การทำแผนที่ดิจิตอลของตะกอนผิวดินในพื้นที่คูบัว จังหวัดราชบุรี

นางสาว ณิชารีย์ อโศกานันท์

โครงงานนี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตร

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DIGITAL MAPPING OF SURFICIAL DEPOSITS IN

KHU BUA AREA, CHANGWAT RATCHABURI

NICHAREE ASOKANAN

A REPORT IN PARTIAL FULFILLMENT OF THE REQUIREMENT

FOR THE DEGREE OF THE BACHELOR OF SCIENCE

DEPARTMENT OF GEOLOGY, FACULTY OF SCIENCE

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บทคัดย่อ

ชื่อโครงการ **การทำแผนที่ดิจิตอลของตะกอนผิวดินในพื้นที่คูบัว จังหวัดราชบุรี**

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อาจารย์ที่ปรึกษาโครงการ **ผศ.ดร. สมบัติ อยู่เมือง**

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อจัดทำแผนที่ดิจิตอลของตะกอนผิวดินในบริเวณพื้นที่ศึกษา อำเภอเมืองราชบุรี อำเภอปากท่อ อำเภอวัดเพลง อำเภอดำเนินสะดวก จังหวัดราชบุรี และอำเภอบางคนที อำเภออัมพวา จังหวัดสมุทรสงคราม ซึ่งครอบคลุมพื้นที่ 170 ตารางกิโลเมตร กระทำโดยใช้ข้อมูลที่จัดทำและแปลความหมายด้วยระบบสารสนเทศภูมิศาสตร์ ระบบโทรสัมผัส และข้อมูลจากการสำรวจภาคสนาม จากข้อมูลดังกล่าวสามารถนำมาแบ่งลักษณะของตะกอนผิวดินในพื้นที่ศึกษาและจัดทำข้อมูลฐานออกมาเป็นแผนที่ในระบบดิจิตอล โดยการนำระบบสารสนเทศภูมิศาสตร์ และระบบโทรสัมผัสมาใช้ในการแบ่งตะกอนผิวดินในครั้งนี้จะใช้การแบ่งลักษณะต่างๆที่ปรากฏจากภาพถ่ายดาวเทียม Landsat 8 OLI ข้อมูลแบบจำลองความสูงเชิงตัวเลข แผนที่ธรณีวิทยาโดยกรมทรัพยากรธรณี และแผนที่ชุดดินโดยกรมพัฒนาที่ดิน ในการแบ่งตะกอนผิวดินในพื้นที่ศึกษา จากนั้นนำข้อมูลจากการสำรวจภาคสนาม มาใช้ในการตรวจสอบและปรับแก้ขอบเขตแต่ละหน่วยให้มีความถูกต้องมากยิ่งขึ้น โดยผลลัพธ์ที่ได้จะออกมาในรูปแบบแผนที่ดิจิตอลของตะกอนผิวดินในบริเวณพื้นที่ศึกษา และข้อมูลฐานที่มีความละเอียด และสามารถนำไปปรับยุกต์ใช้ได้ในงานอื่นๆต่อไปได้

ผลจากการศึกษาในครั้งนี้สามารถจำแนกตะกอนผิวดินออกจากหินฐานและสิ่งปลูกสร้าง ได้ทั้งหมด 5 หน่วยเรียงจากทิศตะวันตกไปยังทิศตะวันออกได้แก่หน่วย V ประกอบด้วยตะกอนทรายแป้ง อยู่บริเวณรอบเขาด้านทิศตะวันตก เป็นพื้นที่แห้งแล้ง มีการเพาะปลูกต่ำ หน่วย W ประกอบด้วยตะกอนทรายปนดินเคลย์ พื้นที่ส่วนใหญ่เป็นทุ่งนา หน่วย X ประกอบด้วยดินเคลย์เนื้อแน่น พื้นที่ส่วนใหญ่เป็นทุ่งนาและมีบ้านเรือนบางประปราย หน่วย Y ประกอบ ตะกอนดินเคลย์ปนดินเคลย์เนื้อแน่นเหนียว พื้นที่ส่วนใหญ่มีการยกร่องใช้เพาะปลูกพืชสวน และมีน้ำในร่องบางฤดูกาล หน่วย Z ประกอบ ตะกอนดินเคลย์เนื้อแน่นเหนียว พื้นที่ส่วนใหญ่มีการยกร่องใช้เพาะปลูกพืชสวน และมีน้ำในร่องตลอดเวลา ซึ่งผลลัพธ์ที่ได้นำเสนอออกมาในรูปแบบแผนที่ดิจิตอลของตะกอนผิวดินในบริเวณพื้นที่ศึกษา และข้อมูลฐานที่เป็นดิจิตอล

คำสำคัญ: แผนที่ดิจิตอลของตะกอนผิวดิน, คูบัว, ราชบุรี

Abstract

Project name	**Digital Mapping of Surficial Deposits in Khu Bua Area, Changwat Ratchaburi**
Department	**Geology**
Producer	**Miss Nicharee Asokanan ID 5532717523**
Advisor	**Assist.Prof.Dr. Sombat Yumuang**

Thematic (GIS and remote sensing) data preparation, laboratory analysis, and field investigation were carried out to generate the surficial deposits map and improve the Quaternary units in Amphoe Muang Ratchaburi, Amphoe Paktho, Amphoe Wat Phleng and Amphoe Dam Noen, Changwat Ratchaburi and Saduak, Amphoe Bang Khonthi, Amphoe Amphawa, Changwat Samut Songkham. The area comprising approximately 170 square kilometers. This research generated map by the combining of classified imagery (satellite image from Landsat8 OLI/TIRS), field investigation data and morphologically defined areas derived from 1m digital elevation models (DEM).

The result from this study can discriminate surficial deposits units to 5 units: Unit V is the foothill field which compose of silt with sand, Unit W is the field with stiff grayish yellow silt, Unit X is the field with gray clay, Unit Y is the cropland with soft brown and light brown clay and Unit Z is the wet cropland with soft dark brown and light gray silt.

Finally, the field data is also significantly to improve and confirm the exact boundary detail of surficial deposits units from the secondary supervised classification with using field data as training area. Although the digital classification technique cannot use to identify all of the lithologic characteristics but it help us to spend less time in the large area and should be very fruitful to update for the more accurate surficial deposits of the traditional geological data and map in the low land areas. The result from this study is adaptable to support the surficial deposits and materials management in study area and the other applications.

Keywords: digital surficial deposits map, Khu Bua Area, Changwat Ratchaburi

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I honestly thank my Advisor, Asst. Prof. Dr. Sombat Yumuang of Chulalongkorn University for his supports, valuable ideas, encouragements, critically advises and reviews of this research. And I would also like to thank Mr. Katawut Waiyasusri for technical support.

I sincerely gratify United States Geological Survey, Department of Mineral Resources, Land Development Department of the Ministry of Agriculture and Cooperation, Royal Thai Survey Department, the Electricity Generating Authority of Thailand and Department of Public Works and Town & Country Planning of the Ministry of Interior for their permission to use essential data for this research.

Finally, I thank my family, Asokanan’s family and my classmate, Geo’56 for their support and encouragement throughout this time of hardship.

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CHAPTER 1

INTRODUCTION

The digital surficial deposits map of Khu Bua area, Changwat Ratchaburi presents the surficial deposits that accumulated or formed during the past two million years, the period that includes all activities of the human. These materials are at the surface of the Earth. Most of our human activity is related in one way or another to these surface materials. As a result, surficial deposits and materials have become a focus of much interest by scientists, environmentalists, governmental agencies, and the general public. They are the foundations of our ecosystems, the materials that support plant growth and animal habitat, and materials through which travels much of the water required for our agriculture, our industry, and our general well-being. They also are materials that can be contaminated by pesticides, fertilizers, acid rain, and toxic wastes (Fullerton *et al*., 2003). Therefore, this research studied and generated the surficial deposits map of Khu Bua area, Changwat Ratchaburi to digital map that is adaptable to support the surficial deposits and materials management in study area and the other applications.

1.1 Rationale

The surficial deposits map of Thailand was generated from the aerial photographs interpretation, field traverses, and sampling that was usually time consuming and wasn't general form therefore this map was unsuitable to use, hard to ensure accuracy, and unadaptable. Recently, there are Remote Sensing and GIS applications to digital mapping of surficial deposits that combined with detailed field studies in selected areas provides useful regional maps of surficial units until time and funding is available for more field intensive studies (Jayko *et al*., 2005). These advances have now reached a stage where it is effective to develop to support traditional mapping techniques.

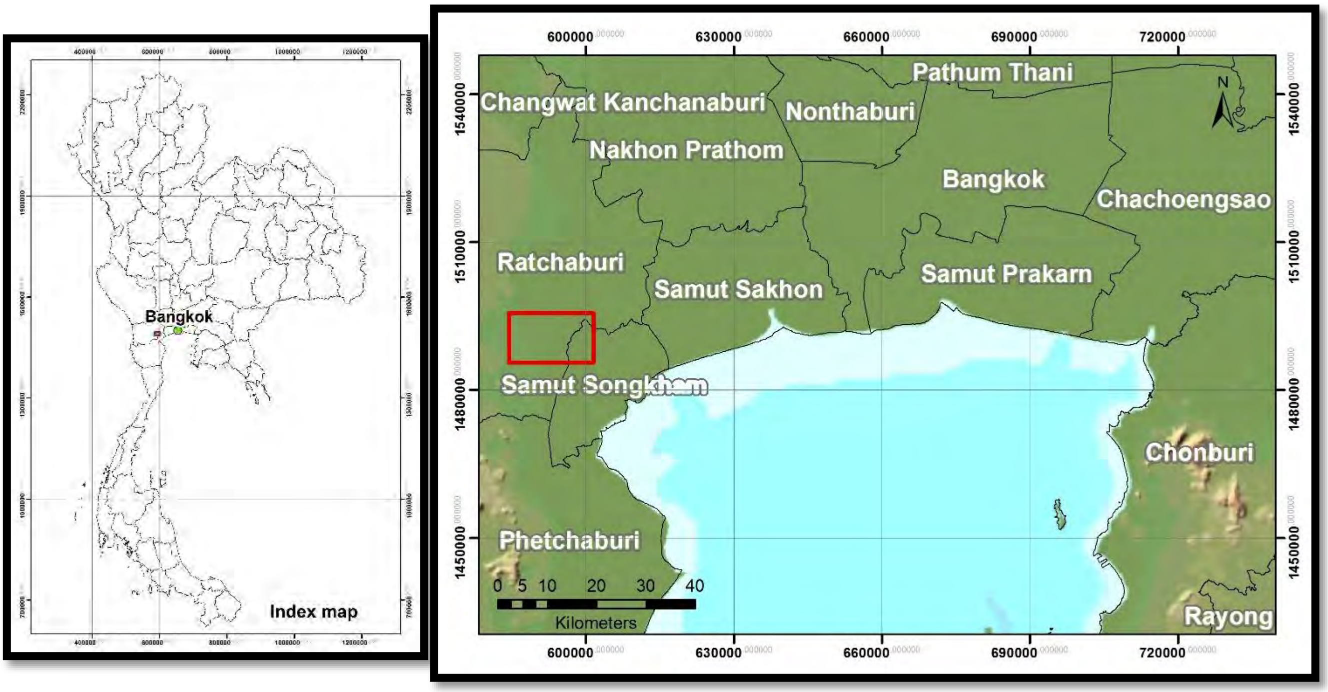
1.2 Objectives

The aim of this study are

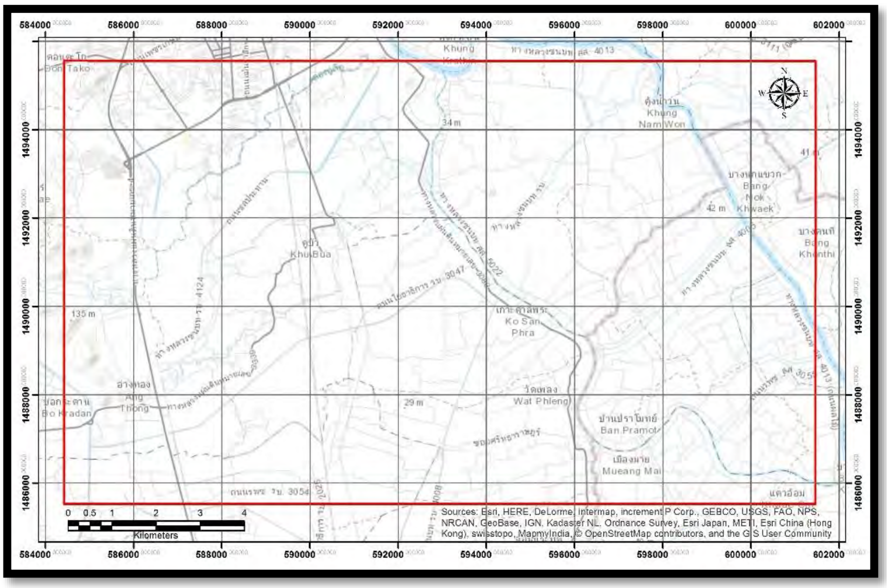
- To generate the map from a combination of digital elevation data (DEMs), satellite imagery using a GIS platform and digital processing techniques to discriminate surficial units.
- To improve the Quaternary units in study area.

1.3 Location of the study area

The study area (Figure 1-1) is located in the western rim of the Lower Central Plain or also known as Chao Phraya Basin, Thailand. The area comprising approximately 170 square kilometers (17 km long and 10 km wide) and is in Amphoe Muang Ratchaburi, Amphoe Paktho, Amphoe Wat Phleng and Amphoe Dam Noen, Changwat Ratchaburi and Saduak, Amphoe Bang Khonthi, Amphoe Amphawa, Changwat Samut Songkham. The extents of the coordinates of the study area are approximately defined as 1495500 N, 584400 E in the northwestern edge and 1485500 N, 601400 E in the southeastern edge in Universal Transverse Mercator projection with 47 North zone in WGS 1984.



a)



b)

Figure 1-1 a) Geographic setting of the study area, and

b) Topographic map of the study area.

1.4 Research methodology

To reach the objectives, the four sequential steps are designed in this research. Each of which is described as follows:

1.4.1 Preparation

This step includes:

- Literature review of the related researches in the study area, lower central plain of Thailand.
- Acquisition and study of the previous data acquisition, i.e. satellite images of medium resolution (Landsat), topographic map, geologic map, and soil map to understand the topography, geology, and soil units of the study area as general background information.
- Intensive comprehension on the conceptual framework of surficial deposits and digital mapping.

1.4.2 Laboratorial studies

The laboratorial analysis is carried out as follows:

- Thematic (GIS and remote sensing) data preparation. These inventory data consist of topography, geology, geomorphology, morphometry (digital elevation model (DEM) and slope), and soil map. Softwares of geographic information system (GIS) and remote sensing (ArcMap 10.3.1 and ERDAS IMAGINE 2014) are applied in developing, manipulating, and analyzing the digital data.
- Interpretation of satellite images of medium resolution from Landsat 8 OLI path 129 row 051 that were recorded on 4th January 2015. The interpretation was acquired before and after field investigation. This sub-step was conducted to create the primary surficial deposit map from remote sensing and GIS analysis, and improve the final surficial deposit map from ground-truth information from the field investigation.
- Remote sensing analysis conducts by Visual interpretation, Unsupervised classification, Normalized Difference Vegetation Index (NDVI) analysis, and Supervised classification. This sub-step is conducted to classify the primary

surficial units. Then DEM, soil map, and GIS database are inputted to GIS analysis for creating boundaries of units.

1.4.3 Field investigation

The field investigation is conducted as follows:

- To check ground-truth to inspect the correctness of the analyzed results from the remote sensing image analysis and interpretation. (i.e. the physical conditions, geologic characteristics, soil characteristics and landform conditions)
- To define geomorphologic conditions to classify landform in study area.

1.4.4 Synthesis, discussion and conclusion

This step includes:

- Synthesizing, discussing and concluding surficial units in study area from remote sensing image analysis and field investigation data.
- Synthesis, discussion and concluding the relationship between the surficial units and the landform classification.
- Synthesis, discussion and concluding the relationship between the surficial deposits map and the previous geological map in study area.

In order to accomplish the objectives of this research, the schematic diagram illustrating the present methodology system was designed as shown in Figure 1-2

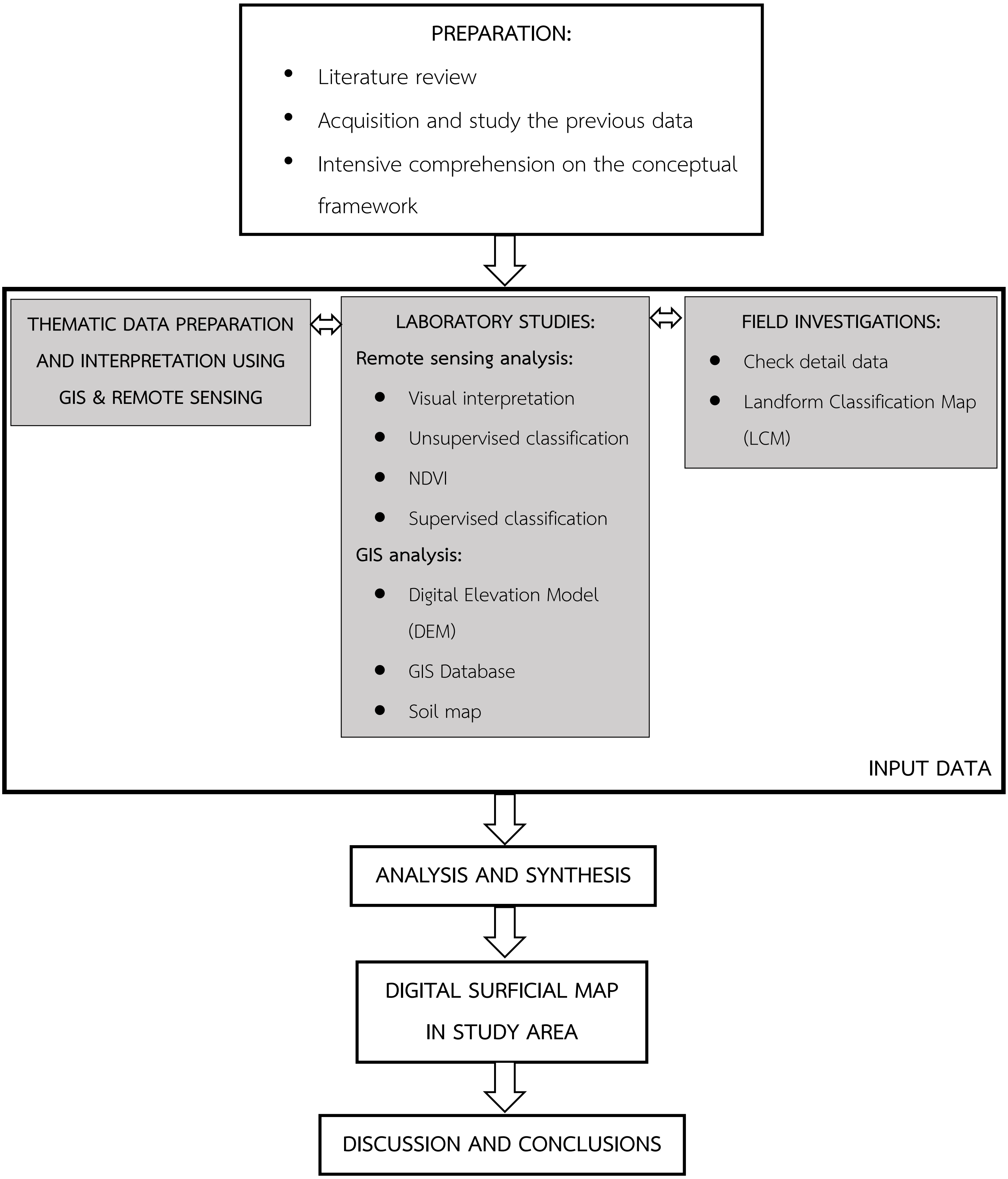


Figure 1-2 Schematic diagram illustrating the present methodology system.

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction

In this chapter, the definition and terminology given for surficial deposits and digital mapping are reviewed. Besides, use of the remote sensing and geographic information system (GIS) techniques in digital surficial deposits mapping and Geology of study area are also briefly mentioned.

2.2 Surficial deposits

Superficial deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 2.6 million years from the present and refer to unconsolidated sediments in a lithology. They rest on older deposits or rocks referred to as bedrock (BGS, 2016). This is classified by grain size and composition, and is often attached to an interpretation of the environment that the unit formed. Surficial deposits can be given to lacustrine, coastal, fluvial, aeolian, glacial, and recent volcanic deposits, among others. In addition, The SGU (Geological Survey of Sweden) creates Quaternary geology databases that contain information on the properties of surficial deposits. This information, particularly at a scale of 1:50 000, can be used for many different purposes in farming and forestry, including avoiding erosion, assessing growing conditions, estimating risks in terms of nutrient leaching and releasing of toxic substances, planning site preparation, road construction, felling and extraction operations, judging accessibility etc. (SGU, 2012)

The classification of Quaternary sediments (superficial deposits) in Thailand (Figure 2-1) is based on geomorphology, lithology, depositional environments, geologic structure and fossils. Generally, Pleistocene deposits are related to neo-tectonics, changing of alluvial and fluvial systems, weathering in-place of the bed rocks, and evidences of sea-level change in restrictive areas. Generally, Holocene deposits are concern mainly with climatic changes and marine sediments relating to the great fluctuation of sea-level. The present coastal area of Thailand was derived by inundation of Holocene sea-level. While in the upland area flood plain, levee, and young alluvial fan were developed

(Sinsakul *et al*., 2002).

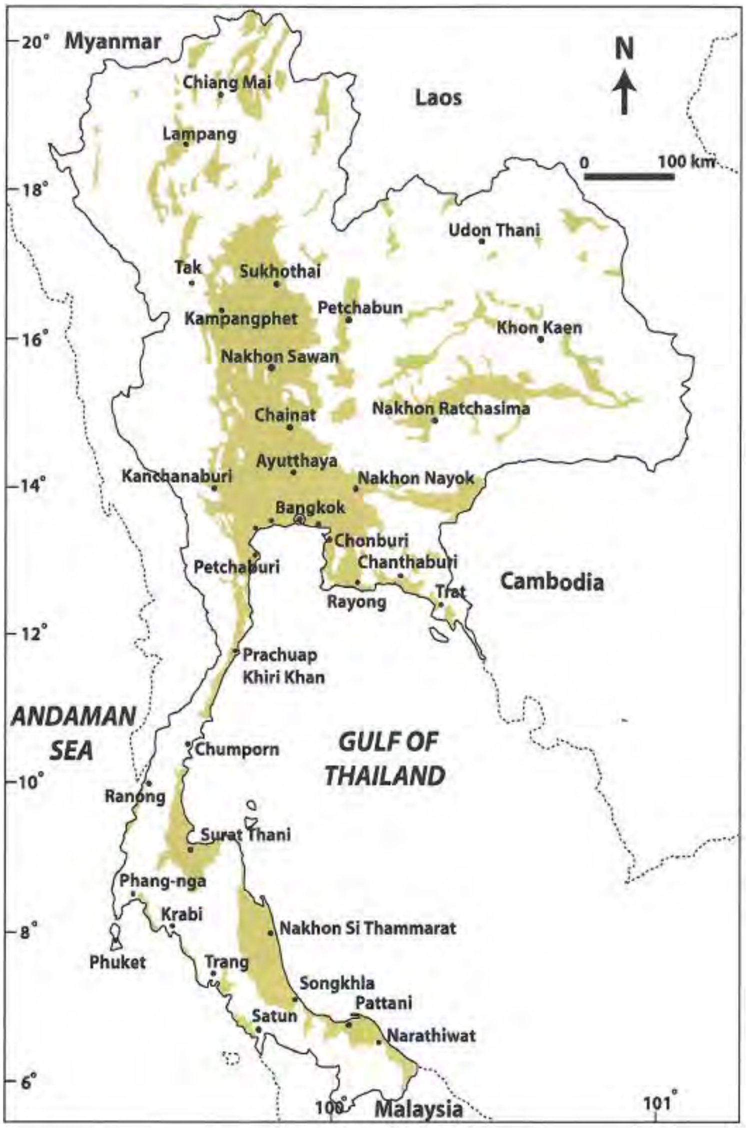


Figure 2-1 Map showing the distribution of Quaternary deposits in Thailand. (compiled from the Geological Map of Thailand, Department of Mineral Resources, 2004)

2.3 Digital mapping

Digital geological mapping (DGM) is the process of mapping and collecting geological data using some form of portable computer and Global Positioning System (GPS), rather than a traditional approach based on notebook and paper map (Clegg *et al*., 2006). DGM is not simply a direct replacement for traditional paper-based mapping methods; importantly, it gives the geoscientist the enhanced ability to collect geospatially georeferenced field data that can be analyzed and visualized in ways (McCaffrey *et al*., 2005).

DGM is discussed the many advantages over traditional methods (e.g. Struik et al., 1991; Brodaric, 1997; Briner et al., 1999; Kramer, 2000; Brimhall and Vanegas, 2001; Edmondo, 2002; McCaffrey et al., 2003; Jones et al., 2004; Wilson et al., 2005; McCaffrey et al., 2005), which include:

- There is a streamlined workflow from data collection to final map production without the need for disparate and separate data processing.
- Data derived using other geophysical and geographical systems can be easily integrated e.g. satellite imagery, gravity and magnetic surveys, geochemical sampling, Digital Elevation Models (DEM) etc.
- Data management and storage capability are enhanced.
- There is greater accessibility to data for a wider audience through data archives.
- Accuracy and precision of GPS positional data can be tested and quantified.

2.4 Use of remote sensing in digital surficial deposits mapping

Remote Sensing can be defined as the instrumentation, techniques and methods to observe the Earth's surface at a distance and to interpret the images or numerical values obtained in order to acquire meaningful information of particular objects on earth. Three definitions of remote sensing are given below:

- Remote sensing is the science of acquiring, processing and interpreting images that record the interaction between electromagnetic energy and matter.(Sabins, 1997)
- Remote sensing is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is

not in contact with the object, area, or phenomenon under investigation. (Lillesand and Kiefer, 1994)

- The term remote sensing means the sensing of the Earth's surface from space by making use of the properties of electromagnetic waves emitted, reflected or diffracted by the sensed objects, for the purpose of improving natural resources management, land use and the protection of the environment. (Van Westen, 1994)

The process of Remote Sensing is schematically shown in Figure 2-2

The surficial deposits is affecting the earth's surface, hence it also deposits in the research areas of both aerial and space born remote sensing. The nature of this deposits as it is occurring at the surface of earth allows the earth scientists to exploit this fact using remotely sensed data. The surficial deposits are differentiated through systematic classification based on specific user-defined ranges of spectral values for each unit. The spectral ranges used in the classification are largely dependent on the composite effects of surface characteristics and material properties, including depositional morphology and texture, pavement development, degree of surface clast varnishing, and (or) properties of exposed soils of the alluvial fan units (Jayko *et al*., 2005)

Plenty of researchers have tested the usage of remote sensing products during the last 30 years. Two major groupings could be made upon the investigation of this research. These are aerial photography and space-born sensor images.

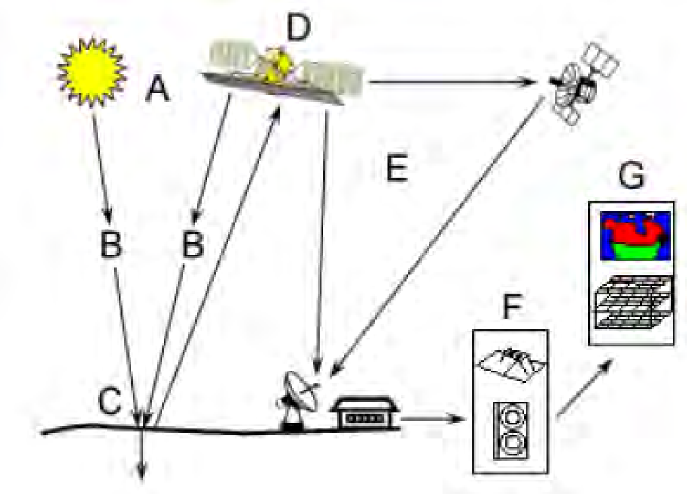


Figure 2-2 Process of Remote Sensing (Van Westen, 1994).

Note: A) Energy source to illuminate the target; B) Interaction of the radiation with the earth’s atmosphere; C) Radiation-target interactions; D) Data reception; E) Data transmission; F) Data processing; G) Data application

The surficial deposits information extracted in the remotely sensing studies normally shows a relationship with the morphology, vegetation and the hydrological conditions of the slope. The slope morphology can be examined with stereographical coverages.

2.5 Geographical Information Systems (GIS) and digital surficial deposits mapping

Geographic data have previously been presented in the form of hard-copy maps. But the recent rapid development of computer hard- and software help introducing them in a digital form which is more applicable. Many organizations now spend so much money on establishing Geographic Information Systems (GIS) and the geographic data bases. The demand for the storage, analysis and display of complex and voluminous environmental data has led, in recent years, to the use of computer for data handling and the creation of sophisticated information systems. Effective use of large spatial volumes depends on the existence of efficient systems that can transform these data into usable information. GIS becomes an essential tool for analyzing and graphically transferring knowledge.

GIS is a "powerful set of tools for collecting, storing, retrieving at will, transforming, and displaying spatial data from the real world for particular set of purposes" (Burrough, 1986). A more specific definition is given by Bonham-Carter (1996) as

"A geographic information system, or simply GIS, is a computer system for managing spatial data. The word geographic implies that the locations of the data items are known, or can be calculated, in terms of geographical coordinates. The word information implies that the data in GIS are organized to yield useful knowledge, often as colored maps and images, but as also statistical graphics, tables and various on-screen responses to interactive queries. The word system implies that a GIS is made up from several interrelated and linked components with different functions. Thus, GIS has functional capabilities for data capture, input, manipulation, transformation, visualization, combination, query, analysis, modeling and output."

These internationally valid definitions of GIS are certainly contradicted to the belief that GIS is only a Computer Aided Drawing (CAD) software or only a drawing tool.

Generally, CAD can only constitute a small portion of the whole integrated system, whereas an ideal GIS and its possible integrated components are as shown in Figure 2-3 and 2-4 GIS, if based on the right components should answer several questions as shown in Figure 2-5

More over the products of mapping and inventory are being stored in data banks for their ultimate retrieval or combination with data from other sources. Often they are incorporated GIS or LIS (Land Information Systems) which serves as a base for programmable data manipulation and selective information extraction for planning and project assessment.

The development of GIS and LIS is of considerable interest in the context of satellite surveying, change detection, and monitoring. The flexibility of digital data processing, combined with quick input of new data (possible from updating on the basis of satellite remote sensing records) offers new possibilities to the surveyor, cartographer and planner.

It is clear that in a rapidly developing society, change detection is of great importance. In modern society, mapping suffers from high rate of change, such as, change in land use in rural and urban areas, change in requirements for maps and inventories, change in concepts in the various disciplines of earth and social sciences, leading to different interpretations of the same data, and change in the economic and technical factors on which mapping methods were based.

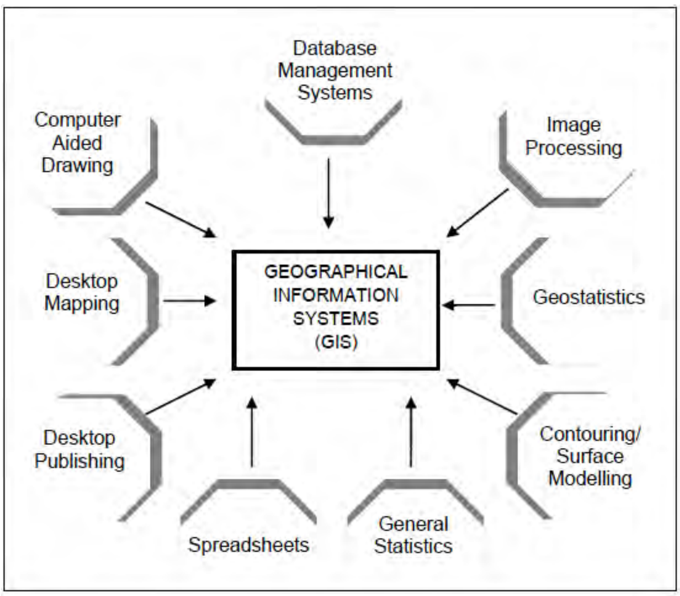


Figure 2-3 GIS and its related software systems as components of GIS (Sgzen, 2002).

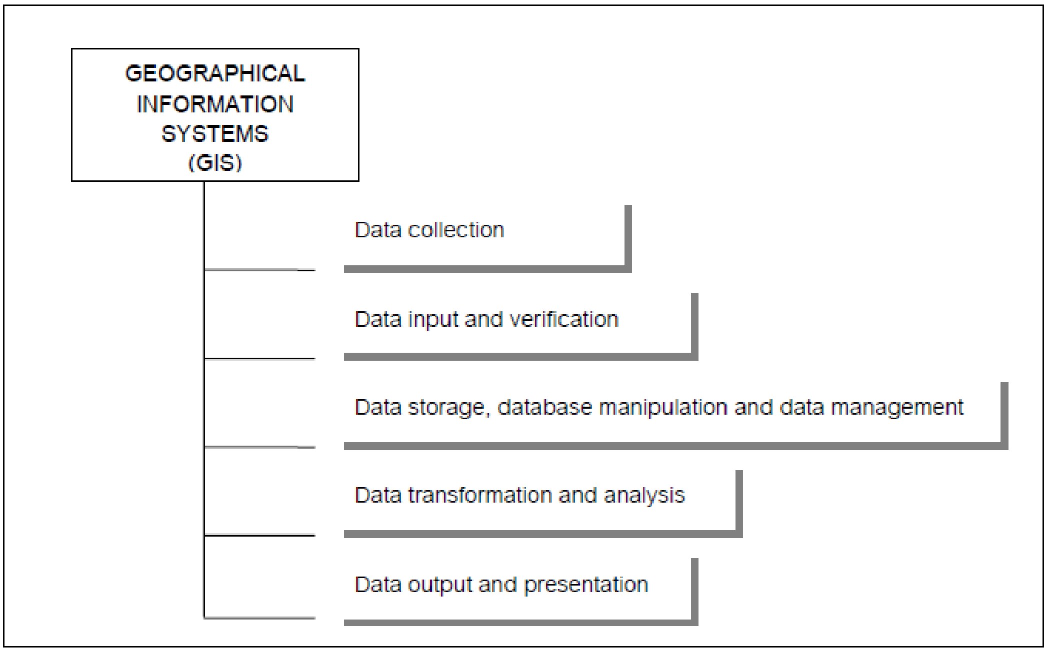


Figure 2-4 Phases of a GIS (Sgzen, 2002).

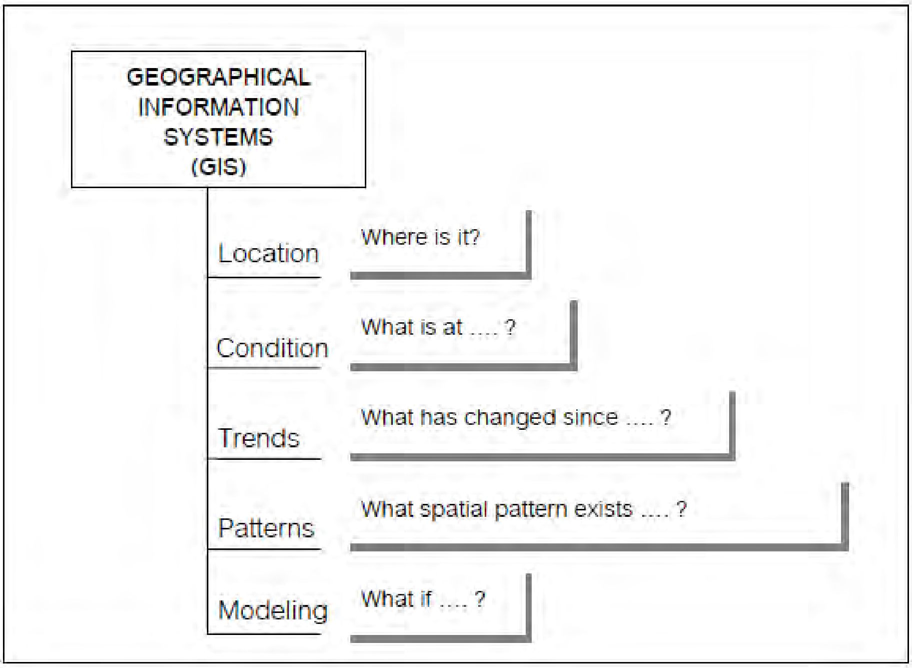


Figure 2-5 Questions which a well-built GIS should answer (Sgzen, 2002).

In order to refine the discussion around surficial deposits mapping, digital elevation models (DEM) is the significant tool to discriminate the region. This automated mapping, implemented in a GIS system, involves an iterative process applied to a combination of DEM and satellite image data. The areas are subsequently classified into surficial map units such as active channels, ground-water discharge zones, and multiple age alluvial-fan piedmont units based on reflective properties of the associated surfaces in the satellite imagery (Jayko *et al*., 2005). GIS is allowed for the storage and manipulation of information concerning the different terrain factors as distinct data layers, and thus provides an excellent tool for surficial deposits zonation.

2.6 Geology of study area

The study area is located in the western rim of the Lower Central Plain (Figure 2-6) or also known as Chao Phraya Basin, Thailand. The rim of Central plain are the area between mountain range and plain. They are characterized by undulating terrain and hillslope with the elevation less than 100 meters from MSL. The Quaternary sediments of western rim are mainly colluvium and weathering inplace of the bed rocks, as granule and boulder. The great alluvial fan deposited from Mae Khlong river, Phasak river and their tributaries. This alluvial fan composed of coarse sand intercalated with thick bedded sand and silty clay layer (Sinsakul *et al*., 2002).

Department of Mineral Resources (2007) divided the Quaternary deposits in study area to 2 units: Unit Qa was the fluvial deposits that composed of gravel, sand, silt, and clay of channel, river bank, and flood basin and Unit Qmc was the coastal tide-dominated deposits which composed of clay, silt, and fine-grained sand of tidal flat, marsh, mangrove swamp and estuary (Figure 2-7).

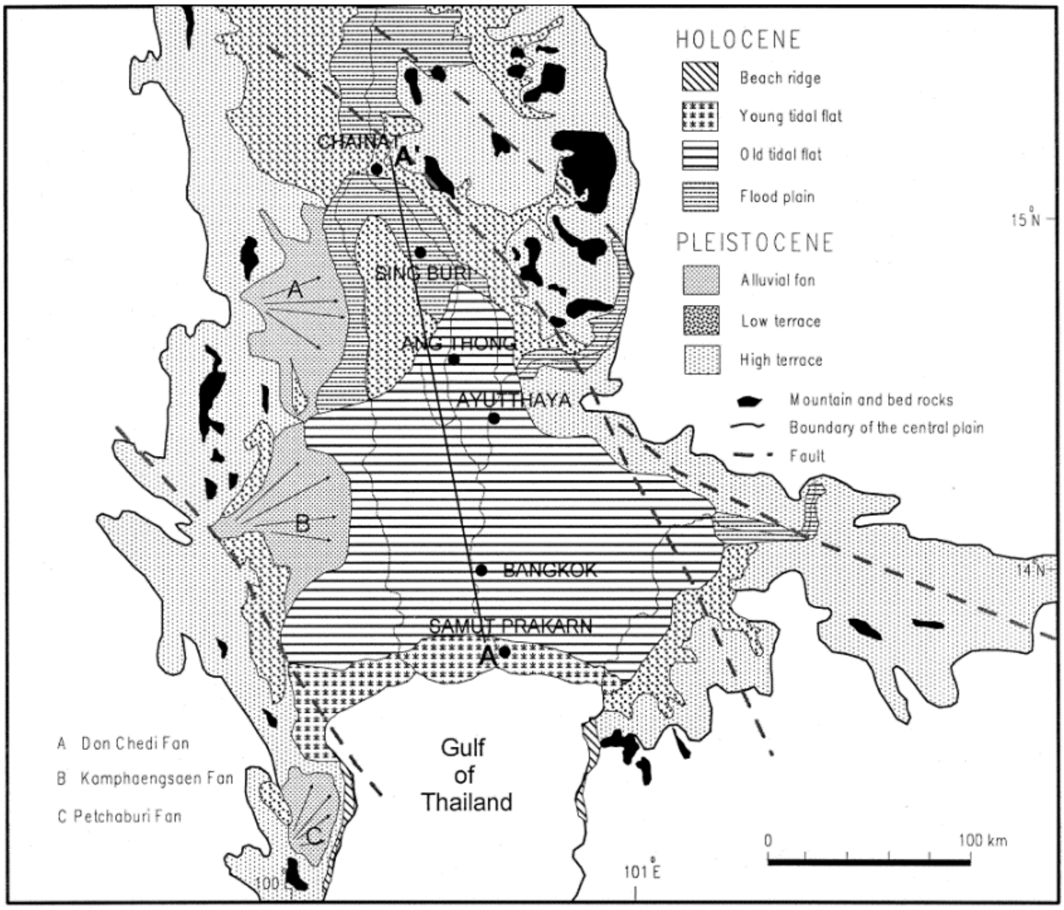
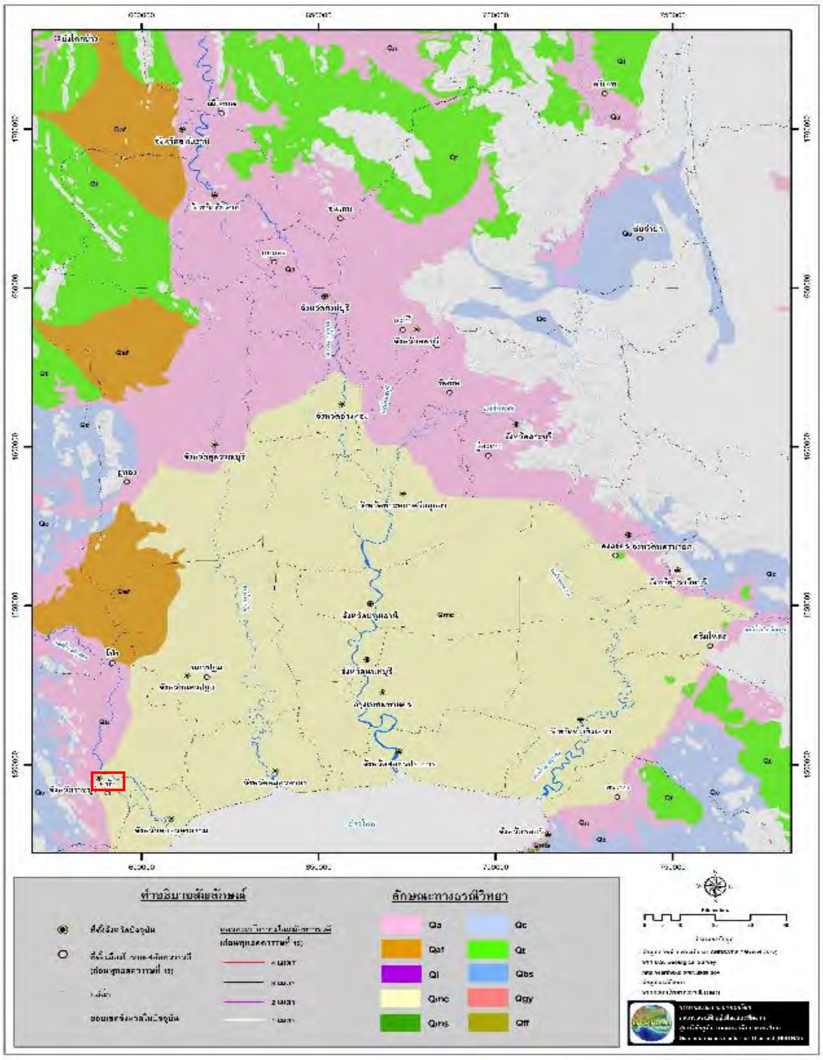


Figure 2-6 Geologic map of Quaternary deposits in the Lower Central Plain (modified after Dheeradilok, 1986).



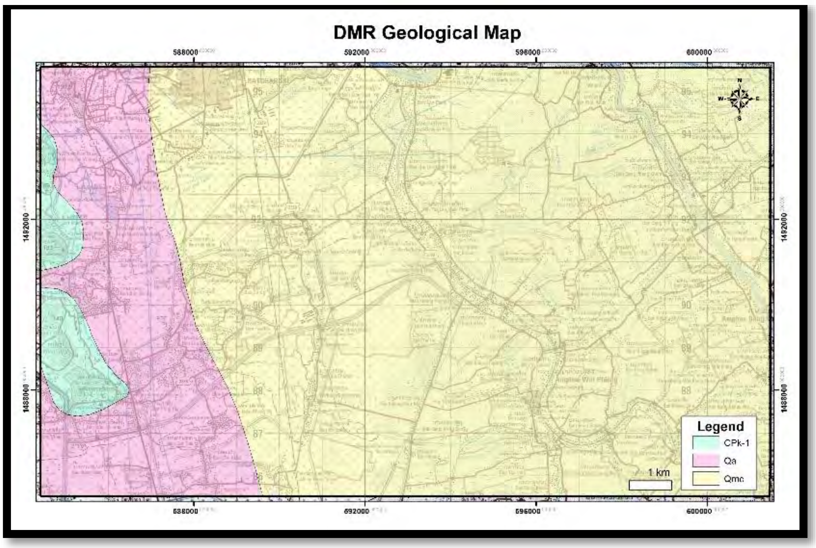


Figure 2-7 Geological map of the study area (DMR, 2007).

CHAPTER 3

OUTPUTS

3.1 Results

Thematic surficial deposit map is generated by the combining of classified imagery (satellite image from Landsat8 OLI/TIRS), field investigation data and morphologically defined areas derived from 1m digital elevation models (DEM). These maps can be empirically compared with published geologic map in study area form Department of Mineral Resources (2007) 1:50,000 scale and soil map in study area form Land Development Department (1995) 1:25,000 scale.

The digital mapping technique discriminates the surficial deposits from bedrock in study area to 5 units from west to east: Unit V, Unit W, Unit X, Unit Y and Unit Z. Each of which is described differences of field investigation data, characteristics from supervised classification, elevation and spectral ranges from digital image.

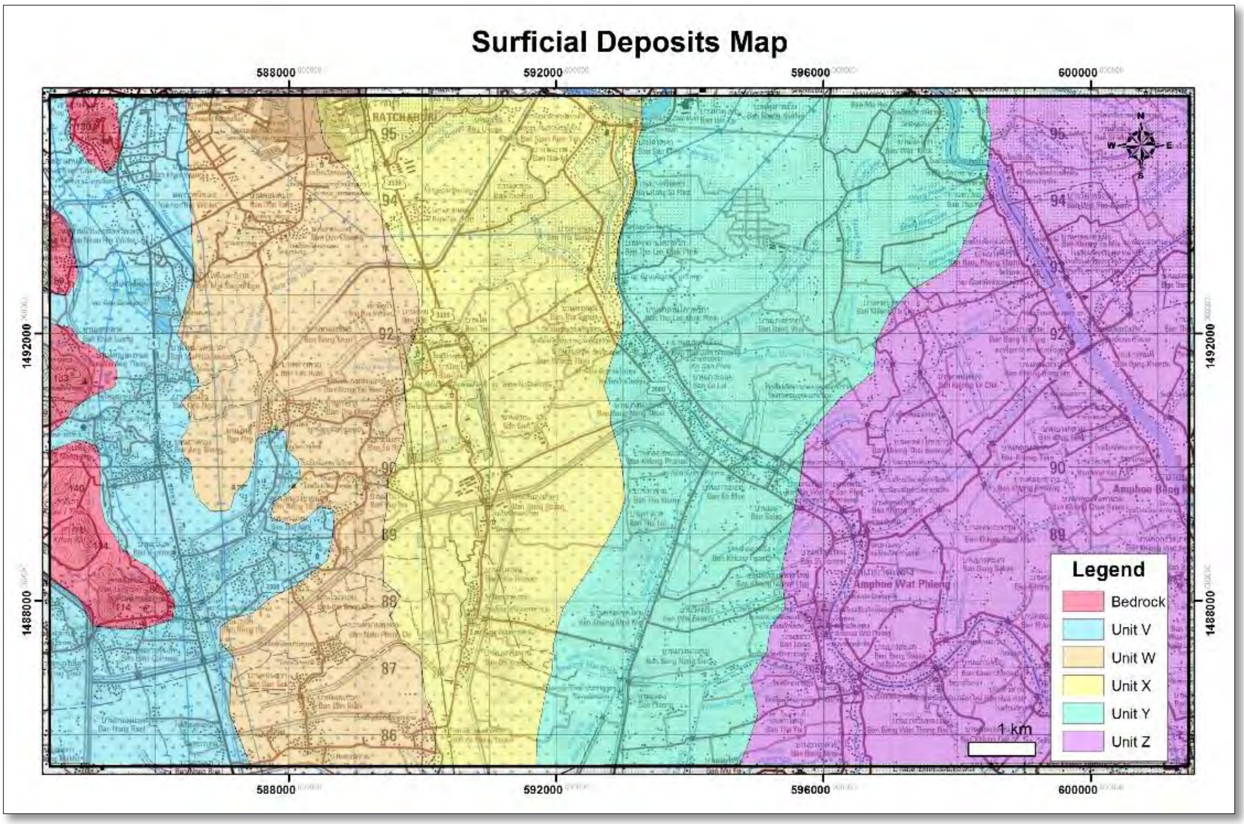


Figure 3-1 Digital surficial deposits map of study area.

3.1.1 Bedrock

The characteristic of bedrock is white sandstone which is found as western hills (50-140 m high from MSL) of study area. The Spectral ranges of bedrock is 50-150.

Figure 3-2 The characteristics of bedrock: a) represent outcrop (looking west); b) and c) hand specimen

3.1.2 Unit V

The characteristics of Unit V are medium dense yellow silt with sand. This unit is located at the foothill of bedrock that has the elevation between 7 and 10 meters from MSL. Unit V is covered by annual crop and urban disturbances along Phetkasem Road. The spectral range of unit V is 50-200.

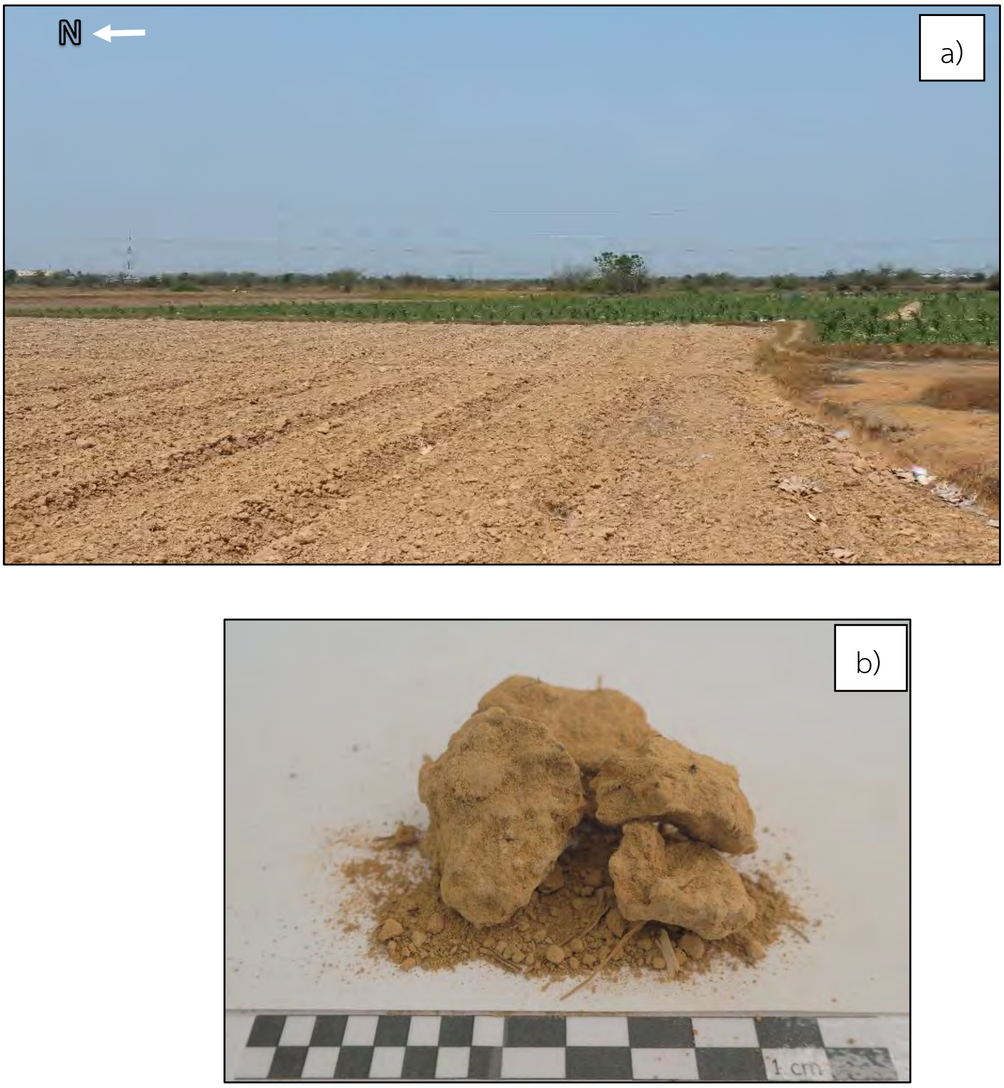


Figure 3-3 The characteristics of unit V: a) physiography and land cover (looking east); b) specimen

3.1.3 Unit W

The characteristics of Unit W are medium to stiff grayish yellow silt. This unit has the elevation between 4 and 7 meters from MSL. Unit W is the rice field and covered by urban disturbances in the north. The spectral range of unit W is 200-250.

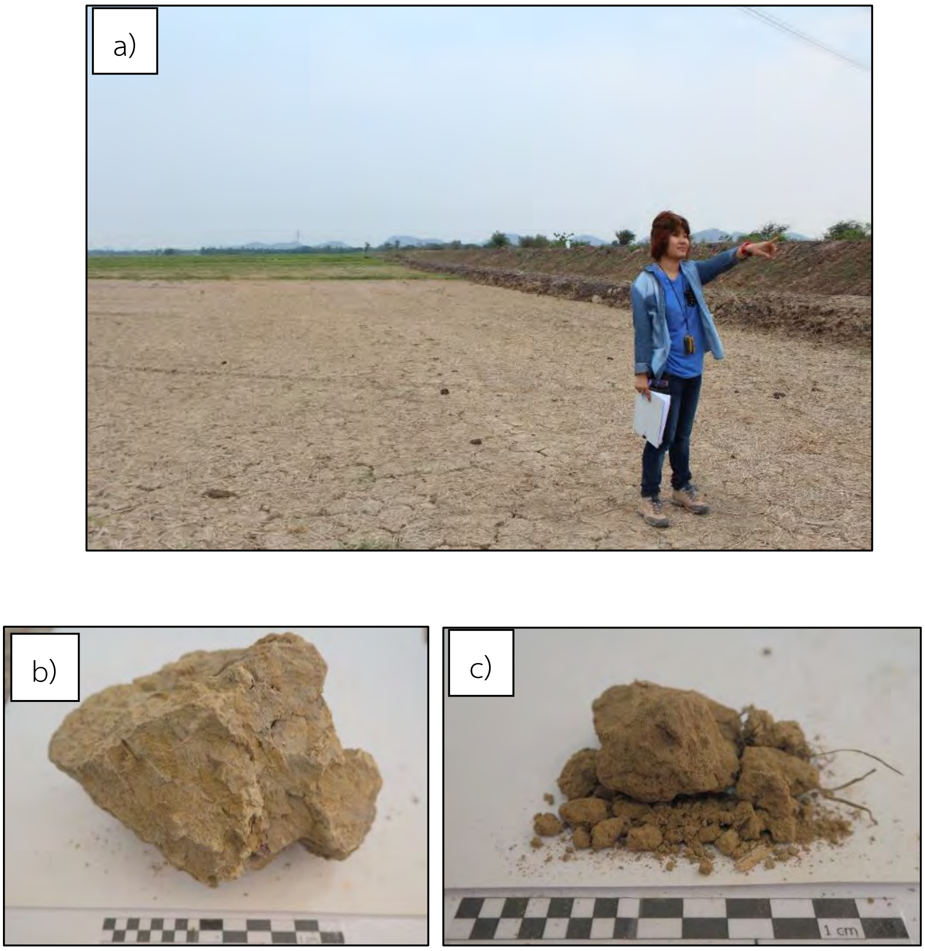


Figure 3-4 The characteristics of unit W: a) physiography (looking south-west); b) and c) specimen

3.1.4 Unit X

The characteristics of Unit X are medium gray clay. This unit is in the middle of study area and has the elevation between 2 and 4 meters from MSL. Unit X is the rice field and covered by ancient town in the center. The spectral range of unit X is 200-250.

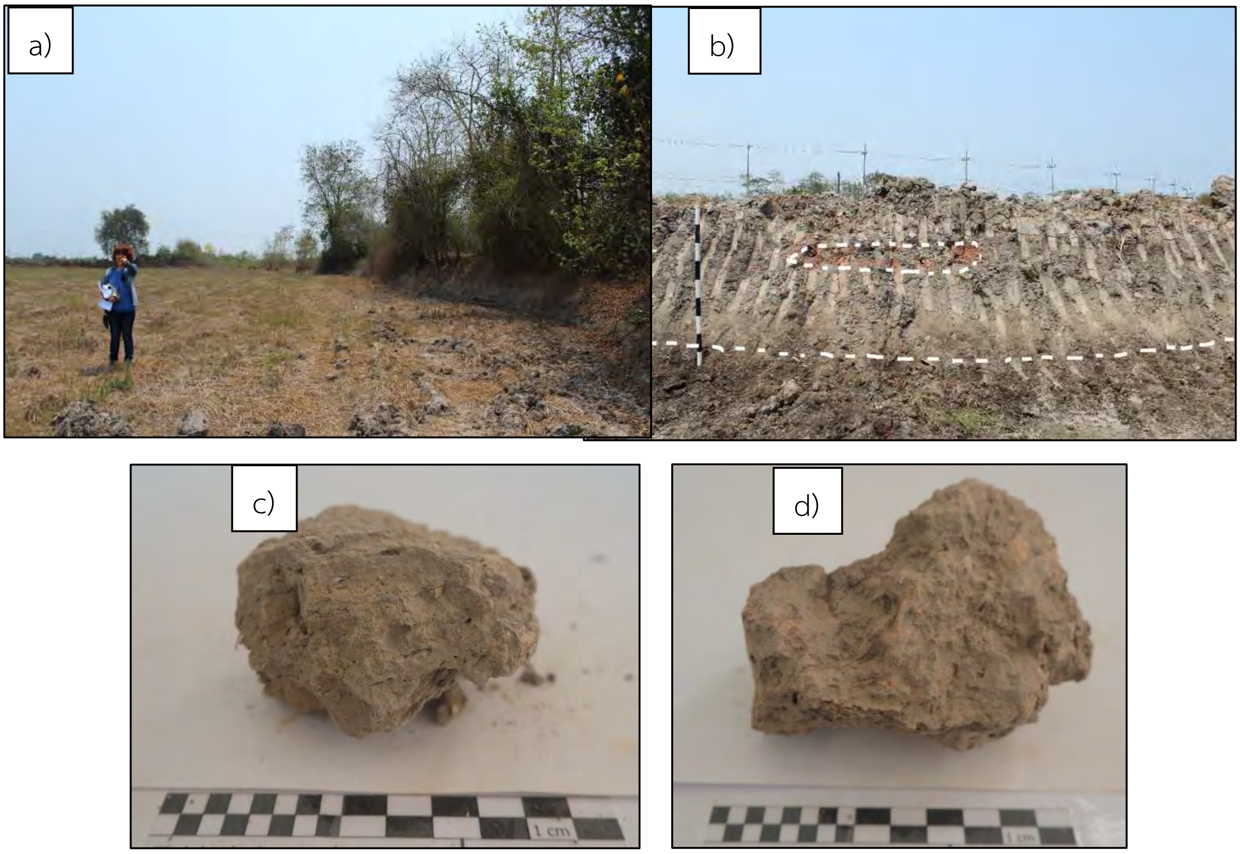


Figure 3-5 The characteristics of unit X: a) physiography (looking south); b) open pit; c) and d) specimen

3.1.5 Unit Y

The characteristics of Unit Y are soft brown and light brown clay. This unit has the elevation between 1 and 2 meters from MSL. Unit Y is the cropland with channel along the upper part of Mae Khlong river. The spectral range of unit Y is 0-150.

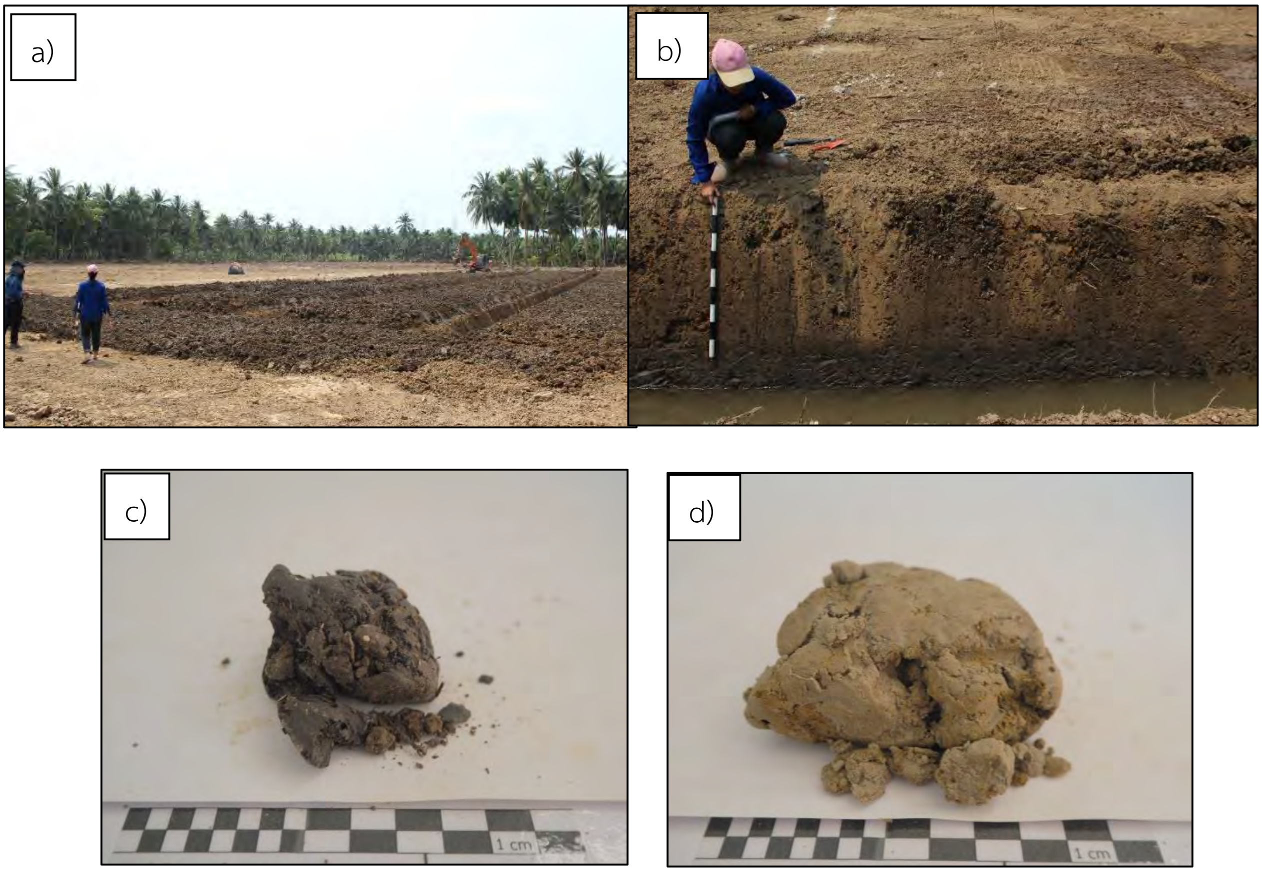


Figure 3-6 The characteristics of unit X: a) physiography (looking west); b) open pit; c) and d) specimen

3.1.6 Unit Z

The characteristics of Unit Z are Soft dark brown and light gray silt. This unit is the eastern of study area and has the elevation less than 1 meters from MSL. Unit Z is the wet cropland with channel along Mae Khlong river. The spectral range of unit Z is 0-100.

Figure 3-7 The characteristics of unit Z: a) physiography (looking west); b) and c) specimen

The surficial deposits units are differentiated through systematic classification based on specific user-defined ranges of spectral values for each unit. The spectral ranges used in the classification are largely dependent on the composite effects of surface characteristics and material properties, including depositional morphology and texture, pavement development, degree of surface clast varnishing, and (or) properties of exposed soils (Jayko *et al*., 2005). The spectral ranges of each surficial units is displayed in figure.

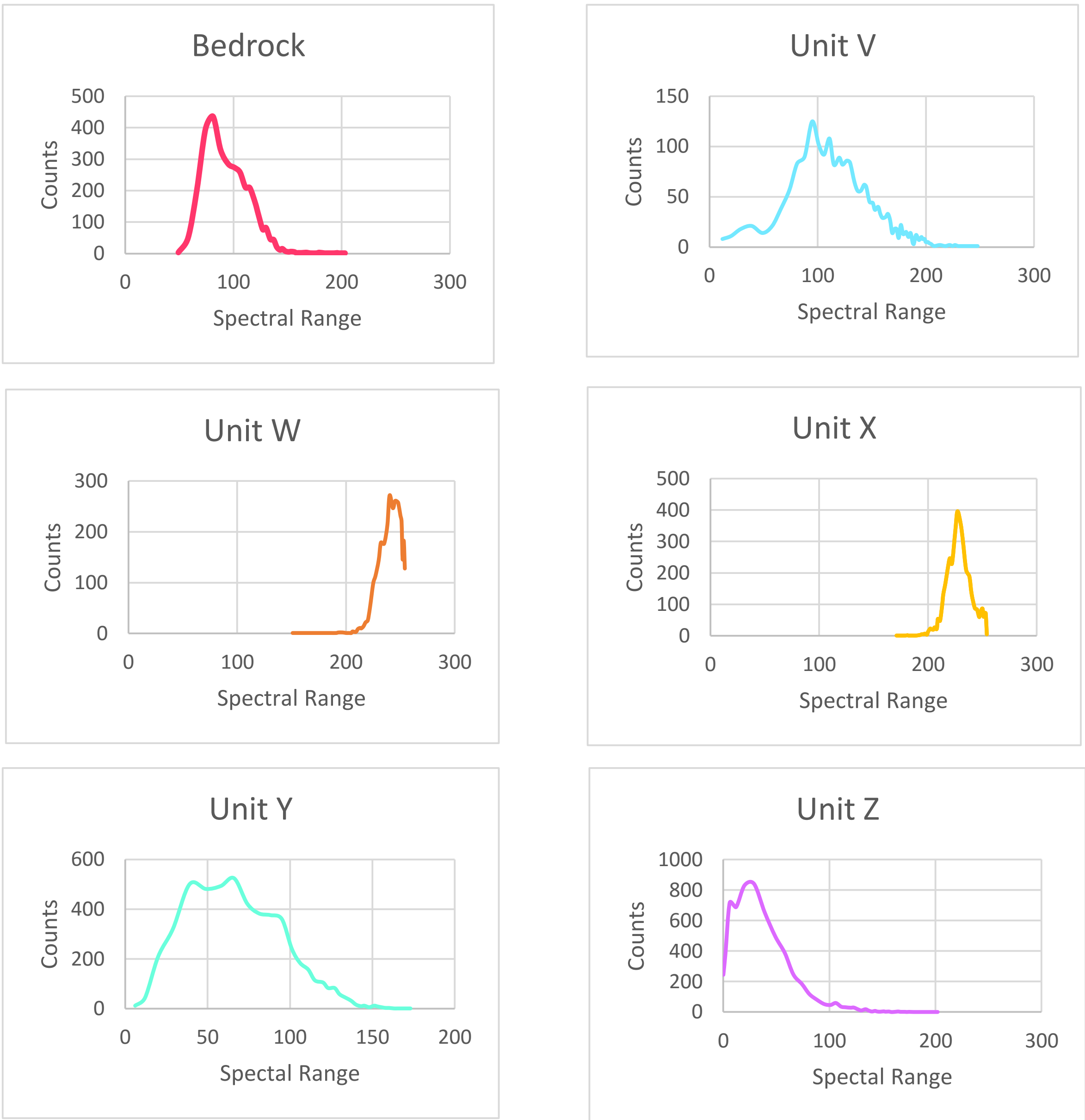


Figure 3-8 The spectral ranges of each unit of the surficial deposits units in the study area.

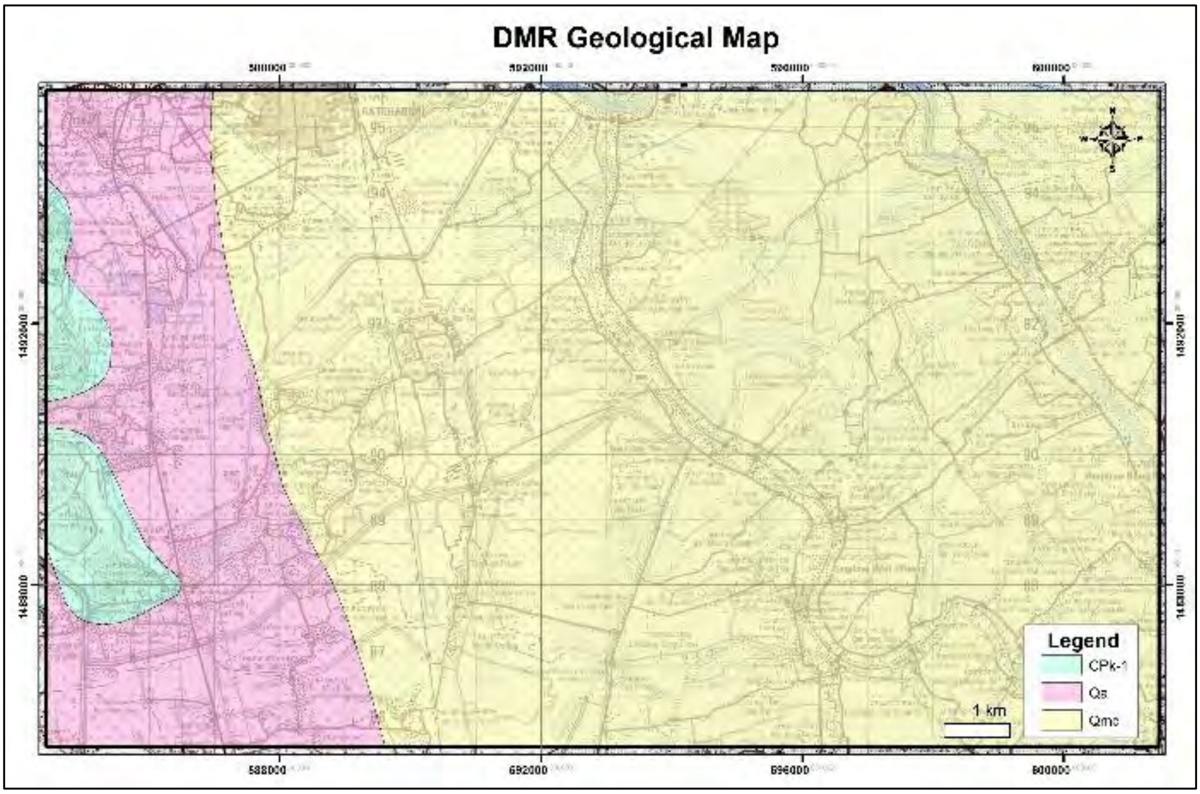
3.2 Discussion

The comparison of Geological map in study area from DMR (2007), the 1^{st} surficial deposits map in study area (interpretation without field investigation data) and the final surficial deposits map in study area (interpretation with field investigation data, supervised classification and DEM) was implemented to find out their relationship with elevation's condition (Figure 3-9).

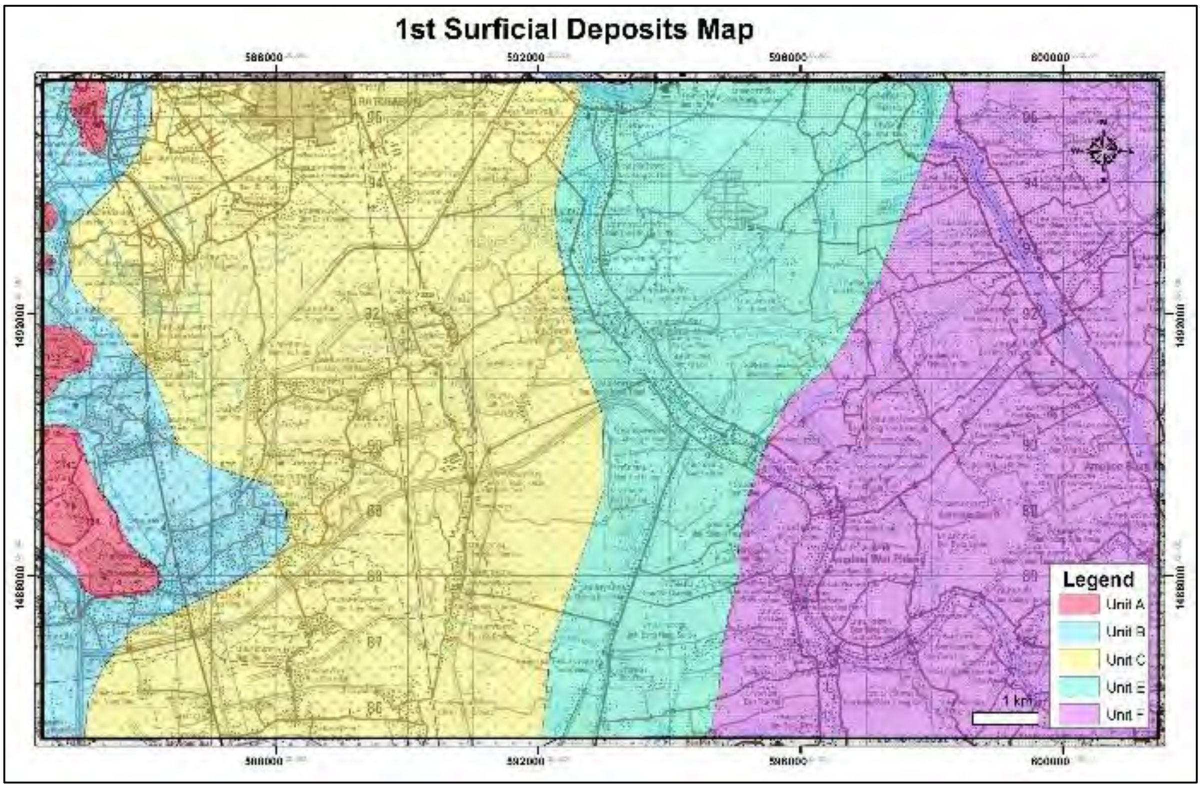
Remote sensing and GIS techniques in digital surficial deposits mapping can help significantly to discriminate the characteristics of land cover. Then the few areas that have the same land cover but different surficial deposits can be separated by field investigation data. And wetland area can define by DEM. Therefore, surficial deposits mapping should do both field investigation and digital method (Remote sensing and GIS techniques) to receive the suitable management and storage data, able to check accuracy and precision of data and enhance audience through data archives.

3.3 Conclusion

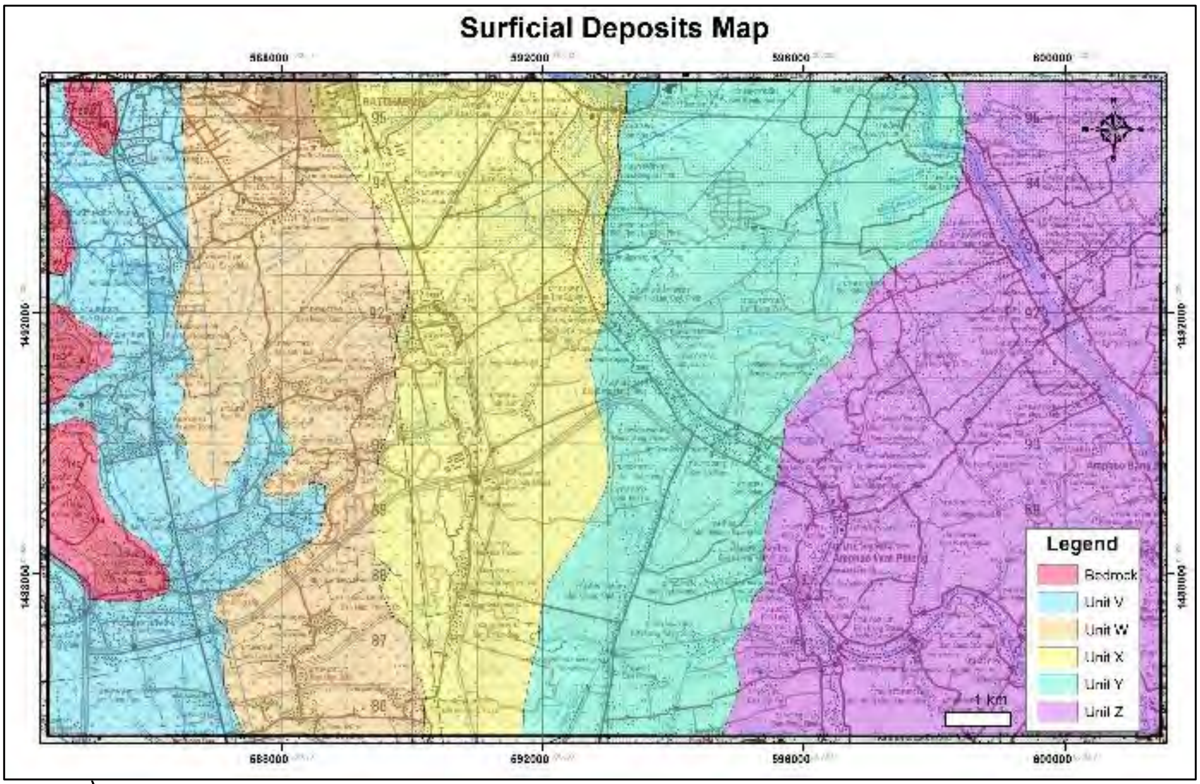
In this research, three data input, which are thematic (GIS and remote sensing) data preparation, laboratory analysis, and field investigation were used to generate the surficial deposits map and improve the Quaternary units in study area. The interpretation of data input can discriminate surficial deposits units to 5 units: Unit V is the foothill field which compose of silt with sand, Unit W is the field with stiff grayish yellow silt, Unit X is the field with gray clay, Unit Y is the cropland with soft brown and light brown clay and Unit Z is the wet cropland with soft dark brown and light gray silt. The output shows the results as the digital map which can be available to use data.


DMR Geological Map
Legend
CPk-1
Qs
Qmc
1 km

a)


1st Surficial Deposits Map
Legend
Unit A
Unit B
Unit C
Unit E
Unit F
1 km

b)



c)

Figure 3-9 The corresponding patterns between a) Geological map in study area from DMR (2007), b) the 1st surficial deposits map in study area and c) the final surficial deposits map in study area

Finally, the main propose to classify surficial deposits units in Khu Bua area is to focus in using the digital data of satellite image and digital elevation model to more accurate and systematic classify the units as the preview works of international geological organizations have been done. Since the digital classification from above technique can be classified and confirmed each unit from the above technique. Moreover, the field data is also significantly to improve and confirm the exact boundary detail of surficial deposits units. Although the digital classification technique cannot use to identify all of the lithologic characteristics but it help us to spend less time in the large area and should be very fruitful to update for the more accurate surficial deposits of the traditional geological data and map in the low land areas. The result from this study is hopefully to be further fruitful applied to be used for better land use management and mitigation of the natural disasters in the study area as well as the other low land areas in the river floodplain basin of our country in the future.

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APPENDICES

Unit	Tone	Color	Texture	Pattern	Shape	NDVI
Water	dark	blue	smooth	line/field		-0.2 - 0
Bedrock	light	light green	rough	field shadow	cloud	0.2 - 0.4 0.4 - 0.6
V	light	light green	rough	dots	large	0.2 - 0.4
X	light	reddish purple	smooth	field	large	0 - 0.2
W	light	light red	smooth	field	large	0 - 0.2
Y	light	smyrna blue	smooth	square in field	large	0.2 - 0.4
Z	light	light green	smooth	field	large	0.4 - 0.6

Table 1 The satellite image characteristics of each units.

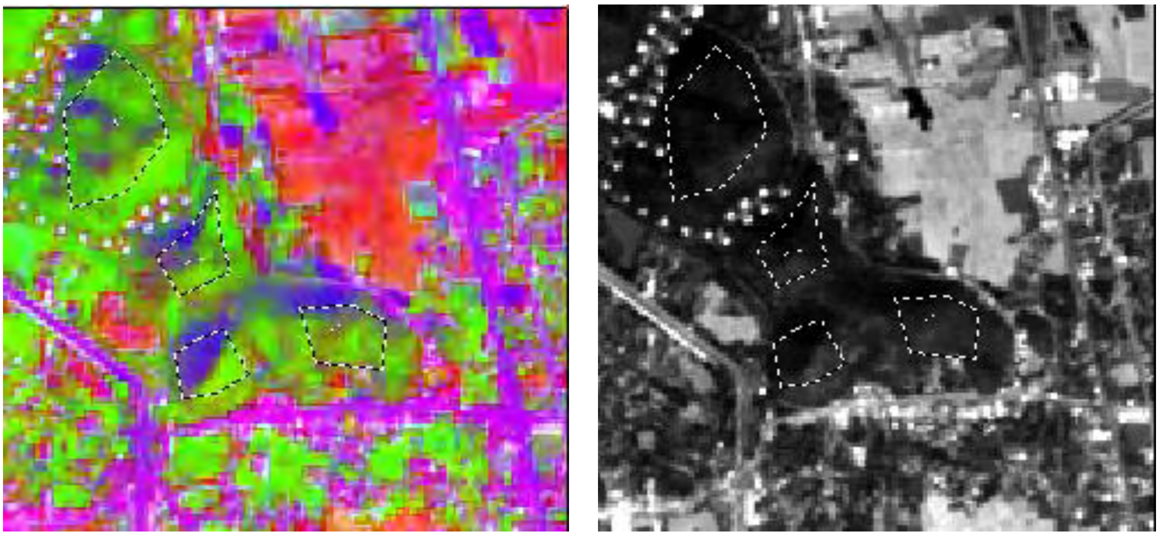

Figure 1 Training area of Bedrock in RGB 752 and Panchromatic

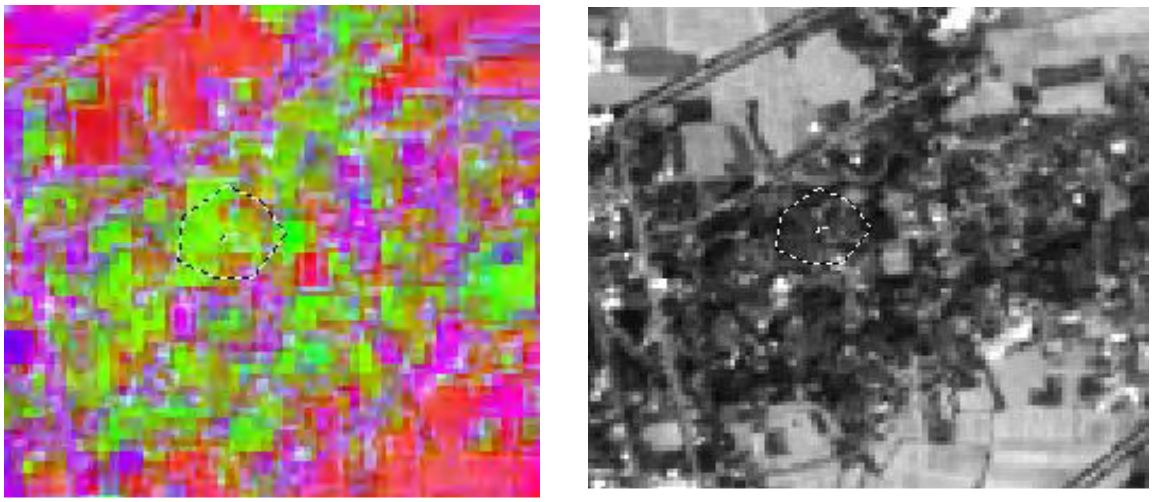

Figure 2 Training area of unit V in RGB 752 and Panchromatic

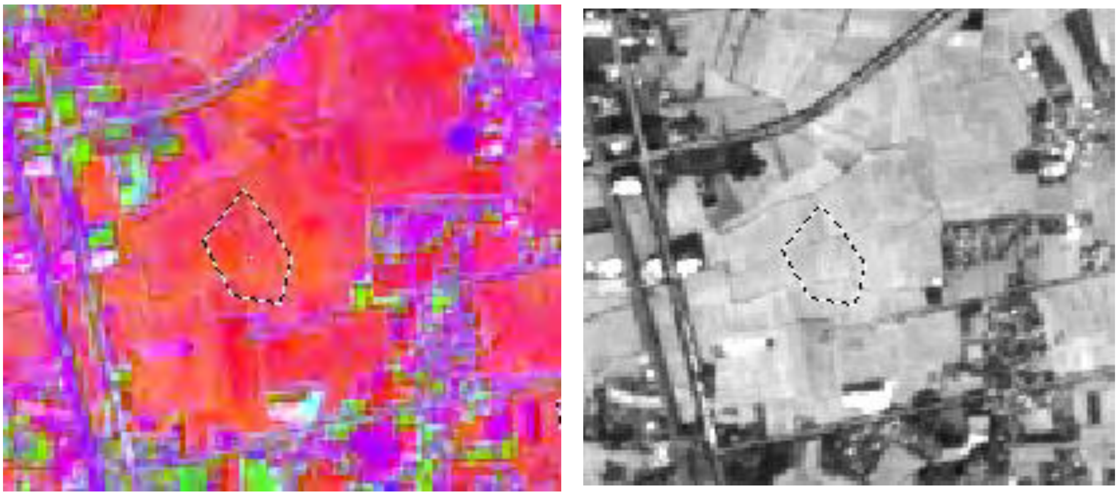

Figure 3 Training area of unit W in RGB 752 and Panchromatic

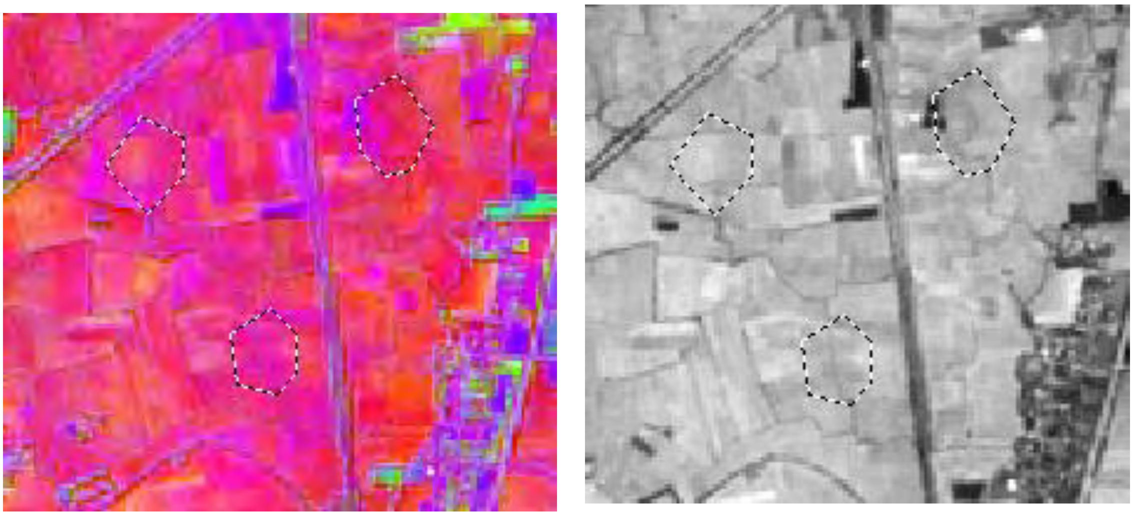

Figure 4 Training area of unit X in RGB 752 and Panchromatic

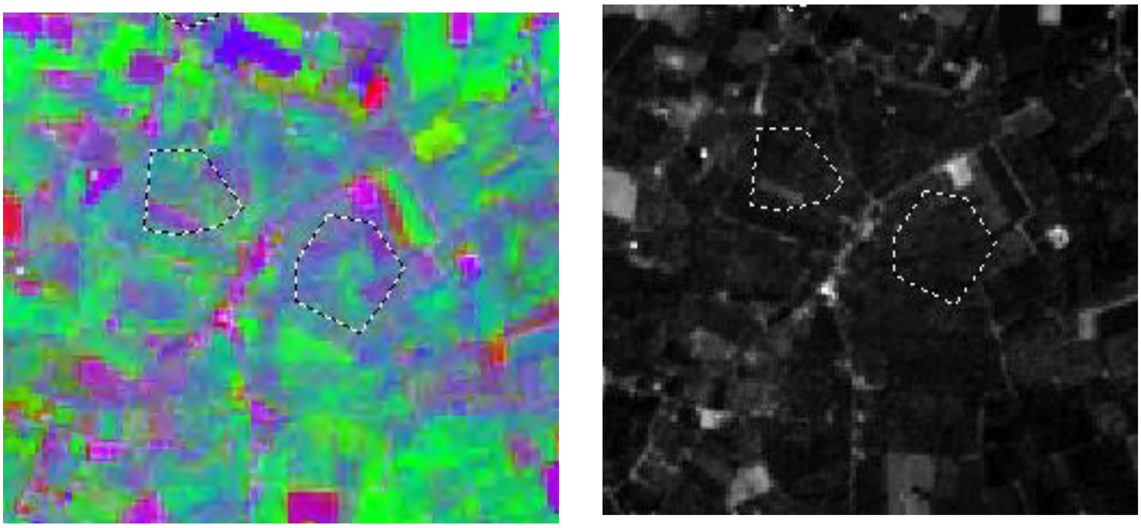

Figure 5 Training area of unit Y in RGB 752 and Panchromatic

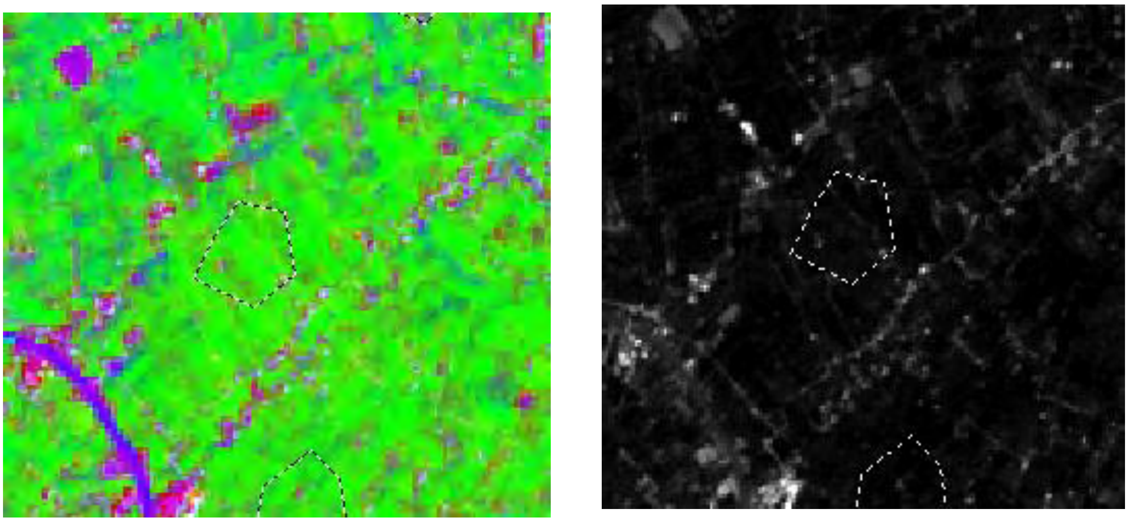

Figure 6 Training area of unit Z in RGB 752 and Panchromatic

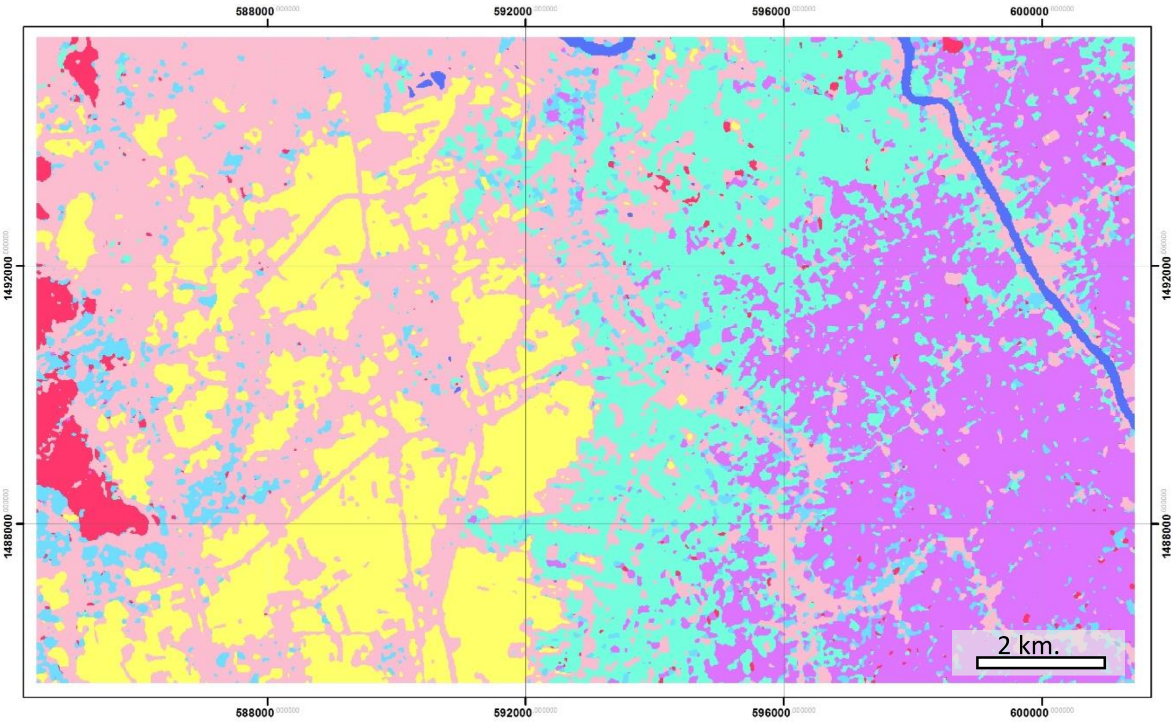

Figure 7 Pre field investigation Supervised Classification

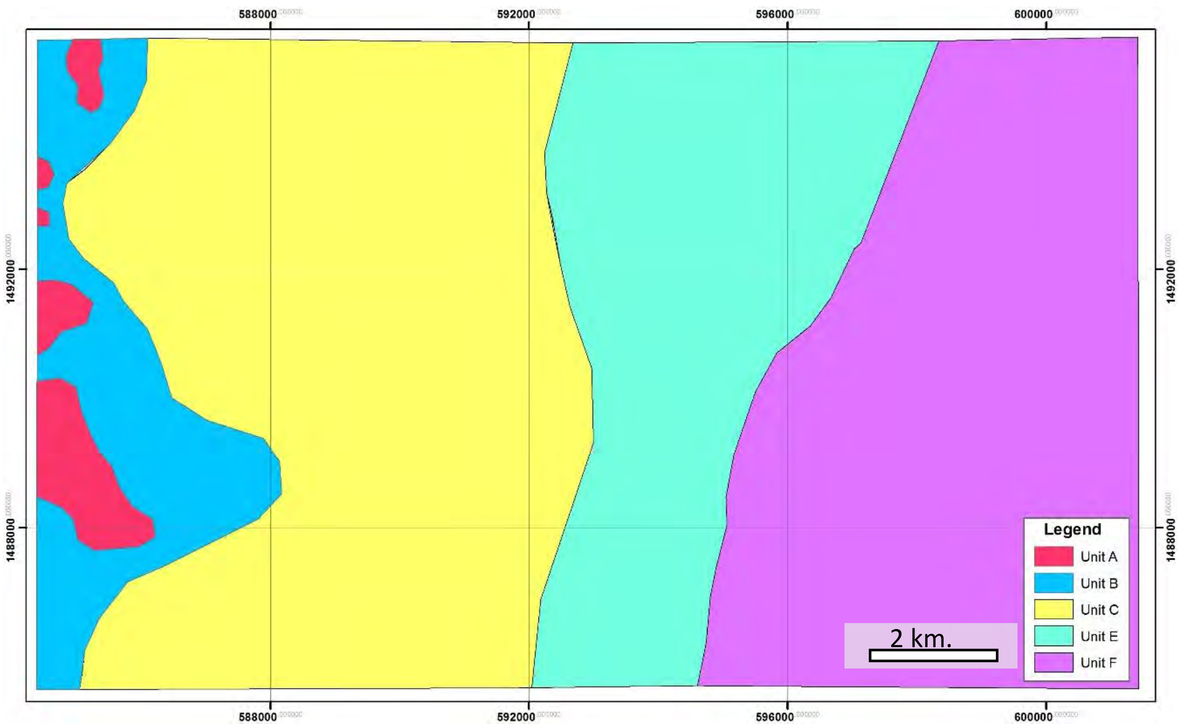

Figure 8 1st Digital Map in study area

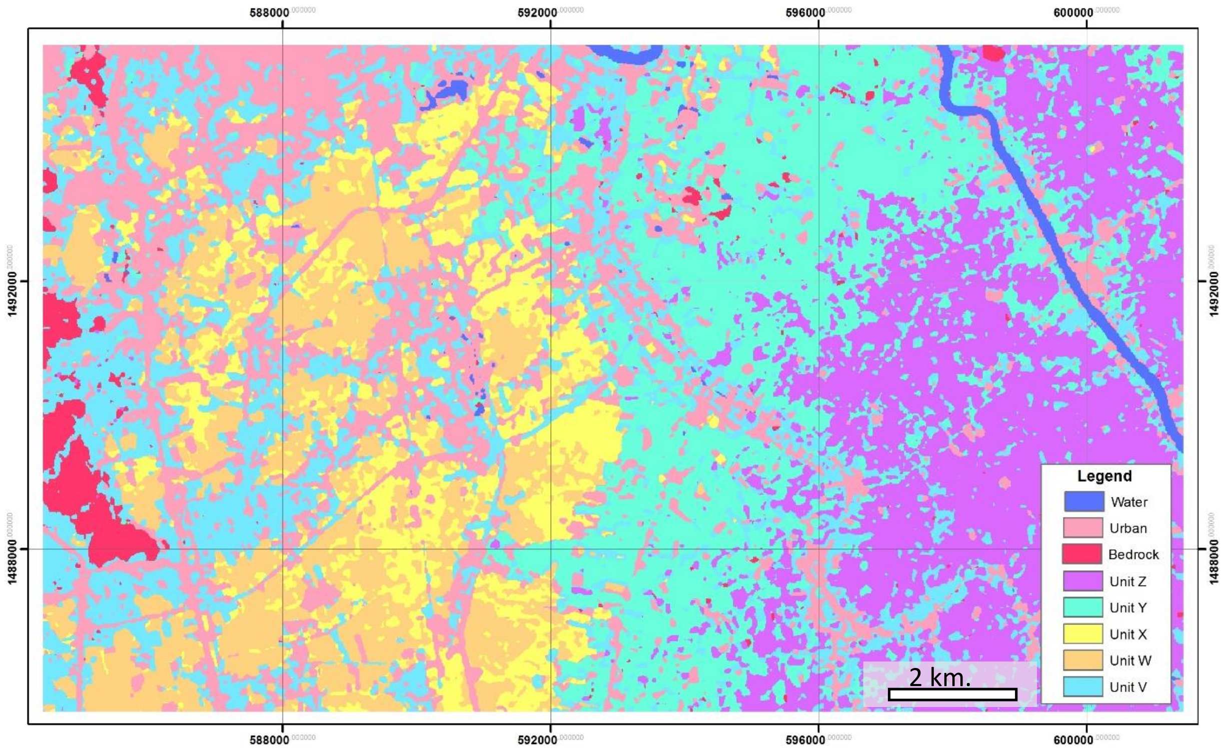

Figure 9 Post field investigation Supervised Classification

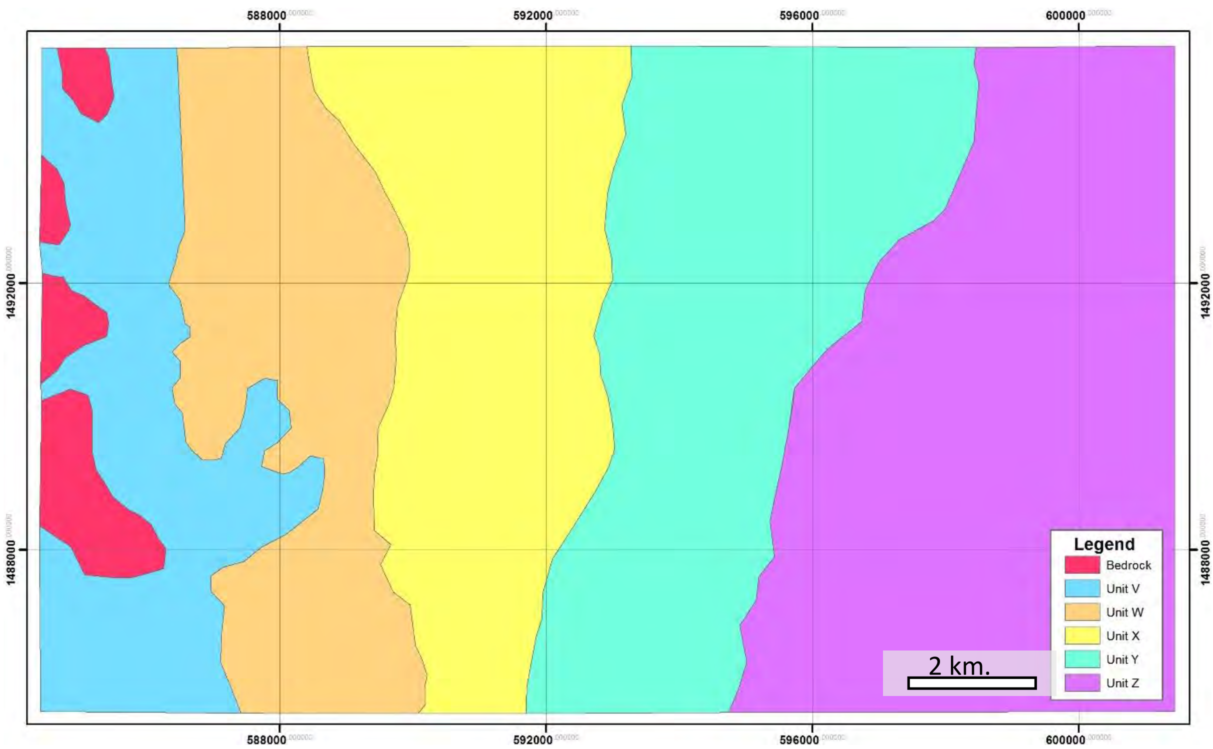

Figure 10 Final Map in study area