Government of the People's Republic of Bangladesh

Ministry of Housing and Public Works

Urban Development Directorate (UDD)

Preparation of Development Plan for Fourteen Upazilas

Package-04

(Saghata Upazila, District: Gaibandha; Sariakandi Upazila and Sonatala Upazila, District: Bogra)

FINAL SURVEY REPORT

PHYSICAL FEATURE, LAND USE, TOPOGRAPHIC SURVEY AND PHOTOGRAMMETRY WORKS

Of

Sariakandi Upazila, Bogra

June, 2017

mepc Modern Engineers Planners & Consultants Ltd.

Letter of Transmittal

Ref No.: MEPC/UDD/2017/49 Date: 04.06.2017

To

The Project Director

"Preparation of Development Plan for Fourteen Upazilas" Project

Urban Development Directorate (UDD)

82 Segun Bagicha, Dhaka-1000.

Subject: Submission of the Final Physical Feature, Land Use, Topographic Survey and Photogrammetry Works Report of Sariakandi Upazila, Bogra.

Dear Sir,

I have the pleasure to submit herewith the Final Physical Feature, Land Use, Topographic Survey and Photogrammetry Works Report of Sariakandi Upazila, Bogra District under "**Preparation of Development Plan for Fourteen Upazilas Project**" Package No: 04 (Saghata Upazila, District- Gaibandha; Sonatala Upazila and Sariakandi Upazila, District-Bogra) for your kind information and further action.

Thanking you and assuring you of our best services.

Best Regards

…… ……

(Engr. A. Sobahan) **(Shamim Mahabubul Haque)**

Managing Director of MEPC Team Leader, Package-4

Executive Summary

Sariakandi Upazila is an upazila of Bogra District in the Division of Rajshahi, Bangladesh. Sariakandi Thana was established in 1886 and was converted into an upazila in 1983. The settlement of this area was started centering the river 'Jamuna'. The fertile land, communication facility over river way and excellent geography exerted a pull on people to live and conduct business here. Thus, settlement developed by the surrounding inhabitants and with the people of remote area as well. It is named after its administrative center, the town of Sariakandi.

Sariakandi Upazila is a flood prone area located at Bogra district under Rajshahi Division. About three-fifths is land and two-fifths is water, chiefly the Jamuna River, which flows south through the upazila. It is the easternmost upazila of Bogra District. It borders Sonatala Upazila to the west and north, Rangpur Division to the north, Dhaka Division to the east, Sirajganj District to the southeast, Dhunat Upazila to the south, and Gabtali Upazila to the west. Most of the business, economic and administrative activities are based on the Sariakandi municipal area.

This report contains four individual reports as following

1. Physical Feature Survey
2. Land Use Survey
3. Topographic Survey and
4. Photogrammetric Works

This report contains introduction of this report and location of the Sariakandi Upazila and the background of the Upazila. The report also provides regarding the Methodology, construction and installation of BM pillar, collection, scanning, Geo-referencing and digitization of Mouza Maps, Edit plot checking of digitized Mouza maps, Joining of Mouza maps, preparation of GIS layout map etc. It also deals with detailed activities of Topographic and Physical Feature survey. All physical feature and topographic survey techniques using sophisticated equipment like RTK-GPS has been described.

Individual chapters and report describes the activities of field level data acquisition of Physical Feature survey in Sariakandi Upazila has been done using the survey base maps from High resolution Ortho-rectified satellite image along with photogrammetric data has been used in preparing base map for conducting the surveys. Survey team was equipped with hand GPS/ GPS enabled Smart Phone, measurement tape, color pens, maker pens, survey map sheet, log book, etc. They were trained properly before going to field and collect required information.

Topographic survey is a survey that measure the surface of the earth of any area with standard known coordinates of X, Y, Z value. This report contains the survey procedures along with findings and analysis of the topography of the project area. The survey was conducted according to the ToR of the project. Topographic features have been extracted by DTM point extraction and Generation of DEM/TIN.

List of Abbreviation/ Acronyms

BM	Bench Mark
BUTM	Bangladesh Universal Transverse Mercator
CS	Cadastral Survey
DLRS	Department of Land Record and Survey
dpi	Dot per inch
GCP	Ground Control Point
GIS	Geographic Information System
GPS	Global Positioning System
JPEG	Joint Photographic Experts Group
MSL	Mean Sea Level
RS	Revenue Survey
RTK	Real Time Kinematic
SoB	Survey of Bangladesh
UDD	Urban Development Directorate
PD	Project Director
PM	Project Manager
ToR	Terms of Reference
DEM	Digital Elevation Model
DTM	Digital Terrain Model
RL	Reduced Level
TIN	Triangulated Irregular Network
KM	Kilometer

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CHAPTER ONE: INTRODUCTION

1. 0 Background

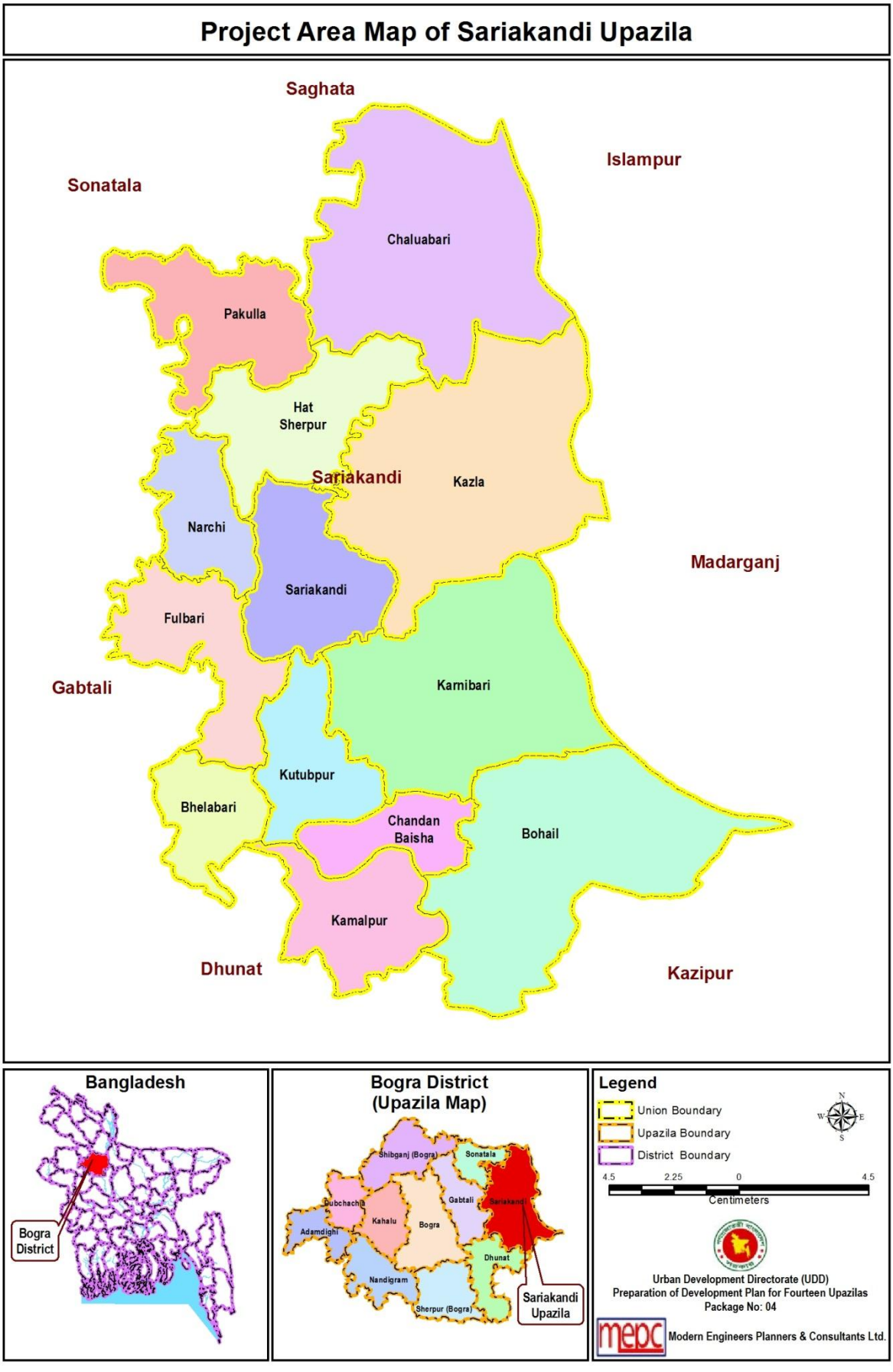
Sariakandi Upazila is an upazila of Bogra District in the Division of Rajshahi, Bangladesh. Sariakandi Thana was established in 1886 and was converted into an upazila in 1983. The settlement of this area was started centering the river 'Jamuna'. The fertile land, communication facility over river way and excellent geography exerted a pull on people to live and conduct business here. Thus, settlement developed by the surrounding inhabitants and with the people of remote area as well. It is named after its administrative center, the town of Sariakandi.

Sariakandi Upazila is a flood prone area located at Bogra district under Rajshahi Division. About three-fifths is land and two-fifths is water, chiefly the Jamuna River, which flows south through the upazila. It is the easternmost upazila of Bogra District. It borders Sonatala Upazila to the west and north, Rangpur Division to the north, Dhaka Division to the east, Sirajganj District to the southeast, Dhunat Upazila to the south, and Gabtali Upazila to the west. Most of the business, economic and administrative activities are based on the Sariakandi municipal area.

Sariakandi Upazila has a total area of 408.50 square kilometres (157.72 sq mi). About three-fifths is land and two-fifths is water, chiefly the Jamuna River, which flows south through the upazila. According to the 2011 Bangladesh census, Sariakandi Upazila had 75,614 households and a population of 270,719, 6.8% of whom lived in urban areas.

Sariakandi Upazila is divided into Sariakandi Municipality and 12 union parishads: Bhelabari, Pakulla, Bohail, Chaluabari, Chandan Baisha, Fulbari, Hat Sherpur, Kamalpur, Karnibari, Kazla, Kutubpur, Narchi, and Sariakandi (See Map 1.1). The union parishads are subdivided into 100 mauzas and 173 villages. The major rivers of the area are Jamuna and Bangali, The sandy land area, homogeneous topography, Char area, moderate moisture etc. are the common geographical characteristics of the study area.

Map 1. 1: Project Area Map of Sariakandi Upazila



CHAPTER TWO: METHODOLOGY

2.0 Reconnaissance Survey

A field visit was conducted in the Upazila areas by a team of Team Leader, Urban planner and urban economist to identify the urban growth factors and potentialities, orderly growth of urban areas, trends of urban growth and expansion of town through observation and consultation with the Upazila authorities and local people. During the visits maps and drawings were consulted in order to identify the national and regional setting, assess the topographical and physical features, acquaint with the changes of the areas, direction of present development and potentialities of future development etc. The purpose of the visits is to provide a context for the future potentialities of development of the town. During visits following points are considered to develop a profile of the Upazila.

- Identify the urban growth factors and potentialities
- Identify the orderly growth of urban areas
- Assess the trends of urban growth and expansion of town

2.1 Compilation and Preparation of Base Map

2.1.1 Collection of Mauza Maps

Mouza sheets were collected from Department of Land Record and Survey (DLRS) of Bangladesh has per the gazette notification of the Upazila Land Office. These maps are currently used in Union Parishad and Upazila for different purpose. The following Table 2.1 shows the list of Mouza Maps in Sariakandi Upazila. The list

Table 2. 1: Mauza Maps Collection from DLRS

Upazilla	Number of Mouza	Total Sheet collected	Mouza Type	Total Collected Mouza Maps (%)
Sariakandi	121	282	RS	100
Total	121	282		**100**

Activities involved in the process of establishment of Bench Marks (BM) and demarcation of existing Upazila boundary for Sariakandi Upazila are as follows:

A. Collection of Mouza Maps

B. Establishment of Bench Marks (BM)

- Site selection
- Construction of BM pillars
- Installation
- Establishment of Coordinate of BM Pillars (x, y, z i.e Northing, Easting and RL in meter)

C. Establishment of Ground Control Points (GCPs)

D. Base Map Preparation

- Scanning of Mouza Maps
- Digitizing of Mouza Maps
- Edit Plot Checking of Digitized Mouza Maps
- Geo-referencing of Mouza Maps
- Joining of Mouza Maps
- Edge-matching of Mouza Maps
- Participation of Upazila in the Demarcation of Upazila Area.
- Preparation of GIS Map Layout

E. Demarcation of Upazila Area

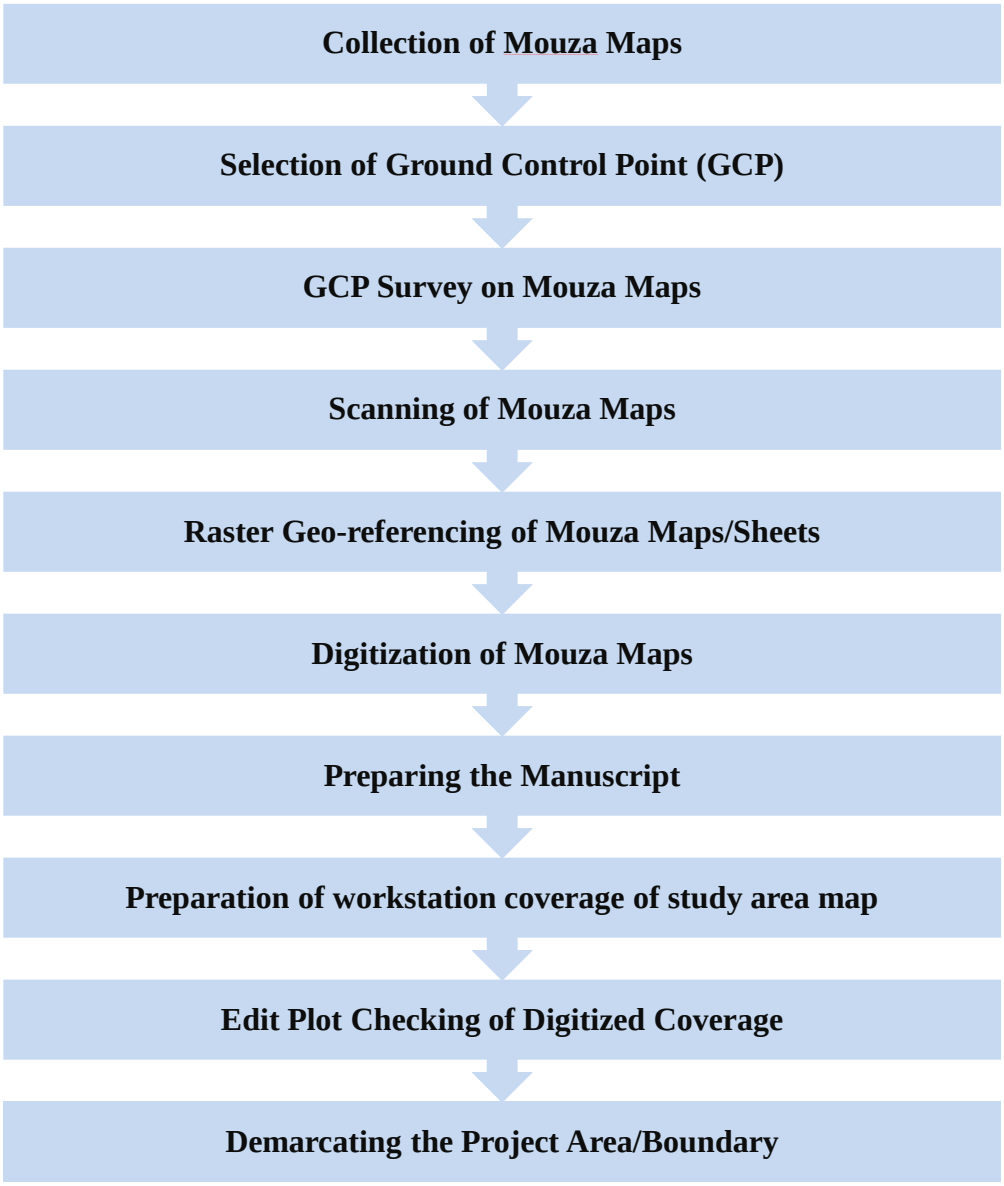


Figure 2. 1: Flow Diagram for Preparation of GIS Database using RS Mauza Map

2.1.2 Approval of Collected Mauza Maps for Scanning and Digitization

Mauza sheets/maps of RS version had been collected from DLRS covering the entire project area. Figure 2.1 shows a sample scanned mouza map. To avoid distortion due to rapping or pasting cloths/tape in the mauza maps been avoided during collection of mauza maps. Before scanning of mauza maps all collected maps submitted to UDD for review and quality check/authentication.

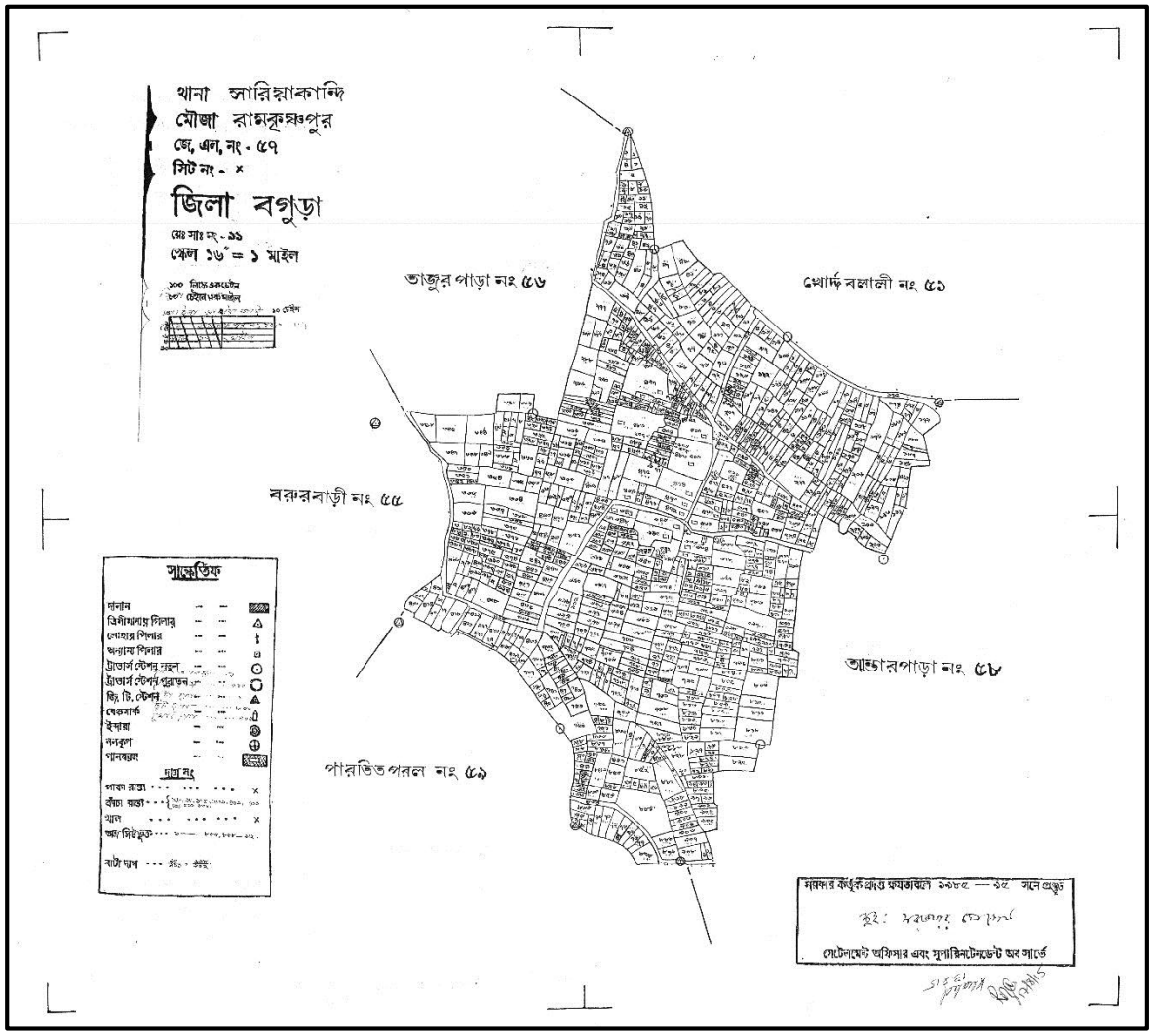


Figure 2. 2: Sample of Scanned Mouza Map.

(Source: DLRS, 2015)

2.1.3 Scanning of Mauza Maps

The scanning is a process, which is followed depending on the type of scanner used. In this work drum type roller scanner was used. Before the actual scanning to be done, each sheet was unfold and straighten, and cleaned. The sheet was then set in the roller of the drum scanner and moved forward and backward several times. When it was ensured that the sheet can move forward and backward through the scanner without any difficulty and

smoothly the sheet was brought to starting point of scanning and the scanning switch was made on. As one sheet was completed the machine was stopped, and the same process was followed for the next sheet. This way scanning of all sheets for the project area was done. Each of the sheets was scanned in drum scanner in 300 dpi. The technical specifications of the scanner to be used for the purpose are provided in Table 2.2 and Table 2.3

Table 2. 2: Specifications for Scanned Mauza Maps

Image Type	Color or Gray scale
Image Format	JPEG
Image Resolution	300 dpi
Image Scale for Digitization period was required Map unit & Display unit select **inches** from drop down Icon. Otherwise, when you gave the Mouza map sheet prints as per same scale that time was not get the print copy of your mouza map scale.	(1:10-15)

Table 2. 3: Specifications of the Scanner used for Scanning of Mauza Maps

Brand & Model	HP Designjet 4200
Scan Resolution, enhanced	• Print speeds ranging from 22.94 sq m/hr (247 sq feet/hr) for a black line drawing to 2 sq m/hr (21 sq feet/hr) for a Best quality image • 2400 x 1200 dpi capability • 136 PostScript built-in Roman fonts
Scan Resolution, hardware	• Fast hardware digital imaging processing • 2400 x 2400 dpi (scaled) and 400 x 400 dpi (optical)
Maximum scan size	Copy or scan documents up to 42 inches wide with 42 inches active scan width

2.1.4 Preparation of Technical Specifications for GIS Database

Before starting the map digitization it is essential to develop feature wise manuscripts for storing all map features with a separate ID in GIS database. To keep the uniqueness of all Mouza features a common feature wise manuscript is prepared as per suggestion and guidelines of PMO. The feature wise manuscripts that followed in map digitization process are given in Annexure-II.

2.1.5 Digitization of Mauza Maps

On screen digitization method was used for digitization of Mouza maps. Esri ArcGIS Desktop v10.2 software was used for digitization and database built. All features were stored in three different feature type (Line, Point and polygon) in ArcGIS Shape file with separate ID or code number. Polygons were built with necessary attribute database of each Mouza maps. Manuscripts given by the client was used for digitization of Mouza maps to keep uniqueness of all features, the ID or code numbers of respective features was

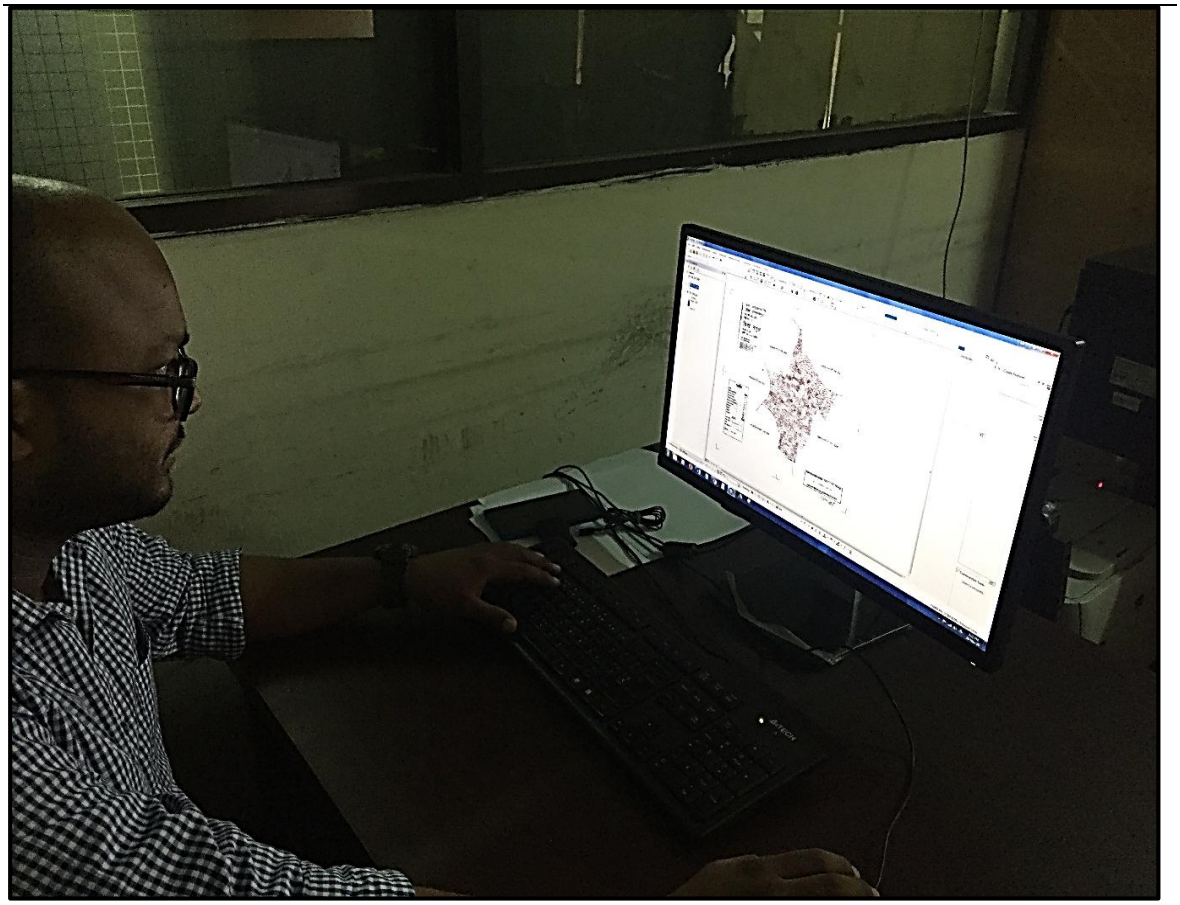
finalized as per suggestion and discussion with client. In This process includes adding a scanned mauza map in ArcMap, creating four empty shape files (2 point, 1 line and 1 polygon) of three basic shape file feature types in ArcCatalog. Then in ArcMap Editor tool was used to draw the mouza lines using drawing tools including advance editing tool bar. All the features of a mauza map such as Plot boundary, North line, Match line, Traverse Station, Plot number, Road, River, Pond, Halot, Canal, Building, Mosque, Temple, etc., are created and stored with attributes in four different vector layers as per the Technical Specification of GIS Database. On-screen digitization process and a sample digitized Mauza map are shown in figure 2.3. Map Unit = Inch and Distance Unit = Inch was determined in Data Frame properties to get 1:1 map scale and later zoom in to 1:30 scale during the digitization process to gain maximum level of accuracy. Table 2.4 and 2.5 show the status of scanned and digitization.

Table 2. 4: Status of Scanning of Mauza Map

Upazila	Number of Mouza	Total Sheet collected	Total Number of Scan Completed Mouza	Total Scan Completed Mouza (%)
Sariakandi	121	282	RS	100
Total	121	282		**100**

Table 2. 5: Status of Digitizing of Mauza Map

Upazila	Number of Mouza	Total Sheet collected	Total Number of Digitizing Completed Mouza	Total Digitizing Completed Mouza (%)
Sariakandi	121	282	RS	100
Total	121	282		**100**



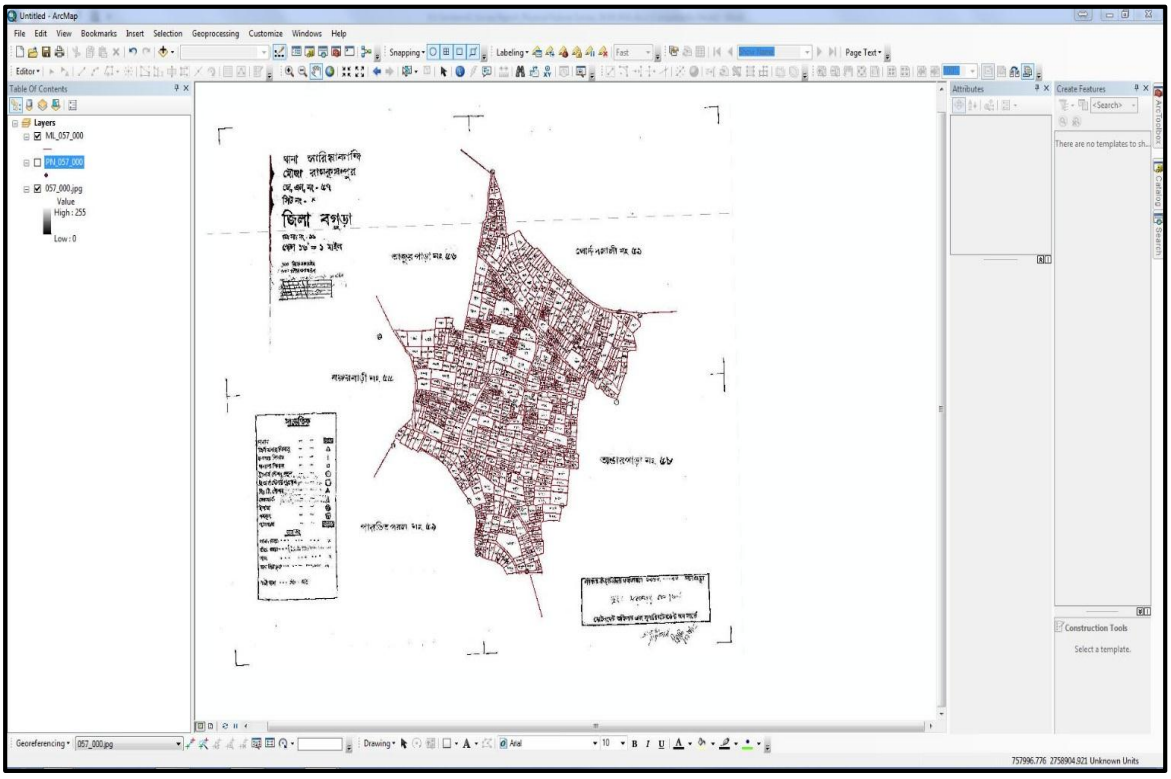


Figure 2. 3: On Screen Digitization and Sample Digitized Mauza Map

2.1.6 Edit Plot checking of the Digitized Mauza Maps

When the digitization of sheet is completed, edit plot checking of digitized coverage of the sheet was then initiated. Edit plots was produced containing all features in different colors. Then the digitized sheets/Mouza maps was individually checked and verified by superimposing on the original Mouza sheets using light table. By the edit plot check all possible errors (missing arcs, dislocated arcs, wrong or missing polygon labels, Tic location and ID etc.) was eliminated and corrected and final Mouza maps was prepared. After completion of edit plot checking, the Mouza maps were stored in computer file and in CD's and also in hard copies. Sample geo-referenced raster mauza map overlaid on satellite image

2.1.7 Geo-referencing of Raster Mouza Map

Geo-referencing of digitized Mouza sheets/maps is the projection of the Mouza maps from digitized unit to real world coordinate units or transformation of coverage from digitized units to projected units. This projection process always involves some distortion of certain map parameters such as shape, area, distance, or direction. Different projection systems produce different distortions. The characteristics of each projection make them useful for some applications and not for others. Digitized Mouza maps/sheets were been geo-referenced with reference to the collected/ surveyed GCP values (Latitude and Longitude value) and were projected to BUTM projection system.

The Coordinate System used for both GCP and ortho-rectified satellite image is the Bangladesh Universal Transverse Mercator (BUTM2010) which is established by the national mapping agency Survey of Bangladesh (SOB). The parameters of BUTM 2010 are as below:

Spheroid : WGS 1984

Datum : WGS 1984

Unit : Meters

False Easting : 500000

False Northing : 0.0

Central Meridian : 90.0

Scale Factor : 0.9996

Latitude of Origin : 0.0

In real world coordinates (Easting, Northing) of any point on the ortho-rectified satellite image, geo-referencing of mauza map had been done by using this geometrically corrected satellite image as reference. The process of geo-referencing of mauza map using satellite

image is actually parcel (plot) of mauza map matching with respect to the ortho-rectified satellite image. The Figure 2.4 shows a sample geo-referenced raster mauza map which is overlaid on ortho-rectified satellite image. A suitable number of GCP (minimum 4), preferably plot corners and building corners, has been taken for proper geo-referencing of mauza map depending on its size and 2nd Order Polynomial Transformation was applied. Total RMS error was kept within 0.5/1.5 meter i.e. within 1 to 3 pixels of the satellite image. Thus individual sheet of the mauza maps get properly geo-referenced. Finally, permanently geo-referenced images of mauza maps have been created by using 'Rectify' tool of ArcMap.

Figure 2. 4: Sample Geo-referenced Raster Mauza Map Overlaid on Satellite Image

2.1.8 Geo-referencing of Vector Mouza Map

To prepare an efficient plan for a Mission Planning was done regarding RTK-GPS Survey. Mission Planning allows to know which GPS satellites should be visible from a given observation point on the surface of the Earth, and for a given period of time (max. 24 hours). Among GPS, GLONASS and SBAS satellites the following satellites were found available during the survey period of June-July 2016 in Sariakandi.

RTK GCP survey was conducted simultaneously with the scanning and digitizing of Mouza Map. At least 3-5 Ground Control Points (GCP's) were selected and identified on Mouza Sheets on the basis of permanent, well-established and suitably located features.

Temporary Control Point (TCP) was also selected on the Mouza Sheets for proper positioning of Map. At least 4 nos. of tentative Ground Control Points (GCP) are selected on each mouza map/sheet identical with the real field condition such as corners of permanent buildings, traverse points, sharp corner of the mouza plots, road intersection, etc.

2.1.9 Edge Matching of Mouza Maps

The mouza maps/sheets, which are already geo-referenced individually, are joined using GIS based Arc GIS/ Arc Info software to get a composite map of the Upazila. The boundary of surrounding mouza maps/sheets are found hardly matched due to some unavoidable technical errors. Therefore, edge-matching of surrounding mouza maps/sheets are done through rubber sheeting and drawing a common line in between the boundary of adjacent maps/sheets.

2.1.10 Demarcation of the Project Area based on Mouza Maps

The latest Gazette of the Upazila was taken for demarcation of present and extended Upazila boundary for the future growth and expansion considering 20 years growth planning. A consultation meeting was conducted with participation of Upazila Nirbahi officer, Upazila Chairman, Councilors, Engineer, other staff and local elites to demarcate the existing Upazila Boundary and Pourashava Ward Boundary.

2.2 Establishment of Ground Control Point (GCP) / BM Pillars

2.2.1 Selection of Sites for BM Pillars with justification

Coordinates (Latitude and Longitude) of these GCP are collected from field using RTK-GPS based fast static survey technique and are stored in WGS84 projection system.

After getting GCP readings from field, we identify the control points on mouza sheet and then we can geo-reference each of the sheets. To facilitate this process, we provide a copy of mouza sheet to our survey engineers to the field. For this, while they are taking a GCP reading, they can mark the point on the respective mouza sheet for future reference.

Total 9 Ground Control Points were collected during field survey in Sariakandi Upazila.

2.2.2 Design and Construction of Pillars

The BM pillars were constructed as per the design (See figure 2.5). The BM Pillars were constructed as per the approved design with local masons and under constant supervision of consultants and Upazila personnel. Proper curing and construction measure were taken during the construction. Total 09 BM Pillars were established at suitable locations within

Sariakandi Upazila area to carry out the survey work conveniently. A BM was established in Upazila premises.

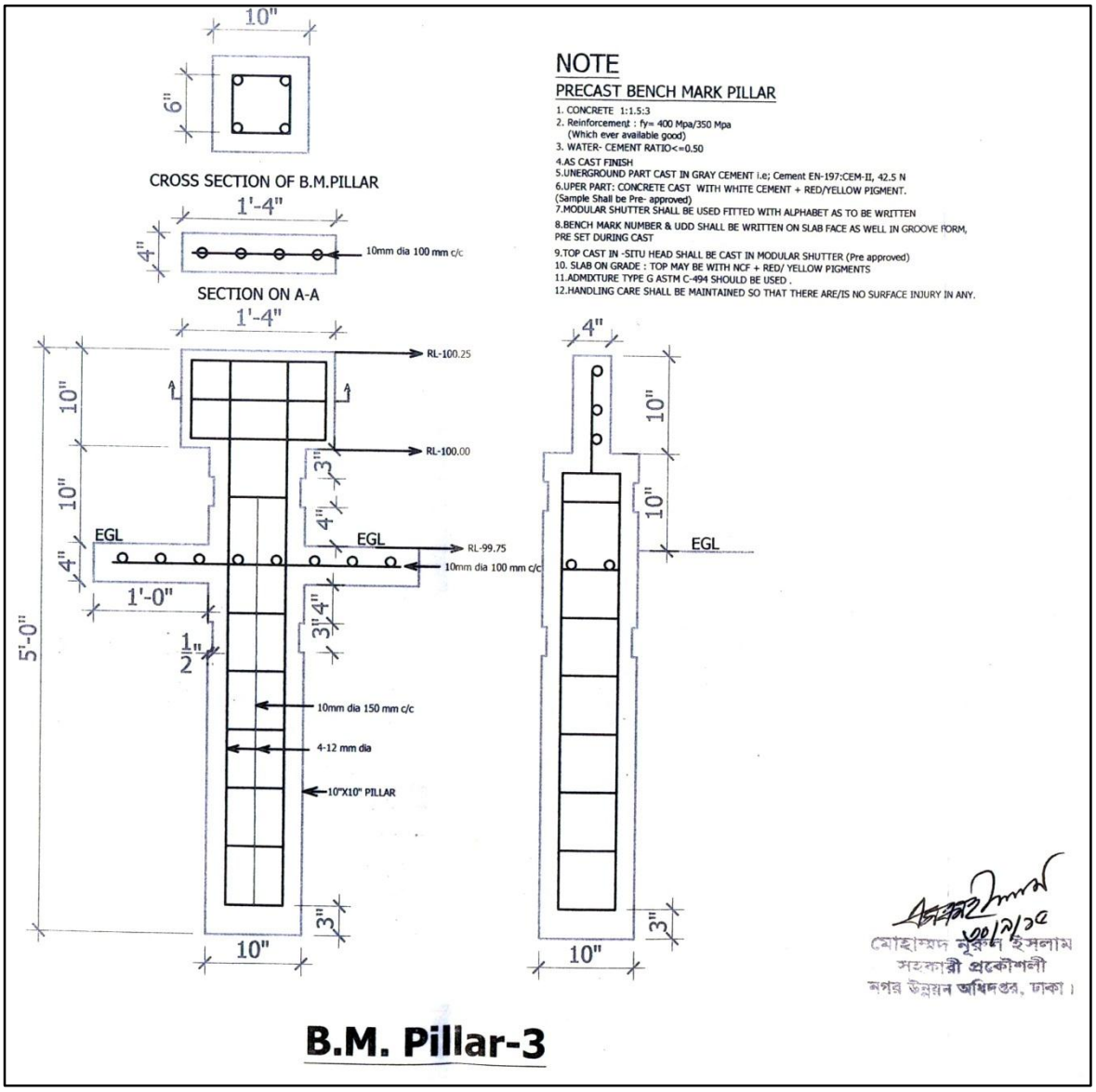


Figure 2. 5: Design of BM Pillars

2.2.3 Construction of BM Pillars

Sariakandi Upazila is covered by 5 BM pillars. The BMs are constructed as per approved design of BM pillar. The BM pillars have been installed in the field. Installation of the BM pillars has been monitored by UDD and the Consultant.

Plate 1: Sample of Constructed BM and Installed BM

2.2.4 Description of Reference BM Pillars

The description, found from SOB about the reference BM Pillar, is stated in the following table (Table: 2.6)

Table 2. 6: Location of Reference BM

Sl. No.	Point ID	Location	Latitude (WGS 84)	Longitude (WGS 84)	RL (in meter)
1.	GPS 1884	SOB 1884, SARIAKANDI	24.89339224930	89.57336791600	17.204

Source: Survey of Bangladesh (SOB), 2016

2.2.5 Baseline Survey by RTK-DGPS Method

The engineering survey (Topographic, Physical Features and Land Use Survey) requires a network of permanent Bench Mark (BM). The location and number of BM Pillars were determined through a reconnaissance survey in presence of Assistant Engineer and finalized by the Mayor of the Sariakandi Upazila. Total 09 BM Pillars were established at suitable locations within Sariakandi Upazila area to carry out the survey work conveniently. Among them one BM was established in Upazila premises. The Latitude, Longitude and Elevation of BM Pillars were established through extensive RTK-GPS survey in respect of the Reference BM **GPS-1884**, established by Survey of Bangladesh (SoB). The location, latitude, longitude and elevation of Reference BM Pillars are presented in Table-2.6 and other BMs are presented in Table 2.7 and location of BM pillars are given in Map-2.1.

2.2.6 Establishment of Coordinates (X,Y,Z) for BM Pillars

At the same time, ten high performance computers including one laptop, having configuration of Intel Core i5, 2.3 GHz Processor, 4 GB RAM, 1TB HD in each are using to download and post-processing of survey data and present it in GIS layout format.

1st Order BM carry/Level

With the outputs of coordinate of BMs in latitude, longitude and ellipsoidal height from baseline survey results, the vertical datum of SoB BMs are in mMSL. By adding .46m with SoB value the datum has been transferred to mPWD, proposed in ToR. 1st order BM carry/Level was conducted for datum transformation. Later on all BM were painted and coordinates were marked as per Tor specification.

Table 2. 7: Coordinates and Descriptions of the BM Pillars

BM No.	R.L (m)	Easting (dd)	Northing (dd)	Location
BM01	15.487	760880.478	2748843.087	Boroikandi BK High School
BM02	17.161	759594.318	2754779.746	Sariakandi Public Field
BM03	17.308	759482.732	2756080.825	Sariakandi Sadar Union
BM04	16.821	758028.503	2761248.746	Nizbolail Islamia Alim Madrasa
BM05	17.955	756885.929	2756995.465	Narchi Union Parisad, Sariakandi
BM06	15.772	755766.448	2753950.831	Phulbari Union Digital Centre
BM07	15.487	757076.374	2745471.445	Jorgacha UP
BM08	15.739	761414.319	2743720.090	Koritala High School
BM09	15.627	760453.251	2745357.997	Chandan Baisha Degree College

2.2.7 Marking of BM Pillars

The marking process was comprised of long time observation from Reference BM to other 09 BM Pillars in Sariakandi Upazila. 3 hours reading for each of the BM Pillars was used to transfer the coordinates from Reference BM. A highly sophisticated RTK-GPS, Magellan PROMARK3 RTK and a Total Station TOPCON GTS 230 were used for the marking purpose. To get a constant error free reading from the satellites, we kept the base unit of RTK-GPS at the Reference BM and kept the Rover unit of RTK-GPS to each of the Bench Mark Pillars of Sariakandi for long time. A sunny day was selected to get best reading. During the process Upazila personnel supported to conduct the tasks.

Table 2. 8: Coordinates and Photographs of the BM Pillars

BM ID	RL (meter MSL)	Easting (dd)	Northing (dd)	Land Mark	BM Photo
BM01	15.487	760880.478	2748843.087	Boroikandi BK High School	
BM02	17.161	759594.318	2754779.746	Sariakandi Public Field	
BM03	17.308	759482.732	2756080.825	Sariakandi Sadar Union	
BM04	16.821	758028.503	2761248.746	Nizbolail Islamia Alim Madrasa	
BM05	17.955	756885.929	2756995.465	Narchi Union Parisad, Sariakandi	
BM06	15.772	755766.448	2753950.831	Phulbari Union Digital Centre	
BM07	15.487	757076.374	2745471.445	Jorgacha UP	
BM08	15.739	761414.319	2743720.090	Koritala High School	
BM09	15.627	760453.251	2745357.997	Chandan Baisha Degree College	

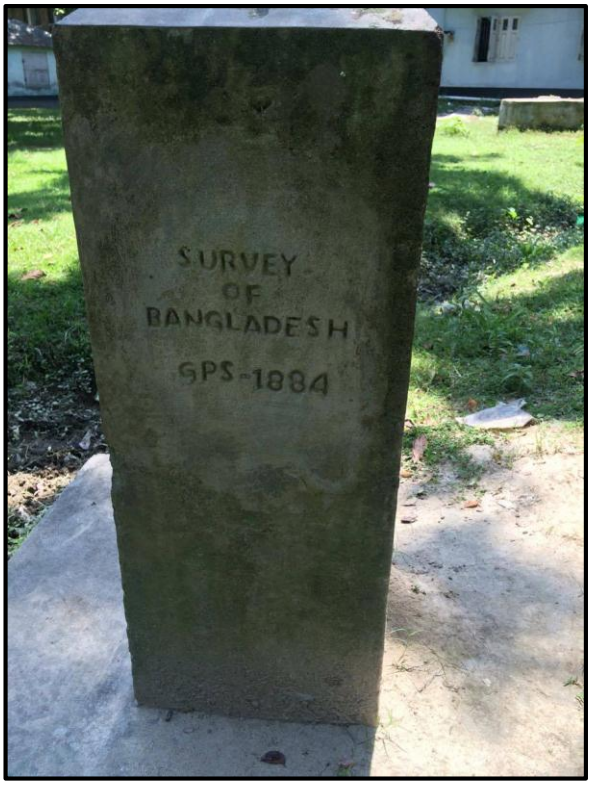
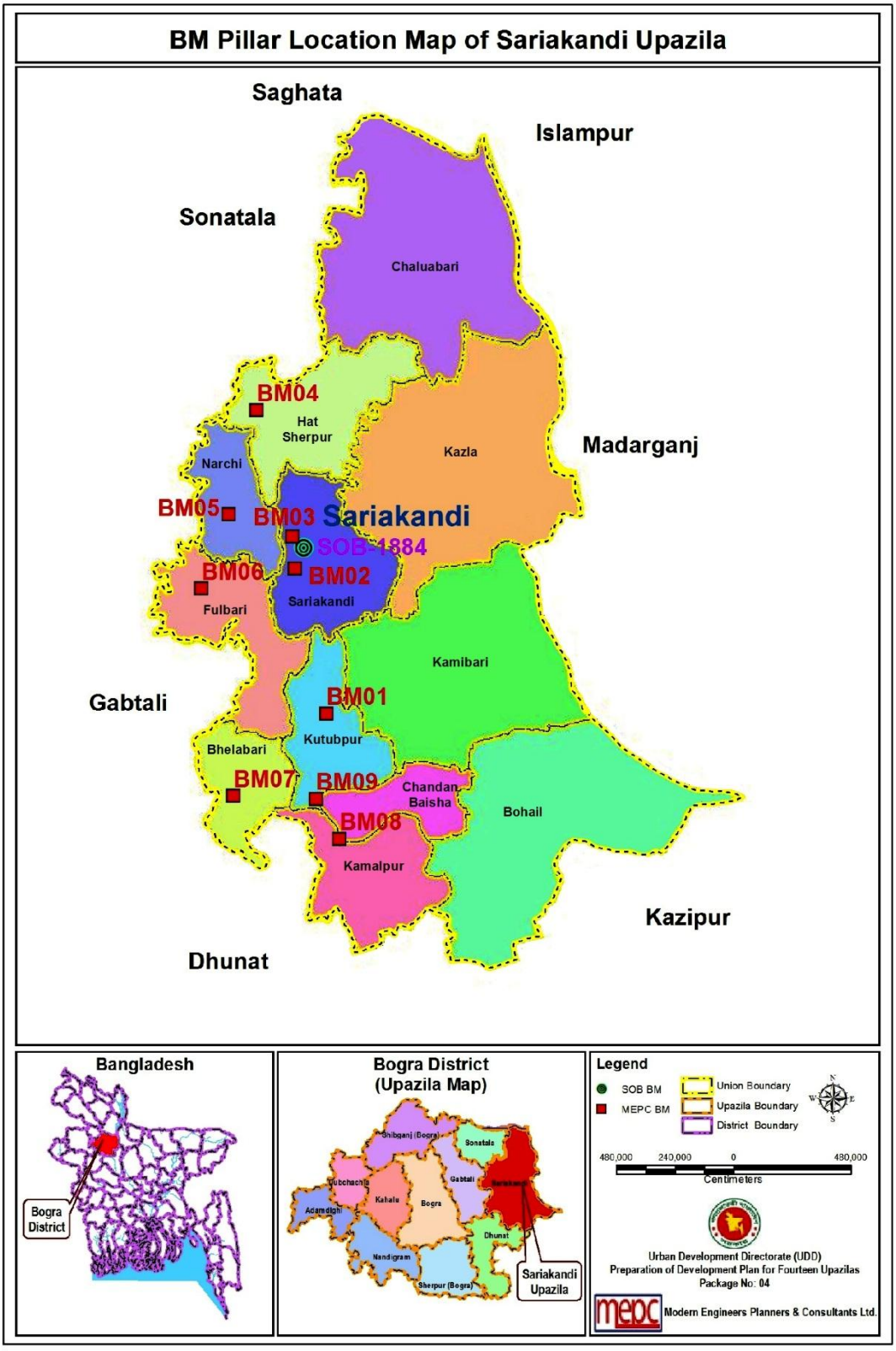


Plate 2: Reference BM Pillar in Sariakandi Upazila

Plate 3: RTK-GPS Observation

Map 2. 1: Location of BM Pillars in Sariakandi Upazila



Map 2. 2: Sample Base Map comprising Satellite Image and Photogrammetric Data

Map 2. 3: Sample Base Map comprising Mauza Map and Photogrammetric Data

2.3 Satellite Image Processing for Data Acquisition

2.3.1 Physical Feature Extraction from Satellite Image

Satellite image came with a certain level of processing. However, for the purpose of features extraction, further processing is needed in a number of steps. After collecting raw satellite imagery in stereo pairs, initial image processing has been done by performing Epi-polar Correction, Color Balance, Contrast Adjustment, Sharpening, Pyramid building and Bit Rate Setting. For geometrical correction of satellite images four reliable GCPs has been collected through RTK-GPS survey study area. Using these GCPs, Aerial Triangulation of the stereo pairs has done and stereo model has been prepared for photogrammetric works. The detail procedure has been described in the report of Photogrammetric Works. The step by step procedures of workflow for stereo satellite image processing and data extraction has been shown in the Figure 2.6.

The Photogrammetric Expert and the GIS Expert was guided the physical feature extraction from satellite image. They monitored the feature extraction works examine the data. After initial image processing and building up of stereo models, extraction of physical features has been done by a team of skilled photogrammetric expert. All type of physical features including Roads, Structures, Water bodies, etc. had been extracted as 3D features. Each vertex of features contains z-value (elevation). Plate 4 is showing digitization by digital photogrammetry.

Plate 4: Digitization by Digital Photogrammetry

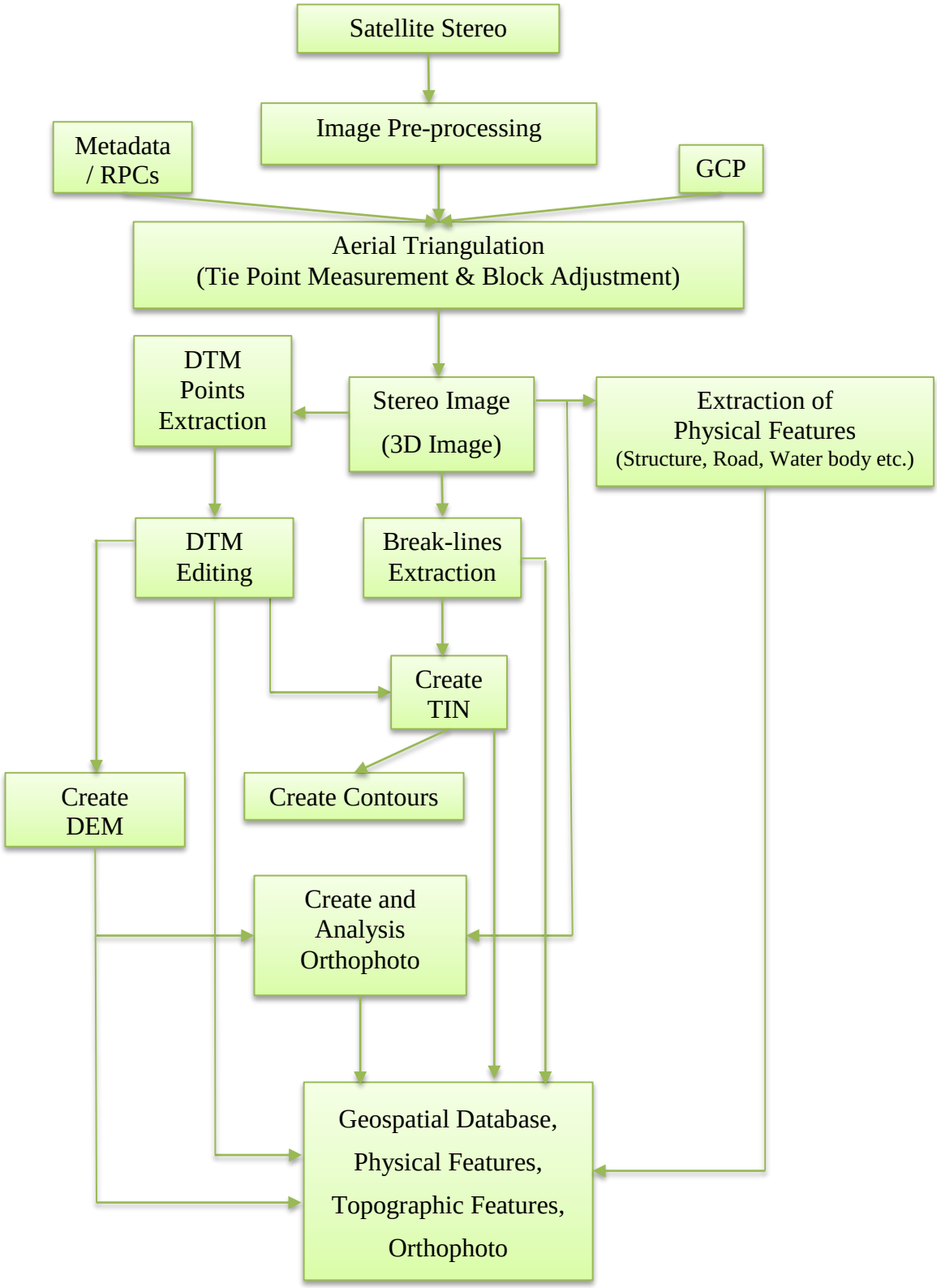


Figure 2. 6: Workflow for Stereo Satellite Image Processing and Data Extraction

2.3.2 Preparation of Survey Base Map

The survey base map has been created by super-imposing Project Area Maps derived from Mauza map and Satellite Image Processed data. This superimposition is very important to form a unique map and database comprising the data collected from satellite imagery and Mauza map data (e.g. plot no, Mauza name, JL no., sheet no.).These base maps have been used to collect attributes of the physical features and missing features which could not be extracted due to dense vegetation in the project area.

Sample of the Grids used to prepare survey base map is shown in Figure-2.7 and Grids with photogrammetric data and satellite image is shown in Figure-2.8. A sample base map comprising photogrammetric data and satellite image is shown in Map-2.4.

Entire Sariakandi Upazila has been divided into 4376 grids and survey base maps had been prepared based on these grids. The base maps have been printed on A3 paper sheet at a scale of 1:990 to make sure that all required physical features are visible enough to carry out the survey works. Total 4376 sheets have been prepared and printed. Those grids are not printed which are fully on agricultural land, on large water body or on forest lands as determined by the satellite image.

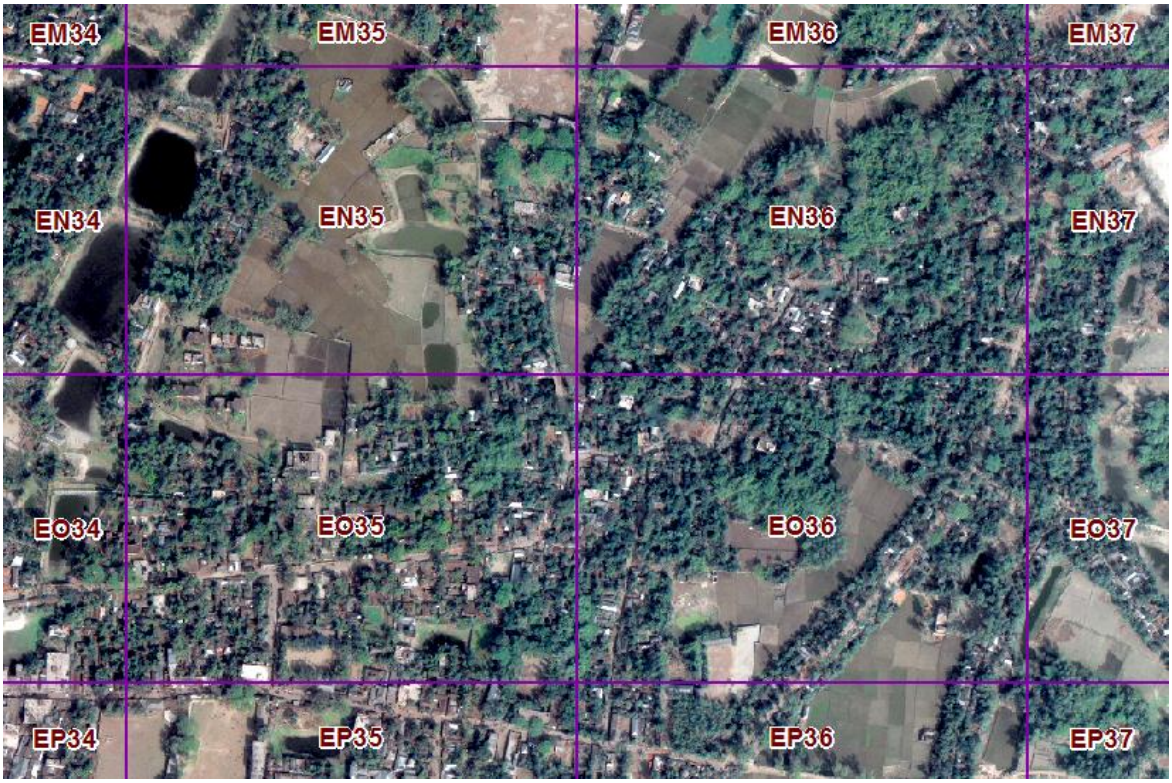


Figure 2. 7: Grids for Survey Base Maps of Sariakandi Upazila

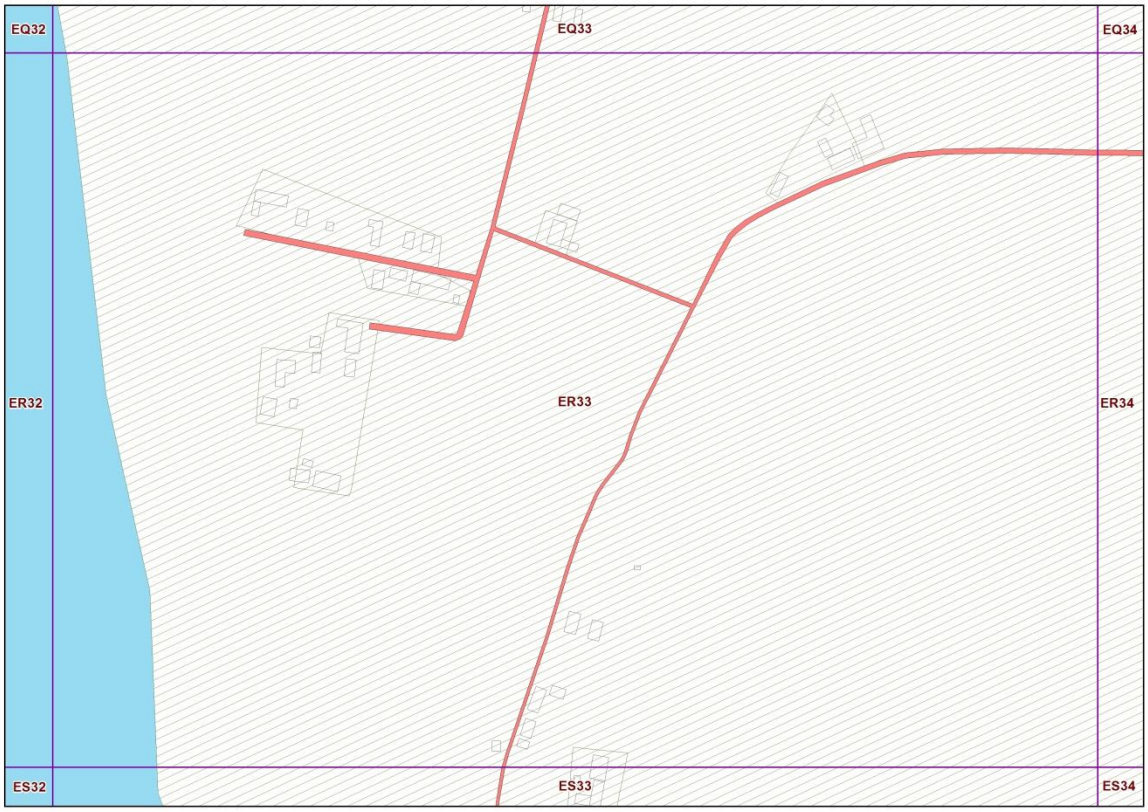


Figure 2. 8: Survey Base Map of Sariakandi Upazila in Grids

2.3.3 Preparation of Log Book for Attribute Collection

A Log Book for data collection forms has been developed to collect attributes or textual information. A Form of the Log Book is given in Annexure-III. Each page of the book contains columns for collecting following information:

- ✓ Type of structure
- ✓ Use of structure
- ✓ Name of the structure, if any
- ✓ Construction year of the structure
- ✓ Owner of the structure
- ✓ Mobile no. of the owner of the structure, if possible
- ✓ Road name beside the structure, if any
- ✓ Plot no. and Mauza name belongs to the structure
- ✓ Ward/Union belongs to the structure
- ✓ Name of the location

CHAPTER THREE: FIELD LEVEL DATA ACQUISITION

3.0 Mobilization of Survey Team

A highly technical survey team comprising Urban Planner, GIS Expert, Survey Expert and Survey Assistants was mobilized to conduct the topographic and physical feature surveys. The Urban Planner led the survey team under the close supervision of the Team Leader of the project to ensure the quality of the survey. A list of Survey team members has been given in Table 3.1

Table 3. 1: Composition of Survey Team

Sl.	Designation	Nos.	Qualification	Year of Experience	Responsibilities
1.	Urban Planner and Survey coordinator	01	Masters of Urban and Regional Planning	10	Coordination of overall survey work
2.	Survey Expert	01	B.Sc Engineering in Civil	07	To conduct, coordinate and monitor physical feature, topographical and land use, survey
3.	Photogrammetric Expert	01	M.Sc in Geography	06	To prepare topographic, physical feature, land use and other related map of the area
4.	GIS Specialist	01	Bachelor in Geography	06	To prepare, supervise, manage and monitor digital database (Spatial and attribute) of the project
5.	RTK-GPS Surveyor	04	Diploma in Civil Engineering	05	Establishing primary and secondary BM/control points
6.	Total Station Surveyor	12	Diploma in Civil Engineering	05	Topographic and physical feature survey

In addition to above key team members 20 nos of survey assistants were involved for assisting survey team at field level and map checking. For physical survey this survey team was divided into 8 groups contained minimum 2 members (1 Surveyor and one data collector/ Logbook writer) to collect all features i.e. structures, water bodies, roads, etc. with their attributes. All these groups were supervised by the Survey Expert and the Survey Supervisor.

3.1 Physical Feature Survey

The Physical Feature survey in Sariakandi Upazila was done using the survey base maps as described in previous chapter. Survey team equipped with hand GPS/ GPS enabled Smart Phone, measurement tape, color pens, maker pens, survey map sheet, log book, etc. They trained properly before going field and collect required information. A sample surveyed map sheet is shown in Figure-3.1.

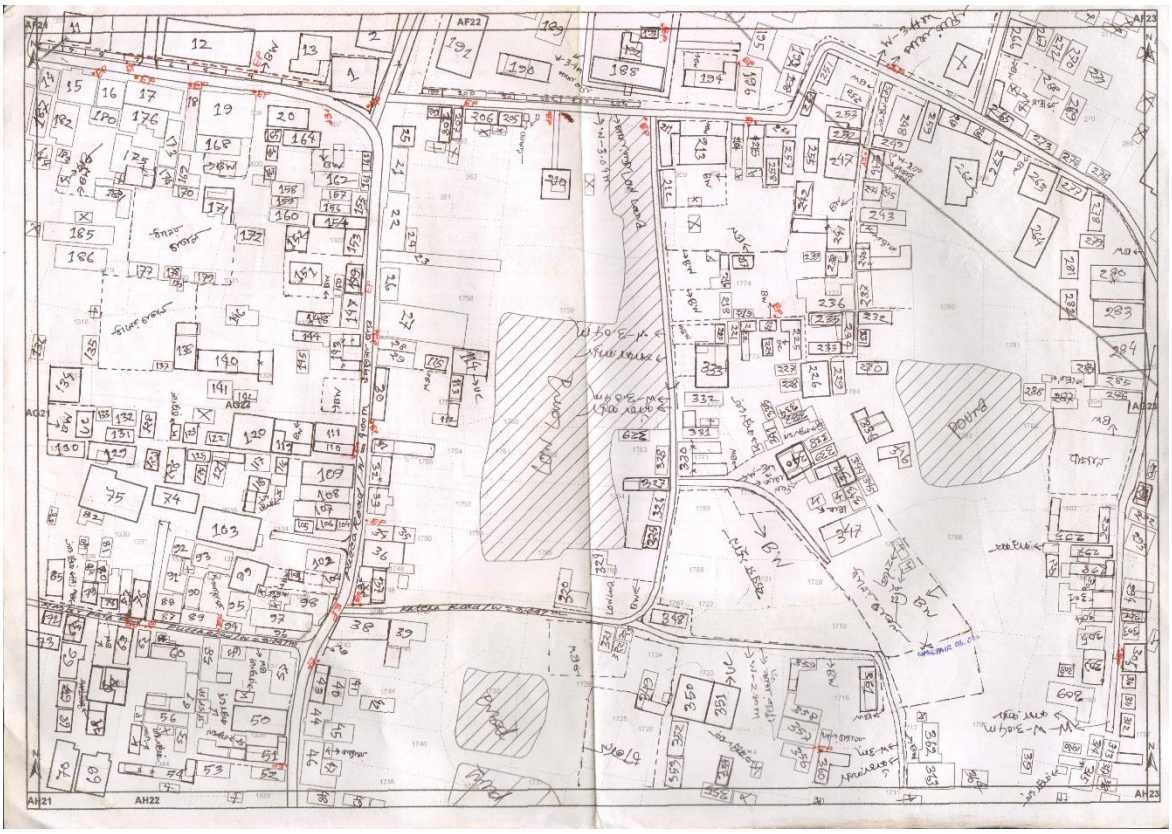
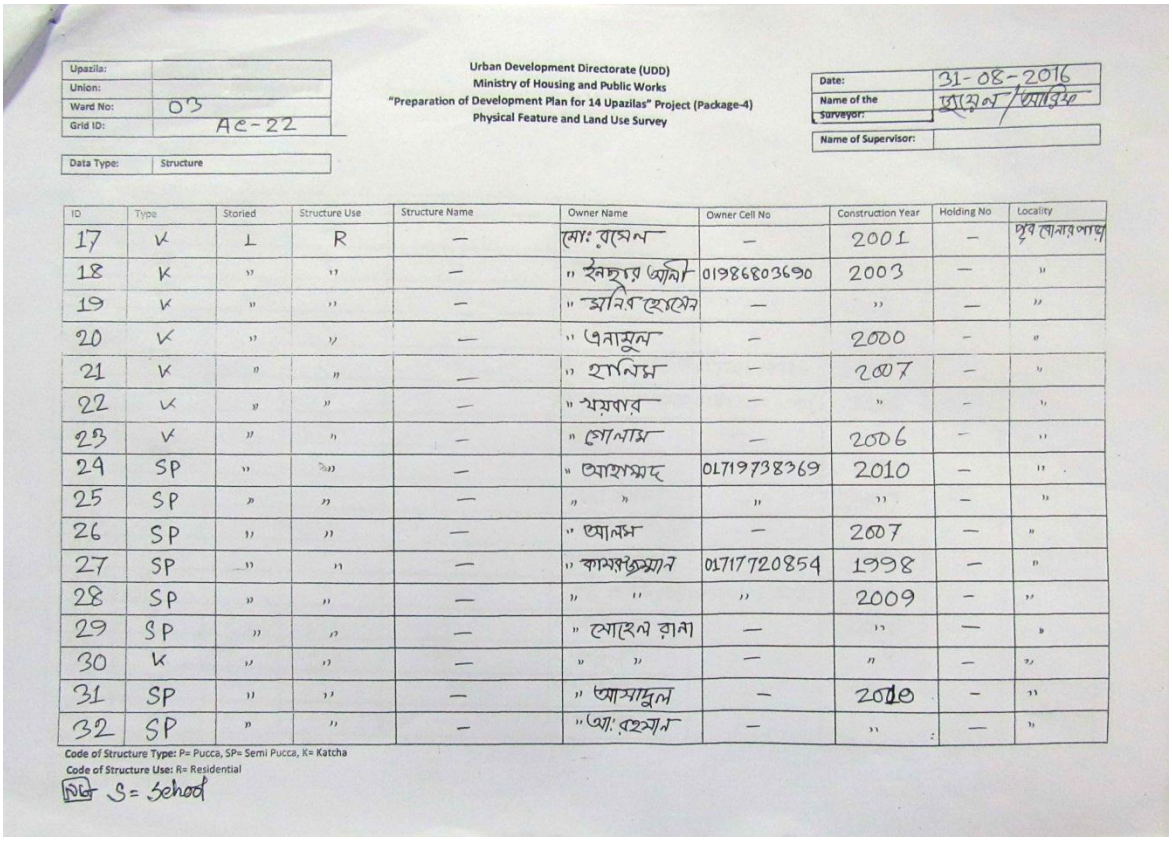


Figure 3. 1: Sample Scanned Base Map for Physical Features and Land Use Survey

The survey team collected the following attributes/ information from field:

- All structures Position, dimension and number of story
- Type of structure construction (Pucca, semi-pucca, katcha)
- Type of structure use (Residential, Commercial, Industrial, Mixed use, etc.)
- Road Network with width and material
- Drainage information with depth, width and construction type with flow direction
- Bridge/Culverts
- Other physical infrastructures like, location of deep tubes well, overhead water tank, electric substation, telephone exchange, Water Treatment plant, waste disposal facilities.

A sample page of log book with collected information is shown in Figure-3.2.



Upazila:
Union:
Ward No: 03
Grid ID: Ae-22

Urban Development Directorate (UDD)
Ministry of Housing and Public Works
"Preparation of Development Plan for 14 Upazilas" Project (Package-4)
Physical Feature and Land Use Survey

Date: 31-08-2016
Name of the Surveyor: রায়হান / আরিফ
Name of Supervisor:

Data Type: Structure

ID	Type	Storied	Structure Use	Structure Name	Owner Name	Owner Cell No	Construction Year	Holding No	Locality
17	K	1	R	—	মো: রফেল	—	2001	—	পূর্ব লোনারপাড়া
18	K	"	"	—	" ইনছার আলী	01986803690	2003	—	"
19	K	"	"	—	" আনিস হোসেন	—	"	—	"
20	K	"	"	—	" এনামুল	—	2000	—	"
21	K	"	"	—	" হাবিবুর	—	2007	—	"
22	K	"	"	—	" খয়বার	—	"	—	"
23	K	"	"	—	" গোলাম	—	2006	—	"
24	SP	"	"	—	" আহাম্মদ	01719738369	2010	—	"
25	SP	"	"	—	" "	"	"	—	"
26	SP	"	"	—	" আলম	—	2007	—	"
27	SP	"	"	—	" কামরুজ্জামান	01717720854	1998	—	"
28	SP	"	"	—	" "	"	2009	—	"
29	SP	"	"	—	" মোহেল রানা	—	"	—	"
30	K	"	"	—	" "	—	"	—	"
31	SP	"	"	—	" আসাদুল	—	2010	—	"
32	SP	"	"	—	" আ: রহমান	—	"	—	"

Code of Structure Type: P= Pucca, SP= Semi Pucca, K= Katcha
Code of Structure Use: R= Residential
S= School

Figure 3. 2: Sample Log Book Page with Information Recorded in Field

Plate 5: Surveyors Working on the Field

CHAPTER FOUR: SURVEY DATA PROCESSING & ANALYSIS

4.1 Processing of Spatial and Attribute Data

After completion of field survey, all type of spatial data is properly processed to obtain layers of physical features such as Structures, Roads, Water bodies, etc. All surveyed sheets are scanned and geo-referenced to superimpose on the satellite imagery. The surveyed features (structures, roads, water bodies, etc.) marked on the sheets were then digitized using the ArcGIS software and stored them layer by layer as per Technical Specifications on GIS Database.

Plate 6: Updating Works through GIS

4.2 Development of GIS Database

The Consultant has developed a GIS database for systematically organizing, storing and easy retrieving the information and data of the project area. ArcGIS File Geo-database was developed this purpose, since File Geo-database offers structural, performance and data management advantages over Personal Geo-database or shape files. The geo-database contains all the layers generated from the Mauza maps, satellite images and field survey.

Specifications of these layers has been developed to standardize GIS data structure such as layer name, layer type, attribute types and attribute values, and provided in Annexure-II.

The Figure-4.1 is showing Log Book Data Entry Interface in Microsoft Access Software of Sariakandi Upazila.

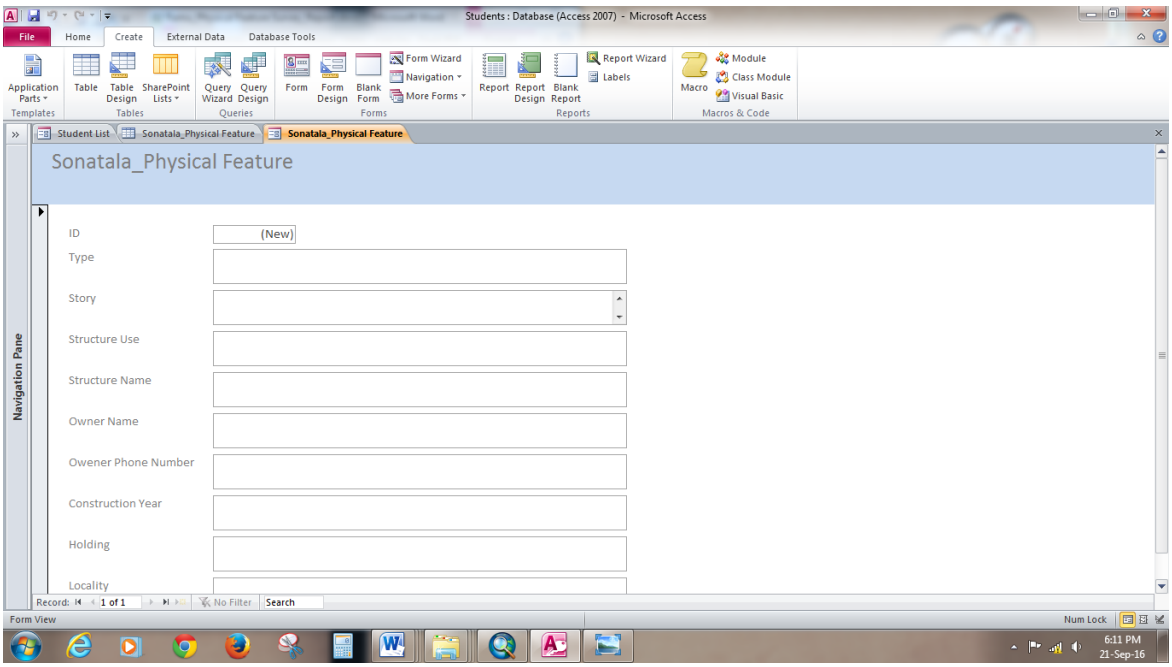


Figure 4. 1: Log Book Data Entry Interface in Microsoft Access Software

The Figure-4.2 is showing Tabular View of Log Book Data Entry in Microsoft Access Software of Sariakandi Upazila.

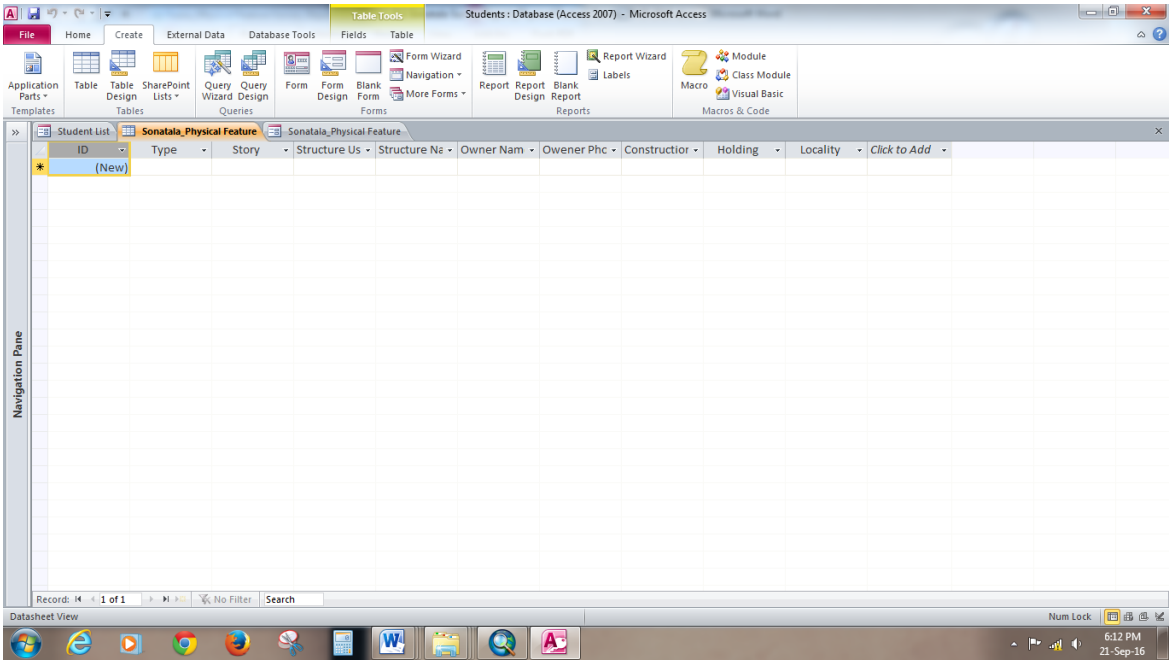


Figure 4. 2: Tabular View of Log Book Data Entry in Microsoft Access Software

The Figure-4.3 is showing Display of Physical Features in Sariakandi Town Area.

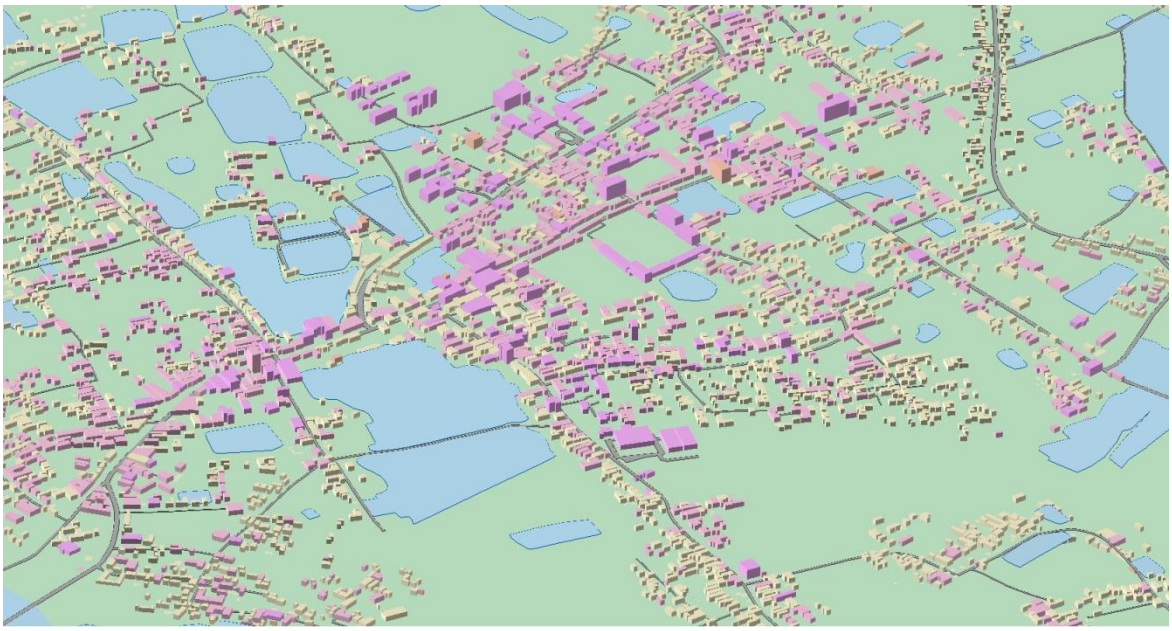
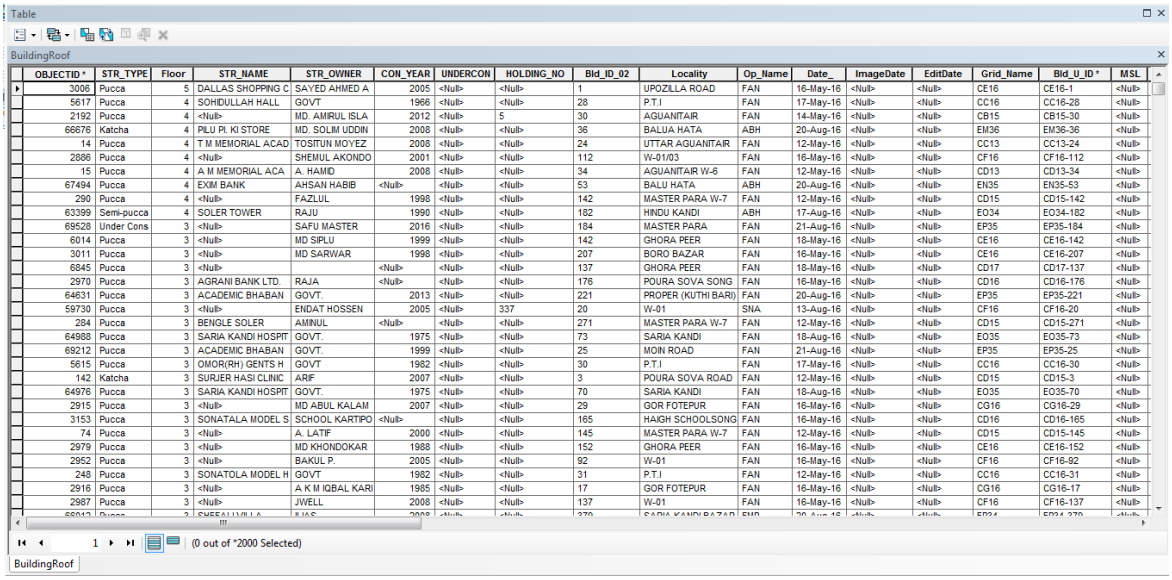


Figure 4. 3: 3D Display of Physical Features in Sariakandi Town Area

The Figure-4.4 is showing Attribute Table of Structure Database of Sariakandi Upazila.



OBJECTID *	STR_TYPE	Floor	STR_NAME	STR_OWNER	CON_YEAR	UNDERCON	HOLDING_NO	Bld_ID_02	Locality	Op_Name	Date_	ImageDate	EditDate	Grid_Name	Bld_U_ID *	MSL
3006	Pucca	5	DALLAS SHOPPING C	SAYED AHMED A	2005	<Null>	<Null>	1	UPOZILLA ROAD	FAN	16-May-16	<Null>	<Null>	CE16	CE16-1	<Null>
5617	Pucca	4	SOHIDULLAH HALL	GOVT	1966	<Null>	<Null>	28	P.T.I	FAN	17-May-16	<Null>	<Null>	CC16	CC16-28	<Null>
2192	Pucca	4	<Null>	MD. AMRUL ISLA	2012	<Null>	5	30	AGUANITAIR	FAN	14-May-16	<Null>	<Null>	CB15	CB15-30	<Null>
66676	Katcha	4	PLU PI. KI STORE	MD. SOLIM UDDIN	2008	<Null>	<Null>	36	BALUA HATA	ABH	20-Aug-16	<Null>	<Null>	EM36	EM36-36	<Null>
14	Pucca	4	T M MEMORIAL ACAD	TOSITUN MOYEZ	2008	<Null>	<Null>	24	UTTAR AGUANITAIR	FAN	12-May-16	<Null>	<Null>	CC13	CC13-24	<Null>
2886	Pucca	4	<Null>	SHEMUL AKONDO	2001	<Null>	<Null>	112	W-01/03	FAN	16-May-16	<Null>	<Null>	CF16	CF16-112	<Null>
15	Pucca	4	A M MEMORIAL ACA	A. HAMID	2008	<Null>	<Null>	34	AGUANITAIR W-6	FAN	12-May-16	<Null>	<Null>	CD13	CD13-34	<Null>
67494	Pucca	4	EXIM BANK	AHSAN HABIB	<Null>	<Null>	<Null>	53	BALU HATA	ABH	20-Aug-16	<Null>	<Null>	EN35	EN35-53	<Null>
290	Pucca	4	<Null>	FAZLUL	1998	<Null>	<Null>	142	MASTER PARA W-7	FAN	12-May-16	<Null>	<Null>	CD15	CD15-142	<Null>
63399	Semi-pucca	4	SOLER TOWER	RAJU	1990	<Null>	<Null>	182	HINDU KANDI	ABH	17-Aug-16	<Null>	<Null>	EO34	EO34-182	<Null>
69528	Under Cons	3	<Null>	SAFU MASTER	2016	<Null>	<Null>	184	MASTER PARA	FAN	21-Aug-16	<Null>	<Null>	EP35	EP35-184	<Null>
6014	Pucca	3	<Null>	MD SIPLU	1999	<Null>	<Null>	142	GHORA PEER	FAN	18-May-16	<Null>	<Null>	CE16	CE16-142	<Null>
3011	Pucca	3	<Null>	MD SARWAR	1998	<Null>	<Null>	207	BORO BAZAR	FAN	16-May-16	<Null>	<Null>	CE16	CE16-207	<Null>
6845	Pucca	3	<Null>		<Null>	<Null>	<Null>	137	GHORA PEER	FAN	18-May-16	<Null>	<Null>	CD17	CD17-137	<Null>
2970	Pucca	3	AGRANI BANK LTD.	RAJA	<Null>	<Null>	<Null>	176	POURA SOVA SONG	FAN	16-May-16	<Null>	<Null>	CD16	CD16-176	<Null>
64631	Pucca	3	ACADEMIC BHABAN	GOVT	2013	<Null>	<Null>	221	PROPER (KUTHI BARI)	FAN	20-Aug-16	<Null>	<Null>	EP35	EP35-221	<Null>
59730	Pucca	3	<Null>	ENDAT HOSSEN	2005	<Null>	337	20	W-01	SNA	13-Aug-16	<Null>	<Null>	CF16	CF16-20	<Null>
284	Pucca	3	BENGLE SOLER	AMINUL	<Null>	<Null>	<Null>	271	MASTER PARA W-7	FAN	12-May-16	<Null>	<Null>	CD15	CD15-271	<Null>
64988	Pucca	3	SARIA KANDI HOSPIT	GOVT.	1975	<Null>	<Null>	73	SARIA KANDI	FAN	18-Aug-16	<Null>	<Null>	EO35	EO35-73	<Null>
69212	Pucca	3	ACADEMIC BHABAN	GOVT.	1999	<Null>	<Null>	25	MOIN ROAD	FAN	21-Aug-16	<Null>	<Null>	EP35	EP35-25	<Null>
5615	Pucca	3	OMOR(RH) GENTS H	GOVT	1982	<Null>	<Null>	30	P.T.I	FAN	17-May-16	<Null>	<Null>	CC16	CC16-30	<Null>
142	Katcha	3	SURJER HASI CLINIC	ARIF	2007	<Null>	<Null>	3	POURA SOVA ROAD	FAN	12-May-16	<Null>	<Null>	CD15	CD15-3	<Null>
64976	Pucca	3	SARIA KANDI HOSPIT	GOVT.	1975	<Null>	<Null>	70	SARIA KANDI	FAN	18-Aug-16	<Null>	<Null>	EO35	EO35-70	<Null>
2915	Pucca	3	<Null>	MD ABUL KALAM	2007	<Null>	<Null>	29	GOR FOTEPUR	FAN	16-May-16	<Null>	<Null>	CG16	CG16-29	<Null>
3153	Pucca	3	SONATALA MODEL S	SCHOOL KARTIPO	<Null>	<Null>	<Null>	165	HAIGH SCHOOLSONG	FAN	16-May-16	<Null>	<Null>	CD16	CD16-165	<Null>
74	Pucca	3	<Null>	A. LATIF	2000	<Null>	<Null>	145	MASTER PARA W-7	FAN	12-May-16	<Null>	<Null>	CD15	CD15-145	<Null>
2979	Pucca	3	<Null>	MD KHONDOKAR	1988	<Null>	<Null>	152	GHORA PEER	FAN	16-May-16	<Null>	<Null>	CE16	CE16-152	<Null>
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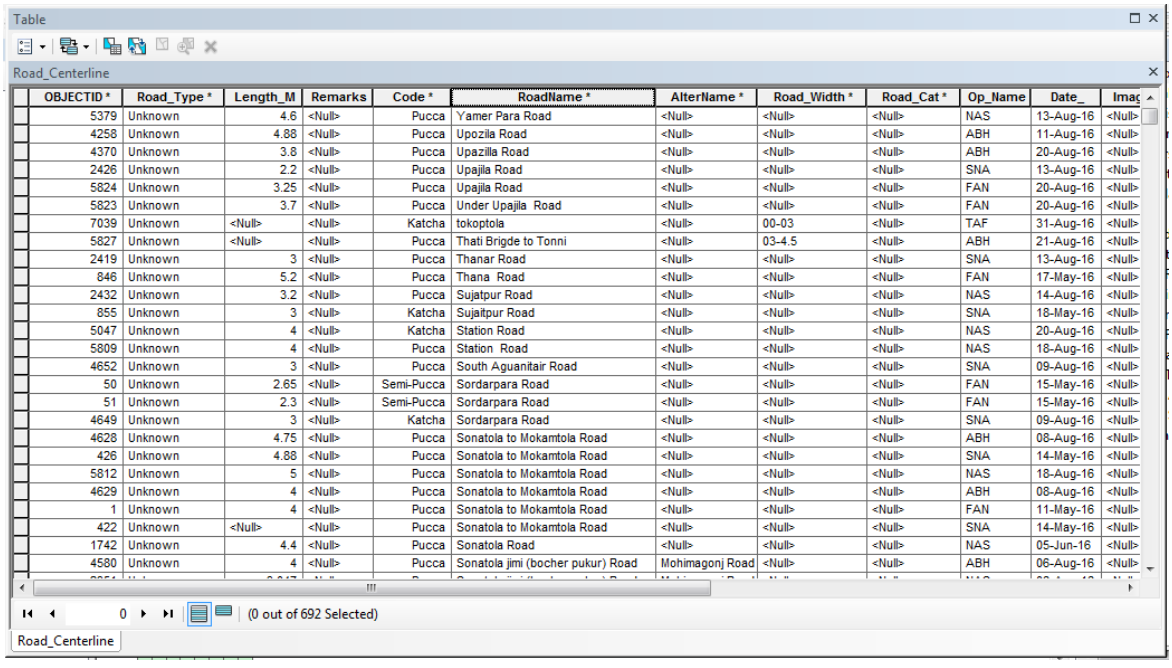
248	Pucca	3	SONATOLA MODEL H	GOVT	1982	<Null>	<Null>	31	P.T.I	FAN	12-May-16	<Null>	<Null>	CC16	CC16-31	<Null>
2916	Pucca	3	<Null>	A K M IQBAL KARI	1985	<Null>	<Null>	17	GOR FOTEPUR	FAN	16-May-16	<Null>	<Null>	CG16	CG16-17	<Null>
2987	Pucca	3	<Null>	JWELL	2008	<Null>	<Null>	137	W-01	FAN	16-May-16	<Null>	<Null>	CF16	CF16-137	<Null>

Figure 4. 4: Attribute Table of Structure Database of Sariakandi Upazila

The Figure-4.5 is showing Attribute Table of Road Centerline of Sariakandi Upazila.



OBJECTID *	Road_Type *	Length_M	Remarks	Code *	RoadName *	AlterName *	Road_Width *	Road_Cat *	Op_Name	Date_	Imag
5379	Unknown	4.6	<Null>	Pucca	Yamer Para Road	<Null>	<Null>	<Null>	NAS	13-Aug-16	<Null>
4258	Unknown	4.88	<Null>	Pucca	Upozila Road	<Null>	<Null>	<Null>	ABH	11-Aug-16	<Null>
4370	Unknown	3.8	<Null>	Pucca	Upazilla Road	<Null>	<Null>	<Null>	ABH	20-Aug-16	<Null>
2426	Unknown	2.2	<Null>	Pucca	Upajila Road	<Null>	<Null>	<Null>	SNA	13-Aug-16	<Null>
5824	Unknown	3.25	<Null>	Pucca	Upajila Road	<Null>	<Null>	<Null>	FAN	20-Aug-16	<Null>
5823	Unknown	3.7	<Null>	Pucca	Under Upajila Road	<Null>	<Null>	<Null>	FAN	20-Aug-16	<Null>
7039	Unknown	<Null>	<Null>	Katcha	tokoptola	<Null>	00-03	<Null>	TAF	31-Aug-16	<Null>
5827	Unknown	<Null>	<Null>	Pucca	Thati Brigde to Tonni	<Null>	03-4.5	<Null>	ABH	21-Aug-16	<Null>
2419	Unknown	3	<Null>	Pucca	Thanar Road	<Null>	<Null>	<Null>	SNA	13-Aug-16	<Null>
846	Unknown	5.2	<Null>	Pucca	Thana Road	<Null>	<Null>	<Null>	FAN	17-May-16	<Null>
2432	Unknown	3.2	<Null>	Pucca	Sujatpur Road	<Null>	<Null>	<Null>	NAS	14-Aug-16	<Null>
855	Unknown	3	<Null>	Katcha	Sujaitpur Road	<Null>	<Null>	<Null>	SNA	18-May-16	<Null>
5047	Unknown	4	<Null>	Katcha	Station Road	<Null>	<Null>	<Null>	NAS	20-Aug-16	<Null>
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50	Unknown	2.65	<Null>	Semi-Pucca	Sordarpara Road	<Null>	<Null>	<Null>	FAN	15-May-16	<Null>
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4649	Unknown	3	<Null>	Katcha	Sordarpara Road	<Null>	<Null>	<Null>	SNA	09-Aug-16	<Null>
4628	Unknown	4.75	<Null>	Pucca	Sonatola to Mokamtola Road	<Null>	<Null>	<Null>	ABH	08-Aug-16	<Null>
426	Unknown	4.88	<Null>	Pucca	Sonatola to Mokamtola Road	<Null>	<Null>	<Null>	SNA	14-May-16	<Null>
5812	Unknown	5	<Null>	Pucca	Sonatola to Mokamtola Road	<Null>	<Null>	<Null>	NAS	18-Aug-16	<Null>
4629	Unknown	4	<Null>	Pucca	Sonatola to Mokamtola Road	<Null>	<Null>	<Null>	ABH	08-Aug-16	<Null>
1	Unknown	4	<Null>	Pucca	Sonatola to Mokamtola Road	<Null>	<Null>	<Null>	FAN	11-May-16	<Null>
422	Unknown	<Null>	<Null>	Pucca	Sonatola to Mokamtola Road	<Null>	<Null>	<Null>	SNA	14-May-16	<Null>
1742	Unknown	4.4	<Null>	Pucca	Sonatola Road	<Null>	<Null>	<Null>	NAS	05-Jun-16	<Null>
4580	Unknown	4	<Null>	Pucca	Sonatola jimi (bocher pukur) Road	Mohimagonj Road	<Null>	<Null>	ABH	06-Aug-16	<Null>

Figure 4. 5: Attribute Table of Road Centerline of Sariakandi Upazila

The Figure-4.6 is showing Attribute Table of Mauza Map of Sariakandi Upazila.

Table

Sonatala_Final_Mouza_Poly

FID	Shape *	OBJECTID	Mouza_Name	JL_No	Sheet_No	Plot_No	Type	SHAPE_Leng	SHAPE_Le_1	SHAPE_Area	C
0	Polygon	1	Bag_Bari Dighor	1	1	507		130.859374	130.859374	1071.617207	0
1	Polygon	2	Bag_Bari Dighor	1	1	504		171.87059	171.87059	1787.797668	0
2	Polygon	3	Bag_Bari Dighor	1	1	503		326.383081	326.378249	5088.195617	0
3	Polygon	4	Bag_Bari Dighor	1	1	501		96.419395	96.34386	482.777705	0
4	Polygon	5	Bag_Bari Dighor	1	1	502		97.099303	97.027088	508.268822	0
5	Polygon	6	Bag_Bari Dighor	1	1	497		93.090507	93.090507	472.922148	0
6	Polygon	7	Bag_Bari Dighor	1	1	496		180.283283	180.283364	1954.18449	0
7	Polygon	8	Bag_Bari Dighor	1	1	499		86.241312	86.241425	417.792451	0
8	Polygon	9	Bag_Bari Dighor	1	1	500		82.993414	82.998654	391.172342	0
9	Polygon	10	Bag_Bari Dighor	1	1	498		93.769581	93.769444	497.456217	0
10	Polygon	11	Bag_Bari Dighor	1	1	495		141.034177	141.034177	1117.487637	0
11	Polygon	12	Bag_Bari Dighor	1	1	491		79.452336	79.452336	331.831218	0
12	Polygon	13	Bag_Bari Dighor	1	1	490		74.411568	74.411568	287.855123	0
13	Polygon	14	Bag_Bari Dighor	1	1	492		88.950278	88.950278	462.206532	0
14	Polygon	15	Bag_Bari Dighor	1	1	505		100.044955	100.044955	508.257329	0
15	Polygon	16	Bag_Bari Dighor	1	1	506		135.771975	135.771975	1145.922685	0
16	Polygon	17	Bag_Bari Dighor	1	1	510		141.242558	132.105212	1066.256488	0
17	Polygon	18	Bag_Bari Dighor	1	1	517		81.212618	81.212618	410.484687	0
18	Polygon	19	Bag_Bari Dighor	1	1	518		104.523265	104.523265	674.476088	0
19	Polygon	20	Bag_Bari Dighor	1	1	516		120.676926	120.676926	897.598145	0
20	Polygon	21	Bag_Bari Dighor	1	1	515		77.951994	77.951994	355.771318	0
21	Polygon	22	Bag_Bari Dighor	1	1	521		178.752949	178.752949	1841.15529	0
22	Polygon	23	Bag_Bari Dighor	1	1	511		157.221768	149.458166	1390.523116	0
23	Polygon	24	Bag_Bari Dighor	1	1	512		106.681238	106.681238	620.210617	0
24	Polygon	25	Bag_Bari Dighor	1	1	513		105.534654	105.534654	622.569337	0
25	Polygon	26	Bag_Bari Dighor	1	1	644		107.98686	107.986938	646.923423	0
26	Polygon	27	Bag_Bari Dighor	1	1	643		100.093111	100.093111	521.694459	0
27	Polygon	28	Bag_Bari Dighor	1	1	645		128.9387	128.9387	1013.168305	0
28	Polygon	29	Bag_Bari Dighor	1	1	642		72.657952	72.657952	328.673269	0
29	Polygon	30	Bag_Bari Dighor	1	1	641		158.447813	158.447813	1259.151916	0

1 (0 out of 144585 Selected)

Sonatala_Final_Mouza_Poly

Figure 4. 6: Attribute Table of Mauza Map of Sariakandi Upazila

The Figure-4.7 is showing Catalog View of Scanned Mauza Map Files of Sariakandi Upazila.

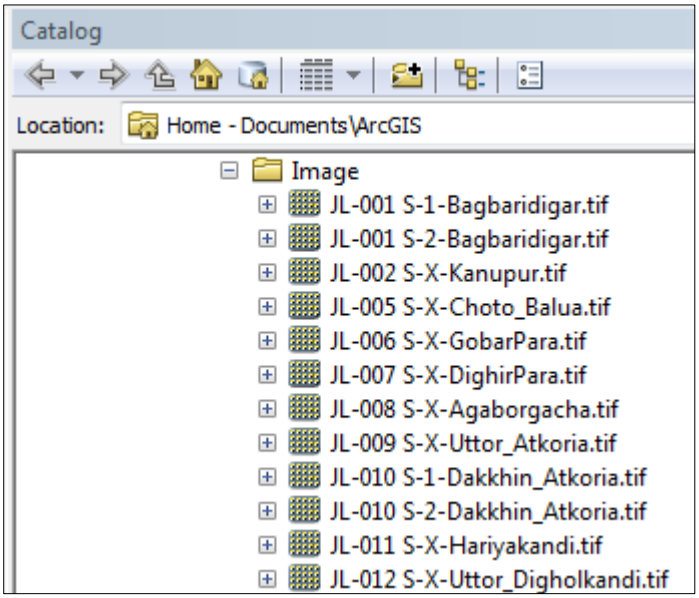


Figure 4. 7: Catalog View of Scanned Mauza Map Files of Sariakandi Upazila

The Figure-4.8 is showing Catalog View of Geodatabases of Digitized Mauza Maps of Sariakandi Upazila Software of Sariakandi Upazila.

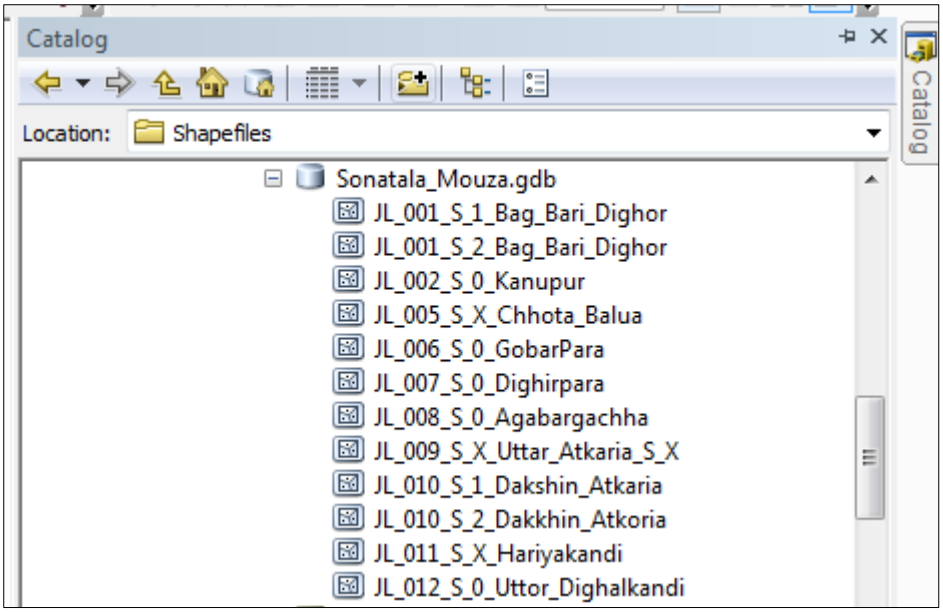
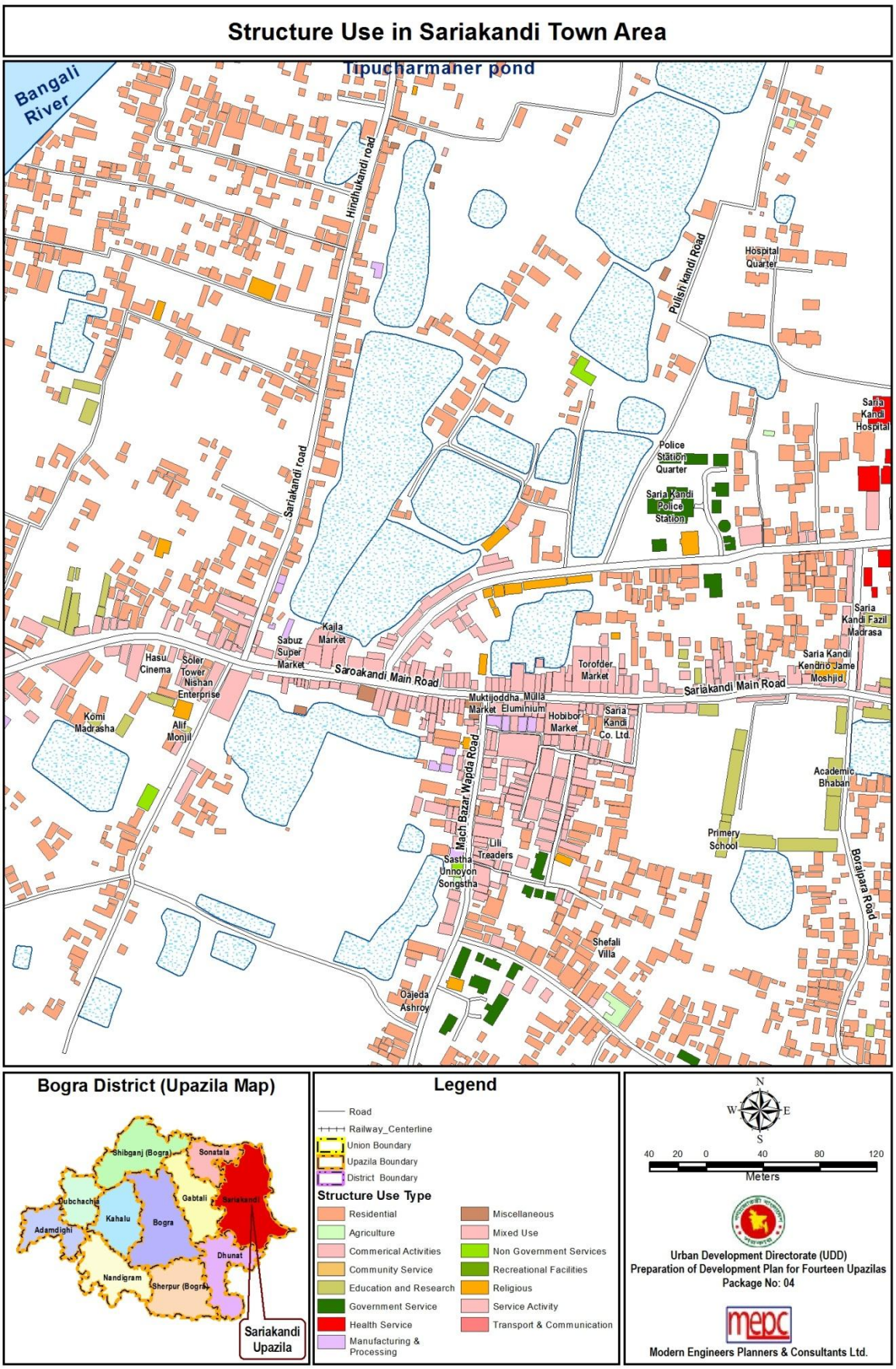
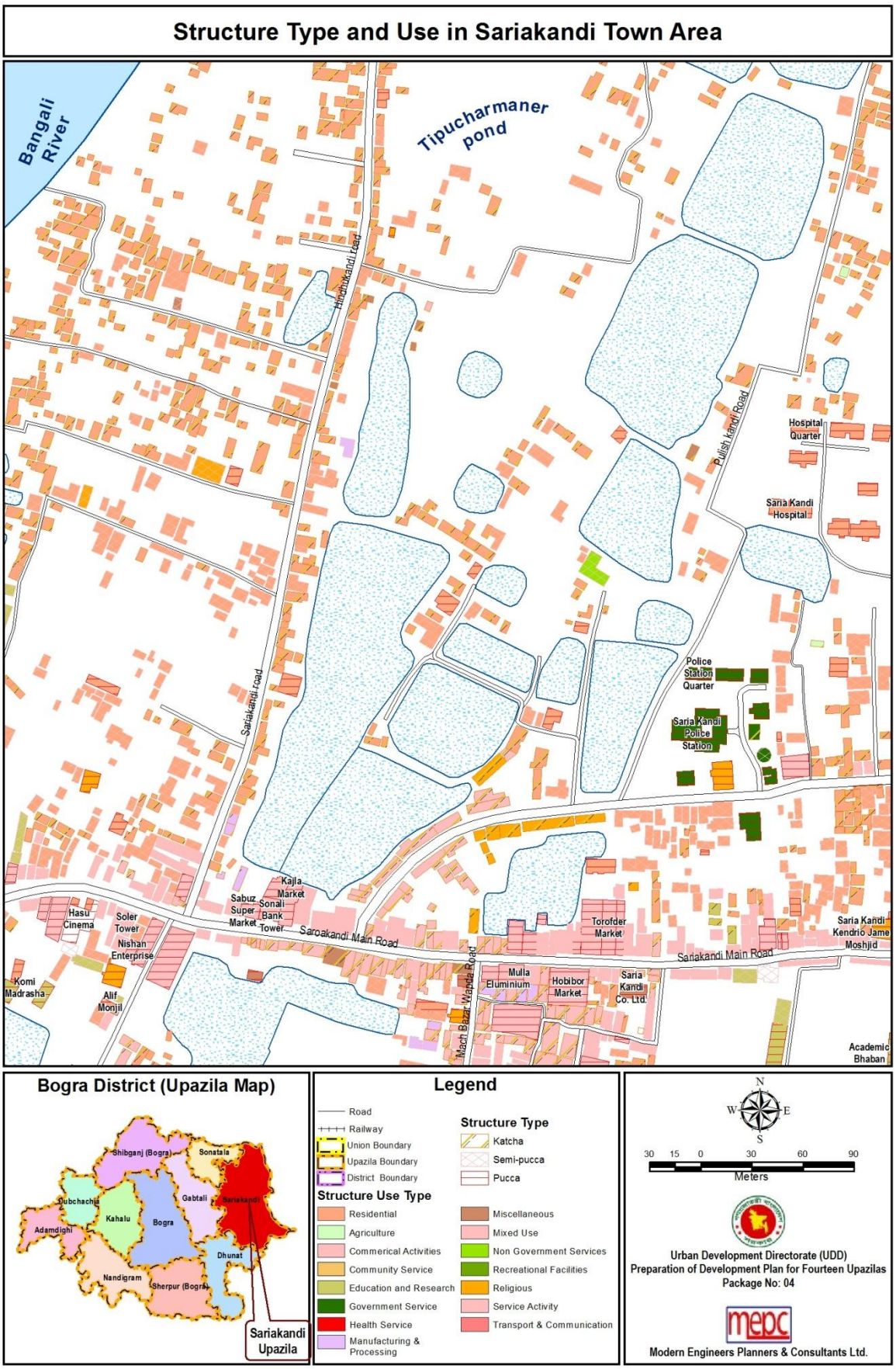


Figure 4. 8: Catalog View of Geodatabases of Digitized Mauza Maps of Sariakandi Upazila

Map 4. 1: Structure Use in Sariakandi Town Area



Map 4. 2: Structure Type and Use in Sariakandi Town Area



CHAPTER-05: WAY FORWARD

The physical feature survey of Sariakandi Upazila has been done through field survey based on high resolution stereo satellite imagery and RTK-GPS. By using Digital Photogrammetry technology, physical features are been digitized having 3D coordinates, i.e. every vertex or point has x, y and z-coordinate. This is one of the best technologies for capturing the existing scenario of a site. This physical survey will lead to a dynamic planning process with 3d visualization of the project area. It will be helpful for the planners for the development of a realistic plan for this upazila town. Physical feature survey data will provide necessary contribution for infrastructure, transportation, environmental, hydrological, drainage, land use etc. planning.

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Annexure-I: RS Mouza List of Sariakandi Upazila

Zila	Upazila	Mouza Name	JL Number	Sheet Number

Annexure-II: Technical Specifications of GIS Data

This document contains the technical specifications for the development of GIS database. It has two sections: Section-A and Section-B. Specifications for mauza map scanning and digitization have been provided in Section-A and specifications of GIS layers for preparing Survey and Plan Maps have been provided in Section-B.

Section-A: Specifications for Mauza Map Scanning & Digitization

This section contains the scanning specifications and digitization of mauza maps.

A.1.0 Specifications for Mauza Map Scanning

The scanning specification of mauza maps specifies Image Type, Image Format and Image Resolution and Image scale as follows:

Image Type	Color or Grayscale
Image Format	JPEG
Image Resolution	300 dpi

A.1.1 Directory Structure for Storing Scanned Mauza Maps

Directory Structure for systematically storing scanned image files of the Mauza maps may be as follows:

Directory Structure	**D:\GIS_Data\Project name & Package\Division name\District name\Upazila name(Data Type)\Union name or Ward No** Where, - **D:\GIS_Data** is the root folder of the UDD's GIS database. - **\Project name** is the abbreviated name of the Project such as **Pkg-5_14Upazila** may be the abbreviated name of the project "Preparation of the Development Plan for Fourteen Upazila – Package-05". -**\Division name** is the name of the Division in which the project area located. -**\District name** is the name of the District in which the project area located. -**\Upazila name** is the name of the Upazila in which the project area located. -**\Data_Type** is the type of GIS data such as **Scanned Mauza Maps**, **Georeferenced Raster Mauza Maps**, **Survey Data**, **Proposed Plan Data**, etc. -**\Union_name** is the different name of the Unions of the respective Upazila or Ward number of the Paurashava. Example D:\GIS_Data_UDD\Pkg-5_14Upazila\Chittagong.div\Chittagong.dis\Sariakandi.upz\Scanned_Mauza**Sariakandi.uni\Ward04** is the **directory** to store the **scanned Mauza maps of Ward No-4 of Sariakandi Upazila**.

A.1.2 File Naming Convention for Scanned Mauza Maps

A systematic naming convention must be followed to name the files of the scanned images of the mauza maps.

File Name: **Mauza Name+_+JL no+_+Sheet No.jpg**

Where,
- **Mauza Name** is the name of the Mauza. No space or special character is allowed, underscore must be used in case of more than one word in the name.
- **JL no** is the Jurisdiction Line/List number (JL no) of the Mauza. It must be as 3 digit number
- **Sheet No** is the particular sheet number of the Mauza. It must be as 3 digit number

Example:

Mauza Name	JL No	Sheet No	File Name
Garzania	3	5	**Garzania_003_005.jpg**

A.2.0 Specifications for Mauza Maps Digitization

The specifications for digitization of mauza maps specifies the settings for map and display unit, scale or zoom level and vertex spacing during the process of on-screen digitization.

Map Unit	Inch
Display Unit	Inch
Scale (zoom level)	1: 15 to 30
No of vertices on linear or polygon feature	- Only 2 vertices along a straight line (or a straight segment of the feature) - Extra vertices are not allowed between Start and End point. - Sufficiently dense vertices must be used for curved/complex linear feature. - Vertex must be inserted at the junction of plot boundaries.
Coordinate System	Unknown (produced by scanning process)

A.2.1 Vector Layers for Mauza Map Digitization

Digitization of Mauza map must be done in five vector layers as the format of Shapefile, Coverage or Geodatabase Featureclass. The Geodatabase is preferable..

Features of the Mauza Map	**Type of Layer**	**Name of Layer (as Shapefile/Covergae/Featureclass)**
All line features, such as plot boundary, road, waterbody, building, etc.	Polyline	**ML_XXX_XXX** Where, -**ML** represents **Mauza** map's **L**ine features. -XXX represents the JL number of the Mauza map (3 digits). -XXX represents the Sheet number of the Mauza map (3 digits).
Dag number (Plot no)	Point	**PN_XXX_XXX** Where, -**PN** represents **P**lot **N**umber of the Mauza map. -**XXX** represents the **JL number** of the Mauza map (**3 digits**). -**XXX** represents the **Sheet number** of the Mauza map (**3 digits**).
Plot area	Polygon	**MP_XXX_XXX** Where, -**MP** represents **Mauza** map as **P**olygon (area) features. -**XXX** represents the **JL number** of the Mauza map (**3 digits**). -**XXX** represents the **Sheet number** of the Mauza map (**3 digits**).
Point features (except plot no)	Point	**PF_XXX_XXX** Where, -**PF** represents **P**oint **F**eatures of the Mauza map except plot numbers. -**XXX** represents the **JL number** of the Mauza map (**3 digits**). -**XXX** represents the **Sheet number** of the Mauza map (**3 digits**).
Other area features	Polygon	**AF_XXX_XXX** Where, -**AF** represents other **A**rea **F**eatures of the Mauza map -**XXX** represents the **JL number** of the Mauza map (**3 digits**). -**XXX** represents the **Sheet number** of the Mauza map (**3 digits**).

A.2.2 Attribute Structure of the Mauza Map Layers

Attribute structure of the above four layers must be as follows:

1) Layer name: **PN_XXX_XXX**
Feature Type: **Point**

This Layer contains dag number (plot number) of the Mauza maps as point features. It contains the fields as described in the following table:

Field **Name**	Field **Type**	**Filed Width**	**Purpose** of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mauza	String	100	To contain name of the Mauza name
JL_No	String	6	To contain JL Number of the Mauza
Sheet_No	String	6	To contain sheet no the Mauza
Mauza_JL_S	String	100	To contain Mauza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Plot_No	Long Integer	10	To contain *dag* number (plot number)
Plot_Type	String	20	To contain following plot types - "Plot" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Pond" - "Canal" - "River"
Scale	String	20	To contain scale of the Mauza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mauza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mauza map.
SV_Period	String	20	To contain survey period of the Mauza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mauza as District code+Thana code+Union/Ward code+Mauza code.
UW_Geocode	String	6	To contain 6-digit BBS Geocode of Union or Ward as District code+Thana code+Union/Ward code
Remarks	String	100	To contain remarks, if any.

2) Laye rname: **ML_XXX_XXX**
Feature Type: **Polyline**

This shape file/Coverage contains all line features of the mauza map. It contains the fields as described in the following table:

Field **Name**	Field **Type**	**Filed Width**	**Purpose** of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mauza	String	100	To contain name of the Mauza name
JL_No	String	6	To contain JL Number of the Mauza
Sheet_No	String	6	To contain sheet no the Mauza
Mauza_JL_S	String	100	To contain Mauza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Scale	String	20	To contain scale of the Mauza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mauza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mauza map
SV_Period	String	20	To contain survey period of the Mauza map; e.g 1973-85
Line_Code	Short Integer	10	To contain feature code or unique ID of different line feature. For example 11, 12 and 14 are the codes for Mauza boundary, Sheet boundary and Plot boundary respectively.
Line_Desc	String	30	To contain the type of plot boundaries and other line features such as - "Mauza boundary" - "Sheet boundary" - "Plot boundary" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Khal" - "Thoka/ Position mark of adjacent sheet" - "North line" - "Other line"
Remarks	String	100	To contain remarks, if any.

3) Layername: **MP_XXX_XXX**
Feature Type: **Polygon**

This Layer contains all the plots of the Mauza maps as area or polygon features. It contains the fields as described in the following table:

Field **Name**	Field **Type**	**Filed Width**	**Purpose** of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mauza	String	100	To contain name of the Mauza name
JL_No	String	6	To contain JL Number of the Mauza
Sheet_No	String	6	To contain sheet no the Mauza
Mauza_JL_S	String	100	To contain Mauza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Plot_No	Long Integer	10	To contain *dag* number (plot number)
Plot_Type	String	20	To contain following plot types - "Plot" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Pond" - "Canal" - "River"
Scale	String	20	To contain scale of the Mauza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mauza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mauza map.
SV_Period	String	20	To contain survey period of the Mauza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mauza as District code+Thana code+Union/Ward code+Mauza code.
UW_Geocode	String	6	To contain 6-digit BBS Geocode of Union or Ward as District code+Thana code+Union/Ward code
Remarks	String	100	To contain remarks, if any.

4) Layer name: **PF_XXX_XXX**
Feature Type: **Point**

This shape file/Coverage contains all point features except the plot numbers of the mauza map. It contains the fields as described in the following table:

Field Name	Field Type	Field Width	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mauza	String	100	To contain name of the Mauza name
JL_No	String	6	To contain JL Number of the Mauza
Sheet_No	String	6	To contain sheet no the Mauza
Mauza_JL_S	String	100	To contain Mauza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Scale	String	20	To contain scale of the Mauza sheet; e.g. “16 inch = 1 mile” or “32 inch = 1 mile”, etc.
MZ_Version	String	20	To contain survey version of the Mauza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mauza map.
SV_Period	String	20	To contain survey period of the Mauza map; e.g 1973-85
Point_Code	String	6	To contain the user ID of different point features. For example: 45 is the ID of Traverse Station (New)
Point_Desc	String	50	To contain Point description of point features such as - “Traverse Station [Old]” - “Traverse Station [New]” - GT Station, etc. And also to contain texts of label features of adjacent mauza map such as “Sheet No. 2”, “Shaktola No. 101”, etc.
Remarks	String	100	To contain remarks, if any.

5) Layername: **AF_XXX_XXX**
Feature Type: **Polygon**

This shape file contains all other area features such as Dalan (Building), Waterbody (Pond), etc. of the mauza map. It contains the fields as described in the following table:

Field Name	Field Type	Field Width	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mauza	String	100	To contain name of the Mauza name
JL_No	String	6	To contain JL Number of the Mauza
Sheet_No	String	6	To contain sheet no the Mauza
Mauza_JL_S	String	100	To contain Mauza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Scale	String	20	To contain scale of the Mauza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mauza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mauza map.
SV_Period	String	20	To contain survey period of the Mauza map; e.g 1973-85
AF_Code	Long Integer	6	To contain the user ID of different polygon features. For example: 31 is the ID of Permanent Structure (Dalan), 32 is for Tinshed Structure, etc.
AF_Desc	String	50	To contain type of features such as - "Permanent Structure [Dalan]" - "Tinshed Structure" - "Other Structure" - "Pond/Waterbody" - "Pan Baraz" - "Graveyard"
Remarks	String	100	To contain remarks, if any.

A.2.3 Feature Codes for Mauza Map Digitization

The following feature codes (Unique ID) is assigned in appropriate fields for digitization of different features of the mauza maps.

Feature Type/Item	Layer Name	Feature Code (ID)
International Boundary	ML_XXX_XXX	10
Division Boundary		11
District Boundary		12
Upazila Boundary		13
Union Boundary		14
Mauza Boundary		15
Sheet Boundary		16
Plot Boundary		17
Thoka/Adjacent\Match Line		18
Embankment		19
Hill		20
Road		21
Halot		22
Khal (Canal)		23
River		24
Rail Line		25
Slope		26
North Line		27
Pucca Road		28
Semi-Pucca Road		29
Katcha Road		30
Unknown Line		99
Permanent Structure [Dalan]	AF_XXX_XXX	31
Tin Shed Structure		32
Other Structure		33
Pan Baraz		34
Pond/Water Body		35
Graveyard		36
Missing or not readable plot number	PN_XXX_XXX	99999
Boundary Pillar	PF_XXX_XXX	41
Bench Mark		42
Iron Pillar		43
Traverse Station(Old)		44
Traverse Station (New)		45
GT Station		46
Other Pillars		47
Pucca Well		51
Tube Well		52
Mosque		53
Temple		54
Adjacent Mauza/Sheet		61

Feature Type/Item	Layer Name	Feature Code (ID)
0tier Info		62
Demarcation Pillar		71
Settlement Pillar		72
Stone		73
Station		74
Pucca Pillar		75
Municipality Pillar		76
CS Iron Pillar		77
Other Point Feature		88
Plot Boundary	ML_XXX_XXX	14
Katcha Road		30
Semi-Pucca Road		29
Pucca Road		28
Halot		22
Pond		14
Canal		23
River		24

Section-B: Specifications for the Layers of Survey and Plan Maps

This section contains the specifications of all physical features, topographical features and proposed plan features. It specifies the name of the spatial layers and the structure of their attribute tables.

B.1.0 File Naming Convention for GIS Layers

A systematic naming convention is followed to name the layers of the physical, topographical plan features. The name is defined by abbreviated name of the layer with the geocode of the Division+District+upazila (UDD Upazila Master Plan 14 Upazila's) in the following tables:

Sl. No.	Division Name	Division Code	District Name	District Code	Upazila Name	Upazila Code
1	Dhaka	30	Dhaka	26	Nawabganj	62
2	Dhaka		Dhaka	26	Dohar	18
3	Chittagong	20	Chittagong	15	Rangunia	70
4	Chittagong	20	Cox bazar	22	Ramu	66
5	Rajshahi	50	Rajshahi	81	Bagmara	12
6	Dhaka	30	Faridpur	29	Faridpur Sadar	47
7	Dhaka		Mymensingh	61	Ishwarganj	31
8	Dhaka		Madaripur	54	Shibchar	87
9	Dhaka		Narsingdi	68	Shibpur	76
10	Dhaka		Narsingdi	68	Raipura	64
11	Rajshahi	50	Bogra	10	Sariakandi	81
12	Rajshahi		Bogra	10	Sonatala	95
13	Rangpur	55	Gaibanda	32	Saghata	88
14	Khulna	40	Meherpur	57	Gangni	47

File Name: **Layer Name+Division+District+Upazila Geocode will be added with Layer Name such as ADBL306864.**
Where,
- **Layer Name** is the abbreviated name of the layer. No space or special character is allowed.
- **Division Geocode** is the 2-digit BBS Geocode of the Division; eg. Geocode of Dhaka is 30.
- **District Geocode** is the 2-digit BBS Geocode of the Dhaka; eg. Geocode of Narsingdi is 68.
- **Upazila Geocode** is the 2-digit BBS Geocode of the upazila; eg. Geocode of Raipura Upazila is 64.

Example:	
Layer Description	**Layer name**
Administrative Boundary as line features	ADBL306864
Plots of Merged Mauza maps as polygon features	MMP306864
Plots of Merged Mauza maps as polyline features	MML306864
Plot Numbers of Merged Mauza maps as polyline features	MMN306864
Structures within the project area	STR306864
Existing Roads of the project area as polygon features	RDP306864
Existing Roads of the project area as polyline features	RDL306864
Centerlines of Existing Roads as polyline features	RDCL306864
Footpaths in the project area as polygon features	RDFP306864
Road Islands in the project area as polygon features	RDIL306864
Waterbodies in the project area as polygon features	WBD306864
Embankments in the project area as polygon features	EMB306864
DTM points (Spot Heights) on the project area as point features	DTM306864
BM pillars established in the project area as point features	BM306864
Contour lines of the project area as polyline features	CON306864
Existing Land use of the project area as polygon features	ELU306864
Rural Homestead areas of the project area as polygon features	HOM306864
Bridge, Culvert, etc. of the project area as polygon features	BRG306864
Bridge, Culvert, etc. of the project area as polyline features	BRGL306864
Bridge, Culvert, etc. of the project area as point features	BRGP306864
Existing Drains of the project area as polyline features	DRN306864
Boundary of the project area as polyline features	BW306864
Water Supply pipe lines of the project area as polyline features	WSL306864
Overhead Tanks in the project area as point features	OHT306864
High voltage Electric Supply Lines in the project area as polyline features	ESL306864
Utilities in the project area as point features	UTL306864
Sewerage network lines in the project area as polyline features	SEW306864
Other Polygon features of the project area as polygon features	OP306864
All other Point features of the project area as point features	AP306864
Important names of locations or structures of the project area as point features	NAM306864
Important Road Names in the project area as Annotation/Polyline features	RN306864
Centerlines of Proposed Roads in the project area as polyline features	PRL306864
Union/Ward derived by dissolving merged mauza for Population mapping	POP306864
Proposed policy (Structure Plan) of the project area as polygon features	STP306864

B.1.1 Attribute Structure of the Layers

Attribute structure of the above layers must be as follows:

1) Layer name: **ADBL306864**
Feature Type: **Polyline**

This Layer contains administrative boundaries of project area. It contains the fields as described in the following table:

Field Name	Field Type	Field Width	Purpose of the field
Line_Code	Long Integer	**10**	To Contain Polyline ID
Type	String	100	To contain the following administrative boundaries "International Boundary" "Division Boundary" "District Boundary" "Upazila Boundary" "Paurashava Boundary" "Union Boundary" "Ward Boundary" "Mauza Boundary" "Sheet Boundary" "Plot Boundary" "Katcha Road" "Semi-Pucca Road" "Pucca Road" "Halot" "Pond" "Canal" "River"

2) Layer name: **MMP306864**
Feature Type: **Polygon**

This Layer contains plots of edge-matched and merged Mauza maps of project area as polygon features. It contains the fields as described in the following table:

Field Name	**Field Type**	**Field Width**	**Purpose of the field**
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Paurashava	String	25	To contain name of the Paurashava.
Union_Ward	String	25	To contain name of the current Union or Ward No.
Mauza	String	100	To contain name of the Mauza name
JL_No	String	6	To contain JL Number of the Mauza
Sheet_No	String	6	To contain sheet no the Mauza
Mauza_JL_S	String	100	To contain Mauza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Plot_No	Long Integer	10	To contain *dag* number (plot number)
Plot_Type	String	20	To contain following plot types - "Plot" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Pond" - "Canal" - "River"
Scale	String	20	To contain scale of the Mauza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mauza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mauza map.
SV_Period	String	20	To contain survey period of the Mauza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mauza as District code+Thana code+Union/Ward code+Mauza code.
UW_Geocode	String	6	To contain 6-digit BBS Geocode of Union or Ward as District code+Thana code+Union/Ward code
Land_use	string	50	To contain existing land use as - "Administrative" - "Agriculture" - "Commercial" - "Circulation Network" - "Institutional" - "Flood Flow Zone"

Field Name	Field Type	Field Width	Purpose of the field
			- "Industrial" - "Mixed Use" - "Recreational" - "Restricted / Special Use" - "Socio-Cultural" - "Transport & Communication" - "Urban Residential" - "Urban Services" - "Vacant Land" - "Water Body"
Single_Crop	string	50	To contain the single crop land
Double_Crop	string	50	To contain the double crop land
Triple_Crop	string	50	To contain triple crop land
Remarks	String	100	To contain remarks, if any.

3) Layer name: **MML306864**
Feature Type: **Polyline**

This Layer contains line features of edge-matched and merged Mauza maps of project area as polyline features. It contains the fields as described in the following table:

Field **Name**	Field **Type**	**Filed Width**	**Purpose** of the field
ID	Long Integer	16	To Contain Mauza polyline ID.
Type	String	20	"Plot Boundary" "Sheet Boundary" "Mauza Boundary" "Katcha Road" "Semi-Pucca Road" "Pucca Road" "Halot" "Pond" "Canal" "River"
Remarks	String	100	To contain remarks, if any.

4) Layer name: **MMN306864**
Feature Type: **Point**

This layer contains Plot numbers of edge-matched and merged Mauza maps of project area as point features. It contains the fields as described in the following table:

Field **Name**	Field **Type**	**Filed Width**	**Purpose** of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Paurashava	String	25	To contain name of the Paurashava.
Union_Ward	String	25	To contain name of the current Union or Ward No.
Mauza	String	100	To contain name of the Mauza name
JL_No	String	6	To contain JL Number of the Mauza
Sheet_No	String	6	To contain sheet no the Mauza
Mauza_JL_S	String	100	To contain Mauza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Plot_No	Long Integer	10	To contain *dag* number (plot number)
Plot_Type	String	20	To contain following plot types - "Plot" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Pond" - "Canal" - "River"
Scale	String	20	To contain scale of the Mauza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mauza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mauza map.
SV_Period	String	20	To contain survey period of the Mauza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mauza as District code+Thana code+Union/Ward code+Mauza code.
UW_Geocode	String	6	To contain 6-digit BBS Geocode of Union or Ward as District code+Thana code+Union/Ward code
Remarks	String	100	To contain remarks, if any.

5) Layer name: **STR306864**
Feature Type: **Polygon**

This Layer contains the information of each structure within the project area. It contains thirteen fields as described in the following table:

Field **Name**	Field **Type**	**Filed Width**	**Purpose** of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila
Pourashava			To contain name of Paurashava.
Union_Ward	String	25	To contain name of the current Union\Ward.
ID	Long Integer	16	To Contain Structure ID.
Plot_No	Long Integer	10	To Contain the plot No.
Area_Sqft	Double	0	To Contain Structure area in square feet.
Str_Type	String	20	To contain the type of the structure as follows - "Pucca" - "Semi-pucca" - "Katcha"
Storied	Short Integer	-	To contain the number of floors of the structure.
Str_Use1t	String	100	1. To contain the use (1st) of the structure. 2. The attributes should be according to the given "Existing_Landuse" categories.
Str_Use2t	String	100	To contain the use (2nd) of the structure.
Str_Use3t	String	100	To contain the use (3rd) of the structure.
Str_name	String	100	To contain the name of the structure.
Cons_Year	Short Integer	-	To contain the year of construction.
Undercons	String	3	To contain the information if it was being under construction during the feature survey. - Yes/No ; True/False ; 1/0
Struc_Owner	String	100	To contain the owner name of the structure.
Owner_Cell	String	100	To contain the owner Cell No. of the structure.
Struc_Use	String	100	To contain the structure use of the Government or private and so on.
Hyperlink	String	100	To contain the picture of the structure.
Holding_no	String	50	To contain Holding number of the structure.
Road_ID	String	50	To contain adjacent road number, It must be follow of the Road Categories.
Road_name	String	100	To contain the name of the nearby road
Locality	String	50	To contain the name of the location.

6) Layer name: **RDP306864**
Feature Type: **Polygon**

This Layer contains the existing roads of the project area as polygon features. It contains three fields as described in the following table:

Field **Name**	Field **Type**	**Filed Width**	**Purpose** of the field
Road_name	string	100	To contain the name of the road, if any
Road_ID	string	20	To contain the ID of Road
Road_type	string	20	To contain the physical type of the road as follows - "Pucca" - "HBB" - "Katcha"
Road_Class	string	100	To contain the Class of road according to RHD & LGED in the followings: RHD Road Class - "National Highways " - "Regional Highways" - "District\Zila Road" LGED Road Class - "Upazila Road(Pucca" - "Upazila Road(Katcha)" - "Union Road(Pucca)" - "Union Road(Katcha)" - "Village Road A (Pucca)" - "Village Road A (Katcha)" - "Village Road B (Pucca)" - "Village Road B (Katcha)"

7) Layer name: **RDL306864**
Feature Type: **Polyline**

This Layer contains the existing roads of the project area as polyline features. It contains three fields as described in the following table:

<table>
<tr><th>Field Name</th><th>Field Type</th><th>Field Width</th><th colspan="5">Purpose of the field</th></tr>
<tr><td>Road_name</td><td>string</td><td>100</td><td colspan="5">To contain the name of the road, if any</td></tr>
<tr><td>Road_ID</td><td>string</td><td>20</td><td colspan="5">To contain the ID of Road</td></tr>
<tr><td>Road_Type</td><td>string</td><td>20</td><td colspan="5">To contain the physical type of the road as follows
- “Pucca”
- “WBM”
- “HBB”
- “Katcha”</td></tr>
<tr><td>Road_Class</td><td>string</td><td>100</td><td colspan="5">To contain the Class of road according to RHD & LGED in the followings:
RHD Road Class
- “National Highways ”
- “Regional Highways”
- “District\Zila Road”
LGED Road Class
- “Upazila Road(Pucca”
- “Upazila Road(Katcha)”
- “Union Road(Pucca)”
- “Union Road(Katcha)”
- “Village Road A (Pucca)”
- “Village Road A (Katcha)”
- “Village Road B (Pucca)”
- “Village Road B (Katcha)”</td></tr>
<tr><td rowspan="5">Remarks</td><td colspan="3" rowspan="5">To prepare the inventory of road, Electricity, Telephone, drainage, Sewerage, pipe line and etc. The inventory will help for the present status of features. Please follow the example right side of the Data Table.</td><td colspan="2">Change in Meters</td><td rowspan="2">Road Condition</td><td rowspan="2">Type</td><td rowspan="2">Additional +Field</td></tr>
<tr><td>From</td><td>To</td></tr>
<tr><td>0</td><td>500</td><td>Pucca</td><td>Pucca</td><td>To add more field as per Required.</td></tr>
<tr><td>500</td><td>504</td><td>Culvert</td><td>Culvert</td><td>To add more field as per Required.</td></tr>
<tr><td>504</td><td>1000</td><td>Katcha</td><td>Katcha</td><td>To add more field as per Required.</td></tr>
<tr><td>1000</td><td>1012</td><td>Bridge</td><td>Bridge</td><td>To add more field as per Required.</td></tr>
</table>

8) Layer name: **RDCL306864**
Feature Type: **Polyline**

This shape file contains the centerlines of the existing roads of the project area as polyline features. It contains the following fields compatible to network analysis:

Field Name	Field Type	Filed Width	Purpose of the field
Road_name	string	100	To contain the name of the road, if any
Road_no	string	20	To contain road number, if any
Road_ID	string	20	To contain the ID of Road
Road_type	string	20	To contain the physical type of the road as follows - "Pucca" - "WBM" - "HBB" - "Katcha"
Road_Class	string	100	To contain the Class of road according to RHD & LGED in the followings: RHD Road Class - "National Highways " - "Regional Highways" - "District\Zila Road" LGED Road Class - "Upazila Road(Pucca" - "Upazila Road(Katcha)" - "Union Road(Pucca)" - "Union Road(Katcha)" - "Village Road A (Pucca)" - "Village Road A (Katcha)" - "Village Road B (Pucca)" - "Village Road B (Katcha)"
Road_width	numeric		To contain average width of the road segment in meter
Road_length	numeric		To contain calculated length of the road segment in meter
Num_Lanes	numeric		To contain number of lanes on the road segment such as 1, 2, etc.
Road_own	string	100	To contain the name of the department or organization to which the road segment belongs.
METERS	Double	-	To contain length of the road in meters
FT_MINUTES	Float	-	To contain the time duration needed to travel the arc from the start node unto the end node, measured in minutes.
TF_MINUTES	Float	-	To conation the time duration needed to ravel the arc from the end node unto the start node of the arc, measured in minutes,
Oneway	string	2	To contain the value to represent the possible directions to travel an arc

Hierarchy	Long		To contain order or rank assigned to road network elements.

9) Layer name: **RDFP306864**
Feature Type: **Polygon**

This Layer contains footpath of project area. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Road_name	string	50	To contain road name
Road_ID	string	20	To contain the adjacent Road ID
Width	numeric		To contain width of Footpath
Status	string	50	To contain footpath conditions.

10) Layer name: **RDIL306864**
Feature Type: **Polygon**
This Layer contains road islands of the project area. It contains the fields as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Road_name	string	50	To contain road name
Road_No	string	20	To contain road number if any
Road_ID	string	20	To contain the adjacent Road ID
Width	Long integer	20	To contain width of Island
Type	string	50	To contain footpath conditions.

11) Layer name: **WBD306864**
Feature Type: **Polygon**
This shape file contains water bodies of project area. It contains the field as described in the following table:

Field Name	Field Type	Field Width	Purpose of the field
WBD_ID	Long integer	20	To contain Water body ID.
Type	string	50	To contain following type of water bodies - “River” - “Khal” - “Irrigation Canal” - “Swamp” - “Pond” - “Ditch” - “Borrow Pits”
Type	string	50	To contain the use of water body such as Private or Public use

12) Layer name: **EMB306864**
Feature Type: **Polyline**

This Layer contains embankment features of project area. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Emb _name	string	100	To contain the name of the road, if any
Emb_ID	string	20	To contain the ID of Road
Emb_Type	string	20	To contain the physical type of the Embankment to follow the road preparing method.
Emb_Class	string	100	To contain the Class of the Embankment -"Road cum Embankment" -"Embankment"
Emb_width	numeric		To contain average width of the road segment in meter
Emb _width	numeric		To contain average width of the embankment segment in meter
Emb _length	numeric		To contain calculated length of the road segment in meter
Num_Lanes	numeric		To contain number of lanes on the road segment such as 1, 2, etc.
Owner	string	100	To contain the name of the department or organization to which the embankment segment belongs.
Remarks			To follow the Road preparing Methods.

13) Layer name: **DTM306864**
Feature Type: **Point**

This shape file contains spot heights as 3D points at regular interval (10m x 10m OR 20m x 20m or as specified) in project area. It contains four fields as described in the following table:

Field Name	Field Type	Filed Width	No. of Decimal Places	Purpose of the field
ID	Sort Integer	**10**		To contain the ID
RL	Double	-	-	To contain Reduced Level (RL) of a point in meter as referenced with PWD
Easting	Double	-	-	To contain X-coordinate of the point
Northing	Double	-	-	To contain Y-coordinate of the point

14) Layer name: **BM306864**
Feature Type: **Point**

This shape file contains BM Pillars established in the project area. It contains four fields as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
RL	Double	-	To contain Reduced Level (RL) of a point in meter as referenced with PWD
Easting	Double	-	To contain X-coordinate of the point
Northing	Double	-	To contain Y-coordinate of the point
Organization	String	100	To contain name of the organization
Cons_Year		10	To contain the year of construction
Remarks	String	100	To contain remarks, if any.

15) Layer name: **CON306864**
Feature Type: **Polyline**

This shape file contains the contour lines of the area under project area. It contains three fields as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Contour	Double	-	To contain the value (RL) of the contours up to three decimal places.
Label	Double	-	To contain the value of contour up to one decimal place. This can be used to label the contours in map.
Type	String	7	To contain the value of this field as follows: - "Index" - "Intermediate" The purpose of this field is to symbolize and label the contours only. (The values must be calculated in such way that after successive 4 thin (Regular) contours there should be one thick (Index) contour in map. That is if 0.00 is a thick (Index) contour then 0.3, 0.6, 0.9, and 1.2 will be (Regular) contours and 1.5 will be thick contour.

16) Layer name: **ELU306864**
Feature Type: **Polygon**

This shape file contains existing land use of project area which will be prepared on the basis of physical feature and land use survey. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Land_use	string	50	To contain existing land use as - "Administrative" - "Agriculture" - "Commercial" - "Circulation Network" - "Institutional" - "Flood Flow Zone" - "Industrial" - "Mixed Use" - "Recreational" - "Restricted / Special Use" - "Socio-Cultural" - "Transport & Communication" - "Urban Residential" - "Urban Services" - "Vacant Land" - "Water Body"
Single_Crop	string	50	To contain the single crop land
Double_Crop	string	50	To contain the double crop land
Triple_Crop	string	50	To contain triple crop land
Remarks	string	100	To contain remarks, if any.

17) Layer name: **HOM306864**
Feature Type: **Polygon**

This shape contains rural homestead areas in project area as polyline features. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Location	String	20	To contain the name of Mauza (Mauza_JL_Sheet) or the locality in which homestead areas lies.
Type			To contain the type of homestead area (Accordingly structures) -Urban -Rural

18) Layer name: **BRG306864**
Feature Type: **Polygon**

This shape file contains Bridge/Culvert/Box culvert/Over bridge/Railway Bridge etc as polygon features in project area. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Length	Double	0	To contain the length of the bridge/culvert
Width	Double	0	To contain the width of the bridge/culvert
Abutment	Long integer	20	To contain the number of abutment
Span	Double	0	To contain the span of the bridge/culvert
Location	String	30	To contain the area name (Mauza_JL_Sheet or locality)
Remarks	String	254	To contain comments about the bridge such as conditions of abutment, deck, wing wall, etc. *** To follow the road map preparing methods.

19) Layer name: **BRGL306864**
Feature Type: **Polyline**

This shape file contains Bridge/Culvert/Box culvert/Over bridge/Railway Bridge etc as polyline features in project area. Each feature must be a multipart feature. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Length	Double	-	To contain the length of the bridge/culvert
Width	Double	-	To contain the width of the bridge/culvert
Abutment	Double	-	To contain the number of abutment
Span	Double	-	To contain the span of the bridge/culvert
Location	String	20	To contain the area name (locality)
Remarks	String	254	To contain comments about the bridge such as conditions of abutment, deck, wing wall, etc. *** To follow the road map preparing methods.

20) Layer name: **BRGP306864**
Feature Type: **Polygon**

This shape file contains Bridge/Culvert/Box culvert/Over bridge/Railway Bridge etc as point features in project area. It is expected that this shape file will be generated/produced from converting the Bridge_CL.shp file into centroids. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Length	Double	-	To contain the length of the bridge/culvert
Angle			To contain the Geographic angle of the bridge/culvert
Width	Double	-	To contain the width of the bridge/culvert
Abutment	numeric	20	To contain the number of abutment
Span	Double	-	To contain the span of the bridge/culvert
Location	String	20	To contain the area name (Mauza_JL_Sheet or locality)
Remarks	String	254	To contain comments about the bridge such as conditions of abutment, deck, wing wall, etc. *** To follow the road map preparing methods.

21) Layer name: **DRN306864**
Feature Type: **Polyline**

This shape file contains the information of existing drains in the project area. It contains three fields as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Type	string	20	To contain the (construction) type of the drain. The value of the field may be any of the following two - Surface (Katcha) - Surface (Uncovered) - Surface (Covered) - Pipe
Drain_width	Double	0	To contain the width of the drain
Drain_depth	Double	0	To contain the depth of the drain
Drain_radius	Double	0	To contain the radios of the drain
Road_ID	string	20	To contain the adjacent Road ID
Remarks	String	254	*** To follow the road map preparing methods.

22) Layer name: **BW306864**
Feature Type: **Polyline**

This shape file contains boundary walls as line features of project area. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Type	string	50	To contain line features such as Boundary wall.

23) Layer name: **WSL306864**
Feature Type: **Polyline**

This shape file contains water distribution pipe network as line features in project area. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Type	string	20	To contain type of pipe (Steel, PVC, etc)
Dia	Double	0	Diameter of pipe in mm
Remarks	String	254	*** To follow the road map preparing methods.

24) Layer name: **OHT306864**
Feature Type: **Point**

This shape file contains overhead water tanks as point features in project area. It contains the field as described in the following table:

Field **Name**	Field **Type**	**Filed Width**	**Purpose** of the field
Capacity	Double	-	To contain the capacity of the overhead tank.
Catchment	Double	-	To contain the catchment area in sq. meter
Owner	String	100	Contains the owner name

25) Layer name: **ESL306864**
Feature Type: **Polyline**

This shape file contains High Voltage Electric Lines as line features in project area. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
capacity	string	20	Contains the capacity of each line as 11KV, 33 KV etc.
Owner	string	20	Contains the name of Organization
Remarks	String	254	*** To follow the road map preparing methods.

26) Layer name: **UTL306864**
Feature Type: **Point**

This shape file contains locations of various utility features as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Type	string	20	To contain - "Electric Pole" - "Electric Tower" - "High Volt Electric Tower" - "Electric Box" - "Power Station" - "Power Sub-station" - "Transformer" - "Gas Transmission Center - "Light Post" - "Telephone Pole" - "Telephone Box" - "Fire Service Station" - "Traffic Signal Pole"
Owner			Contains the name of the owner
Remarks	String	100	*** To follow the road map preparing methods.

27) Layer name: **SEW306864**
Feature Type: **Polyline**

This shape file contains sewerage network as line features in [project area. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Size	string	20	To contain pipe diameter of sewerage line
Type	string	25	Contains type of waste water carried by the sewerage line such as storm sewerage or household sewerage line etc.
Location	string	20	Contains location of sewerage line
Owner			Contains the name of the owner
Remarks	String	100	

28) Layer name: **OP306864**
Feature Type: **Polygon**

This shape file contains various polygon features of project area. It contains the field as described in the following table:

Field **Name**	Field **Type**	**Filed Width**	**Purpose** of the field
Type	string	50	To contain boundary of following features - "Graveyard" - "Crematorium" - "Cemetery" - "Eidgah" - "Restricted Area" - "Airport" - "Brick Field" - "Rikshaw Garage" - "Automobile Garage" - "Slum" - "Monument" - "Open Space" - "Parks" - "Playground" - "Stadium" - "Golf Course" - "Botanical Garden" - "Zoological Park" - "Power Plant/Station" - "Bus Terminal" - "Truck Terminal" - "Water Treatment Plant" - "Sewerage Treatment Plant" - "Waste Disposal Plant" - "Railway Station"

			- "Bazaar Boundary" - "Forest Land" - "Sand Fill" - "Swimming Pool" - - *Other if necessary*
Owner			Contains the name of the owner

29) Layer name: **AP306864**
Feature Type: **Point**

This shape file contains point features of project area. It contains the field as described in the following table:

Field Name	**Field Type**	**Filed Width**	**Purpose of the field**
Type	string	50	- "Airport" - "Bazar" - "Government Bank" - "Private Bank" - "Brickfield" - "Bridge" - "Bus Terminal" - "Cemetery" - "Church" - "Cinema Hall" - "College" - "Crematorium" - "Deep tube well" - "Dustbin" - "Filling Station" - "Graveyard" "Growth Center" - "Hand tube well" - "Historic site" - " Government High School" " Registered High School" " Non-Registered High School" - "Hospital/Clinic" - "Madrasa" - "Registered Madrasa" - "Non-Registered Madrasa" - "Mazar/Dargah" - "Monument" - "Mosque" - "Museum" - "Oil Reservoir/Depot" - "Over Bridge" - "Pagoda" - "Police Box" - "Police Station" - "Post Office" - "River Port" - "Government Primary School" - "Registered Primary School" - "Non-Registered Primary School"

Field Name	Field Type	Filed Width	Purpose of the field
			- "Sluice gate" - "Temple" - "Theater Hall" - "Truck Terminal" - "Under Pass" - "University" - "Private University" - "Well" - "Culvert" - Other if necessary
Name	string	50	To contain name of the feature, if any
PF_ID	Long integer	6	To contain the point feature ID.
Point Type	string	50	To contain short name "GPS" of the feature, e.g. Government Primary School (GPS)
Owner			Contains the name of the owner
Remark	string		Contains Further Explanation

30) Layer name: **NAM306864**
Feature Type: **Point**

This shape file contains the names of important places and structures as point features in project area.

Field Name	Field Type	Filed Width	Purpose of the field
Name	String	100	To contain - Name of locality, market, bazaar, important structure, historic site, university, play ground, poultry farm, river, khal, lake, pond, etc.

31) Layer name: **RN306864**
Feature Type: **Annotation/Polyline**

This shape file contains the names of important places and structures as point features in project area.

Field Name	Field Type	Filed Width	Purpose of the field
Name	String	100	To contain the name of road segment.

32) Layer name: **PRL306864**
Feature Type: **Polyline**

This shape file contains center lines of proposed roads as line features in the project area.

Field Name	Field Type	Filed Width	Purpose of the field
Width_m	Double	-	To contain width of the proposed road in meter
Width_ft	Double	-	To contain width of the proposed road in foot
From_To	String	100	To contain the names (of road/place) from where the road starts and to where the road ends.
Prop_type	String	20	To contain any of the two - "New" - "Widening"
Type	String	20	To contain any of the following - "Underground" - "Ground" - "Flyover" - "Viaduct"
Remarks	String	254	*** To follow the road map preparing methods.

33) Layer name: **POP306864**
Feature Type: **Polygon**

This shape file contains polygon features of unions/wards derived from dissolved Mauzas of the project area. It contains the field as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Union_Ward	String	50	To contain name of the Mauza
Area_BBS	Double	-	To contain area from BBS records
Area_GIS	Double	-	To contain area calculated by GIS software
Pop_2001	Long Integer	-	To contain Population in the year 2001
Pop_2011	Long Integer	-	To contain Population in the year 2011
Pop_2021	Long Integer	-	To contain Population in the year 2021
Pop_2035	Long Integer	-	To contain Population in the year 2035
Pop_den_2011	Double	-	To contain population density
Division	String	25	To contain name of Division
District	String	25	To contain name of District
Upazila	String	25	To contain name of Upazil;a
Union_Ward	String	25	To contain name of Union/Ward
Geocode	String	11	To contain BBS geocode of the Union
Remarks	String	254	Remarks, if any.

34) Layer name: **STP306864**
Feature Type: **Polygon**

This shape file contains proposed policy on the merged Mauza map of the project area. It contains the fields as described in the following table:

Field Name	Field Type	Filed Width	Purpose of the field
Policy_Zone	String	50	To contain proposed policy on the plots.
Remarks	String	100	To contain remark, if any.

B.1.2 Point Feature Codes

The following feature codes (Unique ID) are assigned in appropriate fields of the layers. The following Point feature codes (Unique ID) are used as follows.

Point Feature Categories	Unique ID
- "Airport"	255
- "Bazar"	260
- "Government Bank"	265
- "Private Bank"	270
- "Brickfield"	275
- "Bridge"	280
- "Bus Terminal"	285
- "Bus Stand"	290
- "Cemetery"	295
- "Church"	300
- "Cinema Hall"	305
- "Government Medical College"	245
- "Private Medical College"	250
- "Government College"	145
- "Government Woman College"	150
- "Registered College"	155
- "Non-Registered College"	160
Government Poly Technical Institute	165
Private Poly Technical Institute	170
Vocational Institute	175
Jubo Unnayan Kendra	310
Government Teacher's Training College	235
Private Teacher's Training College	240
- "Crematorium"	315
- "Deep tube well"	320
- "Dustbin"	325
- "Filling Station"	330
- "Graveyard"	335
"Growth Center"	340
- "Hand tube well"	345
- "Arsenic Hand tube well"	350
- "Tara Pump"	355
- "Historic site"	360
- " Government High School"	125
- " Government Girl's High School"	130
" Registered High School"	135
" Non-Registered High School"	140
- "Hospital/Clinic"	365
- "Government Kamel Madrasa"	180
- "Registered Kamel Madrasa"	185
- "Government Fazel Madrasa"	190
- "Registered Fazel Madrasa"	195

Point Feature Categories	Unique ID
- " Government Alem Madrasa"	200
- " Registered Alem Madrasa"	205
- "Government Eftedayee Madrasa"	210
- "Registered Eftedayee Madrasa"	215
- "Non-Registered Madrasa"	220
- "Mazar/Dargah"	370
- "Monument"	375
- "Mosque"	380
- "Museum"	385
- "ASA NGO"	390
- "BRAC NGO"	395
- "Proshikha NGO"	400
- "TMSS NGO"	405
- "Other's NGO"	410
- "Insurance Company"	415
- "Life Insurance Company"	420
- "Oil Reservoir/Depot"	425
- "Over Bridge"	430
- "Pagoda"	435
- "Police Box"	440
- "Police Station"	445
- "Post Office"	450
- "River Port"	455
- "Government Primary School"	100
- "Registered Primary School"	105
- "Non-Registered Primary School"	110
- "K.G. School"	115
- "Kindergarten School"	120
- "Sluice gate"	460
- "Temple"	465
- "Theater Hall"	470
- "Truck Terminal"	475
- "Under Pass"	480
- "Government University"	225
- "Private University"	230
- "Well"	485
- "Culvert"	490
- *Other if necessary*	To put or add the Unique ID accordingly 5 interval

Annexure-III: Structure Attribute Collection Form

Upazila:	
Union:	
Ward No:	
Grid ID:	

Data Type:	Structure

Urban Development Directorate (UDD)
Ministry of Housing and Public Works
"Preparation of Development Plan for 14 Upazilas" Project (Package-4)
Physical Feature and Land Use Survey

Date:	
Name of the	

Name of	

ID	Type	Storied	Structure Use	Structure Name	Owner Name	Owner Cell No	Construction	Holding	Locality

Code of Structure Type: P= Pucca, SP= Semi Pucca, K= Katcha
Code of Structure Use: R= Residential

Government of the People's Republic of Bangladesh

Ministry of Housing and Public Works

Urban Development Directorate (UDD)

Preparation of Development Plan for Fourteen Upazilas

Package-04

(Saghata Upazila, District: Gaibandha; Sariakandi Upazila and Sonatala Upazila, District: Bogra)

FINAL SURVEY REPORT

LAND USE SURVEY

Of

Saghata Upazila, Gaibandha

June, 2017

Modern Engineers Planners & Consultants Ltd.

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CHAPTER ONE: INTRODUCTION

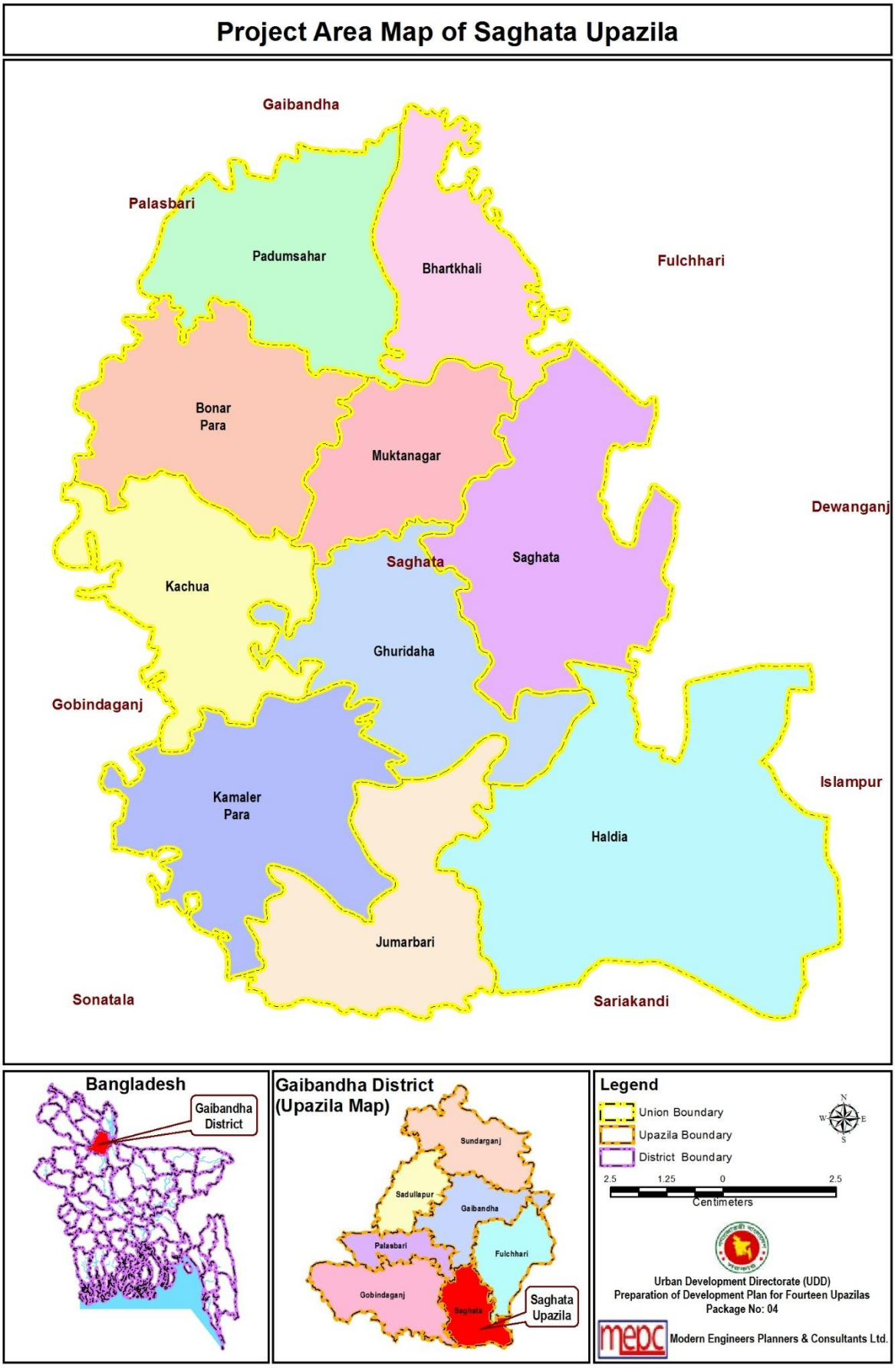
1. 0 Background

Planned development of Upazila is a coordinated way including rural and urban area as are very much important for sustainable development all over the area. Planned development is utmost important to accommodate all social, economic, administrative, infrastructure services and service facilities for the region. The government's intention is to reflect the national policy of bringing development administrative and service facilities to the door step of rural masses and to ensure better delivery of government services to the people. Realizing the fact and importance of formulating development plans for upazilas, Urban Development Directorate has come up with a good initiative to plan those areas. At the first phase of this initiative UDD has decided to prepare development plan for 14 Upazilas under five different packages. For each package separate consultancy team has been appointed to carry out the job more fruitfully. Modern Engineers Planners and Consultants Ltd. (MEPC) has been selected for package-4 (Saghata Upazila of Gaibandha District and Sariakandi Upazila & Sonatala Upazila of Bogra District) by project evaluation committee of UDD.

The proposed Development Plan also includes the suggestion for improvement of the management ability of the Upazilas/ Upazila authorities including revenue earning capability enhancing to building up the Upazilas/ authorities as a self-sustaining local government institutions. The Development Plan exercise will also suggest construction of roads and bridges/ culverts, drainage facilities, streetlights, markets, bus stands, solid waste management, sanitation, water supply and other such infrastructure facilities.

An understanding of the use of land of an area provides valuable information about the reasons of developing of a particular location; its demand, positive and negative side effects on surrounding etc. which are very crucial for suggesting development pattern and control on that land. This information will be incorporated into development plan preparation with aiming of optimizing landuse, assessing suitability, enhancing productivity and ultimately achieving sustainable practices. The assessment of existing landuse pattern of Saghata Upazila has been made through landuse survey to preparation of development plan to forecast the future demand for different landuses and to recommend actions for optimizing the landuse. This chapter includes the methodology followed to conduct survey for further process of preparation of development plan.

Map 1. 1: Project Area Map of Saghata Upazila



CHAPTER TWO: METHODOLOGY

2.0 Reconnaissance Survey

To complete the land use survey report a field visit was conducted in the Upazila areas by a team of Team Leader, Urban planner and urban economist to identify the urban growth factors and potentialities, orderly growth of urban areas, trends of urban growth and expansion of town through observation and consultation with the Upazila authorities and local people. During the visits maps and drawings were consulted in order to identify the national and regional setting, assess the topographical and physical features, acquaint with the changes of the areas, direction of present development and potentialities of future development etc. The purpose of the visit is to provide a context for the future potentialities of development of the upazila town.

2.1 Compilation and Preparation of Base Map

2.1.1 Project Area Based on Mauza Maps

The coverage of the Development Plan area includes existing urban areas and rural areas under the Upazila. The project area is found 227.94 square kilometer (2279390 acres) according to the mouza maps.

2.1.2 Satellite Image Processing

Photogrammetric method used satellite/aerial stereo images to create Digital Elevation Model (DEM) shown in Map 2.1 and make geospatial database more effectively.

Image was collected from Satellite image provider. The Satellite image in 0.5-meter panchromatic and 1.0-meter multi spectral four-band images in stereo pairs procured for town area. The 0.5-meter pan and 1.74-meter multi spectral imagery was also fused to yield 0.5-meter colour imagery (pan-sharpened) and 2.5-meter stereo image was also collected for country area.

Map 2. 1: Digital Elevation Model (DEM) of Saghata Upazila

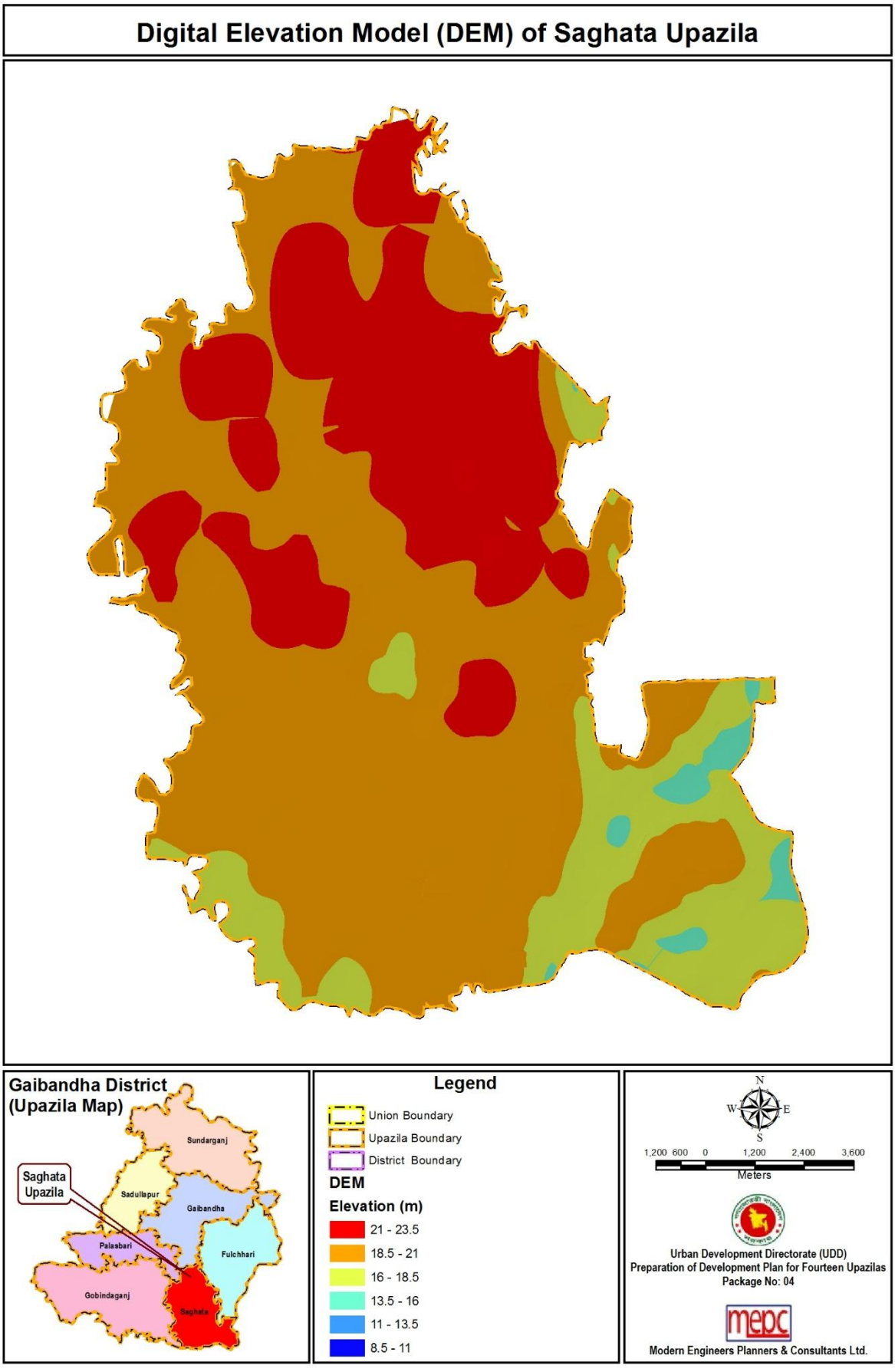


Image Processing

Image processing is done on collecting raw digital images. The tasks involved in image processing are:

- Epi-polar Correction
- Color Balance
- Contrast Adjustment
- Sharpening
- Pyramid
- Bit Rate Setting

GCP Collection

Ground control point has been selected by photo identification of existing ground features. Considerable number of GCP was collected as required for the whole study area. All GCPs has been collected by conducting field survey using RTK GPS method. After collecting GPS data of the GCP, post processing was done day to day in the sites. Accuracy level was maintained within 10 cm.

Aerial Triangulation

Aerial Triangulation is a mathematical process used to determine the real world position, height from mean sea level and orientation of each photograph. Aerial Triangulation was provided the accurate stereo (3D) model of image. One of the most advanced aerial triangulation is Inpho Match-AT.

Input for AT	Output of AT
- IMU, RPC data - GPS (on board) - GCP (collected from field) - Image	Geo-referenced Stereo Model

Digital Mapping from Stereo Model

On orientation of stereo models is used digital mapping was carried out. ArcGIS Geo-database/ shapefile model for storing geo-spatial data. The proposed Geo-database and its Feature classes have been designed based on the followings:

- Projection Parameters of the Coordinate System
- Name and type of layer (feature classes)
- Structure of Attribute Tables of the Feature classes

- Digital Photogrammetric Workstation e.g. Datem Summit Evolution (DPW) was used as the platform for acquiring features from digital stereo images (model).
- Feature registration was done considering and measuring the position of the object under its accuracy level. The Summit Evolution & Stereo Plotter of DAT/EM was used for identifying and registration of the objects and ArcGIS 9.2 or higher version of ESRI was used for vector data storing and editing.

Attribute Data Collection

- Attribute data of the features was collected from the field after producing base map. It was a step by step process.
- Attribute of different floors in each building would be collected by the consulting firm.
- The attribute data shall be collected in HAZUZ compatible format.

Map Updating

Attribute data collected from the field, was incorporated into the features in this stage.

Field Check

Field checking was done check the following:

- Dimension and shape of the features
- Accuracy of feature's attributes
- Missing objects.
- Data was collected by total station where cloud was found in the image or some object which is not able to identify in image.

DTM/DEM/TIN/Contour Generation

- **DTM Point:** Digital photogrammetry is able to acquire 3D points for high spatial resolution DEM generation through semi-automatic procedures, overcoming the problems of process. In the approach, DTM Points was generated from Stereo Pair images by the software, and editing of the software generated DTM points was done by the Photogrammetrist comparing them with stereo model. Creating and editing of Breaklines was done after this stage.
- **Contour:** After creating DTM Points, Contour lines was produced l. The contour lines was delivered in 1 km x 1 km or 5 km x 5 km blocks or one single file for the project area.
- **DEM:** Using DTM Points DEM was generated at a resolution of 10 meters in 1 km x 1 km or 5 km x 5 km blocks or one single file for the project area.
- **TIN:** Using DTM Points TIN was generated and delivered in 1 km x 1 km or 5 km x 5 km blocks for the project area.

- **OrthoPhoto:** An orthophoto or orthophotograph is a photograph which terrain corrected ("orthorectified") such that the scale is uniform: the photo has the same lack of distortion as a map. Orthophotographs are commonly used in the creation of a Geographic Information System (GIS).

a. Ortho-rectification of Images

Ortho-rectification of every image was carried out using digital photogrammetric system based on result of aerial triangulation and the generated DEM.

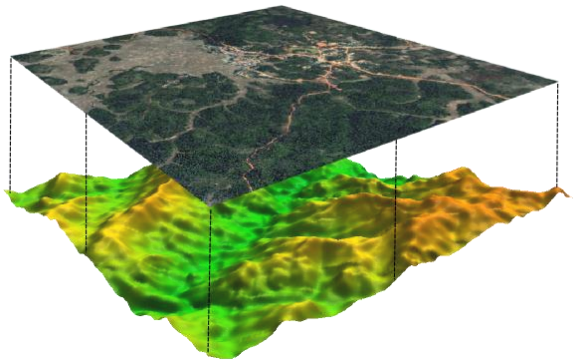


Figure 2. 1: Ortho-rectification of Images

Mosaicking of OrthoPhoto

Individual rectified photograph was assembled to form seamless mosaic.

Mosaicking of OrthoPhoto includes the following tasks

i. Seam line Drawing: Drawing the boundary of the image delineating which part of the image was gone which image.
ii. Balancing of Color and Contrast within different images Feathering

2.1.3 Physical Feature Extraction from Satellite Image

Spatial data are characterized by information about the position, connections with other features. These spatial data can be represented as either layers based or object oriented approach. In both approaches the data must be simplified with feature wise separate entities before incorporate in the GIS database. These entities are:

Point Features: Points were used to represent the locations of the features that are too small to be represented as areas. Different annotations as point features were used in Saghata Upazila Landuse map.

Line features: Line was used to represent geographical features with polyline category, such as road centerline, railway center line, etc.

Polygon features: Polygon or Area was used to represent geographical features with closed boundaries, such as building structures, water bodies, Landuse, topography etc. In Saghata Landuse map, Mouza boundary as polygon features was used.

All of these features contain a numeric user ID representing their feature type in GIS database structure. Every layer is thematic and that reflects either a particular use or a characteristic of the landscape. Spatial data structures are classified into raster or vector data.

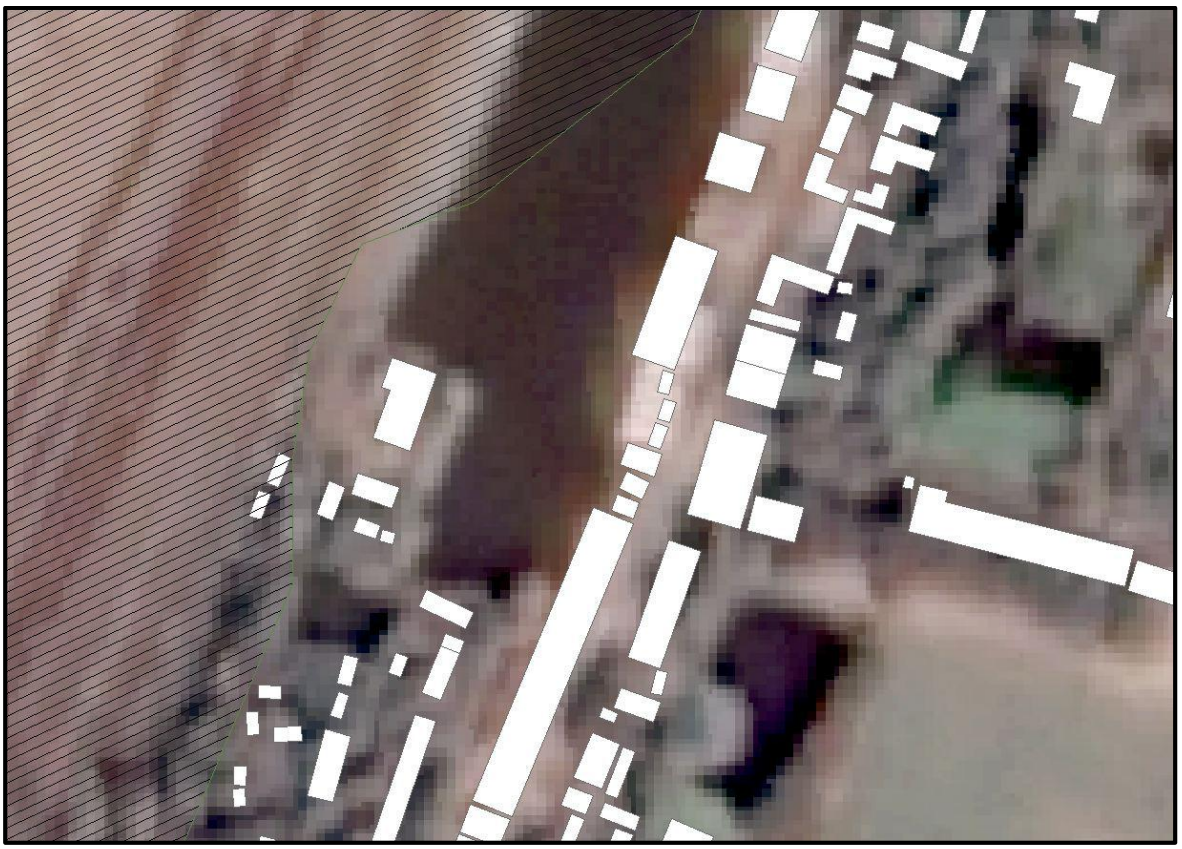


Figure 2. 2: Physical Feature Extraction from Satellite Image

2.1.4 Preparation of Land Use Survey Base Map

Landuse Maps incorporated various shape files such as road, structures, water bodies, utilities facilities etc. Landuse Maps has been prepared and printed on 1:990 scale and grid cells contained a single cell size of about 106650 Sq.m. The Landuse Map has prepared by overlying the physical features survey on RS Mouza map. The landuse map has been prepared according to the detailed categories and presented indicating the broad categories of landuse by extracting from the Mouza map. Different types of landuse maps is illustrated in before prepared according to the Landuse category and presented in the different sub-sections.

2.1.5 Preparation of Log Book for Land Use Attribute Collection

Log book is prepared for land use attribute collection. Attribute is the non-spatial data associated with spatial data i.e. point, line and polygon/area entities. Attributes give additional information about the character of the entities. Each spatial entity may have more than one attribute. For example, a polygon feature presenting a building structure may have a number of other attributes like, building type, the number of floors and purpose of use. A point feature representing the hotel may have a number of other attributes: the number of rooms; the standard accommodation; name and address of the owner. Attributes give additional information about the character of the entities. The all attribute data are managed using GIS software.

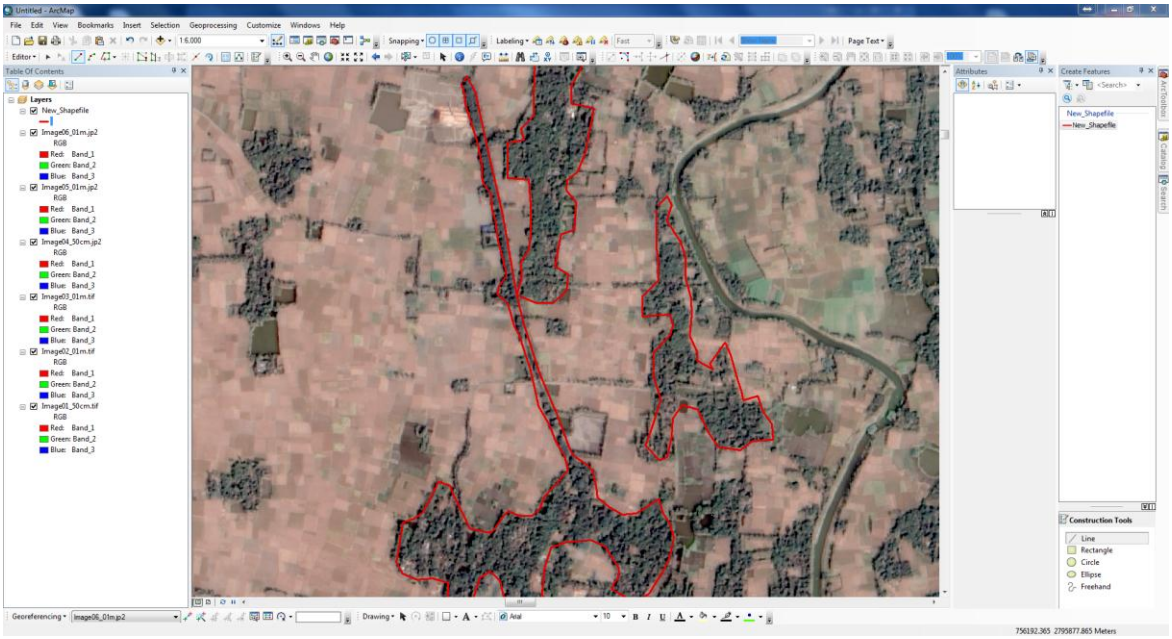


Plate 1: Satellite Image Digitization by Digital Photogrammetry

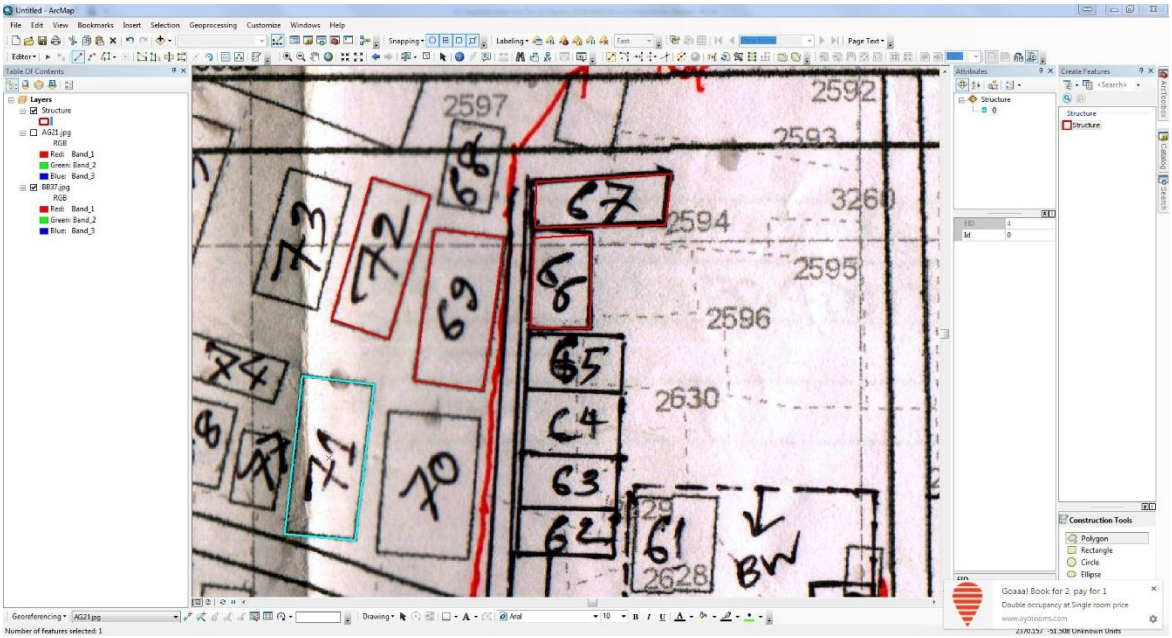


Plate 2: Updating works using Surveyed Map

CHAPTER THREE: FIELD LEVEL DATA ACQUISITION

3.0 Mobilization of Survey Team

A highly technical survey team comprising Urban Planner, GIS Expert, Survey Expert and Survey Assistants was mobilized to conduct the topographic and physical feature surveys. The Urban Planner led the survey team under the close supervision of the Team Leader of the project to ensure the quality of the survey. A list of Survey team is presented in Table 3.1.

Table 3. 1: Composition of Survey Team

Sl.	Designation	Nos.	Qualification	Year of Experience	Responsibilities
1.	Urban Planner and Survey coordinator	01	Masters of Urban and Regional Planning	10	Coordination of overall survey work
2.	Survey Expert	01	B.Sc Engineering in Civil	07	To conduct, coordinate and monitor physical feature, topographical and land use, survey
3.	Photogrammetric Expert	01	M.Sc in Geography	06	To prepare topographic, physical feature, land use and other related map of the area
4.	GIS Specialist	01	Bachelor in Geography	06	To prepare, supervise, manage and monitor digital database (Spatial and attribute) of the project
5.	RTK-GPS Surveyor	04	Diploma in Civil Engineering	05	Establishing primary and secondary BM/control points
6.	Total Station Surveyor	12	Diploma in Civil Engineering	05	Topographic and physical feature survey

3.1 Land Use Survey

The landuse map was prepared indicating the broad categories of land use indicated as shown in the Table 3.2:

Table 3. 2: Broad category of Landuse for Landuse survey

Sl.	Land uses	Illustrated
1.	Residential	Planned Residential Area, Govt. Quarters, Private Housing, Rest/Guest/Circuit House, Banglow, Mess, Orphanage/Old Home, Rural Homestead, Slum, Squatters.
2.	Commercial	Residential Hotel/ Hotel & Restaurant, Wholesale Rice Market, Wholesale Vegetables Market, Wholesale Fish Market, Wholesale Paper Market, Wholesale Grocery Goods Market, Wholesale Fruit Market, Book Stall, Cloths Shop, Paper & Magazine, Stationery Shop, Shoe Shop, Bag & Leather Goods, Cosmetics, Spectacles, Electronic Goods, Audio Video Cassette, Utensils/Crockery, Sports Goods, Computer Goods, Motor Car Parts, Jewelry shops, Show Room, Furniture Shop, Department Store, Mobile Sales Center, Hardware Goods, Sweet Shop, Bakery Shop, Gift Shop, Press & Printing, Grocery Shop, Gun Shop, Iron & Steel Shops, Shopping Center/Mall, Shopping Mall, Super Market, Rubber Stamps, Phone-Fax-Photocopy, Cycle Store, Studio/Colour Lab, Drug/Pharmacy, Pottery shop, Electronics, Sports and Athletics, Kitchen Market, Katcha Bazar, Beauty Parlor/Hair dresser, Govt. Food Godown, Cold Storage, Others Godown.
3.	Mixed Use	Commercial – Residential, Office – Residential, Commercial – Industrial, Two or More categories.
4.	Transport Facilities	RHD Road/LGED Road, Primary Road/ Major Through fare, Secondary Road (Pucca), Secondary Road (Katcha), Local Road (Pucca), Local Road (Katcha), Access Road (Pucca), Access Road (Katcha), Footpath (Paved), Footpath (Unpaved), Walkway, Embankment cum Road, Airport / Bus terminal / Truck terminal / BRTC bus Depot / Tempo stand / Rickshaw stand / Railway station / BIWTA Terminal/ Launch Terminal etc, Broad gauge, Meter gauge, River, Ferry Ghat, Filling Station, Garage, Passenger shed, telephone exchange, ticket counter, transport office etc.
5.	Administrative	Deputy Commissioner's Office, Zila Parishad Office, SP Office/Police Headquarter, Civil Surgeon Office, LGED Office, Upazila Headquarter, Paurashava Office, Union Parishad Office, Settlement Office, Post office, Bank, Public Works Department Office, R&H Office, DPHE Office, Police Station, Ansar Camp, Jailkhana, Statistical Bureau Office, PDB Office, BWDB Office, DoE Office, All types of Government Office, Private Bank/ Insurance Company, Mercantile & Cooperatives, Money Exchange Center, Private company/Different types of NGO/CBO/Club, Construction Office, Commercial Group Office, Trading Corporation Office, Security Service Office, Law

Sl.	Land uses	Illustrated
		Chamber, Doctor's Chamber, Political Party Office, Professional's Association, Labor Union.
6.	General Industry	Green and Orange A categories as per The Environment Conservation Rules, 1997.
7.	Heavy Industry	Other toxic and pollutions Industries (Orange B and Red categories as per The Environment Conservation Rules, 1997)
8.	Agricultural	Single crop land, Double crop land, Triple crop land, Barren land, Mango garden/Litchi/Jackfruit/Banana/Lemon/others, fruits garden etc., Different types of flower garden, Tree cultivation, Hatchery/Gher, Livestock / Poultry Farm / Diary Farm, Agricultural Research Area.
9.	Educational and Research	Kindergarten and Nursery, Primary School, High School, College, Public University, Private University, Public Medical College, Private Medical College, Homeopathic Medical College, Engineering College/University, Law College, Social Research, Health Research, Economic Research, Vocational Training Institute, Physical Training Institute, Nursing Training Institute, Teachers Training College, Computer Training Institute, Dakhil Madrasa, Alim Madrasa, Fazil Madrasa, Kamil Madrasa, Hafezia Madrasa, Tutorial/Coaching Center, Government Training Institute, Library, Museum, Social Welfare Institution
10.	Health Facilities	Govt. Hospital / Pvt Hospital / Mental Hospital/ Maternity/ Children Hospital / Clinic/ Diagnostic Center, Veterinary Hospital.
11.	Recreational Facilities	Cinema Hall, Theater Hall, Museum & Art gallery, Auditorium /Community Center/Town Hall, Park/Playground/Amusement Park/Theme Park, Stadium/ Gymnasium/Swimming Pool, Tennis Complex.
12.	Religious Area	Mosque, Eidgah / Mazar/ Dargha, Temple, Church, Pagoda, Graveyard, Cemetery, Cremation place.
13.	Utility Facilities	Utility services include Overhead Tank, Power Office/Control Room, Public Toilet, Sewerage Office, Waste Disposal, Fire Service, Water Pump House, Water Reservoir, Water Treatment Plant, etc.,
14.	Community Facilities	Community Center, Social Club, Slaughter House, Monument, Shahid Minar etc. which will provide service to the community.
15.	Restricted Facilities	Cantonment/BDR/Navy, TV Station, Radio Station, T&T Board, Power Supply Station.
16.	Open space	Historic Sites, National Park/Botanical Garden, Zoological Park, Forest. Land/Urban Green, Ecological park/sites, River Bank
17.	Water bodies	Pond, Beels, Lakes, River, Khals, Streams, Drain.

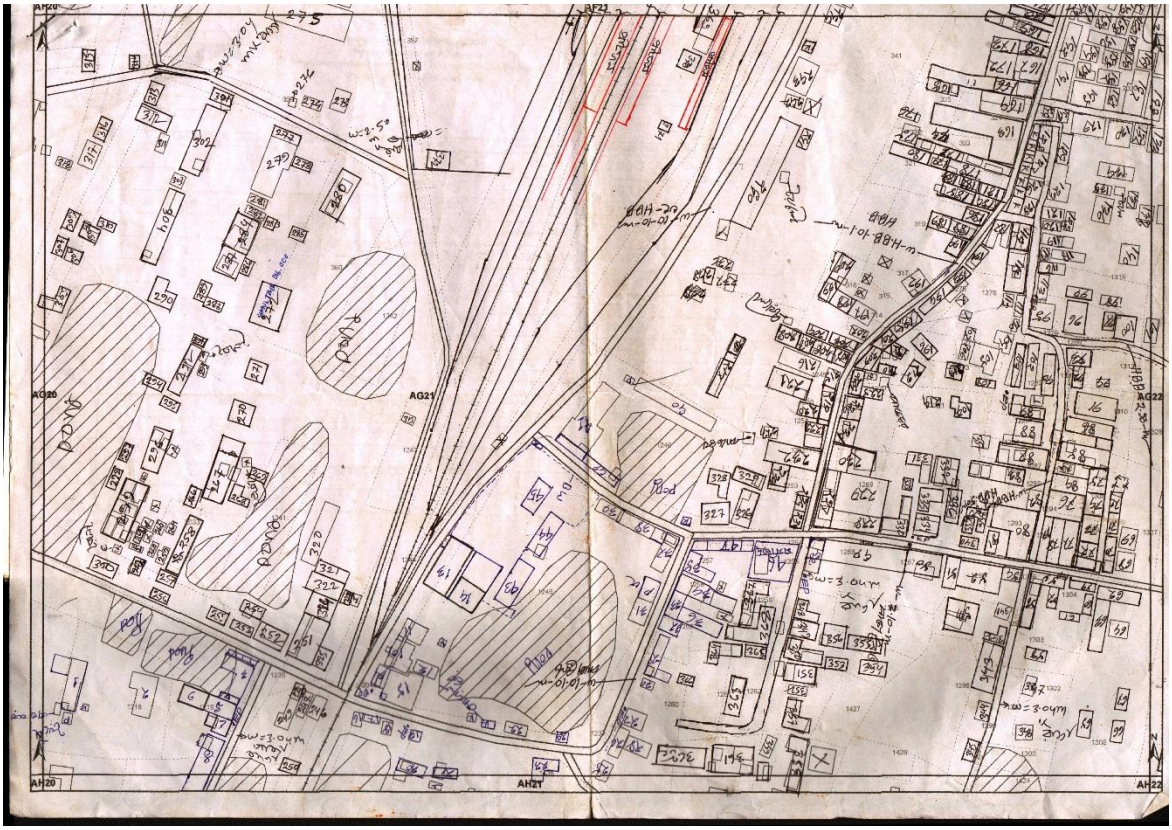


Figure 3. 1: Color used by Color Pencils for Land Use Demarcation

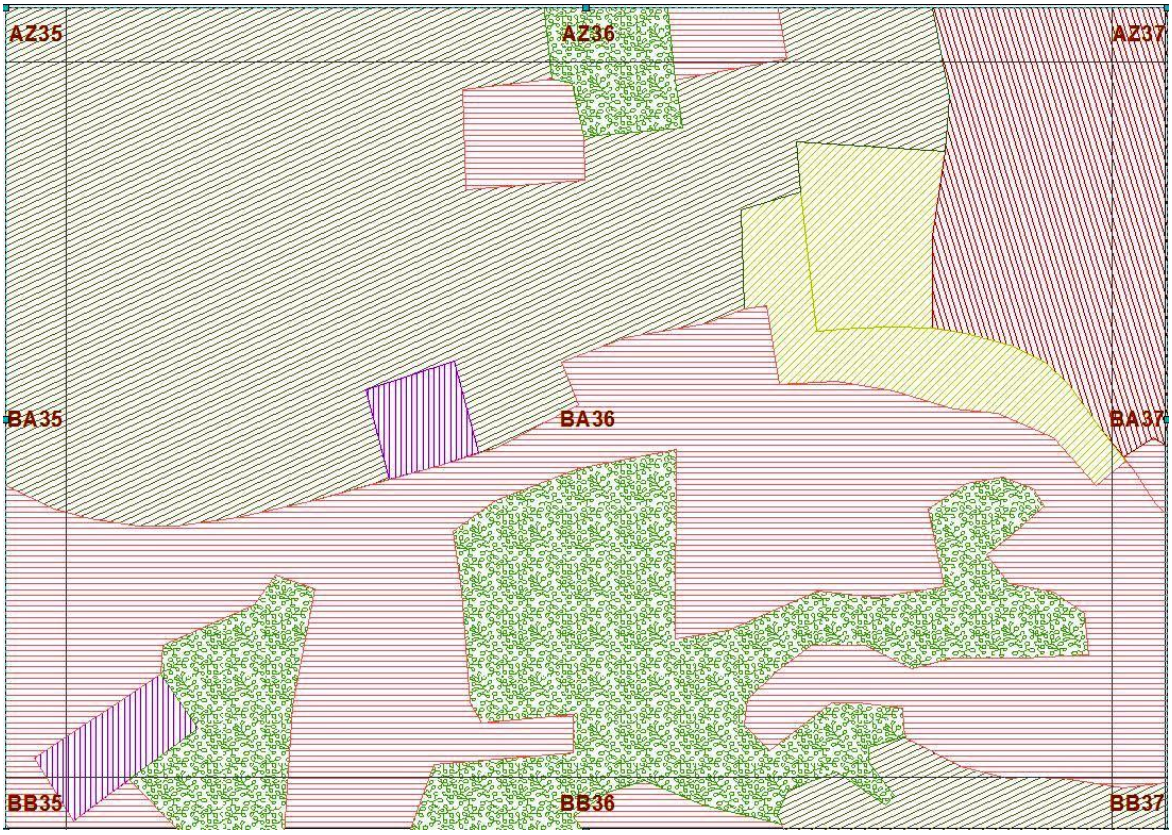


Figure 3. 2: Land-use Base Map used in Saghata Upazila

CHAPTER FOUR: SURVEY DATA PROCESSING & ANALYSIS

4.1 Processing of Land Use Data

Landuses were divided into different categories (with characteristics) at the beginning of the project, Although the Landuse classification was difficult to maintain in Saghata as not all uses are found in the classification scheme, however, it provided a structure for the project. The classification as per ToR has given in the next section.

Spatial information or data of all existing land uses from land use survey was processed and stored under a comprehensive GIS database component. GIS software such as PC ArcGIS has used for processing of physical survey data. Data was stored in WGS-1984 format (latitude, longitude, ellipsoidal height in meter) and later it was projected and stored in BUTM projection system.

The Maps was projected in BUTM coordinates or with the consultation with experts. Projection parameters was as follows

Name of Coordinate System	: BUTM 2010
Projection	: Transverse Mercator
Reference Ellipsoid	: WGS 1984
Datum	: WGS 1984
Latitude of Origin	: 0^{O} N
Central Meridian	: 90^{O} East
False Easting	: 5, 00,000m
False Northing	: 0m
Scale Factor at Central Meridian	: 0.9996

Table 4. 1: Land Use Categories of Urban Area of Saghata

Sl. No.	Land use Type	Total Area (Sq.KM)	Percentage (%)
1	Agriculture	3.204	70.88
2	Commercial	0.038	0.83
3	Education and Research	0.019	0.42
4	Government Services	0.015	0.33
5	Group of Trees / Forest	0.252	5.57
6	Health Services	0.023	0.52
7	Manufacturing and Processing Activities	0.003	0.06
8	Residential	0.938	20.74
9	Vacant Land	0.029	0.64
	Grand Total	**4.521**	**100.00**

Residential

Residential land use covers about 20.74% of total land in this area. From the table it is seen that in this Upazila there is not considerable amount of land devoted to this category and which is about 0.938 sq. km.

Agriculture

From the field survey it is evident/ reflect that about 3.204 acres (70.88%) of the total area is under the use of agriculture.

Commercial

This type of land use covers about 0.83% of total land in urban area of Saghata. From the table it is seen that in this Upazila there is considerable amount of land devoted to this category and which is about 0.038 sq. km.

Government Services

This type of land use covers about 0.33% of total land in urban area of Saghata. From the table it is seen that in this Upazila there is not considerable amount of land devoted to this category and which is about 0.015 sq. km.

Education and Research

This type of land use covers about 0.42% of total land in urban area of Saghata. From the table it is seen that in this Upazila there is not considerable amount of land devoted to this category and which is about 0.019 sq. km.

Health Services

Health Services related land covers about 0.52% of total land in this area. From the table it is seen that in this Upazila there is not considerable amount of land devoted to this category and which is about 0.023 sq. km.

Manufacturing and Processing Activities

Manufacturing and Processing Activities land covers about 0.06% of total land in this area. From the table it is seen that in this Upazila there is not considerable amount of land devoted to this category and which is about 0.003 sq. km.

Group of Trees / Forest

Group of Trees / Forest land covers about 5.57% of total land in this area. From the table it is seen that in this Upazila there is not considerable amount of land devoted to Group of Trees / Forest and which is about 0.252 sq. km.

4.2 Preparation of Land Use Map

To prepare Landuse Maps we incorporated various shape files such as road, structures, water bodies, utilities facilities etc. Landuse Maps have been prepared and printed on 1: 3960 scale. The Landuse Map is prepared by overlying the physical features survey on RS Mouza map. The landuse map is prepared according to the detailed categories and presented indicating the broad categories of landuse by extracting from the Mouza map. Different types of landuse maps were prepared according to the Landuse category.

Land use survey basically records the use of land by its functional activity such as residential, industrial or commercial etc. during the TS and RTK GPS based physical feature survey each survey feature was recorded with individual ID or code representing their use. At the same time, uses of lands without structures were coded on mouza plots. Later on land use features was identified and classified using the recorded code and separated in different layers during data processing stage, from where the category wise land use map has drawn using the identification layers of each land use features. The land use map has prepared indicating the board categories of land use described in ToR. The characteristics of each land use area has described in the survey report.

Map Printing at proper scale

After completing the survey and all the GIS processing, the Maps was printed by the consultant. Maps were printed at given direction with proper annotations, titles and legend. The color grading and symbols for the map layout would be in accordance with the standards of the Client.

Attribute Data Base of the Digitized Mouza Map

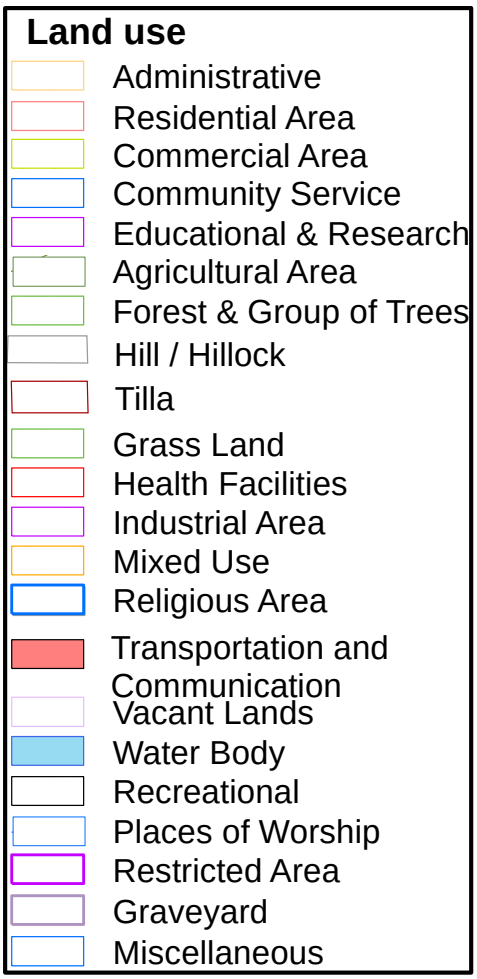
The consultant was submitted all attribute data of all the features in the mouza map including individual plot number, Sheet No, Mouza Name etc. that was generated from the spatial database.

Satellite Image Processing By Using Photogrammetric Method

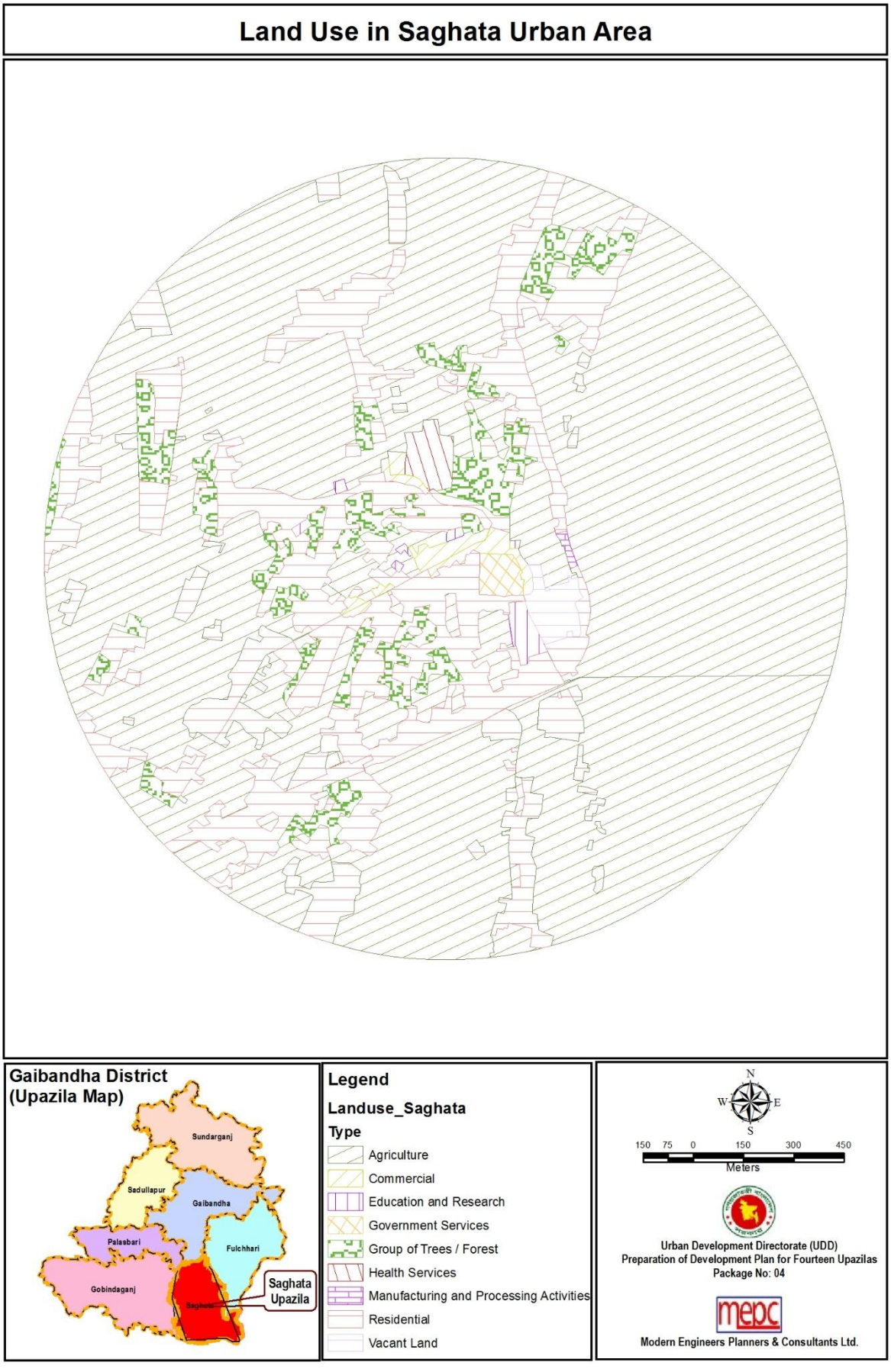
Photogrammetric method uses satellite/aerial stereo images to create Digital Elevation Model and make geospatial database more effectively. With the advent of latest trends in the technologies and unique customer requirements, photogrammetry is now the leading

technology for mapping. The field of photogrammetry is a rapid science with new technologies being developed constantly. Within a short period of time, the practice of photogrammetry has changed from analog to digital. The development of digital aerial cameras has advanced significantly over the past 4-5 years. The use of digital aerial images would be more advantageous for all map and image production especially for Digital vector data and Orthophoto generation.

Figure 4. 1: Legend of Existing Generalized Landuse



Map 4. 1: Land Use in Saghata Upazila Area



CHAPTER FIVE: WAY FORWARD

The preparation of any plan for the development of an urban area, city or town requires reliable factual data regarding existing lanuse conditions such as agriculture, circulation network, commercial, education and research, government services, group of trees / forest, health services, manufacturing and processing activities, religious, residential, transport and communication, vacant land, water body and recreational facilities. The process of collecting such data is called landuse survey.

From the land use survey it has found that Saghata has a domination of agricultural land use. Besides, this town has grown up beside the river. There are a lot of waterbody spread inside the town. This type of land use pattern gives a direction of future planning for this upazila. As this upazila is agriculture dominated and its major land use includes the water body so the future development plan will be agro based and fisheries industry development. Moreover, this land use survey gives a direction of water based transportation development.

The land use of the project area has divided into two categories. They are urban and rural. In urban areas, it is necessary to develop sustainable residential communities both on land zoned for residential development and in mixed use areas. Objectives will promote the use of appropriate residential densities dependent on location, the use of an appropriate variety and mix of good quality, well designed dwelling types and sizes, and the encouragement of infill and brownfield development to consolidate existing towns in preference to urban development. On the other hand the rural areas have a distinctive and valuable asset within the rural area with opportunities for the establishment of sustainable rural communities. Development Plan objectives enhance this particular community aspect and spirit by building upon unique and key strengths. It will ensure development of rural area in such a way as to provide a sustainable mix of commercial and community activity within an identified village core which includes provision for enterprise, residential, retail, commercial, industrial, production and community facilities.

Government of the People's Republic of Bangladesh

Ministry of Housing and Public Works

Urban Development Directorate (UDD)

Preparation of Development Plan for Fourteen Upazilas

Package-04

(Saghata Upazila, District: Gaibandha; Sariakandi Upazila and Sonatala Upazila, District: Bogra)

FINAL SURVEY REPORT

TOPOGRAPHIC SURVEY

Of

Saghata Upazila, Gaibandha

June, 2017

mepc Modern Engineers Planners & Consultants Ltd

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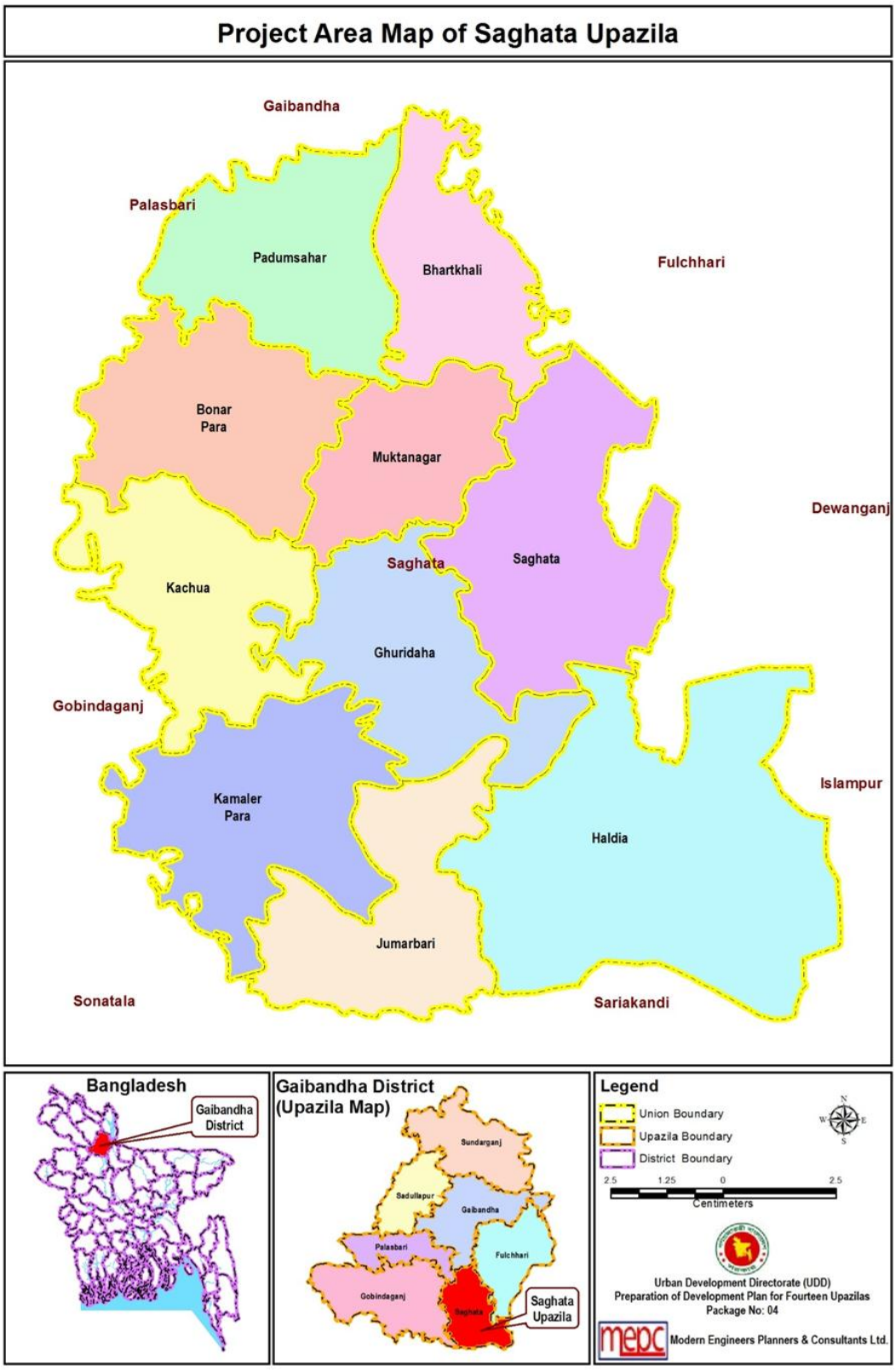
CHAPTER ONE: INTRODUCTION

1.1 Background

Topographic survey is a survey that measure the surface of the earth of any area with standard known coordinates of X, Y, Z value. Topographic survey is a very important survey as it shows terrain, the three dimensional quality of the surface, and the identification of specific landforms for future development. A detailed topographic survey was conducted in Saghata in the survey phase for the "Preparation of the Development Plan for Fourteen Upazilas" project. This report contains the survey procedures along with findings and analysis of the topography of the project area. The survey was conducted according to the ToR of the project. Topographic features have been extracted by DTM point extraction, Break-line extraction, Water bodies extraction, Generation of DEM/TIN. A map of the study area in shown below.

Map 1.1: Project Area Map of Saghata Upazila



Source: MEPC

CHAPTER TWO: METHODOLOGY

2.1 Reconnaissance Survey

A field visit was conducted in the upazila areas by a team of Team Leader, Urban planner and urban economist to identify the urban growth factors and potentialities, orderly growth of urban areas, trends of urban growth and expansion of town through observation and consultation with the Upazila authorities and local people. During the visits maps and drawings were consulted in order to identify the national and regional setting, assess the topographical and physical features, acquaint with the changes of the areas, direction of present development and potentialities of future development etc. The purpose of the visits is to provide a context for the future potentialities of development of the town. During visits following points are considered to develop a profile of the Upazila.

- Identify the urban growth factors and potentialities
- Identify the orderly growth of urban areas
- Assess the trends of urban growth and expansion of town.

2.2 Compilation and Preparation of Base Map

Preparation of base map is an important requirement for planning the project area. The base map was used to depict the survey findings. The steps for the preparation of base map are described in the Physical Feature Survey Report.

2.2.1 Project Area Based on Mauza Maps

Project area boundary and other boundaries have been derived by processing of Mauza maps which is described in detail in the Physical Feature Survey Report. From the mosaic Mauza map of the project area, the administrative boundaries such as District boundary, Upazila boundary, Union boundary, Mauza boundary and Mauza Sheet boundary have been created by using geo-processing tools of ArcGIS such as Dissolve, Erase, Intersect, Spatial Join, etc. The Project Area Map of Saghata Upazila is shown in **Map 2.1.**

2.2.2 Satellite Image Processing

Photogrammetric method uses satellite/aerial stereo images to create Digital Elevation Model and make geospatial database more effectively. With the advent of latest trends in the technologies and unique customer requirements, photogrammetry is now the leading technology for mapping. The field of photogrammetry is a rapid science with new technologies being developed constantly. Within a short period of time, the practice of photogrammetry has

changed from analog to digital. The development of digital aerial cameras has advanced significantly over the past 4-5 years. The use of digital aerial images would be more advantageous for all map and image production especially for Digital vector data and Orthophoto generation.

Since the internal precision of extracted DEMs is strictly related to the mean scale of photographs, image quality, pixel dimension and, obviously, morphology of the area, *Image Collection* is a crucial part of the project. Image was collected from Satellite image provider. The Satellite image in 0.5-meter panchromatic and 1.0-meter multi spectral four-band images in stereo pairs was procured for town area. The 0.5-meter pan and 1.74-meter multi spectral imagery was also be fused to yield 0.5-meter color imagery (pan-sharpened) and 2.5-meter stereo image was also collected for country area. Image processing was done after collecting raw digital images. The tasks involved in image processing are:

- Epi-polar Correction
- Color Balance
- Contrast Adjustment
- Sharpening
- Pyramid
- Bit Rate Setting.

2.2.3 Topographic Feature Extraction from Satellite Image

After initial image processing and building up of stereo models, extraction of topographic features has been done by a team of skilled photogrammetrist. Digital Photogrammetric Workstation (DPW) has been used as the platform for acquiring features from digital stereo images (model). Feature registration has been done considering and measuring the position of the object under its accuracy level. The Summit Evolution & Stereo Plotter of DAT/EM has been used for identifying and registration of the objects and ArcGIS 9.3 of ESRI has been used for topographic data storing and editing.

Topographic features that have been extracted by Digital Photogrammetry are as below:

i. DTM Point Extraction
ii. Break-lines Extraction
iii. Water bodies extraction
iv. Generation of DEM/TIN.

DTM/DEM/TIN/Contour Generation

- **DTM Point:** Digital photogrammetry is able to acquire 3D points for high spatial resolution DEM generation through semi-automatic procedures, overcoming the problems of process. In the approach, DTM Points was generated from Stereo Pair images by the software, and editing of the software generated DTM points was done by the Photogrammetrist comparing them with stereo model. Creating and editing of Breaklines was done after this stage.
- **Contour:** After creating DTM Points, Contour lines was produced l. The contour lines was delivered in 1 km x 1 km or 5 km x 5 km blocks or one single file for the project area.
- **DEM:** Using DTM Points DEM was generated at a resolution of 10 meters in 1 km x 1 km or 5 km x 5 km blocks or one single file for the project area.
- **TIN:** Using DTM Points TIN was generated and delivered in 1 km x 1 km or 5 km x 5 km blocks for the project area.
- **OrthoPhoto:** An orthophoto or orthophotograph is a photograph which terrain corrected ("orthorectified") such that the scale is uniform: the photo has the same lack of distortion as a map. Orthophotographs are commonly used in the creation of a Geographic Information System (GIS).

Ortho-rectification of Images

Orthorectification is a process by which image distortions caused by topography and image orientation are geometrically corrected by the incorporation of a terrain model.

Ortho-rectification of every image was carried out using digital photogrammetric system based on result of aerial triangulation and the generated DEM.

Mosaicking of OrthoPhoto

Individual rectified photograph was assembled to form seamless mosaic.

Mosaicking of OrthoPhoto includes the following tasks

I. Seam line Drawing: Drawing the boundary of the image delineating which part of the image go which image.

II. Balancing of Color and Contrast within different images Feathering.

CHAPTER THREE: TOPOGRAPHIC DATA ACQUISITION

3.1 Mobilization of Survey Team

A highly technical survey team comprising Urban Planner, GIS Expert, Survey Expert and Survey Assistants was mobilized to conduct the topographic and physical feature surveys. The Urban Planner led the survey team under the close supervision of the Team Leader/Deputy Team Leader of the project to ensure the quality of the survey. A list of Survey team members has been attached in Volume-1 of the annexure.

3.2 Topographic Survey

From the reconnaissance survey there are numbers of problems are visually identify in Saghata Upazila. Therefore topographic survey holds certain importance for future plan development. Topography was surveyed by using RTK-GPS and Total Station (TS) survey technique. Topographic survey includes following features:

- Land levels/spot levels for contours at 50m intervals with denser intervals for undulations.
- Alignment and crest levels (not exceeding 50m) of roads, embankments, dike and other drainage divides.
- Alignment of rivers, lake, canal and drainage channels etc.
- Outline of bazaars, water body, swamps and forest, etc.
- Type, width, length and name of road above flood level.
- For closed boundary/outline of homestead, water bodies, swamps, forest etc. junctions, spot heights or land levels was taken roughly at 10m intervals in normal cases and contour was at 0.3 meter interval.
- Crest levels was not exceed 50m along all dyke, roads and drainage divide.

Table 3.1: Topographic Survey

No	Name of activities	Description
1	Land Levels/Spot Levels	The Total Station (TS) based surveys were conducted for measuring the spot levels/land levels of the project area (Northing, Easting, Elevation or RL).
2	General Contour Descriptions	The contour map has been prepared on the basis of spot levels readings obtained from the field survey. The detail contour information is collect by topography survey. Finally prepare a contour map.

No	Name of activities	Description
3	Type and conditions of Roads, Bridge and culverts	Detail Information Collect from field about physical infrastructures.
4	Alignment and crest level survey (Road, Embankment /Dyke)	Detail information collect from field about the type, condition and length of road and embankment.
5	Alignment of River, Lake, Canal & Drainage Channels	Detail information collect from field about type, condition, depth and length of river, lake, canal and drainage channels.

CHAPTER FOUR: DATA PROCESSING AND ANALYSIS

4.1 General Topography of Saghata Upazila

The general topography of the study area is ranges from 3 to 80 meter MSL. The river area mainly low comparatively than the other part of the Upazila.

Using the DTM Points and the Break-lines Triangulated Irregular Network (TIN) and the Digital Elevation Model (DEM has been generated. At the last stage the contour lines have been generated with 0.3 meter interval. **Map 4.1** shows the DEM of Saghata Upazila and the **Map 4.2** shows the Contour Lines of Saghata Upazila.

4.2 Topographic Survey Findings

The findings of topographic survey of Saghata Upazila are described in the following sub-sections and presented in Table 4.1 to Table 4.3, Figure 4.1 to 4.3.

4.2.1 Spot Level Data

We collected spot level data at 221m interval in Saghata Upazila. After analysis, we found that maximum and minimum spot levels at Saghata Upazila are 23.50 m and 14.51. Average elevation of Saghata Upazila area is derived as 15.46 m.

Table 4.1: Summary of Spot Level Data of Saghata

Total Spot Level Points	4656
Highest Elevation	23.50m
Lowest Elevation	14.51m
Mean	19.99m
Standard Deviation	1.49

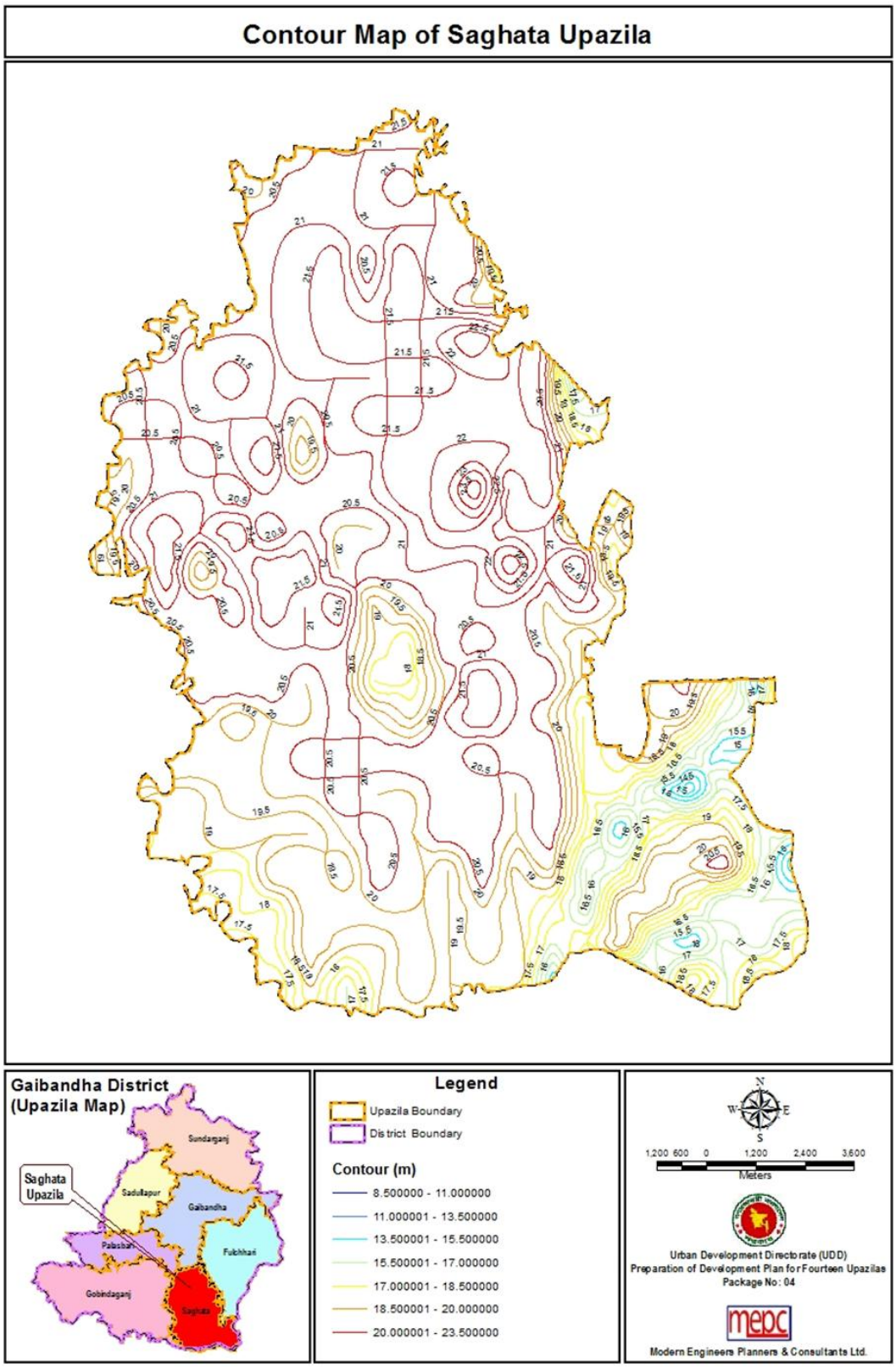
4.2.2 General Contour Description

The following table shows the ward-wise highest, lowest and average spot height of Saghata Upazila.

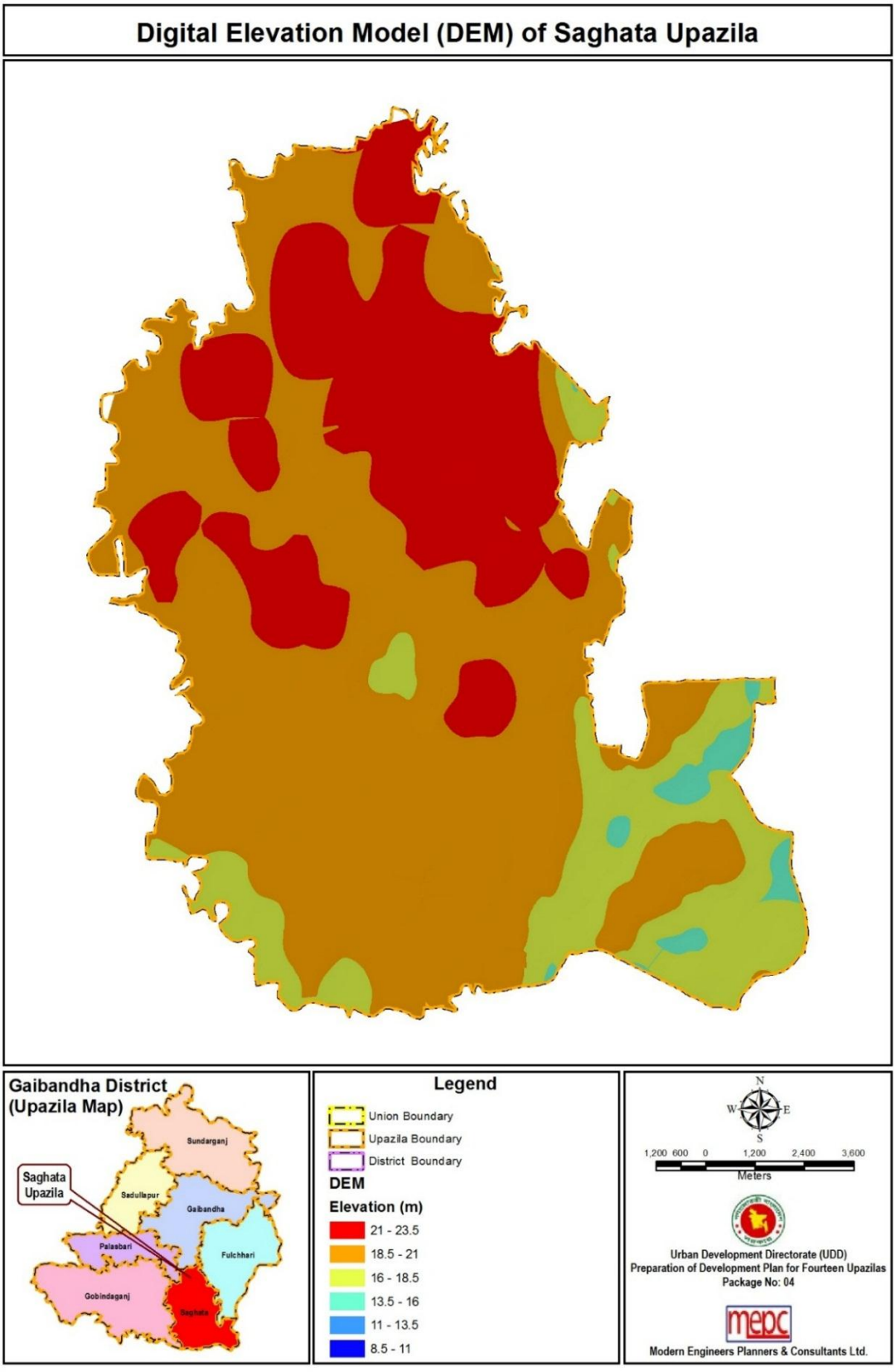
Table 4.2: Summary of Contour Line Data of Saghata

Total Contour Line	**264**
Highest Elevation	23.50m
Lowest Elevation	14.51m
Mean	19.99m
Standard Deviation	1.49

Map 4.1: Contour Map of Saghata



Map 4.2: Surface Analysis of Saghata Upazila



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Package-04

(Saghata Upazila, District: Gaibandha; Sariakandi Upazila and Sonatala Upazila, District: Bogra)

FINAL SURVEY REPORT

PHOTOGRAMMETRY WORK

Of

Saghata Upazila, Gaibandha

June, 2017

Modern Engineers Planners & Consultants Ltd

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CHAPTER ONE: INTRODUCTION

1.1 Background

Photogrammetry enables the conversion of multiple two dimensional (2D) images into three dimensional (3D) models of the earth's surface. Once initial 2D images are converted into 3D, three dimensional measurement applications (software) are used to extract survey data from the stereo model.

1.2 Scope and Limitation

Digital Photogrammetry provides the facilities to capture geo data as 3D features which facilitated to measure height value of any object on the ground. Building height has been calculated from 3D image to generate Digital Elevation Model (DEM) solves the object tiling problem in image.

Photogrammetric technology. Generally images are captured from bird's eye view. So it is difficult to identify object under trees. Under trees, buildings height has been calculated using surroundings height points.

CHAPTER TWO: METHODOLOGY

2.1 Image Collection

The satellite image was ordered from Decode Ltd. the authorized reseller/partner of Digital Globe Inc. The Consultant was purchased 1.0 meter mono image for entire Bangladesh. The specifications of satellite image are as below:

For Saghata Upazila:

Image Sensor	:	World View-2, World View-3, GeoEye-1, Ikonos, QuickBird
Type	:	Ortho ready stereo (3D)
Resolution	:	1.0m Panchromatic, 4.0 meter Multispectral
Source	:	16th October 2015
Bit Rate	:	16 Bit
Company	:	Digital Globe Inc., USA

2.2 Satellite Image Processing

Satellite image came with a certain level of processing. However, for the purpose of features extraction, further processing was done following of steps. The step by step procedures is shown in the Figure 2.1.

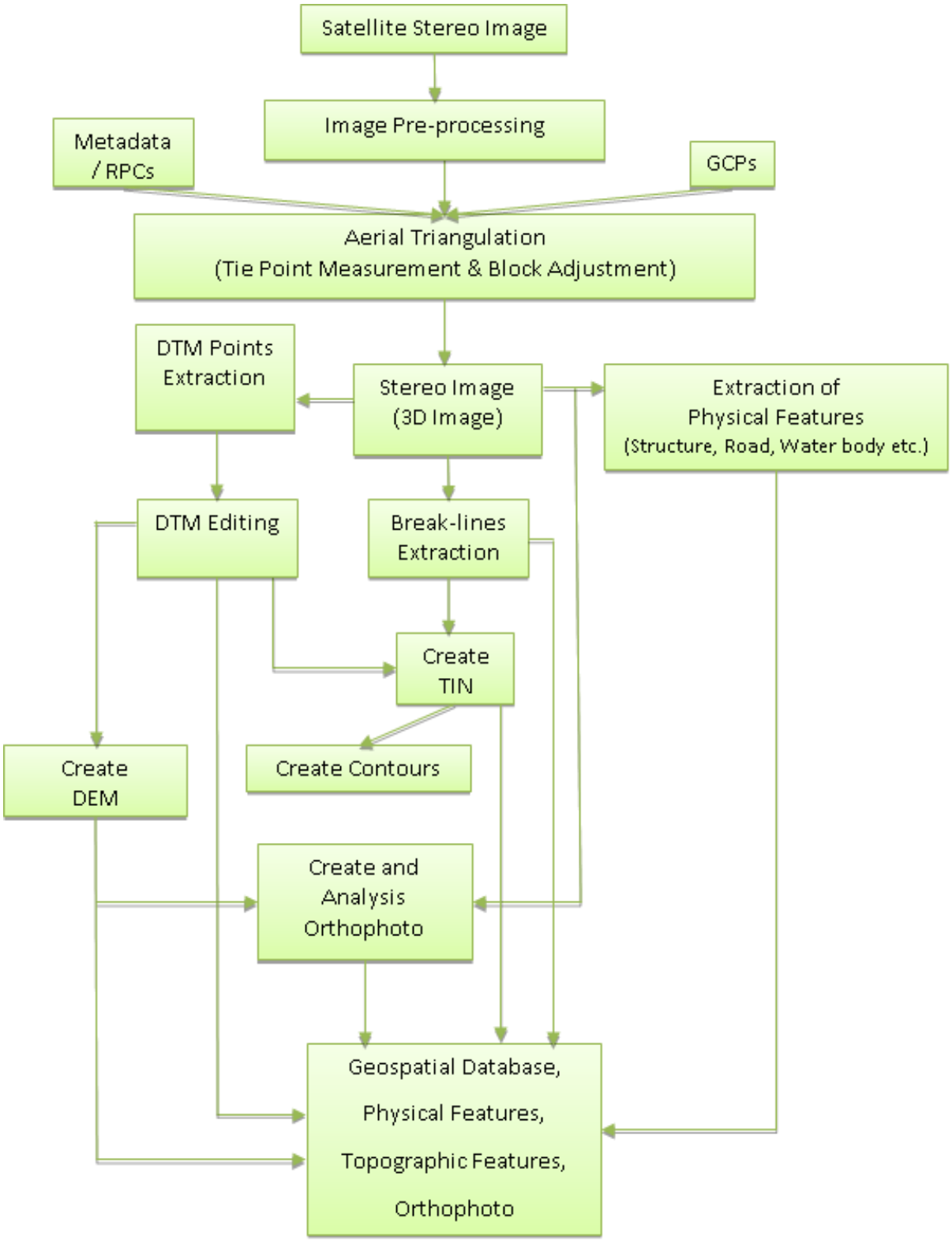

Figure 2.1: General Workflow for Satellite Image Processing and Data Extraction

2.2.1 Image Pre-Processing

Satellite image came with two parts. One has multispectral band which resolution was 4 meter and another one was panchromatic which resolution was 1 meter. However 1 meter multispectral image was made on collection of raw digital images involving image processing:

- ✓ Merge the image tile
- ✓ Color Balance
- ✓ Contrast Adjustment
- ✓ Pan-sharpening.

2.2.1.1 Merge, Color Balance and Pan-Sharpen

Satellite image comes with lots of small segment to create an individual image all image tiles have been merged and thus an individual large image has been created.

During the merge process, color and contrast has been adjusted to get a color balanced image. **Figure 2.2** shows the satellite image tiles without color and contrast balance.

During the image capturing, two types of image, one in multispectral (RGB & NIR) image which is low resolution (4.0 meter) and another in high resolution (1.0 meter) panchromatic image. For this project, 1.0 meter high resolution multispectral image is required. To have this 1.0 meter multispectral image, pan-sharpening tools will be used. This tool produces a 1.0 meter multispectral image by combining 4.0 meter multispectral image and 1.0 meter panchromatic image. **Figure 2.3** shows the merged satellite image with color and contrast balance.

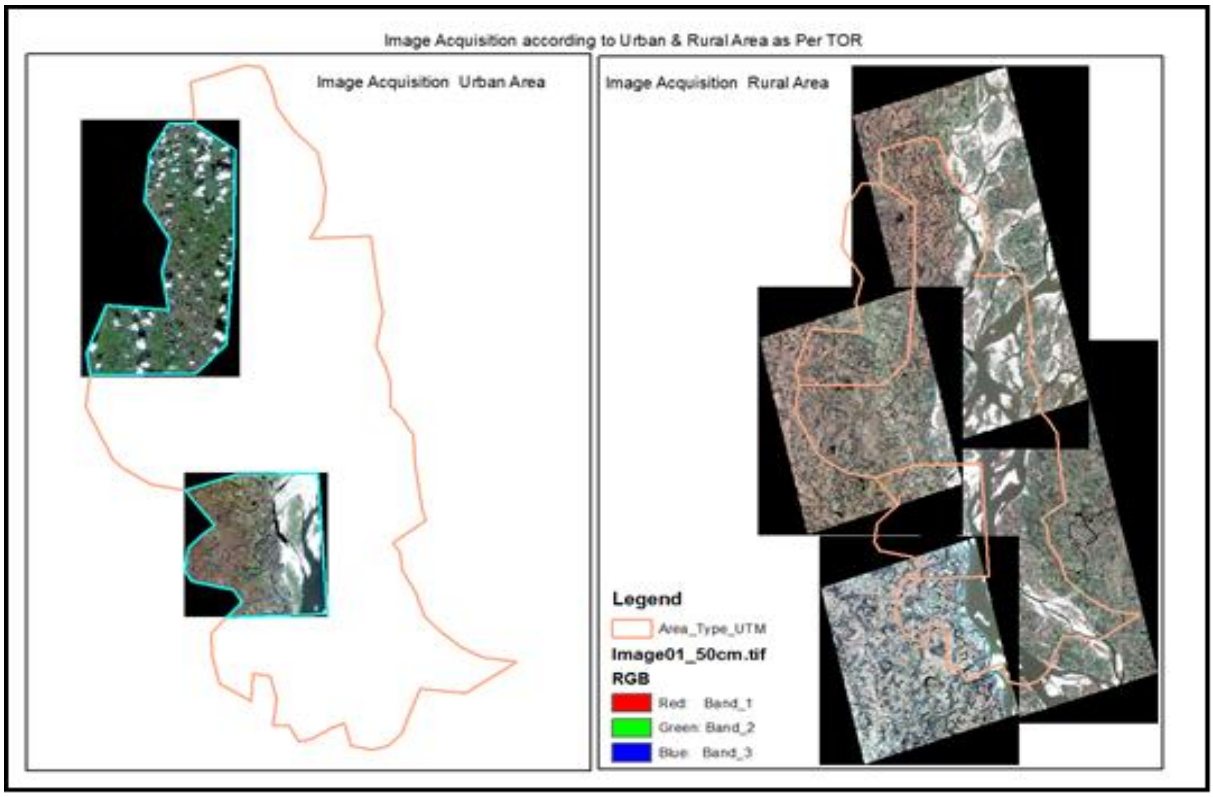

Figure 2.2: Tiles of Sample Satellite Image Color and Contrast Balance

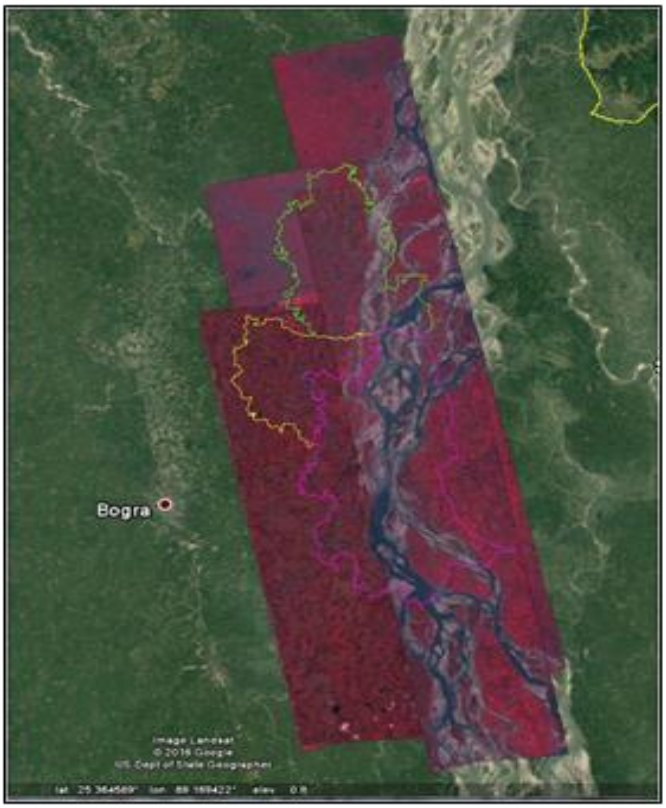

Figure 2.3: Merged Sample Satellite Image (Package-4) with Color and Contrast Balance

Figure 2.4: Satellite Image Multispectral Image

Figure 2.5: Satellite Image Panchromatic 1.0 Meter

Figure 2.6: Pan-sharpen Image-Multispectral 1.0 Meter

2.2.1.2 Bit Rate, Pyramid and Epi-polar Correction

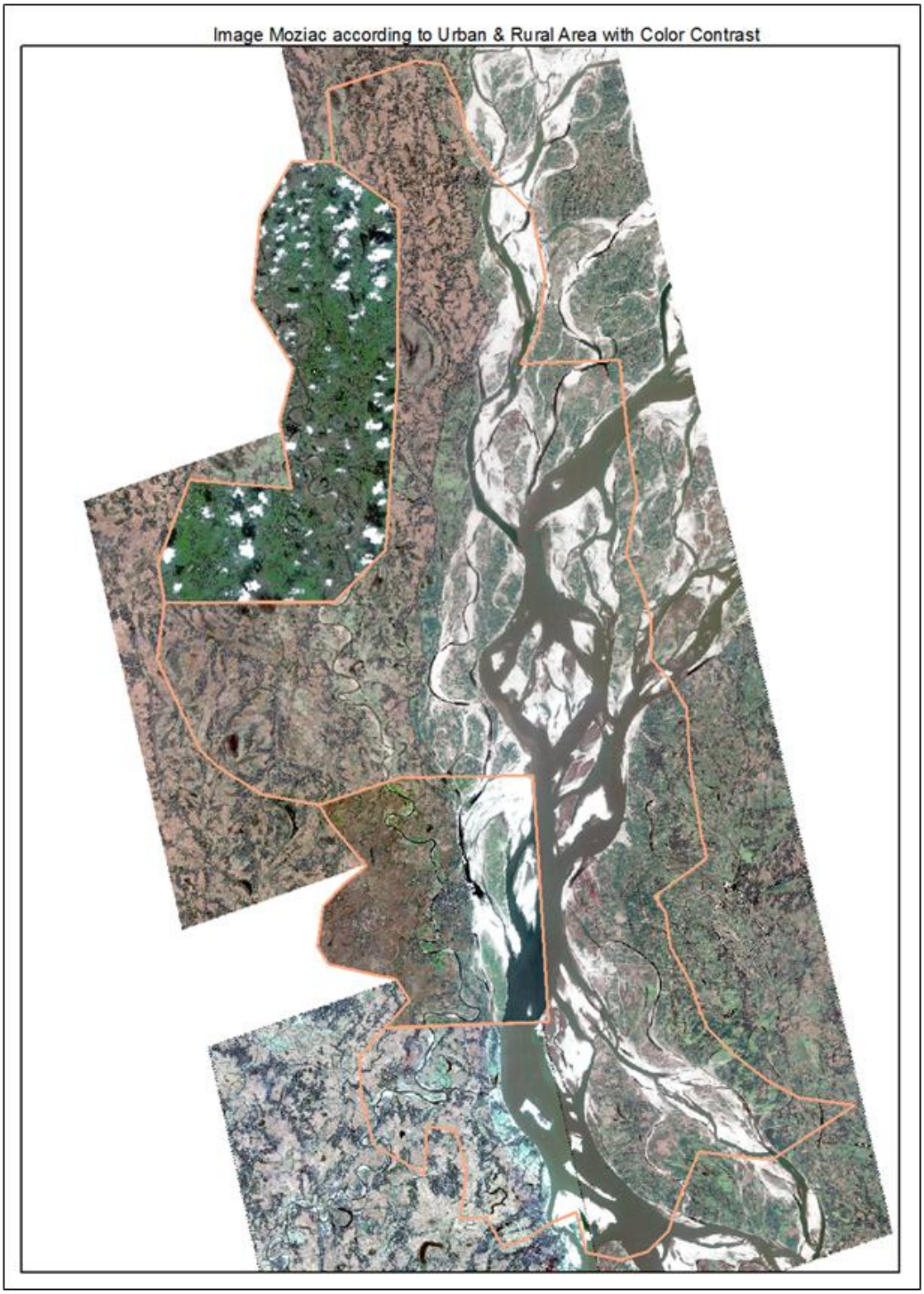

Figure 2.7: Image Mozaic According to Urban and Rural Area with Color Contrast

Bit Rate

In general practice 8 bit images are used. Satellite image can capture 11 bit image. Since the purchased satellite image is in 16 bit, it has been changed the 16 bit to 8 bit for radio matric adjustment and better handling the image.

Pyramid

To efficiently view and pan the image, the pyramid of the image has been built. The DATEM Summit Evolution software has been used for image interpretation.

2.2.2 GPS/INS Processing

Raw IMU (GPS/INS) data of image is processed and adjusted to accomplish Aerial Triangulation. In case of satellite image the RPC file is replaced the GPS/INS file.

2.2.3 Aerial Triangulation

Aerial Triangulation is a mathematical process used to determine the position and orientation of each photograph at the moment of exposure.

Table 2.1: Input-Output in Arial Triangulation

Input for AT	Output of AT
(1) IMU data	Geo-referenced Stereo Model
(2) GPS (on board)	
(3) GCP (collected from field)	
(4) Image	
(5) RPC file	

The GCP and BM collected from SOB have been used for correcting the 3D satellite image coordinate using Inpho Match-AT software.

2.2.4 Image Pyramid

To display the image or access the image efficiently is it must to make a image pyramid for the all the images. We did it by using ArcGIS or Edras Imagine.

2.2.5 Tilling and Mosaicking

For the whole Bangladesh the satellite image was very large. One single file was not be able to store all images. So we divide the image and produce tile for whole Bangladesh.

To access all the tiles for whole Bangladesh in DNA software we need to make a mosaic image. This mosaic image will be then used in GIS server to create a imager service. This image service will be access through http.