Executive Summary

Gangni is an Upazila of Meherpur district in the division of Dhaka, Bnagladesh. The upazila occupies an area of 341.98 sq. km (BBS 2011). It is bounded by Char Bhadrasan Upazila to the north, Nagarkanda Upazila, Boalmari Upazila to the south, Rajbari sadar to the east and Golandia Upazila of Rajbari district to the west. This report contains detailed activities undertaken for Physical Feature Survey, Land Use Survey and Topographic Survey in Gangni Upazila, based on stereo satellite imagery through photogrammetric technology. High resolution ortho-rectified satellite image along with photogrammetric data are used in preparing base map for conducting the surveys.

This report contains four separate reports. These are:

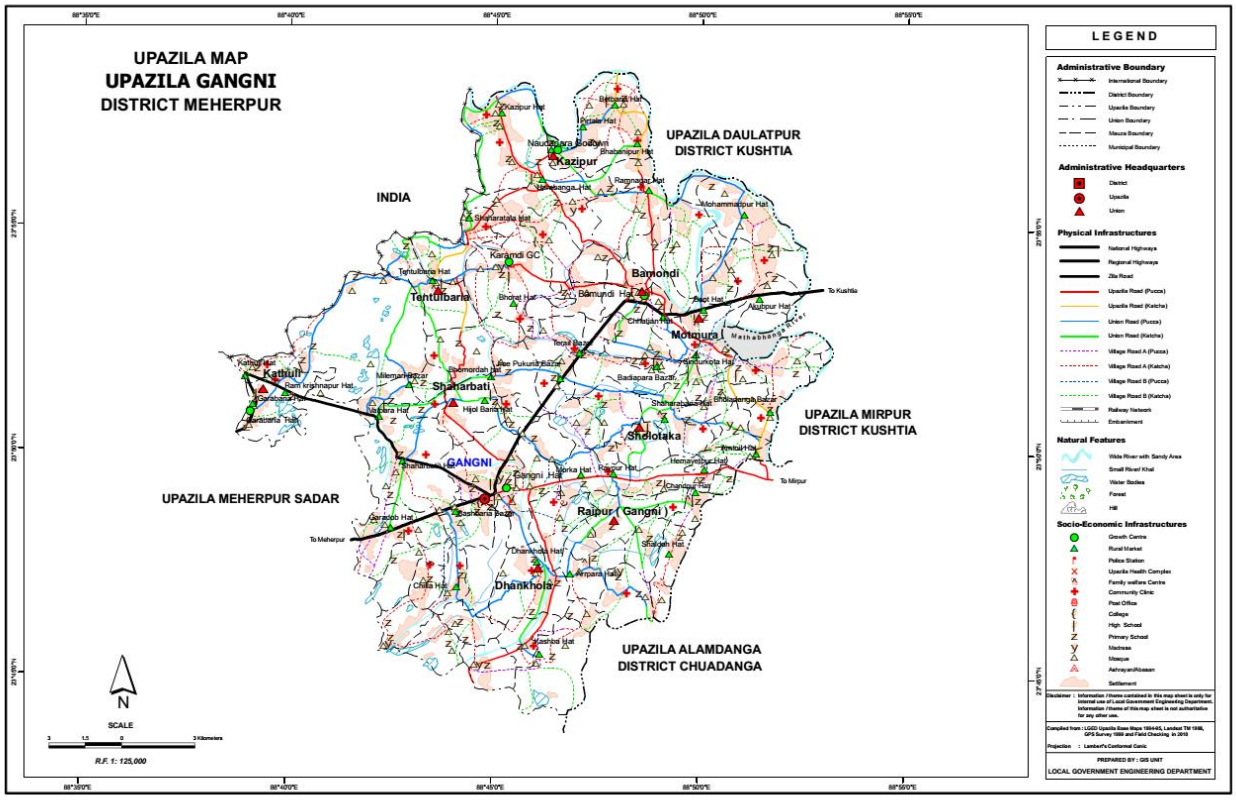
1. Physical Feature Survey
2. Land Use Survey
3. Topographic Survey and
4. Photogrammetric Works

Physical Feature Survey Report covers how the features with their attribute are collected and processed for the preparation of base map for planning. Land Use Survey Report describes the methodology for acquiring and processing of land use data. Topographic Survey Report contains the acquisition and processing of topographic data by using the photogrammetric technology. The report on Photogrammetric Works contains the basic technologies of stereo satellite image processing and extraction of features.

Chapter One: Introduction

1.0 Background

Gangni Upazila (Meherpur district) area 341.98 sq km, located in between 23°44' and 23°52' north latitudes and in between 88°34' and 88°47' east longitudes. It is bounded by daulatpur (kushtia) upazila on the north, alamdanga and meherpur sadar upazilas on the south, Daulatpur (Kushtia), mirpur (Kushtia) and' Alamdanga upazilas on the east, Meherpur Sadar upazila and west bengal state of India on the west. Upazila town is situated on the bank of Kumar river. This report contains detailed activities undertaken for Physical Feature Survey, Land Use Survey and Topographic Survey in Gangni upazila, based on stereo satellite imagery through photogrammetric technology. High resolution ortho-rectified satellite image along with photogrammetric data are used in preparing base map for conducting the surveys. This report contains three separate reports. These are: Physical Feature Survey, Land Use Survey & Topographic Survey. Physical Feature Survey covers how the features with their attribute are collected and processed for the preparation of base map for planning. Land Use Survey portion describes the methodology for acquiring and processing of land use data. Topographic Survey contains the acquisition and processing of topographic data by using the photogrammetric technology. This report aims to give a potential view of the project 'Preparation of Development Plan for Fourteen Upazilas', for the Package-3, Gangni Upazila. All required information for this report has been collected using the advanced technologies in the survey and data Rapid urbanization and development in an unplanned manner, tend to generate the collection process. The survey was carried out according to the methodology mentioned in the TOR. The Project Area map has been shown in **Map-1.1**.



Map-1.1: Project Area Map of Gangni Upazila

Chapter Two: Methodology

2.0 Reconnaissance Survey

A reconnaissance survey of the study area has been conducted to identify the existing problems, development constraints and future development potentialities of the upazilas. This reconnaissance survey has given the planning team an initial overview of the area that was necessary to set on the task of preparing a Master plan. This overview pertains not only to the physical features, prospects and problems of the area, but also the ideas, aspirations and mood of the local residents, which are very much essential to develop the methodological approach for required data collection.

2.1 Compilation and Preparation of Base Map

Preparation of base map is an important requirement for planning the project area. The base map will be used to depict the survey findings. Preparation of base map comprises the following item of works presented in sections.

Major task for the compilation and development of Geospatial data of mauza maps have been summarized in the flow diagram as shown in **Figure-2.1**:

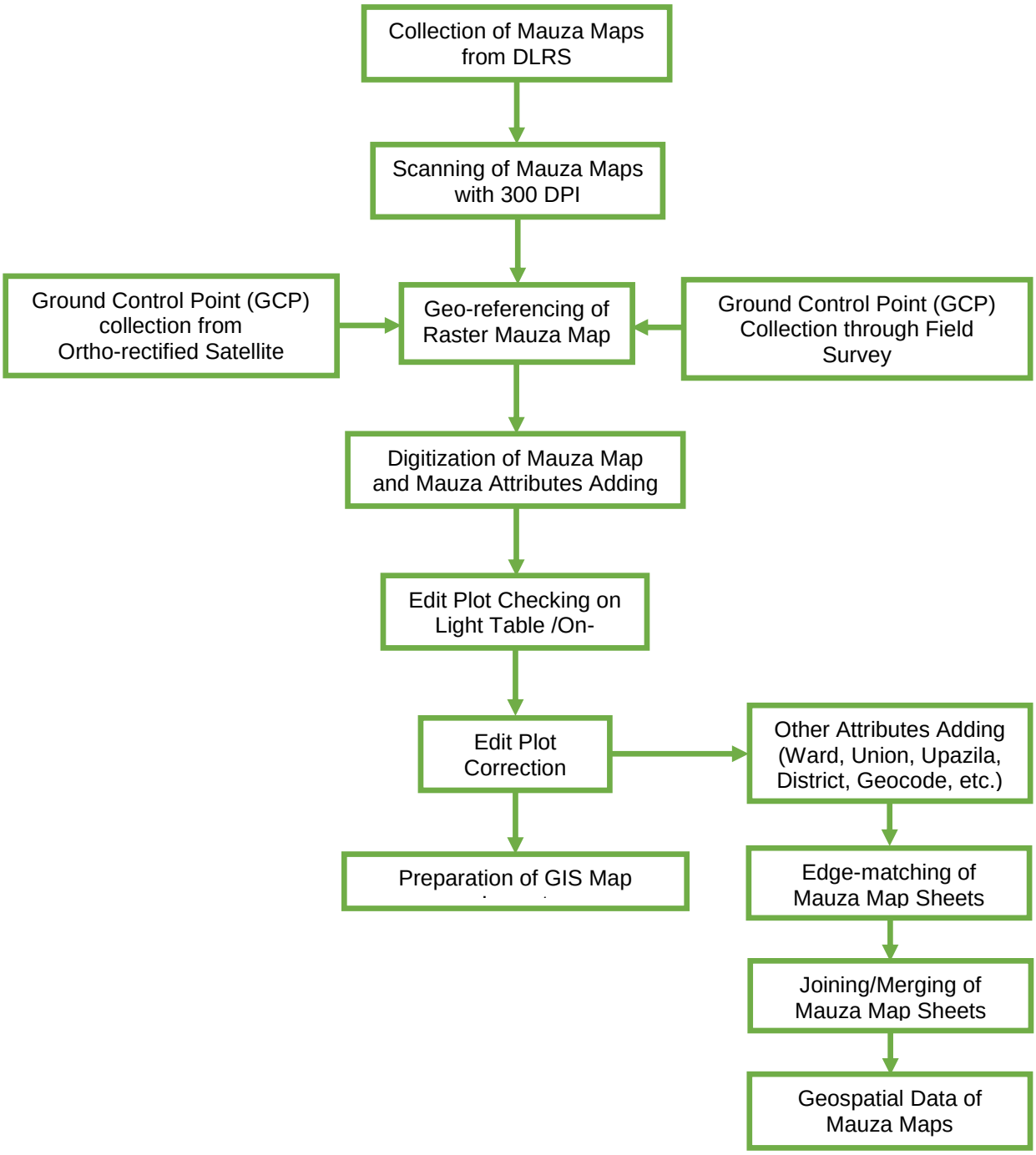


Figure-2.1: Flow Diagram for Preparation of GIS Database using RS Mauza Map

2.1.1 Collection of Mauza Maps

The Consultant has collected all the mauza maps covering the entire project area from DLRS office. The mauza sheets having distortion due to rapping or pasting cloths/tape were avoided during collection of mauza maps. The detail list of Mauza maps are provided in the **Annexure-I**.

Table-2.1: Mauza Maps Collection from DLRS

Upazila	Mauza Version	Mauza Maps		Collection Percentage
		Total No. of Sheet	No of Collected Sheet	
Gangni	RS	**280**	**280**	100%

2.1.2 Approval of Collected Mauza Maps for Scanning and Digitization

After collection of mauza maps of Gangni Upazila from DLRS, all sheets were submitted to PM for review and quality check before scanning and digitizing. The PM of the project has approved all the mauza maps in presence of the Consultant. A sample of approved scanned mauza map is shown in **Figure-2.2**.

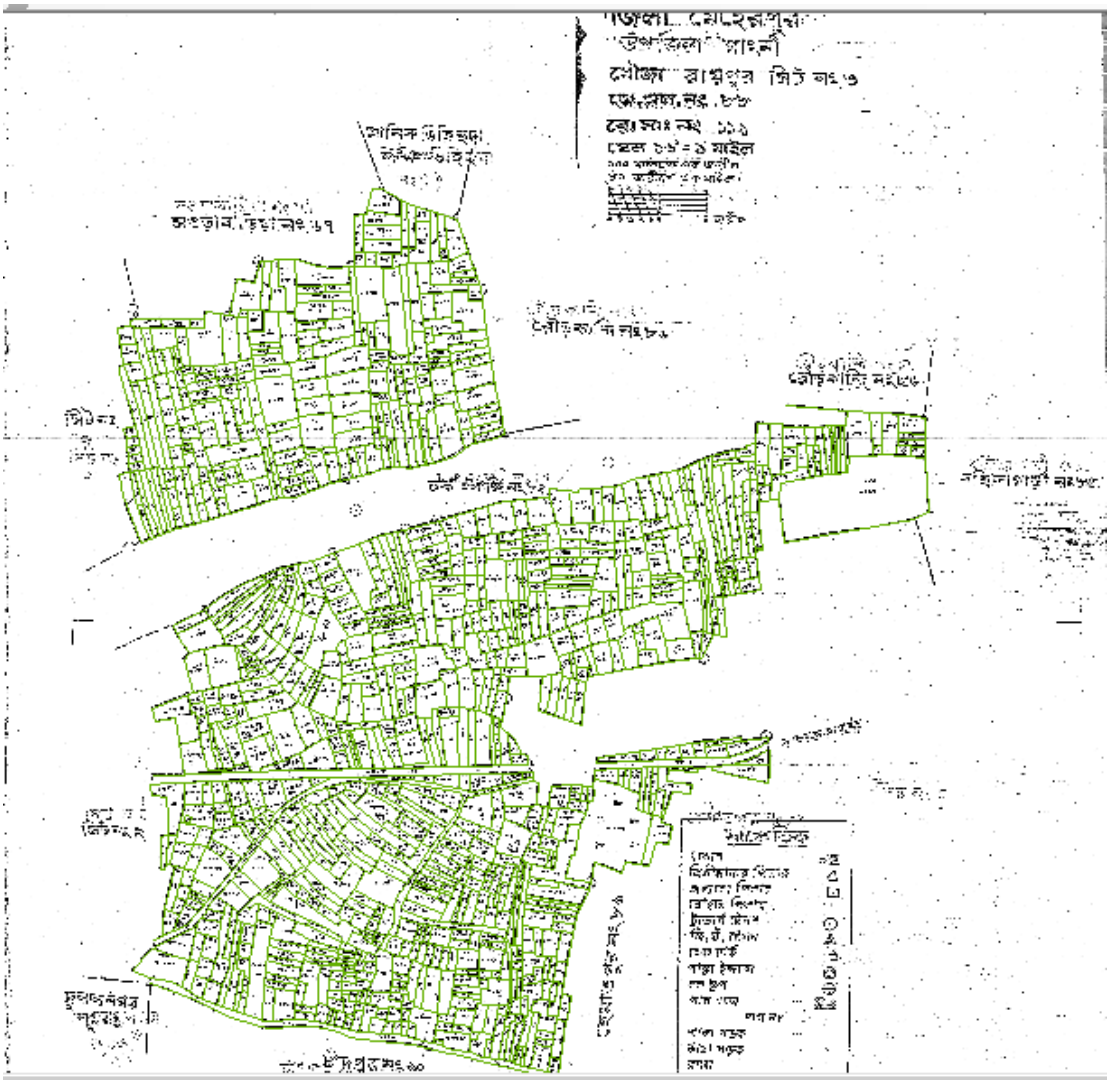


Figure-2.2: Sample of Scanned Mauza Map

2.1.3 Scanning of Mauza Maps

Scanning of all the mauza maps/sheets was started immediately after their approval by PM. As per TOR, scanning of mauza maps/sheets was carried out using drum scanner with 300 DPI to obtain good quality image and saved as JPEG format to be used later on for screen digitization. Extra care was taken during the scanning process for maintaining the proper rotation and alignment to minimize the distortion and deviation. As per TOR, the following specifications have been maintained.

Table 2.2: Specifications for Scanned Mauza Maps

Image Type	Grayscale
Image Format	JPEG
Image Resolution	300 dpi

Table 2.3: Specifications of the Scanner used for Scanning of Mauza Maps

Brand & Model	HP Design jet 815 mfp
Scan Resolution, enhanced	2400×2400 dpi, with variable resolution setting from 50 dpi in increments of 1 dpi
Scan Resolution, hardware	800×800 dpi
Bit Depth	24-bit color
Levels of grayscale	256
Maximum scan size	42×unlimited in

Table 2.4: Status of Scanning of Mauza Map

Upazila	**Mauza Maps**		**Scanning Percentage**
	Total No. of Hard Copy Sheets	**Total No of Scanned Sheets**	
Gangni	**280**	**280**	100%

2.1.4 Preparation of Technical Specifications for GIS Database

A document on technical specifications of GIS database was prepared for storing spatial and attribute database of all layers including mauza maps. Later this document was finalized in consultation with PM and GIS Experts of all the packages. This document is given in **Annexure-II**.

2.1.5 Digitization of Mauza Maps

The mauza maps have been digitized through On-screen Digitization process using ArcGIS software. In brief, this process involves adding a scanned mauza map in ArcMap, creating four empty shape files of three basic feature types (point, line, and polygon) in ArcCatalog, and using ArcMap's drawing tools and the mouse to trace features from the image into the shape files. All the features of a mauza map such as Plot boundary, Plot number, Road, Canal, Building, Mosque, Temple, Traverse Station, Iron Pillar, etc., are created and stored with attributes in four different vector layers as per the Technical Specification of GIS Database. For attaining maximum level of digitizing accuracy, the

Data Frame properties have been set as Map Unit = Inch and Distance Unit = Inch to get 1:1 map scale and later zoom in to 1:30 scale during the digitization process. The **Figure-2.3** shows the on-screen digitization and a sample digitized mauza map.

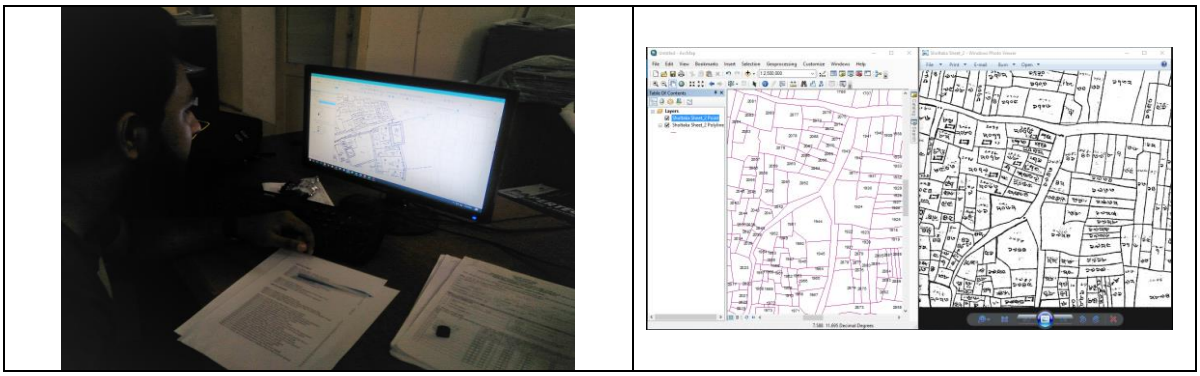


Figure 2.3: On Screen Digitization and Sample Digitized Mauza Map

Table-2.5: Status of Digitizing of Mauza Map

Upazila	Mauza Maps		Digitization Percentage
	Total No. of Mauza Sheets	Total No of Digitized Sheets	
Gangni	**280**	**280**	100%

2.1.6 Edit Plot checking of the Digitized Mauza Maps

After digitization of mauza maps edit plots were produced containing all the features in different colors. The digitized mauza maps were checked and verified by superimposing on the original mauza maps. This checking was done with the joint team of UDD and the GIS Expert. The observed errors normally were, wrong Id of lines, plot numbers and symbols. In some sheets, few arcs have found as missing.

After completion of edit plot checking, necessary corrections have been done using ArcGIS. After correction, the Mauza maps/sheets were printed out again and were checked to ensure that corrections were made accordingly. In this way, utmost effort has been made to ensure quality of digitization. After finalization of digitization of all the mauza maps, both soft and hard copies of them have been submitted to Project Director.

2.1.7 Geo-referencing of Raster Mauza Map

Georeferencing is the process of establishing real world coordinates or geographical coordinates of certain points of the map (at least 4 points) with great accuracy while the remaining points are calculated automatically, based on transformation formulas.

In addition to GCP survey for georeferencing mauza maps, otho-rectified satellite image of the study area has been used as a control layer. This layer contains a rich source of real world coordinates, because it is derived by aerial triangulation of stereo images in photogrammetric environment and later ortho-rectified by the generated DEM of the area. It should be noted here that a required number of GCPs were acquired through RTK-GPS/DGPS method for the process of Aerial Triangulation that is a pre-requisite for photogrammetric works.

The Coordinate System used for both GCP and otho-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

Since, we can pick real world coordinates (Easting, Northing) of any point on the ortho-rectified satellite image, geo-referencing of mauza map has 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.

Figure-2.4: Sample Geo-referenced Raster Mauza Map Overlaid on 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 wasapplied. 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 georeferenced. Finally, permanently georeferenced images of mauza maps have been created by using 'Rectify' tool of ArcMap.

2.1.8 Geo-referencing of Vector Mauza Map

After geo-referencing of scanned image of mauza maps (raster mauza maps), geo-referencing of vector mauza maps have been done. The vector maps i.e. the shape files of each mauza map sheet have been spatially adjusted to the respective georeferenced raster mauza map sheet. The Spatial Adjustment Tools of ArcMap have been used to do this.

2.1.9 Edge Matching of Mauza Maps

A parcel or plot based digital map of the whole project area is a pre-requisite for planning. But edge-matching is a critical component of creating such a map. The project area encompasses many mauzas each of which contains one or more than one map sheets. The adjacent mauza maps are coincident and share the same location of coordinates, boundaries, or nodes. The problem is that, in reality, the common boundaries of adjacent Mauza map sheets actually do not match exactly with each other. Hence the edge-matching problem arises. Mauza maps are especially prone to this problem.

Edge-matching is used to align features along the edges of adjacent layers. Usually, the layer with the less accurate features is adjusted, while the other layer is used as the target layer. By superimposing the vectorized mauza maps on satellite image the accuracy of the common boundaries with respect to satellite image have been investigated. Then, edge-matching of two adjacent mauza map layers have been done by comparing the accuracy of their linear features with reference to the satellite image, identifying and keeping more accurate common features from one layer and deleting the less accurate features from other layer. In case of common roads, rivers or canals, the more accurate features have been kept entirely (both edges) from a mauza map sheet and the same features which belong to other layer have been deleted. The arisen errors such as undershoots, overshoots, etc. have been fixed immediately after deleting features.

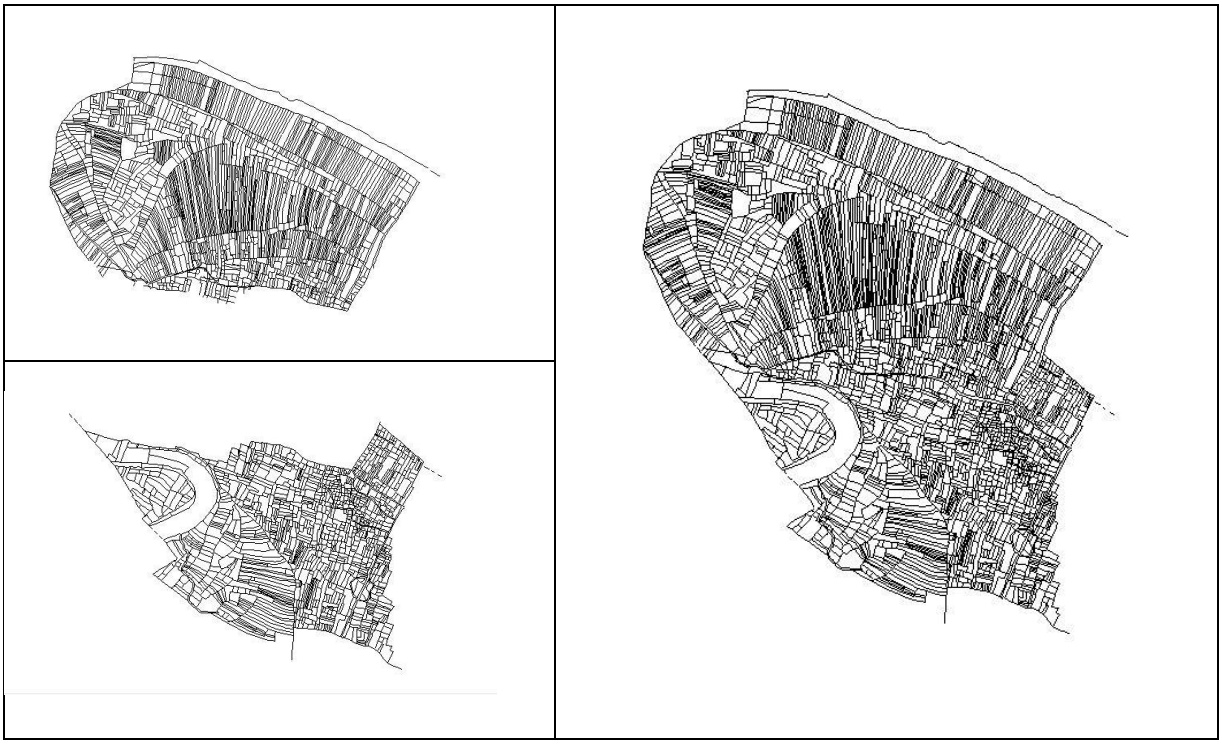


Figure-2.5: Sample Diagram of Edge-matching

2.1.10 Demarcation of the Project Area based on Mauza Maps

Mosaicing of all mauza maps belonged to the Upazila form the actual boundary of the project area. Before mosaicking, edge-matched mauza maps have been made as free of topological errors. Finally

plot based mosaic mauza maps of the project area have been created by using 'Merge' tool of ArcGIS. The boundary of this merged mauza map becomes the Project Area Boundary with real world coordinates. Project Area Map of Gangni Upazila is shown in **Map 2.1**

The consultant in cooperation with UDD officials has demarcated the actual boundary of the project in the newly formed mosaic Mauza map. Later on, the project boundary was finalized by field verification, which was considered and used for the project after duly approved by UDD.

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.

Map 2.1: Mouza Map of Gangni Upazila (partial).

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

A network of permanent Bench Mark (BM)/Ground Control Point has been established having real world coordinates (Easting, Northing, and Elevation) within the study area to carry out the topographic, physical features and land use survey. 13 BM pillars have been established in Gangni Upazila. The network establishment for the survey comprises the following item of works:

2.2.1 Selection of Sites for BM Pillars with justification

Appropriate site selection is crucial for establishing BM pillars. The consultant has considered the following points in selecting sites for ground control points:

i. The site is suitable for RTK-GPS/DGPS observation. There exists Good Sky Visibility (15 degree cut of angle above the horizon) and far from mobile tower or high voltage electric line.

ii. The site is located on undisturbed location due to natural or human activities.

iii. The site is located on a corner of government own land, playground, school or beside of road.

iv. The site is located on such a place that is suitable to set up Total Station equipment in future work.

v. Two successive BM pillars are inter-visible and at least 100 meters apart.

2.2.2 Design of Pillars

BM pillars in the Study area have been constructed according to the design supplied by UDD. The approved design sheet appears at **Figure-2.6.**

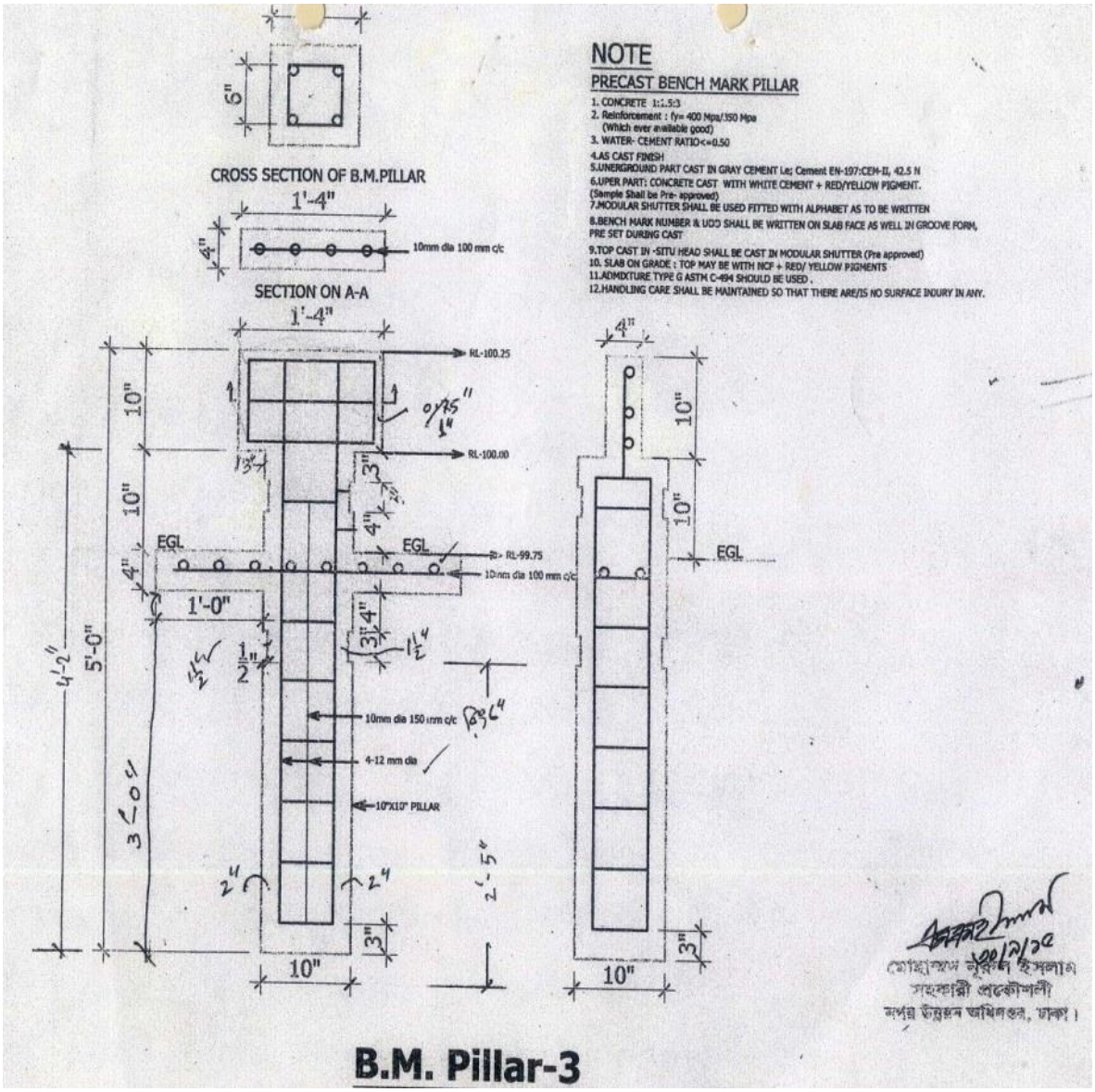


Figure-2.6: Design of BM Pillar

2.2.3 Construction of BM Pillars

Gangni Upazila is covered by 15 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

For the selection of reference BM, the survey team considered the BM 533, GPS 2317 and GPS 3533 of Survey of Bangladesh (SOB) as reference BM pillar in Gangni Upazila. The information of Reference BM Pillars has been collected from Survey of Bangladesh.

Plate-2: Reference BM Pillar in Gangni Upazila

The location and its x, y and z value are given in **Table-2.6**. On the basis of this reference BM, 14 BMs have been established as local reference control points within the Project Area.

Table-2.6: Location of Reference BM

BM no.	Height above MSL	Coordinate (WGS-1984)		Location
		Lat	Long	
5588	14.329	23.8892930466000	88.8031262642000	Bamondi Nishipur High school, Beside the shahid Minar

Source: Survey of Bangladesh (SOB), 2016

2.2.5 Baseline Survey by RTK-DGPS Method

The baseline survey is the instantaneous data collection in static mode at two or more fixed points using two or more dual frequency RTK-GPS receivers. The measurement network for RTK-GPS baseline survey is planned by connecting the BM points to be established and the selected reference BM (Known latitude, longitude and ellipsoidal height) near the Study Area. A line connecting two measurement points is known as baseline.

The GPS measurements consists a simultaneous static measurement with two dual frequency GPS receivers one on the known reference BM (base) and another one will be on the BM to be established (Rover). The simultaneous measurement or logging time for a session is usually 20 minutes to an hour depending on the availability of satellite and distance. During taking the measurements, the GPS receivers at the two points record the satellites information or data and the stored data is processed using software.

Plate-3: RTK-GPS Observation

The GPS Survey Team has conducted survey by RTK/DGPS methods. The Base station has been established by connecting to the Reference BM (BM 533, GPS 2317 and GPS 3533) of SOB) and 10 hours of continuous observation to get precise coordinates. After establishing the base station, the rovers are positioned on the newly installed BM Pillars one by one and observations have been made for each of the 13 BM in the project area.

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

The GPS data acquired through RTK-GPS/DGPS survey has been processed by using post processing software and the co-ordinates (Northing, Easting and Elevation) of BM Pillars are achieved. Thus the coordinates of all the 13 BM pillars have been established in the Project Area along with their RL (height above MSL). The location of BM's and its x, y and z values are given with photograph of BM are given in **Table-2.7** and location of BM pillars are given in **Map-2.2**.

Table-2.7: Coordinates and Descriptions of the BM Pillars

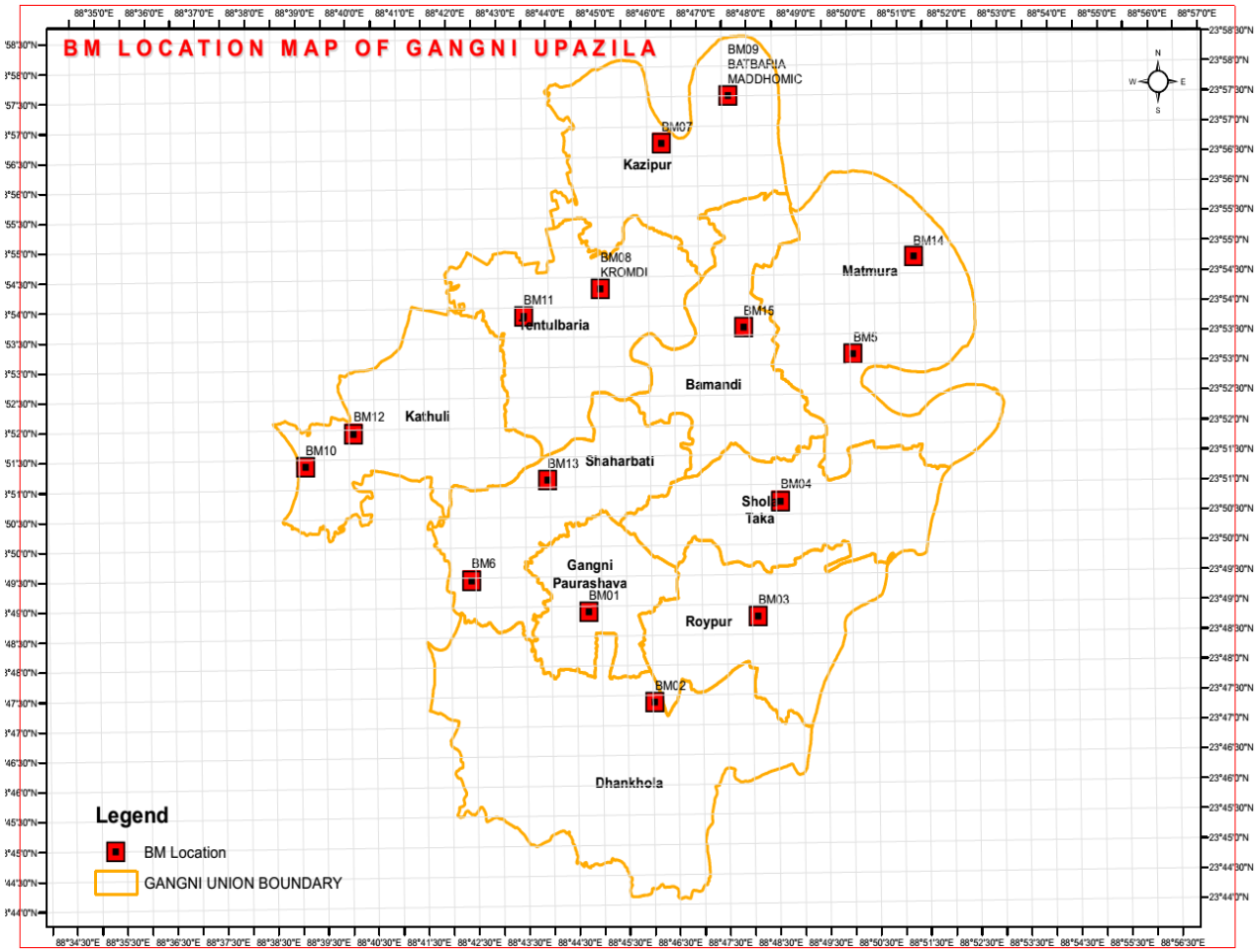
BM No.	RL	Lat.	Long.	Northing	Easting	Location	Photo
1	12.157	23.815399702 7778	88.7457 1871944 44	26348 83.106	677829 .957	Gangni Upazila Complex, Infront of the Gangni Agriculture office	
2	13.737	23.789 830069 4444	88.7673 2392500 00	26320 78.609	680066 .534	Dhankhola UP complex, left side of the entry gate	
3	13.550	23.813 387638 8889	88.8019 4782500 00	26347 31.916	683561 .902	Raipur UP complex, in the compound of UP complex	
4	13.086	23.845 569477 7778	88.8098 1253055 56	26383 06.222	684317 .749	Sholotaka UP complex, left side of compound in garden	
5	14.355	23.886 299119 4444	88.8344 5495833 33	26428 49.332	686769 .545	Matmura UP complex, left side of the compound under sign board	
6	14.610	23.824 478405 5556	88.7069 1503611 11	26358 40.409	673864 .265	Shaharbati Primary school, beside the school tube-well	
7	15.471	23.945 636366 6667	88.7715 7849722 22	26493 39.225	680284 .162	Kazipur UP complex, infront of the main building to the left	

8	15.086	23.905293116 6667	88.7507 8375000 00	26448 44.885	678222 .929	Koromdi primary school, Tentulbaria, infront of the school building	
9	16.316	23.958 520772 2222	88.7938 6899166 67	26507 94.833	682534 .901	Betbaria High School, front left side of the compound in the back of Shahid Minar	
10	15.290	23.856 507691 6667	88.6522 4636388 89	26393 21.454	668253 .362	Kathuli UP complex, front left corner of the entry gate	
11	15.417	23.897 725302 7778	88.7251 5523888 89	26439 74.692	675623 .737	Tentulbaria UP complex, Left corner beside flag stand	
12	13.530	23.865 755652 7778	88.6682 3879444 44	26403 64.703	669870 .165	Kathuli Primary school, Dhola, Beside the school tube-well	
13	11.817	23.852 189713 8889	88.7325 5975277 78	26389 41.009	676439 .423	Shaharbati UP complex, Right front corner of the main building	
14	15.296	23.913 061725 0000	88.8548 5579166 67	26458 40.430	688808 .195	Hogolbaria-Mohammadpur high school, Matmura, beside the shahid minar	

15	14.508	23.893950630 5556	88.798223700000	26436 49.353	683069 .166	Bamondi UP complex, infront of the right corner of main building	

2.2.7 Marking of BM Pillars

The number of the respective BM pillars has also been inscribed on the face of each pillar as per specification provided by UDD. The team members of the consultant firm have properly supervised the marking of Bench Mark Pillars.



Map-2.2: Location of BM Pillars in Gangni Upazila

2.3 Satellite Image Processing for Data Acquisition

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. The step by step procedures has been shown in the **Figure 2.7**.

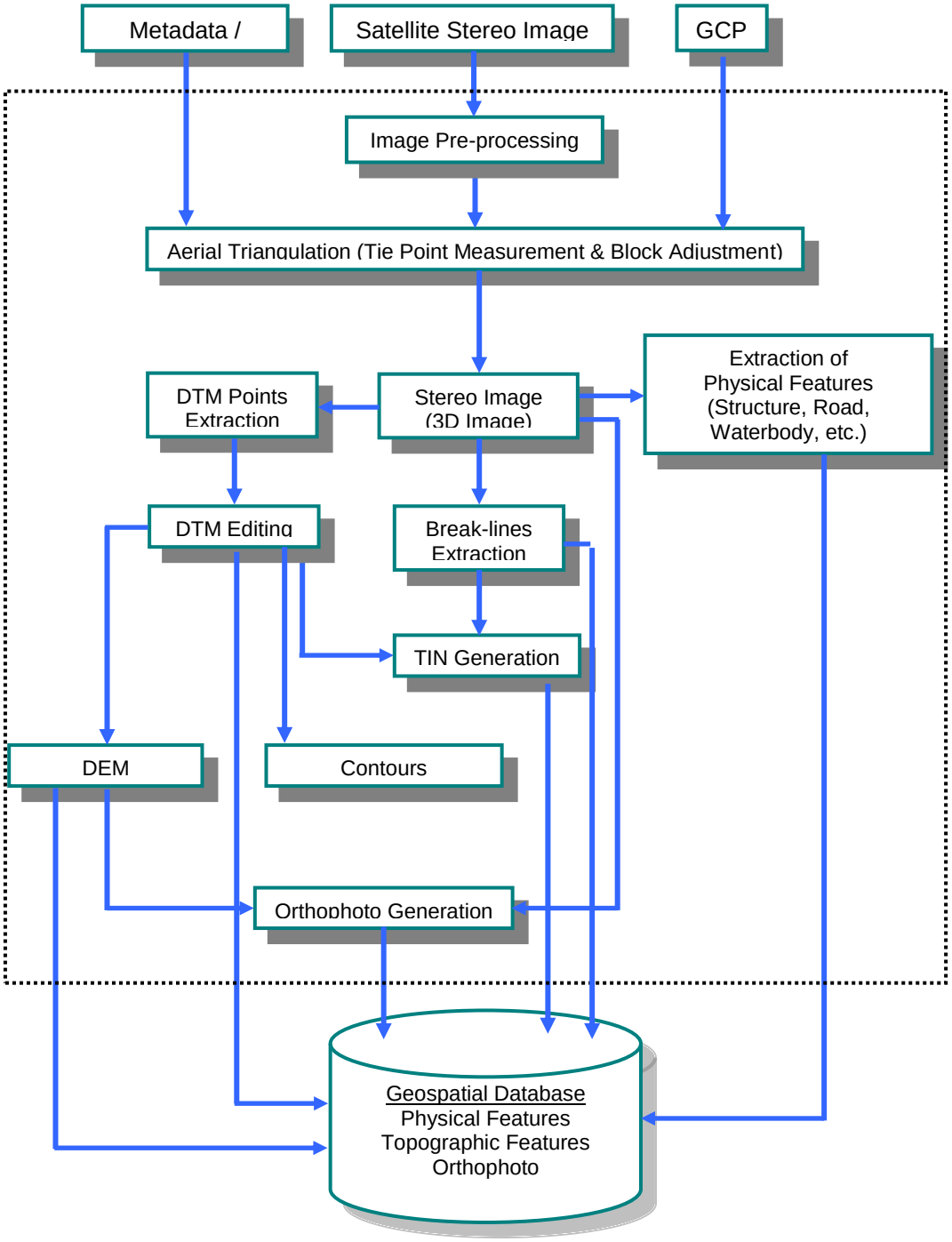


Figure-2.7: Workflow of Stereo Satellite Image Processing and Data Extraction

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 2.4.

2.3.1 Physical Feature Extraction from Satellite Image

After initial image processing and building up of stereo models, extraction of physical features has been done by a team of skilled photogrammetrist. All type of physical features including Structures

(katcha, pucca, semi-pucca, etc.), Roads, Water bodies, etc. have been extracted as 3D features. Each vertex of features contains z-value (elevation).

Plate-4: Digitization by Digital Photogrammetry

The Photogrammetric Expert and the GIS Expert has monitored the feature extraction works examine the data for their proper registration.

2.3.2 Preparation of Survey Base Map

The survey base map has been created by superimposing 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. Entire Gangni Upazila has been divided into 3790 grids and survey base maps have 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. The Grids used to prepare survey base map is shown in **Figure-2.8** and Grids with photogrammetric data and satellite image is shown in **Figure-2.9**.

A sample base map comprising photogrammetric data and satellite image is shown in **Map-2.3** and photogrammetric data with mauza map is shown in **Map-2.4**.

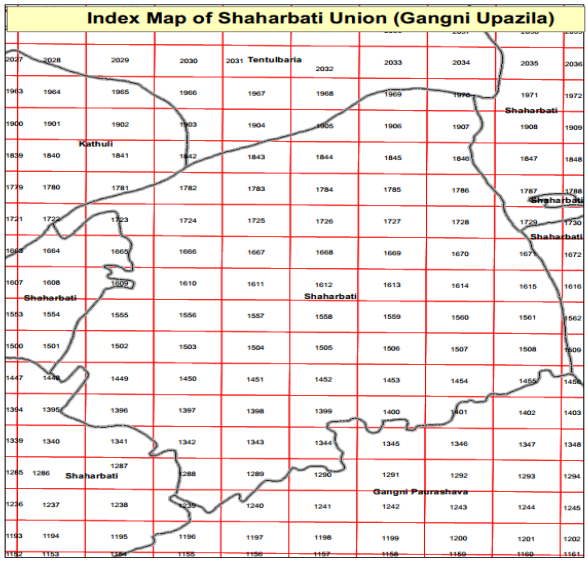


Figure-2.8: Grids for Survey Base Maps of Gangni Upazila (Shaharbati Union)

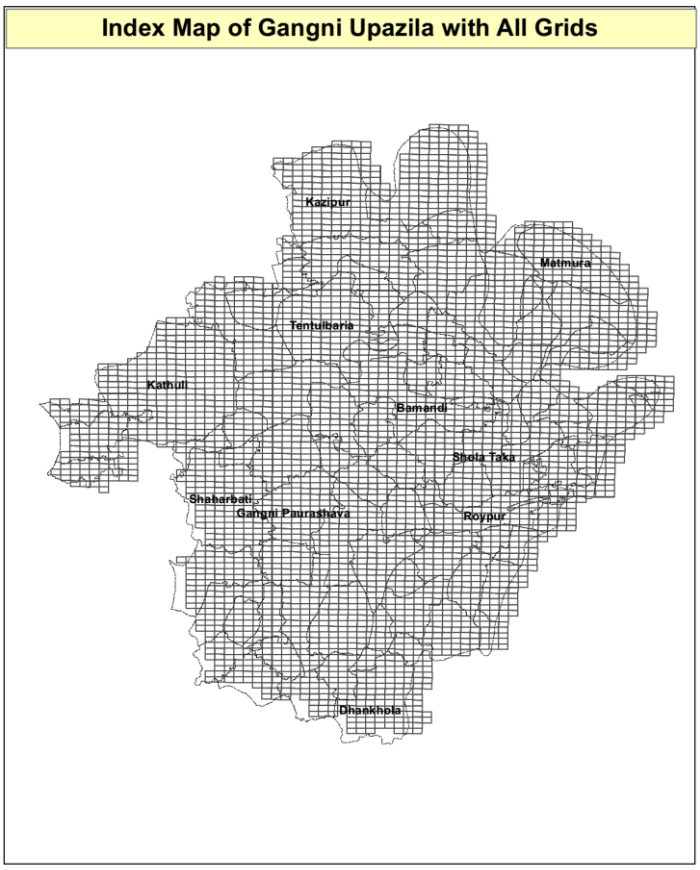
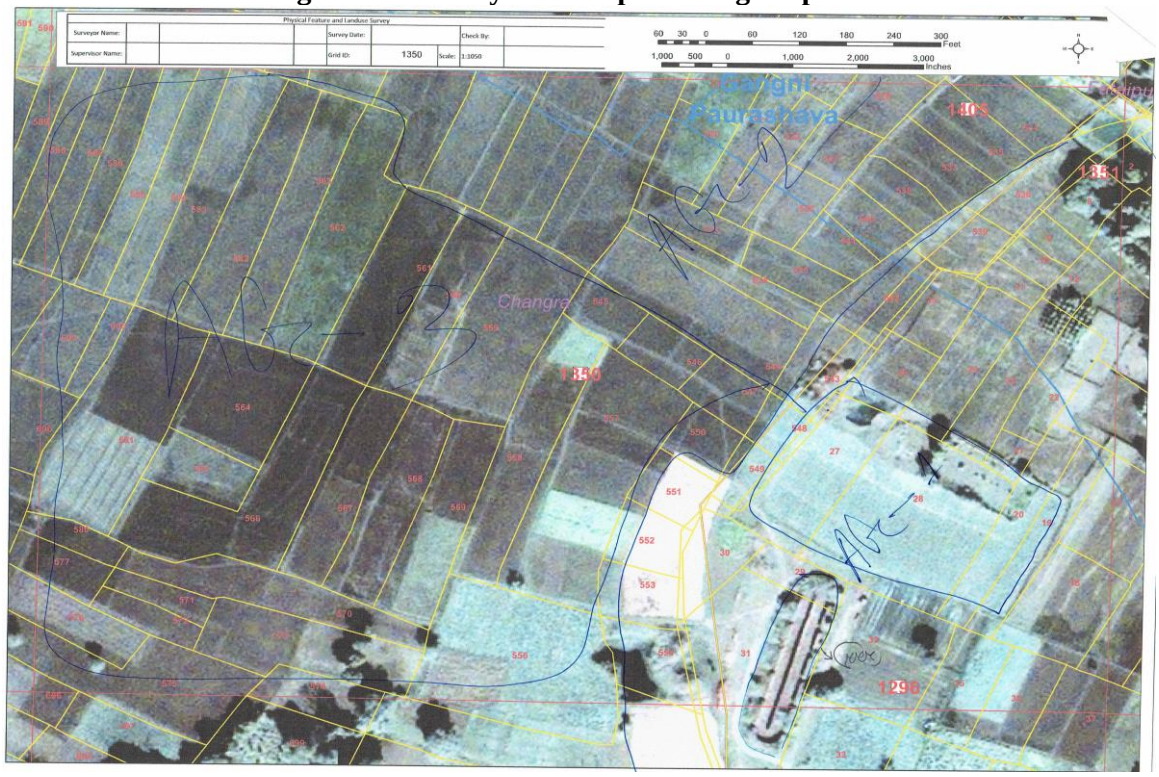
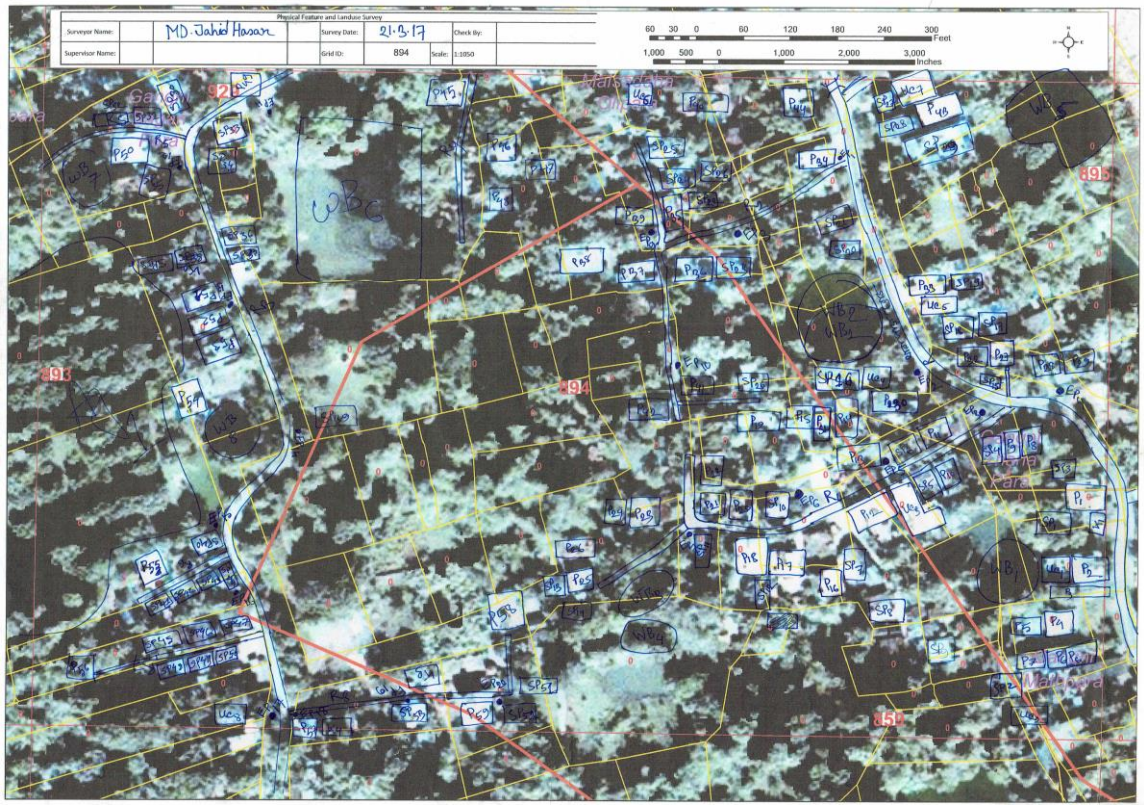


Figure-2.9: Survey Base Maps of Gangni Upazila in Grids



Map 2.3: Sample Survey Base Map Comprising Satellite Image and Photogrammetric Data



Map 2.4: Sample Survey Base Map comprising Mauza Map and Photogrammetric Data

2.3.3 Preparation of Log Book for Attribute Collection

To collect attributes or textual information, a Log Book comprising data collection forms has been developed. 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

2.4 Satellite Image Processing

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. The step by step procedures has been shown in the **Figure-2.10**

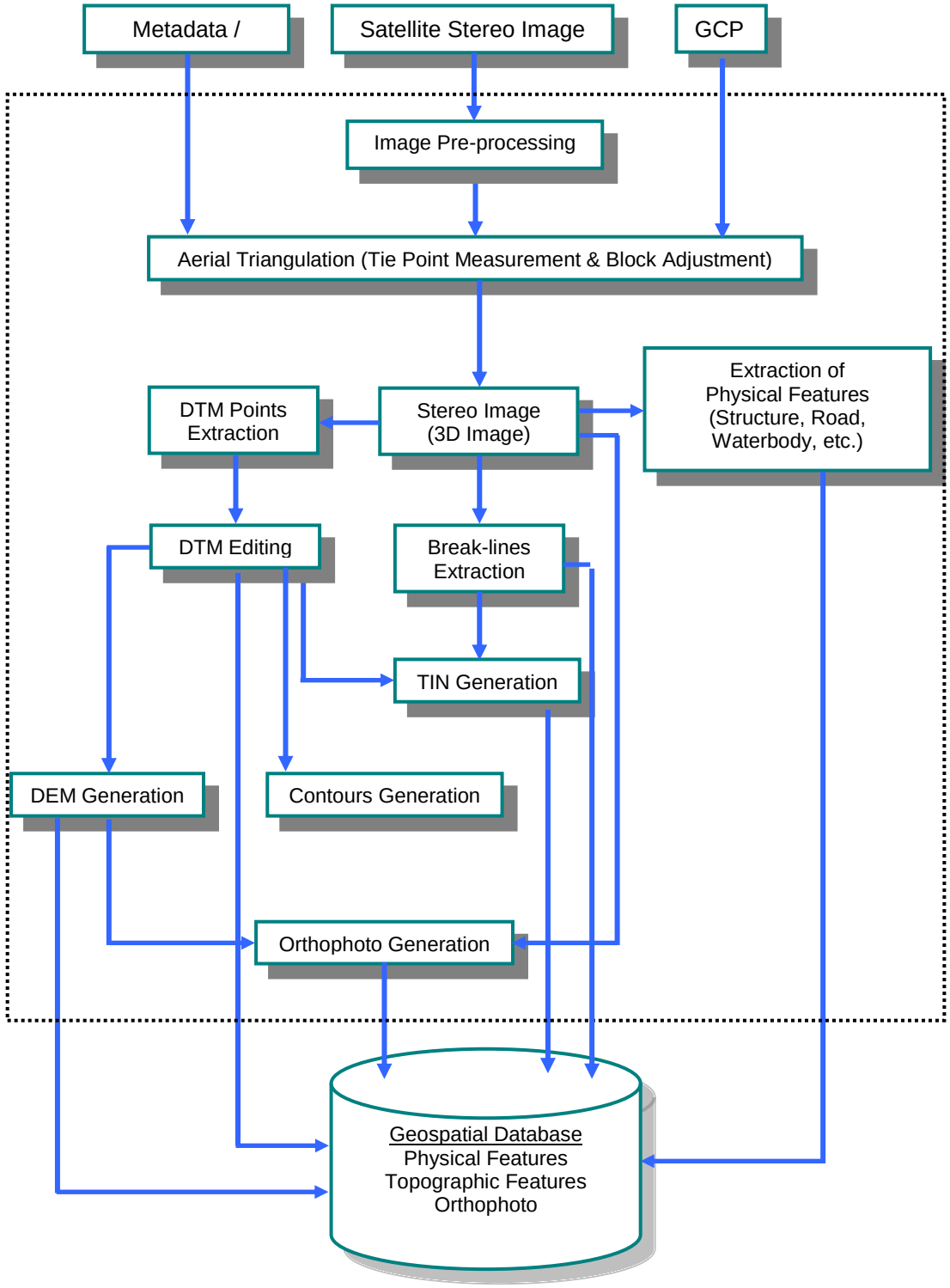


Figure-2.10: Workflow of Stereo Satellite Image Processing and Data Extraction

2.4.1 Image Collection

The satellite image was ordered to Airbus, France. The authorized reseller/partner of Airbus. 0.5 meter stereo pair image has been purchased by the Consultant for Gangni. The specifications of the purchased satellite image are as below:

Gangni Upazila:

Image Sensor	: Airbus
Type	: Ortho ready stereo (3D)
Resolution	: 0.5m Panchromatic, 2.0 meter Multispectral
Source	: New Acquisition, 12 March 2016
Total Area	: 341.98 Sq. km.
Bit Rate	: 16 Bit
Company	: Airbus Defence and Space.

2.4.2 Image Pre-Processing

Satellite image came with two parts. One is multispectral band which resolution is 1.74 meter and another one is panchromatic which resolution is 0.5 meter. We need 0.5 meter multispectral image for feature extraction. After collecting raw digital images, the tasks involved in image processing are:

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

2.4.2.1 Merge, Color Balance and Pan-Sharpen

Satellite image comes with lots of small segment which called image tile so that image can be sent by the provider on DVD media. To create an individual image all image tiles have been merged and thus an individual large image has been created.

Image tiles may vary in color and contrast. So during the merge process, color and contrast has been adjusted to get a color balanced image. **Figure-2.11** shows the satellite image tiles without color and contrast balance.

During the image capturing time, satellite captures two types of image, one in multispectral (RGB & NIR) image which is low resolution (2.0 meter) and another in high resolution (0.5 meter) panchromatic image. For feature extraction, 0.5 meter high resolution (0.5m) multispectral image is required. To have this 0.5 meter multispectral image, pan-sharpening tools have been used. This tool produces a 0.5 meter multispectral image by combining 2.0 meter multispectral image and 0.5 meter panchromatic image. **Figure-2.12** shows the merged satellite image with color and contrast balance.

Figure-2.11: Tiles of satellite image without color and contrast balance

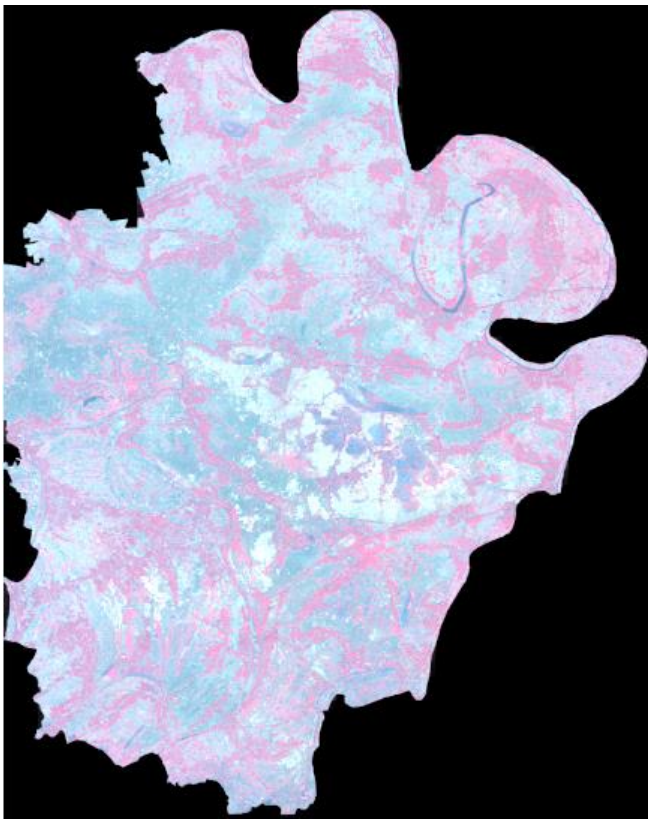


Figure-2.12: Merged satellite image with color and contrast balance

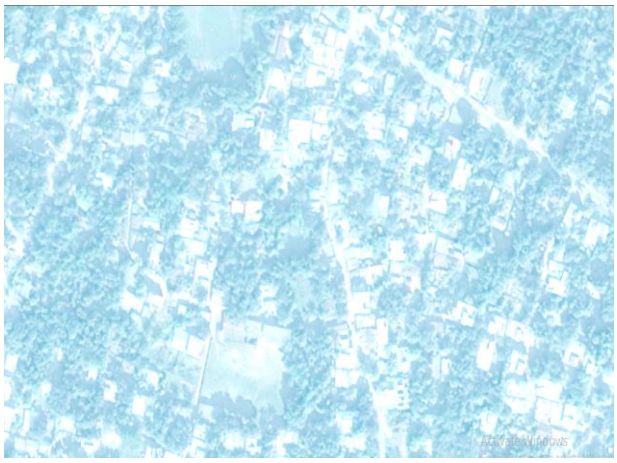


Figure-2.13: Satellite Image Multispectral Image 2.0 meter

Figure-2.14: Satellite Image Panchromatic 0.5 meter

Figure-2.15: Pan-sharpen Image - multispectral 0.5 meter

2.4.2.2 Bit Rate, Pyramid and Epi-polar Correction

Bit Rate: In general practice 8 bit images are used. Satellite image can capture 11 bit image. Since the purchased satellite image is in 16bit, 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.

Epi-polar Correction: Epi-polar geometry is the geometry of stereo vision. When two cameras view a 3D scene from two distinct positions, there are a number of geometric relations between the 3D points and their projections onto the 2D images that lead to constraints between the image points. The 3D models have been created by using the Summit Evolution software.

2.4.3 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.

2.4.4 Aerial Triangulation

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

Table-2.8: Input-output in Aerial 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.

2.4.5 Digital Mapping (Feature Extraction) from Stereo Model

After the orientation of stereo models, digital mapping has been carried out. ArcGIS Geo-database model has been used for storing geo-spatial data. The Geo-database and its feature classes has been designed based on ToR.

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 vector data storing and editing.

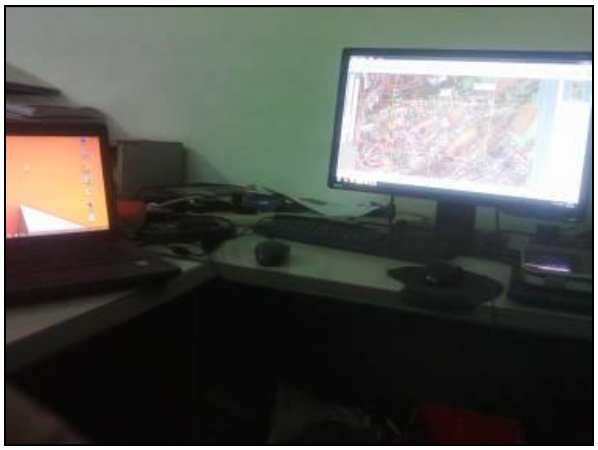


Plate-5: Digital Photogrammetric Workstation (DPW)

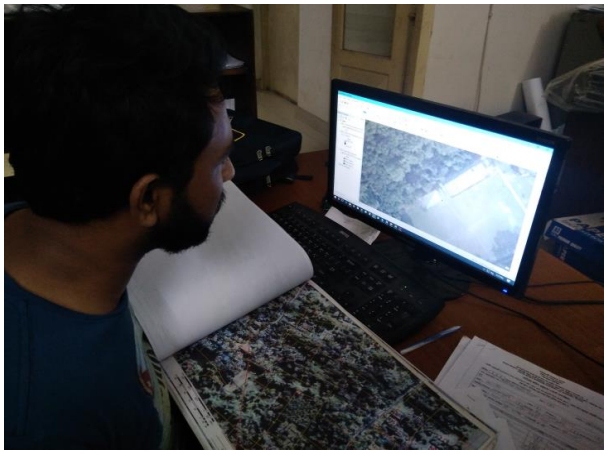


Plate-6: Photogrammetrist Extracting Features in DPW

A team of photogrammetrists has digitized Building roof with MSL height, bridge/culvert, road, khal, pond, lake, ditch, marsh/swam, river, etc. All features have been digitized in 3-dimension (X,Y,Z). **Figure-2.16** and **Figure-2.17** shows the extracted features of Gangni Upazila at a glance.

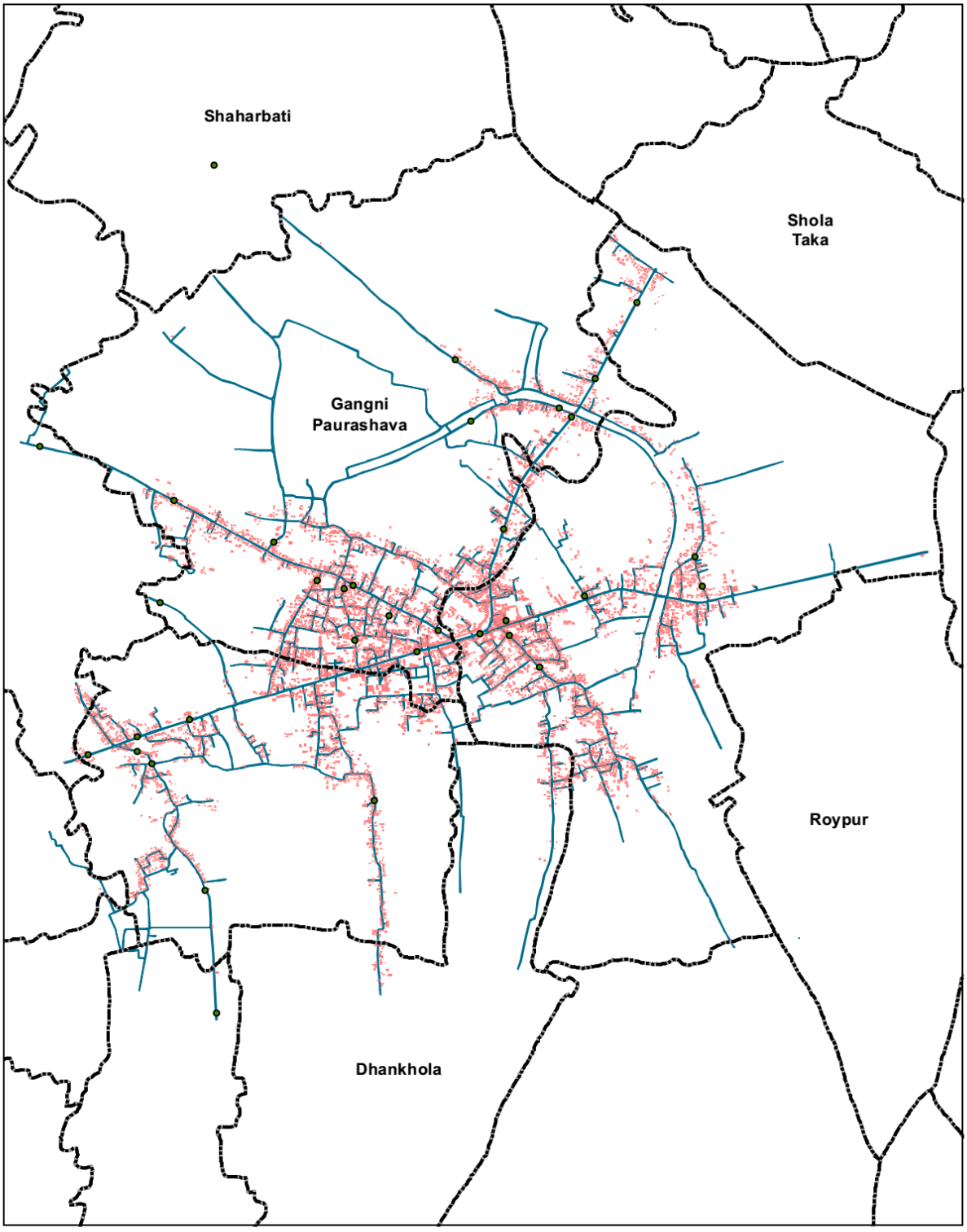


Figure-2.16: Extracted Features of Entire Gangni Upazila by Photogrammetry

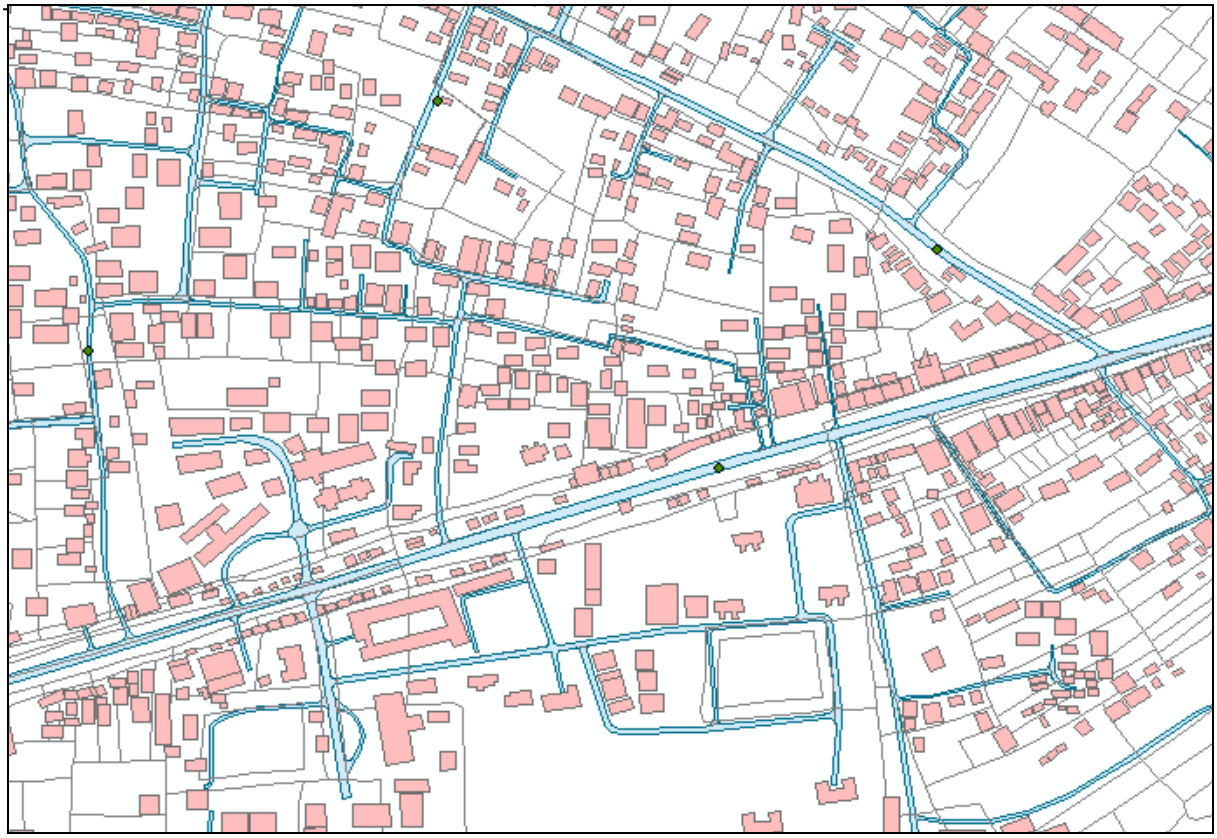


Figure 2.17: Enlarged Partial View of Extracted Features of Gangni

For spot heights acquisition, firstly the DTM points have been generated automatically from stereo pair images by the software. Spot heights or land levels are extracted as DTM points at 10 m intervals for urban area and 20 m intervals for rural areas as described in the TOR. These automatically generated points have been then checked and edited by comparing them with stereo model in photogrammetric workstations. **Figure 2.18** shows the Digital Elevation Model of Meherpur Paurashava of Gangni Upazila. **Figure 2.19** shows the Contour Lines partially of Meherpur paurashava of Gangni Upazila.

The Break-lines have been created and edited after extraction of DTM Points.

The DTM Points and the Break-lines has been used later to create Triangulated Irregular Network (TIN), Digital Elevation Model (DEM) and the Contour Lines which is described in the Topographic Survey Report.

Figure-2.18: Digital Elevation Map (DEM) of Gangni Paurashava (Partial)

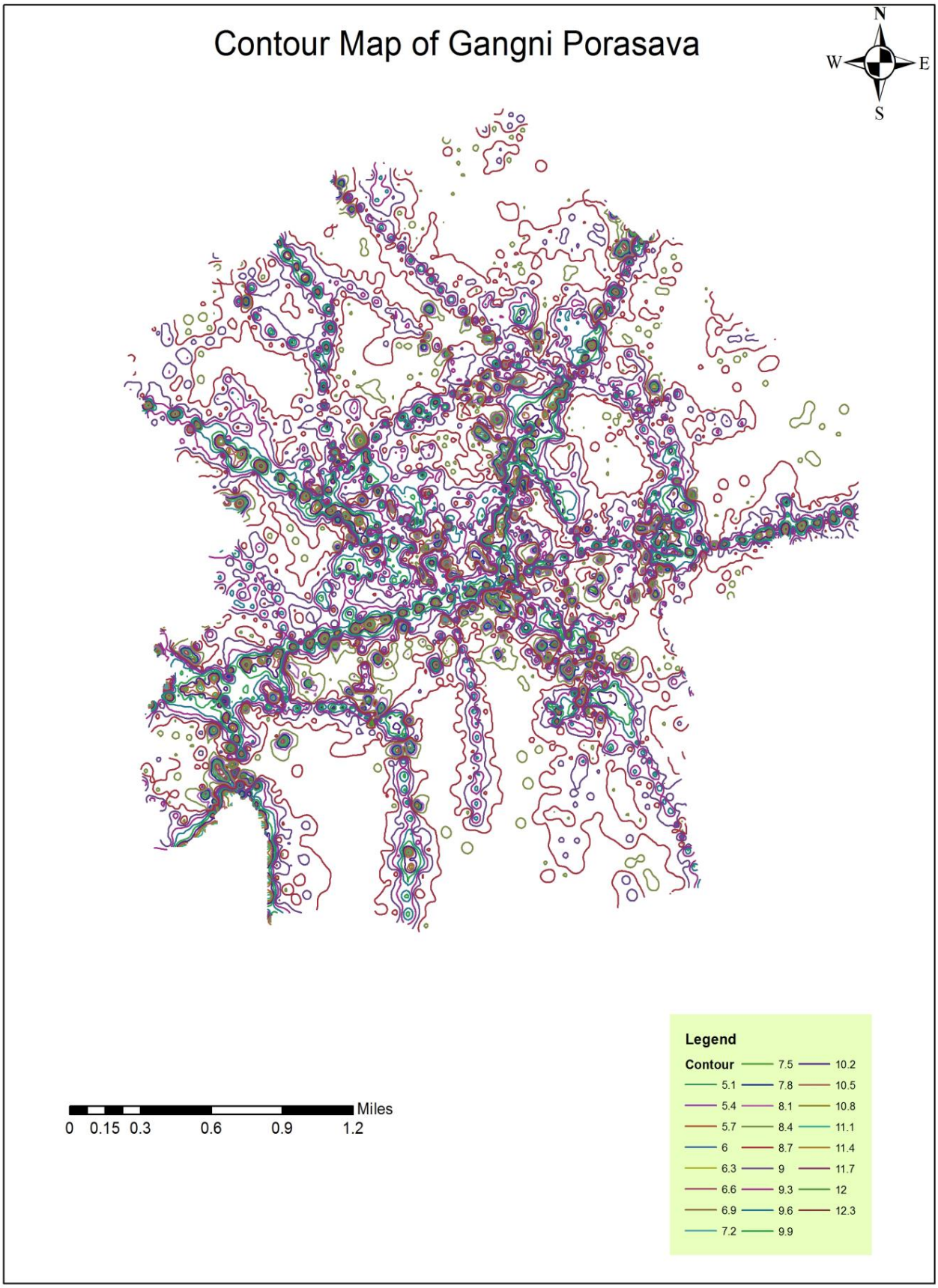


Figure-2.19: Contour Lines of Gangni Paurashava (Partial)

2.4.6 Generation of Ortho-rectified Image

An ortho-rectified image or ortho-photo is an image which has been "corrected" for the geometric distortions (different projection, lens/sensor distortion, relief) so that it can be used as a map.

Using the DEM of the Upazila, the Ortho-rectified image has been created using photogrammetric software. Figure-2.20 shows a part ortho-rectified satellite image of Gangni Upazila.

Figure 2.20: Ortho-Rectified Image of Gangni Upazila (Partial)

Chapter Three: Physical Feature Survey

3.1 Field Level Data Aquisition

The portion contains the survey findings of physical feature survey consisting of all existing structures according to their floor height, structure type as well as uses like residential, commercial activities, industrial activities, educational facilities, health facilities, administrative uses, recreational facilities, religious facilities etc. Moreover it contains the findings of all types of road, bridge/culverts, dyke/embankment, drain/canal, sewer system, solid waste management, water supply system, utility services etc.

3.1.1 Mobilization of Survey Team

A dynamic and qualified survey team experienced with the GPS and Satellite Image based advance technology was mobilized to carry out physical feature survey, landuse survey and topographic survey. The composition of survey team with their qualification is given **Table-3.1**:

Table 3.1: Composition of Survey Team

Field of Expertise	Qualification	No. of Expert/ Technical Staff
Survey Expert	Bachelor of Urban & Regional Planning (BURP)	1
Survey Supervisor	Diploma in Survey/Civil Engineering	3
Surveyor	Diploma in Survey/Civil Engineering	10
Surveyor	Diploma in Survey Engineering	10

For physical survey this survey team was divided into 7 groups (each group contains two surveyors) 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.

3.1.2 Physical Feature Survey

The Physical Feature survey in Gangni Upazila has been carried out using the survey base maps as described in previous chapter. Survey team equipped with GPS/Smart Phone, tape, color pen, map sheet, log book, etc. have gone to field and collected required information. A sample surveyed map sheet is shown in **Figure-3.1** and a sample page of log book with collected information is shown in **Figure-3.2**.

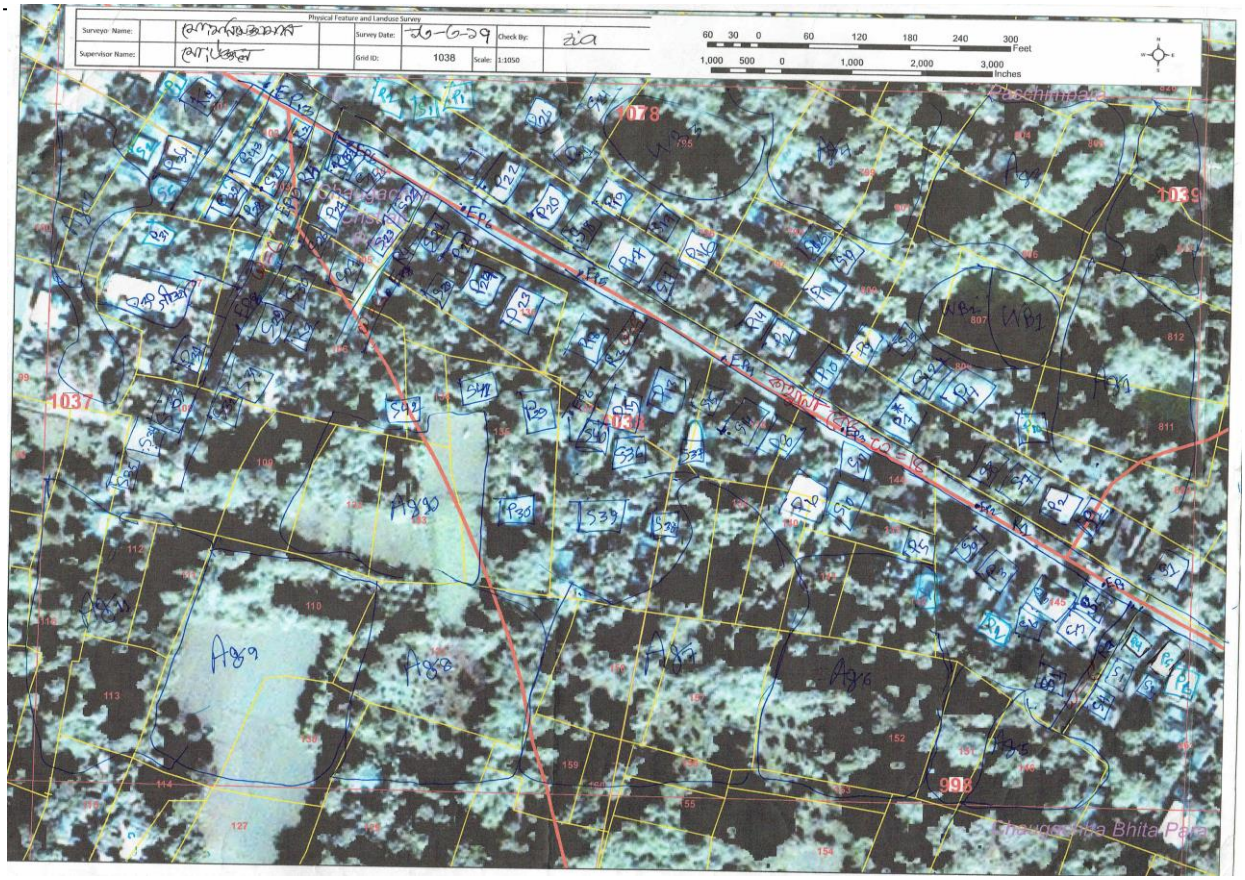


Figure-3.1: Sample Scanned Base Map for Physical Features and Land use Survey

The survey team has collected following information from field:

- Position, dimension and number of story of all structures
- Type of structures according to their construction (Pucca, semi-pucca, katcha).
- Type of structures according to their use (Residential, Commercial, Industrial, Mixed use, etc.)
- Bridge/Culverts, drain along with flow direction width and depth, location of deep tubes well, overhead water tank, electric substation, telephone exchange, Water Treatment plant, waste disposal facilities.

Plate-7: Surveyors Working on the Field in Gangni

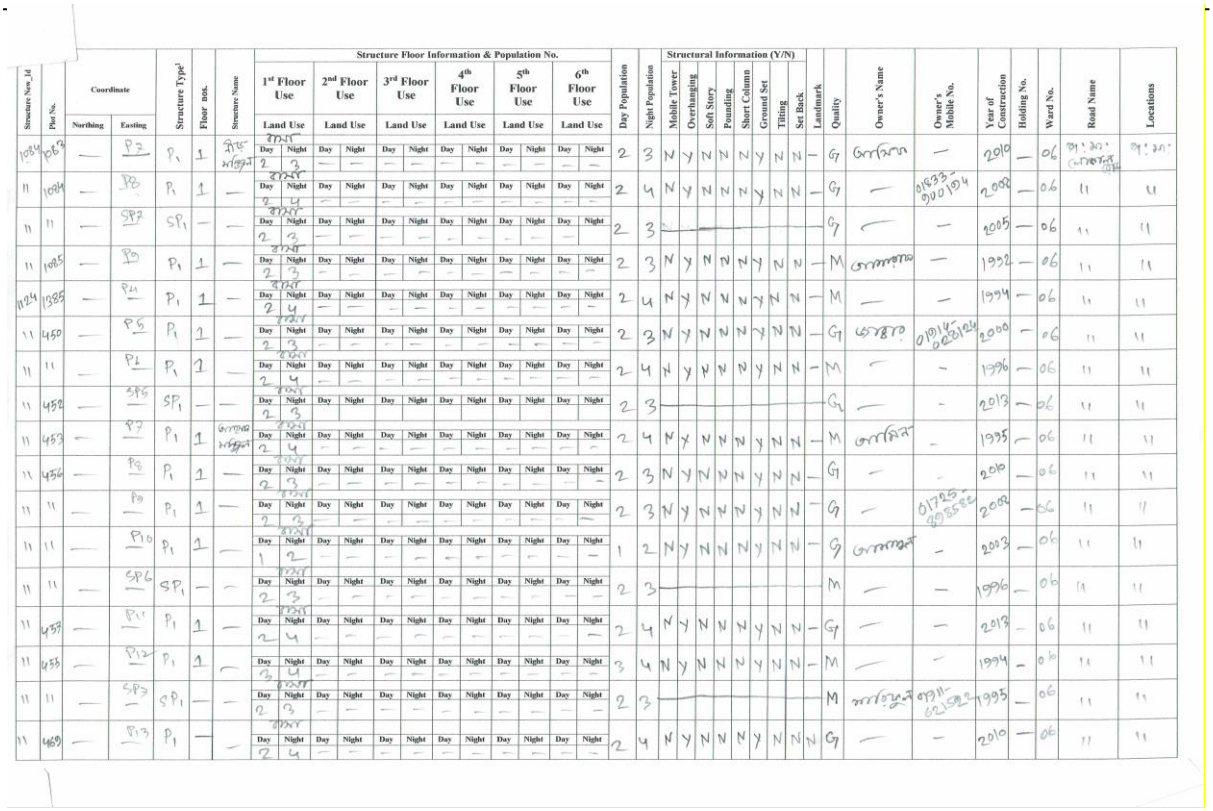


Figure-3.2: Sample Log Book Page with Information Recorded in Field

3.2 Survey Data Processing & Analysis

3.2.1 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.

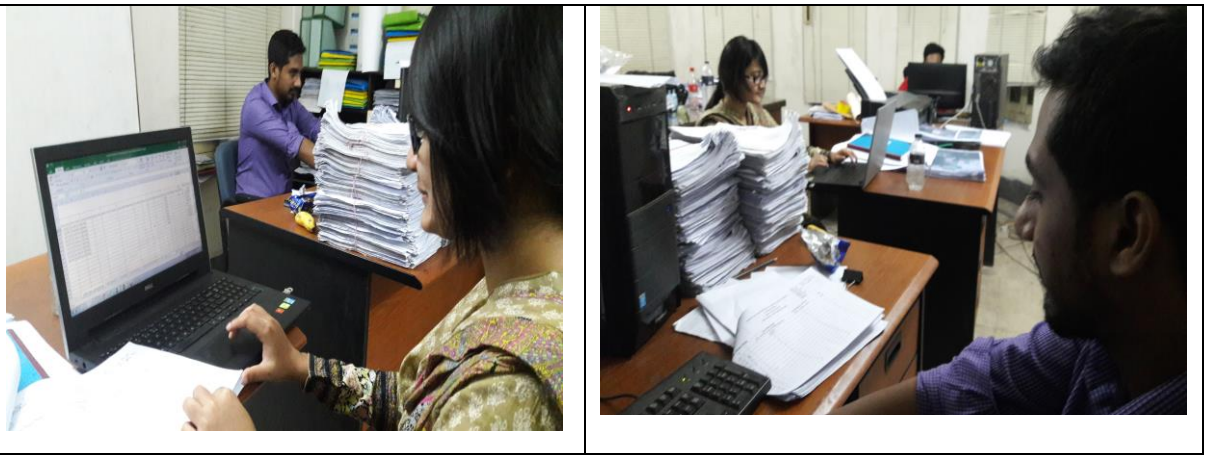


Plate-8: Updating Works through GIS

After digitizing all surveyed features, editing and merging and has been done to get complete data sets of different layers of physical features.

The attribute data collected in the Log Book during the field survey have been entered in a relational database through Microsoft Access. The **Figure-3.3** shows the interface of Data Entry and **Figure-3.4** shows the tabular view of entered data in Microsoft Access.

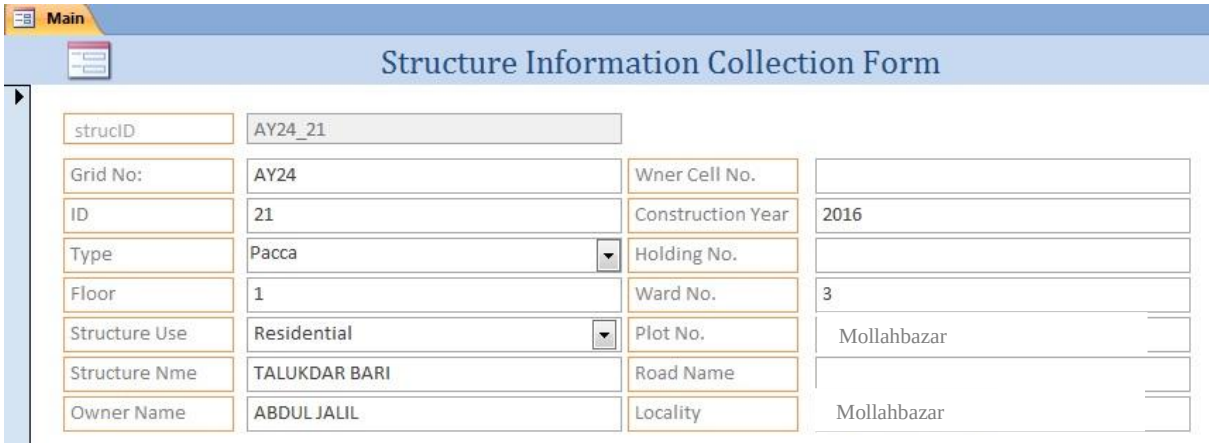


Figure-3.3: Log Book Data Entry Interface in Microsoft Access Software

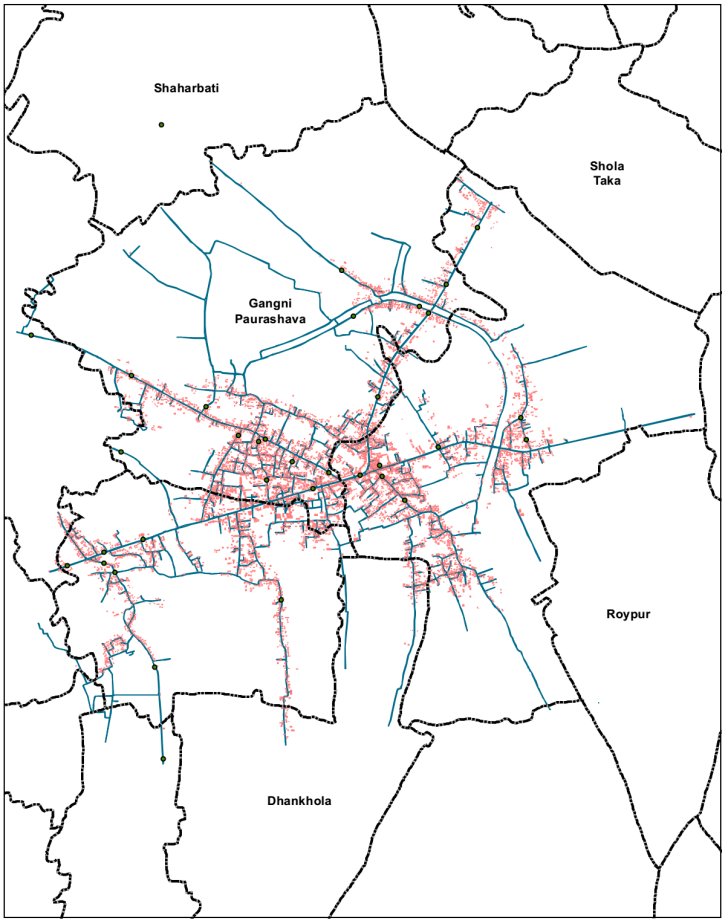
Main | Main

strucID	GridN	SLid	struTyp	Floor	StrUse_1	StrUse	StrNam	OwnerNam	WnerCell	Conty	Holdi
BO14_44	BO14	44	Pacca	1	Mosque	Religious Area	basir mohammad jame mosq	basir mohamm		1970	
BC31_4	BC31	4	Pacca	1	TEMPLE	Religious Area	SRE SRE BOKKHO KALI MANDI			1935	
BO25_25	BO25	25	Pacca	2	Mosque	Religious Area	North Ghatcheck Shahi Jame			1994	
BK29_2	BK29	2	Semi Pacca	1	temple	Religious Area	jogonando mondir			1995	
BR15_8	BR15	8	Pacca	2	Mosque	Religious Area	Dullober Bari Jame Mosque			2000	
BP27_95	BP27	95	Pacca	1	Temple	Religious Area	Maitra Mandir	Dharmasen Ba	01815697679	2013	
BC29_4	BC29	4	Pacca	1	Mosque	Religious Area	FOKANIA MASJID	HAFIZ MAWLA	01819624739	1971	
BC29_6	BC29	6	Pacca	1	ORPHANAGE	Religious Area	FOKANIA	SHAHDAT HOS	01819624739	1971	
BG31_31	BG31	31	Semi Pacca	1	temple	Religious Area	thakur ghor	shomoronjon s			
BR17_15	BR17	15	Pacca	1	Mosque	Religious Area	Mohammadia Jame Mosque			1993	
BA28_16	BA28	16	Pacca	1	Mosque	Religious Area	MOGHOL HAT JAME MOSQUE	MOGHOL BARI		2014	
BK29_14	BK29	14	Pacca	1	Mosque	Religious Area	ali ha mosque			2006	
BL31_51	BL31	51	Pacca	1	Mosque	Religious Area	bokhottor jame mosque			2005	
BG25_61	BG25	61	Pacca	1	Mosque	Religious Area	baitul nur jam e mosque			2006	
BL31_17	BL31	17	Pacca	1	temple	Religious Area	sarbojonin			2002	
BQ21_7	BQ21	7	Katcha	1	Mosque	Religious Area	Khaza Gariber Newaz Jame M			2013	
BD24_33	BD24	33	Pacca	1	TEMPLE	Religious Area		BIRENDRALAL	01823059336	2003	
BK31_58	BK31	58	Pacca	1	Mosque	Religious Area	FORKANUA JAME MASJID			1940	
BD38_54	BD38	54	Pacca	1	Mosque	Religious Area	south nischinta pur jame mos			1970	
BQ11_43	BQ11	43	Semi Pacca	1	MAZAR	Religious Area	HAZRAT ASHRAF UDDIN SHAH	HAZRAT ASHRA		2002	
BP26_61	BP26	61	Katcha	1	MAZAR	Religious Area	SAT ANI JA MAZAR	MURADNAGAF	01868578896	1990	
BQ11_1	BQ11	1	Pacca	1	Mosque	Religious Area	ROSAIPARA JAME MOSJID	AHMED HOSAI		1970	
BN27_66	BN27	66	Semi Pacca	1	mazar	Religious Area	hazrat mustain musa pir auliy				

Figure-3.4: Tabular View of Log Book Data Entry in Microsoft Access Software

The data entry works have been checked and processed as usable format. These attribute data have been linked to spatial data of structures through GIS. Finally structures and all other physical data layers have been developed and finally transformed them in to Bangladesh Universal Transverse Mercator (BUTM2010) Coordinate System.

The processed data have been symbolized using different attribute to visualize the physical features of the project area. Sample processed data has been shown in **Map-3.1** and **Map-3.2.** A 3D display of physical features has been shown in **Figure-3.5**.



Map-3.1: Structure Use in Gangni Town Area

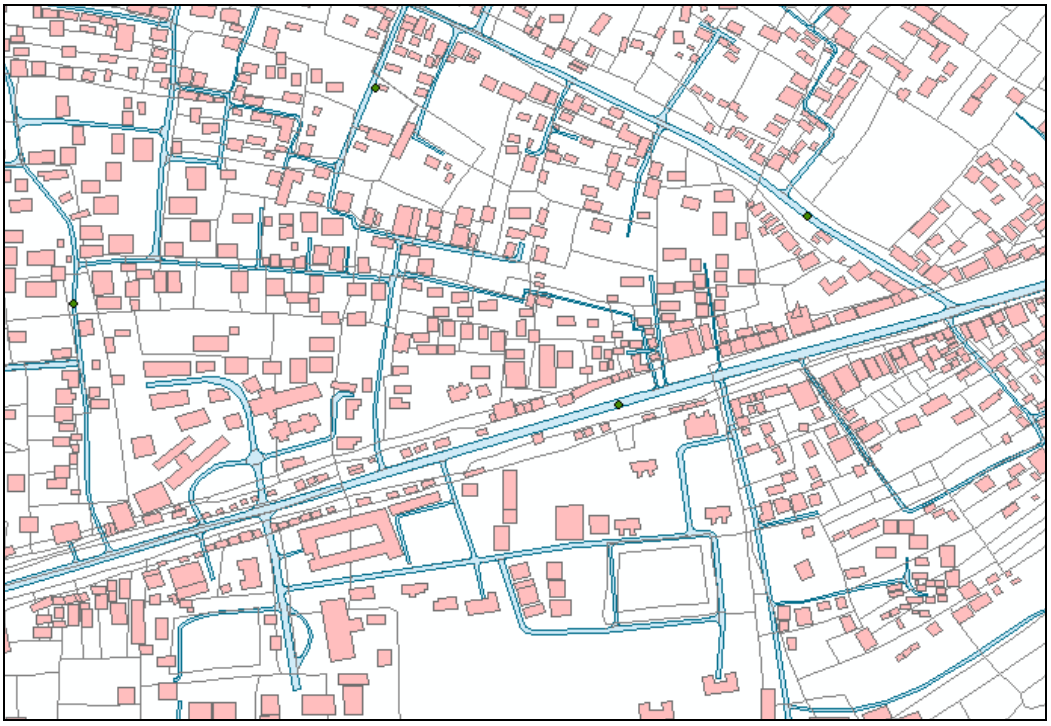
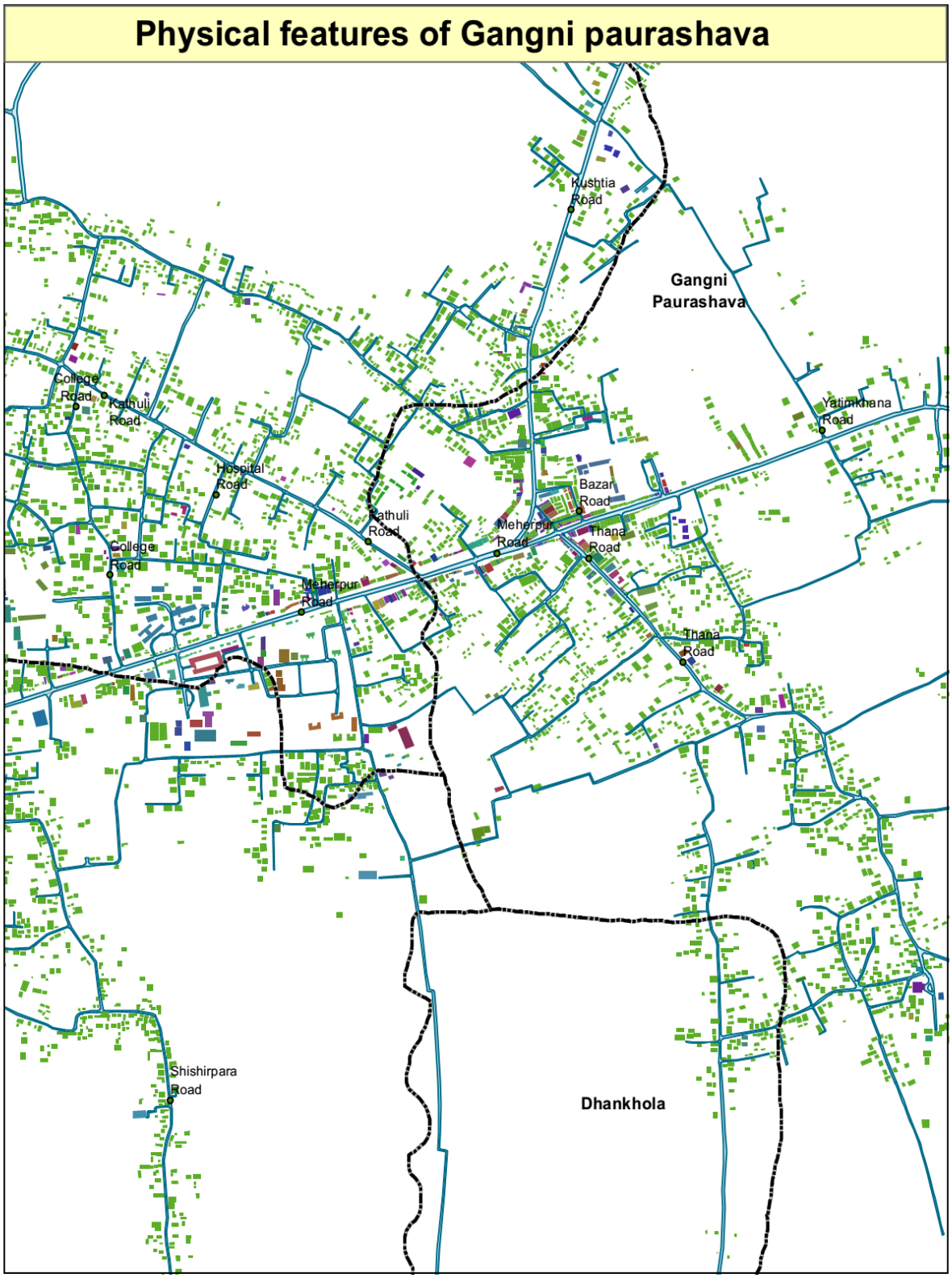


Figure-3.5: 3D Display of Physical Features in Gangni Town Area



Map-3.2: Structure Type and Use in Gangni Town Area

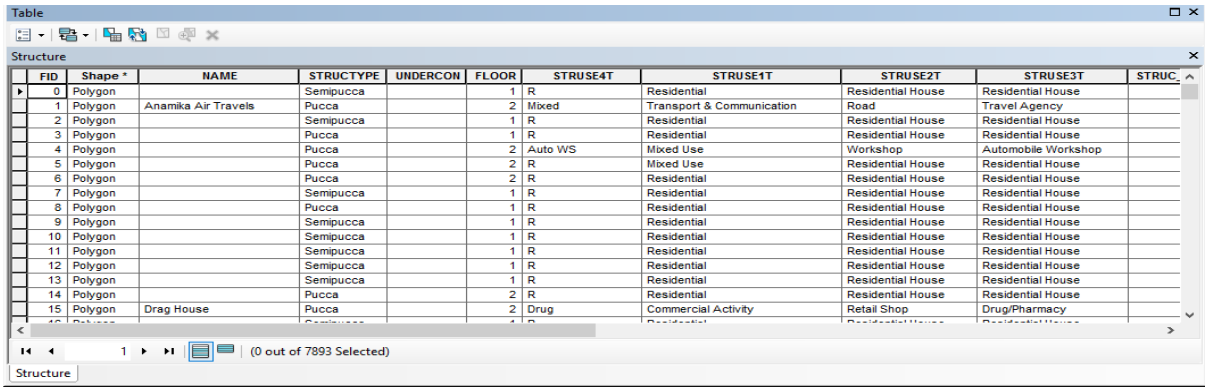
3.2.2 Development of GIS Database

A GIS database has been developed for systematically organizing, storing and easy retrieving the information and data of the project area. ArcGIS File Geo-database has 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**.

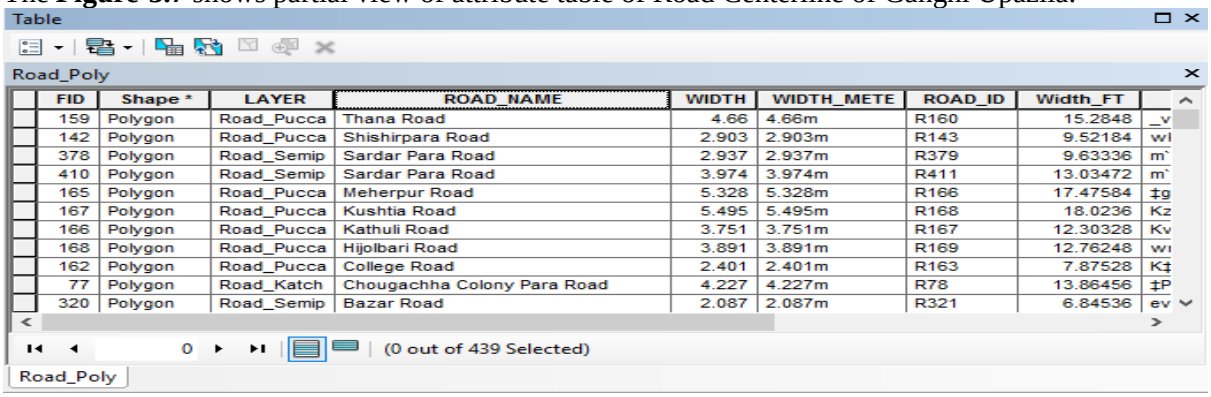
The **Figure-3.6** shows partial view of attribute table of Structures of Gangni Upazila.



FID	Shape *	NAME	STRUCTYPE	UNDERCON	FLOOR	STRUSE4T	STRUSE1T	STRUSE2T	STRUSE3T	STRUC
0	Polygon		Semipucca		1	R	Residential	Residential House	Residential House	
1	Polygon	Anamika Air Travels	Pucca		2	Mixed	Transport & Communication	Road	Travel Agency	
2	Polygon		Semipucca		1	R	Residential	Residential House	Residential House	
3	Polygon		Pucca		1	R	Residential	Residential House	Residential House	
4	Polygon		Pucca		2	Auto WS	Mixed Use	Workshop	Automobile Workshop	
5	Polygon		Pucca		2	R	Mixed Use	Residential House	Residential House	
6	Polygon		Pucca		2	R	Residential	Residential House	Residential House	
7	Polygon		Semipucca		1	R	Residential	Residential House	Residential House	
8	Polygon		Pucca		1	R	Residential	Residential House	Residential House	
9	Polygon		Semipucca		1	R	Residential	Residential House	Residential House	
10	Polygon		Semipucca		1	R	Residential	Residential House	Residential House	
11	Polygon		Semipucca		1	R	Residential	Residential House	Residential House	
12	Polygon		Semipucca		1	R	Residential	Residential House	Residential House	
13	Polygon		Semipucca		1	R	Residential	Residential House	Residential House	
14	Polygon		Pucca		2	R	Residential	Residential House	Residential House	
15	Polygon	Drag House	Pucca		2	Drug	Commercial Activity	Retail Shop	Drug/Pharmacy	

Figure-3.6: Attribute Table of Structure Database of Gangni Upazila

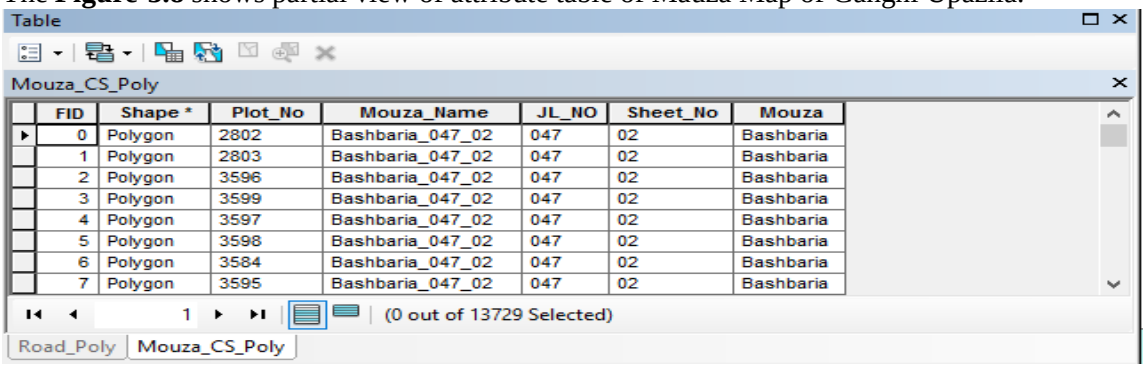
The **Figure-3.7** shows partial view of attribute table of Road Centerline of Gangni Upazila.



FID	Shape *	LAYER	ROAD_NAME	WIDTH	WIDTH_METE	ROAD_ID	Width_FT	
159	Polygon	Road_Pucca	Thana Road	4.66	4.66m	R160	15.2848	_v
142	Polygon	Road_Pucca	Shishirpara Road	2.903	2.903m	R143	9.52184	wl
378	Polygon	Road_Semip	Sardar Para Road	2.937	2.937m	R379	9.63336	m`
410	Polygon	Road_Semip	Sardar Para Road	3.974	3.974m	R411	13.03472	m`
165	Polygon	Road_Pucca	Meherpur Road	5.328	5.328m	R166	17.47584	‡g
167	Polygon	Road_Pucca	Kushtia Road	5.495	5.495m	R168	18.0236	Kz
166	Polygon	Road_Pucca	Kathuli Road	3.751	3.751m	R167	12.30328	Kv
168	Polygon	Road_Pucca	Hijolbari Road	3.891	3.891m	R169	12.76248	wı
162	Polygon	Road_Pucca	College Road	2.401	2.401m	R163	7.87528	K‡
77	Polygon	Road_Katch	Chougachha Colony Para Road	4.227	4.227m	R78	13.86456	‡P
320	Polygon	Road_Semip	Bazar Road	2.087	2.087m	R321	6.84536	ev

Figure-3.7: Attribute Table of Road Polygon of Gangni Upazila

The **Figure-3.8** shows partial view of attribute table of Mauza Map of Gangni Upazila.



FID	Shape *	Plot_No	Mouza_Name	JL_NO	Sheet_No	Mouza
0	Polygon	2802	Bashbaria_047_02	047	02	Bashbaria
1	Polygon	2803	Bashbaria_047_02	047	02	Bashbaria
2	Polygon	3596	Bashbaria_047_02	047	02	Bashbaria
3	Polygon	3599	Bashbaria_047_02	047	02	Bashbaria
4	Polygon	3597	Bashbaria_047_02	047	02	Bashbaria
5	Polygon	3598	Bashbaria_047_02	047	02	Bashbaria
6	Polygon	3584	Bashbaria_047_02	047	02	Bashbaria
7	Polygon	3595	Bashbaria_047_02	047	02	Bashbaria

Figure-3.8: Attribute Table of Mauza Map of Gangni Upazila

The **Figure-3.9** shows partial view of Scanned Mauza Map Files of Gangni Upazila.

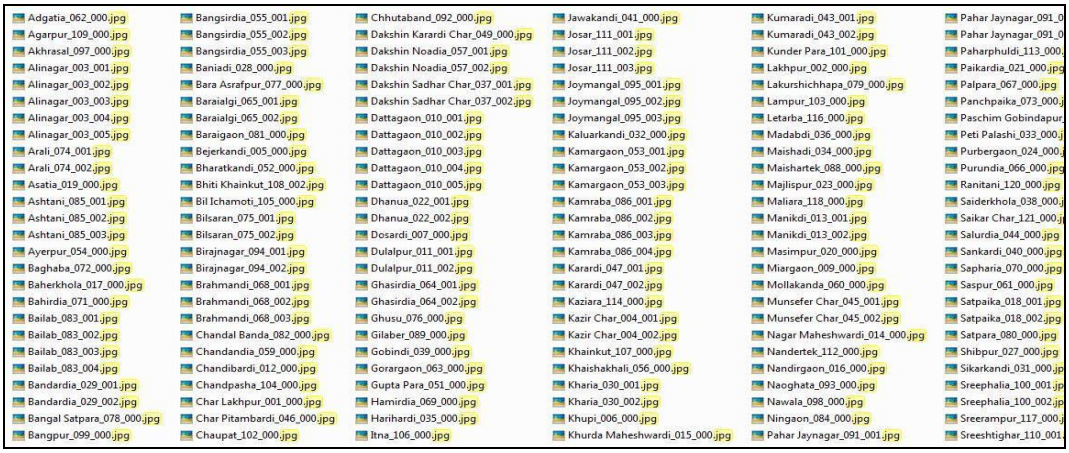


Figure-3.9: Catalog View of Scanned Mauza Map Files of Gangni Upazila

The **Figure-3.10** shows partial view of Geodatabase of Digitized Mauza Maps Files of Gangni Upazila.

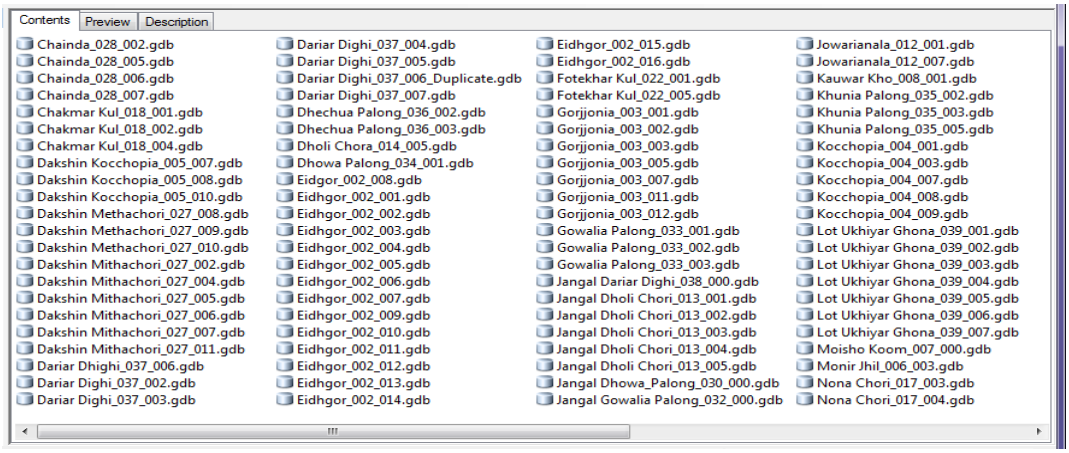


Figure-3.10: Catalog View of Geodatabases of Digitized Mauza Maps of Gangni Upazila

3.2.3 Field Verification/Ground Truthing

After developing the GIS database and preparing the field checking map the accuracy of the physical feature database is checked by the UDD and the consulting firm jointly. From 17th august, 2016 the surveyors of UDD and consulting firm are visited the Gangni upazila for field checking. Field checking is done by keeping focus on the following area:

- Dimension and shape of the features
- Accuracy of feature's attributes
- Missing objects.

Plate-9: Field Checking in Gangni by UDD and Consulting Firm

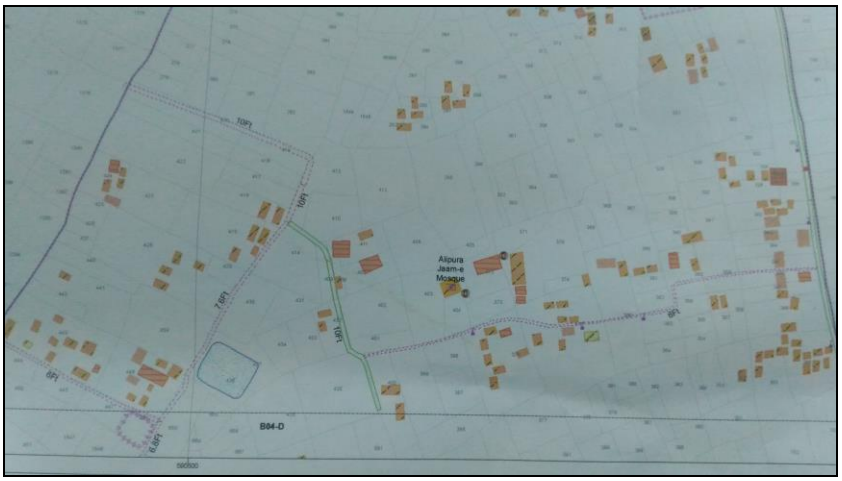


Plate-10: Physical Feature Map for Field Checking in Gangni

3.2.4 Earthquake Vulnerability Assessment

Structural vulnerability assessment involves checking whether a building in a seismically active area has sufficient robustness to withstand a specific magnitude earthquake. This is done by analyzing the building structurally in terms of its design, construction and materials in terms of international standards and local building codes, as appropriate. Where buildings are found to be non-resistant or have insufficient resilience to an expected earthquake of a given magnitude (e.g. a 'design' earthquake) remedial measures can be designed and costed for subsequent retrofitting. In extreme cases, the buildings should be demolished and reconstructed.

For this vulnerability assessment some criteria of a structure have been assessed. Such as: Pounding effect, Tilting, ground setting, set back rules, Overhanging, Soft story, Short column etc. The survey has been done through the whole upazila and if any of the problems is found the data has been collected with pictures. Some example of data collection of vulnerability assessment is given below:

Plate-11: Vulnerability Assessment at Gangni Upazila

Chapter Four: Land Use Survey

Land Use Survey is a major element in any planning endeavor. Thorough detail land use survey and collection of required information of the project area are needed that helps draw up the plan in a better way.

The Land use survey was carried out by recording the current use of the land in the study area. The current use of land was classified according to the provisions given in the TOR. Land use survey, basically, records the use of land by its functional activity such as residential, industrial, commercial etc. The maps prepared for physical survey were used as base map for land use survey. Land use features were identified and classified using the recorded code and separated in different layers during data processing stage, from where category wise land use map were drawn using the identification layers of each of the land uses features.

4.0 Field Level Data Acquisition

4.1.1 Mobilization of Survey Team

A dynamic and qualified survey team experienced with the GPS and Satellite Image based advance technology was mobilized to carry out land use survey and along with physical feature survey. The composition of survey team with their qualification is given below:

Table 4.1: Composition of Survey Team

Field of Expertise	Qualification	No. of Expert/ Technical Staff
Survey Expert	Bachelor of Urban & Regional Planning (BURP)	1
Survey Supervisor	Diploma in Survey/Civil Engineering	1
Surveyor	Diploma in Survey/Civil Engineering	12
Surveyor	Diploma in Survey Engineering	10

For Land use survey, this survey team was divided into 7 groups (each group contains two surveyors) to collect land use boundary and all physical features i.e. structures, water bodies, roads, etc. with their attributes. All these groups were supervised by the Survey Expert and the Survey Supervisor.

4.1.2 Land Use Survey

The Land use survey has been carried out by recording the current use of the land in the study area. The current use of land has been classified according to provision given in the TOR. Land use survey basically records the use of land by its functional activity such as residential, industrial or commercial. The maps prepared through physical survey have been used as base map for land use survey. Land use features were identified and classified using the recorded code and drawing the boundaries using different color pencils (Figure 4.1). The following color code has been applied in field work of land use map. The Figure 4.2 shows the land use base map after survey.

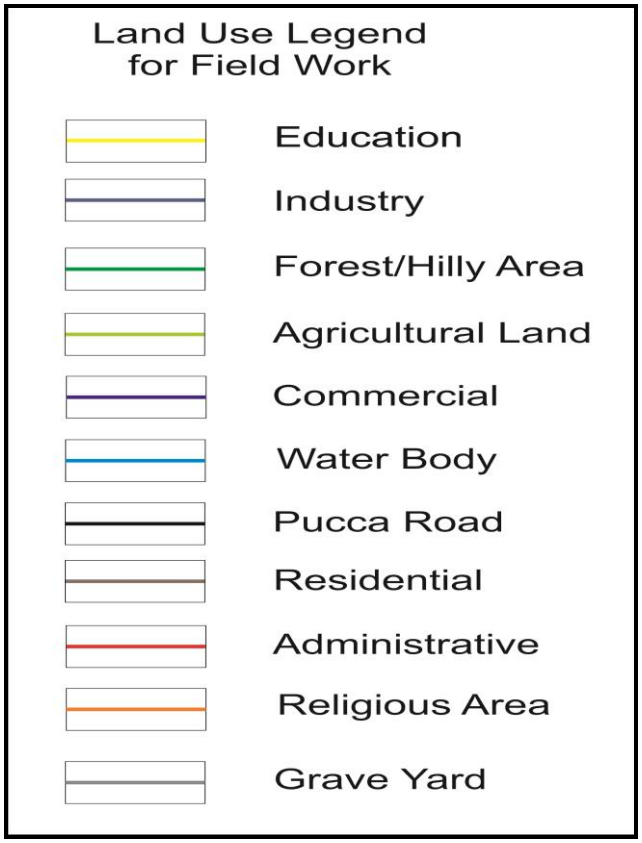


Figure 4.1: Color used by Color pencil for Land Use Demarcation

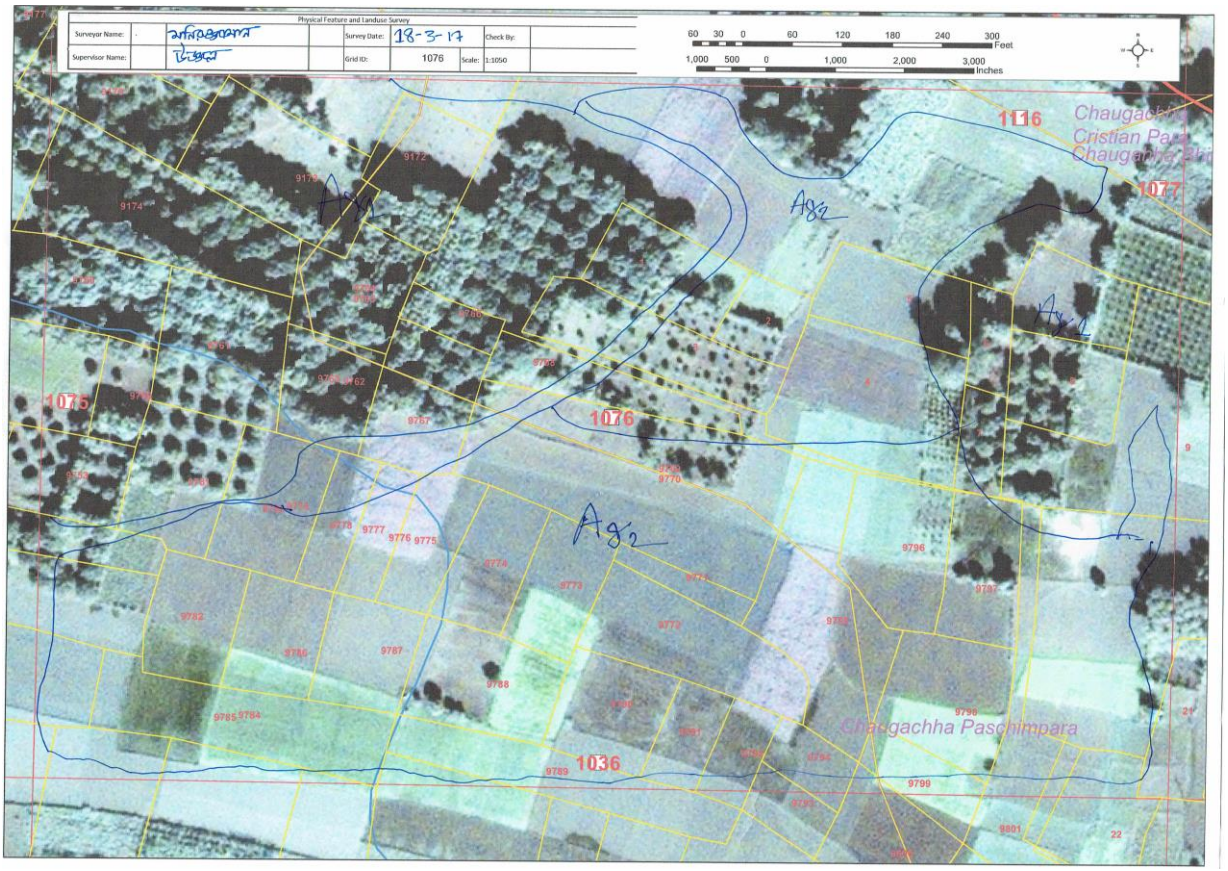


Figure 4.2: Landuse Base Map used in Gangni Upazila

The methodology and technique followed are as follows:

- Checking every plot of land and demarking unique uses with color pencils
- Checking building and other structure and its current use.
- Checking infrastructure provisions
  - ✓ Social infrastructure e.g. school, hospital, etc. with location
  - ✓ Physical infrastructure e.g. housing, offices, energy, work, sanitation etc.
  - ✓ Transportation with width of roads with and without drainage links with other areas etc.
- Recording of natural physical conditions of the land like: rivers, drainage, canals etc.
- Review of topography of the area from the Topographic Maps.

4.2 Survey Data Processing & Analysis

4.2.1 Processing of Land Use Data

During data processing stage, all type of land use data has been properly processed to obtain the unique land uses. Firstly, survey map sheets have been scanned and geo-referenced, then land use boundary have been digitized with their attributes. On the other hand, physical feature data has been used to identify land use boundaries and categorize then into respective land use categories. The surveyed physical features (structures, roads, water bodies, etc. and land use boundaries, etc.) marked on the sheets were then digitized using the ArcGIS software.

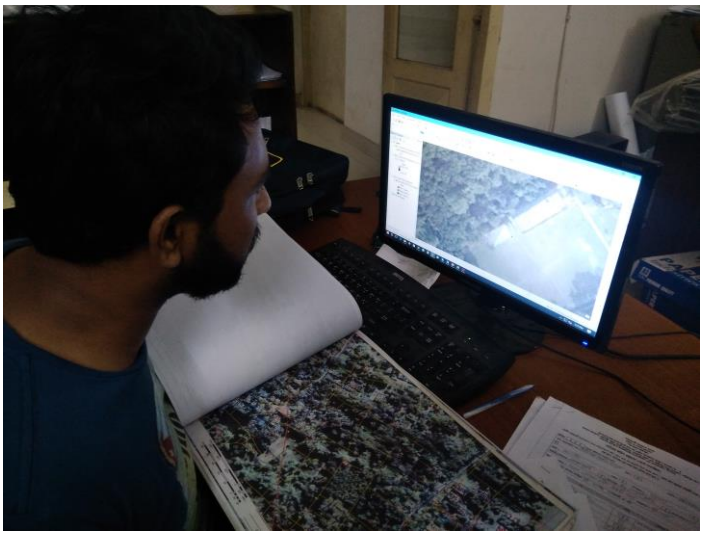
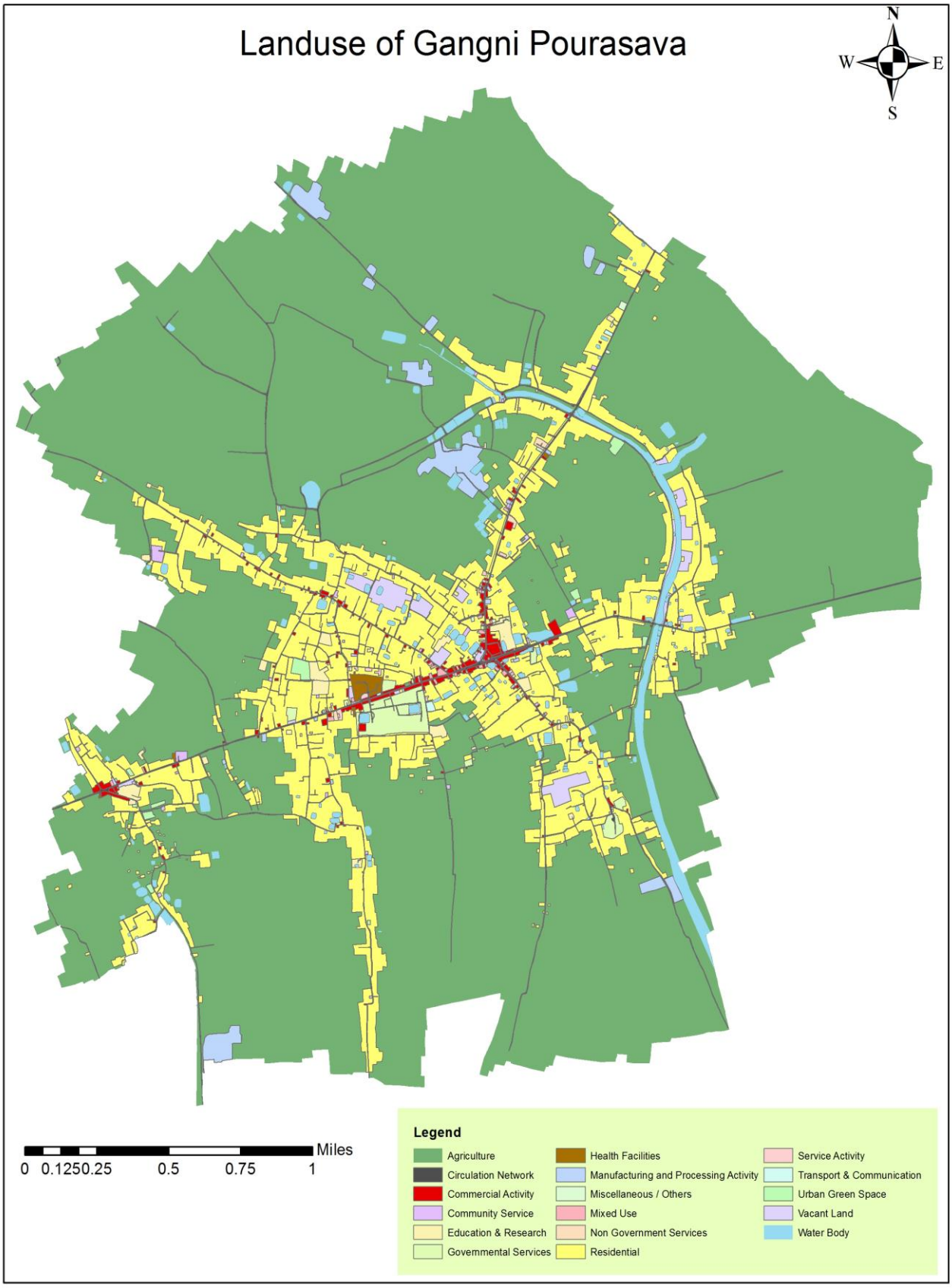


Plate-10: Updating works using Surveyed Map

4.2.2 Preparation of Land Use Map

Utilizing the land use and physical feature base map the land use maps were prepared showing the broad categories of land use. The characteristics of each land use area have fully been described in the survey report. The Land Use Maps were prepared at specified scale based on the data collected through land use survey and the information of the base map.

Details about land use have been provided in Table 4.2 and generalized land use pattern of Gangni town area has been presented in Map-4.1.



Map-4.1: Land Use in Gangni Town Area

Table 4.2: Land Use Categories

Sl. No.	Land uses	Illustrated
1.	**Urban Residential Zone**	Planned Residential Area, Govt. Quarters, Private Housing, Rest/Guest/Circuit House, Banglow, Mess, Orphanage/Old Home, Rural Homestead, Slum, Squatters. House type Pacca, Semi-pacca, Katcaha and Tin Shed are also enlisted at urban residential zone.
2.	**Rural Settlement**	Rural settlement includes the low dense residential area which is scattered and rural in nature. It may permit only low density uses. Aiming to control the growth in this zone, less service and facilities will be provided.
3.	**Commercial Zone**	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. Growth centers, Small Bazar, Watehouses are also enlisted under commercial zone.
4.	**Mixed Use Zone**	Commercial – Residential, Office – Residential, Commercial – Industrial, Two or More categories more use.
5.	**General Industrial Zone**	Green and Orange, A categories as per The Environment Conservation Rules, 1997
6.	**Heavy Industrial Zone**	Other toxic and pollution industries (Orange B and Red categories as per the Environment Conservation Rules, 1997)
7.	**Government Services/ 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 Chamber, Doctor's Chamber, Political Party Office, Professional's Association, Labor Union. Upazila Hearquarter, AC (Land) office can also mark as government services.
8.	**Non-Government Services**	Other office/service area which are not included in government services.
9.	**Educational and Research Zone**	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

Sl. No.	Land uses	Illustrated
		Institute, Library, Museum, Social Welfare Institution, Kindergarten, University and Madrasas.
10.	**Agricultural Zone**	Single crop land, Double crop land, Triple crop land, Barren land, Mangogarden/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.
11.	**Water body**	Equal or more than 0.25 acre and justification by the consultant and wel land will merge with water body. Pond, Beels/Marshlands, /Lake/Ditch, Lakes, River, Khals, Streams, Drain.
12.	**Open Space**	Playground, Park, Botanical Garden, Stadium, Zoo etc. (Facilities without or with minimum building structure)
13.	**Vacant Land**	Barren Land, Char Land, Gravel Pits, Low Laying Area, Sand Quarries.
14.	**Recreational Facilities**	Facilities other than those mentioned to Open Space and indoor based facilities with designated building structure such as: Cinema Hall, Theater Hall, Museum & Art gallery, Auditorium /Community Center/Town Hall, Park/Playground/Amusement Park/Theme Park, Stadium/ Gymnasium/ Swimming Pool, Tennis Complex.
15.	**Circular Network**	All areas covered by the roads and rail ways (Broad/Meter Gauge) network. Bridge, Culvert, Foot over Bridge, Railway Bridge.
16.	**Transport Facilities and Communication**	Under transport and communication land use, both transport and communication services are considered. This category includes Roads, Airport, Helicopter Station, Rail Station, Bus/Truck Terminal/Stand, Boat/Ferry Ghat, Refueling Filing Station, Garage, Launch Terminals, Passenger Shed, Telephone Exchange, Ticket counter, Road Island, Footpath, Transport office, post office/Post Box, River Port, Traffic Signal Port etc.
17.	**Utility Services**	Utility services include Overhead Tank, Power Office/Control Room, Public Toilet, Sewerage Office, Waste Disposal, Water Pump House, Water Reservoir, Drainage and Sewerage System, Water/Sewerage Supply Line, Water Treatment Plant etc.
18.	**Health Services/ Facilities**	Govt. Hospital / Pvt Hospital / Mental Hospital/ Maternity/ Children Hospital / Clinic/ Diagnostic Center, Clinic, Community Hospital and Veterinary Hospital.
19.	**Community Facilities/ Services**	Community Center, Social Club, Slaughter House, Monument, Graveyard, Crematorium, Cemetery, Eidgah, Shahid Minar etc. which will provide service to the community.
20.	**Religious Area/ Facilities**	Mosque, Eidgah/Mazar/Dargha, Madrasha, Temple, Church, Pagoda, Graveyard, Cemetery, Cremation place.
21.	**Historical and Heritage Site**	The entire mentionable historical and heritage site.
22.	**Restricted Area/ Facilities**	A Restricted Area is an area where no one but certain people can enter. Here, the areas which are not accessible for the general public except some high ranked personnel are considered as restricted area. Cantonment/BDR/Navy, Reserved Forest, TV Station, Radio Station, T&T Board, Power Supply Station.
23.	**Forest/ Groups of Trees**	Designated Forest area or Forest land.
24.	**Beach**	Sea Beach
25.	**Hilly Area/ Hillock**	Designated Hilly Area with Tilla.
26.	**Miscellaneous**	Any other categories which are not related to above categories. EPZ, BM, Growth Centre, Fire Service, Garland, Brick Field, Drainage Outfall, Embankment, River cum embankment, Char, Coastline, Flood Wall, Slum.

The Legend for Existing Generalized Land use is shown in Figure-4.3.

Legend

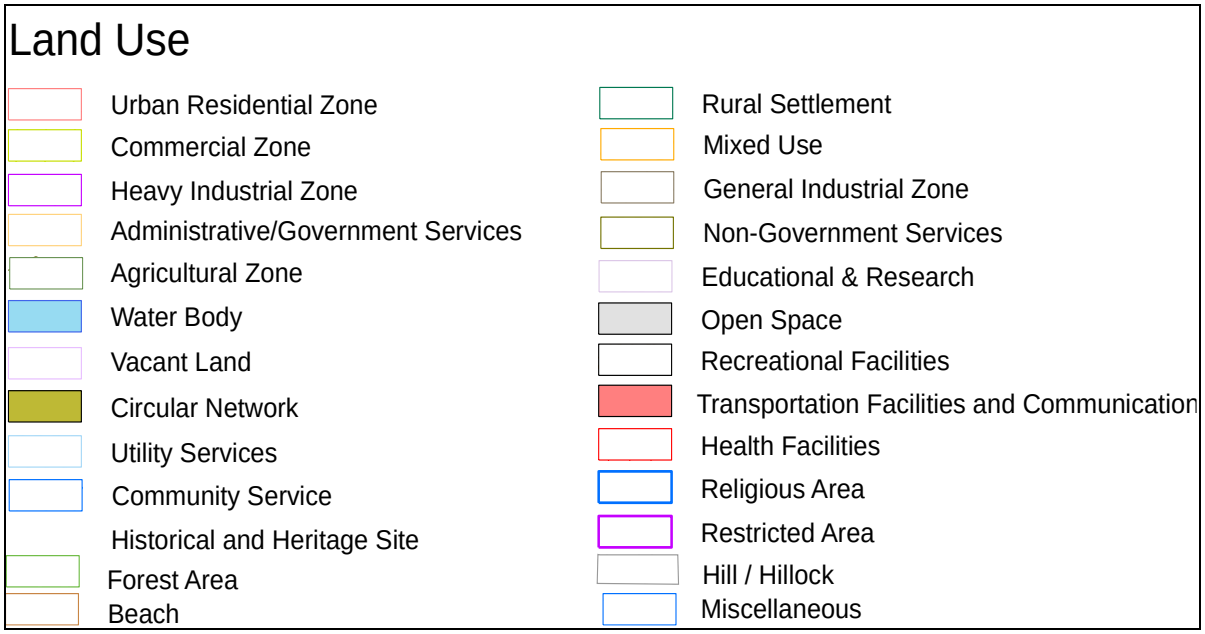


Figure-4.3: Legend for Existing Generalized Landuse

Figure-4.4: Legend for Existing Important Point Feature

Table- 4.3: Generalize Land Use Information of the Project Area (The table below is for Gangni Paurashava)

Sl	LANDUSE	Area
1	Agriculture	3304.59
2	Circulation Network	67.07
3	Commercial Activity	23.80
4	Community Service	5.48
5	Education & Research	18.43
6	Governmental Services	23.83
7	Health Facilities	5.07
8	Manufacturing and Processing Activity	42.66
9	Miscellaneous / Others	1.05
10	Mixed Use	2.65
11	Non Government Services	1.98
12	Residential	682.06
13	Service Activity	2.71
14	Transport & Communication	1.06
15	Urban Green Space	6.31
16	Vacant Land	29.38
17	Water Body	89.47

Chapter Five: Topographic Survey

Topography is the study of the shape and features of the surface of the Earth and other observable objects. The topography of an area could refer to the surface shapes and features themselves or a description, specially their depiction in maps. Topographic surveys are carried out to identify and map the contours of the ground and features on the surface or slightly above or below the surface of the earth. Contours are imaginary lines that connect locations of similar elevation. A topographic map is a detailed and accurate two-dimensional representation of natural and human-made features on the Earth's surface. These maps are used for a number of applications like land use planning, resource management, , urban planning etc.

Topographic survey is a very important survey as it shows the suitable land for future development. Topographic Survey means measuring the surface of the earth of any area with standard known coordinates of X, Y, and Z value.

5.1 Field Level Data Acquisition

5.1.1 Mobilization of Survey Team

A dynamic and qualified survey team experienced with the GPS and Satellite Image based advance technology was mobilized to carry out land use survey and along with physical feature survey. The composition of survey team with their qualification is given below:

Table 5.1: Composition of Survey Team

Field of Expertise	Qualification	No. of Expert/ Technical Staff
Survey Expert	Bachelor of Urban & Regional Planning (BURP)	1
Survey Supervisor	Diploma in Survey/Civil Engineering	3
Surveyor	Diploma in Survey/Civil Engineering	10
Surveyor	Diploma in Survey Engineering	10

For Topographic survey, the survey team was divided into 7 groups (each group contains two surveyors) to collect topographic features which could not be collected through photogrammetry due to dense vegetation, clouds, etc. All these groups were supervised by the Survey Expert and the Survey Supervisor

5.1.2 Topographic Survey

The topographic survey of whole project area is inconvenient for direct ground surveying using RTK-GPS and Total Stations within a survey season. Hence, the Consultant adopted the photogrammetric surveying by which topographic data have been extracted from the 3D imagery (stereo imagery) of the project area.

In Photogrammetric Surveying, all topographic features are recorded in three dimensions (x, y, z coordinates) and topography is described by using mass points (spot levels) and break-lines (to describe a change of slope). Spot heights or land levels are extracted as DTM points at 10 m intervals for urban area and 20 m intervals for rural areas as described in the TOR. This data, together with 3D features (road edges, bank of river and other water bodies, etc), are used as break-lines to make

Digital Terrain Models (DTMs), Digital Elevation Model (DEM), Triangulated Irregular Network (TIN), and the Contours.

In the densely vegetated area and clouded area RTK-GPS and Total Stations are used mainly to obtain 3-D data (X,Y, Z value) for enriching the photogrammetric data of roads, flood embankments and other drainage divides, drainage and irrigation channels. The Survey team carried out the survey to collect topographic features as much as possible using survey equipment and the satellite image based map sheets. The surveyors collected the following features from the field:

- Alignment of rivers, lake, canal and drainage channels etc. showing depth and direction of flow.
- Alignment of roads, embankments, dykes and other drainage divides.
- Outline of bazaars, water body, swamps, barren land, low land, borrow pits, forest, open space, restricted area, etc.

5.2 Data Processing & Analysis

5.2.1 Processing of Topographic Data

Using the photogrammetric data of DTM Points and the Break-lines Triangulated Irregular Network (TIN) and the Digital Elevation Model (DEM) has been generated. From these derived data the contour lines have been generated with 0.3 meter interval using ArcGIS software. **Map-5.1** shows the DEM of of Gangni paurashava of Gangni Upazila and the **Map-5.2** shows the Contour Lines partially of Gangni Paurashava of Gangni Upazila.

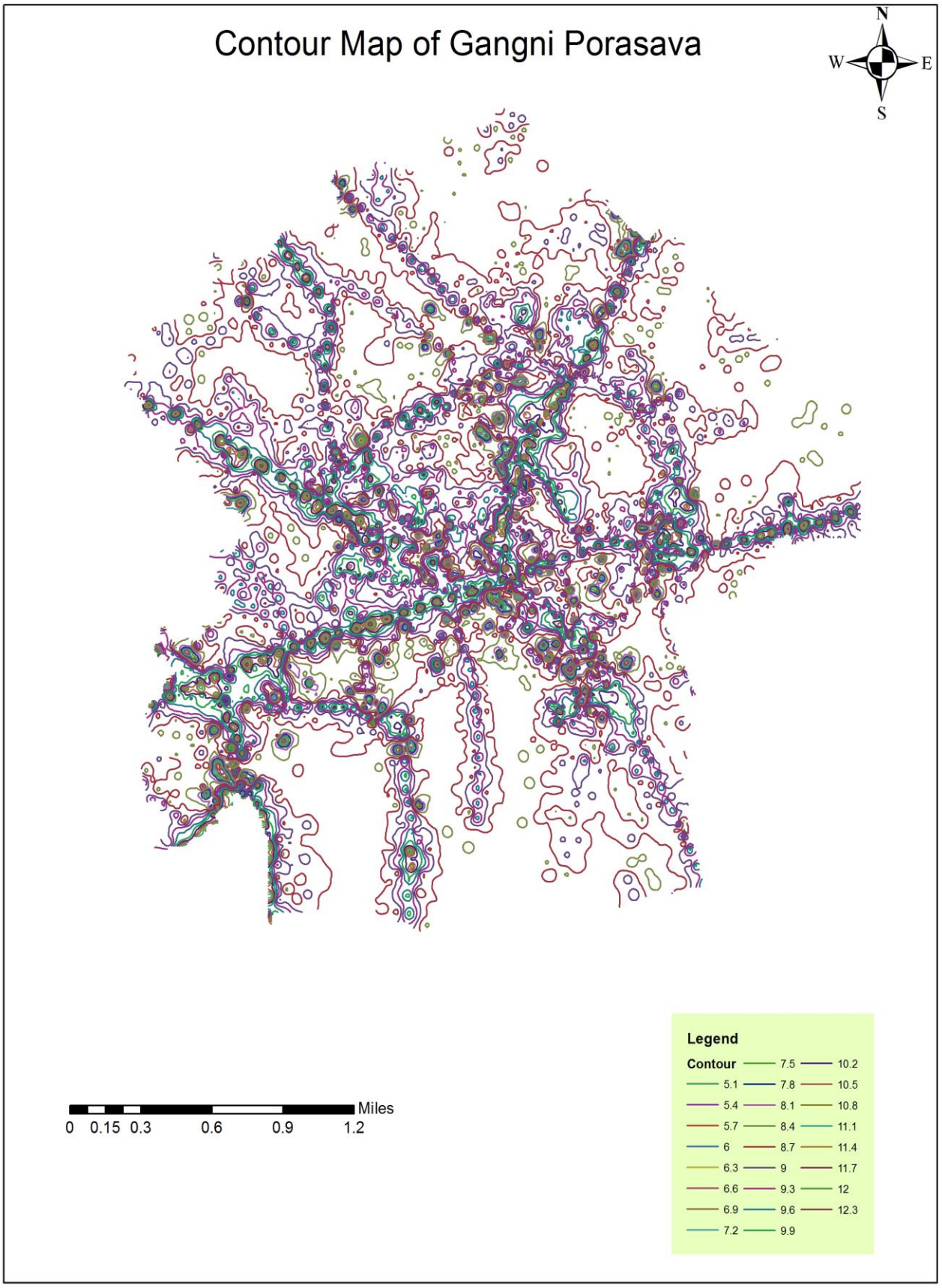
5.2.2 General Topography of Gangni Upazila

Almost the whole of the Meherpur a number of small rivers and channels is uniform level. The general topography of the study area is ranges from 5.1 **to 12.3** meter MSL.

Table 5.2: General Height Information

Total Project Area	Maximum Height (Meter)	Average Height (Meter)	Minimum Height (Meter)
341.98 **sq.km**	**12.3**	**9.0**	**5.1**

Map-5.1: Digital Elevation Model of Gangni Upazila


Contour Map of Gangni Porasava
N
W
E
S
Legend
Contour
7.5
10.2
5.1
7.8
10.5
5.4
8.1
10.8
5.7
8.4
11.1
6
8.7
11.4
6.3
9
11.7
6.6
9.3
12
6.9
9.6
12.3
7.2
9.9
Miles
0 0.15 0.3 0.6 0.9 1.2

Map-5.2: Contour map of Gangni Paurashava (Partial)

5.2.3 Alignment and Crest Level of Major Roads

The alignment is the route of the road and crest level is the top surface of road, usually known as carriageway.

Geographically, most of the study area lies above flood level and as a result road is the prime means of movement. In Gangni, two major highways pass through the study area neighboring area like Gangni to Nagarkanda Road, Rajbari Sadar to Gangni Road etc. Besides, the study area is also well connected by number of arterial roads with all parts of the study area.

Table-5.3: Crest level of major roads along their alignment in Gangni

Name of the road	Height of crest level from MSL, in meter		
	Minimum	Maximum	Average
Gangni to MeherpurRoad	9.4	12.3	10.3
Kathuli to Gangni Road	9.6	12.1	10.41
Gangni to Kushtia Road	8.9	12.0	9.8

Source: Topographic survey, 2016

Chapter Six: Photogrammetric Works

6.1 Satellite Image Processing

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. The step by step procedures has been shown in the **Figure-6.1**

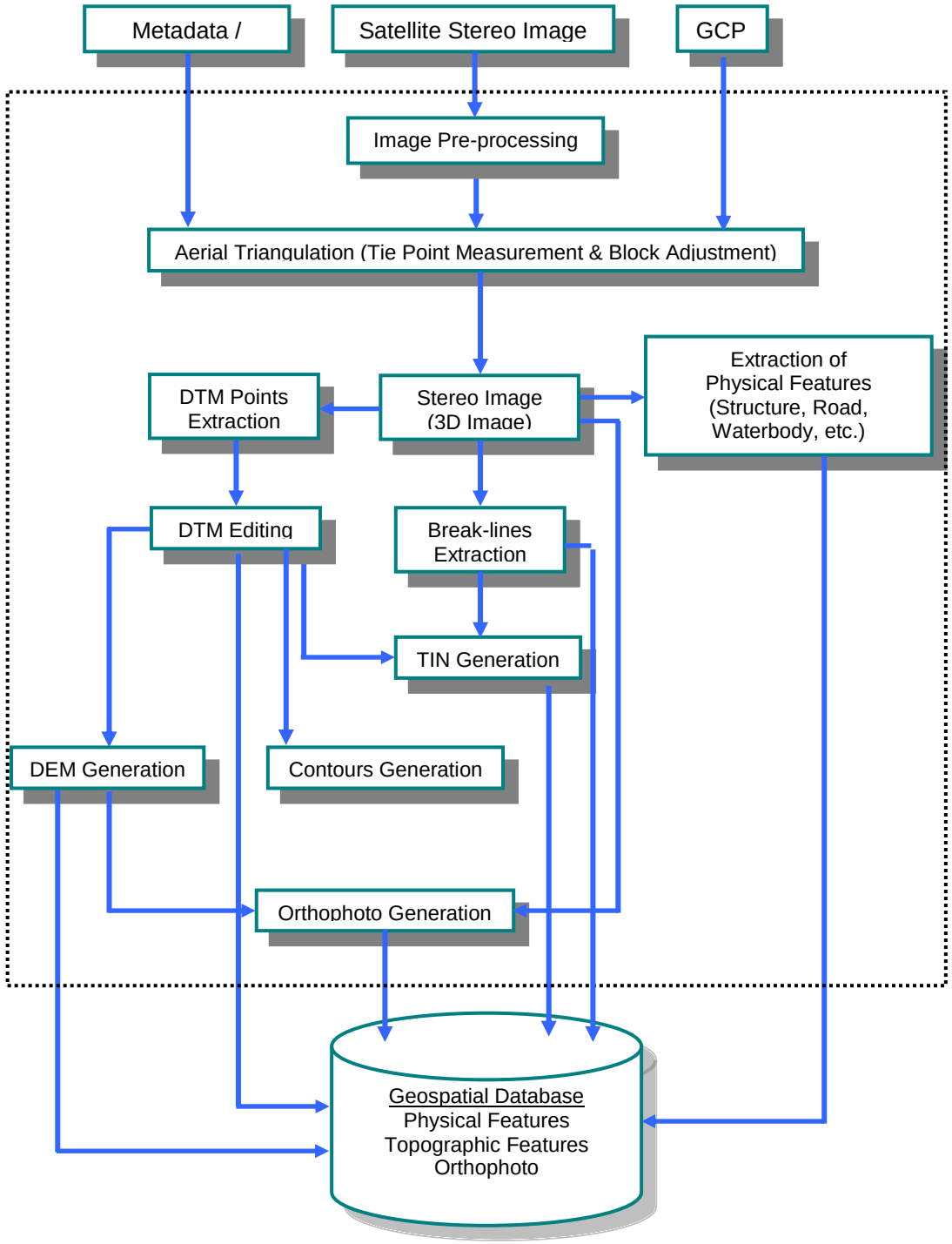


Figure-6.1: Workflow of Stereo Satellite Image Processing and Data Extraction

6.1.1 Image Collection

The satellite image was ordered to Airbus, France. The authorized reseller/partner of Airbus. 0.5 meter stereo pair image has been purchased by the Consultant for Gangni. The specifications of the purchased satellite image are as below:

Gangni Upazila:

Image Sensor	: Airbus
Type	: Ortho ready stereo (3D)
Resolution	: 0.5m Panchromatic, 2.0 meter Multispectral
Source	: New Acquisition, 12 March 2016
Total Area	: 341.98 Sq. km.
Bit Rate	: 16 Bit
Company	: Airbus Defence and Space.

6.1.2 Image Pre-Processing

Satellite image came with two parts. One is multispectral band which resolution is 1.74 meter and another one is panchromatic which resolution is 0.5 meter. We need 0.5 meter multispectral image for feature extraction. After collecting raw digital images, the tasks involved in image processing are:

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

6.1.2.1 Merge, Color Balance and Pan-Sharpen

Satellite image comes with lots of small segment which called image tile so that image can be sent by the provider on DVD media. To create an individual image all image tiles have been merged and thus an individual large image has been created.

Image tiles may vary in color and contrast. So during the merge process, color and contrast has been adjusted to get a color balanced image. **Figure-6.2** shows the satellite image tiles without color and contrast balance.

During the image capturing time, satellite captures two types of image, one in multispectral (RGB & NIR) image which is low resolution (2.0 meter) and another in high resolution (0.5 meter) panchromatic image. For feature extraction, 0.5 meter high resolution (0.5m) multispectral image is required. To have this 0.5 meter multispectral image, pan-sharpening tools have been used. This tool produces a 0.5 meter multispectral image by combining 2.0 meter multispectral image and 0.5 meter panchromatic image. **Figure-6.3** shows the merged satellite image with color and contrast balance.

Figure-2.11: Tiles of satellite image without color and contrast balance

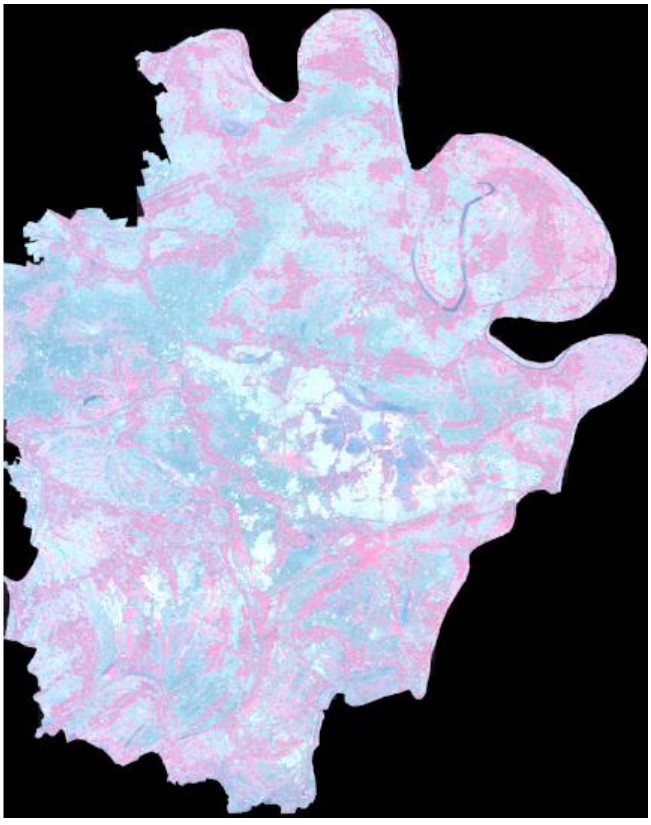


Figure-2.12: Merged satellite image with color and contrast balance

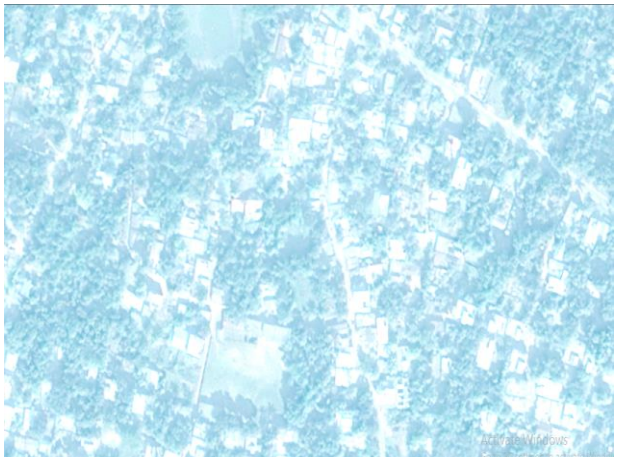


Figure-2.13: Satellite Image Multispectral Image 2.0 meter

Figure-2.14: Satellite Image Panchromatic 0.5 meter

Figure-2.15: Pan-sharpen Image - multispectral 0.5 meter

6.1.2.2 Bit Rate, Pyramid and Epi-polar Correction

Bit Rate: In general practice 8 bit images are used. Satellite image can capture 11 bit image. Since the purchased satellite image is in 16bit, 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.

Epi-polar Correction: Epi-polar geometry is the geometry of stereo vision. When two cameras view a 3D scene from two distinct positions, there are a number of geometric relations between the 3D points and their projections onto the 2D images that lead to constraints between the image points. The 3D models have been created by using the Summit Evolution software.

6.1.3 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.

6.1.4 Aerial Triangulation

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

Table-6.1: Input-output in Aerial Triangulation

	Input for AT	Output of AT
(6)	IMU data	Geo-referenced Stereo Model
(7)	GPS (on board)	
(8)	GCP (collected from field)	
(9)	Image	
(10)	RPC file	

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

6.1.5 Digital Mapping (Feature Extraction) from Stereo Model

After the orientation of stereo models, digital mapping has been carried out. ArcGIS Geo-database model has been used for storing geo-spatial data. The Geo-database and its feature classes has been designed based on ToR.

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 vector data storing and editing.

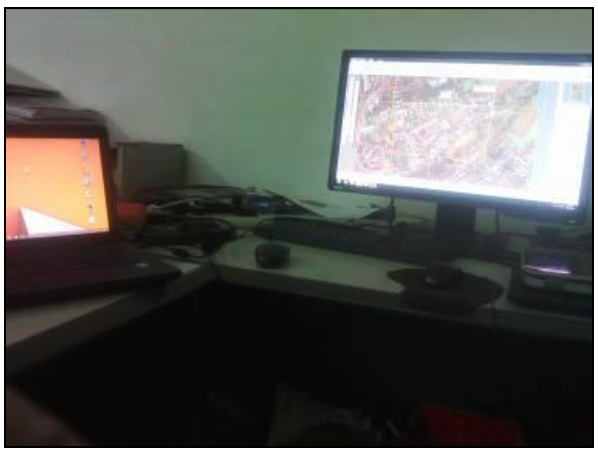


Plate-11: Digital Photogrammetric Workstation (DPW)

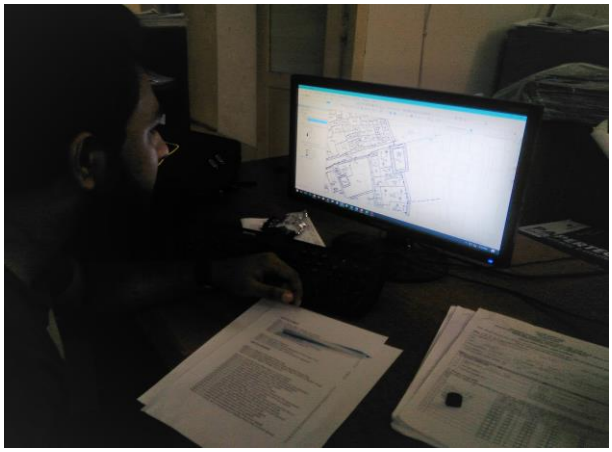


Plate-12: Photogrammetrist Extracting Features in DPW

A team of photogrammetrists has digitized Building roof with MSL height, bridge/culvert, road, khal, pond, lake, ditch, marsh/swam, river, etc. All features have been digitized in 3-dimension (X,Y,Z).

Figure-6.7 and **Figure-6.8** shows the extracted features of Gangni Upazila at a glance.

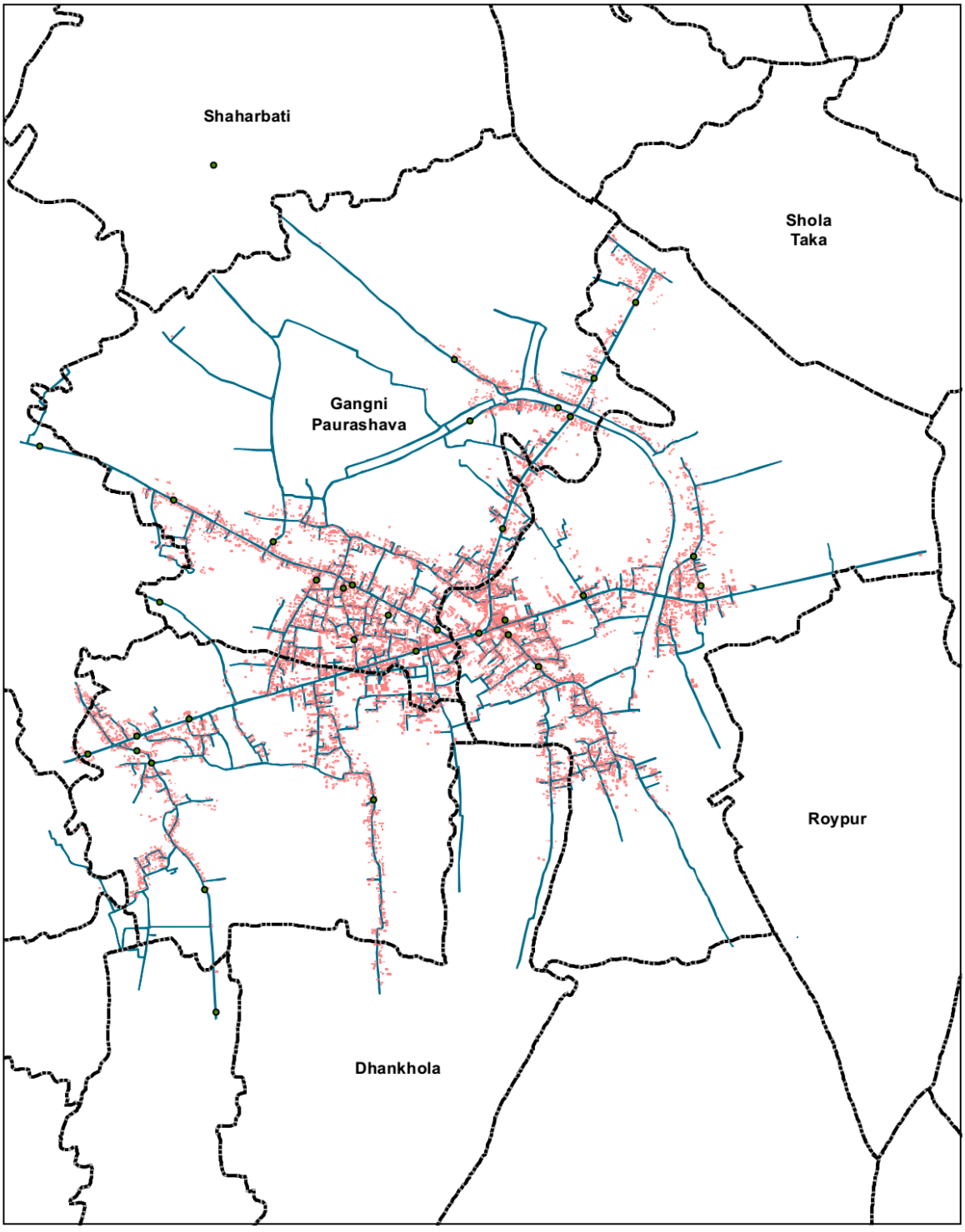


Figure-6.7: Extracted Features of Entire Gangni Upazila by Photogrammetry

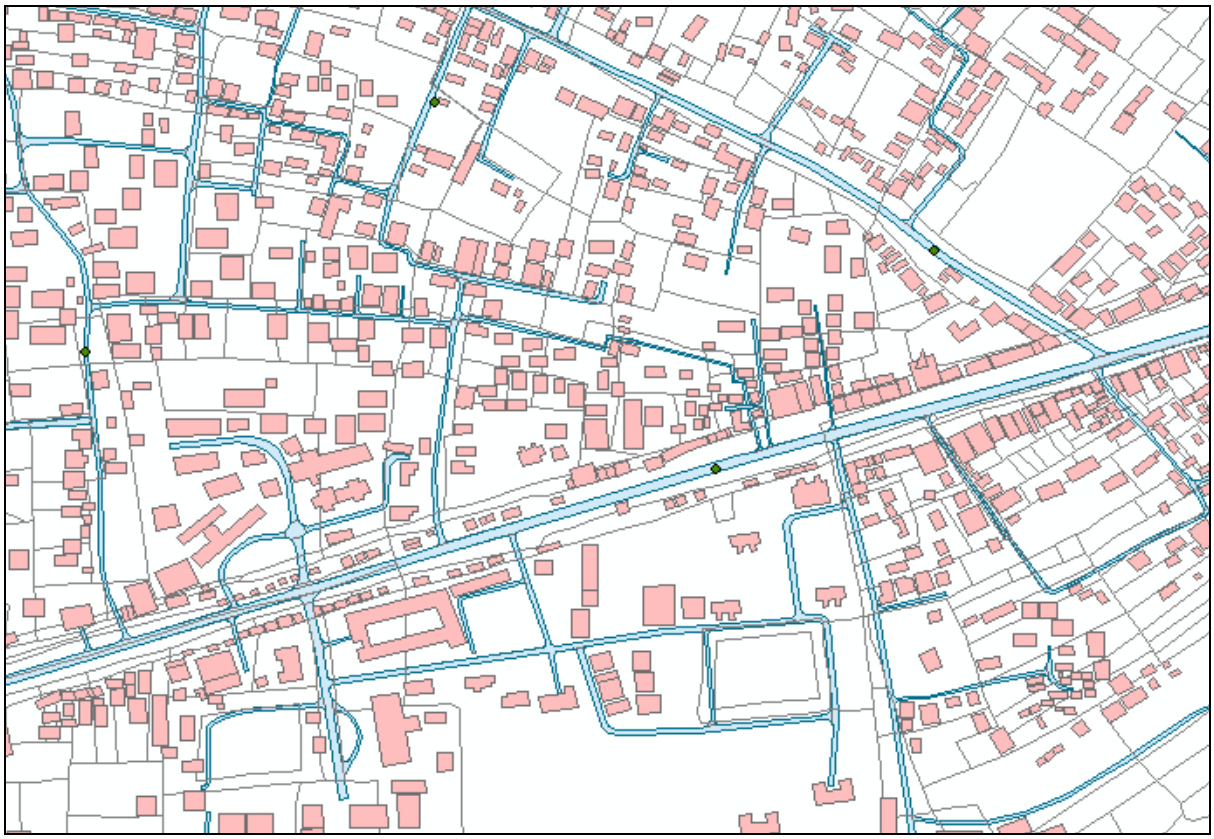


Figure-6.8: Enlarged Partial View of Extracted Features of Gangni

For spot heights acquisition, firstly the DTM points have been generated automatically from stereo pair images by the software. Spot heights or land levels are extracted as DTM points at 10 m intervals for urban area and 20 m intervals for rural areas as described in the TOR. These automatically generated points have been then checked and edited by comparing them with stereo model in photogrammetric workstations. **Figure 6.9** shows the Digital Elevation Model of Gangni Paurashava of Gangni Upazila. **Figure 6.10** shows the Contour Lines partially of Gangni paurashava of Gangni Upazila.

The Break-lines have been created and edited after extraction of DTM Points.

The DTM Points and the Break-lines has been used later to create Triangulated Irregular Network (TIN), Digital Elevation Model (DEM) and the Contour Lines which is described in the Topographic Survey Report.

Figure-6.9: Digital Elevation Map (DEM) of Gangni Paurashava (Partial)

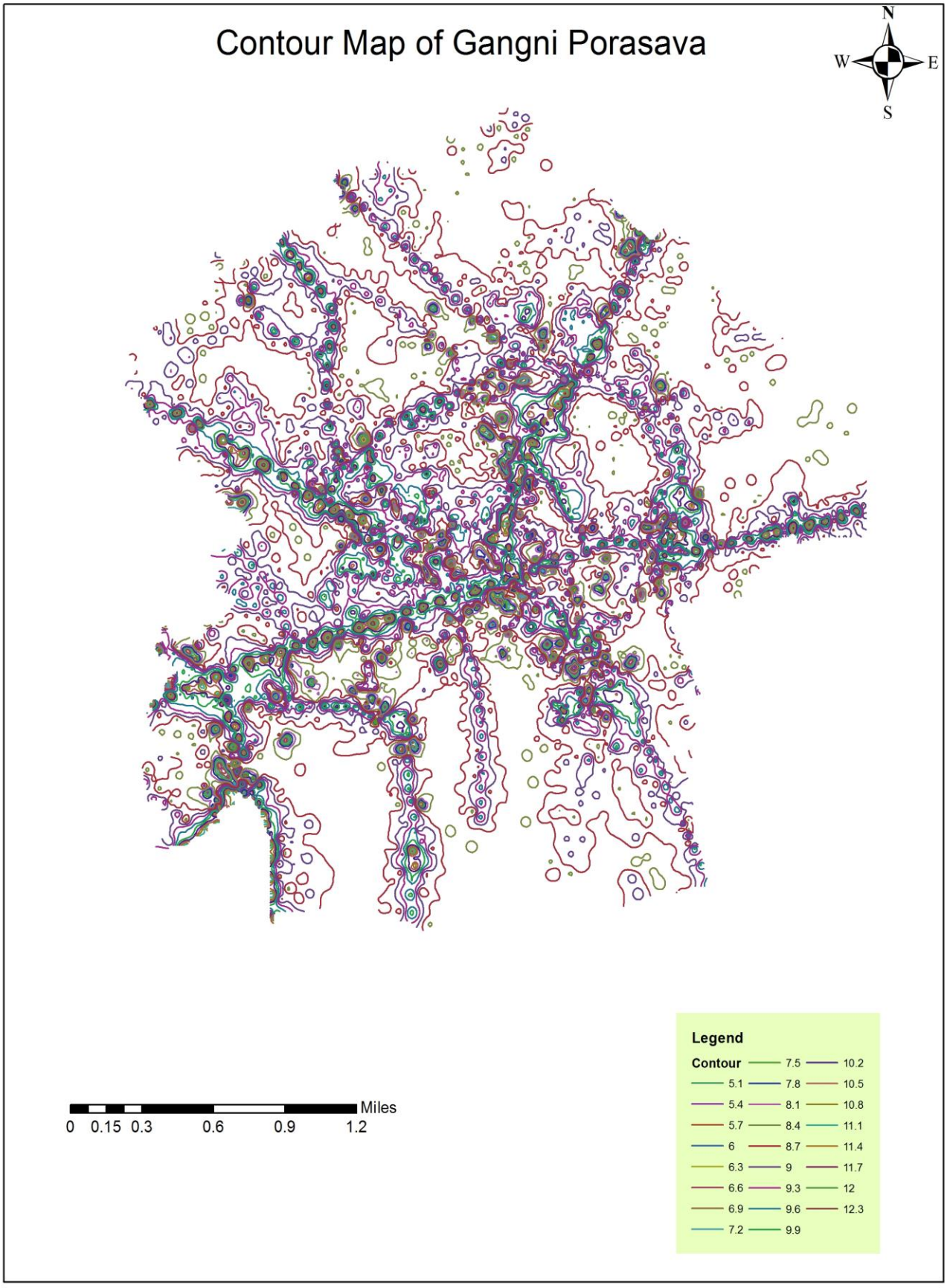


Figure-6.10: Contour Lines of Gangni Paurashava (Partial)

6.1.6 Generation of Ortho-rectified Image

An ortho-rectified image or ortho-photo is an image which has been "corrected" for the geometric distortions (different projection, lens/sensor distortion, relief) so that it can be used as a map.

Using the DEM of the Upazila, the Ortho-rectified image has been created using photogrammetric software. Figure-2.20 shows a part ortho-rectified satellite image of Gangni Upazila.

Figure-6.11: Ortho-Rectified Image of Gangni Upazila (Partial)

Chapter Seven: Conclusion

The land use features of Gangni Upazila have been acquired through field survey based on high resolution stereo satellite imagery and RTK-GPS. The existing land use data acquired through land use survey and photogrammetry can play vital role for preparation of development plans of Gangni Upazila. By using these data in planning phase, decisions can be made where different socioeconomic activities such as agriculture, housing, industry, recreation, and commerce should take place and which areas should be protected from development due to environmental, cultural, historical, or similar reasons.

The topographic features of Gangni Upazila have been acquired mainly through photogrammtric method by using high resolution stereo satellite imagery. These data may be updated and fine-tuned by RTK-GPS based Total Station survey especially in the vegetated and clouded area.

Topographic surveyed data and the derived data such as DEM, Contours, TIN, etc. can play important roles in hydrological analysis (watershed, stream network analysis and flood analysis, etc.), erosion and land slide analysis. Thus topographic survey data can be used to find out the suitable attributes for future developmental activities in the study area.

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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 Mouza 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 Mouza Map Scanning & Digitization

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

A.1.0 Specifications for Mouza Map Scanning

The scanning specification of Mouza 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 Mouza Maps

Directory Structure for systematically storing scanned image files of the Mouza 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-3_14Upazila** may be the abbreviated name of the project "Preparation of the Development Plan for Fourteen Upazila – Package-03". - **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 Mouza Maps**, **Georeferenced Raster Mouza 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-3_14Upazila\Dhaka.div\Narsingdi.dis\Gangni.upz\Scanned_Mouza**.uni\Kathuli _Union** is the **directory** to store the **scanned Mouza maps of Kathuli _Union of Gangni_Upazila**.

A.1.2 File Naming Convention for Scanned Mouza Maps

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

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

Where,
- **Mouza Name** is the name of the Mouza. 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 Mouza. It must be as 3 digit number
- **Sheet No** is the particular sheet number of the Mouza. It must be as 3 digit number

Example:

Mouza Name	JL No	Sheet No	File Name
Kanaipur	32	4	**Roypur_011_001.jpg**

A.2.0 Specifications for Mouza Maps Digitization

The specifications for digitization of Mouza 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 Mouza Map Digitization

Digitization of Mouza map must be done in five vector layers as the format of Shape file, Coverage or Geo data base Feature class. The Geodatabase is preferable.

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Features of the Mouza Map	Type of Layer	Name of Layer (as Shapefile/Coverage/Feature class)
All line features, such as plot boundary, road, waterbody, building, etc.	Polyline	**ML_XXX_XXX** Where, -**ML** represents **Mouza** map's **L**ine features. -XXX represents the JL number of the Mouza map (3 digit). -XXX represents the Sheet number of the Mouza map (3 digit).
Dag number (Plot no)	Point	**PN_XXX_XXX** Where, -**PN** represents **P**lot **N**umber of the Mouza map. -**XXX** represents the **JL number** of the Mouza map

Features of the Mouza Map	Type of Layer	Name of Layer (as Shapefile/Coverage/Feature class)
		(**3 digit**). -**XXX** represents the **Sheet number** of the Mouza map (**3 digit**).
Plot area	Polygon	**MP_XXX_XXX** Where, -**MP** represents **Mouza** map as **P**olygon (area) features. -**XXX** represents the **JL number** of the Mouza map (**3 digit**). -**XXX** represents the **Sheet number** of the Mouza map (**3 digit**).
Point features (except plot no)	Point	**PF_XXX_XXX** Where, -**PF** represents **P**oint **F**eatures of the Mouza map except plot numbers. -**XXX** represents the **JL number** of the Mouza map (**3 digit**). -**XXX** represents the **Sheet number** of the Mouza map (**3 digit**).
Other area features	Polygon	**AF_XXX_XXX** Where, -**AF** represents other **A**rea **F**eatures of the Mouza map -**XXX** represents the **JL number** of the Mouza map (**3 digit**). -**XXX** represents the **Sheet number** of the Mouza map (**3 digit**).

A.2.2 Attribute Structure of the Mouza Map Layers

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

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

This Layer will contain dag number (plot number) of the Mouza maps as point features. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	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.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza 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 Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mouza as District code+Thana code+Union/Ward code+Mouza 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 will contain all line features of the Mouza map. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	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.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map
SV_Period	String	20	To contain survey period of the Mouza 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 Mouza boundary, Sheet boundary and Plot boundary respectively.
Line_Desc	String	30	To contain the type of plot boundaries and other line features such as - "Mouza 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) Layer name: **MP_XXX_XXX**
Feature Type: **Polygon**

This Layer will contain all the plots of the Mouza maps as area or polygon features. It must contain the fields as described in the following table:

Field Name	**Field Type**	**Width of the field**	**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.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza 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 Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mouza as District code+Thana code+Union/Ward code+Mouza 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 will contain all point features except the plot numbers of the Mouza map. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	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.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name + single space + JLno (3-digits) + single space + sheet no(3-digits)
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza 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 Mouza map such as "Sheet No. 2", "Aliabad No. 101", etc.
Remarks	String	100	To contain remarks, if any.

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

This shape file will contain all other area features such as Dalan (Building), Waterbody (Pond), etc. of the Mouza map. It must contain 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.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza 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 Mouza Map Digitization

The following feature codes (Unique ID) must be assigned in appropriate fields for digitization of different features of the Mouza 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
Mouza 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 Mouza/Sheet		61
0tier Info		62
Demarcation Pillar		71
Settlement Pillar		72
Stone		73

Feature Type/Item	Layer Name	Feature Code (ID)
Station	ML_XXX_XXX	74
Pucca Pillar		75
Municipality Pillar		76
CS Iron Pillar		77
Other Point Feature		88
Plot Boundary		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 must be 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 Meherpur is 29.
- **Upazila Geocode** is the 2-digit BBS Geocode of the upazila; eg. Geocode of Gangni Upazila is 47.

Example:

Layer Description	Layer name
Administrative Boundary as line features	ADBL306864
Plots of Merged Mouza maps as polygon features	MMP306864
Plots of Merged Mouza maps as polyline features	MML306864
Plot Numbers of Merged Mouza 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 Mouza 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 will contain administrative boundaries of project area. It must contain the fields as described in the following table:

Field Name	**Field Type**	**Width of the field**	**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” “Mouza 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 will contain plots of edge-matched and merged Mouza maps of project area as polygon features. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	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.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza 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 Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mouza as District code+Thana code+Union/Ward code+Mouza 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" - "Industrial" - "Mixed Use" - "Recreational" - "Restricted / Special Use" - "Socio-Cultural" - "Transport & Communication" - "Urban Residential"

Field Name	Field Type	Width of the field	Purpose of the field
			- ”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 will contain line features of edge-matched and merged Mouza maps of project area as polyline features. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
ID	Long Integer	16	To Contain Mouza polyline ID.
Type	String	20	“Plot Boundary” “Sheet Boundary” “Mouza 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 will contain Plot numbers of edge-matched and merged Mouza maps of project area as point features. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	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.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza 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 Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mouza as District code+Thana code+Union/Ward code+Mouza 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 will contain the information of each structure within the project area. It must contain thirteen fields as described in the following table:

Field Name	Field Type	Width of the field	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 will contain the existing roads of the project area as polygon features. It must contain three fields as described in the following table:

Field Name	**Field Type**	**Width of the field**	**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 will contain the existing roads of the project area as polyline features. It must contain three fields as described in the following table:

<table>
<tr><th>Field Name</th><th>Field Type</th><th>Width of the field</th><th>Purpose of the field</th></tr>
<tr><td>Road_name</td><td>string</td><td>100</td><td>To contain the name of the road, if any</td></tr>
<tr><td>Road_ID</td><td>string</td><td>20</td><td>To contain the ID of Road</td></tr>
<tr><td>Road_Type</td><td>string</td><td>20</td><td>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>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>Remarks</td><td colspan="3">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.
<table>
<tr><th colspan="2">Chainage in Meters</th><th rowspan="2">Road_ Condition</th><th rowspan="2">Type</th><th rowspan="2">Additional +Field</th></tr>
<tr><th>From</th><th>To</th></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></td></tr>
</table>

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

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

Field Name	Field Type	Width of the field	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 will contain footpath of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 will contain road islands of the project area. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	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 will contain water bodies of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 will contain embankment features of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 will contain spot heights as 3D points at regular interval (10m x 10m OR 20m x 20m or as specified) in project area. It must contain four fields as described in the following table:

Field Name	Field Type	Width of the field	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 will contain BM Pillars established in the project area. It must contain four fields as described in the following table:

Field Name	Field Type	Width of the field	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 will contain the contour lines of the area under project area. It must contain three fields as described in the following table:

Field Name	Field Type	Width of the field	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 will contain existing land use of project area which will be prepared on the basis of physical feature and land use survey. It may contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 file will contain rural homestead areas in project area as polyline features. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Location	String	20	To contain the name of Mouza (Mouza_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 will contain Bridge/Culvert/Box culvert/Over bridge/Railway Bridge etc as polygon features in project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 (Mouza_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 will contain Bridge/Culvert/Box culvert/Over bridge/Railway Bridge etc as polyline features in project area. Each feature must be a multipart feature. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 will contain 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 must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 (Mouza_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 will contain the information of existing drains in the project area. It must contain three fields as described in the following table:

Field Name	Field Type	Width of the field	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 will contain boundary walls as line features of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 will contain water distribution pipe network as line features in project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 will contain overhead water tanks as point features in project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 will contain High Voltage Electric Lines as line features in project area. It must contain the field as described in the following table:

Field Name	**Field Type**	**Width of the field**	**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 will contain locations of various utility features as described in the following table:

Field Name	**Field Type**	**Width of the field**	**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 will contain sewerage network as line features in [project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 will contain various polygon features of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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 will contain point features of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	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"

Field Name	Field Type	Width of the field	Purpose of the field
			- "Registered Primary School" - "Non-Registered Primary School" - "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.
PointType	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 will contain the names of important places and structures as point features in project area.

Field Name	Field Type	Width of the field	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.

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

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

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

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

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

Field Name	Field Type	Width of the field	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 will contain polygon features of unions/wards derived from dissolved Mouzas of the project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Union_Ward	String	50	To contain name of the Mouza
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 Upazila
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 will contain proposed policy on the merged Mouza map of the project area. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	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) must be assigned in appropriate fields of the layers.

The following Point feature codes (Unique ID) will be 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

Point Feature Categories	Unique ID
- "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
- "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

Abbreviations and Acronyms

BM ---------- : Bench Mark
BUTM---------- : Bangladesh Universal Transverse Mercator
DEM---------- : Digital Elevation Model
DGPS---------- : Differential Global Positioning System
DLRS---------- : Directorate of Land Records & Surveys
DPI---------- : Dot Per Inch
DPW---------- : Digital Photogrammetry Workstation
DTM---------- : Digital Terrain Model
GCP---------- : Ground Control Point
GIS---------- : Geographic Information System
GPS ---------- : Global Positioning System
HBB ---------- : Herring Bone Bond
JPEG---------- : Joint Photographic Experts Group
Km ---------- : Kilometer
MSL ---------- : Mean Sea Level
PD---------- : Project Director
PM ---------- : Project Manager
RL---------- : Reduced Level
RMS ---------- : Root Mean Square
RS ---------- : Revisional Survey
RTK-GPS---------- : Real Time Kinematic Global Positioning System
SOB---------- : Survey of Bangladesh
TIN---------- : Triangulated Irregular Network
TOR---------- : Terms of Reference
UDD ---------- : Urban Development Directorate

Table of Contents

Page No.

Page No.

List of Tables

List of Maps

List of Figures

Page No.

List of Plates

Annexures: