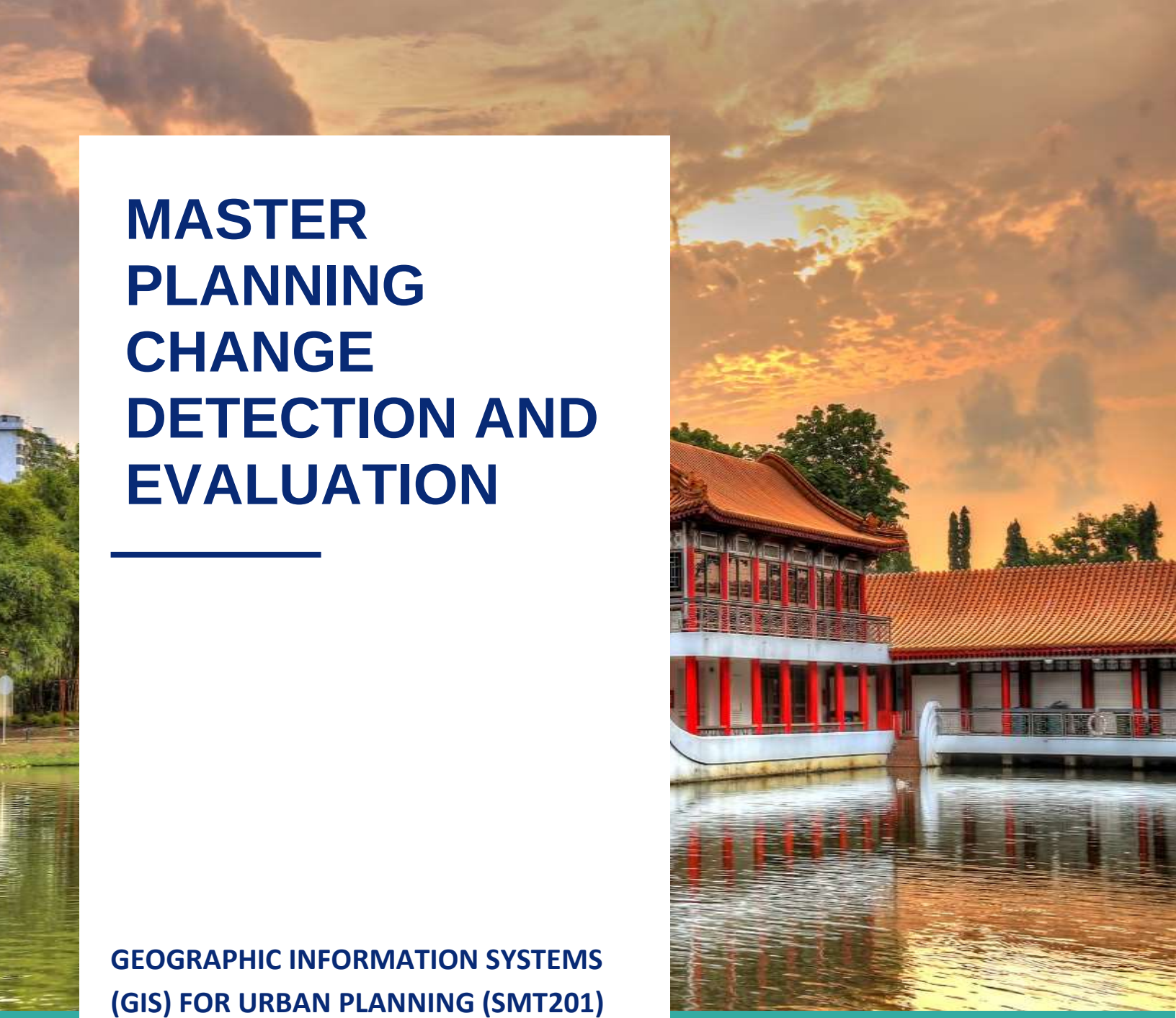

MASTER PLANNING CHANGE DETECTION AND EVALUATION

GEOGRAPHIC INFORMATION SYSTEMS (GIS) FOR URBAN PLANNING (SMT201)
G1 : GROUP 7

GROUP PROJECT REPORT BY

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1. Introduction

With Singapore launching the Smart City Initiative which aims to make Singapore an outstanding city in the world for people to live, work and play in such that Singaporeans would want to continue making Singapore home to them and foreign talent to relocate here, there is a need to analyse Singapore's land use to ensure that there is an efficient allocation of necessary resources to cater to the changing needs and demands of the growing population mix overtime. It is therefore important to adopt a strategic, long-term approach to overcome Singapore's scarce land issue to achieve its economic and social objectives with the ultimate goal of ensuring inclusivity, sustainability, and green neighbourhoods with spaces for community and amenities for all to enjoy.
With the Smart Nation Initiative encouraging the harnessing of info-comm technologies, networks and big data to come up with solutions for modern day problems, we utilized already collected data on websites such as data.gov.sg and singstat.gov.sg to be used with Geographic Information Systems to ensure improved urban planning. This will be done for one of the planning areas in Singapore that we have chosen, Jurong East, before increasing the scale to implement this to the rest of Singapore.

1.1. Project Objective

The objectives are as follows:

1. Identify land use change from 2008 to 2014 via change detection of master plans to project the direction the town is heading towards.
2. Identify population trends for different categories of age groups within chosen subzone with projections of population until the year 2024
3. Identify gaps that could be closed and recommend changes or new uses of land in chosen subzone to meet the needs of residents, workers and visitors of Jurong East.

1.2. Overview of Data Used

The population was segregated according to their age groups as such:

1) Young (aged 0 to 14)

2) Economically active (aged 25 to 64)

3) Elderly (aged 65 and above)

With these different demographics in mind, necessary facilities and amenities that would enhance their quality of life for each group respectively was used to conduct our analysis. The following smart-city features were used for our analysis:

1) Eldercare centres

2) Healthcare

3) Housing (HDB)

4) Education (e.g. Primary Schools)

5) Transportation (Bus Stops, Cycling and Road Networks)

6) Food Centres

7) Gyms

8) Education

9) Public Spaces

1.3. Data Sources used

Data Title	Data Format	Data Type	Source
Land Use Data			
MP08 Land Use	SHP	Polygon	https://data.gov.sg/dataset/mp08-land-use
Master Plan 2008 Planning Area	SHP	Polygon	https://data.gov.sg/dataset/master-plan-2008-planning-area-boundary-no-sea
Master Plan 2008 Subzone	SHP	Polygon	https://data.gov.sg/dataset/master-plan-2008-subzone-boundary-no-sea
Master Plan 2014 Land Use	SHP	Polygon	https://data.gov.sg/dataset/master-plan-2014-land-use
Master Plan 2014 Planning Area	SHP	Polygon	https://data.gov.sg/dataset/master-plan-2014-planning-area-boundary-no-sea
Master Plan 2014 Subzone	SHP	Polygon	https://data.gov.sg/dataset/master-plan-2014-subzone-boundary-no-sea
Buildings	SHP	Polygon	https://download.bbbike.org/osm/bbbike/Singapore/
HDB Property Information	CSV	Point	https://data.gov.sg/dataset/hdb-property-information

ASTER Global Digital Elevation Model (GDEM)	tif	Raster	https://search.earthdata.nasa.gov/search?m=-7.175!25.59375!1!1!0!0%2C2
Population Data			
Singapore Residents by Planning Area Subzone, Age Group, Sex and Type of Dwelling, June 2000-2019	CSV	-	https://www.singstat.gov.sg/find-data/search-by-theme/population/geographic-distribution/latest-data
Transport Data			
Bus Stop Location	SHP	Point	https://www.mytransport.sg/content/mytransport/home/dataMall/search_datasets.html?searchText=bus%20stop
Train Station	SHP	Point	https://www.mytransport.sg/content/mytransport/home/dataMall/search_datasets.html?searchText=train
Roads	SHP	Point	https://download.bbbike.org/osm/bbbike/Singapore/
Cycling Path Network	SHP	Polyline	https://data.gov.sg/dataset/cycling-path-network
Park Connector Line	SHP	Polyline	https://data.gov.sg/dataset/sdcp-park-connector-line
Amenities Data			
Eldercare Service	SHP	Point	https://data.gov.sg/dataset/eldercare-services?resource_id=81244fb2-9d1b-4bd8-98ff-49c041fe53ac
CHAS Clinics	KML	Point	https://data.gov.sg/dataset/chas-clinics
Silver Zone	SHP	Polygon	https://www.mytransport.sg/content/mytransport/home/dataMall/static-data.html
Traffic	SHP	Point	https://www.mytransport.sg/content/mytransport/home/dataMall/static-data.html

Hawker Centres	KML	Point	https://data.gov.sg/dataset/hawker-centres
Fast Food	CSV	Point	https://data.gov.sg/dataset/list-of-nea-licensed-eating-establishments-with-grades-demerit-points-and-suspension-history
Parks	SHP	Point	https://data.gov.sg/dataset/parks
Childcare Services	Text	Point	https://skoolopedia.com/app/childcare/area/jurong-east
Pre-schools	Text	Point	https://www.google.com.sg/search?q=pre+schools+in+jurong+east&ie=&oe=
Schools	CSV	Point	https://data.gov.sg/dataset/school-directory-and-information

1.4. Planning Area

The planning area we chose, Jurong East, is a residential town with an estimated 80,000 residents (2019). It is made out of 10 subzones, namely Jurong Port, Penjuru Crescent, Jurong River, Teban Gardens, Lakeside, Jurong Gateway, International Business Park, Toh Guan, Yuhua East and Yuhua West (See Figure 1 and 2 for Jurong East Subzones in 2008 and 2014 respectively).

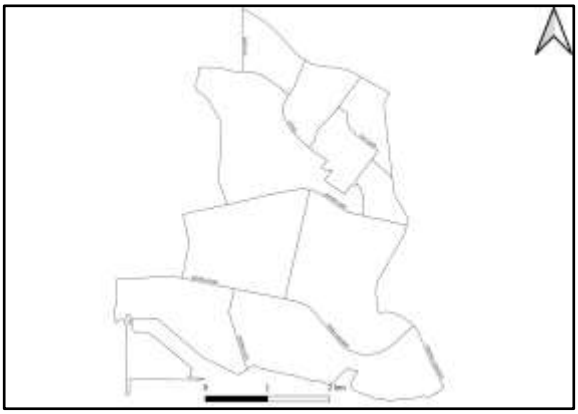


Figure 1: Subzones in Jurong East 2008

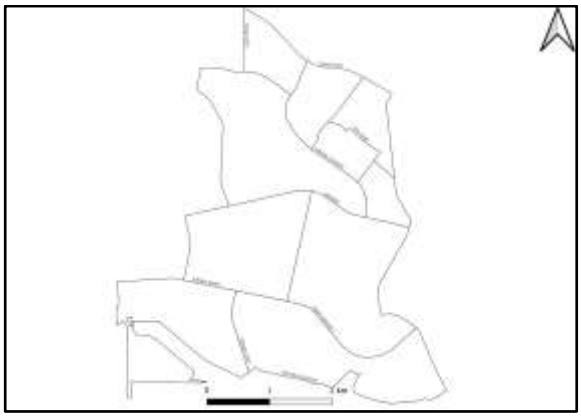


Figure 2: Subzones in Jurong East 2014

The residential areas are identified to be in the upper half of Jurong East while the business areas are identified to be in the lower half of Jurong East. Jurong East is a town bustling with housing and commercial developments, attracting many to live and work with transportation network mainly served by Jurong East MRT, Chinese Garden MRT and Jurong East Bus Interchange. Jurong East is home to Singapore's first business park, International Business Park, which is managed by JTC and is home to many international and homegrown companies. Jurong Port which is in Jurong East is also said to have played a key role in Singapore's economic growth.

Two subzones of Jurong East, Jurong Gateway and Lakeside, would be part of Jurong Lake District (JLD) set to be completed after 2040 in line with URA's decentralised efforts to bring more quality jobs, amenities and recreational areas closer to residential areas. Additionally, about 20,000 new homes have also been planned for the district, making Jurong East a vibrant town where one can work, play and live in.

2. Problems and Issues Identified while Conducting Analysis

We realised that there is still potential to provide a better standard of living to meet the social needs for residents who are currently residing in Jurong East given the changes in population demographics. More resources and essential services can be efficiently allocated to these residents, especially for the elderly population that is growing and will continue to grow over the years. The accessibility and connectivity to these essential services for the entire Jurong East should be looked into.

3. Motivation of Project

Singapore, the world's third most densely populated place with 7148 people per km^2, is a city state with scarce land area of 721.5 km^2 and a population of 5.8 million people in 2019. With this limited land space, Singapore needs to meet the infrastructural needs of its people and achieve its social objectives while preventing overcrowding, balancing the demand for growth and maintaining Singapore's status as a 'Garden City'. Urban planning is also important in creating the ground for

collaboration between local governments, private sector and public to take ownership of the quality of life in Singapore.

With the importance of urban planning in mind, we are motivated to use Geographic Information Systems (GIS) to ensure improved urban planning for one of the planning areas in Singapore, Jurong East, by utilizing already collected data such as land use, population demographics and educational facilities as well as primary data.

4. Population Trends in Jurong East

The population of Jurong East has been steadily decreasing from 86,800 to 79,240 from 2008 to 2019. As mentioned in the previous section, with the JLD aiming to build about 20,000 new homes by 2040, Jurong East's population would increase by manifold in the future. As seen from Figure 3, all population demographics (the young, aged 0-4 and 5-14 and economically active, aged 25-64) are decreasing steadily except for the elderly population (aged 65 and above). The elderly population has a substantial increase from 6, 800 in 2008 to 14,000 in 2019 and is projected to increase even more to 17,000 in 2024, showing that there will be an increase in demand for elderly friendly services and amenities to cater to their needs. The economically active adults make the bulk of Jurong East's population, with about 46,000 of them in both 2019 and 2024. There is not much of a change in the economically active adults population from year 2019 to 2024 and beyond 2024, they are projected to increase with the increase in employment opportunities in Jurong East. For the young population, it is projected that their population would decrease by half from 2008 to 2024 from 14,000 to 7,000 due to declining birth rates and fertility rate dropping to 1.14 per woman in 2019. Some reasons that attribute to this is the increase in women who are career focused, choose to remain single and choose to give birth at a later age.

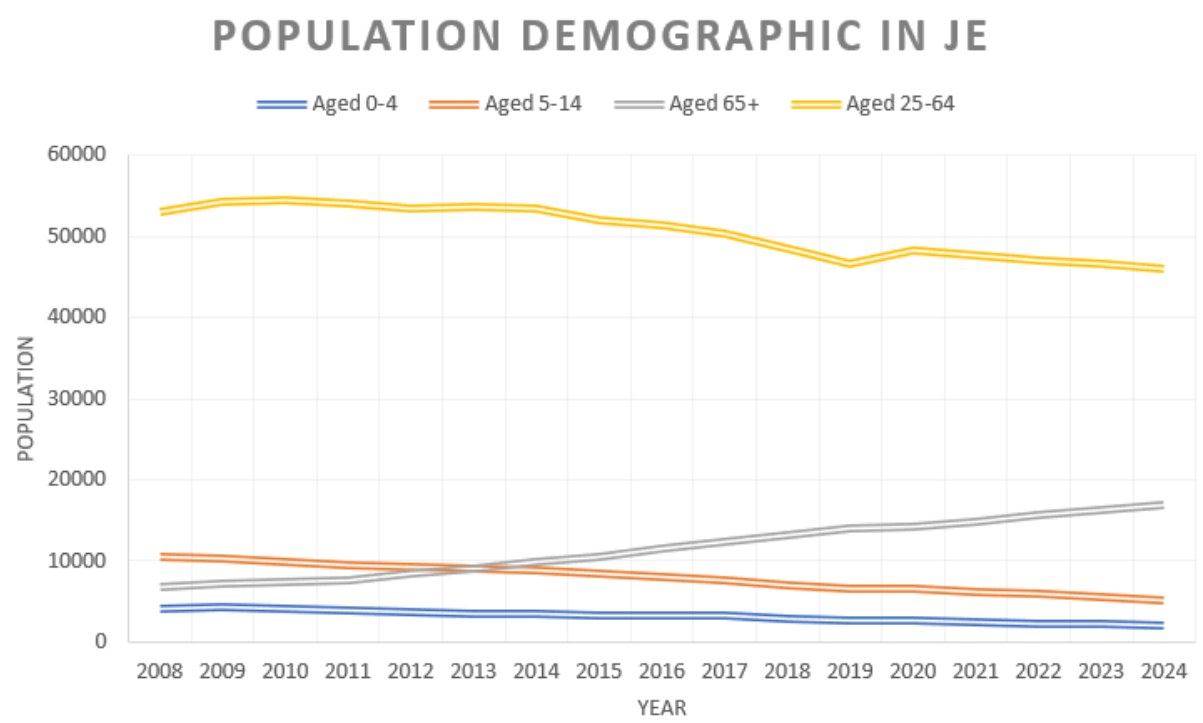


Figure 3: Population Trends for different demographics

The elderly population increased at a similar pace from 2008 to 2019 and will continue to do so until 2024 in the residential subzones of Jurong East (Figure 4). Yuhua East has consistently been the subzone with the most number of elderly residing in it, followed by Teban Gardens, Yuhua West and thereafter Toh Guan. Yuhua East is projected to have about 6000 elderly in 2024, Teban Gardens and Yuhua West to have about 4000 elderly in 2024 and Toh Guan with about 2000 elderly in 2024. The elderly proportion in Singapore is projected to double from 1 in 8 to 1 in 4 by 2030 and 1 in 2 by 2050 mainly due to an increasing life expectancy. Therefore, potential problems that could arise from an ageing population should be addressed through analysis of urban infrastructure, housing and healthcare.

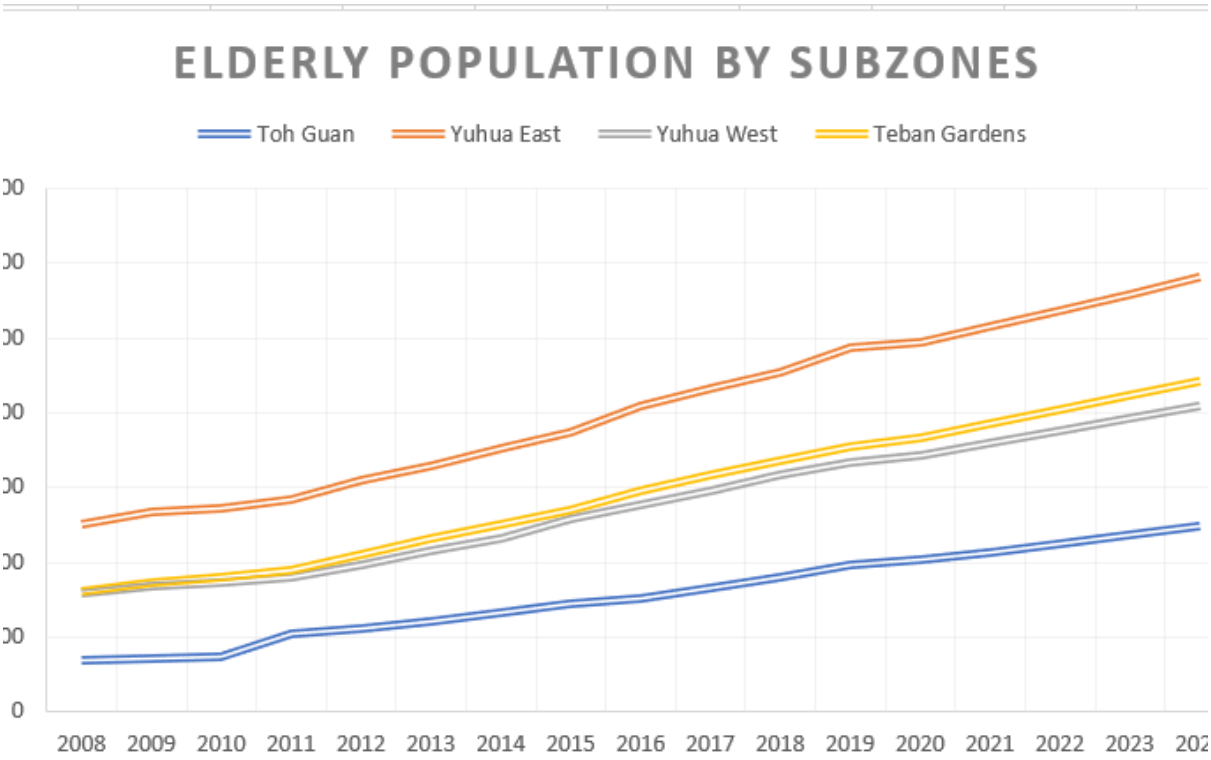


Figure 4: Elderly Population Trends by Subzones

For more detailed information about Jurong East's population, please refer to the following table in the link provided:

https://drive.google.com/drive/u/1/folders/1mDD5xbDldnr2MPj5YumQPlbh1qlEFsbU

5. *Processes and Functions used*

5.1. Approach to Identify Changes in Land Use from 2008 to 2014

Firstly, we unioned the two land use datasets from the vector tab → Geoprocessing tools → Union with the input layer being 2008 Jurong East Land Use and overlay layer being 2014 land use to see what has changed from 2008 to 2014 (Figure 5). The land use information for both years are then combined and can be seen side by side in the attribute table of this new union layer created.

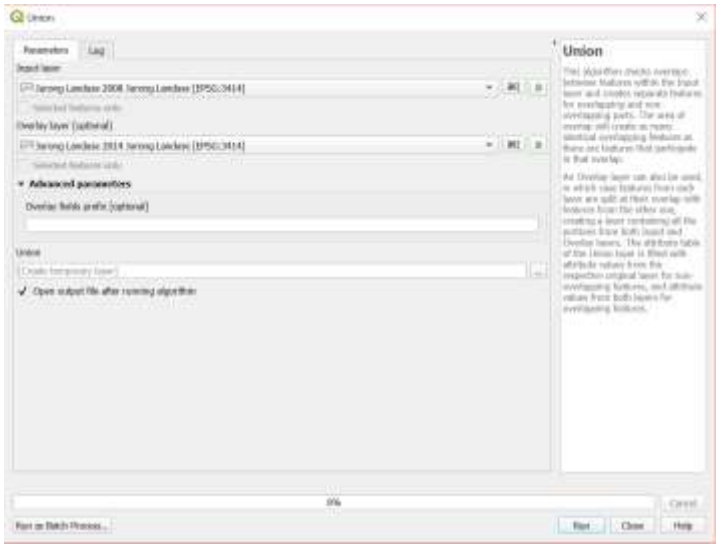


Figure 5: Union 2008 and 2014 land use layers

To specifically highlight the land use that has changed from 2008 to 2014, we selected features using an expression found at the top of the attribute table and input the equation shown in Figure 6 description of land use in 2008 is not equals to the description of land use in 2014.

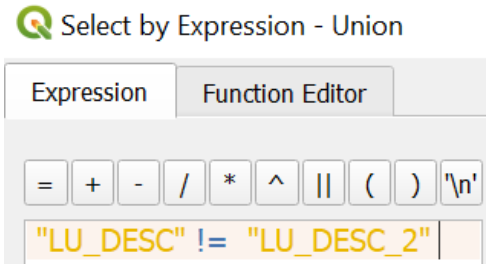


Figure 6: Select by Expression

A new column to easily see the change in landuse was created using the field calculator (Figure 7). The output for those highlighted from Figure 6 is seen in Figure 8.

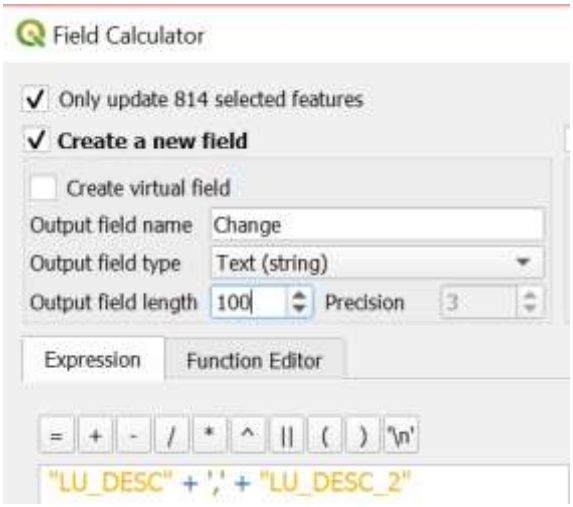


Figure 7: Creating a new column with Field Calculator

Figure 8: Example of output from field calculator

5.2. Approach to Identify Suitable Land

After identifying the decision factors for the land suitability analysis of building new amenities, we first rasterized the layers that contained these factors. We created a new column named POI_CODE with the value '1' (as shown in Figure 9) and thereafter filled up the different aspects of Rasterize (Vector to Raster) as shown in Figure 10. The POI_CODE was created so that it can be used as a field for a burn-in value. The output raster size units is georeferenced units and the resolution should be 5 by 5. The extracted Jurong East ASTER_GDEM Layer was used as the output extent. Rasterize (Vector to Raster) was accessed through Raster tab → Conversion → Rasterize.

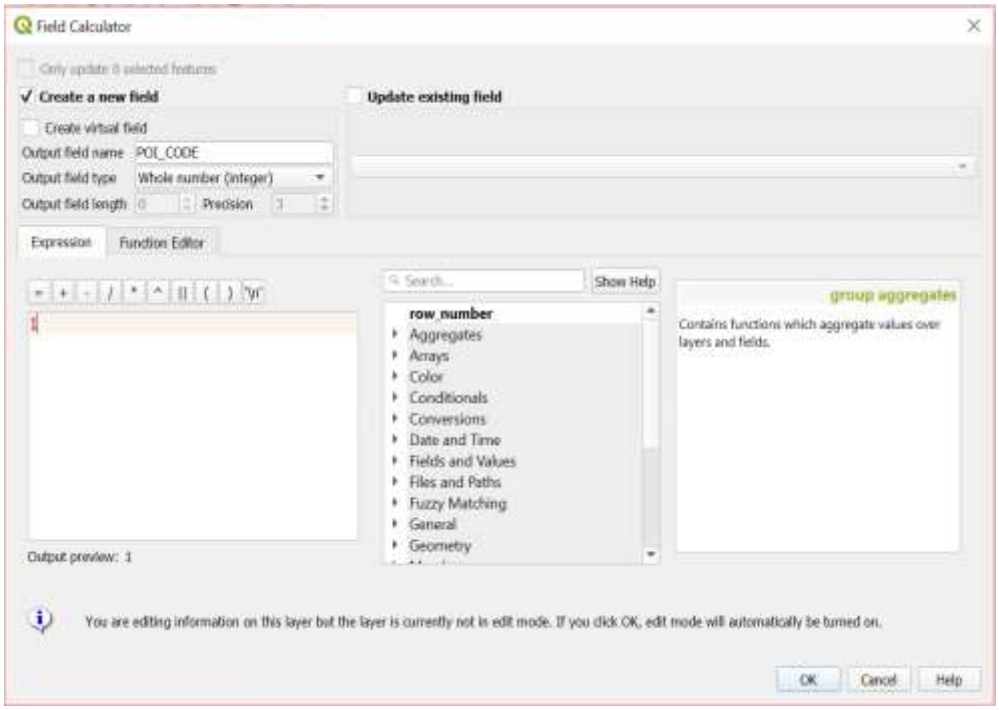


Figure 9: Field Calculator

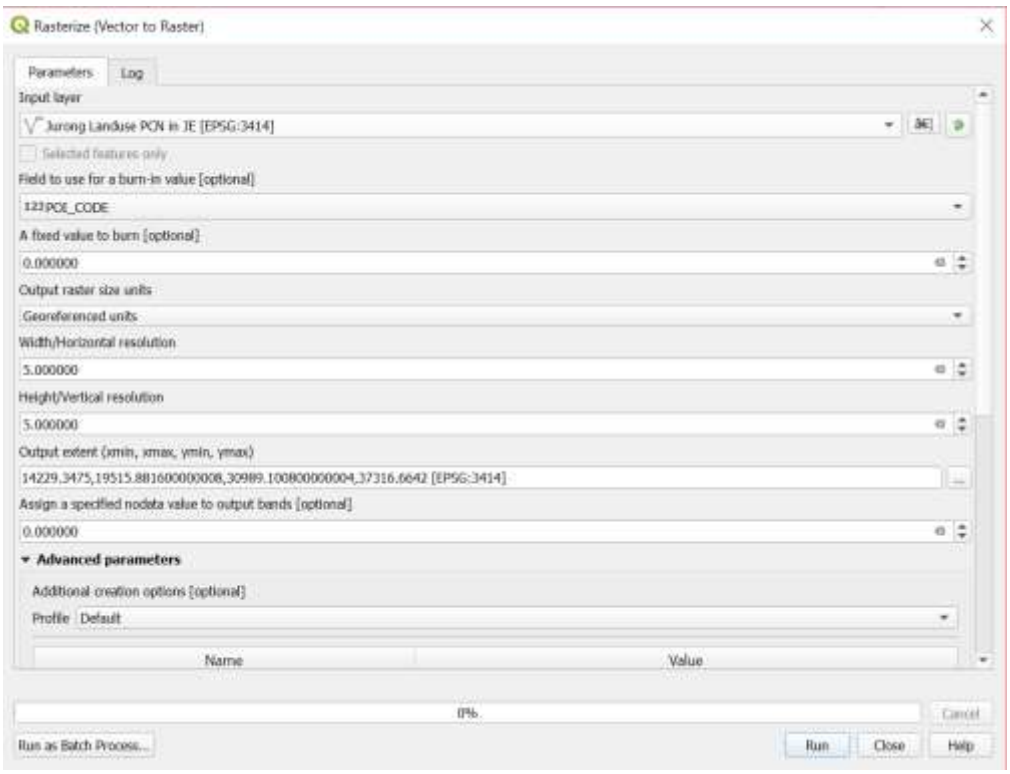


Figure 10: Rasterizing Layer

To calculate the proximity to each respective layer by creating a proximity map, we used Proximity (Raster Distance) by clicking Raster tab → Analysis → Proximity (Raster Distance). The inputs are as follows in Figure 11.

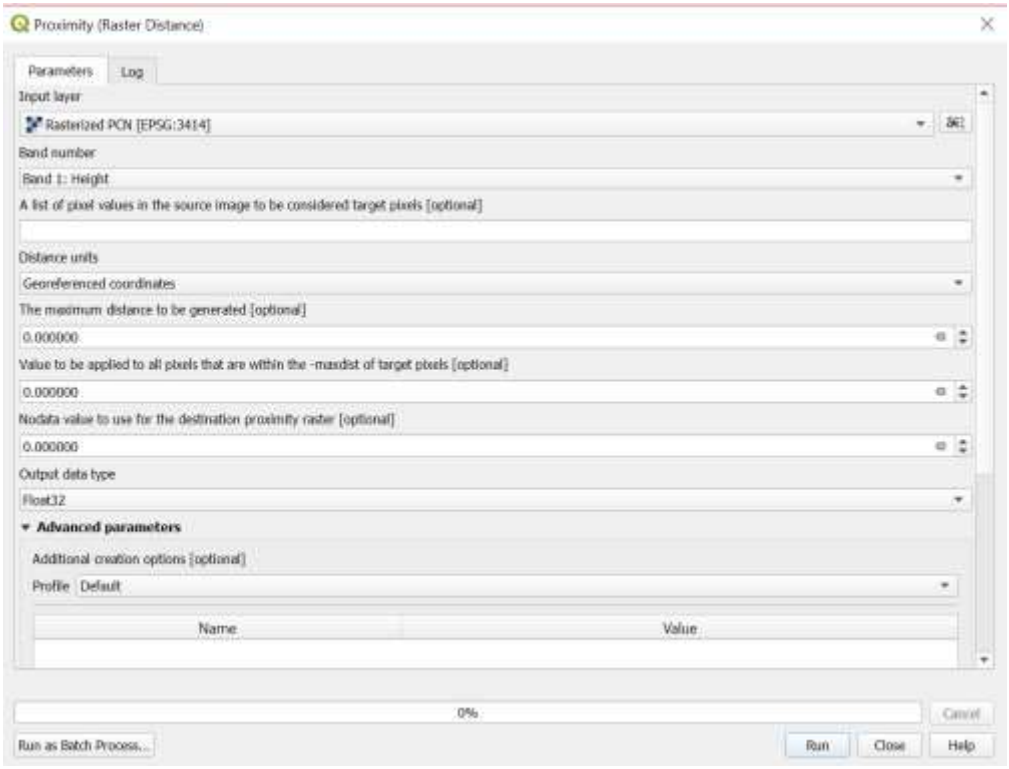


Figure 11: Proximity to Respective Layer

The slope of the Jurong East Planning area was also calculated using GDAL's Slope function as seen in Figure 12 and 12a.

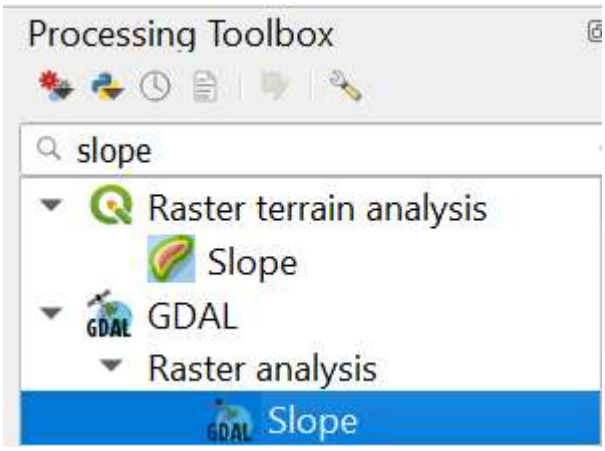


Figure 12: GDAL Slope

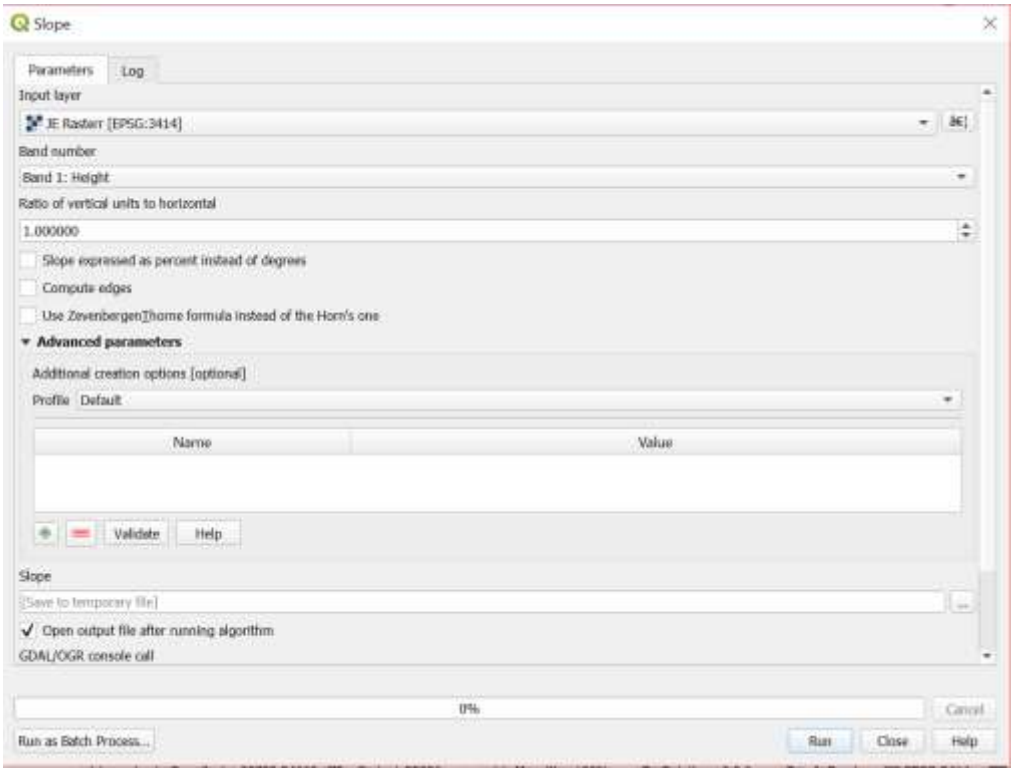


Figure 12a: Slope Dialog Window

The Min-Max Criteria Standardization Technique was used on the proximity and slope raster layers. If a closer proximity to the layer or a gentler slope is preferred, the standardized criterion score = 1 - (Current Proximity/Slope - Min Proximity/Slope)/(Max Proximity/Slope - Min Proximity/Slope), else (Current Proximity/Slope - Min Proximity/Slope)/(Max Proximity/Slope - Min Proximity/Slope). In both cases, the minimum proximity or slope is 0. This was calculated in the Raster Calculator as seen in Figure 13.

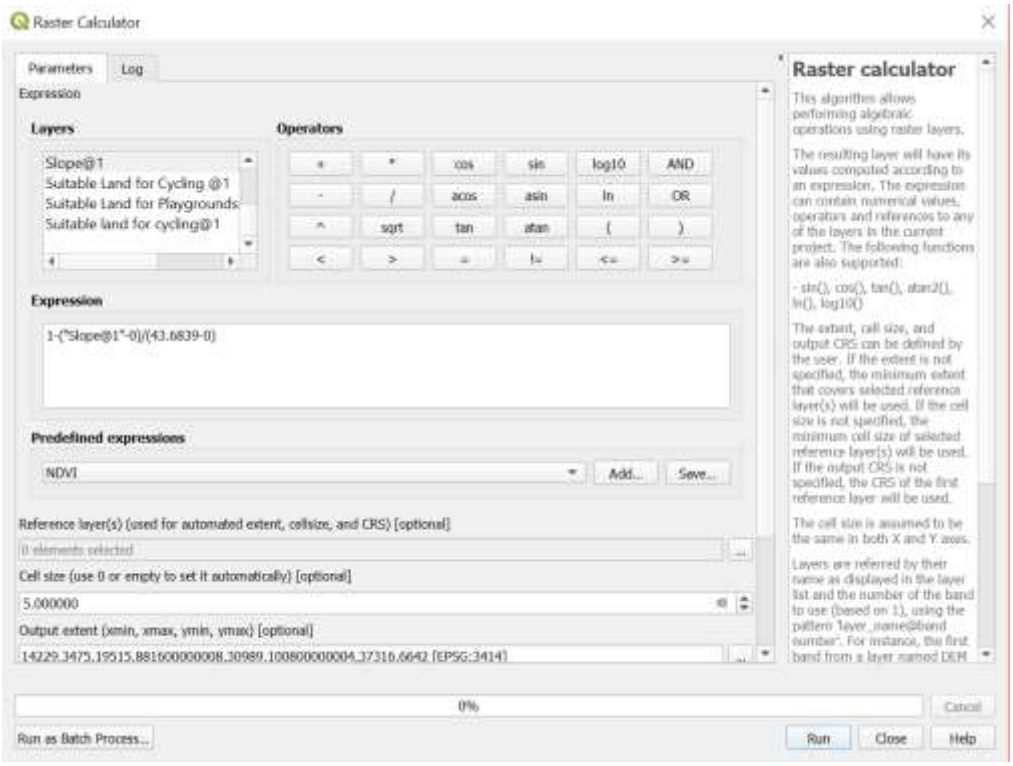


Figure 13: Standardization for Slope

The Excel-based Analytical Hierarchical Process (AHP) library such as the AHP Template provided by SCB Associates was used to give different weights to the different decision factors to increase the reliability of the results. This is because the decision factors are not of equal importance, with some being more important than the others. The level of importance is tied to a value as shown in Figure 14.

Analytic Hierarchy Template: n=	4	Criteria

Fundamental Scale (Row v Column)	
Extremely less important	1/9
	1/8
Very strongly less important	1/7
	1/6
Strongly less important	1/5
	1/4
Moderately less important	1/3
	1/2
Equal Importance	**1**
	2
Moderately more important	3
	4
Strongly more important	5
	6
Very strongly more important	7
	8
Extremely more important	9

Figure 14: Importance Scores

The relative importance of one factor to another can be compared using the Pairwise Comparison Matrix. For example, the slope of the land (Row) is strongly more important than the scenery (proximity to water bodies)(Column), as seen in Figure 15.

Pairwise Comparison Matrix

	Slope	Safety	Connectivity	Scenery
Slope	1	1/2	2	5
Safety	2	1	3	7
Connectivity	1/2	1/3	1	3
Scenery	1/5	1/7	1/3	1

Figure 15: Pairwise Comparison Matrix

A weight for each decision factor is then generated based on pairwise comparisons of the criteria (in this case, 0.288, 0.489, 0.162 and 0.060 for factor 1, 2, 3 and 4 respectively). The consistency of the result is also confirmed under the Consistency check table shown in Figure 16.

	AHP		Consistency check
1	0.288	28.8%	Consistency OK
2	0.489	48.9%	1%
3	0.162	16.2%	
4	0.060	6.0%	
5	0.000	0.0%	
6	0.000	0.0%	
7	0.000	0.0%	
8	0.000	0.0%	
9	0.000	0.0%	
10	0.000	0.0%	
11	0.000	0.0%	
12	0.000	0.0%	
13	0.000	0.0%	
14	0.000	0.0%	
15	0.000	0.0%	

Figure 16: AHP

Lastly, the standardized scores of each decision factor is then multiplied with its respective AHP score calculated previously and the results are all summed up to a final value using the raster calculator as seen in Figure 17. The higher the final value, the more suitable the plot of land is to build the amenities.

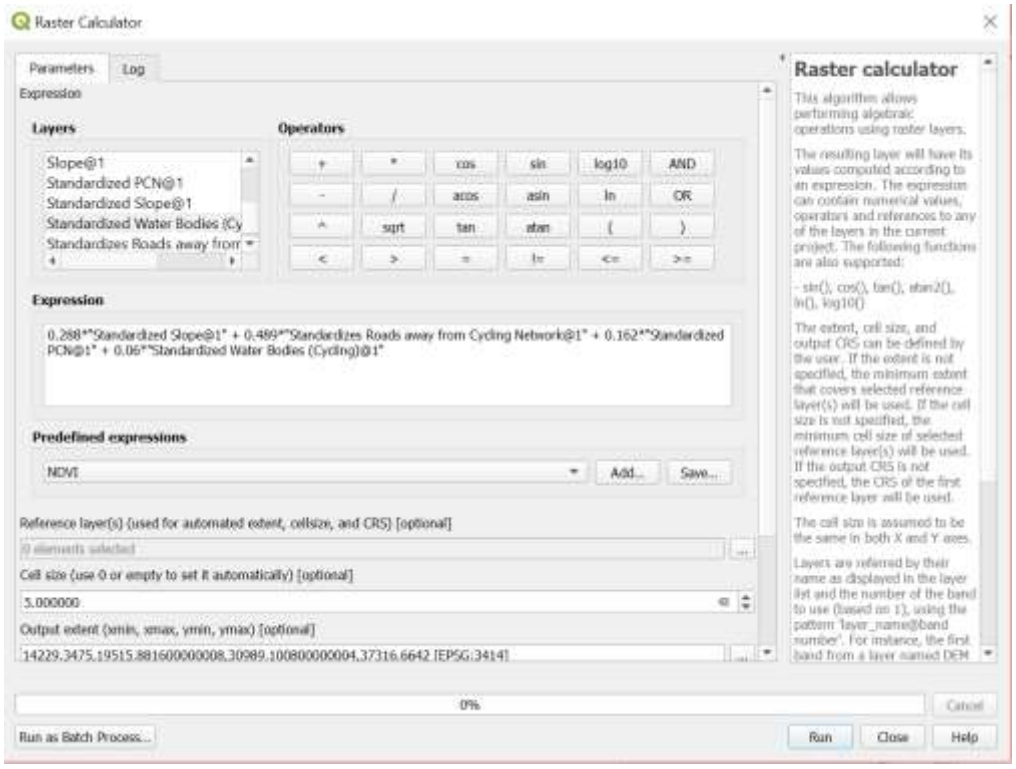


Figure 17: Product Sum of Standardized Scores with AHP Scores

Lastly, to only consider the land suitable in Jurong East, we Clip Raster by Mask Layer by clicking on Raster → Extraction → Clip Raster by Mask Layer. The input layer is the map as a result of the above analysis and the mask layer is the chosen planning area map (Figure 18).

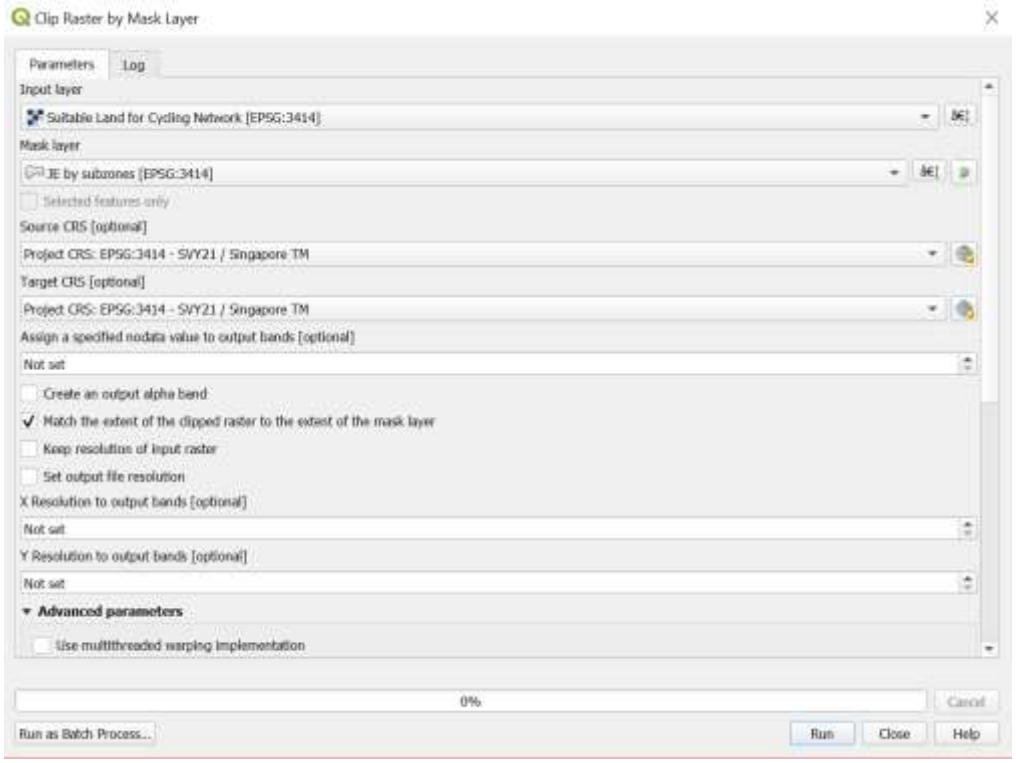


Figure 18: Clip Raster by Mask Layer (Jurong East)

In order to differentiate the extent of suitability of the land in Jurong East based on the final values found beforehand, the range of values are categorized according to quantiles and 5 classes namely “Not suitable”, “Slightly Suitable”, “Moderately Suitable”, “Considerably Suitable” and “Suitable” (Figure 19). Suitable plots of land were then considered for our site selection.

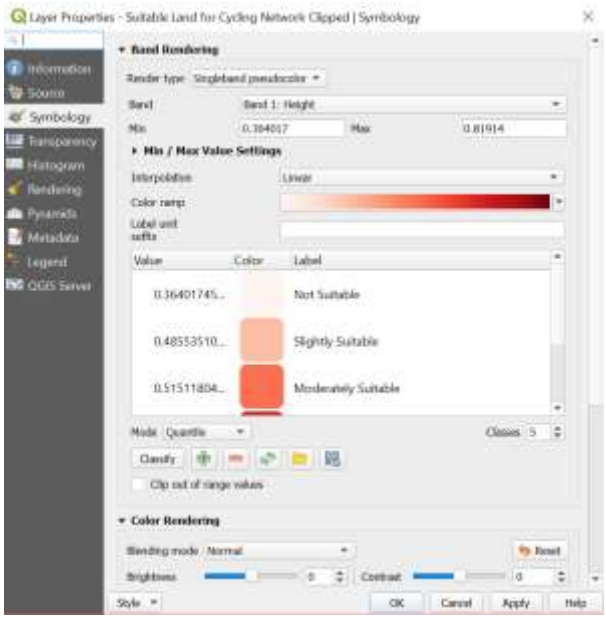


Figure 19: Color Coding Suitability of Land

5.3. Data Cleaning

In order to analyse the population trends of Jurong East, Excel was used to extract out the relevant information. The population data was split into two worksheets, one having data from 2001 to 2010 and 2011 to 2019. 2008-2010 data was taken from the former and 2011-2019 data from the latter.

From the planning area column, ‘Jurong East’ was filtered out (Figure 20 and 21). From there, we filtered the different subzones and age groups we needed accordingly and place this data on a separate worksheet.

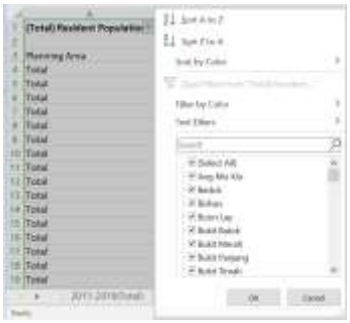


Figure 20: All planning areas in Singapore

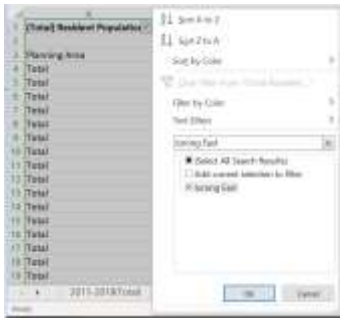
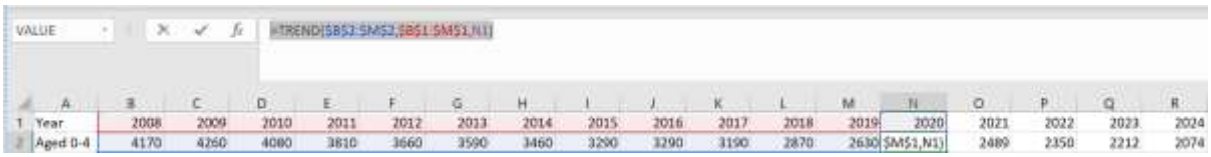


Figure 21: Filtering Jurong East only

The trend function in excel was used to project the population numbers from 2020 to 2024. The formula, =TREND($B$2:$M$2,$B$1:$M$1,N1), for example, first takes in the range of values of the population from 2008 to 2019 ($B$2:$M$2), then takes in the range of values of the years with population data so far ($B$1:$M$1), and lastly takes in the cell with the year that we want to project the population for (2020 in this case). The results are as follows in Figure 22. This trend function computes the linear trend line and predicts the population value based least square method.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2	Aged 0-4	4170	4260	4080	3810	3660	3590	3460	3290	3290	3190	2870	2630	$M$1,N1)	2489	2350	2212	2074

Figure 22: Projecting Population Numbers until 2024

We then generated graphs to better visualise the population trends using 2-D line graphs that can be found under the insert tab → Charts → Line graph logo. The dataset that we want to translate to graphs should be first highlighted before making the line graph (Figure 23).

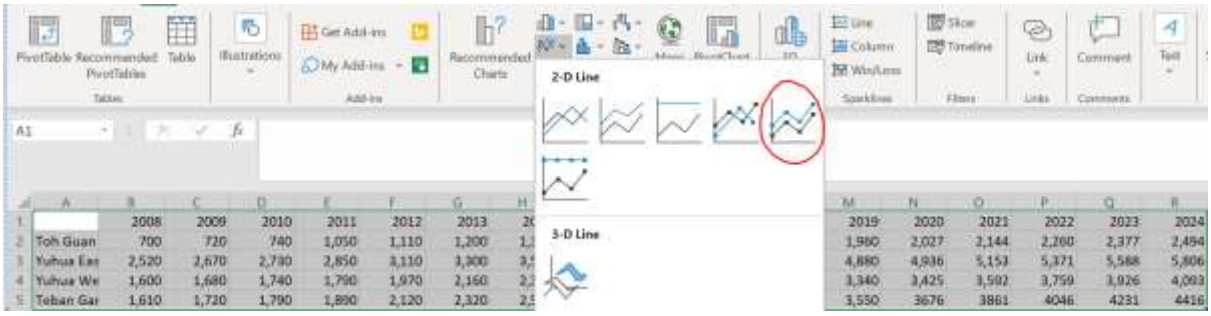


Figure 23: Creating line graph

5.4. Geocoding

We mainly cleaned the data in Excel to prepare them for geocoding. Some of the information required in our analysis did not come in shape files and could not be clipped with the Jurong East Planning Area to see the locations of existing facilities. For example, some of the datasets from data.gov (e.g. https://data.gov.sg/dataset/hdb-property-information) only had addresses as relevant information that could be used to identify those from Jurong East. Those from Jurong East were identified under the column “Building Contract” which indicated the planning area the HDB blocks were in. At first, the block number and street was in separate cells and we merged this information to get the full address by

using the formula =A2&" "&B2, where A2 and B2 are the cells with the information we want to merge together. Thereafter, to get the Postal Codes of these HDB blocks in Jurong East, we pasted the full address in https://www.singpost.com/find-postal-code. The results are as follows and saved in a CSV as seen in Figure 24.

blk_no	street	Postal Coc	Country	Full Address
101	JURONG E	600101	Singapore	101 JURONG EAST ST 13
102	JURONG E	600102	Singapore	102 JURONG EAST ST 13
103	JURONG E	600103	Singapore	103 JURONG EAST ST 13
104	JURONG E	600104	Singapore	104 JURONG EAST ST 13
105	JURONG E	600105	Singapore	105 JURONG EAST ST 13
106	JURONG E	600106	Singapore	106 JURONG EAST ST 13
107	JURONG E	600107	Singapore	107 JURONG EAST ST 13
108	JURONG E	600108	Singapore	108 JURONG EAST ST 13
109	JURONG E	600109	Singapore	109 JURONG EAST ST 13
110	JURONG E	600110	Singapore	110 JURONG EAST ST 13
111	JURONG E	600111	Singapore	111 JURONG EAST ST 13
112	JURONG E	600112	Singapore	112 JURONG EAST ST 13
113	JURONG E	600113	Singapore	113 JURONG EAST ST 13
114	JURONG E	600114	Singapore	114 JURONG EAST ST 13
115	JURONG E	600115	Singapore	115 JURONG EAST ST 13
116	JURONG E	600116	Singapore	116 JURONG EAST ST 13
20	TEBAN GD	600020	Singapore	20 TEBAN GDNS RD
201	JURONG E	600201	Singapore	201 JURONG EAST ST 21

Figure 24: Information for Geocoding

To add them as points in QGIS, we used MMQGIS plugin → Geocode → Geocode CSV with Web Service (Figure 25)

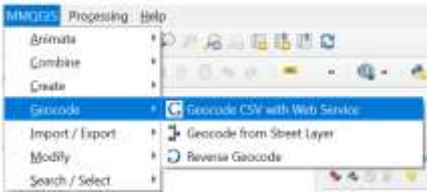


Figure 25: MMQGIS Geocoding

The dialog window appears and the input CSV File is the one in Figure 24, Address is the Full Address found, City is the Postal Code found and State and Country is “Singapore”. Web Service is changed from Google to OpenStreetMap as seen in Figure 26.

Figure 26: Geocoding Dialog Window

Thereafter, we saved the results in a geopackage and changed the CRS to the Project CRS ie EPSG:3414 - SVY21 / Singapore ™ (Figure 27).

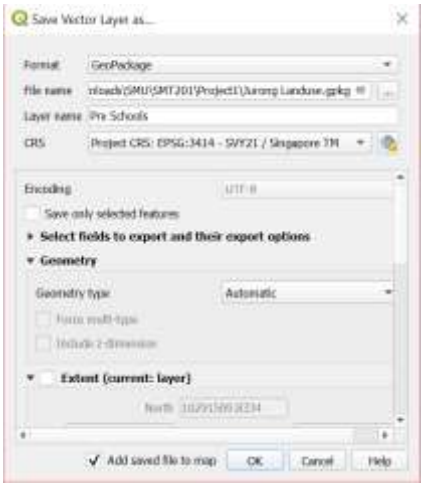


Figure 27: Saving Geocoded Points as Geopackage

For the facilities that did not have datasets at all, we went to Google to extract the exact addresses and postal codes of the facilities specifically in Jurong East. Thereafter, we used the same method above to geocode the points.

6. *Changes in Jurong East Land Use from 2008 to 2014*

Figure 28: Land use of Jurong East in 2008

Figure 29: Land use of Jurong East in 2014

Please refer to the following links below for a detailed analysis of the changes in Jurong East from 2008 to 2014:

i. Change Detection Table
https://docs.google.com/document/d/1yxGD3Zte0HmTk6SJ28aFJjZ6MQdjDAjRr21L70u-iAg/edit?usp=sharing

The Change Detection Table displays all the changes in Jurong East Land Use from 2008 to 2014, categorised according to the 2014 subzones. Changes include a general change in land-use, splitting or merging of areas, and change in size. Affected areas are circled in red.

ii. Changes in Land Use Size
https://drive.google.com/file/d/1t2Ngq2E7aLLHWrKeMqTIlKwyX_BCeWVj/view?usp=sharing

This excel sheet shows the size of every type of land-use in Jurong East in 2008 and 2014. The final table summarises the change in size of each land-use from 2008 to 2014, including an increase, decrease or a total change of land-use, hence we can observe major to minor changes in Jurong East.

7. *Analysis and Results*

7.1. Senior Citizens (Aged 65 and above)

Based on historical population data from 2008 to 2019, Jurong East is experiencing a rapid increase in the size of the elderly population. As the elderly population is growing in size, more amenities which are able to serve the elderly would also need to be increased. Examples of such amenities are eldercare centres and silver zone areas. Based on our further analysis of the elderly population in Jurong East, we are able to observe that the top two subzones which are experiencing the highest growth of the elderly population are Yuhua East and Teban Gardens. As the elderly population is increasing rapidly in these two subzones, Jurong East will face the problem of lack of amenities for the elderly population and this problem would be a challenge to both Yuhua East and Teban Gardens.

Eldercare centres

Currently in Jurong East, eldercare centres are only present in Yuhua West which is a subzone located at the north of Jurong East. However, as the elderly population is growing rapidly in both Yuhua East and Teban Gardens, we have decided to carry out our land suitability analysis in order to determine the best location in Jurong East where new eldercare centres can be allocated and developed.

In order to carry out the land suitability analysis, we have considered some important decision factors which would influence the development of the new eldercare centres. The decision factors which we

have taken into consideration are:

- Convenience factor (near to footways, pedestrian roads and residential roads)
- Accessibility factor (near to service roads)
- Business factor (far from business areas)
- Economic factor (slope)
- Noise factor or safety factor (far from motorways and motorway links)

Convenience factor

Eldercare centres should be built in areas which are near to footways, pedestrian roads and residential roads. These areas would be convenient for elderly who are staying in the eldercare centres to have a walk or take a stroll outside of the eldercare centres during their leisure time.

Accessibility factor

It is important for the eldercare centres to be located in areas which have service roads, especially during the construction phase, as these areas are more accessible for movement of carriage of construction materials and more accessible to the transportation used by contractors.

Business factor

Eldercare centres should be located far from business areas because the hustle and bustle of areas for business development would affect the comfort of the elderly while staying in the eldercare centres.

Economic factor

Sloped areas are not suitable for the development of new eldercare centres as these areas would incur high development costs as well as high construction costs. Furthermore, it is also safer and more convenient for elderly to walk on areas that are less uneven.

Noise factor/Safety factor

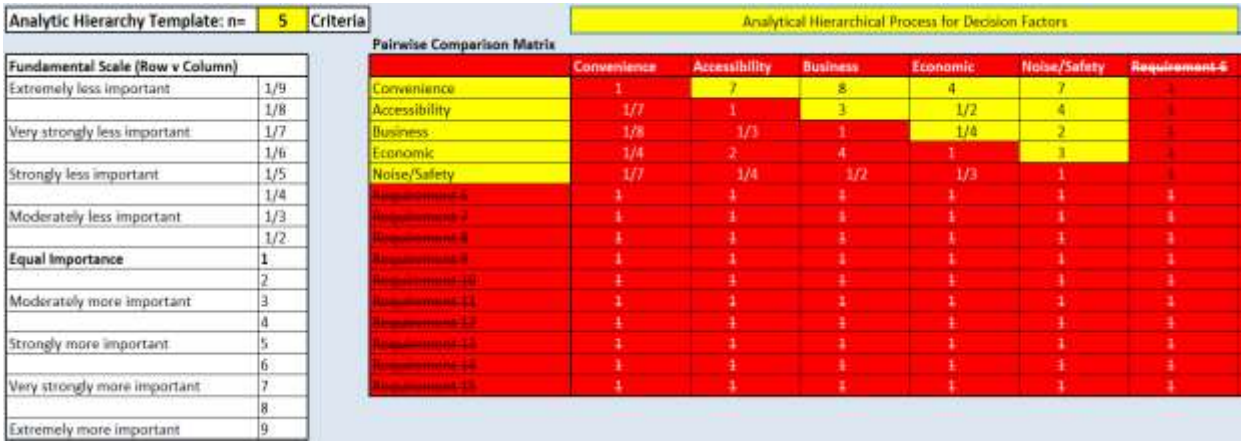
It is also important for eldercare centres to be located far from motorways and motorway links because the noises created by vehicles throughout the motorways and motorway links would affect the comfort of the elderly while staying in the eldercare centres. Moreover, it is also not safe for the elderly to take a stroll outside the eldercare centres if the eldercare centres are built near the motorways and motorway links due to a great number of vehicles passing through the motorways and motorway links.

After considering all the relevant decision factors to carry out the land suitability analysis, every feature layer which represents every decision factor are used and clipped according to the 'Jurong East Subzone 2014' layer as we would want to analyse every feature which is present only within Jurong East. The features which we have considered for each decision factor are:

- Footways, pedestrian roads and residential roads (Convenience factor)

- Service roads (Accessibility factor)
- Business areas (Business factor)
- Rasterized Jurong East layer (Economic factor)
- Motorways and motorway links (Noise factor or safety factor)

Every feature, originally in the form of vector layer, are rasterized in order to create a raster layer of each feature which will then be used to create the proximity raster layer of each feature. The proximity raster layer of each feature shows the distance between each feature and the different areas in Jurong East. The proximity raster layers allow us to analyse the areas which are suitable to allocate the new eldercare centres as the new eldercare centres are more suitable to be built near certain features (footways, pedestrian roads, residential roads and service roads) and far from the other features (business areas, motorways and motorway links). A slope analysis has also been carried out with the rasterized Jurong East layer in order to determine the different levels of elevation in different areas of Jurong East. Furthermore, the proximity raster layers and slope raster layer are also standardised by using the Min-Max Criteria Standardization Technique.



Analytic Hierarchy Template: n=	5	Criteria

Analytical Hierarchical Process for Decision Factors

Fundamental Scale (Row v Column)	
Extremely less important	1/9
	1/8
Very strongly less important	1/7
	1/6
Strongly less important	1/5
	1/4
Moderately less important	1/3
	1/2
Equal Importance	**1**
	2
Moderately more important	3
	4
Strongly more important	5
	6
Very strongly more important	7
	8
Extremely more important	9

Pairwise Comparison Matrix

	Convenience	Accessibility	Business	Economic	Noise/Safety	Requirement 6
Convenience	1	7	8	4	7	1
Accessibility	1/7	1	3	1/2	4	1
Business	1/8	1/3	1	1/4	2	1
Economic	1/4	2	4	1	3	1
Noise/Safety	1/7	1/4	1/2	1/3	1	1
Requirement 6	1	1	1	1	1	1
Requirement 7	1	1	1	1	1	1
Requirement 8	1	1	1	1	1	1
Requirement 9	1	1	1	1	1	1
Requirement 10	1	1	1	1	1	1
Requirement 11	1	1	1	1	1	1
Requirement 12	1	1	1	1	1	1
Requirement 13	1	1	1	1	1	1
Requirement 14	1	1	1	1	1	1
Requirement 15	1	1	1	1	1	1

Figure 29: Pairwise Comparison Matrix for new eldercare centres

Moreover, an AHP has been carried out to compute the scores for the importance of each decision factor as shown in Figure 29. The importance of a particular decision factor is compared relatively with every other decision factor by row. For instance, when the convenience factor is compared with accessibility factor, a score of 7 is given. This means that the convenience factor is very strongly more important than the accessibility factor while considering to select suitable areas and build new eldercare centres.

AHP		Consistency check
0.564	56.4%	Consistency OK
0.136	13.6%	10%
0.065	6.5%	
0.185	18.5%	
0.051	5.1%	

Figure 30: Overall AHP scores for each decision factor

After the allocation of different values to represent the different levels of importance when one decision factor is compared with every other decision factor, the overall AHP scores for each decision factor (as shown in Figure 30) are computed and used as the weightage of importance of every decision factor in analysing the suitable areas to allocate new eldercare centres in Jurong East.

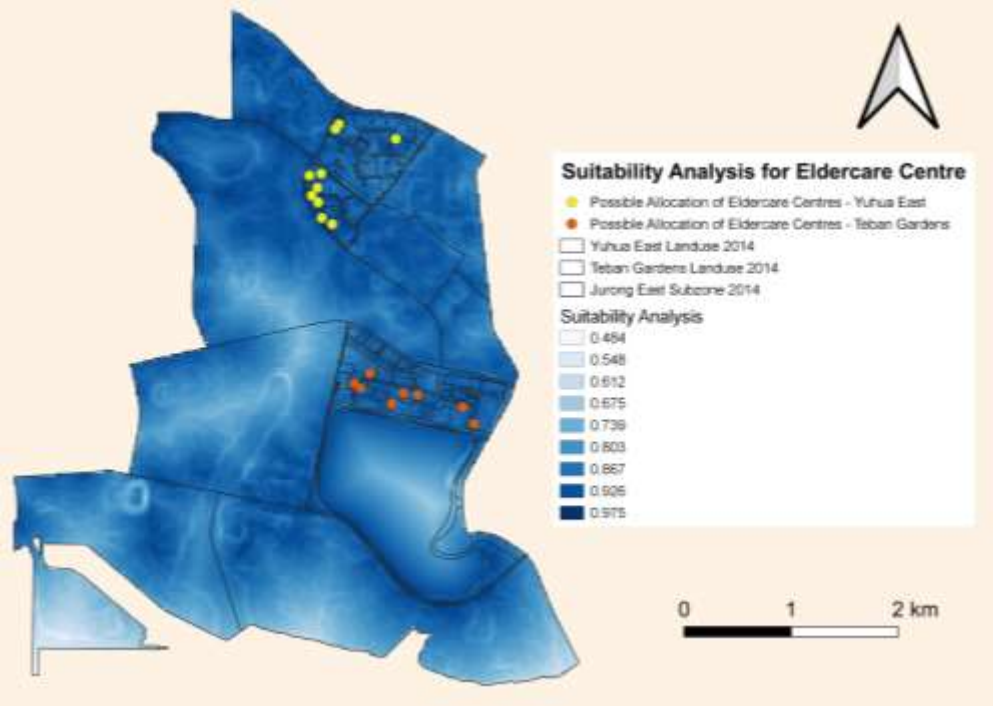


Figure 31: Land Use Suitability Analysis Map for Allocation of New Eldercare Centres

The land use suitability analysis enables us to determine and allocate the suitable areas where the new eldercare centres can be built. As Yuhua East and Teban Gardens are the top two subzones with rapid increase in the size of elderly population, we have allocated new eldercare centres in some possible areas within the two subzones according to our land suitability analysis. Since the darkest shade of blue has the highest score, the areas represented by the darkest shade of blue are the most suitable locations to allocate new eldercare centres. Hence, point features are used to allocate the new eldercare centres in areas which are the most suitable locations within Yuhua East and Teban Gardens.

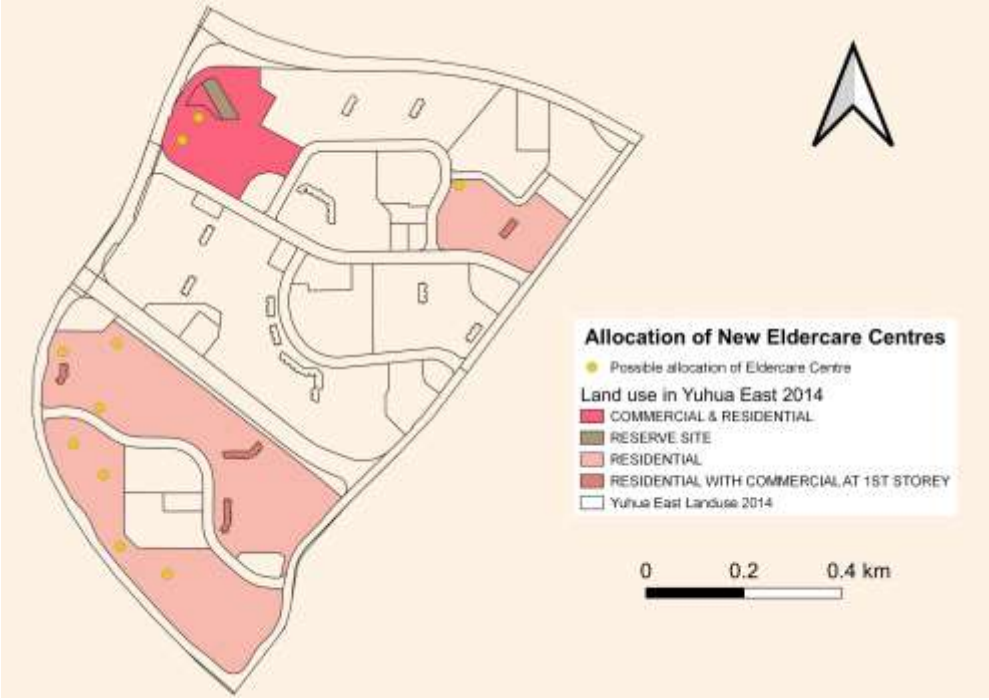


Figure 32: Allocation of New Eldercare Centres with Land Use of Yuhua East

While determining the areas which are suitable to allocate new eldercare centres, we have also considered the current land use of every suitable area to understand the other amenities which are useful to the elderly and should be located near the eldercare centres. For example, elderly can spend their leisure time, taking a stroll in a park instead of always staying in the eldercare centres. Therefore, as the south of Yuhua East is located near the Jurong Lake Gardens, a park area, most of the new eldercare centres are allocated in the south region of Yuhua East. The allocation of new eldercare centres in the north of Yuhua East, as shown in Figure 32, is based on the proximity to commercial and residential areas as new eldercare centres which are allocated near commercial areas would allow elderly to spend some time walking around the commercial areas instead of always staying in the eldercare centres. They would also have the opportunity to spend their leisure time in the commercial areas to buy items which they need or have a meal with their friends. Besides, most of the new eldercare centres are also allocated in residential areas because this would be convenient for residents to send the senior members in their family to the eldercare centres when they leave home for work and pick them up later while they are on their way back from their workplace.

Figure 33: Allocation of New Eldercare Centres with Land Use of Teban Gardens

As for Teban Gardens, according to the land suitability analysis as shown in Figure 5 and land use of Teban Gardens (as shown in Figure 33), new eldercare centres are suggested to be allocated in the north of Teban Gardens which mainly comprises of residential areas and has the darkest shade of blue compared to the other regions of Teban Gardens. The allocation of new eldercare centres in residential areas is deemed to be more suitable because this would be convenient for families, who stay in the residential areas, to send the senior members in their family to the new eldercare centres and pick them up while they are on their way back from their workplace. Furthermore, the presence of a park next to the residential areas would also be a good place for the elderly to spend their leisure time by going for a walk or doing light exercises in the park.

	fid	id	HubName	HubDist
1	9	38	FIRST CARE FA...	39.3975667259...
2	5	34	JURONG EAST ...	44.6658758881...
3	8	37	FIRST CARE FA...	91.9448623577...
4	6	35	JURONG EAST ...	102.459388676...
5	7	36	JURONG EAST ...	127.157813696...
6	1	30	JURONG EAST ...	145.014723573...
7	4	33	E.J. TAN CLINIC ...	170.450155103...
8	2	31	JURONG EAST ...	222.396882743...
9	3	32	E.J. TAN CLINIC ...	227.019079596...
10	10	39	MEDICO CLINIC...	292.810101820...

Figure 34: Hub distances between new eldercare centres and CHAS clinics for Yuhua East

	fid	id	HubName	HubDist
1	8	15	ACUMED MEDI...	31.4734790344...
2	6	16	NEWLIFE FAMIL...	37.4055552529...
3	1	10	NEWLIFE FAMIL...	94.9382157331...
4	4	13	ACUMED MEDI...	103.055248216...
5	7	17	PANDAN CLINI...	117.128188686...
6	2	11	NEWLIFE FAMIL...	155.057191074...
7	3	12	ACUMED MEDI...	166.594693290...
8	5	14	PANDAN CLINI...	240.275926849...

Figure 35: Hub distances between new eldercare centres and CHAS clinics for Teban Gardens

After finding out the suitable areas to allocate new eldercare centres, we carried out further analysis to determine three locations which are most suitable to build the new eldercare centres. In order to carry out this further analysis, we have taken into consideration the proximity of the allocated new eldercare centres to the locations of the CHAS clinics in both Yuhua East and Teban Gardens. To analyse the proximity of each allocated new eldercare centre to the CHAS clinics, we computed the hub distance between each allocated eldercare centre and its respective nearest CHAS clinics for both Yuhua East and Teban Gardens as shown in Figure 34 and Figure 35 respectively.

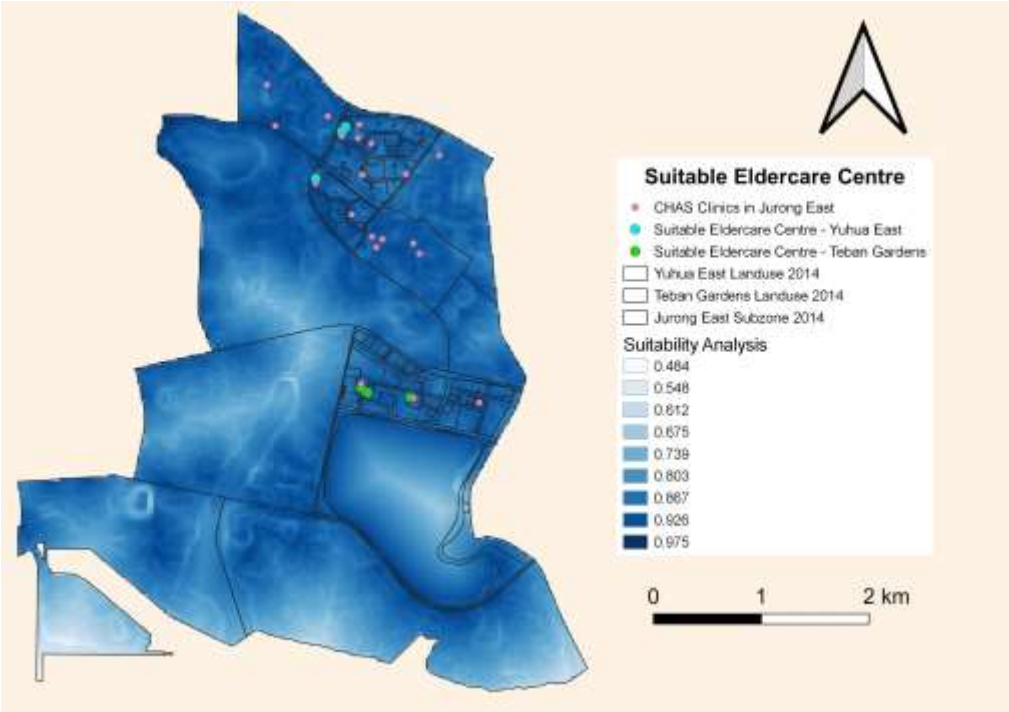
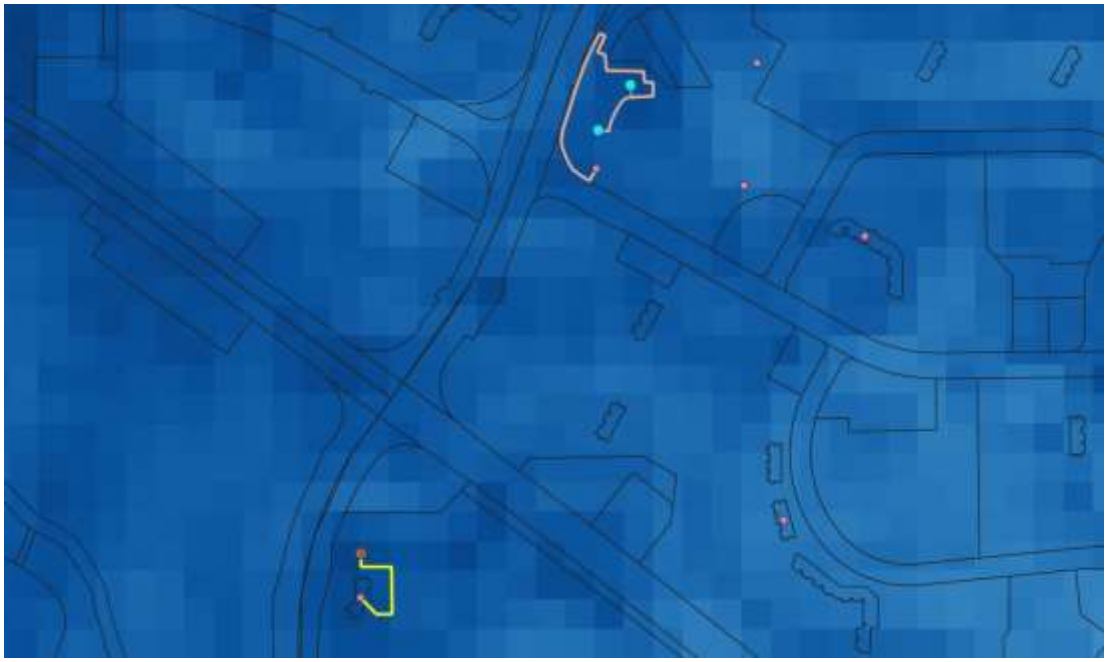


Figure 36: Three most suitable new eldercare centres for Yuhua East and Teban Gardens

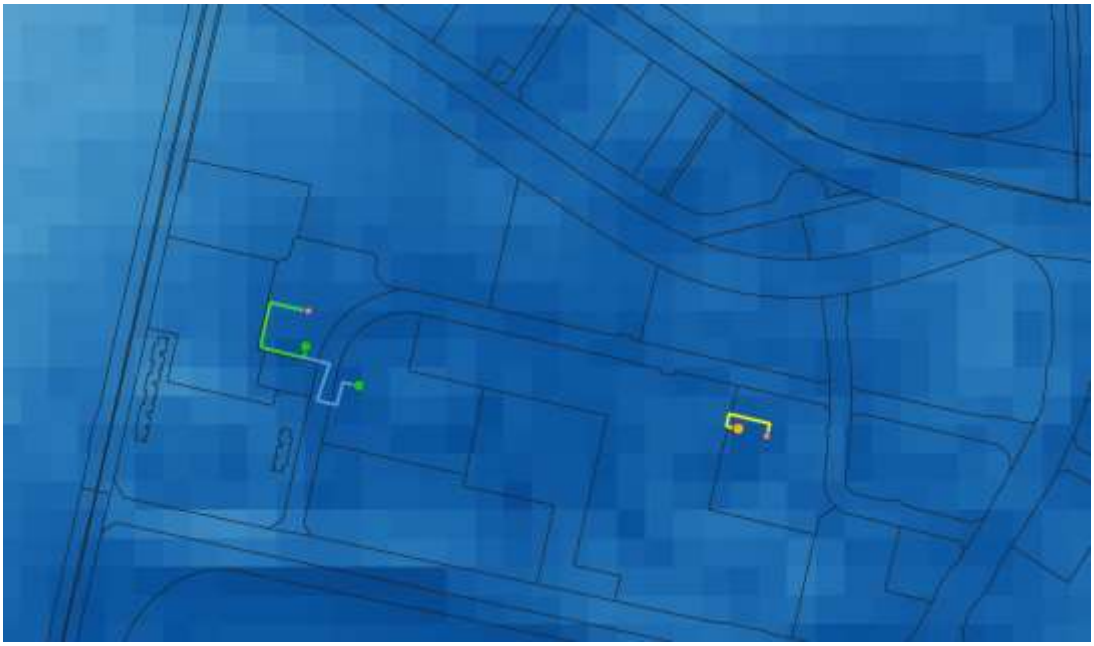
Furthermore, the allocated new eldercare centres which have the top three shortest hub distances of Yuhua East and Teban Gardens (as shown in Figure 36) are selected and exported respectively. Further analysis is then carried out to analyse and determine the shortest path to travel from each of the three eldercare centres to its respective nearest CHAS clinics for both Yuhua East and Teban Gardens. The shortest path to travel from each of the three most suitable allocated new eldercare centres to its respective nearest CHAS clinics is analysed to determine which allocated new eldercare centre is the most suitable to be suggested.



	fid	start_id	start_coordinates	start_entry_cost	end_id	end_coordinates	end_exit_cost	cost_on_graph	total_cost	*	layer	path
1	1	A	17015.394262, 3...	13.0024370555...	B	17014.76639, 35...	23.7305993114...	95.6377379633...	132.370794330...		Shortest Path 3 ...	C:/GIS Project [...
2	1	A	17292.034735, 3...	12.4451633863...	B	17256.999469, 3...	14.6655752561...	313.224519573...	340.335258216...		Shortest Path 2 ...	C:/GIS Project [...
3	1	A	17258.883085, 3...	11.0324915241...	B	17256.999469, 3...	14.2333047974...	357.848279912...	383.114076234...		Shortest Path 1 ...	C:/GIS Project [...

Figure 37: A map and table for the shortest path analysis of Yuhua East

As shown in Figure 37 above, the shortest path for each of the three most suitable allocated new eldercare centres in Yuhua East are computed and analysed. Based on the map, the path which is highlighted in yellow has the lowest total cost, which is 132.371, indicating that this path provides the shortest distance, compared to the other two paths, in order to travel from the allocated new eldercare centre (brown in colour) to its nearest CHAS clinic. Therefore, the brown point represents the suggested suitable location to build a new eldercare centre in Yuhua East.



fid	start_id	start_coordinates	start_entry_cost	end_id	end_coordinates	end_exit_cost	cost_on_graph	total_cost	layer	path
1	A	17894.475924, 3...	12.8034413376...	B	17934.739362, 3...	13.5386468474...	57.4766594311...	83.8187476162...	Shortest Path 1 ...	C:/GIS Project [...
1	A	17436.94763, 33...	12.5001111473...	B	17439.082395, 3...	41.400329849727	93.9606318908...	147.861072887...	Shortest Path 2 ...	C:/GIS Project [...
1	A	17492.451528, 3...	17.4981695656...	B	17439.207969, 3...	41.6606504418...	208.708551197...	267.867371205...	Shortest Path 3 ...	C:/GIS Project [...

Figure 38: A map and table for the shortest path analysis of Teban Gardens

Similarly, based on the map in Figure 38, the shortest path which is highlighted in yellow has the lowest total cost, which is 83.819, compared to the other two shortest path. This indicates that the distance needed to be travelled from the new allocated eldercare centre (orange in colour) to its nearest CHAS clinic by using the highlighted path is the shortest compared to the other two shortest paths. Therefore, the orange point represents the suggested suitable location which the new eldercare centre can be built in Teban Gardens.

Silver Zones

Based on our analysis, we observed that Jurong East currently does not have any development of silver zone. Thus, we have decided to introduce the allocation of silver zones in some areas of Jurong East as an amenity which would be useful to the elderly population. As the elderly who are sent to the new eldercare centres are likely to take a stroll outside the eldercare centres, silver zones can be introduced in the areas where the pedestrian traffic lights are close to the eldercare centres as these silver zones would provide better safety to the elderly while taking a stroll.

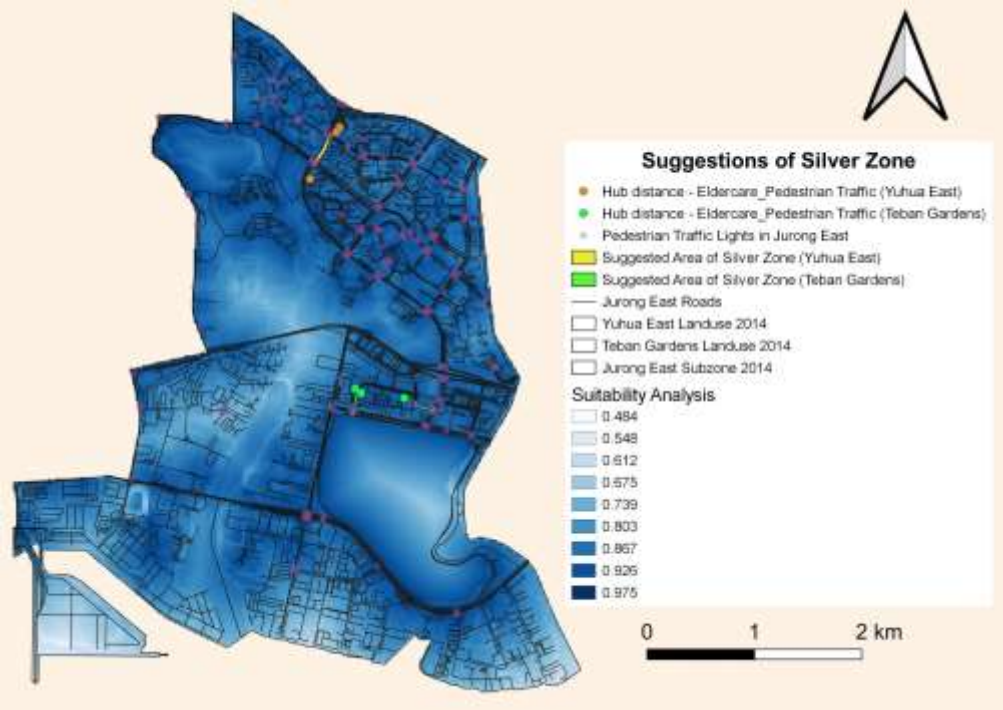


Figure 39: Land Use Suitability Analysis Map for Allocation of New Silver Zones

Therefore, we analysed the pedestrian traffic lights which are close to the three most suitable allocated new eldercare centres in both Yuhua East and Teban Gardens respectively by computing the hub distance between each suitable eldercare centre and nearby pedestrian traffic lights to determine the areas which are suitable to be allocated as silver zones.

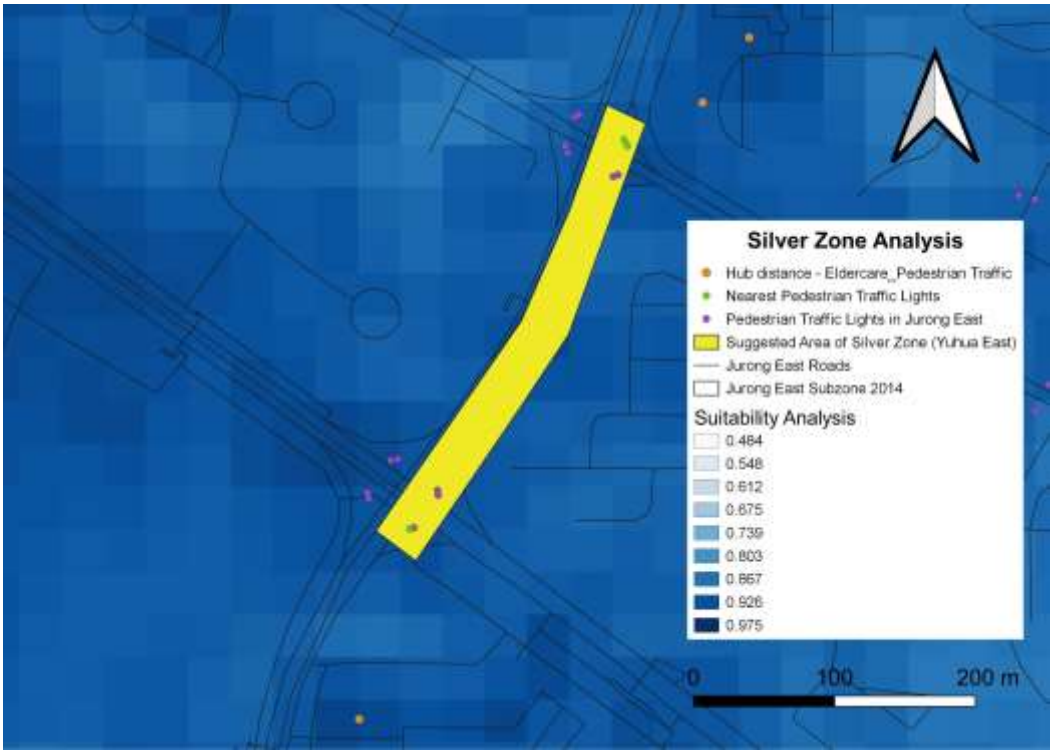


Figure 40: Suggestion of Silver Zone in Yuhua East

Based on the figure above, since the green points are the nearest pedestrian traffic lights to each allocated new eldercare centre, the areas around the pedestrian traffic lights are suitable to be suggested for the allocation of new silver zones in Yuhua East.

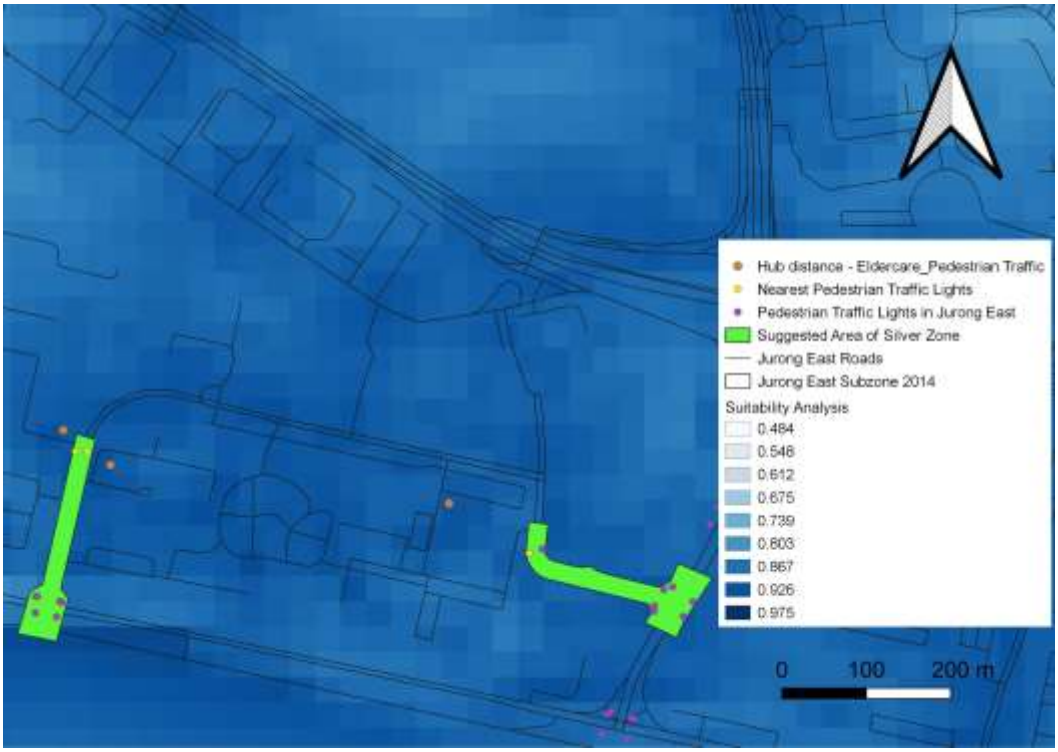


Figure 41: Suggestion of Silver Zones in Teban Gardens

Moreover, according to the figure above, as the yellow points are the nearest pedestrian traffic lights to each allocated new eldercare centre, the areas around the yellow points are suitable to be allocated as new silver zones in Teban Gardens.

7.2. Economically Active Adults (Aged between 25 and 64)

Transportation (Bus Stops) in Jurong East

Accessibility to public transportation is an important factor for citizens. According to a government survey, six out of ten Singapore residents take public transportation including Mass Rapid Transit (MRT), Light Rail Transit (LRT), Buses and Taxis. We chose to look into the accessibility of bus stops from residential areas and office buildings in Jurong East to determine whether the current bus transportation meets the needs of residents in Jurong East.

Figure 42: Accessibility Map of Bus Stops from Residential and Office Buildings

The accessibility map above shows buildings of different relative distances from their nearest bus stop. The light pink points represent buildings that are within 250 meters from the nearest bus stop, while darker red points represent buildings that are further away from the nearest bus stop, the furthest being more than one kilometer away. In general, the proximity of the buildings to their surrounding bus stops is shown in different shades of green, ranging from a dark green shade representing areas that are most accessible to a pale green shade representing areas that are least accessible.

Buildings that are least accessible are those at Jurong River, Jurong Port, and Penjuru Crescent. Hence, there is a need to build more bus stops in these areas.

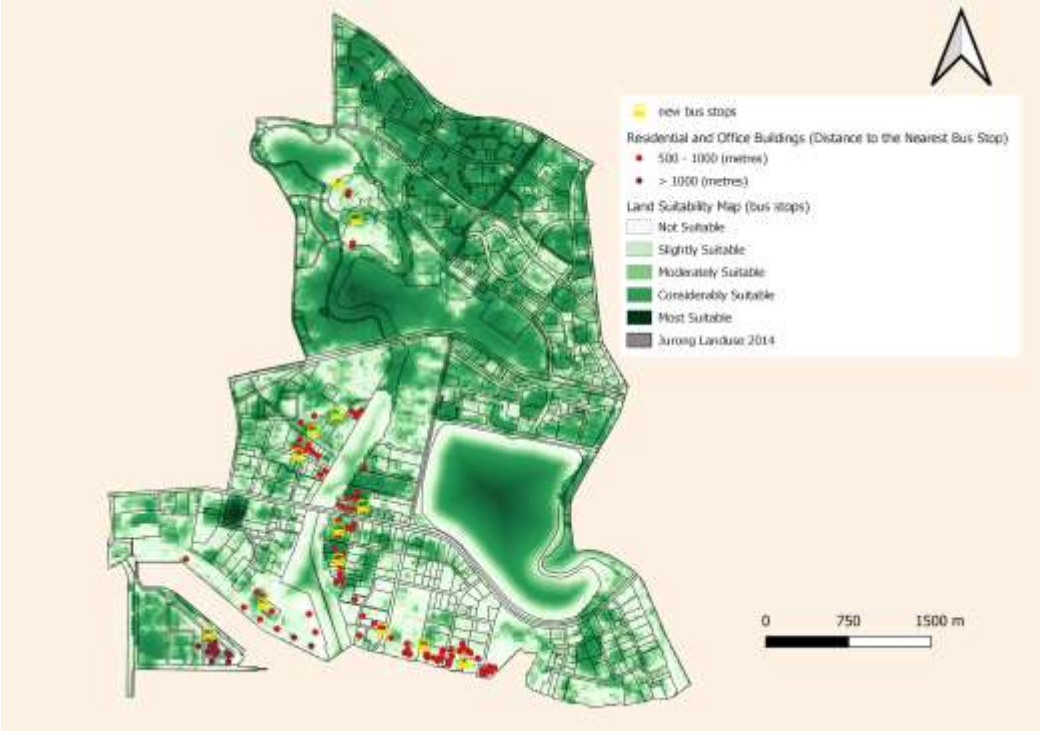


Figure 43: Land Use Suitability Analysis Map for Building New Bus Stops

To improve upon the areas which have lower accessibility to bus stops, we conducted a land use suitability analysis on Jurong East to select the areas that are suitable for new bus stops to be built. The factors that we have taken into consideration for the land-use suitability analysis are:

1. Safety factor: The selected location cannot be on a steep slope to prevent potential accidents.
2. Accessibility factor: The selected location must be near to the residential and office buildings.
3. Feasibility factor: The selected location has to be along the road network.

As shown in the Land Use Suitability Map above, the areas in a darker shade of green are locations that are more suitable for new bus stops to be built. Since we are more concerned with the lower half of Jurong East with less access to bus stops (more than 500 meters away), namely the subzones Jurong River, Jurong Port and Penjuru Crescent, we recommend several new bus stops to be built in these areas, as represented by the yellow bus icons on the map.

Food Centres in Jurong East

Food centres are a great necessity, especially for office workers who have less mealtime flexibility, therefore food centres should be within a relatively short distance from office buildings. We examined the accessibility of food centres from the office buildings in the business areas in Jurong East to determine if the current food centres are sufficient for the working population there.

Figure 44: Accessibility Map of Food Centres from Office Buildings

We combined three different data sets to retrieve information on the location of hawker centres, food centres and retail buildings such as shopping malls where food is sold; this final layer will be referred to as food centres. The accessibility map above shows that most of the food centres in Jurong East are centered around the top half of Jurong East where there are more residential and commercial buildings and hence greater demand. However, there are only two food centres in the lower half of Jurong East where the business areas are located, which is definitely insufficient for the working population there. As seen from the map, most of the office buildings fall within the 'Least accessible' zone and are more than one kilometer away from the nearest food centre. This suggests the need for more food centres to be built near business areas.

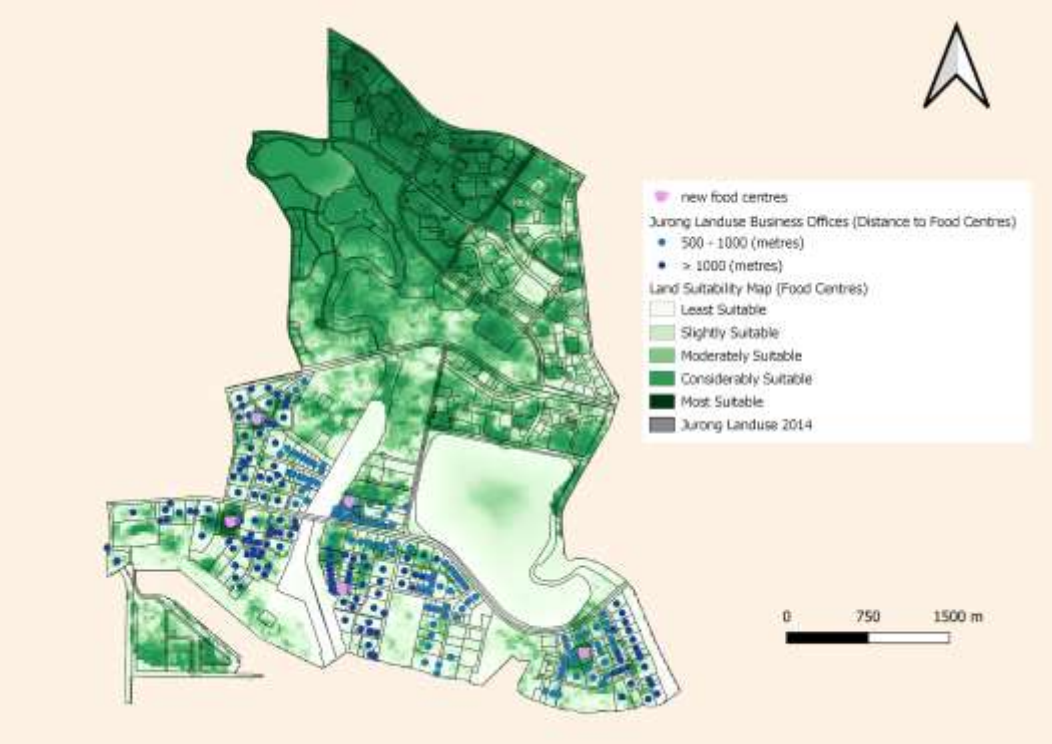


Figure 45: Land Use Suitability Analysis Map for Building New Food Centres

The land use suitability analysis map above shows the suitable locations where new food centres can be built. We conducted a land-use suitability analysis on the Jurong East land area and took several factors into consideration:

1. Economic factor: The selected location cannot be on a steep slope to avoid additional construction costs.
2. Accessibility via office buildings factor: The selected location should be close to office buildings in Jurong East.
3. Accessibility via roads factor: The selected location should be close to roads and pedestrian walkways.

As seen from the map, areas of a darker shade of green are more suitable for food centres to be built. Since our areas of concern are in the lower half of Jurong East, we recommend building the new food centres in these areas comprising Jurong River, Jurong Port, and Penjuru Crescent, with one food centre within every cluster of office buildings, as shown by the light purple icons. Additionally, in line with the Health Promotion Board's Healthy 365 movement, these food centres should provide healthier food choices for office workers.

Gyms in Jurong East

According to a study conducted by BMC Public Health on the patterns of physical activity and sedentary behavior of a representative group of Singaporeans, the prevalence of regular exercise was lowest among 30 to 39 years aged participants. Moreover, participants who were not in full-time employment exercised more regularly and were less likely to report high levels of sedentary behavior than those in full-time employment. Hence, it can be observed that full-time employed working adults are less likely to exercise regularly, which may be due to lack of time, work exhaustion or can be contributed by the fact that fitness facilities are not readily accessible. To find out whether the working population in Jurong East has good access to fitness facilities in the area, we will analyze the locations of gyms in Jurong East.

Figure 46: Accessibility Map of Gyms from Office Buildings

The availability of gyms and fitness facilities is likely to encourage people to have an active lifestyle. However, as seen from the accessibility map above, there are only three gyms in Jurong East, in the subzones Yuhua East, Jurong Gateway and International Business Park. Office workers working in the buildings located within these subzones thus have relatively easy access to the gyms. However, office buildings located in the lower half of Jurong East are more than one kilometer away from these facilities, as represented by the dark purple points on the map. To promote a healthy lifestyle as part of ActiveSG, there is a need for more gyms to be built closer to these office buildings, to cater to the needs of working individuals.

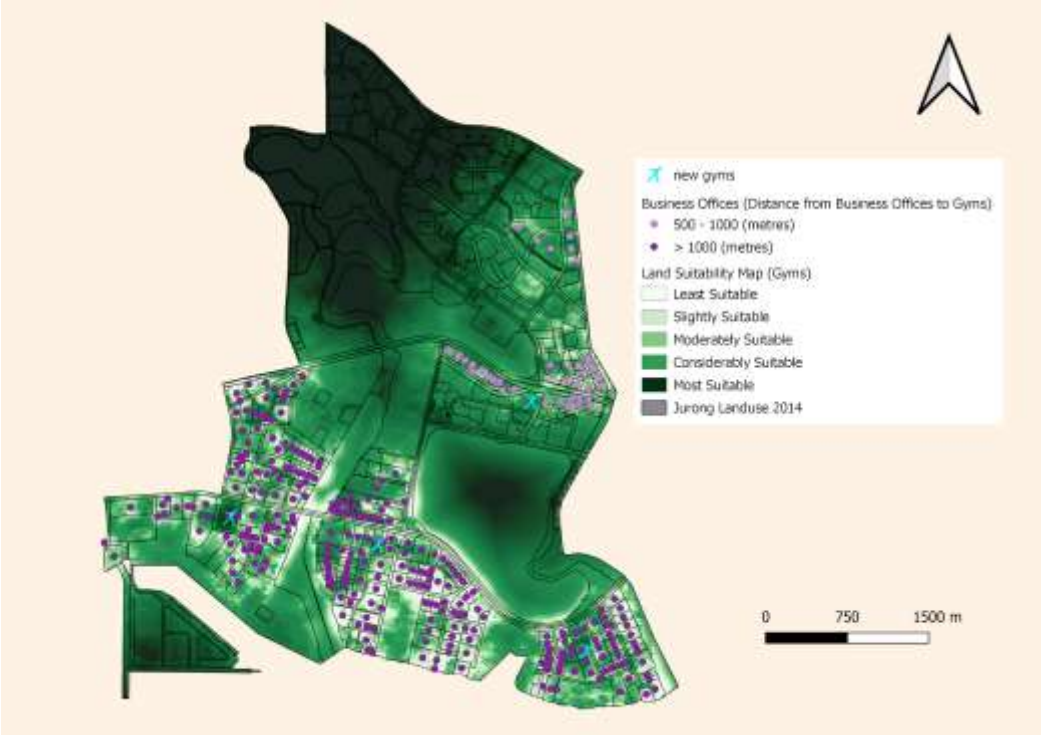


Figure 47: Land Use Suitability Analysis Map for Building New Gyms

In selecting suitable locations for the new gyms to be built, we considered several factors (similar to the factors considered for the building of new food centres):

1. Economic factor: The selected location cannot be on a steep slope to avoid additional construction costs.
2. Accessibility via office buildings factor: The selected location should be close to office buildings in Jurong East.
3. Accessibility via roads factor: The selected location should be close to roads and pedestrian walkways.

The land-use suitability map above shows the possible areas where the new gyms can be built, as represented by a darker shade of green. Although the top half of Jurong East is more suitable, we want to focus on providing office workers in the subzones Teban Gardens, Jurong River, Jurong Port and Penjuru Crescent with greater access to gyms. Hence, we recommend building four new gyms in each of the subzones, represented by the blue exercise icons on the map.

Cycling Path Network

JLD was identified as one of the five areas identified by the LTA as one of the car-lite precincts in November 2018. Car-lite precincts aim for greater connectivity to public transport and alternative travel options like cycling. With the aim of integrating work, live and play within the same vicinity alongside the trend of more working adults choosing to find jobs within their community due to family commitments, encouraging alternative transport methods and making improvements to first- and last-mile connections in industrial districts, we decided to analyse cycling networks in Jurong East, especially to the in the South of Jurong East for the economically active adults. This is also in line with the LTA Master Plan 2040 released on May 25 2019 to increase cycling path networks by a third to 1000km by 2040.
Currently, the cycling path networks and Park Connectors in Jurong East are mainly clustered at the residential areas in the North of Jurong East (Figure 47). We decided to conduct a land suitability analysis to determine the most suitable routes from the current road networks that potential cycling networks can be built close to or built on in the future.

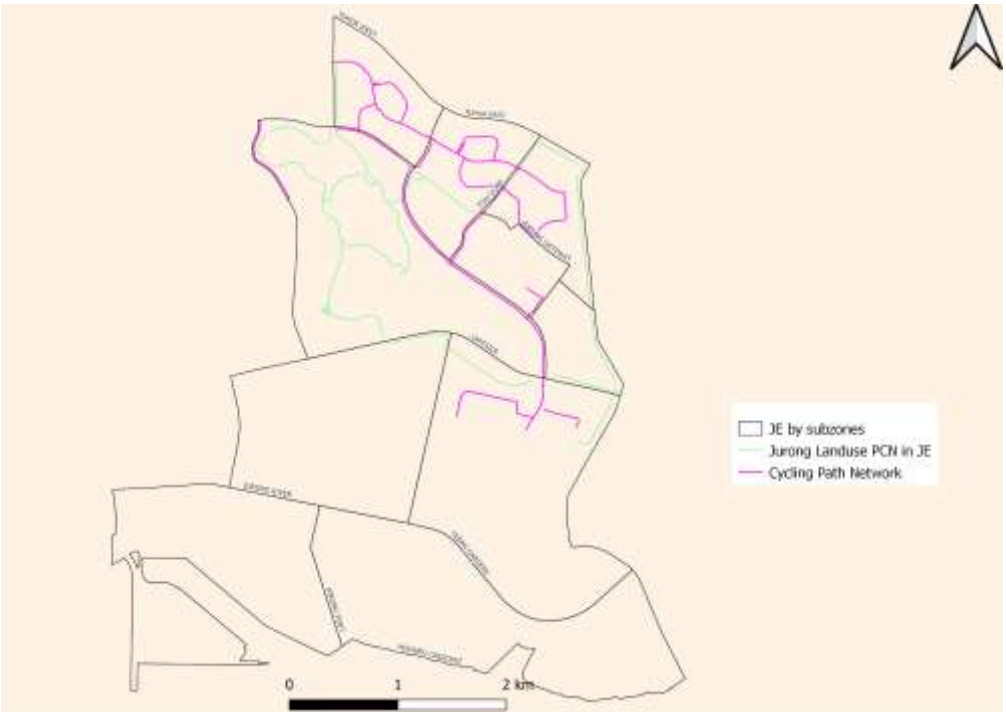


Figure 48: Current Cycling Path Network in Jurong East

There were 4 decision factors we took into account for the suitability analysis.

Economic Factor
Building on sloped lands would increase the time and expense to create the steady foundation for the cycling network to be built on. Also, steep gradients for cycling would require too much energy and effort from cyclists to travel efficiently and hence a slope as gentle as possible is preferred.

Safety Factor

These cycling path networks should be as far away from expressways, expressway links, primary roads and primary road links as there is heavy traffic and the maximum speed limit is high on these roads

Connectivity Factor

In order to increase intra- and inter-town connectivity, closer proximity and greater accessibility to existing park connectors is preferred so that cycling path networks can be continued from there

Scenery Factor

Closer proximity to water bodies are preferred so that cyclists can have a more pleasant view of something different besides concrete roads and buildings as they commute to work

The standardization of the 4 decision factors are as follows:
Economic Factor: 1-("Slope@1")/(43.6839)
Safety Factor: ("Proximity Road@1")/(2463.71)
Connectivity Factor: 1-("Proximity PCN@1")/(2518.22)
Scenery Factor: 1-("Proximity Childcare@1")/(1786)
We decided that safety was the most important, followed by economic, connectivity and scenery factor.

The AHP table and product sum of the AHP weights and standardized scores for each factor can be seen under "*Approach to identify suitable land*" section above.

The "Most Suitable" plots of land for the proposed cycling path network can be seen in Figure 49.

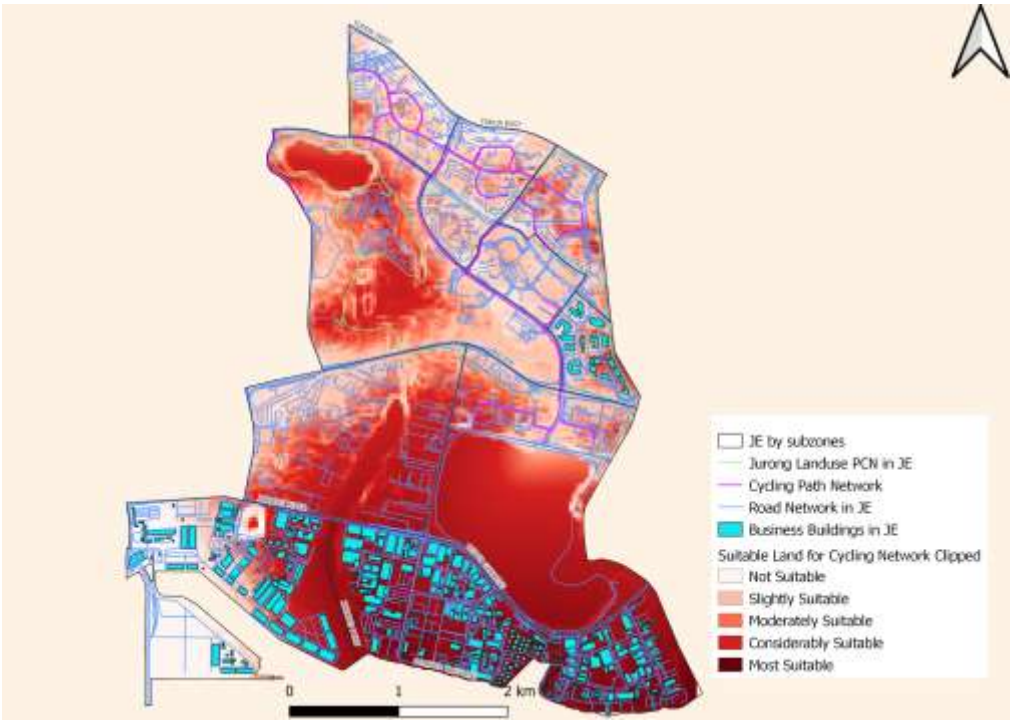


Figure 49: Land Use Suitability Analysis Map for Cycling Path Networks in Jurong East

To trace out the proposed cycling network that would be the most efficient, QNEAT3 - Qgis Network Analysis Toolbox (searched from Processing Toolbox) → Routing → Shortest Path (point to point) was used (Figure 50).

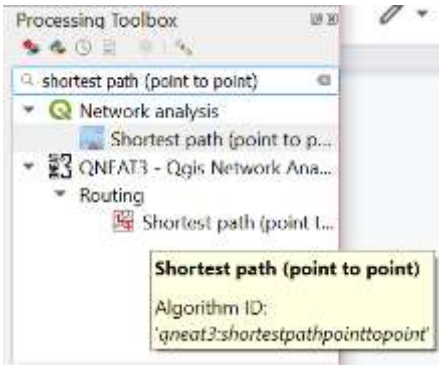


Figure 50: Shortest Path (point to point)

The dialog window (Figure 51) then appear. The Network Layer should be the layer you want to build the cycling path network close to or on (ie current road network in Jurong East). The start and end points can be selected on the map itself (Figure 52 and 53). The start point chosen in this case was the end of the cycling path network nearest to the south of JE and the end point is at the most bottom of Penjuru Crescent.

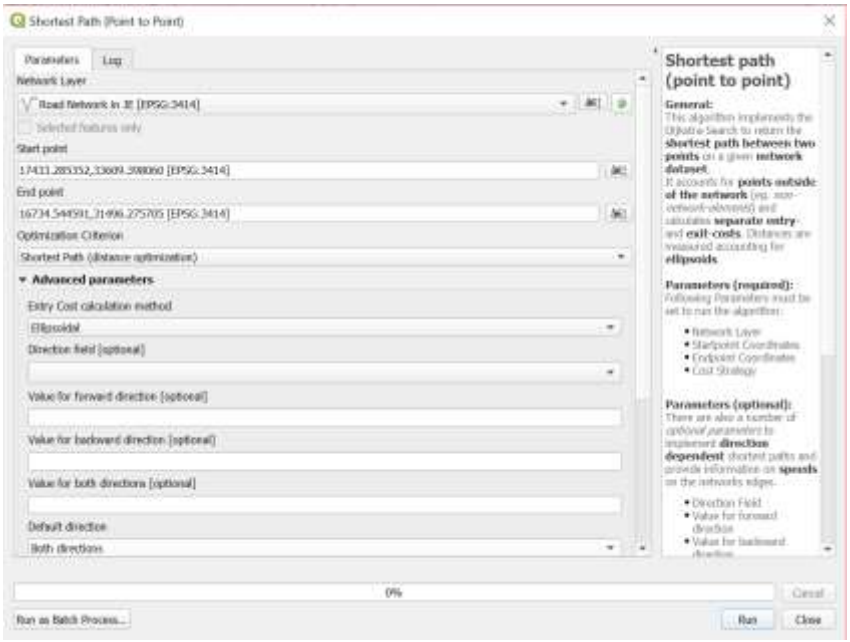


Figure 51: Shortest Path (point to point) dialog window

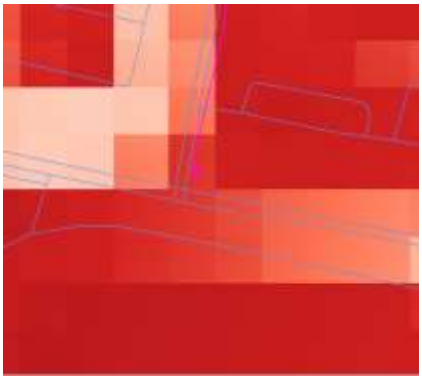


Figure 52: Shortest Path (point to point) start point

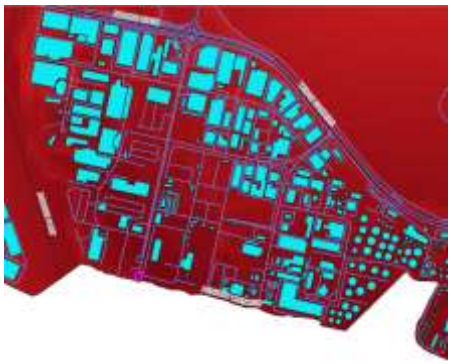


Figure 53: Shortest Path (point to point) end point

The shortest path that is generated thereafter is checked to be on either most suitable or considerably suitable land. This was done a few times to generate a few routes that allow different parts of the southern region of Jurong East to be accessible by these cycling path networks. The final proposed cycling path networks are shown in Figure 54.

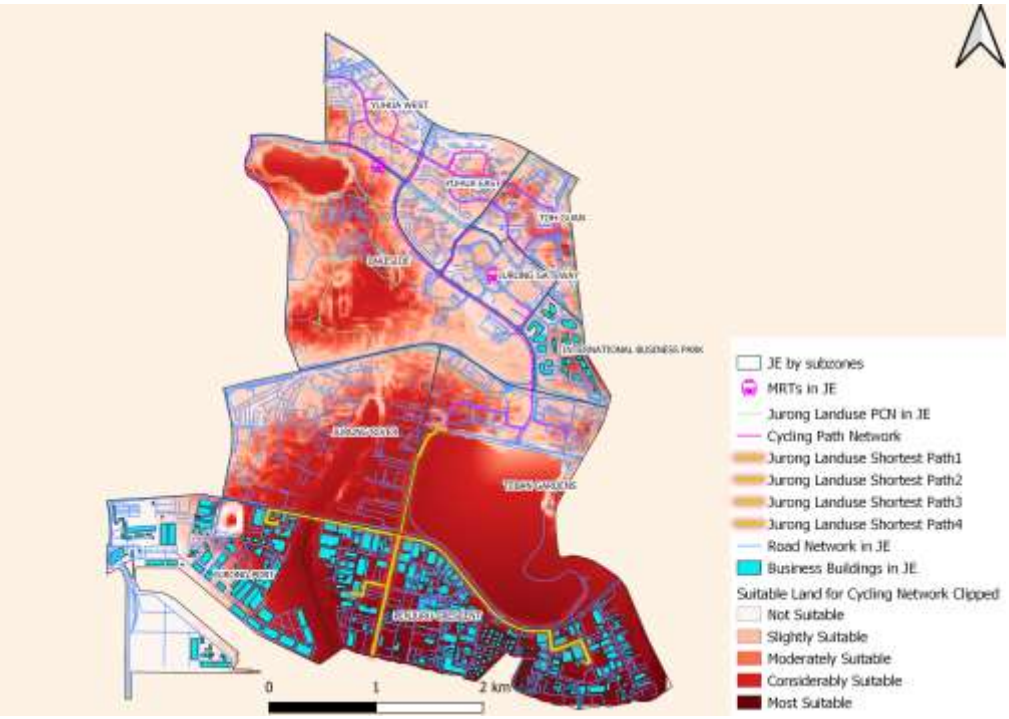


Figure 54: Proposed Cycling Network in Jurong East

7.3. Children (Aged between 0 and 14)

Parks with Playgrounds and Fitness Corners

For children aged 0 to 14, we decided to focus on parks with playgrounds and fitness corners to accommodate to both the children and their adult caregivers who would accompany these children to the playgrounds. For the adult caregivers, the presence of these fitness corners would motivate them to exercise while supervising their children or serve as a good reminder to exercise, promoting a healthier lifestyle among both age groups. The greenery in parks have the potential to improve the mental, physical and emotional well-being of people and on top of that, community playgrounds within parks have proven to increase children's creativity and imagination and create a sense of belonging by bringing people together.

From the National Parks Data, there is only one park with playgrounds and fitness corners in the Teban Gardens subzone (Figure 54). We decided to conduct a land suitability analysis to determine the best site to build parks with playgrounds and fitness corners given the benefits mentioned above to make JE's environment even more liveable.

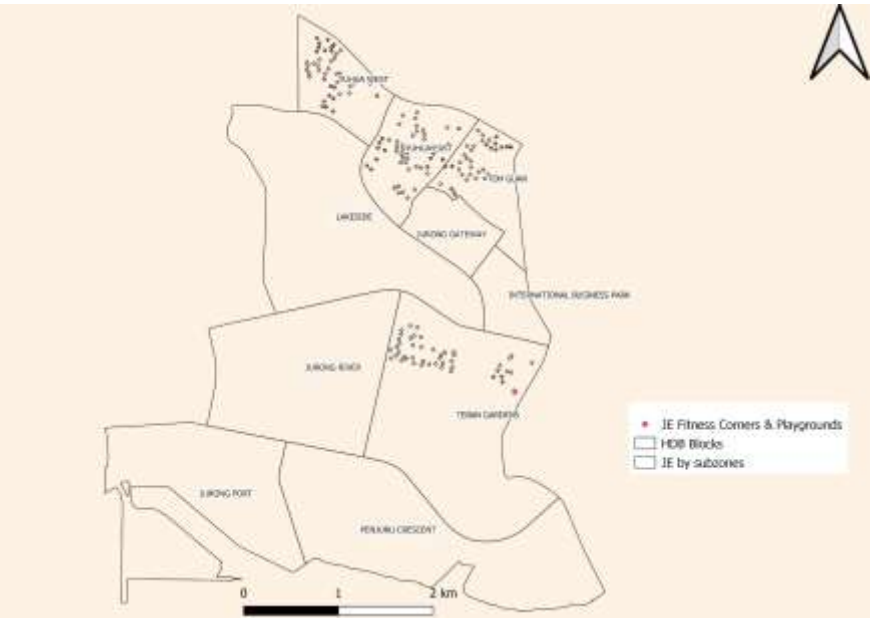


Figure 55: Fitness Corners and Playgrounds in Jurong East

There were 6 decision factors we took into account for the suitability analysis.

Economic Factor

Building on sloped lands would increase the time and expense to create the steady foundation for the playground to be built on, excavation fees and making additional structural supports. Therefore, building the parks with playgrounds and fitness corners should be done on land with lowest slope as possible.

Safety Factor

Playgrounds should be as far away from roads as possible as children are not as aware of their surroundings and have a tendency to run about which might be dangerous for them should they oncoming traffic on roads.

Accessibility Factor

These playgrounds should be of close proximity to four different locations with children in them, namely HDB Blocks, childcares, primary schools and pre-schools.

The standardization of the 6 decision factors are as follows:
Slope: 1-(“Slope@1”)/(43.6839)
Road: (“Proximity Road@1”)/(1680.36)
HDB Blocks: 1-(“Proximity to HDB Blocks@1”)/2632.81
Childcares: 1-("Proximity Childcare@1")/(2782.39)
Pri Schools: 1-("Proximity Pri Sch@1"-385)/(2782.39-385)
Pre-Schools: 1-("Proximity Pre Schh@1")/(2803.47)

We decided that safety was the most important, followed by the accessibility from the 4 locations with most children in them and then the economic factor (Figure 56).

Pairwise Comparison Matrix

	Slope	Safety	Accessibility from	Accessibility from	Accessibility from	Accessiblity from
Slope	1	1/2	1/2	1/2	1/2	1/2
Safety	2	1	3	3	3	3
Accessibility from Pri Schools	2	1/3	1	1	1	1
Accessibility from Pre Schools	2	1/3	1	1	1	1
Accessibility from Childcare Cer	2	1/3	1	1	1	1
Accessiblity from HDB Blocks	2	1/3	1	1	1	1

Figure 56: Pairwise Comparison Matrix for Decision Factors for building Playgrounds

The weights of each factor was then computed to be 0.089 for economic factor, 0.356 for safety factor and 0.139 for accessibility factors (Figure 57).

	AHP		Consistency check
1	0.089	8.9%	Consistency OK
2	0.356	35.6%	2%
3	0.139	13.9%	
4	0.139	13.9%	
5	0.139	13.9%	
6	0.139	13.9%	

Figure 57: AHP table for different criterion

The final land use suitability analysis map (Figure 58) was computed with the following formula: "Standardized Slope@1" * 0.089 + "Standardized Roads@1" * 0.356 + "Standardized Pre Schh@1" * 0.139 + "Standardized Pri Sch@1" * 0.139 + "Standardized HDB Blocks@1" * 0.139 + "Standardized Childcares@1" * 0.139

For the final site selection, we decided to build one park with playground and fitness corner in Yuhua West, Yuhua East, Toh Guan and Teban Gardens on the land that is “Most Suitable” and fulfills all criteria the best.

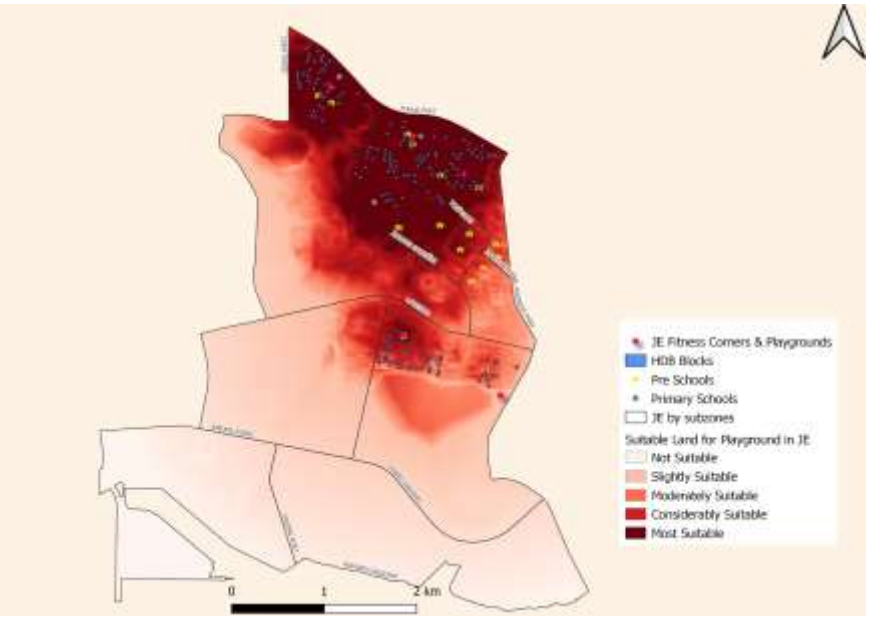


Figure 58: Land Use Suitability Analysis Map for Parks with Playgrounds and Fitness Corners

7.4. Repurposing Facilities

The demand for facilities such as eldercare centres and childcare centres would most likely change according to the demographic changes as mentioned before. Therefore, with the rapid increase of the elderly population in Jurong East and decreasing trend of children in Jurong East due to low birth rates, repurposing of childcare centres to eldercare centres can be looked into to meet the new and changing needs of the Jurong East resident population.

We decided to pilot the repurposing in Yuhua East where the number of elderly residents (close to 6000) is projected to be the most in Yuhua East over all the other subzones.

To determine which childcare centre to repurpose specifically, we decided to focus on the number of HDB Blocks that are closest to each childcare centre in Yuhua East. This would determine the average number of elderly residents who have the closest access to potential eldercare centres.

This was done by creating hublines from HDB Blocks to their nearest childcare centre using MMQGIS' Hublines. This was accessed from the MMQGIS Plugin tab → Create → Hub Lines/Distance (Figure 59).

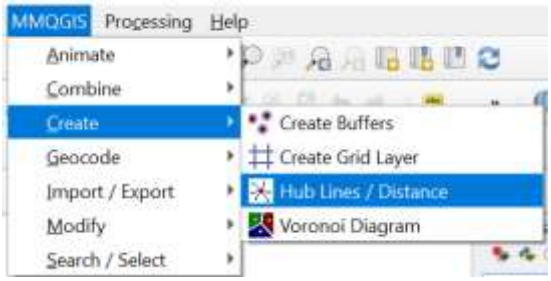


Figure 59: Creation of Hub Lines

The Hub Layer would be the facility considered for repurposing (Childcare centres) and the Spoke layer would be the layer you want to allocate to the closest hub (ie HDB Blocks).

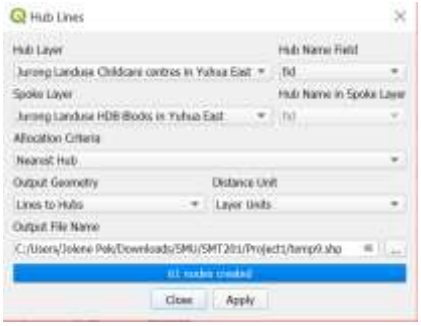


Figure 60: Dialog Window of Hublines

From the results, the childcare centres with the most number of hub lines connected to it can be considered for repurposing. The circled childcare centres have 10 and 9 HDB Blocks closest to them respectively and hence were chosen (Figure 61).

Figure 61: HDB Blocks closest to Childcare Centres in Yuhua East

It is crucial for eldercare centres to be within the community not only because of increased accessibility but other social and health reasons as well. It would be easier for elderly residents to get treatment they need, give other healthier residents nearby the opportunity to volunteer their services, interact and spend time with the elderly. This will build a more caring and inclusive society for the elderly in Jurong East to age in.

Another building that can be proposed for repurposing is the previously largest warehouse retail mall, Big Box, that recently closed down and was put up for sale in the Jurong Gateway subzone (Refer to Figure 62 for exact location of Big Box in the Jurong Gateway Subzone).

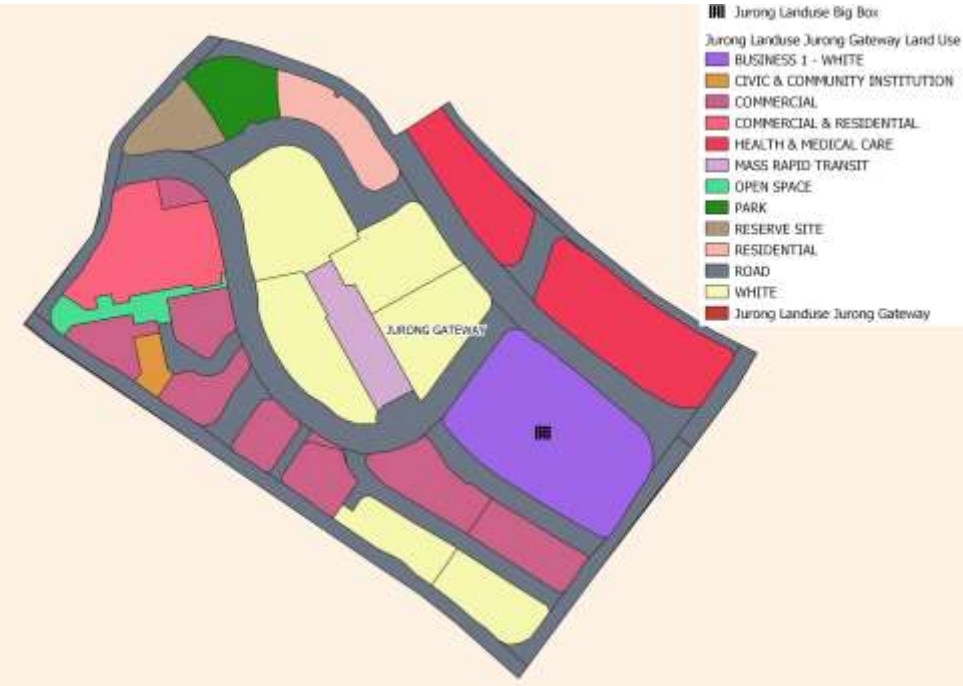


Figure 62: Proposed Repurposing of Big Box in Jurong Gateway Subzone

With Big Box's strategic location accessible from Jurong East MRT, 4 other shopping malls (Jcube, Jem, Westgate, IMM) with a good tenant mix of shops, restaurants and bars and Genting Hotel within Jurong Gateway Subzone, this 8-storey building of an area of about 56,000 square metres would make it a popular choice for different kinds of events. With this exhibition and convention centre situated in the heart of Singapore's next Central Business District with key tourism attractions according to URA's Jurong Lake District Master Plan and STB's strategy to spread out tourism offerings across various parts of Singapore, this repurposing plan will add to the vibrancy of the area. The current Business 1 Land use can be converted to commercial land use instead for this proposal.

Also, current prominent exhibition and convention centres such as Singapore EXPO, Suntec Singapore, Marina Bay Sands and Raffles City are situated in the Central and East of Singapore. Having a convention centre in the western region of Singapore would be in line with URA's decentralisation efforts to bring more quality jobs, amenities and recreational options closer to homes.

Should the convention centre hold MICE conventions, there is a potential to bring in more business visitors which will increase tourist spending in Singapore. More revenue will be pumped into local economies, helping to drive long-term economic development, innovation, exchange of knowledge, growth and vibrancy which will benefit Singapore in the long term.

Given the condition, layout, durability, maintenance, commercial value and lease period, Big Box is considerably feasible for repurposing.

8. Conclusion

Based on the results of our land use analysis, population analysis and land suitability analysis, we are able to determine and suggest new amenities which can be introduced to cater to the needs of the different groups of population, living in Jurong East. With the introduction and development of these new amenities, Jurong East would be able to create a comfortable and friendly environment for its residents as well as improve their standard of living. Therefore, according to our population analysis, the size of elderly population in Jurong East is increasing more rapidly than the size of the economically active adult population and the size of children population. We would suggest that the development of new amenities for the elderly population should be the main focus in order to provide good and useful services to the elderly population which would provide them with greater convenience to carry out their daily activities.

9. Future Work

As the elderly population in Jurong East is growing rapidly in line with the concern of the increasing overall growth of the elderly population in Singapore, new amenities which are able to help and assist the elderly population will need to be increased to provide the elderly with better support and convenience. Therefore, several new eldercare centres can be introduced in several areas of Jurong East to provide convenience to working adults for sending the senior citizens in their family to the eldercare centres before leaving their homes for work. New eldercare centres will also provide better safety to the senior citizens as various services can be provided in the new eldercare centres to take care of them. Moreover, every senior citizen will also have the opportunity to interact with each other while staying together in the new eldercare centres instead of being left alone in their own house. Besides introducing new eldercare centres, repurposing some of the childcare centres into eldercare centres can also be implemented due to the change of demographics in Jurong East. This idea of repurposing will also help in saving land space.

Furthermore, recently, there are several future district-level underground plans introduced by Urban Redevelopment Authority (URA) of Singapore to build some facilities and amenities below ground level in Jurong Innovation District, such as bus and rail networks, car parks and utilities, to free up spaces on the surface level which can be utilised to develop other facilities and amenities which are more for people-centric uses. Therefore, the implementation of such future plans can be extended to the regions in Jurong East as well because this would enable more public amenities, such as new eldercare centres and parks, that can cater to the needs of the elderly to be built and developed in the new available areas and spaces. Besides building new eldercare centres, we suggest that these available areas and spaces can also be utilised to develop other public amenities such as food centres, gyms, as well as parks with playgrounds and fitness corners to provide convenience to the economically active adult population in Jurong East to have a meal in food centres nearby during their short lunch hours, encourage them to adopt a healthier lifestyle by going to the gym and spend more time with their family by going to the park together. In addition, the future district-level underground plans can be

extended to Jurong East for the development of new underground bus stops and bus stations in areas of Jurong East that have lower accessibility to the nearest bus stops and bus stations.

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