SITE SELECTION FOR NEW MEMORIAL PARK USING GIS : *Muslim Memorial Park*

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Abstract

The need for a cemetery (memorial park) is equally important like other needs of basic facilities. When developing a housing area, memorial park aspect has always been left out and has caused problems to the community because the local authority has no proper plan for a cemetery area. In due course, there is a requirement to find out a suitable new site for cemetery using GIS technology and digital mapping applications is. This method is expected to give solution to local authority when choosing an appropriate place for cemetery. Three main objectives drawn in this study will contribute effectively to the planning and selection of Muslim cemetery in Mukim Cheras area. Data collection of applicable spatial vector and raster as well as the attribute data from various agencies were made to achieve the research goal. The usage of Remote Sensing and GIS software such as Erdas Imagine 8.5 and ArcGIS 9.0 helps in facilitating this study. Various GIS analyses such as modeling analysis, buffering analysis and overlay analysis were carried out in order to ultimately produce a spatial product of suitable criterion. The end products portraying suitable areas for cemetery with spatial location, within related cadastral lot and slope condition suitability can contribute values and standards to the urban planning unit of Local Authority. The method and analysis carried out and the final product achieved by means of GIS application can allegedly assist Local Authority in efficiently planning few other developments in line with the neighborhood needs. The GIS method utilized in this study will facilitate urban planning authority in identifying areas for various developments and thus minimizing the issues that relates to the lack of land for cemetery in our country. Furthermore, planning developments can be more effectively enhanced through processing and visualization of relatively accurate physical location of areas in analysis in a computing environment.

Keywords: Digital Mapping, Urban Planning, GIS

1.0 INTRODUCTION

The objective of town and rural planning in this country is to establish quality human dwellings at all level of settlements, whether in towns or villages. The quality level of settlement influences and usually relates to quality of human life that is attained through a level of social environmental condition, man-made buildings and Mother Nature that can provide society to live with comfort, productive and safe.

Under the Town and Rural Planning Act 1976, every Local Authority (LA) needs to provide development plan (Structure Plan and Local Plan) to control land usage and development in its area. This means every development plan that becomes basis of reference in development always needs to be updated. This process definitely needs a change towards the capability of a development process to receive and threat latest information as well as using modern approaches and equipments. The need for cemetery is equally important with other basic facilities. When developing housing area, this requirement was left out and this will create problem to the residences because there is no plan for cemetery. This problem becomes more critical especially in high-density area, such as is town, due to lack of land parcel. Social factors such as multi-cultural town residence also need to be given attention in planning cemetery sites.

In line with the recent rapid development in computer technology, many management and maintenance activities are done with the technology. It is done so because the capability of computer in handling various tasks at one time as well as minimizing errors. This development provides opportunity to test new approaches in processing of planning data, which simultaneously increase new dimension towards data management, analysis and presentation that are needed in the process to determine planning output.

This study will assist the local authorities in implementing planning and monitoring for cemetery area with the assistant of database that has been produced by using Geographic Information System (GIS) software that is more easy and effective. Beside that, the methodology also facilitates local authorities or housing developers to reserve or develop suitable location for cemetery area in the area under development using GIS technology. Output from the study can provides a true picture on the development of social location in line with the criteria that have been set based on guidelines which have been determine, important matters that warrant action, appropriate data and others. It can assist or become a reference source in the future. Information from the output of the analysis and queries to the system can assist in producing management and development systems of cemetery areas which can be adopted by agencies that are involved like Housing Developers, Department of Town and Rural, Islamic Religious Council, Local Authorities, and responsible Bodies in cemetery matters. This study can also introduced and widen the concept of spatial enabling government agencies', with the adoption of all forms of benefits offered by this technology and with this, the level of management of an agency that involve in monitoring and administration will become more effective and efficient.

2.0 MODELLING OF SITE SELECTION CRITERIONS

This study is focused on criterions that have been determined in the planning guideline for Muslim and Non-Muslim Cemeteries 17/97(2002) issued by the Department of Town and Rural Planning of Peninsular Malaysia.

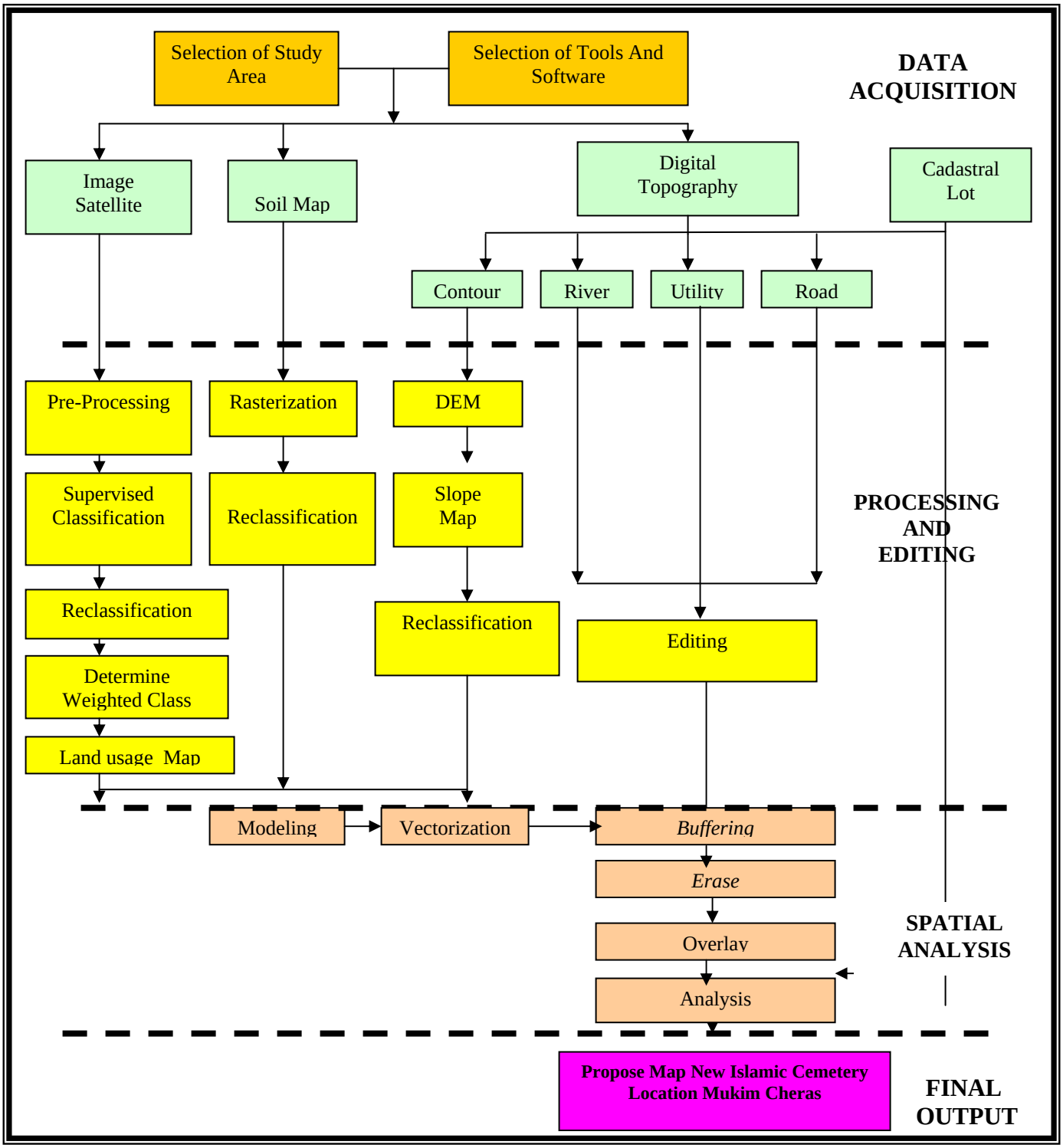

Figure 1.1: Methodology of Site Selection Stages

2.1 Data Acquisition

Existing data sources were obtained from government agencies. There are two categories of data that have been collected namely primary and secondary data. Most of the datasets were obtained in shapefile format. The data consist of two types which are spatial data and attributes data:

2.1.1 Spatial Data

i. **Malaysian Centre for Geospatial Data Infrastructure (MaCGDI)** - Quickbird satellite image 0.6 meter resolution. The dates of images obtained were 18 March 2003 and 15 October 2004. These image were use to produce map of land usage by using supervise technology and also digitizing process (on screen) to produce road map.

ii. **Department of Surveying and Mapping, Malaysia (DSMM) –** Contain contour information scale 1:2500 serial map (L8028). Year of issued is 2000 and was used for the purpose of slope analysis.

iii. **Department of Town and Rural Planning, Malaysia** – Contain administration borders. Used to identify district borders and Mukim Cheras administrative area.

iv. **Department of Agriculture, Malaysia** – Contains soils information in 1996 scaled 1: 1,000,000. This information was used to identify type of soils which are suitable for the purpose of study.

v. **Department of Surveying and Mapping, Malaysia (DSMM)** –
Digital Cadastral Database for Mukim Cheras year 2000 and Hydrography data (River) year 2000.

vi. Roads map based on digitizing process from Quickbird Satellite image year 2003 and year 2004.

2.1.2 Study Area

Study area is located at Mukim Cheras which is one of the mukims in the state of Selangor. The estimated area for this Mukim is about 5,973 hectares and having population

density of 99,700 (2000) (JPBD,2000) that consist of multi-racials and multi-religions community (Figure 2.1).

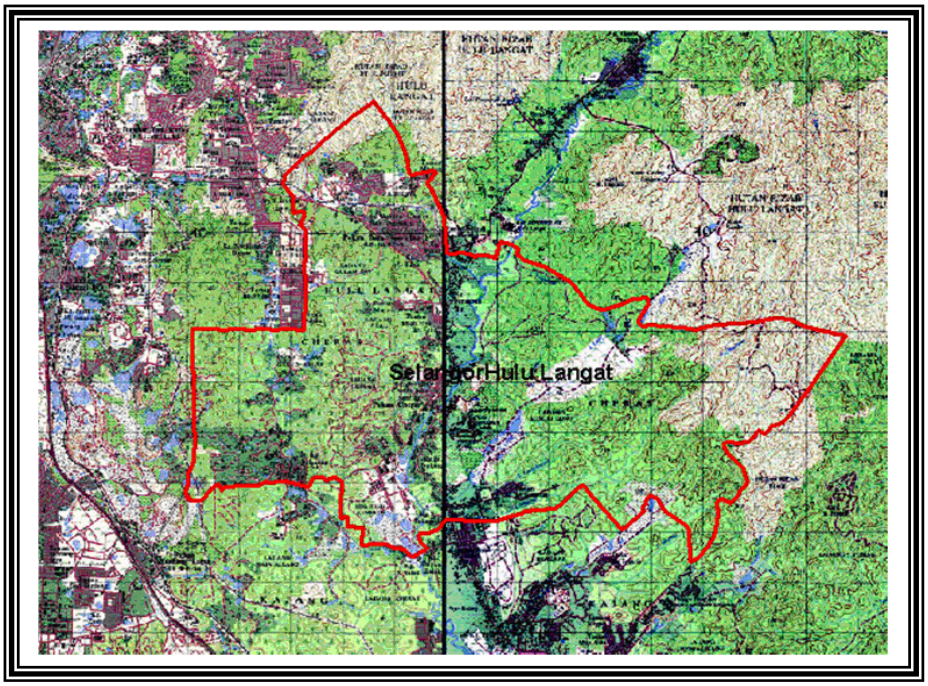

Figure 2.1: Study Area.

2.2 Criterion For Site Selection

Cemetery Planning based on settlement hierarchy (Guidelines on Muslim and Non-Muslim Cemetery Planning JPBD, 2002).

i. Town and Small Towns Areas.
For the big towns (more than 200,000 people) the needs for cemetery used is 20 hectares in area. If exceed 20 hectares it can be distributed to several places.

2.2.1 Site Planning

i. Muslim Cemetery

a. Located near the mosque and housing area to facilitate funeral management in praying before burial as well as facilitating the visitors of the dead person.

b. It is compulsory for the *"jenazah"* to be buried facing the kiblat or ka'abah (direction towards Mecca). For this propose flat land is more suitable.

ii. General Health

Distance between cemetery and nearest residential house is not less than 30 meter

iii. Topographic and Land Structure

a. Most suitable land is open land
b. Must be far from rivers, drainages or other water resources
c. Suitable to be located in the outskirt of area under development and near to house for worship
d. Swap and clay type

3.0 ANALYSES OF NEW SITE SELECTION AREA

Analysis stage is an important stage in conducting the analytical study to determine a suitable new memorial park in Mukim Cheras Hulu Langat, Selangor. This part explained the analytical outputs that based on methodology explained in Section 2. In order to get reliable analyse output, analytical functions for iinstances like overlay, union, classification, reclassify and modeling were used.

3.1 Producing Land Classification Map Based on Data from Quick bird Satellite Image

The map for land used in Mukim Cheras was produced through processing Mukim Cheras Quick bird satellite image dated 15 October 2004 and 18 March 2003. The image classification process was done using supervised classification approach. The classification process had been divided into five classes namely water, cloud, and building, developing area (cleared land), forest, various crops and furthermore vacant land like what is shown in Table 3.1 below.

Table 3.1: Classification of Mukim Cheras Suitable Land Usage

Weightage	Types of Land Usage	Suitability
1	Unclassified/water/Cloud	Very unsuitable
2	Buildings (Housing, Commercial)	Unsuitable

3	*Cleared Land* (Area under development)	Less suitable
4	Forest and various crops	Suitable
5	Vacant Land/Clear Land	Very suitable

Land usage map which is produced through the supervised classification process had been tested the value of its accuracy by making comparison between the image and earth's sample as in (Table 3.2 and 3.3) below. Overall assessment accuracy for the supervised classification was 90.00%. This output allows the land usage map to be adopted.

Table 3.2: Accuracy Assessment Based on Supervised Process

Class	Vacant Area	Area Under Development	Forest and Various Crops	Buildings	Accuracy
Vacant Area	4	1	0	0	80%
Area Under Development	1	4	0	0	80%
Forest and Various Crops	0	0	5	0	100%
Buildings	0	0	0	5	100%
Accuracy	80%	80%	100%	100%	90%

Table 3.3: Accuracy Assessment Report

Class Name	Total of References	Total of Classified	Number Correct	User Accuracy
Vacant Area	5	5	4	80.00%
Area Under Development	5	5	4	80.00%
Forest and Various Crops	5	5	5	100.00 %
Buildings	5	5	5	100.00%
Total	20	20	18	90.00%

The output from the field study showed that four samples from vacant area visited matched with the classification in the image whilst one sample was not matched with the desired classification because its spectrum was included in area under development (cleared) land classification. This possibly due to the spectrum for vacant land is closer to the spectrum for area under development class. Whilst two more classes namely forest and various crops areas as well as building classes matched with accuracy of 100%. This is due

to the spectrum produced was more distinct and facilitate the selection of sample training area for the purpose of classification.

Based on the land usage map of Mukim Cheras that has been produced, the area of every class for land use is depicted in (Table 3.4) below. Forest and various crops classes were the highest coverage with a percentage of 32%, followed by building with 28.2%. For vacant land its width is 907.4 hectares accounted for 15.2% as against watery area and cloudy area by 12.8% and followed by area under development which is 11.8% with an area at 703 hectares. Through the land usage map produced, (Figure 3.2) several analyses were conducted like masking, overlay and buffering to produce area that is suitable for Muslim cemetery area.

Table 3.4: Percentage of Mukim Cheras Land Use

Land Usage	Area Width (Ha)	Percentage (%)
Water, Cloud	769.5	12.8
Buildings	1682.3	28.2
Cleared Land	703	11.8
Forest & Various Crops	1910.8	32
Vacant Land	907.4	15.2
Total Width	5972.6	100

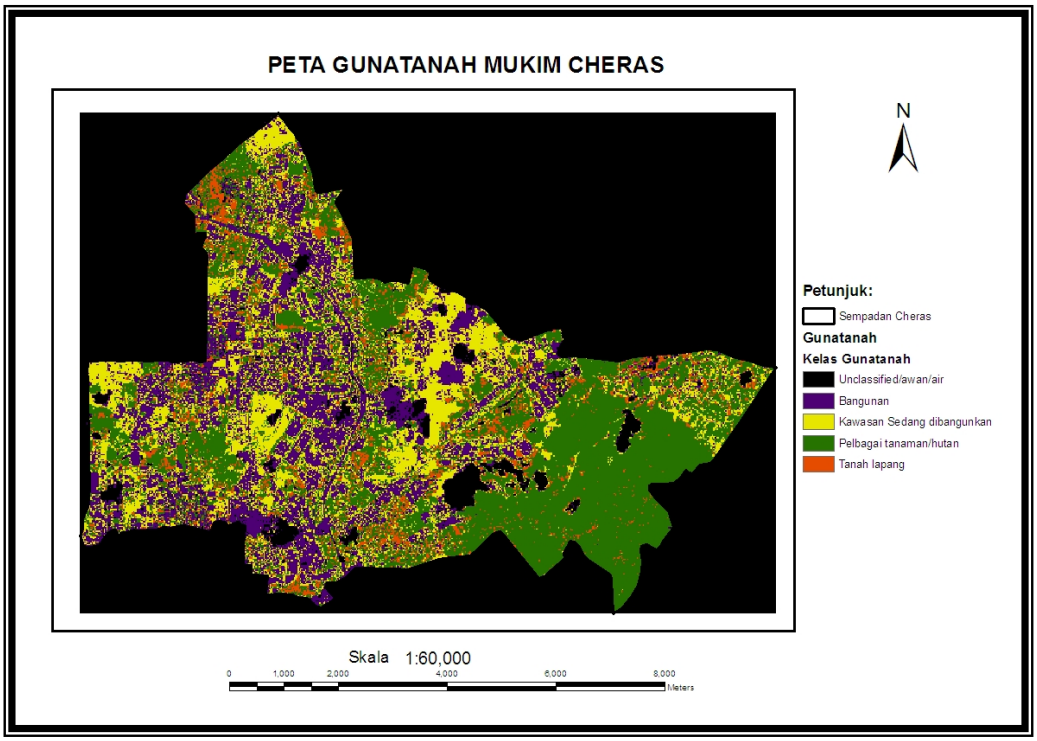

Figure 3.2 : Mukim Cheras Landuse Map

3.2 Slope Analysis

Slope analysis was conducted based on the study area land, which consists of different topography conditions. The study to determine the suitable new site for the Muslim cemetery need to follow guidelines set by Department of Town and Rural Planning, which one of its criteria needs a flat land shape. Through the criteria outlined for Muslim cemetery area, the earth slope of an area was not fixed in detail. For this study, "*Garis Panduan Pemeliharaan Topografi Semulajadi Dalam Perancangan Dan Pembangunan Fizikal Mengikut Akta Perancangan Bandar Dan Desa 1976"* was used as depicted in Table 3.5 and Table 3.6 below.

Table 3.5 : Guidelines on Land Development in Hilly Areas

Slope	Class
< 12˚	Low Risk
12˚- 20˚	Medium Risk
> 20˚	High Risk

Table 3.6 : Suitability Class Based on Weightage and Land Width

Weightage	Slope Degree	Suitability	Area (m2)	Percentage (%)
1	40˚- 50˚	Very unsuitable	25600	0.2
2	30˚- 40˚	Unsuitable	360800	0.3
3	20˚ - 30˚	Less suitable	6299600	4.5
4	10˚- 20˚	Suitable	17938800	12.6
5	0˚- 10˚	Very suitable	115361200	82.4
Total			**139986000**	**100**

As a result, the most suitable class having a slope of 0˚- 10˚ with an area of 82.4% accounted for the whole area of Mukim Cheras. The degree of slope is regarded as the most suitable for Muslim cemetery area because the slope is regarded as flat. The area comprise a width of 115,361,200 square meter which totally covers the west, south and centre parts of Mukim Cheras, Whilst the suitable slope which is between 10˚- 20˚ covers areas in the east and small part in the north which width percentage of 12.6%.

Whilst for the suitable area which slop between 20˚ - 30˚ mostly covers the east area and small part of west area with total width of 6,299,600 square meter which is approximately 4.5% from overall width. Whilst for unsuitable area covering 360, 8000 square meter. Furthermore the most suitable area covers 25,6000 square meter equivalent to 0.2% of the total Mukim Cheras (Figure 3.3).

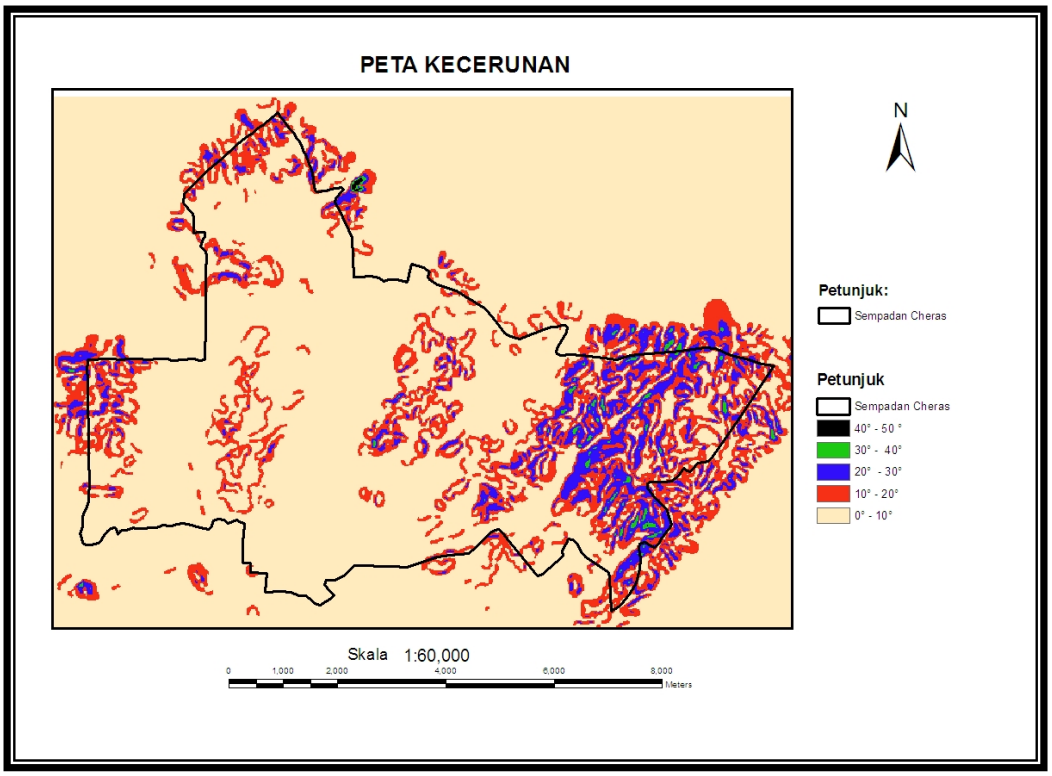

Figure 3.3 : Slope Map of Mukim Cheras

3.3 Suitability Study On Cemetery Site

The suitability study was based on criteria set by Department of Town and Rural Planning using GIS application. In this study the scope of analysis focused on determining the suitability of new Muslim cemetery site in Mukim Cheras, based on the Guidelines on Muslim and non-Muslim Cemetery Planning, JPBD(2002).

3.3.1 Modeling Analysis

Modeling analyzing was conducted based on Weighted Linear Sum model (Voegd, 1983), whereby the formula used is as follow:-

$$S = (WjXij)$$

Where S = Output (Suitable Cemetery Site)

Wj = Weight of Parameter / Variation (weighted for soils, slope and land use)
Xij = Weight of class in parameter (weighted class for soils, slope and land use)

Output which will be produced then were divided into 3 main categories to facilitate the determination of suitable Muslim Cemetery:

i. Very suitable class
ii. Less suitable class
iii. Unsuitable class

3.5.1.1 Parameter Weight Assignment

Parameter (Wj) is the value of parameter weight which is between 3 (most suitable and 1(not suitable) and the value is determine every weight class Xij. Modeling was conducted with the combination of 3 layers of data which are slope, land use map and soil map. The three data layers were produce through classification process to get the best class for purpose of the study. In the analysis every data have the weightage, which represents every class. For Soil Map its weightage is devided into 3 classes, whilst Land Usage Map and Slopes Map were divided into 5 classes as depicted in (Table 3.7) below.

Table 3.7: Classification using Weighted Linear Sum Model

Soil	Slope	Land Usage	Class Total	
3	5	5	3 x 5 x 5 = 75	Very Suitable
2	4	4	2 x 4 x 4 = 32	Less Suitable
1	3	3	1 x 3 x 3 = 9	Unsuitable
1	2	2	1 x 2 x 2 = 4	Unsuitable
1	1	1	1 x 1 x 1 = 1	Unsuitable

Value of the weight that is multiplied by (3x5x5=75) which the highest weight representing the **very suitable class** for area under study. In this study the weight value 3 which represent soil map is regarded most suitable because as it contains the highest percentage of sand as against other soils. This factor will facilitate water and air flows to all direction and further on will make faster decadence of corps as against other soils. Whilst value of weight 5 represents land usage map and slop map. For land usage map it was chosen as most suitable class because the land used consist of vacant area, which was not develop as well as near the housing area. Similarly, slop map represents slope between 0-10 degrees that is categorized as flat land and not steep.

Beside that, **less suitable class** takes weighted value (2x4x4=32) which represents class for soils map as weighted value 2 and weighted value 4 representing land usage map and slopping map. Weighted value 2 is categorized as less suitable class for cemetery land

as interruption in water and air flows caused hard and rocky soil. Whilst for land usage map which categorized as weighted value 4 is regarded less suitable due to land usage were mostly forest and plantation areas. Similarly, slop map regarded as less suitable because the area is a bit hilly.

For weighted value (1x3x3=9) was chosen as **unsuitable** cemetery class because its represents soil map that contain high clay content as compared to sand. Meanwhile weighted value 3, which represents land usage map, is categorized as not suitable as it represents area under development for housing, industrial, infrastructure and other projects. Whilst for slop map, weighted value 3 represents the steepest area. Meanwhile weighted value 1 and 2 which represent land usage map and slopping map are determined as the **most unsuitable class** for purpose of the study.

For the purpose to facilitate the production of land suitability, the value was reclassified into 3 classes namely very suitable, less suitable and unsuitable that based on the following categories tabulated in Figure 3.4 below.

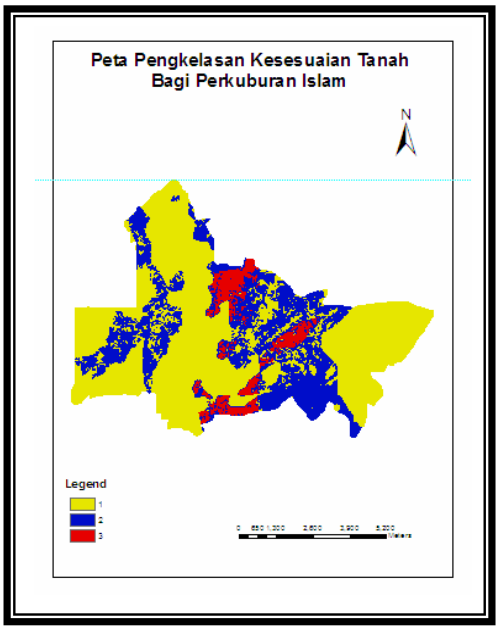

Figure 3.4: Land Suitability Map Mukim Cheras

As a result from the classification conducted, the **very suitable class** is the focus area for this study, which is land usage map that represent vacant land area, which the land has not been developed. Slope map meanwhile represent 0° - 10° slope that was categorized as flat land while soil map represents type of soil that contain high sand content, which is saturated soil structure for the purpose of easy water and air flows to all directions. This type of land can caused faster decadence of corps as against other land.

The study found out that eight areas has seen produced as **very suitable** which possess 2,467,303 square meter area equivalent to 246.7 hectares as compared to less suitable land equivalent to 1,367.1 hectares width. Whilst for **very unsuitable** land, it width is 39,762,602.2 square meter equivalent with 3,976.3 hectares. As a summary, the **very suitable** area to plan for the development of Muslim cemetery is 4.5% from the total area of the land in Mukim Cheras. This explanation is based on Table 3.8.

Table 3.8: Table of Area Classification

Class	Width(Ha)	Percent(%)
Very Suitable	246.7	4.5
Less Suitable	1367.1	24.5
Unsuitable	3976.3	71.0

3.5.2 Overlay Analysis

As a result of model analysis, the study was more focused on the most suitable class to get Muslim cemetery area. Through buffering operations and union operations, data such as rivers, roads, mosque and "*surau*" were separated for the purpose to get suitable cemetery areas. This is for the purpose to get only the desired area which is the most suitable area based on all criteria's which have been set by the Department of Town and Rural Planning through Guideline of Muslim and Non-Muslim Cemeteries Planning no 17/1927 (Figures 3.5).

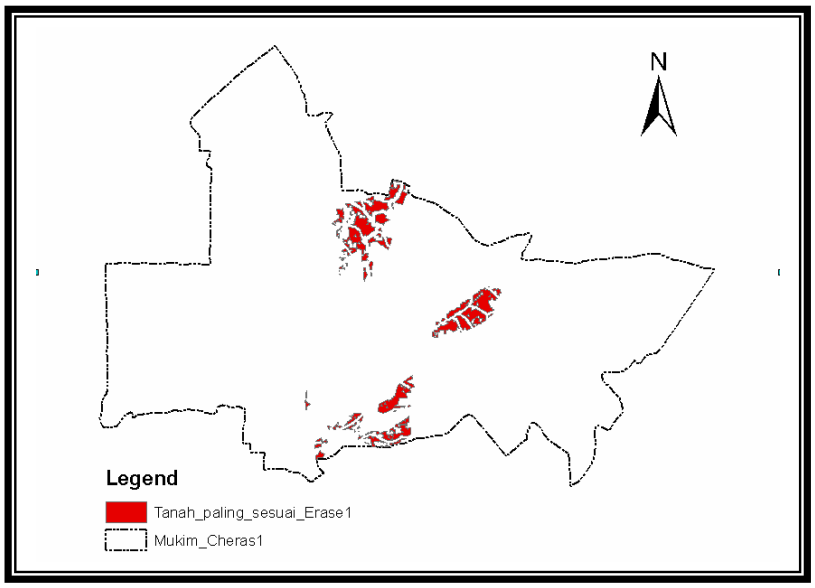

Figure 3.5: Suitable area for Muslim Cemetery in Mukim Cheras

The overlap analysis was carried out between Cadastral lot Mukim Cheras and the most suitable area for the purposed Muslim cemetery site in Mukim Cheras as in (Figure 3.6). The purpose of this analysis is to obtain information on land lots for particular area.

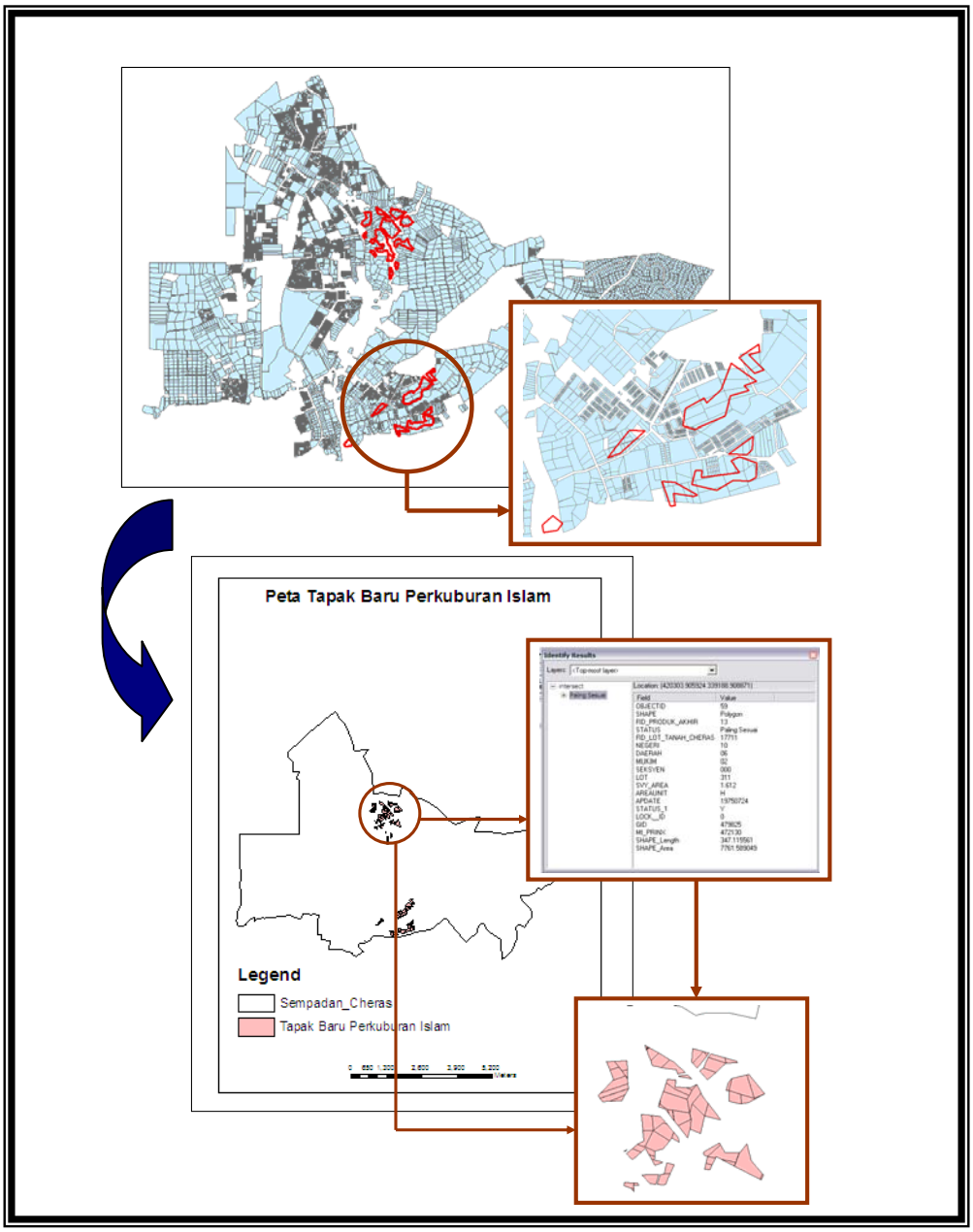

Figure 3.6: New Suitability Location

The area is regarded as the best as it is near to the road, housing area as well as worship house (mosque) which will facilitate the transport of funeral to cemetery. Similarly with topographic characteristic located in flat area and not steep as well as saturated soil type as shown in Figure 3.5 and 3.6. The final output is a Proposed Map for Muslim Cemetery in Mukim Cheras as depicted in (Figure 3.7 and Figure 3.8).

The final output meet the criteria determined by the Department of Town and Rural Planning through Guidelines on Muslim and Non-Muslim Cemeteries Planning No 17/19997.

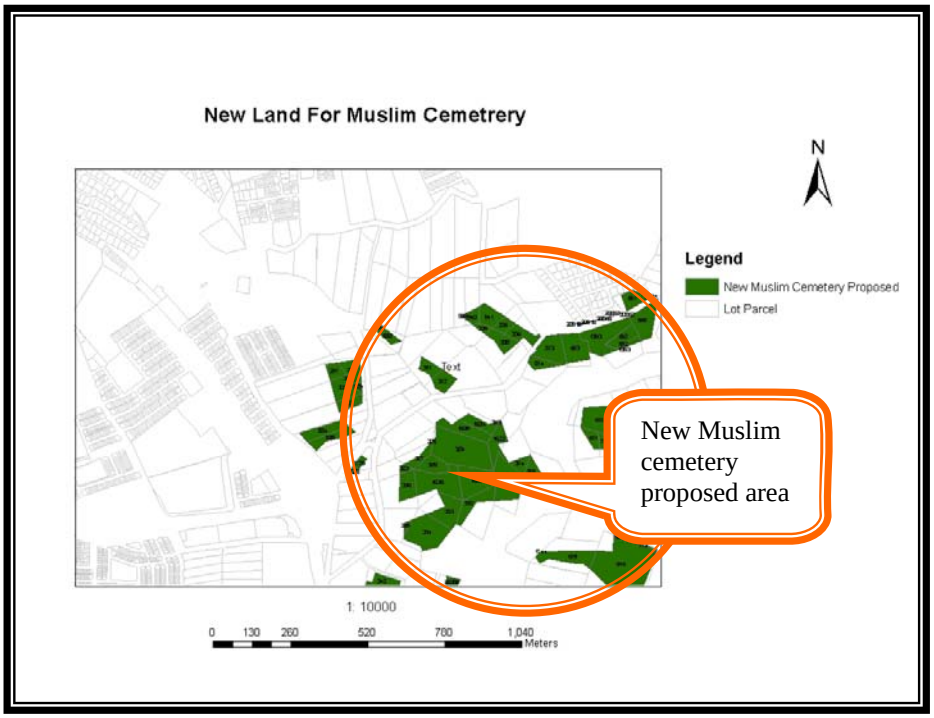

Figure 3.7: New Area for Muslim Cemetery

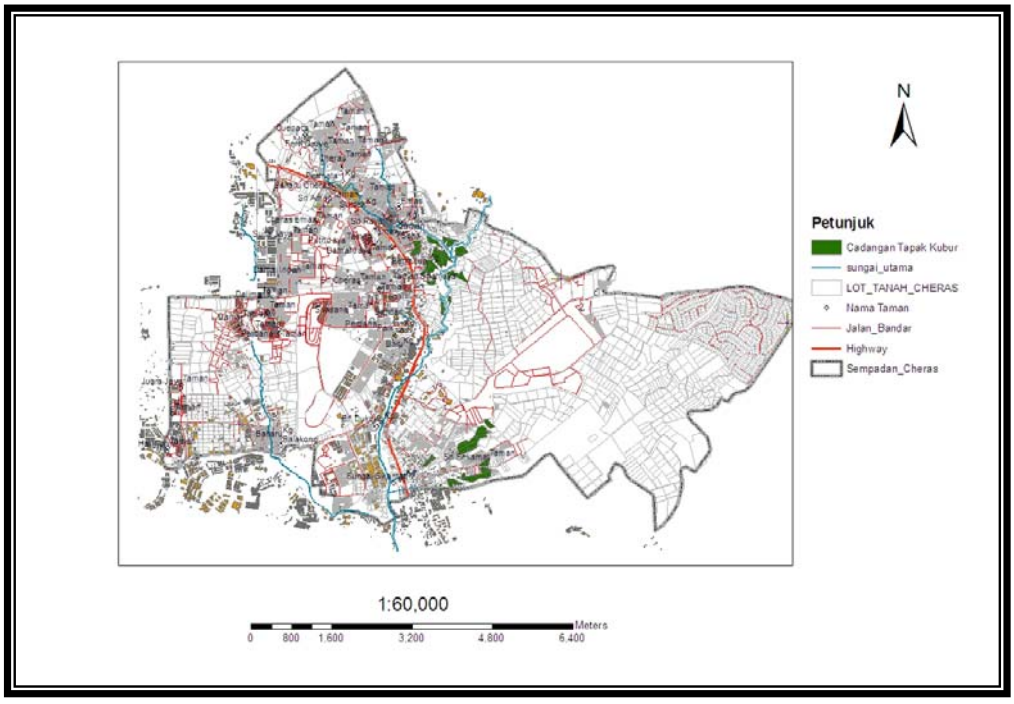

Figure 3.8: Proposed Map for New Muslim Cemetery *(Perkuburan Islam)* site in Muslim Cheras

4.0 CONCLUSION

Based on the outputs, it shown that GIS is capable to become a tool to assist planners in relevant decision making. Information generated from the analysis conducted can be obtained with eased and fast, and indirectly can enhance the efficiency of related agencies. Therefore the overall aim to determine the suitable new muslim cemetery site using GIS and digital mapping in Mukim Cheras has been achieved. This output is based on certain criteria that have been set by Department of Town and Rural Planning Malaysia. The capabilities of GIS software in assisting and implementing the analyses have been proven. Based on the capability which have been displayed, the outputs have increased the confident in assisting planners as well as housing developers in planning a development especially for new Muslim cemetery site selection, more effectively as well as giving emphasized on the concept of sustainable development.

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