopt a softer approach to tackle the social aspects which are made up of the last 2 factors; cycling demographics and public transport modal split. We have decided to employ a 2-pronged approach, incentives and education, to encourage cycling among residents. The former offers similar concept to the many health applications rolled out in recent years. For example, the clocking of certain cycling distance could earn you discount vouchers. The latter includes advertisements and marketing efforts to influence people to adopt cycling as a lifestyle choice. Some examples of the possible promotional efforts are as shown below. They should ideally be of a lighter note, fun and easy to digest by our target audience.

Figure 7.3: Example of marketing advertisements and marketing effort to promote cycling

7.2 Action Plan

Finally, Figure 7.4 is a summary of all the proposed recommendations as per planning area basis. The social factors recommendations will be applicable for all planning areas, thus the distinction is only between the physical solutions to provide more cycling paths, bicycle friendly amenities and e-scooter.

Figure 7.4: Summary of recommended action plan to improve bikeability of planning areas

Increase Cycling Path		Provide More Bicycle Friendly Amenities		E-Scooter
WESTERN ISLANDS	CENTRAL WATER	HOUGANG	MARINA EAST	RIVER VALLEY
LIM CHU KANG	CATCHMENT	BEDOK	SELETAR	NEWTON
MANDAI	MARINA SOUTH	JURONG EAST	SIMPANG	ORCHARD
BISHAN	TANGLIN	ANG MO KIO	BUKIT TIMAH	MUSEUM
MARINE PARADE	SOUTHERN ISLANDS	BUKIT MERAH	CHANGI	SINGAPORE RIVER
NOVENA	NORTH-EASTERN	QUEENSTOWN	PAYA LEBAR	TANGLIN
STRAITS VIEW	ISLANDS	CLEMENTI	WESTERN WATER	SOUTHERN ISLANDS
SUNGEI KADUT	CHANGI BAY	WESTERN ISLANDS	CATCHMENT	BUKIT PANJANG
BOON LAY	OUTRAM	LIM CHU KANG	CENTRAL WATER	
TENGAH	SERANGOON	MANDAI	CATCHMENT	
TUAS	BUKIT TIMAH	SERANGOON	MARINA SOUTH	
PIONEER	SINGAPORE RIVER	BISHAN	SINGAPORE RIVER	
MARINA EAST	RIVER VALLEY	MARINE PARADE	TANGLIN	
SELETAR	NEWTON	NOVENA	RIVER VALLEY	
SIMPANG	MUSEUM	SUNGEI KADUT	SOUTHERN ISLANDS	
CHANGI	ORCHARD	BOON LAY	NEWTON	
PAYA LEBAR	ROCHOR	TENGAH	ORCHARD	
WESTERN WATER	DOWNTOWN CORE	TUAS	NORTH-EASTERN	
CATCHMENT		PIONEER	ISLANDS	
			CHANGI BAY	

CHAPTER EIGHT: LIMITATIONS & FUTURE RESEARCH

There are several limitations to our research.

Firstly, due to time constraints, a total of 150 respondents was surveyed. The accuracy of the survey results in representing how well each factor affects the population's willingness and ability to cycle can thus be improved with having a larger sample size comprising more respondents from different planning areas and demographic profile.

Secondly, this paper adopts an arbitrary weightage determination informed by survey results and expert review. There are literatures that determined the weightage based on regression results as mentioned in the Literature Review section. The former methodology assumes that the factors identified are indeed affecting bikeability based on correlation, while the latter objectively proves the causality and magnitude of factors in relation to bikeability. As there are currently no publicly available data on cycling demand, this research is unable to adopt the more objective method in determining bikeability of towns in Singapore. Nonetheless, this research provides a good ballpark as to the current bikeability of towns in Singapore and future research can look to improve the accuracy when cycling demand is available.

CHAPTER NINE: CONCLUSION

In conclusion, our team have presented the first local research that evaluates bikeability throughout Singapore. Other than simply evaluating the bikeability of our towns, our team took a step further to actively draw links between our research results and the effectiveness of government investment into establishing cycling towns. In addition, our findings will surely be useful for relevant government statutory boards in planning for cycling / alternative transport infrastructure. Our research provide them with insights to some of the key considerations of SIngaporean when it comes to transportation.

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APPENDICES

Appendix A: Survey Results

Appendix B: Bikeability Index of Planning Area

Appendix C: Bikeability Index of Subzones

Appendix D: Bikeability Index of Subzones *(Grouped by Planning Areas)*

Appendix E: Raw Data Name, Type, Sources and Weblinks

Appendix A: Survey Results
Survey Questions

Bikeability in Singapore

The goal of this survey is to understand people's perception with regards to cycling as an alternative means of transport in Singapore, especially for last-mile travel.

Last-mile is defined as the distance of the MRT from your home/ work place.

Thank you for agreeing to participate in this survey. It should only take approximately 5 minutes to complete. Be assured that all the answers provided will be kept in confidentiality.

* Required

How frequent do you cycle? *

- ○ Everyday
- ○ 2-3 times a week
- ○ Once a week
- ○ Once a fortnight
- ○ Once a month
- ○ Rarely/ I don't cycle at all

How frequent do you cycle as A FORM OF LEISURE ACTIVITY? *

- ○ Everyday
- ○ 2-3 times a week
- ○ Once a week
- ○ Once a fortnight
- ○ Once a month
- ○ Rarely/ I don't cycle at all

How frequent do you cycle as an ALTERNATIVE FORM OF TRANSPORT? *

- ○ Everyday
- ○ 2-3 times a week
- ○ Once a week
- ○ Once a fortnight
- ○ Once a month
- ○ Rarely/ I don't cycle at all

Rank the importance of the following factors in affecting your willingness to cycle. (Please rank accordingly and select each rank once.) *

	Slope steepness	Rain	Temperature	Availability of bike facilities (e.g. bike racks)	Presence of proper biking path
1 - Least important	○	○	○	○	○
2	○	○	○	○	○
3	○	○	○	○	○
4	○	○	○	○	○
5 - Most important	○	○	○	○	○

How willing are you to adopt cycling as a form of transportation (especially last-mile travel)? *

	1	2	3	4	5	
Not willing at all	○	○	○	○	○	Very willing

What might be some of the factors deterring you from adopting cycling as a form of transportation (last-mile travel)? *Can choose multiple options. *

- [ ] Other forms of transportation are more frequent, such as LRT and public buses
- [ ] Other transportation is more comfortable (air-con) and I can reach my destination faster than cycling
- [ ] I do not own a bike or subscribe to any shared bike services
- [ ] I find cycling in Singapore very dangerous due to the lack of on-road/off-road cycling lanes
- [ ] Motorists' attitudes towards cyclists in Singapore is not very accommodating
- [ ] Singapore is too hot and humid to cycle, I will reach my destination very sweaty.
- [ ] Other: _____

What is the maximum travel distance you are willing to cycle as a form of transportation (especially last mile travel)? *

- ○ 1.2 kilometres (~ 3 bus stops)
- ○ 2.4 kilometres (~ 6 bus stops)
- ○ 3.6 kilometres (~ 9 bus stops)
- ○ 4.8 kilometres (~ 12 bus stops)
- ○ More than 4.8 kilometres (> 12 bus stops)

Do you own a car? *

- ○ Yes
- ○ No

NEXT

Bikeability in Singapore

* Required

Personal particulars

Please be assured that all the answers you provide will be kept in confidentiality and used only for the purpose of this research.

What is your age? *

- ○ Below 18
- ○ 18 - 35
- ○ 36 - 55
- ○ 55 and above

Which Planning Area do you stay in? *

Choose

What is your annual household income range? *

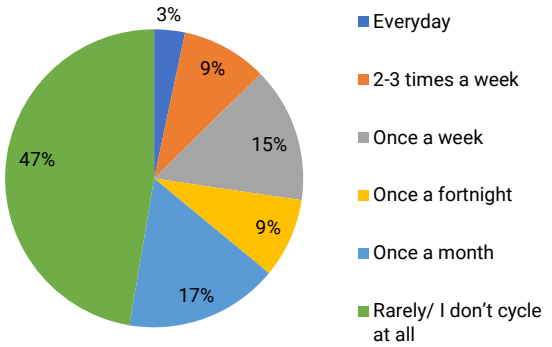
- ○ Less than $25,000
- ○ $25,000 - 39,999
- ○ $40,000 - 69,999
- ○ $70,000 - 99,999
- ○ $100,000 and above.

BACK SUBMIT

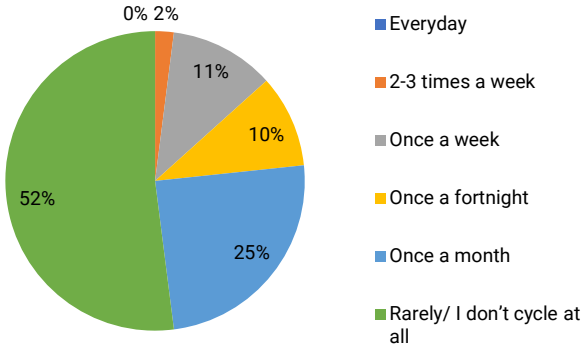
Never submit passwords through Google Forms.

Survey Charts

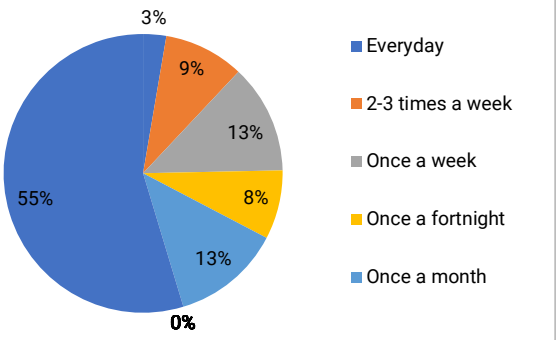
1. How frequent do you cycle?



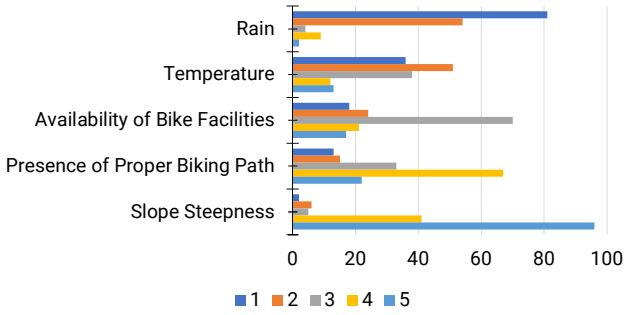
2. How frequent do you cycle as a form of leisure activity?



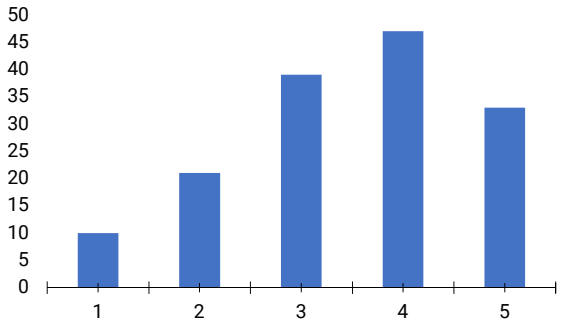
3. How frequent do you cycle as an alternative form of transport?



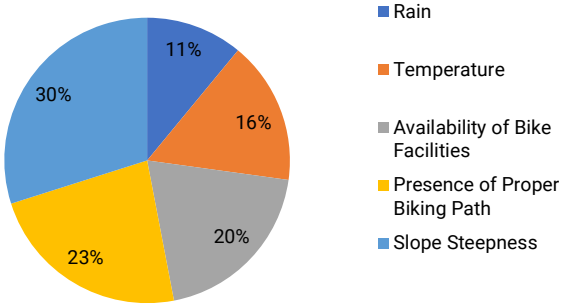
4. Rank the importance of the following factors in affecting your willingness to cycle. (1 being the least important, and 5 the most important)



5. How willing are you to adopt cycling as a form of transportation for last-mile travel?



Factors affecting willingness to cycle

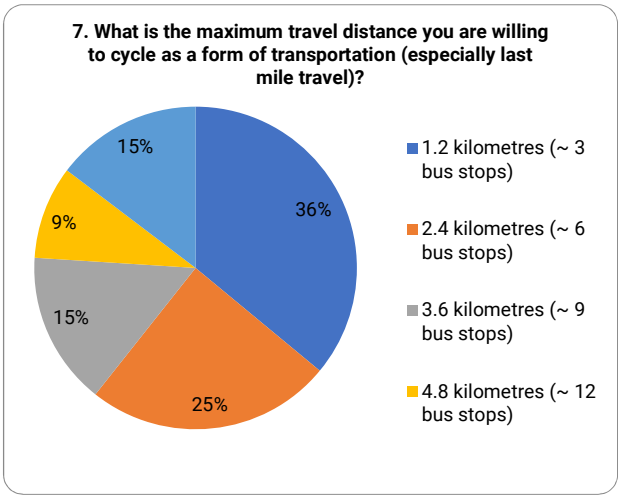


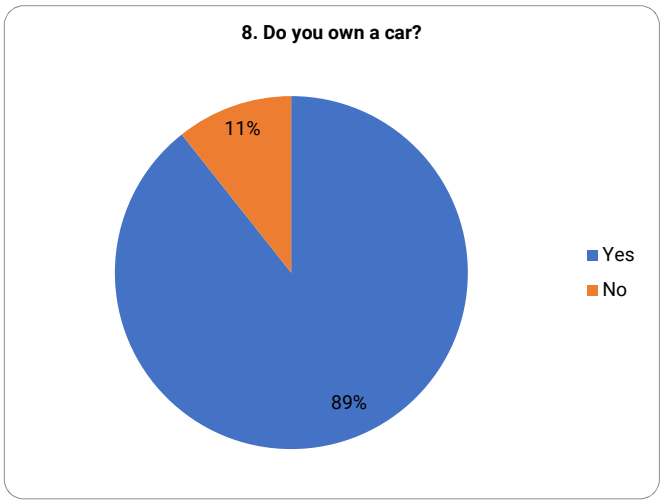
6.What might be some of the factors deterring you from adopting cycling as a form of transportation (last-mile travel)?

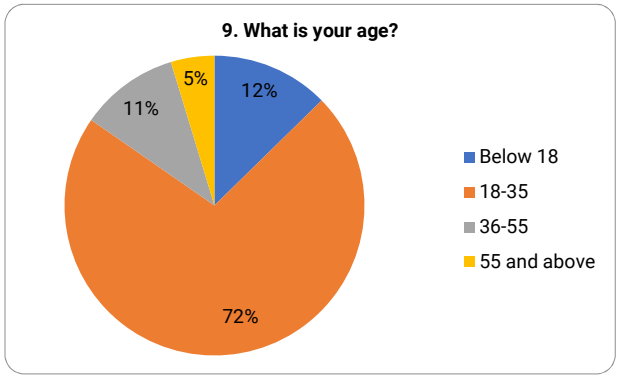
- **51%** find other forms of transportation more frequent, such as LRT and public buses
- **67%** find other transportation more comfortable (air-con) and able to reach destination faster than cycling
- **33%** do not own a bike or subscribe to any shared bike services
- **44%** find cycling in Singapore very dangerous due to the lack of on-road/off-road cycling lanes
- **27%** find motorists' attitudes towards cyclists in Singapore not very accommodating
- **65%** find Singapore is too hot and humid to cycle, and will reach destination very sweaty.

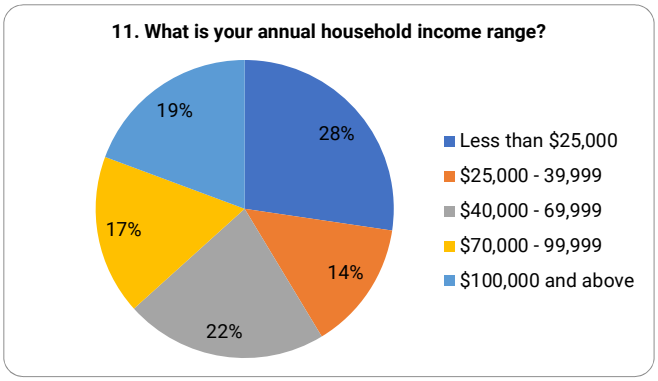
Other responses:

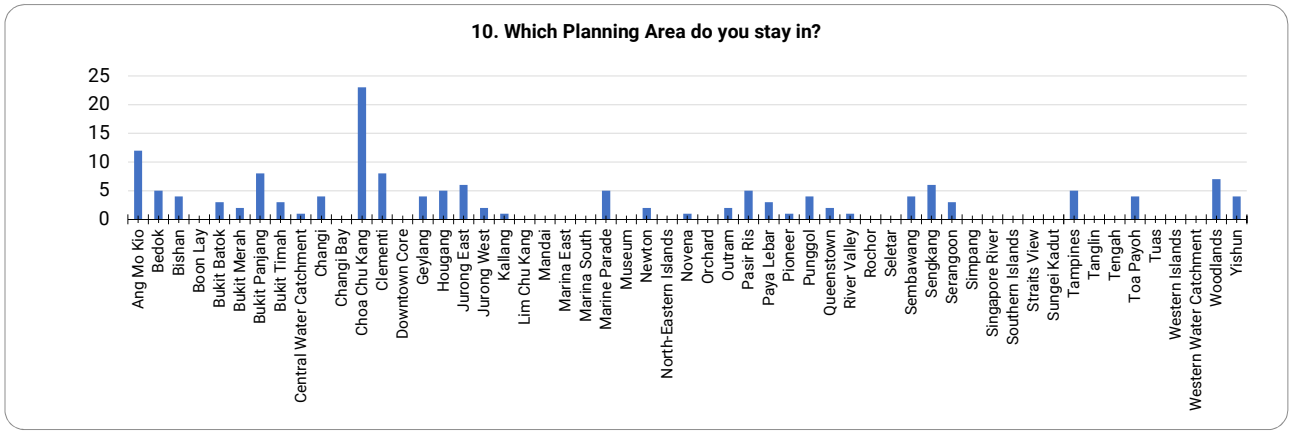
- I use bike sharing services, but sometimes I cannot find a usable bike.
- Not in suitable attire
- People on pavement do not give way to cyclist, as a road user I also find it irritating that cyclist cycles on the road. Bicycle paths are also not well maintained, there are cracks and bumps due to tree roots, thereby making cycling as a form of transportation may be unpleasant.
- Transportation transfer rate is more cost efficient than paying for last mile
- I cannot cycle


7. What is the maximum travel distance you are willing to cycle as a form of transportation (especially last mile travel)?
15%
36%
9%
15%
25%
1.2 kilometres (~ 3 bus stops)
2.4 kilometres (~ 6 bus stops)
3.6 kilometres (~ 9 bus stops)
4.8 kilometres (~ 12 bus stops)


8. Do you own a car?
11%
89%
Yes
No


9. What is your age?
5%
12%
11%
72%
Below 18
18-35
36-55
55 and above


11. What is your annual household income range?
19%
28%
17%
14%
22%
Less than $25,000
$25,000 - 39,999
$40,000 - 69,999
$70,000 - 99,999
$100,000 and above


10. Which Planning Area do you stay in?
25
20
15
10
5
0
Ang Mo Kio
Bedok
Bishan
Boon Lay
Bukit Batok
Bukit Merah
Bukit Panjang
Bukit Timah
Central Water Catchment
Changi
Changi Bay
Choa Chu Kang
Clementi
Downtown Core
Geylang
Hougang
Jurong East
Jurong West
Kallang
Lim Chu Kang
Mandai
Marina East
Marina South
Marine Parade
Museum
Newton
North-Eastern Islands
Novena
Orchard
Outram
Pasir Ris
Paya Lebar
Pioneer
Punggol
Queenstown
River Valley
Rochor
Seletar
Sembawang
Sengkang
Serangoon
Simpang
Singapore River
Southern Islands
Straits View
Sungei Kadut
Tampines
Tanglin
Tengah
Toa Payoh
Tuas
Western Islands
Western Water Catchment
Woodlands
Yishun

Survey Results

1 How frequent do you cycle?

Everyday	5	3.3%
2-3 times a week	14	9.3%
Once a week	22	14.7%
Once a fortnight	13	8.7%
Once a month	25	16.7%
Rarely/ I don't cycle at all	71	47.3%
	150	100%

2 How frequent do you cycle as a form of leisure activity?

Everyday	0	0.0%
2-3 times a week	3	2.0%
Once a week	17	11.3%
Once a fortnight	15	10.0%
Once a month	37	24.7%
Rarely/ I don't cycle at all	78	52.0%
	150	100%

3 How frequent do you cycle as an alternative form of transport?

Everyday	4	2.7%
2-3 times a week	14	9.3%
Once a week	19	12.7%
Once a fortnight	12	8.0%
Once a month	19	12.7%
Rarely/ I don't cycle at all	82	54.7%
	150	100.0%

4 Rank the importance of the following factors in affecting your willingness to cycle. (1 being the least important, and 5 the most important)

	Least important				Most important			
	1	2	3	4	5	Sum Product	Average Points	
Rain	81	54	4	9	2	247	1.65	11%
Temperature	36	51	38	12	13	365	2.43	16%
Availability of Bike Facilities	18	24	70	21	17	445	2.97	20%
Presence of Proper Biking Path	13	15	33	67	22	520	3.47	23%
Slope Steepness	2	6	5	41	96	673	4.49	30%
								100%

5 How willing are you to adopt cycling as a form of transportation (especially last-mile travel)?

Not willing at all	1	10	6.7%
	2	21	14.0%
	3	39	26.0%
	4	47	31.3%
Most willing	5	33	22.0%
		150	100.0%

6 What might be some of the factors deterring you from adopting cycling as a form of transportation (last-mile travel)? *Can choose multiple options.

Other forms of transportation are more frequent, such as LRT and public buses	77	51.3%
comfortable (air-con) and I can reach my destination faster than	101	67.3%
I do not own a bike or subscribe to any shared bike services	49	32.7%
I find cycling in Singapore very dangerous due to the lack of on-road/off-road cycling lanes	66	44.0%
Motorists' attitudes towards	41	27.3%
Singapore is too hot and humid to	98	65.3%

Other responses:		
I use bike sharing services, but sometimes I cannot find a usable bike.	1	0.7%
Not in suitable attire	1	0.7%
People on pavement do not give way to cyclist, as a road user I also find it irritating that cyclist cycles on the road. Bicycle paths are also not well maintained, there are cracks and bumps due to tree roots, thereby making cycling as a form of transportation may be unpleasant.	1	0.7%
Transportation transfer rate is more cost efficient than paying for last mile	1	0.7%
I can't cycle	1	0.7%
	150	100.0%

7 What is the maximum travel distance you are willing to cycle as a form of transportation (especially last mile travel)?

1.2 kilometres (~ 3 bus stops)	54	36.0%
2.4 kilometres (~ 6 bus stops)	37	24.7%
3.6 kilometres (~ 9 bus stops)	23	15.3%
4.8 kilometres (~ 12 bus stops)	14	9.3%
More than 4.8 kilometres (> 12 bus stops)	22	14.7%
	150	100.0%

8 Do you own a car?

Yes	134	89.3%
No	16	10.7%
	150	100.0%

9 What is your age?

Below 18	19	12.7%
18-35	108	72.0%
36-55	16	10.7%
55 and above	7	4.7%
	150	100.0%

10 Which Planning Area do you stay in?

Ang Mo Kio	12	8.0%
Bedok	5	3.3%
Bishan	4	2.7%
Boon Lay	0	0.0%
Bukit Batok	3	2.0%
Bukit Merah	2	1.3%
Bukit Panjang	8	5.3%
Bukit Timah	3	2.0%
Central Water Catchment	1	0.7%
Changi	4	2.7%
Changi Bay	0	0.0%
Choa Chu Kang	23	15.3%
Clementi	8	5.3%
Downtown Core	0	0.0%
Geylang	4	2.7%
Hougang	5	3.3%
Jurong East	6	4.0%
Jurong West	2	1.3%
Kallang	1	0.7%
Lim Chu Kang	0	0.0%
Mandai	0	0.0%
Marina East	0	0.0%
Marina South	0	0.0%
Marine Parade	5	3.3%
Museum	0	0.0%
Newton	2	1.3%
North-Eastern Islands	0	0.0%
Novena	1	0.7%
Orchard	0	0.0%
Outram	2	1.3%
Pasir Ris	5	3.3%
Paya Lebar	3	2.0%
Pioneer	1	0.7%
Punggol	4	2.7%
Queenstown	2	1.3%
River Valley	1	0.7%
Rochor	0	0.0%
Seletar	0	0.0%
Sembawang	4	2.7%
Sengkang	6	4.0%
Serangoon	3	2.0%
Simpang	0	0.0%
Singapore River	0	0.0%
Southern Islands	0	0.0%
Straits View	0	0.0%
Sungei Kadut	0	0.0%
Tampines	5	3.3%
Tanglin	0	0.0%
Tengah	0	0.0%
Toa Payoh	4	2.7%
Tuas	0	0.0%
Western Islands	0	0.0%
Western Water Catchment	0	0.0%
Woodlands	7	4.7%
Yishun	4	2.7%
	150	100.0%

11 What is your annual household income range?

Less than $25,000	41	27.3%
$25,000 - 39,999	21	14.0%
$40,000 - 69,999	33	22.0%
$70,000 - 99,999	26	17.3%
$100,000 and above	29	19.3%
	150	100.0%

Appendix B: Bikeability Index of Planning Area

WEIGHTAGE	30.0%	5.0%	2.5%	17.5%	15.0%	12.0%	8.0%	5.0%	5.0%		
PLANNING AREA	Slope	Cycling Path Density (25%)			Availability of Bicycle Friendly Amenities	Public Transport Modal Split	Cycling Population Density	Precipitation	Temperature	TOTAL BIKEABILITY SCORE	BIKEABILITY INDEX
		Major Road Density	Minor Road Density	Dedicated Cycling Path Density							
CHOA CHU KANG	3	1	3	4	5	5	5	2	4	3.70	Green
YISHUN	4	1	3	5	3	5	2	1	4	3.66	Green
WOODLANDS	3	2	3	4	4	5	4	2	5	3.65	Green
PASIR RIS	4	1	2	5	2	5	2	4	4	3.64	Green
PUNGGOL	4	1	2	5	3	3	3	2	3	3.48	Green
SEMBAWANG	3	2	2	5	3	5	2	1	5	3.44	Green
KALLANG	3	3	3	4	4	4	2	4	2	3.37	Green
TOA PAYOH	3	4	4	3	3	5	3	3	2	3.27	Green
JURONG WEST	3	2	3	4	3	4	3	2	4	3.25	Green
HOUGANG	4	2	4	4	1	4	3	2	1	3.12	Green
TAMPINES	4	1	2	2	3	4	2	4	3	3.09	Green
BEDOK	4	2	2	3	1	4	3	4	2	3.05	Green
JURONG EAST	3	2	2	5	1	4	1	2	4	2.94	Green
SENGKANG	3	2	2	2	4	3	4	2	3	2.93	Green
ANG MO KIO	3	2	4	4	1	4	2	2	4	2.89	Green
BUKIT BATOK	2	2	3	4	2	4	3	2	4	2.80	Green
GEYLANG	3	1	2	2	4	4	2	3	1	2.79	Green
BUKIT MERAH	2	4	5	4	1	4	2	3	3	2.72	Amber
QUEENSTOWN	2	3	4	5	1	4	1	2	3	2.69	Amber
ROCHOR	2	5	5	1	5	3	2	3	3	2.65	Amber
BUKIT PANJANG	2	1	3	5	2	1	3	1	4	2.51	Amber
OUTRAM	3	2	2	1	2	4	3	3	2	2.50	Amber
CLEMENTI	3	2	2	3	1	3	2	2	3	2.50	Amber
WESTERN ISLANDS	5	1	1	1	1	0	1	5	3	2.38	Amber
DOWNTOWN CORE	3	5	4	1	2	2	1	4	2	2.35	Amber
LIM CHU KANG	5	1	1	1	1	0	1	2	5	2.33	Amber
MANDAI	3	1	1	1	1	5	1	1	5	2.28	Amber
SERANGOON	3	2	3	1	1	4	2	2	2	2.24	Amber
BISHAN	3	1	1	1	1	4	2	2	3	2.19	Amber
MARINE PARADE	4	1	2	1	1	1	2	4	1	2.16	Amber
NOVENA	3	1	2	1	1	3	1	3	4	2.12	Amber
STRAITS VIEW	3	1	1	1	4	0	1	4	1	2.08	Amber
SUNGEI KADUT	4	1	1	1	1	0	1	2	5	2.03	Amber
BOON LAY	4	1	1	1	1	0	1	2	4	1.98	Amber
TENGAH	4	1	1	1	1	0	1	2	4	1.98	Amber
TUAS	4	1	1	1	1	0	1	3	3	1.98	Amber
PIONEER	4	1	1	1	1	0	1	2	3	1.93	Amber
MARINA EAST	4	1	1	1	1	0	1	4	1	1.93	Amber
SELETAR	4	1	1	1	1	0	1	1	4	1.93	Amber
SIMPANG	4	1	1	1	1	0	1	1	4	1.93	Amber
BUKIT TIMAH	3	2	3	1	1	1	1	2	4	1.90	Amber
CHANGI	3	1	1	1	1	1	1	4	4	1.90	Amber
PAYA LEBAR	4	1	1	1	1	0	1	2	1	1.83	Amber
WESTERN WATER CATCHMENT	3	1	1	1	1	0	1	2	4	1.68	Red
CENTRAL WATER CATCHMENT	3	1	1	1	1	0	1	1	4	1.63	Red
MARINA SOUTH	3	1	1	1	1	0	1	4	1	1.63	Red
SINGAPORE RIVER	2	2	1	1	1	1	1	3	3	1.55	Red
TANGLIN	2	1	1	1	1	1	1	2	4	1.50	Red
RIVER VALLEY	1	2	2	1	1	1	2	3	4	1.41	Red
SOUTHERN ISLANDS	2	1	1	1	1	0	1	4	2	1.38	Red
NEWTON	1	2	2	1	1	1	1	3	5	1.38	Red
MUSEUM	1	2	1	1	2	0	1	3	3	1.28	Red
ORCHARD	1	2	1	1	1	0	1	3	5	1.23	Red
NORTH-EASTERN ISLANDS	0	1	1	1	1	0	1	4	5	0.93	Red
CHANGI BAY	0	1	1	1	1	0	1	5	3	0.88	Red

Appendix C: Bikeability Index of Subzones

WEIGHTAGE		30.0%	5.0%	2.5%	17.5%	15.0%	12.0%	8.0%	5.0%	5.0%		
			Cycling Path Density (25%)									
Planning Area	SUBZONE	Slope	Major Road Density	Minor Road Density	Dedicated Cycling Path Density	Availability of Bicycle Friendly Amenities	Public Transport Modal Split	Cycling Population Density	Precipitation	Temperature	TOTAL BIKEABILITY SCORE	BIKEABILITY INDEX
KALLANG	BOON KENG	4	2	3	5	5	4	4	4	2	4.10	Green
SEMBAWANG	SEMBAWANG CENTRAL	3	1	3	5	5	5	4	1	5	3.87	Green
YISHUN	YISHUN WEST	4	1	3	3	4	5	5	1	5	3.75	Green
PUNGGOL	WATERWAY EAST	5	1	3	4	1	3	3	2	3	3.33	Green
TAMPINES	TAMPINES EAST	4	1	3	3	2	4	4	4	3	3.30	Green
PASIR RIS	PASIR RIS DRIVE	3	1	3	4	1	5	4	4	4	3.20	Green
PUNGGOL	PUNGGOL TOWN CENTRE	4	1	2	5	2	3	2	2	3	3.17	Green
PASIR RIS	PASIR RIS CENTRAL	3	1	2	4	2	5	3	3	4	3.12	Green
WOODLANDS	WOODLANDS EAST	3	1	4	3	2	5	5	1	5	3.10	Green
YISHUN	YISHUN SOUTH	3	1	3	4	1	5	4	1	4	3.05	Green
ANG MO KIO	SHANGRI-LA	4	1	3	3	1	4	3	2	4	3.02	Green
KALLANG	BENDEMEER	4	1	3	3	1	4	3	3	3	3.02	Green
YISHUN	YISHUN EAST	4	1	3	2	1	5	4	1	4	3.00	Green
PASIR RIS	PASIR RIS PARK	4	1	1	3	1	5	1	3	4	2.98	Green
WOODLANDS	WOODLANDS REGIONAL CENTRE	3	1	2	1	5	5	1	2	5	2.96	Amber
DOWNTOWN CORE	TANJONG PAGAR	5	3	4	1	3	2	1	3	2	2.95	Amber
BUKIT BATOK	HONG KAH NORTH	4	1	3	2	1	4	4	2	4	2.93	Amber
HOUGANG	KANGKAR	4	1	2	3	1	4	4	2	1	2.93	Amber
CHOA CHU KANG	CHOA CHU KANG NORTH	3	1	3	3	1	5	4	2	4	2.92	Amber
KALLANG	GEYLANG BAHRU	4	2	2	3	1	4	2	3	2	2.92	Amber
ROCHOR	FARRER PARK	4	1	5	1	3	3	2	3	4	2.87	Amber
ROCHOR	MACKENZIE	3	3	4	1	5	3	1	3	4	2.87	Amber
PASIR RIS	LOYANG WEST	4	1	1	2	1	5	1	4	4	2.86	Amber
YISHUN	KHATIB	4	1	2	2	2	5	1	1	5	2.86	Amber
GEYLANG	ALJUNIED	4	1	3	2	2	4	2	4	2	2.84	Amber
BEDOK	BEDOK RESERVOIR	4	1	1	3	1	4	2	3	2	2.84	Amber
PUNGGOL	PUNGGOL CANAL	5	1	1	2	1	3	1	2	4	2.82	Amber
PASIR RIS	FLORA DRIVE	4	1	3	1	1	5	2	4	4	2.81	Amber
JURONG WEST	HONG KAH	3	1	3	3	1	4	4	2	4	2.80	Amber
JURONG EAST	YUHUA EAST	3	1	3	3	1	4	4	2	4	2.80	Amber
TOA PAYOH	POTONG PASIR	3	1	3	3	1	5	3	3	2	2.79	Amber
SEMBAWANG	SEMBAWANG SPRINGS	4	1	2	2	1	5	1	1	5	2.78	Amber
QUEENSTOWN	MEI CHIN	2	2	3	5	1	4	3	2	3	2.77	Amber
GEYLANG	MACPHERSON	4	1	3	2	1	4	3	3	1	2.75	Amber
TOA PAYOH	KIM KEAT	4	1	3	1	1	5	3	3	2	2.74	Amber
MANDAI	MANDAI ESTATE	4	1	4	1	1	5	2	1	5	2.74	Amber
PUNGGOL	MATILDA	4	1	2	2	1	3	4	2	3	2.73	Amber
JURONG WEST	BOON LAY PLACE	4	1	2	1	1	4	4	2	4	2.73	Amber
BUKIT BATOK	BUKIT BATOK EAST	2	2	3	4	1	4	4	2	4	2.73	Amber
CHOA CHU KANG	CHOA CHU KANG CENTRAL	3	1	2	2	2	5	3	2	4	2.72	Amber
BEDOK	KEMBANGAN	4	1	3	2	1	4	2	3	2	2.72	Amber
QUEENSTOWN	PORT	5	1	1	1	1	4	1	3	2	2.71	Amber
JURONG EAST	TEBAN GARDENS	5	1	1	1	1	4	1	2	3	2.71	Amber
PASIR RIS	LOYANG EAST	4	1	2	1	1	5	1	4	4	2.71	Amber
ANG MO KIO	TOWNSVILLE	3	2	3	2	1	4	5	2	3	2.71	Amber
CHOA CHU KANG	PENG SIANG	2	1	3	3	1	5	5	2	4	2.70	Amber
JURONG WEST	TAMAN JURONG	3	1	3	2	2	4	3	2	4	2.70	Amber
WOODLANDS	WOODLANDS WEST	3	1	2	2	1	5	3	2	5	2.69	Amber
WOODLANDS	MIDVIEW	3	1	4	1	1	5	5	1	5	2.68	Amber
ANG MO KIO	YIO CHU KANG WEST	4	1	2	1	1	4	4	1	4	2.68	Amber
BUKIT BATOK	BUKIT BATOK CENTRAL	3	2	3	2	1	4	4	2	4	2.68	Amber
BEDOK	BEDOK NORTH	4	1	3	1	1	4	3	4	2	2.67	Amber
PASIR RIS	PASIR RIS WEST	3	1	3	2	1	5	3	3	3	2.67	Amber
WOODLANDS	WOODGROVE	3	1	3	2	1	5	3	1	5	2.67	Amber
WOODLANDS	WOODLANDS SOUTH	3	1	3	2	1	5	3	1	5	2.67	Amber
OUTRAM	PEOPLE'S PARK	3	2	3	1	4	4	1	3	2	2.66	Amber
WOODLANDS	SENOKO WEST	4	1	2	1	1	5	1	2	5	2.66	Amber

SEMBAWANG	SEMBAWANG STRAITS	3	1	2	3	1	5	1	1	5	2.66	Amber
HOUGANG	HOUGANG EAST	3	1	3	3	1	4	4	2	1	2.65	Amber
KALLANG	LAVENDER	4	1	3	1	1	4	2	4	3	2.64	Amber
PUNGGOL	CONEY ISLAND	5	1	1	1	1	3	1	2	4	2.64	Amber
JURONG WEST	KIAN TECK	4	1	1	2	1	4	1	2	4	2.64	Amber
SEMBAWANG	SENOKO NORTH	4	1	1	1	1	5	1	2	5	2.63	Amber
JURONG WEST	YUNNAN	3	1	3	2	1	4	4	2	4	2.63	Amber
CHOA CHU KANG	TECK WHYE	3	1	3	2	1	5	3	1	4	2.62	Amber
ANG MO KIO	YIO CHU KANG	4	1	1	2	1	4	1	1	4	2.59	Amber
PASIR RIS	PASIR RIS WAFER FAB PARK	4	1	1	1	1	5	1	3	3	2.58	Amber
ROCHOR	LITTLE INDIA	4	2	5	1	1	3	2	3	3	2.57	Amber
HOUGANG	TAI SENG	4	2	2	2	1	4	1	2	1	2.56	Amber
WOODLANDS	NORTH COAST	3	2	1	2	1	5	1	2	5	2.56	Amber
CLEMENTI	CLEMENTI NORTH	3	2	3	2	1	3	4	2	4	2.56	Amber
CHOA CHU KANG	YEW TEE	1	1	4	2	3	5	5	2	4	2.55	Amber
ANG MO KIO	KEBUN BAHRU	3	1	3	2	1	4	3	2	4	2.55	Amber
QUEENSTOWN	TANGLIN HALT	3	2	3	2	1	4	3	2	3	2.55	Amber
CHOA CHU KANG	KEAT HONG	3	2	3	1	1	5	3	2	4	2.54	Amber
GEYLANG	GEYLANG EAST	4	1	3	1	1	4	2	4	1	2.54	Amber
TOA PAYOH	LORONG 8 TOA PAYOH	3	1	3	2	1	5	2	3	2	2.54	Amber
YISHUN	LOWER SELETAR	4	1	1	1	1	5	1	1	4	2.53	Amber
TOA PAYOH	SENNETT	4	1	3	1	1	5	1	3	1	2.53	Amber
YISHUN	SPRINGLEAF	4	1	1	1	1	5	1	1	4	2.53	Amber
HOUGANG	HOUGANG WEST	3	1	3	2	1	4	4	2	2	2.53	Amber
CLEMENTI	CLEMENTI WEST	3	2	2	3	1	3	3	2	2	2.53	Amber
HOUGANG	LORONG AH SOO	4	1	3	1	1	4	3	2	1	2.52	Amber
BEDOK	KAKI BUKIT	4	2	2	1	1	4	2	3	1	2.52	Amber
TOA PAYOH	BRADDELL	3	2	2	1	1	5	3	3	3	2.52	Amber
SEMBAWANG	SEMBAWANG NORTH	2	1	2	3	1	5	3	1	5	2.52	Amber
BEDOK	FRANKEL	4	1	3	1	1	4	1	4	2	2.51	Amber
KALLANG	KAMPONG BUGIS	4	2	1	1	1	4	1	4	2	2.51	Amber
JURONG EAST	LAKESIDE	3	1	1	3	1	4	1	2	4	2.51	Amber
SENGKANG	COMPASSVALE	4	1	2	1	2	3	3	2	2	2.50	Amber
ANG MO KIO	CHONG BOON	3	1	3	2	1	4	3	2	3	2.50	Amber
DOWNTOWN CORE	CENTRAL SUBZONE	5	1	2	1	1	2	1	4	1	2.50	Amber
JURONG WEST	JURONG WEST CENTRAL	2	1	4	2	3	4	2	2	4	2.49	Amber
SERANGOON	SERANGOON GARDEN	4	1	3	1	1	4	2	2	2	2.49	Amber
CLEMENTI	WEST COAST	4	1	2	2	1	3	1	2	3	2.49	Amber
YISHUN	NORTHLAND	3	1	3	1	1	5	3	1	5	2.49	Amber
ANG MO KIO	SEMBAWANG HILLS	4	1	4	1	1	4	1	1	4	2.49	Amber
TOA PAYOH	WOODLEIGH	3	2	2	2	1	5	1	3	2	2.48	Amber
YISHUN	YISHUN CENTRAL	3	1	2	2	1	5	1	1	5	2.48	Amber
JURONG EAST	TOH GUAN	1	1	3	5	1	4	3	2	4	2.47	Amber
QUEENSTOWN	GHIM MOH	3	1	2	2	1	4	3	2	3	2.47	Amber
TAMPINES	TAMPINES WEST	3	1	2	2	1	4	3	3	2	2.47	Amber
DOWNTOWN CORE	BAYFRONT SUBZONE	5	1	1	1	1	2	1	4	1	2.47	Amber
DOWNTOWN CORE	CLIFFORD PIER	5	1	1	1	1	2	1	4	1	2.47	Amber
TOA PAYOH	PEI CHUN	3	1	4	1	1	5	3	3	2	2.47	Amber
JURONG WEST	CHIN BEE	4	1	1	1	1	4	1	2	4	2.46	Amber
JURONG WEST	WENYA	4	1	1	1	1	4	1	2	4	2.46	Amber
TAMPINES	XILIN	4	1	1	1	1	4	1	4	2	2.46	Amber
ANG MO KIO	YIO CHU KANG EAST	4	1	1	1	1	4	1	2	4	2.46	Amber
SERANGOON	SELETAR HILLS	4	1	3	1	1	4	1	2	3	2.46	Amber
TAMPINES	TAMPINES NORTH	4	1	1	1	1	4	1	3	3	2.46	Amber
BUKIT MERAH	ALEXANDRA NORTH	2	1	2	4	1	4	1	3	4	2.46	Amber
PUNGGOL	PUNGGOL FIELD	3	1	3	2	1	3	4	2	3	2.46	Amber
BUKIT BATOK	BUKIT BATOK WEST	3	1	3	1	1	4	4	2	4	2.45	Amber
MARINE PARADE	KATONG	5	1	3	1	1	1	1	4	2	2.45	Amber
HOUGANG	TRAFALGAR	3	1	3	2	1	4	3	2	2	2.45	Amber
TAMPINES	SIMEI	3	1	2	2	1	4	2	4	2	2.44	Amber
HOUGANG	KOVAN	4	1	3	1	1	4	2	2	1	2.44	Amber
HOUGANG	HOUGANG CENTRAL	3	1	3	1	3	4	2	2	1	2.44	Amber
SERANGOON	SERANGOON NORTH IND ESTATE	4	1	2	1	1	4	1	2	3	2.44	Amber
SENGKANG	FERNVALE	4	1	2	1	1	3	3	1	3	2.43	Amber
JURONG EAST	PENJURU CRESCENT	4	1	1	1	1	4	1	2	3	2.41	Amber

ANG MO KIO	YIO CHU KANG NORTH	4	1	1	1	1	4	1	1	4	2.41	Amber
OUTRAM	CHINATOWN	3	2	4	1	1	4	3	3	2	2.40	Amber
HOUGANG	DEFU INDUSTRIAL PARK	4	2	2	1	1	4	1	2	1	2.39	Amber
WESTERN ISLANDS	JURONG ISLAND AND BUKOM	5	1	1	1	1	0	1	4	4	2.38	Amber
SENGKANG	ANCHORVALE	3	1	3	2	1	3	3	2	3	2.38	Amber
DOWNTOWN CORE	RAFFLES PLACE	4	3	3	1	1	2	1	4	2	2.37	Amber
ANG MO KIO	ANG MO KIO TOWN CENTRE	3	2	3	1	1	4	2	2	4	2.34	Amber
KALLANG	KAMPONG JAVA	3	1	3	1	1	4	2	3	4	2.34	Amber
BEDOK	BAYSHORE	3	1	1	2	1	4	1	4	2	2.34	Amber
LIM CHU KANG	LIM CHU KANG	5	1	1	1	1	0	1	2	5	2.33	Amber
SUNGEI KADUT	PANG SUA	5	1	1	1	1	0	1	2	5	2.33	Amber
SUNGEI KADUT	RESERVOIR VIEW	5	1	1	1	1	0	1	2	5	2.33	Amber
TUAS	TUAS VIEW EXTENSION	5	1	1	1	1	0	1	4	3	2.33	Amber
BUKIT MERAH	TELOK BLANGAH RISE	3	1	3	1	1	4	3	3	2	2.32	Amber
TOA PAYOH	BOON TECK	2	2	3	1	1	5	4	3	3	2.32	Amber
OUTRAM	PEARL'S HILL	3	2	2	1	1	4	2	3	3	2.32	Amber
HOUGANG	LORONG HALUS	4	1	1	1	1	4	1	2	1	2.31	Amber
KALLANG	TANJONG RHU	3	1	2	2	1	4	1	4	1	2.31	Amber
SEMBAWANG	THE WHARVES	3	1	2	1	1	5	1	1	5	2.31	Amber
BUKIT PANJANG	FAJAR	3	1	3	2	1	1	5	1	4	2.30	Amber
BEDOK	BEDOK SOUTH	3	1	3	1	1	4	2	4	2	2.29	Amber
SEMBAWANG	ADMIRALTY	2	1	3	2	1	5	2	1	5	2.29	Amber
TOA PAYOH	JOO SENG	3	2	3	1	1	5	1	3	1	2.28	Amber
MANDAI	MANDAI EAST	3	1	1	1	1	5	1	1	5	2.28	Amber
YISHUN	NEE SOON	3	1	1	1	1	5	1	1	5	2.28	Amber
SEMBAWANG	SENOKO SOUTH	3	1	1	1	1	5	1	1	5	2.28	Amber
SERANGOON	SERANGOON NORTH	3	1	3	1	1	4	3	2	2	2.27	Amber
BUKIT MERAH	HENDERSON HILL	2	2	2	2	1	4	3	3	3	2.27	Amber
BISHAN	BISHAN EAST	3	1	2	1	1	4	2	3	3	2.27	Amber
GEYLANG	KAMPONG UBI	3	1	2	2	1	4	1	3	1	2.26	Amber
CHANGI	CHANGI AIRPORT	4	1	1	1	1	1	1	5	4	2.25	Amber
SENGKANG	LORONG HALUS NORTH	4	1	1	1	1	3	1	2	2	2.24	Amber
CLEMENTI	FABER	3	1	2	2	1	3	1	2	4	2.24	Amber
ROCHOR	KAMPONG GLAM	3	3	5	1	1	3	1	4	2	2.24	Amber
BISHAN	MARYMOUNT	3	1	3	1	1	4	2	2	3	2.24	Amber
SENGKANG	SENGKANG WEST	4	1	1	1	1	3	1	1	3	2.24	Amber
JURONG EAST	INTERNATIONAL BUSINESS PARK	2	1	2	3	1	4	1	2	4	2.24	Amber
SENGKANG	RIVERVALE	2	2	3	2	1	3	5	2	2	2.24	Amber
TUAS	TUAS VIEW	5	1	1	1	1	0	1	3	2	2.23	Amber
TOA PAYOH	BIDADARI	3	2	1	1	1	5	1	3	1	2.23	Amber
ANG MO KIO	CHENG SAN	2	1	3	1	2	4	4	2	4	2.23	Amber
JURONG EAST	YUHUA WEST	2	1	2	2	1	4	3	2	4	2.22	Amber
SERANGOON	SERANGOON CENTRAL	3	1	3	1	1	4	3	2	1	2.22	Amber
WOODLANDS	GREENWOOD PARK	2	1	1	2	1	5	1	2	5	2.21	Amber
SERANGOON	UPPER PAYA LEBAR	3	2	3	1	1	4	2	2	1	2.19	Amber
ROCHOR	ROCHOR CANAL	3	2	3	1	1	3	1	4	3	2.19	Amber
KALLANG	KALLANG BAHRU	3	1	2	1	1	4	1	4	2	2.19	Amber
SERANGOON	LORONG CHUAN	3	2	2	1	1	4	1	3	2	2.19	Amber
JURONG EAST	JURONG GATEWAY	2	1	2	1	3	4	1	2	4	2.19	Amber
SEMBAWANG	SEMBAWANG EAST	2	1	2	2	1	5	1	1	5	2.18	Amber
NOVENA	BALESTIER	3	1	3	1	1	3	2	3	3	2.17	Amber
BUKIT PANJANG	SAUJANA	2	1	3	3	1	1	5	1	4	2.17	Amber
TOA PAYOH	TOA PAYOH CENTRAL	2	1	2	1	1	5	3	3	3	2.17	Amber
NOVENA	MALCOLM	3	1	2	1	1	3	1	3	5	2.17	Amber
JURONG WEST	SAFTI	3	1	1	1	1	4	1	2	4	2.16	Amber
SENGKANG	SENGKANG TOWN CENTRE	2	1	3	1	2	3	5	2	2	2.16	Amber
BUKIT MERAH	REDHILL	2	1	3	1	1	4	4	3	3	2.15	Amber
BUKIT MERAH	TIONG BAHRU	2	1	3	1	1	4	4	3	3	2.15	Amber
QUEENSTOWN	MARGARET DRIVE	2	2	2	2	1	4	2	2	3	2.14	Amber
BUKIT MERAH	CITY TERMINALS	3	1	2	1	1	4	1	3	2	2.14	Amber
QUEENSTOWN	ONE NORTH	3	1	2	1	1	4	1	2	3	2.14	Amber
ANG MO KIO	TAGORE	3	1	2	1	1	4	1	1	4	2.14	Amber
BISHAN	UPPER THOMSON	3	1	2	1	1	4	1	2	3	2.14	Amber
TOA PAYOH	TOA PAYOH WEST	2	2	2	1	1	5	2	3	3	2.14	Amber
BUKIT MERAH	TELOK BLANGAH WAY	2	1	2	1	1	4	4	3	3	2.13	Amber

CLEMENTI	**CLEMENTI CENTRAL**	3	1	3	1	1	3	2	2	3	**2.12**	**Amber**
BUKIT BATOK	**HILLVIEW**	2	1	1	2	1	4	2	2	4	**2.12**	**Amber**
JURONG EAST	**JURONG PORT**	3	1	1	1	1	4	1	2	3	**2.11**	**Amber**
JURONG EAST	**JURONG RIVER**	3	1	1	1	1	4	1	2	3	**2.11**	**Amber**
GEYLANG	**KALLANG WAY**	3	1	3	1	1	4	1	3	1	**2.11**	**Amber**
QUEENSTOWN	**HOLLAND DRIVE**	2	1	3	1	1	4	4	2	3	**2.10**	**Amber**
CLEMENTI	**CLEMENTI WOODS**	3	1	2	1	1	3	2	2	3	**2.10**	**Amber**
NOVENA	**DUNEARN**	3	1	3	1	1	3	1	2	4	**2.09**	**Amber**
BUKIT PANJANG	**BANGKIT**	2	1	3	3	1	1	4	1	4	**2.09**	**Amber**
MARINE PARADE	**MOUNTBATTEN**	4	1	2	1	1	1	1	4	1	**2.08**	**Amber**
QUEENSTOWN	**COMMONWEALTH**	2	2	3	1	1	4	3	2	3	**2.07**	**Amber**
BUKIT MERAH	**KAMPONG TIONG BAHRU**	2	1	3	1	1	4	3	3	3	**2.07**	**Amber**
DOWNTOWN CORE	**CECIL**	3	3	3	1	1	2	1	4	2	**2.07**	**Amber**
NOVENA	**MOUNT PLEASANT**	3	1	2	1	1	3	1	2	4	**2.07**	**Amber**
BUKIT BATOK	**BUKIT BATOK SOUTH**	2	1	2	2	1	4	1	2	4	**2.06**	**Amber**
BEDOK	**SIGLAP**	2	1	2	2	1	4	1	4	2	**2.06**	**Amber**
MARINE PARADE	**MARINA EAST (MP)**	4	1	1	1	1	1	1	4	1	**2.05**	**Amber**
DOWNTOWN CORE	**BUGIS**	2	3	2	1	3	2	1	4	2	**2.05**	**Amber**
OUTRAM	**CHINA SQUARE**	2	3	3	1	1	4	2	3	2	**2.04**	**Amber**
PUNGGOL	**NORTHSHORE**	3	1	1	1	1	3	1	2	4	**2.04**	**Amber**
CLEMENTI	**TOH TUCK**	3	1	1	1	1	3	1	2	4	**2.04**	**Amber**
PIONEER	**GUL BASIN**	4	1	1	1	1	0	1	3	4	**2.03**	**Amber**
SUNGEI KADUT	**KRANJI**	4	1	1	1	1	0	1	2	5	**2.03**	**Amber**
CHANGI	**CHANGI POINT**	2	1	2	3	1	1	1	4	5	**2.03**	**Amber**
DOWNTOWN CORE	**CITY HALL**	3	3	1	1	1	2	1	4	2	**2.02**	**Amber**
BOON LAY	**TUKANG**	4	1	2	1	1	0	1	2	4	**2.01**	**Amber**
BUKIT MERAH	**BUKIT HO SWEE**	1	2	3	2	1	4	3	3	3	**2.00**	**Amber**
KALLANG	**CRAWFORD**	2	2	1	1	1	4	2	4	2	**1.99**	**Amber**
BUKIT MERAH	**DEPOT ROAD**	2	1	3	1	1	4	2	3	3	**1.99**	**Amber**
BUKIT MERAH	**EVERTON PARK**	2	2	3	1	1	4	2	3	2	**1.99**	**Amber**
CLEMENTI	**PANDAN**	3	1	1	1	1	3	1	2	3	**1.99**	**Amber**
ROCHOR	**SELEGIE**	2	5	3	1	1	3	1	3	3	**1.99**	**Amber**
QUEENSTOWN	**QUEENSWAY**	2	1	1	2	1	4	1	2	3	**1.99**	**Amber**
QUEENSTOWN	**SINGAPORE POLYTECHNIC**	2	1	1	2	1	4	1	2	3	**1.99**	**Amber**
MARINE PARADE	**MARINE PARADE**	3	1	2	1	1	1	3	4	2	**1.99**	**Amber**
MANDAI	**MANDAI WEST**	2	1	1	1	1	5	1	1	5	**1.98**	**Amber**
BUKIT TIMAH	**FARRER COURT**	3	2	3	1	1	1	2	2	4	**1.98**	**Amber**
PIONEER	**BENOI SECTOR**	4	1	1	1	1	0	1	2	4	**1.98**	**Amber**
PIONEER	**JOO KOON**	4	1	1	1	1	0	1	2	4	**1.98**	**Amber**
PIONEER	**PIONEER SECTOR**	4	1	1	1	1	0	1	3	3	**1.98**	**Amber**
BOON LAY	**SAMULUN**	4	1	1	1	1	0	1	2	4	**1.98**	**Amber**
BOON LAY	**SHIPYARD**	4	1	1	1	1	0	1	2	4	**1.98**	**Amber**
TENGAH	**TENGAH**	4	1	1	1	1	0	1	2	4	**1.98**	**Amber**
TUAS	**TENGEH**	4	1	1	1	1	0	1	2	4	**1.98**	**Amber**
TUAS	**TUAS BAY**	4	1	1	1	1	0	1	3	3	**1.98**	**Amber**
TUAS	**TUAS NORTH**	4	1	1	1	1	0	1	3	3	**1.98**	**Amber**
TUAS	**TUAS PROMENADE**	4	1	1	1	1	0	1	3	3	**1.98**	**Amber**
BUKIT MERAH	**TIONG BAHRU STATION**	1	1	4	1	1	4	5	3	3	**1.96**	**Amber**
ROCHOR	**SUNGEI ROAD**	2	1	4	1	1	3	2	4	3	**1.95**	**Amber**
BUKIT MERAH	**ALEXANDRA HILL**	2	1	3	1	1	4	2	2	3	**1.94**	**Amber**
PIONEER	**GUL CIRCLE**	4	1	1	1	1	0	1	2	3	**1.93**	**Amber**
PAYA LEBAR	**PAYA LEBAR EAST**	4	1	1	1	1	0	1	3	2	**1.93**	**Amber**
SELETAR	**PULAU PUNGGOL TIMOR**	4	2	1	1	1	0	1	1	3	**1.93**	**Amber**
MARINA EAST	**MARINA EAST**	4	1	1	1	1	0	1	4	1	**1.93**	**Amber**
SELETAR	**PULAU PUNGGOL BARAT**	4	1	1	1	1	0	1	1	4	**1.93**	**Amber**
SELETAR	**SELETAR AEROSPACE PARK**	4	1	1	1	1	0	1	1	4	**1.93**	**Amber**
SIMPANG	**SIMPANG SOUTH**	4	1	1	1	1	0	1	1	4	**1.93**	**Amber**
SIMPANG	**TANJONG IRAU**	4	1	1	1	1	0	1	1	4	**1.93**	**Amber**
BUKIT MERAH	**SINGAPORE GENERAL HOSPITAL**	2	1	3	1	1	4	1	3	3	**1.91**	**Amber**
CHANGI	**CHANGI WEST**	3	1	1	1	1	1	1	4	4	**1.90**	**Amber**
QUEENSTOWN	**PASIR PANJANG 1**	2	3	2	1	1	4	1	2	2	**1.89**	**Amber**
BUKIT MERAH	**BUKIT MERAH**	2	1	2	1	1	4	1	3	3	**1.89**	**Amber**
PAYA LEBAR	**PAYA LEBAR NORTH**	4	1	1	1	1	0	1	2	2	**1.88**	**Amber**
SELETAR	**SELETAR**	4	1	1	1	1	0	1	1	3	**1.88**	**Amber**
ROCHOR	**MOUNT EMILY**	2	1	4	1	1	3	1	3	4	**1.87**	**Amber**

NOVENA	MOULMEIN	2	1	2	1	1	3	1	3	5	1.87	Amber
BUKIT BATOK	BRICKWORKS	2	1	1	1	1	4	1	2	4	1.86	Amber
BUKIT MERAH	MARITIME SQUARE	2	2	1	1	1	4	1	3	2	1.86	Amber
SINGAPORE RIVER	BOAT QUAY	3	2	3	1	1	1	1	3	2	1.85	Amber
BUKIT TIMAH	CORONATION ROAD	3	1	3	1	1	1	1	2	4	1.85	Amber
BUKIT TIMAH	LEEDON PARK	3	1	3	1	1	1	1	2	4	1.85	Amber
BUKIT BATOK	GUILIN	1	1	2	2	1	4	2	2	4	1.84	Red
QUEENSTOWN	DOVER	2	1	2	1	1	4	1	2	3	1.84	Red
PAYA LEBAR	AIRPORT ROAD	4	1	1	1	1	0	1	2	1	1.83	Red
PAYA LEBAR	PAYA LEBAR WEST	4	1	1	1	1	0	1	2	1	1.83	Red
BUKIT TIMAH	ANAK BUKIT	3	1	2	1	1	1	1	2	4	1.83	Red
MARINE PARADE	EAST COAST	3	1	2	1	1	1	1	4	2	1.83	Red
BUKIT TIMAH	HILLCREST	3	1	2	1	1	1	1	2	4	1.83	Red
BUKIT TIMAH	HOLLAND ROAD	3	1	2	1	1	1	1	2	4	1.83	Red
BUKIT TIMAH	SWISS CLUB	3	1	2	1	1	1	1	2	4	1.83	Red
DOWNTOWN CORE	ANSON	2	4	4	1	1	2	1	3	2	1.80	Red
BUKIT PANJANG	SENJA	1	1	3	3	1	1	4	1	4	1.79	Red
QUEENSTOWN	NATIONAL UNIVERSITY OF S'PORE	2	1	2	1	1	4	1	2	2	1.79	Red
BUKIT PANJANG	DAIRY FARM	3	1	2	1	1	1	1	1	4	1.78	Red
ROCHOR	BENCOOLEN	1	4	2	1	2	3	1	3	3	1.77	Red
CLEMENTI	SUNSET WAY	2	1	2	1	1	3	1	2	4	1.77	Red
NEWTON	NEWTON CIRCUS	2	3	3	1	1	1	1	3	5	1.75	Red
SUNGEI KADUT	TURF CLUB	3	1	1	1	1	0	1	2	5	1.73	Red
DOWNTOWN CORE	PHILLIP	2	2	4	1	1	2	1	3	2	1.70	Red
BOON LAY	LIU FANG	3	1	1	1	1	0	1	2	4	1.68	Red
WESTERN WATER CATCHMENT	WESTERN WATER CATCHMENT	3	1	1	1	1	0	1	2	4	1.68	Red
NEWTON	GOODWOOD PARK	2	2	2	1	1	1	1	3	5	1.68	Red
NEWTON	MONK'S HILL	2	2	2	1	1	1	1	3	5	1.68	Red
RIVER VALLEY	PATERSON	2	2	2	1	1	1	1	3	5	1.68	Red
BUKIT MERAH	TELOK BLANGAH DRIVE	1	2	2	1	1	4	2	3	2	1.67	Red
CENTRAL WATER CATCHMENT	CENTRAL WATER CATCHMENT	3	1	1	1	1	0	1	1	4	1.63	Red
MARINA SOUTH	MARINA SOUTH	3	1	1	1	1	0	1	4	1	1.63	Red
SIMPANG	SIMPANG NORTH	3	1	1	1	1	0	1	1	4	1.63	Red
STRAITS VIEW	STRAITS VIEW	3	1	1	1	1	0	1	4	1	1.63	Red
DOWNTOWN CORE	MAXWELL	2	1	3	1	1	2	1	3	2	1.62	Red
SINGAPORE RIVER	CLARKE QUAY	2	3	1	1	1	1	1	3	3	1.60	Red
BUKIT PANJANG	JELEBU	1	1	2	2	1	1	4	1	4	1.59	Red
TANGLIN	NASSIM	2	1	2	1	1	1	1	2	5	1.58	Red
RIVER VALLEY	OXLEY	2	1	2	1	1	1	1	3	4	1.58	Red
ROCHOR	VICTORIA	1	3	2	1	1	3	1	3	3	1.57	Red
QUEENSTOWN	KENT RIDGE	1	1	2	1	1	4	1	2	3	1.54	Red
QUEENSTOWN	PASIR PANJANG 2	1	2	2	1	1	4	1	2	2	1.54	Red
SOUTHERN ISLANDS	SENTOSA	2	1	2	2	1	0	1	3	2	1.53	Red
PAYA LEBAR	PLAB	3	1	1	1	1	0	1	2	1	1.53	Red
TANGLIN	RIDOUT	2	1	2	1	1	1	1	2	4	1.53	Red
TANGLIN	TYERSALL	2	1	2	1	1	1	1	2	4	1.53	Red
BUKIT TIMAH	ULU PANDAN	2	1	2	1	1	1	1	2	4	1.53	Red
BUKIT BATOK	GOMBAK	1	1	1	1	1	4	1	1	4	1.51	Red
RIVER VALLEY	ONE TREE HILL	1	2	2	1	1	1	1	3	5	1.38	Red
NEWTON	CAIRNHILL	1	1	3	1	1	1	1	3	5	1.35	Red
SUNGEI KADUT	GALI BATU	2	1	1	1	1	0	1	1	4	1.33	Red
ORCHARD	SOMERSET	1	3	3	1	1	0	1	3	5	1.33	Red
ORCHARD	TANGLIN	1	3	3	1	1	0	1	3	5	1.33	Red
NEWTON	ISTANA NEGARA	1	1	2	1	1	1	1	3	5	1.33	Red
RIVER VALLEY	LEONIE HILL	1	2	2	1	1	1	1	3	4	1.33	Red
NEWTON	ORANGE GROVE	1	1	2	1	1	1	1	3	5	1.33	Red
DOWNTOWN CORE	MARINA CENTRE	1	2	1	1	1	2	1	4	1	1.32	Red
TANGLIN	CHATSWORTH	1	1	2	1	1	1	1	3	4	1.28	Red
RIVER VALLEY	INSTITUTION HILL	1	1	2	1	1	1	1	3	4	1.28	Red
SINGAPORE RIVER	ROBERTSON QUAY	1	2	2	1	1	1	1	3	3	1.28	Red
MUSEUM	DHOBY GHAUT	1	3	2	1	1	0	1	3	4	1.26	Red
ORCHARD	BOULEVARD	1	2	2	1	1	0	1	3	5	1.26	Red
MUSEUM	BRAS BASAH	1	4	2	1	1	0	1	3	3	1.26	Red
BUKIT PANJANG	NATURE RESERVE	1	1	1	1	1	1	1	1	4	1.15	Red
MUSEUM	FORT CANNING	1	1	2	1	1	0	1	3	3	1.11	Red

NORTH-EASTERN ISLANDS	**NORTH-EASTERN ISLANDS**	0	1	1	1	1	0	1	4	5	**0.93**	**Red**
CHANGI BAY	**CHANGI BAY**	0	1	1	1	1	0	1	5	3	**0.88**	**Red**
WESTERN ISLANDS	**SUDONG**	0	1	1	1	1	0	1	5	2	**0.83**	**Red**
WESTERN ISLANDS	**SEMAKAU**	0	1	1	1	1	0	1	5	1	**0.78**	**Red**
SOUTHERN ISLANDS	**SOUTHERN GROUP**	0	1	1	1	1	0	1	4	2	**0.78**	**Red**
SIMPANG	**PULAU SELETAR**	0	1	1	1	1	0	1	1	4	**0.73**	**Red**

Appendix D: Bikeability Index of Subzones *(Grouped by Planning Areas)*

WEIGHTAGE		30.0%	5.0%	2.5%	17.5%	15.0%	12.0%	8.0%	5.0%	5.0%		
			Cycling Path Density (25%)									
Planning Area	SUBZONE	Slope	Major Road Density	Minor Road Density	Dedicated Cycling Path Density	Availability of Bicycle Friendly Amenities	Public Transport Modal Split	Cycling Population Density	Precipitation	Temperature	TOTAL BIKEABILITY SCORE	BIKEABILITY INDEX
ANG MO KIO	SHANGRI-LA	4	1	3	3	1	4	3	2	4	3.02	Green
	TOWNSVILLE	3	2	3	2	1	4	5	2	3	2.71	Amber
	YIO CHU KANG WEST	4	1	2	1	1	4	4	1	4	2.68	Amber
	YIO CHU KANG	4	1	1	2	1	4	1	1	4	2.59	Amber
	KEBUN BAHRU	3	1	3	2	1	4	3	2	4	2.55	Amber
	CHONG BOON	3	1	3	2	1	4	3	2	3	2.50	Amber
	SEMBAWANG HILLS	4	1	4	1	1	4	1	1	4	2.49	Amber
	YIO CHU KANG EAST	4	1	1	1	1	4	1	2	4	2.46	Amber
	YIO CHU KANG NORTH	4	1	1	1	1	4	1	1	4	2.41	Amber
	ANG MO KIO TOWN CENTRE	3	2	3	1	1	4	2	2	4	2.34	Amber
	CHENG SAN	2	1	3	1	2	4	4	2	4	2.23	Amber
	TAGORE	3	1	2	1	1	4	1	1	4	2.14	Amber
BEDOK	BEDOK RESERVOIR	4	1	1	3	1	4	2	3	2	2.84	Amber
	KEMBANGAN	4	1	3	2	1	4	2	3	2	2.72	Amber
	BEDOK NORTH	4	1	3	1	1	4	3	4	2	2.67	Amber
	KAKI BUKIT	4	2	2	1	1	4	2	3	1	2.52	Amber
	FRANKEL	4	1	3	1	1	4	1	4	2	2.51	Amber
	BAYSHORE	3	1	1	2	1	4	1	4	2	2.34	Amber
	BEDOK SOUTH	3	1	3	1	1	4	2	4	2	2.29	Amber
	SIGLAP	2	1	2	2	1	4	1	4	2	2.06	Amber
BISHAN	BISHAN EAST	3	1	2	1	1	4	2	3	3	2.27	Amber
	MARYMOUNT	3	1	3	1	1	4	2	2	3	2.24	Amber
	UPPER THOMSON	3	1	2	1	1	4	1	2	3	2.14	Amber
BOON LAY	TUKANG	4	1	2	1	1	0	1	2	4	2.01	Amber
	SAMULUN	4	1	1	1	1	0	1	2	4	1.98	Amber
	SHIPYARD	4	1	1	1	1	0	1	2	4	1.98	Amber
	LIU FANG	3	1	1	1	1	0	1	2	4	1.68	Red
BUKIT BATOK	HONG KAH NORTH	4	1	3	2	1	4	4	2	4	2.93	Amber
	BUKIT BATOK EAST	2	2	3	4	1	4	4	2	4	2.73	Amber
	BUKIT BATOK CENTRAL	3	2	3	2	1	4	4	2	4	2.68	Amber
	BUKIT BATOK WEST	3	1	3	1	1	4	4	2	4	2.45	Amber
	HILLVIEW	2	1	1	2	1	4	2	2	4	2.12	Amber
	BUKIT BATOK SOUTH	2	1	2	2	1	4	1	2	4	2.06	Amber
	BRICKWORKS	2	1	1	1	1	4	1	2	4	1.86	Amber
	GUILIN	1	1	2	2	1	4	2	2	4	1.84	Red
	GOMBAK	1	1	1	1	1	4	1	1	4	1.51	Red
BUKIT MERAH	ALEXANDRA NORTH	2	1	2	4	1	4	1	3	4	2.46	Amber
	TELOK BLANGAH RISE	3	1	3	1	1	4	3	3	2	2.32	Amber
	HENDERSON HILL	2	2	2	2	1	4	3	3	3	2.27	Amber
	REDHILL	2	1	3	1	1	4	4	3	3	2.15	Amber
	TIONG BAHRU	2	1	3	1	1	4	4	3	3	2.15	Amber
	CITY TERMINALS	3	1	2	1	1	4	1	3	2	2.14	Amber
	TELOK BLANGAH WAY	2	1	2	1	1	4	4	3	3	2.13	Amber
	KAMPONG TIONG BAHRU	2	1	3	1	1	4	3	3	3	2.07	Amber
	BUKIT HO SWEE	1	2	3	2	1	4	3	3	3	2.00	Amber
	DEPOT ROAD	2	1	3	1	1	4	2	3	3	1.99	Amber
	EVERTON PARK	2	2	3	1	1	4	2	3	2	1.99	Amber
	TIONG BAHRU STATION	1	1	4	1	1	4	5	3	3	1.96	Amber
	ALEXANDRA HILL	2	1	3	1	1	4	2	2	3	1.94	Amber
	SINGAPORE GENERAL HOSPITAL	2	1	3	1	1	4	1	3	3	1.91	Amber
	BUKIT MERAH	2	1	2	1	1	4	1	3	3	1.89	Amber
	MARITIME SQUARE	2	2	1	1	1	4	1	3	2	1.86	Amber
	TELOK BLANGAH DRIVE	1	2	2	1	1	4	2	3	2	1.67	Red
BUKIT PANJANG	FAJAR	3	1	3	2	1	1	5	1	4	2.30	Amber
	SAUJANA	2	1	3	3	1	1	5	1	4	2.17	Amber
	BANGKIT	2	1	3	3	1	1	4	1	4	2.09	Amber
	SENJA	1	1	3	3	1	1	4	1	4	1.79	Red

	DAIRY FARM	3	1	2	1	1	1	1	1	4	1.78	Red
	JELEBU	1	1	2	2	1	1	4	1	4	1.59	Red
	NATURE RESERVE	1	1	1	1	1	1	1	1	4	1.15	Red
BUKIT TIMAH	FARRER COURT	3	2	3	1	1	1	2	2	4	1.98	Amber
	CORONATION ROAD	3	1	3	1	1	1	1	2	4	1.85	Amber
	LEEDON PARK	3	1	3	1	1	1	1	2	4	1.85	Amber
	ANAK BUKIT	3	1	2	1	1	1	1	2	4	1.83	Red
	HILLCREST	3	1	2	1	1	1	1	2	4	1.83	Red
	HOLLAND ROAD	3	1	2	1	1	1	1	2	4	1.83	Red
	SWISS CLUB	3	1	2	1	1	1	1	2	4	1.83	Red
	ULU PANDAN	2	1	2	1	1	1	1	2	4	1.53	Red
CENTRAL WATER CATCHMENT	CENTRAL WATER CATCHMENT	3	1	1	1	1	0	1	1	4	1.63	Red
CHANGI	CHANGI AIRPORT	4	1	1	1	1	1	1	5	4	2.25	Amber
	CHANGI POINT	2	1	2	3	1	1	1	4	5	2.03	Amber
	CHANGI WEST	3	1	1	1	1	1	1	4	4	1.90	Amber
CHANGI BAY	CHANGI BAY	0	1	1	1	1	0	1	5	3	0.88	Red
CHOA CHU KANG	CHOA CHU KANG NORTH	3	1	3	3	1	5	4	2	4	2.92	Amber
	CHOA CHU KANG CENTRAL	3	1	2	2	2	5	3	2	4	2.72	Amber
	PENG SIANG	2	1	3	3	1	5	5	2	4	2.70	Amber
	TECK WHYE	3	1	3	2	1	5	3	1	4	2.62	Amber
	YEW TEE	1	1	4	2	3	5	5	2	4	2.55	Amber
	KEAT HONG	3	2	3	1	1	5	3	2	4	2.54	Amber
CLEMENTI	CLEMENTI NORTH	3	2	3	2	1	3	4	2	4	2.56	Amber
	CLEMENTI WEST	3	2	2	3	1	3	3	2	2	2.53	Amber
	WEST COAST	4	1	2	2	1	3	1	2	3	2.49	Amber
	FABER	3	1	2	2	1	3	1	2	4	2.24	Amber
	CLEMENTI CENTRAL	3	1	3	1	1	3	2	2	3	2.12	Amber
	CLEMENTI WOODS	3	1	2	1	1	3	2	2	3	2.10	Amber
	TOH TUCK	3	1	1	1	1	3	1	2	4	2.04	Amber
	PANDAN	3	1	1	1	1	3	1	2	3	1.99	Amber
	SUNSET WAY	2	1	2	1	1	3	1	2	4	1.77	Red
DOWNTOWN CORE	TANJONG PAGAR	5	3	4	1	3	2	1	3	2	2.95	Amber
	CENTRAL SUBZONE	5	1	2	1	1	2	1	4	1	2.50	Amber
	BAYFRONT SUBZONE	5	1	1	1	1	2	1	4	1	2.47	Amber
	CLIFFORD PIER	5	1	1	1	1	2	1	4	1	2.47	Amber
	RAFFLES PLACE	4	3	3	1	1	2	1	4	2	2.37	Amber
	CECIL	3	3	3	1	1	2	1	4	2	2.07	Amber
	BUGIS	2	3	2	1	3	2	1	4	2	2.05	Amber
	CITY HALL	3	3	1	1	1	2	1	4	2	2.02	Amber
	ANSON	2	4	4	1	1	2	1	3	2	1.80	Red
	PHILLIP	2	2	4	1	1	2	1	3	2	1.70	Red
	MAXWELL	2	1	3	1	1	2	1	3	2	1.62	Red
	MARINA CENTRE	1	2	1	1	1	2	1	4	1	1.32	Red
GEYLANG	ALJUNIED	4	1	3	2	2	4	2	4	2	2.84	Amber
	MACPHERSON	4	1	3	2	1	4	3	3	1	2.75	Amber
	GEYLANG EAST	4	1	3	1	1	4	2	4	1	2.54	Amber
	KAMPONG UBI	3	1	2	2	1	4	1	3	1	2.26	Amber
	KALLANG WAY	3	1	3	1	1	4	1	3	1	2.11	Amber
HOUGANG	KANGKAR	4	1	2	3	1	4	4	2	1	2.93	Amber
	HOUGANG EAST	3	1	3	3	1	4	4	2	1	2.65	Amber
	TAI SENG	4	2	2	2	1	4	1	2	1	2.56	Amber
	HOUGANG WEST	3	1	3	2	1	4	4	2	2	2.53	Amber
	LORONG AH SOO	4	1	3	1	1	4	3	2	1	2.52	Amber
	TRAFALGAR	3	1	3	2	1	4	3	2	2	2.45	Amber
	KOVAN	4	1	3	1	1	4	2	2	1	2.44	Amber
	HOUGANG CENTRAL	3	1	3	1	3	4	2	2	1	2.44	Amber
	DEFU INDUSTRIAL PARK	4	2	2	1	1	4	1	2	1	2.39	Amber
	LORONG HALUS	4	1	1	1	1	4	1	2	1	2.31	Amber
JURONG EAST	YUHUA EAST	3	1	3	3	1	4	4	2	4	2.80	Amber
	TEBAN GARDENS	5	1	1	1	1	4	1	2	3	2.71	Amber
	LAKESIDE	3	1	1	3	1	4	1	2	4	2.51	Amber
	TOH GUAN	1	1	3	5	1	4	3	2	4	2.47	Amber
	PENJURU CRESCENT	4	1	1	1	1	4	1	2	3	2.41	Amber
	INTERNATIONAL BUSINESS PARK	2	1	2	3	1	4	1	2	4	2.24	Amber

	YUHUA WEST	2	1	2	2	1	4	3	2	4	2.22	Amber
	JURONG GATEWAY	2	1	2	1	3	4	1	2	4	2.19	Amber
	JURONG PORT	3	1	1	1	1	4	1	2	3	2.11	Amber
	JURONG RIVER	3	1	1	1	1	4	1	2	3	2.11	Amber
JURONG WEST	HONG KAH	3	1	3	3	1	4	4	2	4	2.80	Amber
	BOON LAY PLACE	4	1	2	1	1	4	4	2	4	2.73	Amber
	TAMAN JURONG	3	1	3	2	2	4	3	2	4	2.70	Amber
	KIAN TECK	4	1	1	2	1	4	1	2	4	2.64	Amber
	YUNNAN	3	1	3	2	1	4	4	2	4	2.63	Amber
	JURONG WEST CENTRAL	2	1	4	2	3	4	2	2	4	2.49	Amber
	CHIN BEE	4	1	1	1	1	4	1	2	4	2.46	Amber
	WENYA	4	1	1	1	1	4	1	2	4	2.46	Amber
	SAFTI	3	1	1	1	1	4	1	2	4	2.16	Amber
KALLANG	BOON KENG	4	2	3	5	5	4	4	4	2	4.10	Green
	BENDEMEER	4	1	3	3	1	4	3	3	3	3.02	Green
	GEYLANG BAHRU	4	2	2	3	1	4	2	3	2	2.92	Amber
	LAVENDER	4	1	3	1	1	4	2	4	3	2.64	Amber
	KAMPONG BUGIS	4	2	1	1	1	4	1	4	2	2.51	Amber
	KAMPONG JAVA	3	1	3	1	1	4	2	3	4	2.34	Amber
	TANJONG RHU	3	1	2	2	1	4	1	4	1	2.31	Amber
	KALLANG BAHRU	3	1	2	1	1	4	1	4	2	2.19	Amber
	CRAWFORD	2	2	1	1	1	4	2	4	2	1.99	Amber
LIM CHU KANG	LIM CHU KANG	5	1	1	1	1	0	1	2	5	2.33	Amber
MANDAI	MANDAI ESTATE	4	1	4	1	1	5	2	1	5	2.74	Amber
	MANDAI EAST	3	1	1	1	1	5	1	1	5	2.28	Amber
	MANDAI WEST	2	1	1	1	1	5	1	1	5	1.98	Amber
MARINA EAST	MARINA EAST	4	1	1	1	1	0	1	4	1	1.93	Amber
MARINA SOUTH	MARINA SOUTH	3	1	1	1	1	0	1	4	1	1.63	Red
MARINE PARADE	KATONG	5	1	3	1	1	1	1	4	2	2.45	Amber
	MOUNTBATTEN	4	1	2	1	1	1	1	4	1	2.08	Amber
	MARINA EAST (MP)	4	1	1	1	1	1	1	4	1	2.05	Amber
	MARINE PARADE	3	1	2	1	1	1	3	4	2	1.99	Amber
	EAST COAST	3	1	2	1	1	1	1	4	2	1.83	Red
MUSEUM	DHOBY GHAUT	1	3	2	1	1	0	1	3	4	1.26	Red
	BRAS BASAH	1	4	2	1	1	0	1	3	3	1.26	Red
	FORT CANNING	1	1	2	1	1	0	1	3	3	1.11	Red
NEWTON	NEWTON CIRCUS	2	3	3	1	1	1	1	3	5	1.75	Red
	GOODWOOD PARK	2	2	2	1	1	1	1	3	5	1.68	Red
	MONK'S HILL	2	2	2	1	1	1	1	3	5	1.68	Red
	CAIRNHILL	1	1	3	1	1	1	1	3	5	1.35	Red
	ISTANA NEGARA	1	1	2	1	1	1	1	3	5	1.33	Red
	ORANGE GROVE	1	1	2	1	1	1	1	3	5	1.33	Red
NORTH-EASTERN ISLANDS	NORTH-EASTERN ISLANDS	0	1	1	1	1	0	1	4	5	0.93	Red
NOVENA	BALESTIER	3	1	3	1	1	3	2	3	3	2.17	Amber
	MALCOLM	3	1	2	1	1	3	1	3	5	2.17	Amber
	DUNEARN	3	1	3	1	1	3	1	2	4	2.09	Amber
	MOUNT PLEASANT	3	1	2	1	1	3	1	2	4	2.07	Amber
	MOULMEIN	2	1	2	1	1	3	1	3	5	1.87	Amber
ORCHARD	SOMERSET	1	3	3	1	1	0	1	3	5	1.33	Red
	TANGLIN	1	3	3	1	1	0	1	3	5	1.33	Red
	BOULEVARD	1	2	2	1	1	0	1	3	5	1.26	Red
OUTRAM	PEOPLE'S PARK	3	2	3	1	4	4	1	3	2	2.66	Amber
	CHINATOWN	3	2	4	1	1	4	3	3	2	2.40	Amber
	PEARL'S HILL	3	2	2	1	1	4	2	3	3	2.32	Amber
	CHINA SQUARE	2	3	3	1	1	4	2	3	2	2.04	Amber
PASIR RIS	PASIR RIS DRIVE	3	1	3	4	1	5	4	4	4	3.20	Green
	PASIR RIS CENTRAL	3	1	2	4	2	5	3	3	4	3.12	Green
	PASIR RIS PARK	4	1	1	3	1	5	1	3	4	2.98	Green
	LOYANG WEST	4	1	1	2	1	5	1	4	4	2.86	Amber
	FLORA DRIVE	4	1	3	1	1	5	2	4	4	2.81	Amber
	LOYANG EAST	4	1	2	1	1	5	1	4	4	2.71	Amber
	PASIR RIS WEST	3	1	3	2	1	5	3	3	3	2.67	Amber
	PASIR RIS WAFER FAB PARK	4	1	1	1	1	5	1	3	3	2.58	Amber
	PAYA LEBAR EAST	4	1	1	1	1	0	1	3	2	1.93	Amber

PAYA LEBAR	PAYA LEBAR NORTH	4	1	1	1	1	0	1	2	2	1.88	Amber
	AIRPORT ROAD	4	1	1	1	1	0	1	2	1	1.83	Red
	PAYA LEBAR WEST	4	1	1	1	1	0	1	2	1	1.83	Red
	PLAB	3	1	1	1	1	0	1	2	1	1.53	Red
PIONEER	GUL BASIN	4	1	1	1	1	0	1	3	4	2.03	Amber
	BENOI SECTOR	4	1	1	1	1	0	1	2	4	1.98	Amber
	JOO KOON	4	1	1	1	1	0	1	2	4	1.98	Amber
	PIONEER SECTOR	4	1	1	1	1	0	1	3	3	1.98	Amber
	GUL CIRCLE	4	1	1	1	1	0	1	2	3	1.93	Amber
PUNGGOL	WATERWAY EAST	5	1	3	4	1	3	3	2	3	3.33	Green
	PUNGGOL TOWN CENTRE	4	1	2	5	2	3	2	2	3	3.17	Green
	PUNGGOL CANAL	5	1	1	2	1	3	1	2	4	2.82	Amber
	MATILDA	4	1	2	2	1	3	4	2	3	2.73	Amber
	CONEY ISLAND	5	1	1	1	1	3	1	2	4	2.64	Amber
	PUNGGOL FIELD	3	1	3	2	1	3	4	2	3	2.46	Amber
	NORTHSHORE	3	1	1	1	1	3	1	2	4	2.04	Amber
QUEENSTOWN	MEI CHIN	2	2	3	5	1	4	3	2	3	2.77	Amber
	PORT	5	1	1	1	1	4	1	3	2	2.71	Amber
	TANGLIN HALT	3	2	3	2	1	4	3	2	3	2.55	Amber
	GHIM MOH	3	1	2	2	1	4	3	2	3	2.47	Amber
	MARGARET DRIVE	2	2	2	2	1	4	2	2	3	2.14	Amber
	ONE NORTH	3	1	2	1	1	4	1	2	3	2.14	Amber
	HOLLAND DRIVE	2	1	3	1	1	4	4	2	3	2.10	Amber
	COMMONWEALTH	2	2	3	1	1	4	3	2	3	2.07	Amber
	QUEENSWAY	2	1	1	2	1	4	1	2	3	1.99	Amber
	SINGAPORE POLYTECHNIC	2	1	1	2	1	4	1	2	3	1.99	Amber
	PASIR PANJANG 1	2	3	2	1	1	4	1	2	2	1.89	Amber
	DOVER	2	1	2	1	1	4	1	2	3	1.84	Red
	NATIONAL UNIVERSITY OF S'PORE	2	1	2	1	1	4	1	2	2	1.79	Red
	KENT RIDGE	1	1	2	1	1	4	1	2	3	1.54	Red
	PASIR PANJANG 2	1	2	2	1	1	4	1	2	2	1.54	Red
RIVER VALLEY	PATERSON	2	2	2	1	1	1	1	3	5	1.68	Red
	OXLEY	2	1	2	1	1	1	1	3	4	1.58	Red
	ONE TREE HILL	1	2	2	1	1	1	1	3	5	1.38	Red
	LEONIE HILL	1	2	2	1	1	1	1	3	4	1.33	Red
	INSTITUTION HILL	1	1	2	1	1	1	1	3	4	1.28	Red
ROCHOR	FARRER PARK	4	1	5	1	3	3	2	3	4	2.87	Amber
	MACKENZIE	3	3	4	1	5	3	1	3	4	2.87	Amber
	LITTLE INDIA	4	2	5	1	1	3	2	3	3	2.57	Amber
	KAMPONG GLAM	3	3	5	1	1	3	1	4	2	2.24	Amber
	ROCHOR CANAL	3	2	3	1	1	3	1	4	3	2.19	Amber
	SELEGIE	2	5	3	1	1	3	1	3	3	1.99	Amber
	SUNGEI ROAD	2	1	4	1	1	3	2	4	3	1.95	Amber
	MOUNT EMILY	2	1	4	1	1	3	1	3	4	1.87	Amber
	BENCOOLEN	1	4	2	1	2	3	1	3	3	1.77	Red
	VICTORIA	1	3	2	1	1	3	1	3	3	1.57	Red
SELETAR	PULAU PUNGGOL TIMOR	4	2	1	1	1	0	1	1	3	1.93	Amber
	PULAU PUNGGOL BARAT	4	1	1	1	1	0	1	1	4	1.93	Amber
	SELETAR AEROSPACE PARK	4	1	1	1	1	0	1	1	4	1.93	Amber
	SELETAR	4	1	1	1	1	0	1	1	3	1.88	Amber
SEMBAWANG	SEMBAWANG CENTRAL	3	1	3	5	5	5	4	1	5	3.87	Green
	SEMBAWANG SPRINGS	4	1	2	2	1	5	1	1	5	2.78	Amber
	SEMBAWANG STRAITS	3	1	2	3	1	5	1	1	5	2.66	Amber
	SENOKO NORTH	4	1	1	1	1	5	1	2	5	2.63	Amber
	SEMBAWANG NORTH	2	1	2	3	1	5	3	1	5	2.52	Amber
	THE WHARVES	3	1	2	1	1	5	1	1	5	2.31	Amber
	ADMIRALTY	2	1	3	2	1	5	2	1	5	2.29	Amber
	SENOKO SOUTH	3	1	1	1	1	5	1	1	5	2.28	Amber
	SEMBAWANG EAST	2	1	2	2	1	5	1	1	5	2.18	Amber
SENGKANG	COMPASSVALE	4	1	2	1	2	3	3	2	2	2.50	Amber
	FERNVALE	4	1	2	1	1	3	3	1	3	2.43	Amber
	ANCHORVALE	3	1	3	2	1	3	3	2	3	2.38	Amber
	LORONG HALUS NORTH	4	1	1	1	1	3	1	2	2	2.24	Amber
	SENGKANG WEST	4	1	1	1	1	3	1	1	3	2.24	Amber
	RIVERVALE	2	2	3	2	1	3	5	2	2	2.24	Amber

	SENGKANG TOWN CENTRE	2	1	3	1	2	3	5	2	2	2.16	Amber
SERANGOON	SERANGOON GARDEN	4	1	3	1	1	4	2	2	2	2.49	Amber
	SELETAR HILLS	4	1	3	1	1	4	1	2	3	2.46	Amber
	SERANGOON NORTH IND ESTATE	4	1	2	1	1	4	1	2	3	2.44	Amber
	SERANGOON NORTH	3	1	3	1	1	4	3	2	2	2.27	Amber
	SERANGOON CENTRAL	3	1	3	1	1	4	3	2	1	2.22	Amber
	UPPER PAYA LEBAR	3	2	3	1	1	4	2	2	1	2.19	Amber
	LORONG CHUAN	3	2	2	1	1	4	1	3	2	2.19	Amber
SIMPANG	SIMPANG SOUTH	4	1	1	1	1	0	1	1	4	1.93	Amber
	TANJONG IRAU	4	1	1	1	1	0	1	1	4	1.93	Amber
	SIMPANG NORTH	3	1	1	1	1	0	1	1	4	1.63	Red
	PULAU SELETAR	0	1	1	1	1	0	1	1	4	0.73	Red
SINGAPORE RIVER	BOAT QUAY	3	2	3	1	1	1	1	3	2	1.85	Amber
	CLARKE QUAY	2	3	1	1	1	1	1	3	3	1.60	Red
	ROBERTSON QUAY	1	2	2	1	1	1	1	3	3	1.28	Red
SOUTHERN ISLANDS	SENTOSA	2	1	2	2	1	0	1	3	2	1.53	Red
	SOUTHERN GROUP	0	1	1	1	1	0	1	4	2	0.78	Red
STRAITS VIEW	STRAITS VIEW	3	1	1	1	1	0	1	4	1	1.63	Red
SUNGEI KADUT	PANG SUA	5	1	1	1	1	0	1	2	5	2.33	Amber
	RESERVOIR VIEW	5	1	1	1	1	0	1	2	5	2.33	Amber
	KRANJI	4	1	1	1	1	0	1	2	5	2.03	Amber
	TURF CLUB	3	1	1	1	1	0	1	2	5	1.73	Red
	GALI BATU	2	1	1	1	1	0	1	1	4	1.33	Red
TAMPINES	TAMPINES EAST	4	1	3	3	2	4	4	4	3	3.30	Green
	TAMPINES WEST	3	1	2	2	1	4	3	3	2	2.47	Amber
	XILIN	4	1	1	1	1	4	1	4	2	2.46	Amber
	TAMPINES NORTH	4	1	1	1	1	4	1	3	3	2.46	Amber
	SIMEI	3	1	2	2	1	4	2	4	2	2.44	Amber
TANGLIN	NASSIM	2	1	2	1	1	1	1	2	5	1.58	Red
	RIDOUT	2	1	2	1	1	1	1	2	4	1.53	Red
	TYERSALL	2	1	2	1	1	1	1	2	4	1.53	Red
	CHATSWORTH	1	1	2	1	1	1	1	3	4	1.28	Red
TENGAH	TENGAH	4	1	1	1	1	0	1	2	4	1.98	Amber
TOA PAYOH	POTONG PASIR	3	1	3	3	1	5	3	3	2	2.79	Amber
	KIM KEAT	4	1	3	1	1	5	3	3	2	2.74	Amber
	LORONG 8 TOA PAYOH	3	1	3	2	1	5	2	3	2	2.54	Amber
	SENNETT	4	1	3	1	1	5	1	3	1	2.53	Amber
	BRADDELL	3	2	2	1	1	5	3	3	3	2.52	Amber
	WOODLEIGH	3	2	2	2	1	5	1	3	2	2.48	Amber
	PEI CHUN	3	1	4	1	1	5	3	3	2	2.47	Amber
	BOON TECK	2	2	3	1	1	5	4	3	3	2.32	Amber
	JOO SENG	3	2	3	1	1	5	1	3	1	2.28	Amber
	BIDADARI	3	2	1	1	1	5	1	3	1	2.23	Amber
	TOA PAYOH CENTRAL	2	1	2	1	1	5	3	3	3	2.17	Amber
	TOA PAYOH WEST	2	2	2	1	1	5	2	3	3	2.14	Amber
TUAS	TUAS VIEW EXTENSION	5	1	1	1	1	0	1	4	3	2.33	Amber
	TUAS VIEW	5	1	1	1	1	0	1	3	2	2.23	Amber
	TENGEH	4	1	1	1	1	0	1	2	4	1.98	Amber
	TUAS BAY	4	1	1	1	1	0	1	3	3	1.98	Amber
	TUAS NORTH	4	1	1	1	1	0	1	3	3	1.98	Amber
	TUAS PROMENADE	4	1	1	1	1	0	1	3	3	1.98	Amber
WESTERN ISLANDS	JURONG ISLAND AND BUKOM	5	1	1	1	1	0	1	4	4	2.38	Amber
	SUDONG	0	1	1	1	1	0	1	5	2	0.83	Red
	SEMAKAU	0	1	1	1	1	0	1	5	1	0.78	Red
WESTERN WATER CATCHMENT	WESTERN WATER CATCHMENT	3	1	1	1	1	0	1	2	4	1.68	Red
WOODLANDS	WOODLANDS EAST	3	1	4	3	2	5	5	1	5	3.10	Green
	WOODLANDS REGIONAL CENTRE	3	1	2	1	5	5	1	2	5	2.96	Amber
	WOODLANDS WEST	3	1	2	2	1	5	3	2	5	2.69	Amber
	MIDVIEW	3	1	4	1	1	5	5	1	5	2.68	Amber
	WOODGROVE	3	1	3	2	1	5	3	1	5	2.67	Amber
	WOODLANDS SOUTH	3	1	3	2	1	5	3	1	5	2.67	Amber
	SENOKO WEST	4	1	2	1	1	5	1	2	5	2.66	Amber
	NORTH COAST	3	2	1	2	1	5	1	2	5	2.56	Amber
	GREENWOOD PARK	2	1	1	2	1	5	1	2	5	2.21	Amber

YISHUN	YISHUN WEST	4	1	3	3	4	5	5	1	5	**3.75**	**Green**
	YISHUN SOUTH	3	1	3	4	1	5	4	1	4	**3.05**	**Green**
	YISHUN EAST	4	1	3	2	1	5	4	1	4	**3.00**	**Green**
	KHATIB	4	1	2	2	2	5	1	1	5	**2.86**	**Amber**
	LOWER SELETAR	4	1	1	1	1	5	1	1	4	**2.53**	**Amber**
	SPRINGLEAF	4	1	1	1	1	5	1	1	4	**2.53**	**Amber**
	NORTHLAND	3	1	3	1	1	5	3	1	5	**2.49**	**Amber**
	YISHUN CENTRAL	3	1	2	2	1	5	1	1	5	**2.48**	**Amber**
	NEE SOON	3	1	1	1	1	5	1	1	5	**2.28**	**Amber**

Appendix E: Raw Data Name, Type, Sources and Weblinks

Category	Data Name	Data Type	Source Name	Weblink
Basemap Related Data				
Singapore Boundary	Singapore National Map Polygon	Vector, Polygon	Government Technology Agency of Singapore (data.gov.sg)	https://data.gov.sg/dataset/national-map-polygon
Master Plan Planning Area	Singapore Master Plan 2014 Planning Area Boundary	Vector, Polygon	Government Technology Agency of Singapore (data.gov.sg)	https://data.gov.sg/dataset/master-plan-2014-planning-area-boundary-web
Master Plan Subzone	Singapore Master Plan 2014 Subzone Boundary	Vector, Polygon	Government Technology Agency of Singapore (data.gov.sg)	https://data.gov.sg/dataset/master-plan-2014-subzone-boundary-web
Waterbody	Singapore Waterbody outline	Vector, Polygon	Government Technology Agency of Singapore (data.gov.sg)	https://data.gov.sg/dataset/mp14-sdcp-pw-plan-waterbody
Geographical Factors				
Temperature and Precipitation	Daily temperature and precipitation readings for each weather station	Excel	Meteorological Service Singapore	http://www.weather.gov.sg/climate-historical-daily/
Slope	Space Shuttle Radar Topography Mission (SRTM) 30 meter	Raster	US Geological Survey (USGS)	https://earthexplorer.usgs.gov/

Social Factors				
Cycling Population	Age Group per Subzone and Planning Area	Pdf	Singapore Population Census 2017 by Department of Statistics, Singapore	http://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/population_and_population_structure/population2017.pdf
	Percentage of demographic age group that cycles	Pdf	National Sports Participation Survey 2011 by Singapore Sports Council	https://www.sportsingapore.gov.sg/about-us/~/media/corporate/files/about/publications/national%20sports%20participation%20survey%202011.pdf
Public Transport Modal Split	Number of Resident Working Persons by Usual Mode of Transport to Work	Pdf	Singapore Population Census 2010 by Department of Statistics, Singapore	https://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/cop2010/census_2010_release1/cop2010sr1.pdf
Infrastructural Factors				
Road Network	OSM extracts for Singapore	Vector, Line	OpenStreetMap	http://download.bbbike.org/osm/bbbike/Singapore/
Cycling Path Network	Cycling Path Network	Vector, Line	Government Technology Agency of	https://data.gov.sg/dataset/cy

			Singapore (data.gov.sg)	cling-path-network
	Park Connector Loop	Vector, Line	Government Technology Agency of Singapore (data.gov.sg)	https://data.gov.sg/dataset/park-connector-loop
	Park Connector Line	Vector, Line	Government Technology Agency of Singapore (data.gov.sg)	https://data.gov.sg/dataset/mp14-sdcp-pw-plan-park-connector-line
Cycling Infrastructure	Bicycle Crossing	Pdf	Land Transport Authority of Singapore	https://www.lta.gov.sg/content/ltaweb/en/walk-cycle-ride/integrating-cycling-with-public-transport/supporting-cycling-infrastructure.html
	Bicycle Rack	Vector, Points	Government Technology Agency of Singapore (data.gov.sg)	https://data.gov.sg/dataset/lta-bicycle-rack
	Traffic Sign and Road Markings	Vector, Points	Data Mall, Land Transport Authority of Singapore	https://www.mytransport.sg/content/dam/datamall/datasets/Geospatial/TrafficSign.zip